(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 October 2017 (26.10.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/184590 A1

(51) International Patent Classification:
G01N 33/569 (2006.01)

(21) International Application Number:
PCT/US2017/028122

(22) International Filing Date:
18 April 2017 (18.04.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

62/324,228	18 April 2016 (18.04.2016)	US
62/345,556	03 June 2016 (03.06.2016)	US
62/458,954	14 February 2017 (14.02.2017)	US

(71) Applicants: **THE BROAD INSTITUTE INC.** [US/US]; 415 Main Street, Cambridge, MA 02142 (US). **MASSACHUSETTS INSTITUTE OF TECHNOLOGY** [US/US]; 77 Massachusetts Ave., Cambridge, MA 02139 (US). **PRESIDENT AND FELLOWS OF HARVARD COLLEGE** [US/US]; 17 Quincy Street, Cambridge, MA 02138 (US). **DANA-FARBER CANCER INSTITUTE, INC.** [US/US]; 450 Brookline Ave., Boston, MA 02215 (US). **THE GENARAL HOSPITAL CORPORATION** [US/US]; 55 Fruit Street, Boston, MA 02114 (US).

(72) Inventors; and

(71) Applicants: **CARR, Steven, A.** [US/US]; 12B Mulberry Street, Boxford, MA 01921 (US). **HACOHEN, Nir** [US/US]; 117 Mason Terrace, Brookline, MA 02446 (US). **WU, Catherine, J.** [US/US]; 117 Mason Terrace, Brookline, MA 02446 (US). **ABELIN, Jennifer, G.** [US/US]; 51 Perry Street, Apt. 2, Somerville, MA 02143 (US). **SARKIZOVA, Siranush** [US/US]; c/o President and Fellows of Harvard College, 17 Quincy Street, Cambridge, MA 02138 (US). **KESKIN, Derin, B.** [US/US]; c/o The Broad Institute Inc., 415 Main Street, Cambridge, MA 02142 (US). **CLAUSER, Karl, R.** [US/US]; c/o The Broad Institute Inc., 415 Main Street, Cambridge, MA 02142 (US). **ROONEY, Michael, S.** [US/US]; 33 Maher Street, Boston, MA 02124 (US).

(74) Agent: **KOWALSKI, Thomas, J.** et al.; Vedder Price P.C., 1633 Broadway, New York, NY 10019 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: IMPROVED HLA EPITOPE PREDICTION

(57) Abstract: Adaptive immune responses rely on the ability of cytotoxic T cells to identify and eliminate cells displaying disease-specific antigens on human leukocyte antigen (HLA) class I molecules. Investigations into antigen processing and display have immense implications in human health, disease and therapy. To extend understanding of the rules governing antigen processing and presentation, immunopurified peptides from B cells, each expressing a single HLA class I allele, were profiled using accurate mass, high-resolution liquid chromatography- mass spectrometry (LC-MS/MS). A resource dataset containing thousands of peptides bound to 28 distinct class I HLA-A, -B, and -C alleles was generated by implementing a novel allele-specific database search strategy. Applicants discovered new binding motifs, established the role of gene expression in peptide presentation and improved prediction of HLA-peptide binding by using these data to train machine-learning models. These streamlined experimental and analytic workflows enable direct identification and analysis of endogenously processed and presented antigens.

WO 2017/184590 A1

IMPROVED HLA EPITOPE PREDICTION

RELATED APPLICATIONS AND INCORPORATION BY REFERENCE

[0001] This application claims priority and benefit of U.S. Provisional application serial numbers 62/324,228 filed April 18, 2016, 62/345,556 filed June 3, 2016, and 62/458,954 filed February 14, 2017, incorporated herein by reference.

[0002] The foregoing applications, and all documents cited therein or during their prosecution ("appln cited documents") and all documents cited or referenced in the appln cited documents, and all documents cited or referenced herein ("herein cited documents"), and all documents cited or referenced in herein cited documents, together with any manufacturer's instructions, descriptions, product specifications, and product sheets for any products mentioned herein or in any document incorporated by reference herein, are hereby incorporated herein by reference, and may be employed in the practice of the invention. More specifically, all referenced documents are incorporated by reference to the same extent as if each individual document was specifically and individually indicated to be incorporated by reference.

FEDERAL FUNDING LEGEND

[0003] This invention was made with government support under grant numbers CA155010, CA160034 and HG002295 awarded by the National Institutes of Health. The government has certain rights in the invention.

FIELD OF THE INVENTION

[0004] The present application relates to methods for improved prediction of HLA-peptide binding, datasets for predicting HLA-peptide binding and selection of HLA-binding peptides and compositions comprising HLA-binding peptides obtained by these methods.

BACKGROUND OF THE INVENTION

[0005] The HLA Class I proteins (HLA-A, B and C) are expressed on the surface of almost all nucleated cells in the human body and are required for presentation of short peptides for detection by T cell receptors. The HLA-bound peptides arise from endogenous or foreign proteins cleaved by the proteasome and ER peptidases and loaded on HLA Class I proteins. The HLA genes are the most polymorphic genes across the human population, with more than 10,000

HLA class I allele variants identified to date *(6;* IPD-IMGT/HLA database Release 3.24.0.1*)*. Each HLA allele is estimated to bind and present ~1,000-10,000 unique peptides to T cells *(1–5)* (≤0.1% of ~10 million potential 9mer peptides from human protein-coding genes). The peptide-binding rules are only known for a relatively limited set of common alleles *(5)*, and have been encoded in algorithms that predict the binding of an arbitrary peptide to specific HLA alleles, and thus accelerate the discovery of epitopes.

[0006] Personalized immunotherapy using tumor-specific peptides has been described (Ott et al., *Hematol. Oncol. Clin. N. Am.* 28 (2014) 559-569). Efficiently choosing which particular peptides to utilize as an immunogen requires the ability to predict which tumor-specific peptides would efficiently bind to the HLA alleles present in a patient. Neural network based learning approaches with validated binding and non-binding peptides have advanced the accuracy of prediction algorithms for the major HLA-A and -B alleles (Zhang et al, Machine learning competition in immunology – Prediction of HLA class I binding peptides, *J Immunol Methods* 374:1 (2011); Lundegaard et al., Prediction of epitopes using neural network based methods, *J Immunol Methods* 374:26 (2011)).

[0007] Even using advanced neural network-based algorithms to encode HLA-peptide binding rules *(7, 8)*, several factors limit the power to predict peptides presented on HLA alleles. First, the provenance of peptide data upon which these algorithms are trained is diverse, ranging from peptide library screens to Edman degradation and only sometimes endogenous peptides *(3–5, 9)*. In fact, the algorithms most commonly used today are trained almost exclusively on measurements of biochemical affinity of synthetic peptides (Trolle et al., Automated benchmarking of peptide-MHC class I binding predictions, *Bioinformatics*, 2015 Jul. 1, 31(13):2174-2181). Second, many existing prediction algorithms have focused on predicting binding but may not fully take into account endogenous processes that generate and transport peptides prior to binding *(10)*. Third, the number of binding peptides for many HLA alleles is too small to develop a reliable predictor. Until now, however, the generation of high-quality resource datasets has been hampered by inefficient protocols that necessitate prohibitively large amounts of input cellular material, and a lack of database search tools for HLA-peptide sequencing *(5, 7, 8, 11)*.

[0008] Thus, there is a need for improved tools and methods for prediction of antigen presentation.

[0009] Citation or identification of any document in this application is not an admission that such document is available as prior art to the present invention.

SUMMARY OF THE INVENTION

[0010] One objective of the present is to provide an improved tool for predicting peptides that are presented by HLA proteins. Another objective of the present invention is to provide peptides capable of inducing an immune response upon administration to a subject.

[0011] In one aspect, the invention provides methods of generating an HLA- allele specific binding peptide sequence database comprising:

(a) providing a population of cells expressing a single HLA allele;

(b) isolating HLA-peptide complexes from said cells;

(c) isolating peptides from said HLA-peptide complexes; and

(d) sequencing said peptides.

[0012] In particular embodiments, the methods are methods of generating an HLA class I - allele specific binding peptide sequence database comprising:

(a) providing a population of cells expressing a single HLA class I allele;

(b) isolating class I HLA-peptide complexes from said cells;

(c) isolating peptides from said HLA-peptide complexes; and

(d) sequencing said peptides.

[0013] In particular embodiments the methods are methods of generating an HLA class II- allele specific binding peptide sequence database comprising:

(a) providing a population of cells expressing a pair of HLA Class II genes, consisting of one α and one β subunit;

(b) isolating class II HLA -peptide complexes from said cells;

(c) isolating peptides from said HLA-peptide complexes; and

(d) sequencing said peptides.

[0014] In particular embodiments, said sequencing is ensured by LC-MS/MS.

[0015] In particular embodiments, the population of cells comprises at least 10^7 cells.

[0016] In particular embodiments, the cells are dendritic cells, macrophages or B-cells.

[0017] In particular embodiments, the cells are tumor cells.

[0018] In particular embodiments, the cells are contacted with an agent or condition prior to isolating said HLA-peptide complexes from said cells. In particular embodiments, said agent or condition is an inflammatory cytokines, a chemical agent, a therapeutic agent or radiation.

[0019] In particular embodiments, the HLA allele is a mutated HLA allele. In particular embodiments, the HLA allele is selected from A*01:01, A*02:01, A*02:03, A*02:04, A*02:07, A*03:01, A*24:02, A*29:02, A*31:01, A*68:02, B*35:01, B*44:02, B*44:03, B*51:01, B*54:01, B57:01, C*03:02, C*03:04, C*04:01, C*05:01, C*06:02, C*08:01, C*08:02, C*12:02, C*14:02, C*14:03, C*15:02, and C*16:01.

[0020] In particular embodiments, step (b) comprises lysing the cells and isolating the HLA-peptide complexes by immunoprecipitation.

[0021] In particular embodiments, the methods involve carrying out steps (a) to (d) subsequently for different HLA alleles.

[0022] In a further aspect the application provides HLA- allele specific binding peptide sequence databases obtained by carrying out the methods as described herein. Further, the application provides combinations of two or more HLA-allele specific binding peptide sequence databases obtained by carrying out the methods as described herein, each time using a different HLA- allele.

[0023] In a further aspect, the application provides methods for generating a prediction algorithm for identifying HLA- allele specific binding peptides, which methods comprise training a machine with the peptide sequence database or the combinations of peptide sequence databases described herein. In particular embodiments of the methods provided herein, the machine combines one or more linear models, support vector machines, decision trees and neural networks. In particular embodiments, the variables used to train the machine comprise one or more variables selected from the group consisting of peptide sequence, peptide upstream and downstream sequence, amino acid physical properties, amino acid similarity, peptide physical properties, expression level of the source protein of a peptide within a cell, various properties of peptide source, e.g., protein/transcript length, cell localization, GC content, number of exons, disorder quantification, ubiquination sites, etc., and peptide cleavability. The application further provides a prediction algorithm for identifying HLA- allele specific binding peptides generated by the methods described herein.

[0024] The application further provides methods for identifying HLA- allele specific binding peptides, which method comprises analyzing the sequence of a peptide with a machine which has been trained with a peptide sequence database obtained by carrying out the methods for predicting the binding of peptides to said HLA- protein described herein. In particular embodiments, the methods comprise: determining the expression level of the source protein of the peptide within a cell; wherein the source protein expression is one of the predictive variables used by the machine. In particular embodiments, the expression level is determined by measuring the amount of source protein or the amount of RNA encoding said source protein.

[0025] In a further aspect, the application provides methods of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from a given set of peptides the plurality of peptides capable of binding an HLA protein of the subject, wherein said ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with peptide sequence databases corresponding to the specific HLA-binding peptides for each of the HLA-alleles of said subject.

[0026] The application further provides methods of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from set given set of peptides the plurality of peptides determined as capable of binding an HLA protein of the subject, ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with a peptide sequence database obtained by carrying out the methods for identifying HLA- allele specific binding peptides as described herein.

[0027] The application further provides methods of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, wherein the subject has a tumor and the subject-specific peptides are specific to the subject and the subject's tumor, said method comprising: (a) whole genome or whole exome nucleic acid sequencing of a sample of the subject's tumor and a non-tumor sample of the subject; (b) determining based on the whole genome or whole exome nucleic acid sequencing: (i) non-silent mutations present in the genome of cancer cells of the subject but not in normal tissue from the subject, and (ii) the HLA genotype of the subject; wherein the non-silent mutations comprise a point, splice-site, frameshift, read-through, new open reading frame (neoOFR), or gene-fusion mutation; said method further

comprising step (c) selecting from the identified non-silent mutations the plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each having a predictive score indicative of processing and binding an HLA protein of the subject, wherein said predictive score is determined by analyzing peptides (e.g., analyzing the sequence, context and properties of peptides) derived from the non-silent mutations by carrying out the methods for identifying HLA- allele specific binding peptides described herein.

[0028] The application further provides methods of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, said method comprising selecting a plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each having a predictive score indicative of binding an HLA protein of the subject, wherein said predictive score is determined by analyzing the peptides (e.g., analyzing the sequence, context and properties of peptides) derived from the non-silent mutations by carrying out the methods for identifying HLA- allele specific binding peptides described herein.

[0029] In a further aspect, the invention provides, immunogenic compositions for use in a method of inducing a tumor specific immune response, said immunogenic composition comprising two or more peptides identified with the method according to the methods provided herein and a pharmaceutically acceptable carrier. In particular embodiments, the application provides immunogenic composition for use in a method of inducing a tumor specific immune response, comprising autologous dendritic cells or antigen presenting cells that have been pulsed with the two or more peptides identified with the method according to the methods provided herein. The application further provides immunogenic compositions for use in a method of inducing a tumor specific immune response, comprising at least one vector capable of expressing the two or more peptides identified with the methods for identifying subject-specific peptides for preparing a subject-specific immunogenic compositions described herein. In particular embodiments, the vector is a viral vector. The present invention also encompasses immunogenic compositions comprising one or more peptides, or one or more vectors expressing the one or more peptides, of Tables 1A, 1B and/or 1C as well as a library comprising the same.

[0030] Accordingly, it is an object of the invention not to encompass within the invention any previously known product, process of making the product, or method of using the product

such that Applicants reserve the right and hereby disclose a disclaimer of any previously known product, process, or method. It is further noted that the invention does not intend to encompass within the scope of the invention any product, process, or making of the product or method of using the product, which does not meet the written description and enablement requirements of the USPTO (35 U.S.C. §112, first paragraph) or the EPO (Article 83 of the EPC), such that Applicants reserve the right and hereby disclose a disclaimer of any previously described product, process of making the product, or method of using the product. It may be advantageous in the practice of the invention to be in compliance with Art. 53(c) EPC and Rule 28(b) and (c) EPC. All rights to explicitly disclaim any embodiments that are the subject of any granted patent(s) of applicant in the lineage of this application or in any other lineage or in any prior filed application of any third party is explicitly reserved Nothing herein is to be construed as a promise.

[0031] These and other embodiments are disclosed or are obvious from and encompassed by, the following Detailed Description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

[0033] The following detailed description, given by way of example, but not intended to limit the invention solely to the specific embodiments described, may best be understood in conjunction with the accompanying drawings.

[0034] **Figure 1A-1D** illustrates an efficient sample processing and analysis pipeline for HLA-peptide sequencing. **A.** Overview of the experimental workflow. 721.221 B cells were transfected with single HLA alleles and 30-90 million cells were used for HLA-peptide immunopurifications. Eluted peptides were analyzed with high resolution LC-MS/MS. HLA-associated peptides were sequenced and identified using an HLA allele-specific database search. **B.** Schema of the HLA-specific database search strategy. The number of peptide spectrum matches (PSMs) identified through this strategy per HLA allele are shown in **Figure 6A,** with all peptide identifications provided in **Table 2**. **C.** Peptide length distributions from all HLA-A and HLA-B alleles. **D**. HLA class I-associated peptide identifications from 16 characterized HLA

alleles. Total numbers of unmodified (left segment), modified (middle segment), and negative control peptides (right segment) identified per allele are shown (see **Figure 6C** for distribution of peptide modifications). Negative control peptides are listed in **Table 1E**. Allele frequencies among Caucasian, Asian, and Black populations are shown. "*" denotes alleles for which LC-MS/MS experiments have generated a greater number of peptides than reported in IEDB (see **Figure 6D**).

[0035] **Figure 2A-2F** illustrates novel HLA peptide-binding motifs enriched in LC-MS/MS data relative to IEDB **A.** Average distance comparisons between pairs of 9mer peptides (left bars-LC-MS/MS data; middle bars-IEDB data) presented by a particular allele. The average distance between IEDB and LC-MS/MS peptides, right bars, (see **Figure 7A** and **B** for individual HLA alleles). **B.** Summary plot of entropy per position across all HLA alleles in LC-MS/MS (bottom) and IEDB (top) datasets. **C.** Sequence logos comparing the HLA-binding motifs for HLA-A*02:01 and -A*29:02–associated 9mers sequenced by LC-MS/MS (left) and reported by IEDB (right). **D.** Systematic evaluation of the frequencies of each amino acid (positions 1-9) within 9mers sequenced by LC-MS/MS for the 13 of 16 HLA alleles for which IEDB data has reported. Orange/light - Amino acids overrepresented in LC-MS/MS data (scaled by p-value); blue/dark - amino acids underrepresented in LC-MS/MS data (scaled by p-value). **E,F.** Non-metric multidimensional scaling (NMDS) was used to visualize peptide distances in two dimensions for each analyzed HLA allele (**Figure 8**), with examples provided for HLA-A*02:01 (**E**, top) and -A*29:02-associated peptides (**F**, top). Each circle represents a unique 9mer peptide from either the LC-MS/MS (orange/light) or IEDB (blue/dark) datasets, with the size of each circle proportional to a peptide's NetMHCpan-2.8 predicted binding affinity. Sequence logos representing these LC-LC-MS/MS and IEDB data are also shown for the highlighted peptide clusters presented by HLA-A*02:01(**E**, bottom) and HLA-A*29:02 (**F**, bottom).

[0036] **Figure 3A-3D** illustrates analysis of peptide cleavage signatures and MHC-binding registers. **A.** The cleavage specificity of the proteasome represented by the percent change from background in amino acid frequencies upstream (U1-U6) and downstream (D1-D6) of the N- and C-termini of peptides (average over 16 HLA alleles). Amino acid positions are colored according to the directionality and significance of the enrichment. **B.** Cleavability scores based on amino acid enrichments and depletions upstream ('N-terminal scoring'-green) and downstream ('C-

terminal scoring'-black) of HLA-presented peptides ("hits") and a set of 1 x 10^6 random genomic 9mers ("decoys"). The low average ratio of hit:decoy cleavability scores at internal peptide positions illustrate below-average cleavability, while high ratios at the N- and C-termini illustrate high cleavability. **C.** Peptides sequenced by LC-MS/MS ("hits"-red/right) appeared significantly more cleavable than decoys (purple/left) when scored by a novel peptide cleavability model based on observations in **3A** and **3B (**see **Methods**). An analogous analysis was performed using the tool NetChop(**Figure 9A)**. **D.** The observed number of peptides at each position (relative distance from protein N-terminus) compared to the expected number, assuming each MS-observed peptide was equally likely to have arisen from any position in its source protein (black solid line). Red dashed line -- the expected result if a large proportion of HLA-presented peptides arose from aborted translation products.

[0037] **Figure 4A-4G** illustrates evaluation of HLA-peptide characteristics that impact HLA-binding predictions. **A.** Distributions of NetMHCpan2.8-predicted HLA-binding affinities of peptides identified by LC-MS/MS ("hits"; left peak) compared to 1 x 10^6 random 9mer peptides from protein-coding genes ("decoys"; right peak). **B**. Distributions of source RNA transcript expression (summed transcripts for each gene) of hits vs. decoys peptides. **C**. Hits and decoys binned according to expression (y-axis) and predicted affinity (x-axis) for each allele and summed. Hit (top) and decoy (bottom) counts are reported for each bin, which is colored according to the hit:decoy ratio (red/upper left= hits>decoys; blue/lower right hits<decoys). Bins with the same expression:affinity ratio that demonstrate roughly equivalent hit:decoy ratio are highlighted (orange-Group A peptides with high expression ; white-Group C peptides with low expression). **D**. Cellular localization of HLA-associated peptide source proteins are reported as a frequency relative to expression-matched decoy peptides**.** The same analysis without expression-matching is shown in **Figure 9B. E**. NetMHCStab predicted peptide-binding stability of peptides sequenced by LC-MS/MS and affinity- and expression-matched decoys (p-values by t-test; all alleles **Figure 9C**). **F**. Approximately 200 protein-protein interaction experiments (Behrends et al., 2010, *Nature* 466, 68–76; Christianson et al., 2012, *Nat. Cell Biol.* 14, 93–105; Sowa et al., 2009, *Cell* 138, 389–403), each yielding set of 50-100 high confidence interacting proteins for a given bait (usually a known protein turnover pathway gene) were scored according to their enrichment for LC-MS/MS-observed peptides, here depicted as a histogram. Each block corresponds to one experiment and is colored according to the directionality and significance

(chi-square test) of the enrichment (see key). The bait protein used in outlier experiments (SQSTM1, PIK3C3, and OTUD4) is marked along with corresponding p-value. **G**. Percent change in amino acid frequency of top-scoring peptides (top 25%) compared to bottom-scoring peptides (bottom 25%) amongst 1 million random proteome 9mers evaluated by NetChop (Saxová et al., 2003, *Int. Immunol.* **15**, 781–787). Color coding indicates directionality and magnitude of percent change (see key).

[0038] **Figure 5A-5H** illustrates evaluation of novel MS-based HLA-peptide binding predictors. **A.** MS 9mer peptides (orange/light) compared to IEDB 9mer peptides (blue/dark). Non-metric multidimensional scaling (NMDS) was used to visualize pairwise peptide distances in two dimensions for each analyzed HLA allele. Peptide distance was defined based on sequence similarity (Kim et al., Derivation of an amino acid similarity matrix for peptide: MHC binding and its application as a Bayesian prior, *BMC Bioinformatics*, 10, 1-11, 2009). The size of each circle corresponds to the NetMHCpan-predicted affinity score of the corresponding peptide. **B.** Experimental validation of MS-based models. Per-allele generalized linear models (trained on LC-MS/MS sequenced peptides and random 9mer peptides from protein-coding genes), NetMHCpan-2.8, and NetMHC-4.0 were used to predict the LC-MS/MS data. Peptides scoring in the top 10% by the MS predictor but the bottom 10% by NetMHC-2.8 were selected for experimental validation. All successfully synthesized peptides for 4/5 alleles are visualized on NMDS plots (A) and numbered according to the corresponding line in the table of measured and predicted binding probability (MS) or affinities (NetMHC) (for each cell line, the data shown across the four bars is, from left to right, NetMHC-4.0, NetMHCpan-2.8, MS Intrinsic, and MS IntrinsicEC.) (B) (see **Figure 10A** for HLA-B*35:01). The peptide which failed experimental validation is: YIIEREPLI. **C**. Saturation analysis. For each allele, neural network models with peptide-intrinsic features and dummy sequence encoding only were built with increasing number of positive training examples, from 15 to the total number peptides identified by LC-MS/MS per allele. The PPV for each model was evaluated and plotted as a function of the number of binders in the training set. Allele complexity scores, defined as a weighted average of the entropy at each peptide position, are shown in the figure legend (**Methods**, **Figure 7A-B**). **D**. Internal evaluation. Average PPV (top) and AUC (bottom) achieved by NetMHC-2.8, NetMHC-4.0, and the two MS-based ensembles on LC-MS/MS dataset. **E**. Positive predictive value of linear models used to discern 9mer MS peptides amongst a 999-fold excess of 9mer decoys (averaging

across 16 alleles). Models included one or more predictor variables (A = affinity, S = stability, R = RNA-Seq expression, P =protein expression (iBAQ), C= cleavability score, L= source protein localization). **F**. Explanatory contributions of predictor variables derived by monitoring the cumulative improvement in predictive value as predictors are added.**G**. Cartoon representation of the neural network model architecture. The 215 MSIntrinsic inputs included an amino acid encoding (180 nodes), amino acids properties (27 nodes), and peptide properties (8 nodes). The 182 MSIntrinsicEC inputs included the amino acid encoding, expression (1 node), and cleavability (1 node). **H**. External evaluation. In addition to a standardized competition dataset and a HIV epitope dataset (see **Table 4)** MS-binding data from an independent high-throughput published dataset consisting of 6 multi-allele cell lines (*1*) was used to compare the performance of MSIntrinsic and MSIntrinsicEC, and neural networks against NetMHC-2.8 and NetMHC-4.0 (**Figure 10D**). Evaluations were performed for all alleles that overlap with our data. For each cell line and overlapping allele combination, binders to other alleles in the cell line were removed from the evaluation set if they had NetMHCpan-2.8 predicted binding affinity < 500nM for another allele and > 1000nM for the allele being evaluated. Peptides which did not have a match in the transcriptome of the sequencing data were also excluded to allow for a direct comparison between MSIntrinsic and MSIntrinsicEC. PPV was calculated after combining the remaining hits with 999*n* random decoys. (First bars correspond to NetMHC-4.0 data; Second bars correspond to NetHMCpan-2.8 data; third bars correspond to MS Intrinsic data; and fourth bars correspond to MS Intrinsic EC data).

[0039] **Figure 6A-6E: A**. The number of peptide spectrum matches (PSMs) identified from both the no enzyme and HLA-specific rounds of database searches are shown for each HLA allele dataset. These PSMs represent the unique peptide identifications reported in **Table 2**. **B**. The overlap of unique peptides identified from biological replicates of our LC-MS/MS data (orange) and published data (purple) (*3*) generated from immunopurifications of HLA-A*02:01 expressing cells. Unique peptide overlap between our HLA-A*02:01 dataset and this published dataset is also shown. **C**. The distribution of peptide modifications represented by the "Modified peptides" category in Figure 1 is shown as a pie chart. Peptide modifications included oxidized Met (m), deamidation (n), N-term Pyroglutamate (q), phosphorylation (sty), and cysteinylation (c). **D**. A bar plot comparing the total number of unique peptide sequences reported in IEDB to the number of unique peptides identified using the LC-MS/MS-based workflow. (Total (control

removed) – top bars; IEDB peptides – bottom bars). **E**. The average amino acid frequencies observed across both IEDB and LC-MS/MS datasets compared to the natural amino acid frequencies calculated from the UCSC protein database used for proteomic database searches. The average amino acid frequencies across all 9mers within IEDB and the MS datasets were calculated after removing both position 2 and the last position anchors.

[0040] **Figure 7A-7B: A.** Sequence logos generated using 9mer data for the 28 HLA alleles characterized by LC-MS/MS. **B**. Individual allele entropy calculations for each amino acid positions within 9mer peptides sequenced by LC-MS/MS (entropy is normalized by log(20) and shown on to [0,1] scale).

[0041] **Figure 8**: NMDS plots showing HLA-associated 9mer peptide clustering for individual HLA alleles.

[0042] **Figure 9A-9J: A.** NetChop cleavability scores of LC-MS/MS identified peptides compared to random decoys.**B**. Cellular localization of HLA-associated peptide source proteins not corrected for expression. **C**. NetMHCStab predictions, available at the time of submission, for the alleles HLA-A*01:01, A*02:01, A*03:01, A*24:02, B*35:01. **D**. Distribution of predicted affinities for the short isoforms (leftmost tall peak) and long isoforms (wide shallow double peak) of nested sets as well as for simulated long isoforms (where random amino acids were added at the beginning or end of the short isoforms, shown in the dark rightmost tall peak). **E**. MS peptides with high (red) and low (blue) MS1 ion intensities (top and bottom 10%, respectively), plotted by their NetMHCpan-predicted affinity and source transcript expression. **F**. Each LC-MS/MS identified peptide was matched to ten random proteome 9mer decoys with approximately equal expression but different source genes. The observed count of MS peptides divided by the expected count (based on decoy frequencies) is shown as a function of the number of upstream ATGs. P-values were calculated by t-test. **G**. Observed vs. expected HLA-peptide counts (using expression-matched decoys) as a function of source protein instability index (Guruprasad et al., 1990, *Protein Eng.* 4, 155–161). P-values calculated by t-test. **H**. Similar analysis to (F) showing enrichments as a function of the amount of intrinsically disordered sequence within each peptide's source protein. **I**. Enrichments according to the count of ubiquitination sites, as previously observed (Kronke et al., 2015, *Nature* (2015) 523(7559); Krönke et al., 2014, *Science* (2014) 343(6168); Udeshi et al., 2012, *Molecular & Cellular Proteomics* (2012) 11: 148-59), within the source protein. **J.** The observed count of LC-MS/MS

identified HLA-peptides mapping to each localization (Uniprot) relative to the expected count relative to random 9mer decoys (left) or expression-matched decoys (right).

[0043] Figure 10A-10D: Machine Learning model performance for individual HLA alleles. **A.** Experimental validation as in Figure 5A,B for B*35:01. **B.** Sequence logos generated for decoys ranked within the top *n* positions based on 'MSIntrinsic' and NetMHC-4.0 evaluations of hits merged with 999*n* decoys, where *n* is the number of binders for the allele in the LC-MS/MS data. **C.** NMDS visualization of the 10% lowest ranked hits which were not in the top *n* (false negatives) based on the same evaluation as in B. **D.** Standard AUC plots are shown per allele for the same evaluation as in B. (left) and AUC zooming into the [0,0.1]% false positive rate (right, where the top two curves are MS intrinsic EC and MS intrinsic, respectively, and bottom two lines are netMHC-4.0 and netMHCpan-2.8).

[0044] Figure 11A-11G: A. HLA cell surface presentation of single-HLA cell lines were compared to primary lymphocytes using FACS analysis. Cell lines that resulted in high (top; HLAA*02:01, -A*02:07) and low (bottom; HLA-A*31:01, -B*35:01) numbers of HLA-associated peptide identifications by LC-MS/MS are shown. The number of total LC-MS/MS peptide identifications correlates with total cell surface HLA presentation. **B-G**. Heatmaps of amino acid frequencies calculated from external class *HLA* I datasets, including the class II data from MUTZ3 (Mommen et al., 2016, *Mol. Cell. Proteomics MCP* 15, 1412–1423) (**B**), the breast cancer cell line HCC1937 (**C**), colorectal cell line HCT116 (**D**), fibroblasts (**E**), HeLa cells (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673) (**F**), and peripheral blood mononuclear cells (Caron et al., 2015, *Mol. Cell. Proteomics*, 14(12):3105-17) (**G**).

[0045] Figure 12A-12F: **A**. To evaluate LC-MS/MS bias, the "MS Observability Index", as measured by the ESP algorithm (Fusaro et al., 2009, *Nature Biotechnology* **27**, 190 - 198), was calculated for IEDB (left most) and MS (right most) peptide datasets. Distributions of the MS observability are displayed. **B**. Amino acid frequencies within peptides reported in our single-allele dataset are compared to amino acid frequencies in peptides reported in IEDB. **C.** Amino acid frequency ratios for cleavage-influencing amino acids upstream of, downstream of, and within peptides derived from LC-MS/MS identified peptides compared to random proteome 9mers. **D**. Enrichment/depletion of protein sequence features among LC-MS/MS peptides. Each MS peptide was matched to 10 random decoy 9mers from the same source transcript. The relative rates at which hits and decoys mapped to Uniprot-defined sequence features (alpha

helices, beta strands, signal peptides, and so on) were calculated as ratios and assessed by chi-square test. **E**. Expression of proteo-some genes in B721.221 cells and in high-purity (>95%) samples from TCGA. Purity was determined ac-cording to the "percent tumor cell" field in the clinical slide review; if more than five samples were of suffi-cient purity for a given tumor type, only the top five were used. The listing in the figure key corresponds, from top to bottom, to the data from left to right in the table bars. For example, PSMB1 is the left most section of each of the bars on the graph. **F**. Comparison of amino acid frequency between IEDB peptides and Trolle or Mann peptides (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673; Trolle et al., 2016, *J. Immunol.,* 196(4):1480-7), respectively. To avoid biases due to anchor residues, for each comparison, 300 peptides per allele were selected at random for the alleles in the corresponding data set (Trolle: A*01:01, A*02:01, A*24:02, B*51:01; Mann: A*01:01, A*02:01, A*03:01, A*24:02, A*3101, B*51:01) and pooled together before amino acid frequency was calculated.

[0046] **Figure 13**: NMDS plots showing HLA-associated 9mer peptide clustering for a subset of peptides from MS or IEDB with physicochemical properties favorable for MS detection.

DETAILED DESCRIPTION OF THE INVENTION

[0047] Before the present methods of the invention are described, it is to be understood that this invention is not limited to particular methods, components, products or combinations described, as such methods, components, products and combinations may, of course, vary. It is also to be understood that the terminology used herein is not intended to be limiting, since the scope of the present invention will be limited only by the appended claims.

[0048] As used herein, the singular forms “a”, “an”, and “the” include both singular and plural referents unless the context clearly dictates otherwise.

[0049] The terms “comprising”, “comprises” and “comprised of” as used herein are synonymous with “including”, “includes” or “containing”, “contains”, and are inclusive or open-ended and do not exclude additional, non-recited members, elements or method steps. It will be appreciated that the terms “comprising”, “comprises” and “comprised of” as used herein comprise the terms “consisting of”, “consists” and “consists of”, as well as the terms “consisting essentially of”, “consists essentially” and “consists essentially of”. It is noted that in this

disclosure and particularly in the claims and/or paragraphs, terms such as "comprises", "comprised", "comprising" and the like can have the meaning attributed to it in U.S. Patent law; e.g., they can mean "includes", "included", "including", and the like; and that terms such as "consisting essentially of" and "consists essentially of" have the meaning ascribed to them in U.S. Patent law, e.g., they allow for elements not explicitly recited, but exclude elements that are found in the prior art or that affect a basic or novel characteristic of the invention. It may be advantageous in the practice of the invention to be in compliance with Art. 53(c) EPC and Rule 28(b) and (c) EPC. Nothing herein is intended as a promise.

[0050] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within the respective ranges, as well as the recited endpoints.

[0051] The term "about" or "approximately" as used herein when referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, and still more preferably +/-1% or less of and from the specified value, insofar such variations are appropriate to perform in the disclosed invention. It is to be understood that the value to which the modifier "about" or "approximately" refers is itself also specifically, and preferably, disclosed.

[0052] Whereas the terms "one or more" or "at least one" or "X or more", where X is a number and understand to mean X or increases one by one of X, such as one or more or at least one member(s) or "X or more" of a group of members, is clear per se, by means of further exemplification, the term encompasses inter alia a reference to any one of said members, or to any two or more of said members, such as, e.g., any ≥ 3, ≥ 4, ≥ 5, ≥ 6 or ≥ 7 etc. of said members, and up to all said members.

[0053] All references cited in the present specification are hereby incorporated by reference in their entirety. In particular, the teachings of all references herein specifically referred to are incorporated by reference.

[0054] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0055] In the following passages, different aspects of the invention are defined in more detail. Each aspect so defined may be combined with any other aspect or aspects unless clearly indicated to the contrary. In particular, any feature indicated as being preferred or advantageous may be combined with any other feature or features indicated as being preferred or advantageous.

[0056] Standard reference works setting forth the general principles of recombinant DNA technology include Molecular Cloning: A Laboratory Manual, 2nd ed., vol. 1-3, ed. Sambrook et al., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., 1989; Current Protocols in Molecular Biology, ed. Ausubel et al., Greene Publishing and Wiley-Interscience, New York, 1992 (with periodic updates) ("Ausubel et al. 1992"); the series Methods in Enzymology (Academic Press, Inc.); Innis et al., PCR Protocols: A Guide to Methods and Applications, Academic Press: San Diego, 1990; PCR 2: A Practical Approach (M.J. MacPherson, B.D. Hames and G.R. Taylor eds. (1995); Harlow and Lane, eds. (1988) Antibodies, a Laboratory Manual; and Animal Cell Culture (R.I. Freshney, ed. (1987). General principles of microbiology are set forth, for example, in Davis, B. D. et al., Microbiology, 3rd edition, Harper & Row, publishers, Philadelphia, Pa. (1980).

[0057] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to a person skilled in the art from this disclosure, in one or more embodiments. Furthermore, while some embodiments described herein include some but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art. For example, in the appended claims, any of the claimed embodiments can be used in any combination.

[0058] In this description of the invention, reference is made to the accompanying drawings that form a part hereof, and in which are shown by way of illustration only of specific embodiments in which the invention may be practiced. It is to be understood that other

embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

[0059] It is an object of the invention to not encompass within the invention any previously known product, process of making the product, or method of using the product such that Applicants reserve the right and hereby disclose a disclaimer of any previously known product, process, or method. It is further noted that the invention does not intend to encompass within the scope of the invention any product, process, or making of the product or method of using the product, which does not meet the written description and enablement requirements of the USPTO (35 U.S.C. §112, first paragraph) or the EPO (Article 83 of the EPC), such that Applicants reserve the right and hereby disclose a disclaimer of any previously described product, process of making the product, or method of using the product.

[0060] Preferred statements (features) and embodiments of this invention are set herein below. Each statements and embodiments of the invention so defined may be combined with any other statement and/or embodiments unless clearly indicated to the contrary. In particular, any feature indicated as being preferred or advantageous may be combined with any other feature or features or statements indicated as being preferred or advantageous.

[0061] To facilitate an understanding of the present invention, a number of terms and phrases are defined herein:

[0062] Unless specifically stated or obvious from context, as used herein, the term "about" is understood as within a range of normal tolerance in the art, for example within 2 standard deviations of the mean. About can be understood as within 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, 0.5%, 0.1%, 0.05%, or 0.01% of the stated value. Unless otherwise clear from context, all numerical values provided herein are modified by the term about.

[0063] Unless specifically stated or obvious from context, as used herein, the term "or" is understood to be inclusive. Unless specifically stated or obvious from context, as used herein, the terms "a," "an," and "the" are understood to be singular or plural.

[0064] All gene name symbols refer to the gene as commonly known in the art. Gene symbols may be those refered to by the HUGO Gene Nomenclature Committee (HGNC). Any reference to the gene symbol is a reference made to the entire gene or variants of the gene. The

HUGO Gene Nomenclature Committee is responsible for providing human gene naming guidelines and approving new, unique human gene names and symbols. All human gene names and symbols can be searched at www.genenames.org, the HGNC website, and the guidelines for their formation are available there (www.genenames.org/guidelines).

[0065] By “agent” is meant any small molecule chemical compound, antibody, nucleic acid molecule, or polypeptide, or fragments thereof.

[0066] By "ameliorate" is meant decrease, suppress, attenuate, diminish, arrest, or stabilize the development or progression of a disease (e.g., a neoplasia, tumor, etc.).

[0067] By "alteration" is meant a change (increase or decrease) in the expression levels oractivity of a gene or polypeptide as detected by standard art known methods such as those described herein. As used herein, an alteration includes a 10% change in expression levels, preferably a 25% change, more preferably a 40% change, and most preferably a 50% or greater change in expression levels.

[0068] By "analog" is meant a molecule that is not identical, but has analogous functional or structural features. For example, a tumor specific neo-antigen polypeptide analog retains the biological activity of a corresponding naturally-occurring tumor specific neo-antigen polypeptide, while having certain biochemical modifications that enhance the analog's function relative to a naturally-occurring polypeptide. Such biochemical modifications could increase the analog's protease resistance, membrane permeability, or half-life, without altering, for example, ligand binding. An analog may include an unnatural amino acid.

[0069] “Combination therapy” is intended to embrace administration of therapeutic agents (e.g. neoantigenic peptides described herein) in a sequential manner, that is, wherein each therapeutic agent is administered at a different time, as well as administration of these therapeutic agents, or at least two of the therapeutic agents, in a substantially simultaneous manner. Substantially simultaneous administration can be accomplished, for example, by administering to the subject a single capsule having a fixed ratio of each therapeutic agent or in multiple, single capsules for each of the therapeutic agents. For example, one combination of the present invention may comprise a pooled sample of neoantigenic peptides administered at the same or different times, or they can be formulated as a single, co-formulated pharmaceutical composition comprising the peptides. As another example, a combination of the present invention (e.g., a pooled sample of tumor specific neoantigens) may be formulated as separate

pharmaceutical compositions that can be administered at the same or different time. As used herein, the term "simultaneously" is meant to refer to administration of one or more agents at the same time. For example, in certain embodiments, the neoantigenic peptides are administered simultaneously. Simultaneously includes administration contemporaneously, that is during the same period of time. In certain embodiments, the one or more agents are administered simultaneously in the same hour, or simultaneously in the same day. Sequential or substantially simultaneous administration of each therapeutic agent can be effected by any appropriate route including, but not limited to, oral routes, intravenous routes, sub-cutaneous routes, intramuscular routes, direct absorption through mucous membrane tissues (e.g., nasal, mouth, vaginal, and rectal), and ocular routes (e.g., intravitreal, intraocular, etc.). The therapeutic agents can be administered by the same route or by different routes. For example, one component of a particular combination may be administered by intravenous injection while the other component(s) of the combination may be administered orally. The components may be administered in any therapeutically effective sequence. The phrase "combination" embraces groups of compounds or non-drug therapies useful as part of a combination therapy.

[0070] The term "neoantigen" or "neoantigenic" means a class of tumor antigens that arises from a tumor-specific mutation(s) which alters the amino acid sequence of genome encoded proteins.

[0071] By "neoplasia" is meant any disease that is caused by or results in inappropriately high levels of cell division, inappropriately low levels of apoptosis, or both. For example, cancer is an example of a neoplasia. Examples of cancers include, without limitation, leukemia (e.g., acute leukemia, acute lymphocytic leukemia, acute myelocytic leukemia, acute myeloblastic leukemia, acute promyelocytic leukemia, acute myelomonocytic leukemia, acute monocytic leukemia, acute erythroleukemia, chronic leukemia, chronic myelocytic leukemia, chronic lymphocytic leukemia), polycythemia vera, lymphoma (e.g., Hodgkin's disease, non-Hodgkin's disease), Waldenstrom's macroglobulinemia, heavy chain disease, and solid tumors such as sarcomas and carcinomas (e.g., fibrosarcoma, myxosarcoma, liposarcoma, chondrosarcoma, osteogenic sarcoma, chordoma, angiosarcoma, endotheliosarcoma, lymphangiosarcoma, lymphangioendotheliosarcoma, synovioma, mesothelioma, Ewing's tumor, leiomyosarcoma, rhabdomyosarcoma, colon carcinoma, pancreatic cancer, breast cancer, ovarian cancer, prostate cancer, squamous cell carcinoma, basal cell carcinoma, adenocarcinoma, sweat gland carcinoma,

sebaceous gland carcinoma, papillary carcinoma, papillary adenocarcinomas, cystadenocarcinoma, medullary carcinoma, bronchogenic carcinoma, renal cell carcinoma, hepatoma, nile duct carcinoma, choriocarcinoma, seminoma, embryonal carcinoma, Wilm's tumor, cervical cancer, uterine cancer, testicular cancer, lung carcinoma, small cell lung carcinoma, bladder carcinoma, epithelial carcinoma, glioma, astrocytoma, medulloblastoma, craniopharyngioma, ependymoma, pinealoma, hemangioblastoma, acoustic neuroma, oligodenroglioma, schwannoma, meningioma, melanoma, neuroblastoma, and retinoblastoma). Lymphoproliferative disorders are also considered to be proliferative diseases.

[0072] The term "vaccine" is meant to refer in the present context to a pooled sample of tumor-specific neoantigenic peptides, for example at least two, at least three, at least four, at least five, or more neoantigenic peptides. A "vaccine" is to be understood as meaning a composition for generating immunity for the prophylaxis and/or treatment of diseases (e.g., neoplasia/tumor). Accordingly, vaccines are medicaments which comprise antigens and are intended to be used in humans or animals for generating specific defense and protective substance by vaccination. A "vaccine composition " can include a pharmaceutically acceptable excipient, carrier or diluent.

[0073] The term "pharmaceutically acceptable" refers to approved or approvable by a regulatory agency of the Federal or a state government or listed in the U.S. Pharmacopeia or other generally recognized pharmacopeia for use in animals, including humans.

[0074] A "pharmaceutically acceptable excipient, carrier or diluent" refers to an excipient, carrier or diluent that can be administered to a subject, together with an agent, and which does not destroy the pharmacological activity thereof and is nontoxic when administered in doses sufficient to deliver a therapeutic amount of the agent.

[0075] A "pharmaceutically acceptable salt" of pooled tumor specific neoantigens as recited herein may be an acid or base salt that is generally considered in the art to be suitable for use in contact with the tissues of human beings or animals without excessive toxicity, irritation, allergic response, or other problem or complication. Such salts include mineral and organic acid salts of basic residues such as amines, as well as alkali or organic salts of acidic residues such as carboxylic acids. Specific pharmaceutical salts include, but are not limited to, salts of acids such as hydrochloric, phosphoric, hydrobromic, malic, glycolic, fumaric, sulfuric, sulfamic, sulfanilic, formic, toluenesulfonic, methanesulfonic, benzene sulfonic, ethane disulfonic, 2-hydroxyethylsulfonic, nitric, benzoic, 2-acetoxybenzoic, citric, tartaric, lactic, stearic, salicylic,

glutamic, ascorbic, pamoic, succinic, fumaric, maleic, propionic, hydroxymaleic, hydroiodic, phenylacetic, alkanoic such as acetic, HOOC-(CH2)n-COOH where n is 0-4, and the like. Similarly, pharmaceutically acceptable cations include, but are not limited to sodium, potassium, calcium, aluminum, lithium and ammonium. Those of ordinary skill in the art will recognize from this disclosure and the knowledge in the art that further pharmaceutically acceptable salts for the pooled tumor specific neoantigens provided herein, including those listed by Remington's Pharmaceutical Sciences, 17th ed., Mack Publishing Company, Easton, PA, p. 1418 (1985). In general, a pharmaceutically acceptable acid or base salt can be synthesized from a parent compound that contains a basic or acidic moiety by any conventional chemical method. Briefly, such salts can be prepared by reacting the free acid or base forms of these compounds with a stoichiometric amount of the appropriate base or acid in an appropriate solvent.

[0076] By an isolated "polypeptide" or "peptide" is meant a polypeptide that has been separated from components that naturally accompany it. Typically, the polypeptide is isolated when it is at least 60%, by weight, free from the proteins and naturally-occurring organic molecules with which it is naturally associated. Preferably, the preparation is at least 75%, more preferably at least 90%, and most preferably at least 99%, by weight, a polypeptide. An isolated polypeptide may be obtained, for example, by extraction from a natural source, by expression of a recombinant nucleic acid encoding such a polypeptide; or by chemically synthesizing the protein. Purity can be measured by any appropriate method, for example, column chromatography, polyacrylamide gel electrophoresis, or by HPLC analysis.

[0077] As used herein, the terms "prevent," "preventing," "prevention," "prophylactic treatment," and the like, refer to reducing the probability of developing a disease or condition in a subject, who does not have, but is at risk of or susceptible to developing a disease or condition.

[0078] The term "prime/ boost" or "prime/ boost dosing regimen" is meant to refer to the successive administrations of a vaccine or immunogenic or immunological compositions. The priming administration (priming) is the administration of a first vaccine or immunogenic or immunological composition type and may comprise one, two or more administrations. The boost administration is the second administration of a vaccine or immunogenic or immunological composition type and may comprise one, two or more administrations, and, for instance, may comprise or consist essentially of annual administrations. In certain embodiments, administration of the neoplasia vaccine or immunogenic composition is in a prime/ boost dosing regimen.

[0079] Ranges provided herein are understood to be shorthand for all of the values within the range. For example, a range of 1 to 50 is understood to include any number, combination of numbers, or sub-range from the group consisting of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, or 50, as well as all intervening decimal values between the aforementioned integers such as, for example, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, and 1.9. With respect to sub-ranges, "nested sub-ranges" that extend from either end point of the range are specifically contemplated. For example, a nested sub-range of an exemplary range of 1 to 50 may comprise 1 to 10, 1 to 20, 1 to 30, and 1 to 40 in one direction, or 50 to 40, 50 to 30, 50 to 20, and 50 to 10 in the other direction.

[0080] A "receptor" is to be understood as meaning a biological molecule or a molecule grouping capable of binding a ligand. A receptor may serve, to transmit information in a cell, a cell formation or an organism. The receptor comprises at least one receptor unit and frequently contains two or more receptor units, where each receptor unit may consist of a protein molecule, in particular a glycoprotein molecule. The receptor has a structure that complements the structure of a ligand and may complex the ligand as a binding partner. Signaling information may be transmitted by conformational changes of the receptor following binding with the ligand on the surface of a cell. According to the invention, a receptor may refer to particular proteins of MHC classes I and II capable of forming a receptor/ligand complex with a ligand, in particular a peptide or peptide fragment of suitable length.

[0081] The term "subject" refers to an animal which is the object of treatment, observation, or experiment. By way of example only, a subject includes, but is not limited to, a mammal, including, but not limited to, a human or a non-human mammal, such as a non-human primate, bovine, equine, canine, ovine, or feline.

[0082] The terms "treat," "treated," "treating," "treatment," and the like are meant to refer to reducing or ameliorating a disorder and/or symptoms associated therewith (e.g., a neoplasia or tumor). "Treating" may refer to administration of the therapy to a subject after the onset, or suspected onset, of a cancer. "Treating" includes the concepts of "alleviating", which refers to lessening the frequency of occurrence or recurrence, or the severity, of any symptoms or other ill effects related to a cancer and/or the side effects associated with cancer therapy. The term "treating" also encompasses the concept of "managing" which refers to reducing the severity of a

particular disease or disorder in a patient or delaying its recurrence, e.g., lengthening the period of remission in a patient who had suffered from the disease. It is appreciated that, although not precluded, treating a disorder or condition does not require that the disorder, condition, or symptoms associated therewith be completely eliminated.

[0083] The term "therapeutic effect" refers to some extent of relief of one or more of the symptoms of a disorder (e.g., a neoplasia or tumor) or its associated pathology. "Therapeutically effective amount" as used herein refers to an amount of an agent which is effective, upon single or multiple dose administration to the cell or subject, in prolonging the survivability of the patient with such a disorder, reducing one or more signs or symptoms of the disorder, preventing or delaying, and the like beyond that expected in the absence of such treatment. "Therapeutically effective amount" is intended to qualify the amount required to achieve a therapeutic effect. A physician or veterinarian having ordinary skill in the art can readily determine and prescribe the "therapeutically effective amount" (e.g., ED50) of the pharmaceutical composition required. For example, the physician or veterinarian could start doses of the compounds of the invention employed in a pharmaceutical composition at levels lower than that required in order to achieve the desired therapeutic effect and gradually increase the dosage until the desired effect is achieved.

[0084] The terms "spacer" or "linker" as used in reference to a fusion protein refers to a peptide that joins the proteins comprising a fusion protein. Generally, a spacer has no specific biological activity other than to join or to preserve some minimum distance or other spatial relationship between the proteins or RNA sequences. However, in certain embodiments, the constituent amino acids of a spacer may be selected to influence some property of the molecule such as the folding, net charge, or hydrophobicity of the molecule.

[0085] Suitable linkers for use in an embodiment of the present invention are well known to those of skill in the art and include, but are not limited to, straight or branched-chain carbon linkers, heterocyclic carbon linkers, or peptide linkers. The linker is used to separate two neoantigenic peptides by a distance sufficient to ensure that, in a preferred embodiment, each neoantigenic peptide properly folds. Preferred peptide linker sequences adopt a flexible extended conformation and do not exhibit a propensity for developing an ordered secondary structure. Typical amino acids in flexible protein regions include Gly, Asn and Ser. Virtually any permutation of amino acid sequences containing Gly, Asn and Ser would be expected to satisfy

the above criteria for a linker sequence. Other near neutral amino acids, such as Thr and Ala, also may be used in the linker sequence. Still other amino acid sequences that may be used as linkers are disclosed in Maratea et al. (1985), Gene 40: 39-46; Murphy et al. (1986) Proc. Nat'l. Acad. Sci. USA 83: 8258-62; U.S. Pat. No. 4,935,233; and U.S. Pat. No. 4,751,180.

[0086] The recitation of a listing of chemical groups in any definition of a variable herein includes definitions of that variable as any single group or combination of listed groups. The recitation of an embodiment for a variable or aspect herein includes that embodiment as any single embodiment or in combination with any other embodiments or portions thereof.

[0087] Any compositions or methods provided herein can be combined with one or more of any of the other compositions and methods provided herein.

[0088] The therapy disclosed herein constitutes a new method for treating various types of cancer. The therapy described herein also provides a method of therapy for achieving clinical benefit without an unacceptable level of side effects.

[0089] The immune system can be classified into two functional subsystems: the innate and the acquired immune system. The innate immune system is the first line of defense against infections, and most potential pathogens are rapidly neutralized by this system before they can cause, for example, a noticeable infection. The acquired immune system reacts to molecular structures, referred to as antigens, of the intruding organism. There are two types of acquired immune reactions, which include the humoral immune reaction and the cell-mediated immune reaction. In the humoral immune reaction, antibodies secreted by B cells into bodily fluids bind to pathogen-derived antigens, leading to the elimination of the pathogen through a variety of mechanisms, e.g. complement-mediated lysis. In the cell-mediated immune reaction, T-cells capable of destroying other cells are activated. For example, if proteins associated with a disease are present in a cell, they are fragmented proteolytically to peptides within the cell. Specific cell proteins then attach themselves to the antigen or peptide formed in this manner and transport them to the surface of the cell, where they are presented to the molecular defense mechanisms, in particular T-cells, of the body. Cytotoxic T cells recognize these antigens and kill the cells that harbor the antigens.

[0090] The molecules that transport and present peptides on the cell surface are referred to as proteins of the major histocompatibility complex (MHC). MHC proteins are classified into two types, referred to as MHC class I and MHC class II. The structures of the proteins of the two

MHC classes are very similar; however, they have very different functions. Proteins of MHC class I are present on the surface of almost all cells of the body, including most tumor cells. MHC class I proteins are loaded with antigens that usually originate from endogenous proteins or from pathogens present inside cells, and are then presented to naïve or cytotoxic T-lymphocytes (CTLs). MHC class II proteins are present on dendritic cells, B- lymphocytes, macrophages and other antigen-presenting cells. They mainly present peptides, which are processed from external antigen sources, i.e. outside of the cells, to T-helper (Th) cells. Most of the peptides bound by the MHC class I proteins originate from cytoplasmic proteins produced in the healthy host cells of an organism itself, and do not normally stimulate an immune reaction. Accordingly, cytotoxic T-lymphocytes that recognize such self-peptide-presenting MHC molecules of class I are deleted in the thymus (central tolerance) or, after their release from the thymus, are deleted or inactivated, i.e. tolerized (peripheral tolerance). MHC molecules are capable of stimulating an immune reaction when they present peptides to non-tolerized T-lymphocytes. Cytotoxic T-lymphocytes have both T-cell receptors (TCR) and CD8 molecules on their surface. T-Cell receptors are capable of recognizing and binding peptides complexed with the molecules of MHC class I. Each cytotoxic T-lymphocyte expresses a unique T-cell receptor which is capable of binding specific MHC/peptide complexes.

[0091] The peptide antigens attach themselves to the molecules of MHC class I by competitive affinity binding within the endoplasmic reticulum, before they are presented on the cell surface. Here, the affinity of an individual peptide antigen is directly linked to its amino acid sequence and the presence of specific binding motifs in defined positions within the amino acid sequence. If the sequence of such a peptide is known, it is possible to manipulate the immune system against diseased cells using, for example, peptide vaccines. The human leukocyte antigen (HLA) system is a gene complex encoding the major histocompatibility complex (MHC) proteins in humans.

[0092] By "proteins or molecules of the major histocompatibility complex (MHC)", "MHC molecules", "MHC proteins" or "HLA proteins" is thus meant proteins capable of binding peptides resulting from the proteolytic cleavage of protein antigens and representing potential T-cell epitopes, transporting them to the cell surface and presenting them there to specific cells, in particular cytotoxic T-lymphocytes or T-helper cells.

[0093] MHC molecules of class I consist of a heavy chain and a light chain and are capable of binding a peptide of about 8 to 11 amino acids, but usually 9 or 10 amino acids, if this peptide has suitable binding motifs, and presenting it to cytotoxic T-lymphocytes. The peptide bound by the MHC molecules of class I originates from an endogenous protein antigen. The heavy chain of the MHC molecules of class I is preferably an HLA-A, HLA-B or HLA-C monomer, and the light chain is β-2-microglobulin.

[0094] MHC molecules of class II consist of an α-chain and a β-chain and are capable of binding a peptide of about 15 to 24 amino acids if this peptide has suitable binding motifs, and presenting it to T-helper cells. The peptide bound by the MHC molecules of class II usually originates from an extracellular of exogenous protein antigen. The α-chain and the β-chain are in particular HLA-DR, HLA-DQ and HLA-DP monomers.

[0095] Subject specific HLA alleles or HLA genotype of a subject may be determined by any method known in the art. In preferred embodiments, HLA genotypes are determined by any method described in International Patent Application number PCT/US2014/068746, published June 11, 2015 as WO2015085147. Briefly, the methods include determining polymorphic gene types that may comprise generating an alignment of reads extracted from a sequencing data set to a gene reference set comprising allele variants of the polymorphic gene, determining a first posterior probability or a posterior probability derived score for each allele variant in the alignment, identifying the allele variant with a maximum first posterior probability or posterior probability derived score as a first allele variant, identifying one or more overlapping reads that aligned with the first allele variant and one or more other allele variants, determining a second posterior probability or posterior probability derived score for the one or more other allele variants using a weighting factor, identifying a second allele variant by selecting the allele variant with a maximum second posterior probability or posterior probability derived score, the first and second allele variant defining the gene type for the polymorphic gene, and providing an output of the first and second allele variant.

[0096] As described herein, there is a large body of evidence in both animals and humans that mutated epitopes are effective in inducing an immune response and that cases of spontaneous tumor regression or long term survival correlate with CD8+ T-cell responses to mutated epitopes (Buckwalter and Srivastava PK. “It is the antigen(s), stupid” and other lessons from over a decade of vaccitherapy of human cancer. Seminars in immunology 20:296-300

(2008); Karanikas et al, High frequency of cytolytic T lymphocytes directed against a tumor-specific mutated antigen detectable with HLA tetramers in the blood of a lung carcinoma patient with long survival. Cancer Res. 61:3718-3724 (2001); Lennerz et al, The response of autologous T cells to a human melanoma is dominated by mutated neoantigens. Proc Natl Acad Sci U S A.102:16013 (2005)) and that "immunoediting" can be tracked to alterations in expression of dominant mutated antigens in mice and man (Matsushita et al, Cancer exome analysis reveals a T-cell-dependent mechanism of cancer immunoediting Nature 482:400 (2012); DuPage et al, Expression of tumor-specific antigens underlies cancer immunoediting Nature 482:405 (2012); and Sampson et al, Immunologic escape after prolonged progression-free survival with epidermal growth factor receptor variant III peptide vaccination in patients with newly diagnosed glioblastoma J Clin Oncol. 28:4722-4729 (2010)).

[0097] Sequencing technology has revealed that each tumor contains multiple, patient-specific mutations that alter the protein coding content of a gene. Such mutations create altered proteins, ranging from single amino acid changes (caused by missense mutations) to addition of long regions of novel amino acid sequence due to frame shifts, read-through of termination codons or translation of intron regions (novel open reading frame mutations; neoORFs). These mutated proteins are valuable targets for the host's immune response to the tumor as, unlike native proteins, they are not subject to the immune-dampening effects of self-tolerance. Therefore, mutated proteins are more likely to be immunogenic and are also more specific for the tumor cells compared to normal cells of the patient.

Improved HLA epitope prediction, methods and products for use therein

[0098] Provided herein are methods and tools for improved HLA epitope prediction. These are of interest, for example, for use in the production of suitable neoantigen-comprising peptides as described herein below.

[0099] In one aspect, the present disclosure provides methods for generating an HLA- allele specific binding peptide sequence database. Such a database is very useful for predicting suitable HLA-binding peptides, identifying factors which play a role in HLA-peptide presentation and generating a more accurate prediction algorithm for identifying HLA- allele specific binding peptides. The methods comprise isolating and sequencing, for each HLA-allele, the HLA-binding peptides. In particular embodiments, the methods comprise providing a) a population of cells which expresses a single class I HLA allele or a single pair of class II HLA alleles (one α-

chain and one β-chain); b) isolating the respective HLA-peptide complexes from said cells; c) isolating peptides from said HLA-peptide complexes; and d) sequencing said peptides. One of the advantages of the present method is the ability to identify a large number of HLA binding peptides which are specific for a particular HLA allele.

[00100] The method comprises providing a population of cells that expresses either a single class I HLA allele, a single pair of class II HLA alleles, or a single class I HLA allele and a single pair of class II HLA alleles. Suitable cell populations include, e.g., class I deficient cells lines in which a single HLA class I allele is expressed, class II deficient cell lines in which a single pair of HLA class II alleles are expressed, or class I and class II deficient cell lines in which a single HLA class I and/or single pair of class II alleles are expressed. As an exemplary embodiment, the class I deficient B cell line is B721.221. However, it is clear to a skilled person that other cell populations can be generated which are class I and/or class II deficient. An exemplary method for deleting/inactivating endogenous class I or class II genes includes, CRISPR-Cas9 mediated genome editing.

[00101] In preferred embodiments, the population of cells are professional antigen presenting cells such as macrophages, B cells and dendritic cells. Preferably, the cells are B cells or dendritic cells.

[00102] In preferred embodiments the cells are tumor cells or cells from a tumor cell line. In particular embodiments, the cells are cells isolated from a patient.

[00103] In preferred embodiments, the population of cells comprises at least 10^7 cells.

[00104] In some embodiments, the population of cells are further modified, such as by increasing or decreasing the expression and/or activity of at least one gene. In preferred embodiments, the gene encodes a member of the immunoproteasome. The immunoproteasome is known to be involved in the processing of HLA class I binding peptides and includes the LMP2 (β1i), MECL-1 (β2i), and LMP7 (β5i) subunits. The immunoproteasome can also be induced by interferon-gamma. Accordingly, in some embodiments, the population of cells may be contacted with one or more cytokines, growth factors, or other proteins. Preferably, the cells are stimulated with inflammatory cytokines such as interferon-gamma, IL-1β, IL-6, and/or TNF-α. The population of cells may also be subjected to various environmental conditions, such as stress (heat stress, oxygen deprivation, glucose starvation, DNA damaging agents, etc.). In some embodiments the cells are contacted with one or more of a chemotherapy drug, radiation,

targeted therapies, immunotherapy. The methods disclosed herein can therefore be used to study the effect of various genes or conditions on HLA peptide processing and presentation. In particular embodiments, the conditions used are selected so as to match the condition of the patient for which the population of HLA-peptides is to be identified.

[00105] Any HLA allele may be expressed in the cell population. Typically, it will be of interest to sequentially perform the methods provided herein for different HLA alleles, such that resulting datasets can be used in combination. In a preferred embodiment, the HLA allele is a class I HLA allele. In particular embodiments, the class I HLA allele is an HLA-A allele or an HLA-B allele. In a preferred embodiment, the HLA allele is a class II HLA allele. Sequences of class I and class II HLA alleles can be found in the IPD-IMGT/HLA Database. Exemplary HLA alleles include but are not limited to A*01:01, A*02:01, A*02:03, A*02:04, A*02:07, A*03:01, A*24:02, A*29:02, A*31:01, A*68:02, B*35:01, B*44:02, B*44:03, B*51:01, B*54:01 or B57:01 In particular embodiments, the HLA allele is selected so as to correspond to a genotype of interest. In a preferred embodiment, the HLA allele is a mutated HLA allele, which may be non-naturally occurring allele or a naturally occurring allele in an afflicted patient. The methods disclosed herein have the further advantage of identifying HLA binding peptides for HLA alleles associated with various disorders as well as alleles which are present at low frequency. Accordingly, in a preferred method the HLA allele is present at a frequency of less than 1% within a population, such as within the Caucasian population.

[00106] Vectors, promoters, etc for expression. In some embodiments, the nucleic acid sequence encoding the HLA allele further comprises a peptide tag which can be used to immunopurify the HLA-protein. Suitable tags are well-known in the art and include Myc, VSV, V5, His, HA, and FLAG tags.

[00107] The methods further comprise isolating HLA-peptide complexes from said cells. In preferred embodiments the complexes can be isolated using standard immunoprecipitation techniques known in the art with commercially available antibodies. Preferably, the cells are first lysed. HLA class I-peptide complexes can be isolated using HLA class I specific antibodies such as the W6/32 antibody, while HLA class II-peptide complexes can be isolated using HLA class II specific antibodies such as the M5/114.15.2 monoclonal antibody. In some embodiments, the single (or pair of) HLA alleles are expressed as a fusion protein with a peptide tag and the HLA-peptide complexes are isolated using binding molecules that recognize the peptide tags.

[00108] The methods further comprise isolating peptides from said HLA-peptide complexes and sequencing the peptides. The peptides are isolated from the complex by any method known to one of skill in the art, such as acid elution. While any sequencing method may be used, methods employing mass spectrometry, such as liquid chromatography–mass spectrometry (LC-MS or LC-MS/MS, or alternatively HPLC-MS or HPLC-MS/MS) are preferred. These sequencing methods are well-known to a skilled person and are reviewed in Medzihradszky KF and Chalkley RJ. Mass Spectrom Rev. 2015 Jan-Feb;34(1):43-63.

[00109] Typically, an HLA- allele specific binding peptide sequence database comprises at least 1000 different binding peptide sequences.

[00110] The methods disclosed herein may also be used to generate a database comprising the HLA-allele specific binding peptide sequences for more than one HLA-allele. In preferred embodiments, the methods comprise performing the steps a) – d) for at least two different HLA-alleles, preferably at least five, more preferably at least 10 different alleles.

[00111] In one aspect, the present disclosure provides a plurality of HLA-allele specific binding peptides, or the sequences thereof, which peptides correspond to the peptides which are presented by one specific HLA allele. More particularly, an HLA- allele specific binding peptide sequence database is provided obtained by carrying out the method according to the invention. In particular embodiments, combinations of pluralities of peptides, sets of sequences or databases is provided, represent HLA-allele specific peptides, sets of sequences or databases for different HLA alleles. The combination of databases is also referred to herein as a dataset. These combinations differentiate themselves over prior art datasets in that they represent HLA-specific peptides for each HLA-allele individually rather than combining HLA peptides obtained from a combination of HLA-alleles.

[00112] In one aspect, the present disclosure provides methods for generating a prediction algorithm for identifying HLA- allele specific binding peptides, which methods comprise training a neural network with one or more peptide sequence databases (i.e; combinations of databases). In particular embodiments, the methods involve training a machine with one or more peptide sequence databases generated with a method according to the invention. More particularly, the methods comprise training a neural network running on a machine with several peptide sequence databases. In the methods provided herein, the sequences are compared so as to identify prediction algorithms for a peptide to be presented by said HLA-allele.

[00113] Generating a prediction algorithm by training a machine is a well-known technique. The most important in the training of the machine is the quality of the database used for the training. Typically, the machine combines one or more linear models, support vector machines, decision trees and/or a neural network.

[00114] Machine learning can be generalized as the ability of a learning machine to perform accurately on new, unseen examples/tasks after having experienced a learning data set. Machine learning may include the following concepts and methods. Supervised learning concepts may include AODE; Artificial neural network, such as Backpropagation, Autoencoders, Hopfield networks, Boltzmann machines, Restricted Boltzmann Machines, and Spiking neural networks; Bayesian statistics, such as Bayesian network and Bayesian knowledge base; Case-based reasoning; Gaussian process regression; Gene expression programming; Group method of data handling (GMDH); Inductive logic programming; Instance-based learning; Lazy learning; Learning Automata; Learning Vector Quantization; Logistic Model Tree; Minimum message length (decision trees, decision graphs, etc.), such as Nearest Neighbor Algorithm and Analogical modeling; Probably approximately correct learning (PAC) learning; Ripple down rules, a knowledge acquisition methodology; Symbolic machine learning algorithms; Support vector machines; Random Forests; Ensembles of classifiers, such as Bootstrap aggregating (bagging) and Boosting (meta-algorithm); Ordinal classification; Information fuzzy networks (IFN); Conditional Random Field; ANOVA; Linear classifiers, such as Fisher's linear discriminant, Linear regression, Logistic regression, Multinomial logistic regression, Naive Bayes classifier, Perceptron, Support vector machines; Quadratic classifiers; k-nearest neighbor; Boosting; Decision trees, such as C4.5, Random forests, ID3, CART, SLIQ, SPRINT; Bayesian networks, such as Naive Bayes; and Hidden Markov models. Unsupervised learning concepts may include; Expectation-maximization algorithm; Vector Quantization; Generative topographic map; Information bottleneck method; Artificial neural network, such as Self-organizing map; Association rule learning, such as, Apriori algorithm, Eclat algorithm, and FP-growth algorithm; Hierarchical clustering, such as Single-linkage clustering and Conceptual clustering; Cluster analysis, such as, K-means algorithm, Fuzzy clustering, DBSCAN, and OPTICS algorithm; and Outlier Detection, such as Local Outlier Factor. Semi-supervised learning concepts may include; Generative models; Low-density separation; Graph-based methods; and Co-training. Reinforcement learning concepts may include; Temporal difference learning; Q-learning;

Learning Automata; and SARSA. Deep learning concepts may include; Deep belief networks; Deep Boltzmann machines; Deep Convolutional neural networks; Deep Recurrent neural networks; and Hierarchical temporal memory.

[00115] In a preferred embodiment, the methods involve generating models based on predictive variables. In particular embodiments, only peptide-intrinsic features are used as variables (such as sequence, amino acid properties, peptide characteristics). In alternative embodiments, the models also incorporate extrinsic features such as expression and cleavage information. In particular embodiments, the variables used to train the machine comprise one or more predictive variables selected from the group consisting of peptide sequence, amino acid physical properties, peptide physical properties, protein stability, protein translation rate, protein degradation rate, translational efficiencies from ribosomal profiling, protein cleavability, protein localization, motifs of host protein that facilitate TAP transport, whether host protein is subject to autophagy, motifs that favor ribosomal stalling (polyproline stretches) and protein features that favor NMD (long 3' UTR, stop codon >50nt upstream of last exon:exon junction). In particular embodiments, at least two of these features are used. In further embodiments, at least 3, 4, 5, 6, 7, 8, 9 or all ten of these features are used. In a preferred embodiment, the variables used to train the machine comprise the expression level of the source protein of a peptide within a cell. In a preferred embodiment, the variables used to train the machine comprise expression level of the source protein of a peptide within a cell, peptide sequence, amino acid physical properties, peptide physical properties, expression level of the source protein of a peptide within a cell, Protein stability, protein translation rate, protein degradation rate, translational efficiencies from ribosomal profiling, protein cleavability, protein localization, motifs of host protein that facilitate TAP transport, host protein is subject to autophagy, motifs that favor ribosomal stalling (polyproline stretches), protein features that favor NMD (long 3' UTR, stop codon >50nt upstream of last exon:exon junction and peptide cleavability.

[00116] In one aspect, the present disclosure provides methods for identifying HLA- allele specific binding peptides, which method comprises analyzing the sequence of a peptide with a machine which has been trained with a peptide sequence database obtained by carrying out the method according to the invention for said HLA- allele. In a preferred embodiment, the method comprises using information on the expression level of the source protein of the peptide within the cell as a variable. In further embodiments, the method comprises determining the expression

level of the source protein of the peptide within a cell and using the source protein expression as one of the predictive variables used by the machine. Typically, the expression level is determined by measuring the amount of source protein or the amount of RNA encoding said source protein. It is demonstrated herein that the methods provided herein allow a more effective prediction of HLA-binding peptides than methods of the prior art, with fewer false positives. This is important as the number of immunogenic peptides that can practically be generated in the context of an immune therapy is limited. In particular embodiments, the methods are used to determine an effective neoantigen vaccine. In this context, it is of interest to determine which peptides forming neoantigens are likely to bind to a subject's HLA so as to effectively function as immunogenic peptides.

Production of Tumor Specific Neoantigens

[00117] One of the critical barriers to developing curative and tumor-specific immunotherapy is the identification and selection of highly specific and restricted tumor antigens to avoid autoimmunity. Tumor neoantigens, which arise as a result of genetic change (e.g., inversions, translocations, deletions, missense mutations, splice site mutations, etc.) within malignant cells, represent the most tumor-specific class of antigens. Neoantigens have rarely been used in cancer vaccine or immunogenic compositions due to technical difficulties in identifying them, selecting optimized neoantigens, and producing neoantigens for use in a vaccine or immunogenic composition. These problems may be addressed by:

- identifying mutations in neoplasias/tumors which are present at the DNA level in tumor but not in matched germline samples from a high proportion of subjects having cancer;

- analyzing the identified mutations with one or more peptide-MHC binding prediction algorithms to generate a plurality of neoantigen T cell epitopes that are expressed within the neoplasia/tumor and that bind to a high proportion of patient HLA alleles; and

- synthesizing the plurality of neoantigenic peptides selected from the sets of all neoantigen peptides and predicted binding peptides for use in a cancer vaccine

or immunogenic composition suitable for treating a high proportion of subjects having cancer.

[00118] For example, translating sequencing information into a therapeutic vaccine may include:

(1) *Prediction of mutated peptides that can bind to HLA molecules of a high proportion of individuals.* Efficiently choosing which particular mutations to utilize as immunogen requires the ability to predict which mutated peptides would efficiently bind to a high proportion of patient's HLA alleles. Recently, neural network based learning approaches with validated binding and non-binding peptides have advanced the accuracy of prediction algorithms for the major HLA-A and -B alleles.

(2) *Formulating the drug as a multi-epitope vaccine of long peptides.* Targeting as many mutated epitopes as practically possible takes advantage of the enormous capacity of the immune system, prevents the opportunity for immunological escape by down-modulation of a particular immune targeted gene product, and compensates for the known inaccuracy of epitope prediction approaches. Synthetic peptides provide a particularly useful means to prepare multiple immunogens efficiently and to rapidly translate identification of mutant epitopes to an effective vaccine. Peptides can be readily synthesized chemically and easily purified utilizing reagents free of contaminating bacteria or animal substances. The small size allows a clear focus on the mutated region of the protein and also reduces irrelevant antigenic competition from other components (unmutated protein or viral vector antigens).

(3) *Combination with a strong vaccine adjuvant.* Effective vaccines require a strong adjuvant to initiate an immune response. As described below, poly-ICLC, an agonist of TLR3 and the RNA helicase -domains of MDA5 and RIG3, has shown several desirable properties for a vaccine adjuvant. These properties include the induction of local and systemic activation of immune cells *in vivo,* production of stimulatory chemokines and cytokines, and stimulation of antigen-presentation by DCs. Furthermore, poly-ICLC can induce durable CD4+ and CD8+ responses in humans. Importantly, striking similarities in the upregulation of transcriptional and signal transduction pathways were seen in subjects vaccinated with poly-ICLC and in volunteers who had received the highly effective, replication-competent yellow fever vaccine. Furthermore, >90% of ovarian carcinoma patients immunized with poly-ICLC in combination with a NYES0-1 peptide vaccine (in addition to Montanide) showed induction of CD4+ and CD8+ T cell, as

well as antibody responses to the peptide in a recent phase 1 study. At the same time, polyICLC has been extensively tested in more than 25 clinical trials to date and exhibited a relatively benign toxicity profile.

[00119] The application provides improved methods of prediction of peptides, such as mutated peptides, that can bind to HLA molecules of a high proportion of individuals. In particular embodiments, the application provides methods of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from set given set of peptides the plurality of peptides capable of binding an HLA protein of the subject, wherein said ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with peptide sequence databases corresponding to the specific HLA-binding peptides for each of the HLA-alleles of said subject. More particularly, the application provides methods of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from set given set of peptides the plurality of peptides determined as capable of binding an HLA protein of the subject, ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with a peptide sequence database obtained by carrying out the methods described herein above. Thus, in particular embodiments, the application provides methods of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, wherein the subject has a tumor and the subject-specific peptides are specific to the subject and the subject's tumor, said method comprising:

- whole genome or whole exome nucleic acid sequencing of a sample of the subject's tumor and a non-tumor sample of the subject;
- determining based on the whole genome or whole exome nucleic acid sequencing:
    - non-silent mutations present in the genome of cancer cells of the subject but not in normal tissue from the subject, and
    - the HLA genotype of the subject,

wherein the non-silent mutations comprise a point, splice-site, frameshift, read- through or gene-fusion mutation; and

- selecting from the identified non-silent mutations the plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each being identified as capable of binding an HLA protein of the subject, as determined by analyzing the sequence of peptides derived from the non-silent mutations in the methods for predicting HLA binding described herein.

[00120] In particular embodiments, the methods are used to determine whether or not a peptide will bind to an HLA protein. In further embodiments, the methods provide a predictive score indicative of binding an HLA protein of the subject,

[00121] Thus, in particular embodiments, the application provides methods of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, said method comprising selecting a plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each having a predictive score indicative of binding an HLA protein of the subject, wherein said predictive score is determined by analyzing the sequence of peptides derived from the non-silent mutations by carrying out the method of predicting HLA-binding described herein.

[00122] In particular embodiments, the cell used in the method for determining HLA binding as described herein is an antigen-presenting cell.

[00123] In a further aspect, the invention provides methods for identifying tumor neonatigen-comprising peptides, wherein the methods comprise identifying for a given HLA allele, the peptides binding said HLA allele in a tumor cell from a tumor of a patient.

[00124] The application further provides novel neoantigenic peptides identified by the methods provided herein. Accordingly, provided herein are immunogenic compositions comprising a peptide having a sequence selected from $XLXX_4XX_6X_7XX_9$, wherein one or more of X_4 is E or D, X_6 is L, V, or I, X_7 is I, V, or A, and X_9 is L or V, and wherein X is any amino acid; $XLXDXXX_7XX_9$, wherein one or more of X_7 is L and X_9 is Y or F, and wherein X is any amino acid; $XX_2X_3X_4XXXXY$, wherein one or more of X_2 is T, S, or L, X_3 is D or E and X_7 is I, V, or A, and wherein X is any amino acid; $XLXXXX_6XXX_9$, wherein one or more of X_6 is L or V and X_9 is V or L, and wherein X is any amino acid; $XLXX_4XX_6XXX_9$, wherein one or more of X_4 is E or D, X_6 is L or V and X_9 is V or L, and wherein X is any amino acid; $XLDXXXXXX_9$, wherein X_9 is L or V, and wherein X is any amino acid; $XXXXXXLXX_9$, wherein one or more of X_2 is L or V and X_9 is K, Y or R, and wherein X is any amino acid;

$X_1X_2XXXXXXR$, wherein one or more of X_1 is R or A and X_2 is V or L, and wherein X is any amino acid; $EX_2XXXXXXX_9$, wherein one or more of X_2 is V, T, or A and X_9 is V or L, and wherein X is any amino acid; $XX_2XRXXXXX_9$, wherein one or more of X_2 is P or A and X_9 is Y, F, or L, and wherein X is any amino acid; $X_1EXXLXXXX_9$, wherein one or more of X_1 is A or E and X_9 is F, W, or L, and wherein X is any amino acid; $X_1EXXLXLXX_9$, wherein one or more of X_1 is A or E and X_9 is F, W, or L, and wherein X is any amino acid; $DX_2XXXXXXX_9$, wherein one or more of X_2 is P or A and X_9 is I, V, or L, and wherein X is any amino acid; and $X_1YXXXXXXX_9$, wherein one or more of X_1 is M, W, or V and X_9 is F or L, and wherein X is any amino acid.

[00125] The present invention is based, at least in part, on the ability to present the immune system of the patient with a pool of tumor specific neoantigens. One of skill in the art from this disclosure and the knowledge in the art will appreciate that there are a variety of ways in which to produce such tumor specific neoantigens. In general, such tumor specific neoantigens may be produced either in vitro or in vivo. Tumor specific neoantigens may be produced in vitro as peptides or polypeptides, which may then be formulated into a neoplasia vaccine or immunogenic composition and administered to a subject. As described in further detail herein, such in vitro production may occur by a variety of methods known to one of skill in the art such as, for example, peptide synthesis or expression of a peptide/polypeptide from a DNA or RNA molecule in any of a variety of bacterial, eukaryotic, or viral recombinant expression systems, followed by purification of the expressed peptide/polypeptide. Alternatively, tumor specific neoantigens may be produced in vivo by introducing molecules (e.g., DNA, RNA, viral expression systems, and the like) that encode tumor specific neoantigens into a subject, whereupon the encoded tumor specific neoantigens are expressed. The methods of in vitro and in vivo production of neoantigens is also further described herein as it relates to pharmaceutical compositions and methods of delivery of the therapy.

[00126] In certain embodiments the present invention includes modified neoantigenic peptides. As used herein in reference to neoantigenic peptides, the terms "modified", "modification" and the like refer to one or more changes that enhance a desired property of the neoantigenic peptide, where the change does not alter the primary amino acid sequence of the neoantigenic peptide. "Modification" includes a covalent chemical modification that does not alter the primary amino acid sequence of the neoantigenic peptide itself. Such desired properties

include, for example, prolonging the *in vivo* half-life, increasing the stability, reducing the clearance, altering the immunogenicity or allergenicity, enabling the raising of particular antibodies, cellular targeting, antigen uptake, antigen processing, MHC affinity, MHC stability, or antigen presentation. Changes to a neoantigenic peptide that may be carried out include, but are not limited to, conjugation to a carrier protein, conjugation to a ligand, conjugation to an antibody, PEGylation, polysialylation HESylation, recombinant PEG mimetics, Fc fusion, albumin fusion, nanoparticle attachment, nanoparticulate encapsulation, cholesterol fusion, iron fusion, acylation, amidation, glycosylation, side chain oxidation, phosphorylation, biotinylation, the addition of a surface active material, the addition of amino acid mimetics, or the addition of unnatural amino acids.

[00127] The clinical effectiveness of protein therapeutics is often limited by short plasma half-life and susceptibility to protease degradation. Studies of various therapeutic proteins (e.g., filgrastim) have shown that such difficulties may be overcome by various modifications, including conjugating or linking the polypeptide sequence to any of a variety of non-proteinaceous polymers, e.g., polyethylene glycol (PEG), polypropylene glycol, or polyoxyalkylenes (see, for example, typically via a linking moiety covalently bound to both the protein and the nonproteinaceous polymer, e.g., a PEG). Such PEG- conjugated biomolecules have been shown to possess clinically useful properties, including better physical and thermal stability, protection against susceptibility to enzymatic degradation, increased solubility, longer in vivo circulating half-life and decreased clearance, reduced immunogenicity and antigenicity, and reduced toxicity.

[00128] PEGs suitable for conjugation to a polypeptide sequence are generally soluble in water at room temperature, and have the general formula $R(0\text{-}CH_2\text{-}CH_2)_nO\text{-}R$, where R is hydrogen or a protective group such as an alkyl or an alkanol group, and where n is an integer from 1 to 1000. When R is a protective group, it generally has from 1 to 8 carbons. The PEG conjugated to the polypeptide sequence can be linear or branched. Branched PEG derivatives, "star-PEGs" and multi-armed PEGs are contemplated by the present disclosure. A molecular weight of the PEG used in the present disclosure is not restricted to any particular range, but certain embodiments have a molecular weight between 500 and 20,000 while other embodiments have a molecular weight between 4,000 and 10,000.

[00129] The present disclosure also contemplates compositions of conjugates wherein the PEGs have different n values and thus the various different PEGs are present in specific ratios. For example, some compositions comprise a mixture of conjugates where n=l, 2, 3 and 4. In some compositions, the percentage of conjugates where n=l is 18-25%, the percentage of conjugates where n=2 is 50-66%, the percentage of conjugates where n=3 is 12-16%, and the percentage of conjugates where n=4 is up to 5%. Such compositions can be produced by reaction conditions and purification methods know in the art. For example, cation exchange chromatography may be used to separate conjugates, and a fraction is then identified which contains the conjugate having, for example, the desired number of PEGs attached, purified free from unmodified protein sequences and from conjugates having other numbers of PEGs attached.

[00130] PEG may be bound to a polypeptide of the present disclosure via a terminal reactive group (a "spacer"). The spacer is, for example, a terminal reactive group which mediates a bond between the free amino or carboxyl groups of one or more of the polypeptide sequences and polyethylene glycol. The PEG having the spacer which may be bound to the free amino group includes N-hydroxysuccinylimide polyethylene glycol which may be prepared by activating succinic acid ester of polyethylene glycol with N- hydroxy succinylimide. Another activated polyethylene glycol which may be bound to a free amino group is 2,4-bis(0-methoxypolyethyleneglycol)-6-chloro-s-triazine which may be prepared by reacting polyethylene glycol monomethyl ether with cyanuric chloride. The activated polyethylene glycol which is bound to the free carboxyl group includes polyoxyethylenediamine.

[00131] Conjugation of one or more of the polypeptide sequences of the present disclosure to PEG having a spacer may be carried out by various conventional methods. For example, the conjugation reaction can be carried out in solution at a pH of from 5 to 10, at temperature from 4°C to room temperature, for 30 minutes to 20 hours, utilizing a molar ratio of reagent to protein of from 4: 1 to 30: 1. Reaction conditions may be selected to direct the reaction towards producing predominantly a desired degree of substitution. In general, low temperature, low pH (e.g., pH=5), and short reaction time tend to decrease the number of PEGs attached, whereas high temperature, neutral to high pH (e.g., pH>7), and longer reaction time tend to increase the number of PEGs attached. Various means known in the art may be used to terminate the reaction.

In some embodiments the reaction is terminated by acidifying the reaction mixture and freezing at, e.g., -20°C.

[00132] The present disclosure also contemplates the use of PEG Mimetics. Recombinant PEG mimetics have been developed that retain the attributes of PEG (e.g., enhanced serum half-life) while conferring several additional advantageous properties. By way of example, simple polypeptide chains (comprising, for example, Ala, Glu, Gly, Pro, Ser and Thr) capable of forming an extended conformation similar to PEG can be produced recombinantly already fused to the peptide or protein drug of interest (e.g., Amunix' XTEN technology; Mountain View, CA). This obviates the need for an additional conjugation step during the manufacturing process. Moreover, established molecular biology techniques enable control of the side chain composition of the polypeptide chains, allowing optimization of immunogenicity and manufacturing properties.

[00133] For purposes of the present disclosure, "glycosylation" is meant to broadly refer to the enzymatic process that attaches glycans to proteins, lipids or other organic molecules. The use of the term "glycosylation" in conjunction with the present disclosure is generally intended to mean adding or deleting one or more carbohydrate moieties (either by removing the underlying glycosylation site or by deleting the glycosylation by chemical and/or enzymatic means), and/or adding one or more glycosylation sites that may or may not be present in the native sequence. In addition, the phrase includes qualitative changes in the glycosylation of the native proteins involving a change in the nature and proportions of the various carbohydrate moieties present. Glycosylation can dramatically affect the physical properties of proteins and can also be important in protein stability, secretion, and subcellular localization. Proper glycosylation can be essential for biological activity. In fact, some genes from eucaryotic organisms, when expressed in bacteria (e.g., E. coli) which lack cellular processes for glycosylating proteins, yield proteins that are recovered with little or no activity by virtue of their lack of glycosylation.

[00134] Addition of glycosylation sites can be accomplished by altering the amino acid sequence. The alteration to the polypeptide may be made, for example, by the addition of, or substitution by, one or more serine or threonine residues (for O-linked glycosylation sites) or asparagine residues (for N-linked glycosylation sites). The structures of N-linked and O- linked oligosaccharides and the sugar residues found in each type may be different. One type of sugar that is commonly found on both is N-acetylneuraminic acid (hereafter referred to as sialic acid).

Sialic acid is usually the terminal residue of both N-linked and O-linked oligosaccharides and, by virtue of its negative charge, may confer acidic properties to the glycoprotein. A particular embodiment of the present disclosure comprises the generation and use of N-glycosylation variants.

[00135] The polypeptide sequences of the present disclosure may optionally be altered through changes at the DNA level, particularly by mutating the DNA encoding the polypeptide at preselected bases such that codons are generated that will translate into the desired amino acids. Another means of increasing the number of carbohydrate moieties on the polypeptide is by chemical or enzymatic coupling of glycosides to the polypeptide.

[00136] Removal of carbohydrates may be accomplished chemically or enzymatically, or by substitution of codons encoding amino acid residues that are glycosylated. Chemical deglycosylation techniques are known, and enzymatic cleavage of carbohydrate moieties on polypeptides can be achieved by the use of a variety of endo- and exo-glycosidases.

[00137] Dihydrofolate reductase (DHFR) - deficient Chinese Hamster Ovary (CHO) cells are a commonly used host cell for the production of recombinant glycoproteins. These cells do not express the enzyme beta-galactoside alpha-2,6-sialyltransferase and therefore do not add sialic acid in the alpha-2,6 linkage to N-linked oligosaccharides of glycoproteins produced in these cells.

[00138] The present disclosure also contemplates the use of polysialylation, the conjugation of peptides and proteins to the naturally occurring, biodegradable a-(2→8) linked polysialic acid ("PSA") in order to improve their stability and in vivo pharmacokinetics. PSA is a biodegradable, non-toxic natural polymer that is highly hydrophilic, giving it a high apparent molecular weight in the blood which increases its serum half-life. In addition, polysialylation of a range of peptide and protein therapeutics has led to markedly reduced proteolysis, retention of activity in vivo activity, and reduction in immunogenicity and antigenicity (see, e.g., G. Gregoriadis et al., Int. J. Pharmaceutics 300(1-2): 125-30). As with modifications with other conjugates (e.g., PEG), various techniques for site-specific polysialylation are available (see, e.g., T. Lindhout et al., PNAS 108(18)7397-7402 (2011)).

[00139] Additional suitable components and molecules for conjugation include, for example, thyroglobulin; albumins such as human serum albumin (HAS); tetanus toxoid; Diphtheria toxoid; polyamino acids such as poly(D-lysine:D-glutamic acid); VP6 polypeptides of rotaviruses;

influenza virus hemaglutinin, influenza virus nucleoprotein; Keyhole Limpet Hemocyanin (KLH); and hepatitis B virus core protein and surface antigen; or any combination of the foregoing.

[00140] Fusion of albumin to one or more polypeptides of the present disclosure can, for example, be achieved by genetic manipulation, such that the DNA coding for HSA, or a fragment thereof, is joined to the DNA coding for the one or more polypeptide sequences. Thereafter, a suitable host can be transformed or transfected with the fused nucleotide sequences in the form of, for example, a suitable plasmid, so as to express a fusion polypeptide. The expression may be effected in vitro from, for example, prokaryotic or eukaryotic cells, or in vivo from, for example, a transgenic organism. In some embodiments of the present disclosure, the expression of the fusion protein is performed in mammalian cell lines, for example, CHO cell lines. Transformation is used broadly herein to refer to the genetic alteration of a cell resulting from the direct uptake, incorporation and expression of exogenous genetic material (exogenous DNA) from its surroundings and taken up through the cell membrane(s). Transformation occurs naturally in some species of bacteria, but it can also be effected by artificial means in other cells.

[00141] Furthermore, albumin itself may be modified to extend its circulating half-life. Fusion of the modified albumin to one or more Polypeptides can be attained by the genetic manipulation techniques described above or by chemical conjugation; the resulting fusion molecule has a half-life that exceeds that of fusions with non-modified albumin. (See WO2011/051489).

[00142] Several albumin - binding strategies have been developed as alternatives for direct fusion, including albumin binding through a conjugated fatty acid chain (acylation). Because serum albumin is a transport protein for fatty acids, these natural ligands with albumin - binding activity have been used for half-life extension of small protein therapeutics. For example, insulin determir (LEVEMIR), an approved product for diabetes, comprises a myristyl chain conjugated to a genetically-modified insulin, resulting in a long- acting insulin analog.

[00143] Another type of modification is to conjugate (e.g., link) one or more additional components or molecules at the N- and/or C-terminus of a polypeptide sequence, such as another protein (e.g., a protein having an amino acid sequence heterologous to the subject protein), or a carrier molecule. Thus, an exemplary polypeptide sequence can be provided as a conjugate with another component or molecule.

[00144] A conjugate modification may result in a polypeptide sequence that retains activity with an additional or complementary function or activity of the second molecule. For example, a polypeptide sequence may be conjugated to a molecule, e.g., to facilitate solubility, storage, in vivo or shelf half-life or stability, reduction in immunogenicity, delayed or controlled release in vivo, etc. Other functions or activities include a conjugate that reduces toxicity relative to an unconjugated polypeptide sequence, a conjugate that targets a type of cell or organ more efficiently than an unconjugated polypeptide sequence, or a drug to further counter the causes or effects associated with a disorder or disease as set forth herein (e.g., diabetes).

[00145] A Polypeptide may also be conjugated to large, slowly metabolized macromolecules such as proteins; polysaccharides, such as sepharose, agarose, cellulose, cellulose beads; polymeric amino acids such as polyglutamic acid, polylysine; amino acid copolymers; inactivated virus particles; inactivated bacterial toxins such as toxoid from diphtheria, tetanus, cholera, leukotoxin molecules; inactivated bacteria; and dendritic cells.

[00146] Additional candidate components and molecules for conjugation include those suitable for isolation or purification. Particular non-limiting examples include binding molecules, such as biotin (biotin-avidin specific binding pair), an antibody, a receptor, a ligand, a lectin, or molecules that comprise a solid support, including, for example, plastic or polystyrene beads, plates or beads, magnetic beads, test strips, and membranes.

[00147] Purification methods such as cation exchange chromatography may be used to separate conjugates by charge difference, which effectively separates conjugates into their various molecular weights. For example, the cation exchange column can be loaded and then washed with -20 mM sodium acetate, pH -4, and then eluted with a linear (0 M to 0.5 M) NaCl gradient buffered at a pH from about 3 to 5.5, e.g., at pH -4.5. The content of the fractions obtained by cation exchange chromatography may be identified by molecular weight using conventional methods, for example, mass spectroscopy, SDS-PAGE, or other known methods for separating molecular entities by molecular weight.

[00148] In certain embodiments, the amino- or carboxyl- terminus of a polypeptide sequence of the present disclosure can be fused with an immunoglobulin Fc region (e.g., human Fc) to form a fusion conjugate (or fusion molecule). Fc fusion conjugates have been shown to increase the systemic half-life of biopharmaceuticals, and thus the biopharmaceutical product may require less frequent administration.

[00149] Fc binds to the neonatal Fc receptor (FcRn) in endothelial cells that line the blood vessels, and, upon binding, the Fc fusion molecule is protected from degradation and re- released into the circulation, keeping the molecule in circulation longer. This Fc binding is believed to be the mechanism by which endogenous IgG retains its long plasma half-life. More recent Fc-fusion technology links a single copy of a biopharmaceutical to the Fc region of an antibody to optimize the pharmacokinetic and pharmacodynamic properties of the biopharmaceutical as compared to traditional Fc-fusion conjugates.

[00150] The present disclosure contemplates the use of other modifications, currently known or developed in the future, of the Polypeptides to improve one or more properties. One such method for prolonging the circulation half-life, increasing the stability, reducing the clearance, or altering the immunogenicity or allergenicity of a polypeptide of the present disclosure involves modification of the polypeptide sequences by hesylation, which utilizes hydroxyethyl starch derivatives linked to other molecules in order to modify the molecule's characteristics. Various aspects of hesylation are described in, for example, U.S. Patent Appln. Nos. 2007/0134197 and 2006/0258607.

In Vitro Peptide/Polypeptide Synthesis

[00151] Proteins or peptides may be made by any technique known to those of skill in the art, including the expression of proteins, polypeptides or peptides through standard molecular biological techniques, the isolation of proteins or peptides from natural sources, in vitro translation, or the chemical synthesis of proteins or peptides. The nucleotide and protein, polypeptide and peptide sequences corresponding to various genes have been previously disclosed, and may be found at computerized databases known to those of ordinary skill in the art. One such database is the National Center for Biotechnology Information's Genbank and GenPept databases located at the National Institutes of Health website. The coding regions for known genes may be amplified and/or expressed using the techniques disclosed herein or as would be known to those of ordinary skill in the art. Alternatively, various commercial preparations of proteins, polypeptides and peptides are known to those of skill in the art.

[00152] Peptides can be readily synthesized chemically utilizing reagents that are free of contaminating bacterial or animal substances (Merrifield RB: Solid phase peptide synthesis. I. The synthesis of a tetrapeptide. J. Am. Chem. Soc. 85:2149-54, 1963). In certain embodiments, neoantigenic peptides are prepared by (1) parallel solid-phase synthesis on multi-channel

instruments using uniform synthesis and cleavage conditions; (2) purification over a RP-HPLC column with column stripping; and re-washing, but not replacement, between peptides; followed by (3) analysis with a limited set of the most informative assays. The Good Manufacturing Practices (GMP) footprint can be defined around the set of peptides for an individual patient, thus requiring suite changeover procedures only between syntheses of peptides for different patients.

[00153] Alternatively, a nucleic acid (e.g., a polynucleotide) encoding a neoantigenic peptide of the invention may be used to produce the neoantigenic peptide in vitro. The polynucleotide may be, e.g., DNA, cDNA, PNA, CNA, RNA, either single- and/or double-stranded, or native or stabilized forms of polynucleotides, such as e.g. polynucleotides with a phosphorothiate backbone, or combinations thereof and it may or may not contain introns so long as it codes for the peptide. In one embodiment in vitro translation is used to produce the peptide. Many exemplary systems exist that one skilled in the art could utilize (e.g., Retic Lysate IVT Kit, Life Technologies, Waltham, MA).

[00154] An expression vector capable of expressing a polypeptide can also be prepared. Expression vectors for different cell types are well known in the art and can be selected without undue experimentation. Generally, the DNA is inserted into an expression vector, such as a plasmid, in proper orientation and correct reading frame for expression. If necessary, the DNA may be linked to the appropriate transcriptional and translational regulatory control nucleotide sequences recognized by the desired host (e.g., bacteria), although such controls are generally available in the expression vector. The vector is then introduced into the host bacteria for cloning using standard techniques (see, e.g., Sambrook et al. (1989) Molecular Cloning, A Laboratory Manual, Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y.).

[00155] Expression vectors comprising the isolated polynucleotides, as well as host cells containing the expression vectors, are also contemplated. The neoantigenic peptides may be provided in the form of RNA or cDNA molecules encoding the desired neoantigenic peptides. One or more neoantigenic peptides of the invention may be encoded by a single expression vector.

[00156] The term "polynucleotide encoding a polypeptide" encompasses a polynucleotide which includes only coding sequences for the polypeptide as well as a polynucleotide which includes additional coding and/or non-coding sequences. Polynucleotides can be in the form of

RNA or in the form of DNA. DNA includes cDNA, genomic DNA, and synthetic DNA; and can be double-stranded or single-stranded, and if single stranded can be the coding strand or non-coding (anti-sense) strand.

[00157] In embodiments, the polynucleotides may comprise the coding sequence for the tumor specific neoantigenic peptide fused in the same reading frame to a polynucleotide which aids, for example, in expression and/or secretion of a polypeptide from a host cell (e.g., a leader sequence which functions as a secretory sequence for controlling transport of a polypeptide from the cell). The polypeptide having a leader sequence is a preprotein and can have the leader sequence cleaved by the host cell to form the mature form of the polypeptide.

[00158] In embodiments, the polynucleotides can comprise the coding sequence for the tumor specific neoantigenic peptide fused in the same reading frame to a marker sequence that allows, for example, for purification of the encoded polypeptide, which may then be incorporated into the personalized neoplasia vaccine or immunogenic composition. For example, the marker sequence can be a hexa-histidine tag supplied by a pQE-9 vector to provide for purification of the mature polypeptide fused to the marker in the case of a bacterial host, or the marker sequence can be a hemagglutinin (HA) tag derived from the influenza hemagglutinin protein when a mammalian host (e.g., COS-7 cells) is used. Additional tags include, but are not limited to, Calmodulin tags, FLAG tags, Myc tags, S tags, SBP tags, Softag 1, Softag 3, V5 tag, Xpress tag, Isopeptag, SpyTag, Biotin Carboxyl Carrier Protein (BCCP) tags, GST tags, fluorescent protein tags (e.g., green fluorescent protein tags), maltose binding protein tags, Nus tags, Strep-tag, thioredoxin tag, TC tag, Ty tag, and the like.

[00159] In embodiments, the polynucleotides may comprise the coding sequence for one or more of the tumor specific neoantigenic peptides fused in the same reading frame to create a single concatamerized neoantigenic peptide construct capable of producing multiple neoantigenic peptides.

[00160] In certain embodiments, isolated nucleic acid molecules having a nucleotide sequence at least 60% identical, at least 65% identical, at least 70% identical, at least 75% identical, at least 80% identical, at least 85% identical, at least 90% identical, at least 95% identical, or at least 96%, 97%, 98% or 99% identical to a polynucleotide encoding a tumor specific neoantigenic peptide of the present invention, can be provided.

[00161] By a polynucleotide having a nucleotide sequence at least, for example, 95% "identical" to a reference nucleotide sequence is intended that the nucleotide sequence of the polynucleotide is identical to the reference sequence except that the polynucleotide sequence can include up to five point mutations per each 100 nucleotides of the reference nucleotide sequence. In other words, to obtain a polynucleotide having a nucleotide sequence at least 95% identical to a reference nucleotide sequence, up to 5% of the nucleotides in the reference sequence can be deleted or substituted with another nucleotide, or a number of nucleotides up to 5% of the total nucleotides in the reference sequence can be inserted into the reference sequence. These mutations of the reference sequence can occur at the amino- or carboxy-terminal positions of the reference nucleotide sequence or anywhere between those terminal positions, interspersed either individually among nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence.

[00162] As a practical matter, whether any particular nucleic acid molecule is at least 80% identical, at least 85% identical, at least 90% identical, and in some embodiments, at least 95%, 96%, 97%, 98%, or 99% identical to a reference sequence can be determined conventionally using known computer programs such as the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711). Bestfit uses the local homology algorithm of Smith and Waterman, Advances in Applied Mathematics 2:482-489 (1981), to find the best segment of homology between two sequences. When using Bestfit or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set such that the percentage of identity is calculated over the full length of the reference nucleotide sequence and that gaps in homology of up to 5% of the total number of nucleotides in the reference sequence are allowed.

[00163] The isolated tumor specific neoantigenic peptides described herein can be produced in vitro (e.g., in the laboratory) by any suitable method known in the art. Such methods range from direct protein synthetic methods to constructing a DNA sequence encoding isolated polypeptide sequences and expressing those sequences in a suitable transformed host. In some embodiments, a DNA sequence is constructed using recombinant technology by isolating or synthesizing a DNA sequence encoding a wild-type protein of interest. Optionally, the sequence

can be mutagenized by site-specific mutagenesis to provide functional analogs thereof. See, e.g. Zoeller et al., Proc. Nat'l. Acad. Sci. USA 81:5662-5066 (1984) and U.S. Pat. No. 4,588,585.

[00164] In embodiments, a DNA sequence encoding a polypeptide of interest would be constructed by chemical synthesis using an oligonucleotide synthesizer. Such oligonucleotides can be designed based on the amino acid sequence of the desired polypeptide and selecting those codons that are favored in the host cell in which the recombinant polypeptide of interest is produced. Standard methods can be applied to synthesize an isolated polynucleotide sequence encoding an isolated polypeptide of interest. For example, a complete amino acid sequence can be used to construct a back-translated gene. Further, a DNA oligomer containing a nucleotide sequence coding for the particular isolated polypeptide can be synthesized. For example, several small oligonucleotides coding for portions of the desired polypeptide can be synthesized and then ligated. The individual oligonucleotides typically contain 5' or 3' overhangs for complementary assembly.

[00165] Once assembled (e.g., by synthesis, site-directed mutagenesis, or another method), the polynucleotide sequences encoding a particular isolated polypeptide of interest is inserted into an expression vector and optionally operatively linked to an expression control sequence appropriate for expression of the protein in a desired host. Proper assembly can be confirmed by nucleotide sequencing, restriction mapping, and expression of a biologically active polypeptide in a suitable host. As well known in the art, in order to obtain high expression levels of a transfected gene in a host, the gene can be operatively linked to transcriptional and translational expression control sequences that are functional in the chosen expression host.

[00166] Recombinant expression vectors may be used to amplify and express DNA encoding the tumor specific neoantigenic peptides. Recombinant expression vectors are replicable DNA constructs which have synthetic or cDNA-derived DNA fragments encoding a tumor specific neoantigenic peptide or a bioequivalent analog operatively linked to suitable transcriptional or translational regulatory elements derived from mammalian, microbial, viral or insect genes. A transcriptional unit generally comprises an assembly of (1) a genetic element or elements having a regulatory role in gene expression, for example, transcriptional promoters or enhancers, (2) a structural or coding sequence which is transcribed into mRNA and translated into protein, and (3) appropriate transcription and translation initiation and termination sequences, as described in detail herein. Such regulatory elements can include an operator sequence to control

transcription. The ability to replicate in a host, usually conferred by an origin of replication, and a selection gene to facilitate recognition of transformants can additionally be incorporated. DNA regions are operatively linked when they are functionally related to each other. For example, DNA for a signal peptide (secretory leader) is operatively linked to DNA for a polypeptide if it is expressed as a precursor which participates in the secretion of the polypeptide; a promoter is operatively linked to a coding sequence if it controls the transcription of the sequence; or a ribosome binding site is operatively linked to a coding sequence if it is positioned so as to permit translation. Generally, operatively linked means contiguous, and in the case of secretory leaders, means contiguous and in reading frame. Structural elements intended for use in yeast expression systems include a leader sequence enabling extracellular secretion of translated protein by a host cell. Alternatively, where recombinant protein is expressed without a leader or transport sequence, it can include an N-terminal methionine residue. This residue can optionally be subsequently cleaved from the expressed recombinant protein to provide a final product.

[00167] Useful expression vectors for eukaryotic hosts, especially mammals or humans include, for example, vectors comprising expression control sequences from SV40, bovine papilloma virus, adenovirus and cytomegalovirus. Useful expression vectors for bacterial hosts include known bacterial plasmids, such as plasmids from Escherichia coli, including pCR 1, pBR322, pMB9 and their derivatives, wider host range plasmids, such as M13 and filamentous single-stranded DNA phages.

[00168] Suitable host cells for expression of a polypeptide include prokaryotes, yeast, insect or higher eukaryotic cells under the control of appropriate promoters. Prokaryotes include gram negative or gram positive organisms, for example E. coli or bacilli. Higher eukaryotic cells include established cell lines of mammalian origin. Cell-free translation systems could also be employed. Appropriate cloning and expression vectors for use with bacterial, fungal, yeast, and mammalian cellular hosts are well known in the art (see Pouwels et al., Cloning Vectors: A Laboratory Manual, Elsevier, N.Y., 1985).

[00169] Various mammalian or insect cell culture systems are also advantageously employed to express recombinant protein. Expression of recombinant proteins in mammalian cells can be performed because such proteins are generally correctly folded, appropriately modified and completely functional. Examples of suitable mammalian host cell lines include the COS-7 lines of monkey kidney cells, described by Gluzman (Cell 23:175, 1981), and other cell lines capable

of expressing an appropriate vector including, for example, L cells, C127, 3T3, Chinese hamster ovary (CHO), 293, HeLa and BHK cell lines. Mammalian expression vectors can comprise nontranscribed elements such as an origin of replication, a suitable promoter and enhancer linked to the gene to be expressed, and other 5' or 3' flanking nontranscribed sequences, and 5' or 3' nontranslated sequences, such as necessary ribosome binding sites, a polyadenylation site, splice donor and acceptor sites, and transcriptional termination sequences. Baculovirus systems for production of heterologous proteins in insect cells are reviewed by Luckow and Summers, Bio/Technology 6:47 (1988).

[00170] The proteins produced by a transformed host can be purified according to any suitable method. Such standard methods include chromatography (e.g., ion exchange, affinity and sizing column chromatography, and the like), centrifugation, differential solubility, or by any other standard technique for protein purification. Affinity tags such as hexahistidine, maltose binding domain, influenza coat sequence, glutathione-S-transferase, and the like can be attached to the protein to allow easy purification by passage over an appropriate affinity column. Isolated proteins can also be physically characterized using such techniques as proteolysis, nuclear magnetic resonance and x-ray crystallography.

[00171] For example, supernatants from systems which secrete recombinant protein into culture media can be first concentrated using a commercially available protein concentration filter, for example, an Amicon or Millipore Pellicon ultrafiltration unit. Following the concentration step, the concentrate can be applied to a suitable purification matrix. Alternatively, an anion exchange resin can be employed, for example, a matrix or substrate having pendant diethylaminoethyl (DEAE) groups. The matrices can be acrylamide, agarose, dextran, cellulose or other types commonly employed in protein purification. Alternatively, a cation exchange step can be employed. Suitable cation exchangers include various insoluble matrices comprising sulfopropyl or carboxymethyl groups. Finally, one or more reversed-phase high performance liquid chromatography (RP-HPLC) steps employing hydrophobic RP-HPLC media, e.g., silica gel having pendant methyl or other aliphatic groups, can be employed to further purify a cancer stem cell protein-Fc composition. Some or all of the foregoing purification steps, in various combinations, can also be employed to provide a homogeneous recombinant protein.

[00172] Recombinant protein produced in bacterial culture can be isolated, for example, by initial extraction from cell pellets, followed by one or more concentration, salting-out, aqueous ion exchange or size exclusion chromatography steps. High performance liquid chromatography (HPLC) can be employed for final purification steps. Microbial cells employed in expression of a recombinant protein can be disrupted by any convenient method, including freeze-thaw cycling, sonication, mechanical disruption, or use of cell lysing agents.

In Vivo Peptide/Polypeptide Synthesis

[00173] The present invention also contemplates the use of nucleic acid molecules as vehicles for delivering neoantigenic peptides/polypeptides to the subject in need thereof, in vivo, in the form of, e.g., DNA/RNA vaccines (see, e.g., WO2012/159643, and WO2012/159754, hereby incorporated by reference in their entirety).

[00174] In one embodiment neoantigens may be administered to a patient in need thereof by use of a plasmid. These are plasmids which usually consist of a strong viral promoter to drive the in vivo transcription and translation of the gene (or complementary DNA) of interest (Mor, et al., (1995), The Journal of Immunology 155 (4): 2039–2046). Intron A may sometimes be included to improve mRNA stability and hence increase protein expression (Leitner et al. (1997), The Journal of Immunology 159 (12): 6112–6119). Plasmids also include a strong polyadenylation/transcriptional termination signal, such as bovine growth hormone or rabbit beta-globulin polyadenylation sequences (Alarcon et al., (1999), Adv. Parasitol. Advances in Parasitology 42: 343–410; Robinson et al., (2000). Adv. Virus Res. Advances in Virus Research 55: 1–74; Böhmet al., (1996). Journal of Immunological Methods 193 (1): 29–40.). Multicistronic vectors are sometimes constructed to express more than one immunogen, or to express an immunogen and an immunostimulatory protein (Lewis et al., (1999). Advances in Virus Research (Academic Press) 54: 129–88).

[00175] Because the plasmid is the "vehicle" from which the immunogen is expressed, optimising vector design for maximal protein expression is essential (Lewis et al., (1999). Advances in Virus Research (Academic Press) 54: 129–88). One way of enhancing protein expression is by optimising the codon usage of pathogenic mRNAs for eukaryotic cells. Another consideration is the choice of promoter. Such promoters may be the SV40 promoter or Rous Sarcoma Virus (RSV).

[00176] Plasmids may be introduced into animal tissues by a number of different methods. The two most popular approaches are injection of DNA in saline, using a standard hypodermic needle, and gene gun delivery. A schematic outline of the construction of a DNA vaccine plasmid and its subsequent delivery by these two methods into a host is illustrated at Scientific American (Weiner et al., (1999) Scientific American 281 (1): 34–41). Injection in saline is normally conducted intramuscularly (IM) in skeletal muscle, or intradermally (ID), with DNA being delivered to the extracellular spaces. This can be assisted by electroporation by temporarily damaging muscle fibres with myotoxins such as bupivacaine; or by using hypertonic solutions of saline or sucrose (Alarcon et al., (1999). Adv. Parasitol. Advances in Parasitology 42: 343–410). Immune responses to this method of delivery can be affected by many factors, including needle type, needle alignment, speed of injection, volume of injection, muscle type, and age, sex and physiological condition of the animal being injected(Alarcon et al., (1999). Adv. Parasitol. Advances in Parasitology 42: 343–410).

[00177] Gene gun delivery, the other commonly used method of delivery, ballistically accelerates plasmid DNA (pDNA) that has been adsorbed onto gold or tungsten microparticles into the target cells, using compressed helium as an accelerant (Alarcon et al., (1999). Adv. Parasitol. Advances in Parasitology 42: 343–410; Lewis et al., (1999). Advances in Virus Research (Academic Press) 54: 129–88).

[00178] Alternative delivery methods may include aerosol instillation of naked DNA on mucosal surfaces, such as the nasal and lung mucosa, (Lewis et al., (1999). Advances in Virus Research (Academic Press) 54: 129–88) and topical administration of pDNA to the eye and vaginal mucosa (Lewis et al., (1999) Advances in Virus Research (Academic Press) 54: 129–88). Mucosal surface delivery has also been achieved using cationic liposome-DNA preparations, biodegradable microspheres, attenuated Shigella or Listeria vectors for oral administration to the intestinal mucosa, and recombinant adenovirus vectors. DNA or RNA may also be delivered to cells following mild mechanical disruption of the cell membrane, temporarily permeabilizing the cells. Such a mild mechanical disruption of the membrane can be accomplished by gently forcing cells through a small aperture (Ex Vivo Cytosolic Delivery of Functional Macromolecules to Immune Cells, Sharei et al, PLOS ONE | DOI:10.1371/journal.pone.0118803 April 13, 2015).

[00179] The method of delivery determines the dose of DNA required to raise an effective immune response. Saline injections require variable amounts of DNA, from 10 μg-1 mg,

whereas gene gun deliveries require 100 to 1000 times less DNA than intramuscular saline injection to raise an effective immune response. Generally, 0.2 μg – 20 μg are required, although quantities as low as 16 ng have been reported. These quantities vary from species to species, with mice, for example, requiring approximately 10 times less DNA than primates. Saline injections require more DNA because the DNA is delivered to the extracellular spaces of the target tissue (normally muscle), where it has to overcome physical barriers (such as the basal lamina and large amounts of connective tissue, to mention a few) before it is taken up by the cells, while gene gun deliveries bombard DNA directly into the cells, resulting in less "wastage" (See e.g., Sedegah et al., (1994). Proceedings of the National Academy of Sciences of the United States of America 91 (21): 9866–9870; Daheshiaet al., (1997). The Journal of Immunology 159 (4): 1945–1952; Chen et al., (1998). The Journal of Immunology 160 (5): 2425–2432; Sizemore (1995) Science 270 (5234): 299–302; Fynan et al., (1993) Proc. Natl. Acad. Sci. U.S.A. 90 (24): 11478–82).

[00180] In one embodiment, a neoplasia vaccine or immunogenic composition may include separate DNA plasmids encoding, for example, one or more neoantigenic peptides/polypeptides as identified in according to the invention. As discussed herein, the exact choice of expression vectors can depend upon the peptide/polypeptides to be expressed, and is well within the skill of the ordinary artisan. The expected persistence of the DNA constructs (e.g., in an episomal, non-replicating, non-integrated form in the muscle cells) is expected to provide an increased duration of protection.

[00181] One or more neoantigenic peptides of the invention may be encoded and expressed in vivo using a viral based system (e.g., an adenovirus system, an adeno associated virus (AAV) vector, a poxvirus, or a lentivirus). In one embodiment, the neoplasia vaccine or immunogenic composition may include a viral based vector for use in a human patient in need thereof, such as, for example, an adenovirus (see, e.g., Baden et al. First-in-human evaluation of the safety and immunogenicity of a recombinant adenovirus serotype 26 HIV-1 Env vaccine (IPCAVD 001). J Infect Dis. 2013 Jan 15;207(2):240-7, hereby incorporated by reference in its entirety). Plasmids that can be used for adeno associated virus, adenovirus, and lentivirus delivery have been described previously (see e.g., U.S. Patent Nos. 6,955,808 and 6,943,019, and U.S. Patent application No. 20080254008, hereby incorporated by reference).

[00182] The peptides and polypeptides of the invention can also be expressed by a vector, e.g., a nucleic acid molecule as herein-discussed, e.g., RNA or a DNA plasmid, a viral vector such as a poxvirus, e.g., orthopox virus, avipox virus, or adenovirus, AAV or lentivirus. This approach involves the use of a vector to express nucleotide sequences that encode the peptide of the invention. Upon introduction into an acutely or chronically infected host or into a noninfected host, the vector expresses the immunogenic peptide, and thereby elicits a host CTL response.

[00183] Among vectors that may be used in the practice of the invention, integration in the host genome of a cell is possible with retrovirus gene transfer methods, often resulting in long term expression of the inserted transgene. In a preferred embodiment the retrovirus is a lentivirus. Additionally, high transduction efficiencies have been observed in many different cell types and target tissues. The tropism of a retrovirus can be altered by incorporating foreign envelope proteins, expanding the potential target population of target cells. A retrovirus can also be engineered to allow for conditional expression of the inserted transgene, such that only certain cell types are infected by the lentivirus. Cell type specific promoters can be used to target expression in specific cell types. Lentiviral vectors are retroviral vectors (and hence both lentiviral and retroviral vectors may be used in the practice of the invention). Moreover, lentiviral vectors are preferred as they are able to transduce or infect non-dividing cells and typically produce high viral titers. Selection of a retroviral gene transfer system may therefore depend on the target tissue. Retroviral vectors are comprised of cis-acting long terminal repeats with packaging capacity for up to 6-10 kb of foreign sequence. The minimum cis-acting LTRs are sufficient for replication and packaging of the vectors, which are then used to integrate the desired nucleic acid into the target cell to provide permanent expression. Widely used retroviral vectors that may be used in the practice of the invention include those based upon murine leukemia virus (MuLV), gibbon ape leukemia virus (GaLV), Simian Immuno deficiency virus (SIV), human immuno deficiency virus (HIV), and combinations thereof (see, e.g., Buchscher et al., (1992) J. Virol. 66:2731-2739; Johann et al., (1992) J. Virol. 66:1635-1640; Sommnerfelt et al., (1990) Virol. 176:58-59; Wilson et al., (1998) J. Virol. 63:2374-2378; Miller et al., (1991) J. Virol. 65:2220-2224; PCT/US94/05700).

[00184] Also useful in the practice of the invention is a minimal non-primate lentiviral vector, such as a lentiviral vector based on the equine infectious anemia virus (EIAV) (see, e.g.,

Balagaan, (2006) J Gene Med; 8: 275 – 285, Published online 21 November 2005 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/jgm.845). The vectors may have cytomegalovirus (CMV) promoter driving expression of the target gene. Accordingly, the invention contemplates amongst vector(s) useful in the practice of the invention: viral vectors, including retroviral vectors and lentiviral vectors.

[00185] Lentiviral vectors have been disclosed as in the treatment for Parkinson's Disease, see, e.g., US Patent Publication No. 20120295960 and US Patent Nos. 7303910 and 7351585. Lentiviral vectors have also been disclosed for delivery to the Brain, see, e.g., US Patent Publication Nos. US20110293571; US20040013648, US20070025970, US20090111106 and US Patent No. US7259015. In another embodiment lentiviral vectors are used to deliver vectors to the brain of those being treated for a disease.

[00186] As to lentivirus vector systems useful in the practice of the invention, mention is made of US Patents Nos. 6428953, 6165782, 6013516, 5994136, 6312682, and 7,198,784, and documents cited therein.

[00187] In an embodiment herein the delivery is via an lentivirus. Zou et al. administered about 10 µl of a recombinant lentivirus having a titer of 1 x 10^9 transducing units (TU)/ml by an intrathecal catheter. These sort of dosages can be adapted or extrapolated to use of a retroviral or lentiviral vector in the present invention. For transduction in tissues such as the brain, it is necessary to use very small volumes, so the viral preparation is concentrated by ultracentrifugation. The resulting preparation should have at least 10^8 TU/ml, preferably from 10^8 to 10^9 TU/ml, more preferably at least 10^9 TU/ml. Other methods of concentration such as ultrafiltration or binding to and elution from a matrix may be used.

[00188] In other embodiments the amount of lentivirus administered may be 1.x.10^5 or about 1.x.10^5 plaque forming units (PFU), 5.x.10^5 or about 5.x.10^5 PFU, 1.x.10^6 or about 1.x10^6 PFU, 5.x.10^6 or about 5.x.10^6 PFU, 1.x.10^7 or about 1.x.10^7 PFU, 5.x.10^7 or about 5.x.10^7 PFU, 1.x.10^8 or about 1.x.10^8 PFU, 5.x.10^8 or about 5.x.10^8 PFU, 1.x.10^9 or about 1.x.10^9 PFU, 5.x.10^9 or about 5.x.10^9 PFU, 1.x.10^{10} or about 1.x.10^{10} PFU or 5.x.10^{10} or about 5.x.10^{10} PFU as total single dosage for an average human of 75 kg or adjusted for the weight and size and species of the subject. One of skill in the art can determine suitable dosage. Suitable dosages for a virus can be determined empirically.

[00189] Also useful in the practice of the invention is an adenovirus vector. One advantage is the ability of recombinant adenoviruses to efficiently transfer and express recombinant genes in a variety of mammalian cells and tissues in vitro and in vivo, resulting in the high expression of the transferred nucleic acids. Further, the ability to productively infect quiescent cells, expands the utility of recombinant adenoviral vectors. In addition, high expression levels ensure that the products of the nucleic acids will be expressed to sufficient levels to generate an immune response (see e.g., U.S. Patent No. 7,029,848, hereby incorporated by reference).

[00190] As to adenovirus vectors useful in the practice of the invention, mention is made of US Patent No. 6,955,808. The adenovirus vector used can be selected from the group consisting of the Ad5, Ad35, Ad11, C6, and C7 vectors. The sequence of the Adenovirus 5 ("Ad5") genome has been published. (Chroboczek, J., Bieber, F., and Jacrot, B. (1992) The Sequence of the Genome of Adenovirus Type 5 and Its Comparison with the Genome of Adenovirus Type 2, Virology 186, 280-285; the contents if which is hereby incorporated by reference). Ad35 vectors are described in U.S. Pat. Nos. 6,974,695, 6,913,922, and 6,869,794. Ad11 vectors are described in U.S. Pat. No. 6,913,922. C6 adenovirus vectors are described in U.S. Pat. Nos. 6,780,407; 6,537,594; 6,309,647; 6,265,189; 6,156,567; 6,090,393; 5,942,235 and 5,833,975. C7 vectors are described in U.S. Pat. No. 6,277,558. Adenovirus vectors that are E1-defective or deleted, E3-defective or deleted, and/or E4-defective or deleted may also be used. Certain adenoviruses having mutations in the E1 region have improved safety margin because E1-defective adenovirus mutants are replication-defective in non-permissive cells, or, at the very least, are highly attenuated. Adenoviruses having mutations in the E3 region may have enhanced the immunogenicity by disrupting the mechanism whereby adenovirus down-regulates MHC class I molecules. Adenoviruses having E4 mutations may have reduced immunogenicity of the adenovirus vector because of suppression of late gene expression. Such vectors may be particularly useful when repeated re-vaccination utilizing the same vector is desired. Adenovirus vectors that are deleted or mutated in E1, E3, E4, E1 and E3, and E1 and E4 can be used in accordance with the present invention. Furthermore, "gutless" adenovirus vectors, in which all viral genes are deleted, can also be used in accordance with the present invention. Such vectors require a helper virus for their replication and require a special human 293 cell line expressing both E1a and Cre, a condition that does not exist in natural environment. Such "gutless" vectors are non-immunogenic and thus the vectors may be inoculated multiple times for re-vaccination.

The "gutless" adenovirus vectors can be used for insertion of heterologous inserts/genes such as the transgenes of the present invention, and can even be used for co-delivery of a large number of heterologous inserts/genes.

[00191] In an embodiment herein the delivery is via an adenovirus, which may be at a single booster dose containing at least 1 x 10^5 particles (also referred to as particle units, pu) of adenoviral vector. In an embodiment herein, the dose preferably is at least about 1 x 10^6 particles (for example, about 1 x 10^6-1 x 10^{12} particles), more preferably at least about 1 x 10^7 particles, more preferably at least about 1 x 10^8 particles (e.g., about 1 x 10^8-1 x 10^{11} particles or about 1 x 10^8-1 x 10^{12} particles), and most preferably at least about 1 x 10^9 particles (e.g., about 1 x 10^9-1 x 10^{10} particles or about 1 x 10^9-1 x 10^{12} particles), or even at least about 1 x 10^{10} particles (e.g., about 1 x 10^{10}-1 x 10^{12} particles) of the adenoviral vector. Alternatively, the dose comprises no more than about 1 x 10^{14} particles, preferably no more than about 1 x 10^{13} particles, even more preferably no more than about 1 x 10^{12} particles, even more preferably no more than about 1 x 10^{11} particles, and most preferably no more than about 1 x 10^{10} particles (e.g., no more than about 1 x 10^9 articles). Thus, the dose may contain a single dose of adenoviral vector with, for example, about 1 x 10^6 particle units (pu), about 2 x 10^6 pu, about 4 x 10^6 pu, about 1 x 10^7 pu, about 2 x 10^7 pu, about 4 x 10^7 pu, about 1 x 10^8 pu, about 2 x 10^8 pu, about 4 x 10^8 pu, about 1 x 10^9 pu, about 2 x 10^9 pu, about 4 x 10^9 pu, about 1 x 10^{10} pu, about 2 x 10^{10} pu, about 4 x 10^{10} pu, about 1 x 10^{11} pu, about 2 x 10^{11} pu, about 4 x 10^{11} pu, about 1 x 10^{12} pu, about 2 x 10^{12} pu, or about 4 x 10^{12} pu of adenoviral vector. See, for example, the adenoviral vectors in U.S. Patent No. 8,454,972 B2 to Nabel, et. al., granted on June 4, 2013; incorporated by reference herein, and the dosages at col 29, lines 36-58 thereof. In an embodiment herein, the adenovirus is delivered via multiple doses.

[00192] In terms of in vivo delivery, AAV is advantageous over other viral vectors due to low toxicity and low probability of causing insertional mutagenesis because it doesn't integrate into the host genome. AAV has a packaging limit of 4.5 or 4.75 Kb. Constructs larger than 4.5 or 4.75 Kb result in significantly reduced virus production. There are many promoters that can be used to drive nucleic acid molecule expression. AAV ITR can serve as a promoter and is advantageous for eliminating the need for an additional promoter element. For ubiquitous expression, the following promoters can be used: CMV, CAG, CBh, PGK, SV40, Ferritin heavy or light chains, etc. For brain expression, the following promoters can be used: SynapsinI for all

neurons, CaMKIIalpha for excitatory neurons, GAD67 or GAD65 or VGAT for GABAergic neurons, etc. Promoters used to drive RNA synthesis can include: Pol III promoters such as U6 or H1. The use of a Pol II promoter and intronic cassettes can be used to express guide RNA (gRNA).

[00193] With regard to AAV vectors useful in the practice of the invention, mention is made of US Patent Nos. 5658785, 7115391, 7172893, 6953690, 6936466, 6924128, 6893865, 6793926, 6537540, 6475769 and 6258595, and documents cited therein.

[00194] As to AAV, the AAV can be AAV1, AAV2, AAV5 or any combination thereof. One can select the AAV with regard to the cells to be targeted; e.g., one can select AAV serotypes 1, 2, 5 or a hybrid capsid AAV1, AAV2, AAV5 or any combination thereof for targeting brain or neuronal cells; and one can select AAV4 for targeting cardiac tissue. AAV8 is useful for delivery to the liver. The above promoters and vectors are preferred individually.

[00195] In an embodiment herein, the delivery is via an AAV. A therapeutically effective dosage for in vivo delivery of the AAV to a human is believed to be in the range of from about 20 to about 50 ml of saline solution containing from about 1×10^{10} to about 1×10^{50} functional AAV/ml solution. The dosage may be adjusted to balance the therapeutic benefit against any side effects. In an embodiment herein, the AAV dose is generally in the range of concentrations of from about 1×10^{5} to 1×10^{50} genomes AAV, from about 1×10^{8} to 1×10^{20} genomes AAV, from about 1×10^{10} to about 1×10^{16} genomes, or about 1×10^{11} to about 1×10^{16} genomes AAV. A human dosage may be about 1×10^{13} genomes AAV. Such concentrations may be delivered in from about 0.001 ml to about 100 ml, about 0.05 to about 50 ml, or about 10 to about 25 ml of a carrier solution. In a preferred embodiment, AAV is used with a titer of about 2×10^{13} viral genomes/milliliter, and each of the striatal hemispheres of a mouse receives one 500 nanoliter injection. Other effective dosages can be readily established by one of ordinary skill in the art through routine trials establishing dose response curves. See, for example, U.S. Patent No. 8,404,658 B2 to Hajjar, et al., granted on March 26, 2013, at col. 27, lines 45-60.

[00196] In another embodiment effectively activating a cellular immune response for a neoplasia vaccine or immunogenic composition can be achieved by expressing the relevant neoantigens in a vaccine or immunogenic composition in a non-pathogenic microorganism. Well-known examples of such microorganisms are Mycobacterium bovis BCG, Salmonella and Pseudomona (See, U.S. Patent No. 6,991,797, hereby incorporated by reference in its entirety).

[00197] In another embodiment a Poxvirus is used in the neoplasia vaccine or immunogenic composition. These include orthopoxvirus, avipox, vaccinia, MVA, NYVAC, canarypox, ALVAC, fowlpox, TROVAC, etc. (see e.g., Verardiet al., Hum Vaccin Immunother. 2012 Jul;8(7):961-70; and Moss, Vaccine. 2013; 31(39): 4220–4222). Poxvirus expression vectors were described in 1982 and quickly became widely used for vaccine development as well as research in numerous fields. Advantages of the vectors include simple construction, ability to accommodate large amounts of foreign DNA and high expression levels.

[00198] Information concerning poxviruses that may be used in the practice of the invention, such as *Chordopoxvirinae* subfamily poxviruses (poxviruses of vertebrates), for instance, orthopoxviruses and avipoxviruses, e.g., vaccinia virus (e.g., Wyeth Strain, WR Strain (e.g., ATCC® VR-1354), Copenhagen Strain, NYVAC, NYVAC.1, NYVAC.2, MVA, MVA-BN), canarypox virus (e.g., Wheatley C93 Strain, ALVAC), fowlpox virus (e.g., FP9 Strain, Webster Strain, TROVAC), dovepox, pigeonpox, quailpox, and raccoon pox, *inter alia*, synthetic or non-naturally occurring recombinants thereof, uses thereof, and methods for making and using such recombinants may be found in scientific and patent literature, such as:

- US Patents Nos. 4,603,112, 4,769,330, 5,110,587, 5,174,993, 5,364,773, 5,762,938, 5,494,807, 5,766,597, 7,767,449, 6,780,407, 6,537,594, 6,265,189, 6,214,353, 6,130,066, 6,004,777, 5,990,091, 5,942,235, 5,833,975, 5,766,597, 5,756,101, 7,045,313, 6,780,417, 8,470,598, 8,372,622, 8,268,329, 8,268,325, 8,236,560, 8,163,293, 7,964,398, 7,964,396, 7,964,395, 7,939,086, 7,923,017, 7,897,156, 7,892,533, 7,628,980, 7,459,270, 7,445,924, 7,384,644, 7,335,364, 7,189,536, 7,097,842, 6,913,752, 6,761,893, 6,682,743, 5,770,212, 5,766,882, and 5,989,562, and
- Panicali, D. Proc. Natl. Acad. Sci. 1982; 79; 4927-493, Panicali D. Proc. Natl. Acad. Sci. 1983; 80(17): 5364-8, Mackett, M. Proc. Natl. Acad. Sci. 1982; 79: 7415-7419, Smith GL. Proc. Natl. Acad. Sci. 1983; 80(23): 7155-9, Smith GL. Nature 1983; 302: 490-5, Sullivan VJ. Gen. Vir. 1987; 68: 2587-98, Perkus M Journal of Leukocyte Biology 1995; 58:1-13, Yilma TD. Vaccine 1989; 7: 484-485, Brochier B. Nature 1991; 354: 520-22, Wiktor, TJ. Proc. Natl Acd. Sci. 1984; 81: 7194-8, Rupprecht, CE. Proc. Natl Acd. Sci. 1986; 83: 7947-50, Poulet, H Vaccine 2007; 25(Jul): 5606-12, Weyer J. Vaccine 2009; 27(Nov): 7198-201, Buller, RM Nature 1985; 317(6040): 813-5, Buller RM. J. Virol. 1988; 62(3):866-74, Flexner, C. Nature 1987; 330(6145): 259-62, Shida, H. J. Virol.

1988; 62(12): 4474-80, Kotwal, GJ. J. Virol. 1989; 63(2): 600-6, Child, SJ. Virology 1990; 174(2): 625-9, Mayr A. Zentralbl Bakteriol 1978; 167(5,6): 375-9, Antoine G. Virology. 1998; 244(2): 365-96, Wyatt, LS. Virology 1998; 251(2): 334-42, Sancho, MC. J. Virol. 2002; 76(16); 8313-34, Gallego-Gomez, JC. J. Virol. 2003; 77(19); 10606-22), Goebel SJ. Virology 1990; (a,b) 179: 247-66, Tartaglia, J. Virol. 1992; 188(1): 217-32, Najera JL. J. Virol. 2006; 80(12): 6033-47, Najera, JL. J. Virol. 2006; 80: 6033-6047, Gomez, CE. J. Gen. Virol. 2007; 88: 2473-78, Mooij, P. Jour. Of Virol. 2008; 82: 2975-2988, Gomez, CE. Curr. Gene Ther. 2011; 11: 189-217, Cox,W. Virology 1993; 195: 845-50, Perkus, M. Jour. Of Leukocyte Biology 1995; 58: 1-13, Blanchard TJ. J Gen Virology 1998; 79(5): 1159-67, Amara R. Science 2001; 292: 69-74, Hel, Z., J. Immunol. 2001; 167: 7180-9, Gherardi MM. J. Virol. 2003; 77: 7048-57, Didierlaurent, A. Vaccine 2004; 22: 3395-3403, Bissht H. Proc. Nat. Aca. Sci. 2004; 101: 6641-46, McCurdy LH. Clin. Inf. Dis 2004; 38: 1749-53, Earl PL. Nature 2004; 428: 182-85, Chen Z. J. Virol. 2005; 79: 2678-2688, Najera JL. J. Virol. 2006; 80(12): 6033-47, Nam JH. Acta. Virol. 2007; 51: 125-30, Antonis AF. Vaccine 2007; 25: 4818-4827,B Weyer J. Vaccine 2007; 25: 4213-22, Ferrier-Rembert A. Vaccine 2008; 26(14): 1794-804, Corbett M. Proc. Natl. Acad. Sci. 2008; 105(6): 2046-51, Kaufman HL., J. Clin. Oncol. 2004; 22: 2122-32, Amato, RJ. Clin. Cancer Res. 2008; 14(22): 7504-10, Dreicer R. Invest New Drugs 2009; 27(4): 379-86, Kantoff PW.J. Clin. Oncol. 2010, 28, 1099-1105, Amato RJ. J. Clin. Can. Res. 2010; 16(22): 5539-47, Kim, DW. Hum. Vaccine. 2010; 6: 784-791, Oudard, S. Cancer Immunol. Immunother. 2011; 60: 261-71, Wyatt, LS. Aids Res. Hum. Retroviruses. 2004; 20: 645-53, Gomez, CE. Virus Research 2004; 105: 11-22, Webster, DP. Proc. Natl. Acad. Sci. 2005; 102: 4836-4, Huang, X. Vaccine 2007; 25: 8874-84, Gomez, CE. Vaccine 2007a; 25: 2863-85, Esteban M. Hum. Vaccine 2009; 5: 867-871, Gomez, CE. Curr. Gene therapy 2008; 8(2): 97-120, Whelan, KT. Plos one 2009; 4(6): 5934, Scriba, TJ. Eur. Jour. Immuno. 2010; 40(1): 279-90, Corbett, M. Proc. Natl. Acad. Sci. 2008; 105: 2046-2051, Midgley, CM. J. Gen. Virol. 2008; 89: 2992-97, Von Krempelhuber, A. Vaccine 2010; 28: 1209-16, Perreau, M. J. Of Virol. 2011; Oct: 9854-62, Pantaleo, G. Curr Opin HIV-AIDS. 2010; 5: 391–396,

each of which is incorporated herein by reference.

[00199] In another embodiment the vaccinia virus is used in the neoplasia vaccine or immunogenic composition to express a neoantigen. (Rolph et al., Recombinant viruses as vaccines and immunological tools. Curr Opin Immunol 9:517-524, 1997). The recombinant vaccinia virus is able to replicate within the cytoplasm of the infected host cell and the polypeptide of interest can therefore induce an immune response. Moreover, Poxviruses have been widely used as vaccine or immunogenic composition vectors because of their ability to target encoded antigens for processing by the major histocompatibility complex class I pathway by directly infecting immune cells, in particular antigen-presenting cells, but also due to their ability to self-adjuvant.

[00200] In another embodiment ALVAC is used as a vector in a neoplasia vaccine or immunogenic composition. ALVAC is a canarypox virus that can be modified to express foreign transgenes and has been used as a method for vaccination against both prokaryotic and eukaryotic antigens (Horig H, Lee DS, Conkright W, et al. Phase I clinical trial of a recombinant canarypoxvirus (ALVAC) vaccine expressing human carcinoembryonic antigen and the B7.1 co-stimulatory molecule. Cancer Immunol Immunother 2000;49:504–14; von Mehren M, Arlen P, Tsang KY, et al. Pilot study of a dual gene recombinant avipox vaccine containing both carcinoembryonic antigen (CEA) and B7.1 transgenes in patients with recurrent CEA-expressing adenocarcinomas. Clin Cancer Res 2000;6:2219–28; Musey L, Ding Y, Elizaga M, et al. HIV-1 vaccination administered intramuscularly can induce both systemic and mucosal T cell immunity in HIV-1-uninfected individuals. J Immunol 2003;171:1094–101; Paoletti E. Applications of pox virus vectors to vaccination: an update. Proc Natl Acad Sci U S A 1996;93:11349–53; U.S. Patent No. 7,255,862). In a phase I clinical trial, an ALVAC virus expressing the tumor antigen CEA showed an excellent safety profile and resulted in increased CEA-specific T-cell responses in selected patients; objective clinical responses, however, were not observed (Marshall JL, Hawkins MJ, Tsang KY, et al. Phase I study in cancer patients of a replication-defective avipox recombinant vaccine that expresses human carcinoembryonic antigen. J Clin Oncol 1999;17:332–7).

[00201] In another embodiment a Modified Vaccinia Ankara (MVA) virus may be used as a viral vector for a neoantigen vaccine or immunogenic composition. MVA is a member of the Orthopoxvirus family and has been generated by about 570 serial passages on chicken embryo fibroblasts of the Ankara strain of Vaccinia virus (CVA) (for review see Mayr, A., et al.,

Infection 3, 6-14, 1975). As a consequence of these passages, the resulting MVA virus contains 31 kilobases less genomic information compared to CVA, and is highly host-cell restricted (Meyer, H. et al., J. Gen. Virol. 72, 1031-1038, 1991). MVA is characterized by its extreme attenuation, namely, by a diminished virulence or infectious ability, but still holds an excellent immunogenicity. When tested in a variety of animal models, MVA was proven to be avirulent, even in immuno-suppressed individuals. Moreover, MVA-BN®-HER2 is a candidate immunotherapy designed for the treatment of HER-2-positive breast cancer and is currently in clinical trials. (Mandl et al., Cancer Immunol Immunother. Jan 2012; 61(1): 19–29). Methods to make and use recombinant MVA has been described (e.g., see U.S. Patent Nos. 8,309,098 and 5,185,146 hereby incorporated in its entirety).

[00202] In another embodiment the modified Copenhagen strain of vaccinia virus, NYVAC and NYVAC variations are used as a vector (see U.S. Patent No. 7,255,862; PCT WO 95/30018; U.S. Pat. Nos. 5,364,773 and 5,494,807, hereby incorporated by reference in its entirety).

[00203] In one embodiment recombinant viral particles of the vaccine or immunogenic composition are administered to patients in need thereof. Dosages of expressed neoantigen can range from a few to a few hundred micrograms, e.g., 5 to 500 .mu.g. The vaccine or immunogenic composition can be administered in any suitable amount to achieve expression at these dosage levels. The viral particles can be administered to a patient in need thereof or transfected into cells in an amount of about at least $10^{3.5}$ pfu; thus, the viral particles are preferably administered to a patient in need thereof or infected or transfected into cells in at least about 10^4 pfu to about 10^6 pfu; however, a patient in need thereof can be administered at least about 10^8 pfu such that a more preferred amount for administration can be at least about 10^7 pfu to about 10^9 pfu. Doses as to NYVAC are applicable as to ALVAC, MVA, MVA-BN, and avipoxes, such as canarypox and fowlpox.

[00204] Vaccine or Immunogenic Composition Adjuvant

[00205] Effective vaccine or immunogenic compositions advantageously include a strong adjuvant to initiate an immune response. As described herein, poly-ICLC, an agonist of TLR3 and the RNA helicase –domains of MDA5 and RIG3, has shown several desirable properties for a vaccine or immunogenic composition adjuvant. These properties include the induction of local and systemic activation of immune cells in vivo, production of stimulatory chemokines and cytokines, and stimulation of antigen-presentation by DCs. Furthermore, poly-ICLC can induce

durable CD4+ and CD8+ responses in humans. Importantly, striking similarities in the upregulation of transcriptional and signal transduction pathways were seen in subjects vaccinated with poly-ICLC and in volunteers who had received the highly effective, replication-competent yellow fever vaccine. Furthermore, >90% of ovarian carcinoma patients immunized with poly-ICLC in combination with a NY-ESO-1 peptide vaccine (in addition to Montanide) showed induction of CD4+ and CD8+ T cell, as well as antibody responses to the peptide in a recent phase 1 study. At the same time, poly-ICLC has been extensively tested in more than 25 clinical trials to date and exhibited a relatively benign toxicity profile. In addition to a powerful and specific immunogen the neoantigen peptides may be combined with an adjuvant (e.g., poly-ICLC) or another anti-neoplastic agent. Without being bound by theory, these neoantigens are expected to bypass central thymic tolerance (thus allowing stronger anti-tumor T cell response), while reducing the potential for autoimmunity (e.g., by avoiding targeting of normal self-antigens). An effective immune response advantageously includes a strong adjuvant to activate the immune system (Speiser and Romero, Molecularly defined vaccines for cancer immunotherapy, and protective T cell immunity Seminars in Immunol 22:144 (2010)). For example, Toll-like receptors (TLRs) have emerged as powerful sensors of microbial and viral pathogen “danger signals”, effectively inducing the innate immune system, and in turn, the adaptive immune system (Bhardwaj and Gnjatic, TLR AGONISTS: Are They Good Adjuvants? Cancer J. 16:382-391 (2010)). Among the TLR agonists, poly-ICLC (a synthetic double-stranded RNA mimic) is one of the most potent activators of myeloid-derived dendritic cells. In a human volunteer study, poly-ICLC has been shown to be safe and to induce a gene expression profile in peripheral blood cells comparable to that induced by one of the most potent live attenuated viral vaccines, the yellow fever vaccine YF-17D (Caskey et al, Synthetic double-stranded RNA induces innate immune responses similar to a live viral vaccine in humans J Exp Med 208:2357 (2011)). In a preferred embodiment Hiltonol®, a GMP preparation of poly-ICLC prepared by Oncovir, Inc, is utilized as the adjuvant. In other embodiments, other adjuvants described herein are envisioned. For instance oil-in-water, water-in-oil or multiphasic W/O/W; see, e.g., US 7,608,279 and Aucouturier et al, Vaccine 19 (2001), 2666-2672, and documents cited therein.

Indications

[00206] Examples of cancers and cancer conditions that can be treated with the therapy of this document include, but are not limited to a patient in need thereof that has been diagnosed as having cancer, or at risk of developing cancer. The subject may have a solid tumor such as breast, ovarian, prostate, lung, kidney, gastric, colon, testicular, head and neck, pancreas, brain, melanoma, and other tumors of tissue organs and hematological tumors, such as lymphomas and leukemias, including acute myelogenous leukemia, chronic myelogenous leukemia, chronic lymphocytic leukemia, T cell lymphocytic leukemia, and B cell lymphomas, tumors of the brain and central nervous system (e.g., tumors of the meninges, brain, spinal cord, cranial nerves and other parts of the CNS, such as glioblastomas or medulla blastomas); head and/or neck cancer, breast tumors, tumors of the circulatory system (e.g., heart, mediastinum and pleura, and other intrathoracic organs, vascular tumors, and tumor-associated vascular tissue); tumors of the blood and lymphatic system (e.g., Hodgkin's disease, Non-Hodgkin's disease lymphoma, Burkitt's lymphoma, AIDS-related lymphomas, malignant immunoproliferative diseases, multiple myeloma, and malignant plasma cell neoplasms, lymphoid leukemia, myeloid leukemia, acute or chronic lymphocytic leukemia, monocytic leukemia, other leukemias of specific cell type, leukemia of unspecified cell type, unspecified malignant neoplasms of lymphoid, hematopoietic and related tissues, such as diffuse large cell lymphoma, T-cell lymphoma or cutaneous T-cell lymphoma); tumors of the excretory system (e.g., kidney, renal pelvis, ureter, bladder, and other urinary organs); tumors of the gastrointestinal tract (e.g., esophagus, stomach, small intestine, colon, colorectal, rectosigmoid junction, rectum, anus, and anal canal); tumors involving the liver and intrahepatic bile ducts, gall bladder, and other parts of the biliary tract, pancreas, and other digestive organs; tumors of the oral cavity (e.g., lip, tongue, gum, floor of mouth, palate, parotid gland, salivary glands, tonsil, oropharynx, nasopharynx, puriform sinus, hypopharynx, and other sites of the oral cavity); tumors of the reproductive system (e.g., vulva, vagina, Cervix uteri, uterus, ovary, and other sites associated with female genital organs, placenta, penis, prostate, testis, and other sites associated with male genital organs); tumors of the respiratory tract (e.g., nasal cavity, middle ear, accessory sinuses, larynx, trachea, bronchus and lung, such as small cell lung cancer and non-small cell lung cancer); tumors of the skeletal system (e.g., bone and articular cartilage of limbs, bone articular cartilage and other sites); tumors of the skin (e.g., malignant melanoma of the skin, non-melanoma skin cancer, basal cell carcinoma of skin,

squamous cell carcinoma of skin, mesothelioma, Kaposi's sarcoma); and tumors involving other tissues including peripheral nerves and autonomic nervous system, connective and soft tissue, retroperitoneoum and peritoneum, eye, thyroid, adrenal gland, and other endocrine glands and related structures, secondary and unspecified malignant neoplasms of lymph nodes, secondary malignant neoplasm of respiratory and digestive systems and secondary malignant neoplasm of other sites. Thus the population of subjects described herein may be suffering from one of the above cancer types. In other embodiments, the population of subjects may be all subjects suffering from solid tumors, or all subjects suffering from liquid tumors.

[00207] Of special interest is the treatment of Non-Hodgkin's Lymphoma (NHL), clear cell Renal Cell Carcinoma (ccRCC), metastatic melanoma, sarcoma, leukemia or a cancer of the bladder, colon, brain, breast, head and neck, endometrium, lung, ovary, pancreas or prostate. In certain embodiments, the melanoma is high risk melanoma.

[00208] Cancers that can be treated using the therapy described herein may include among others cases which are refractory to treatment with other chemotherapeutics. The term "refractory, as used herein refers to a cancer (and/or metastases thereof), which shows no or only weak antiproliferative response (e.g., no or only weak inhibition of tumor growth) after treatment with another chemotherapeutic agent. These are cancers that cannot be treated satisfactorily with other chemotherapeutics. Refractory cancers encompass not only (i) cancers where one or more chemotherapeutics have already failed during treatment of a patient, but also (ii) cancers that can be shown to be refractory by other means, e.g., biopsy and culture in the presence of chemotherapeutics.

[00209] The therapy described herein is also applicable to the treatment of patients in need thereof who have not been previously treated.

[00210] The therapy described herein is also applicable where the subject has no detectable neoplasia but is at high risk for disease recurrence.

[00211] Also of special interest is the treatment of patients in need thereof who have undergone Autologous Hematopoietic Stem Cell Transplant (AHSCT), and in particular patients who demonstrate residual disease after undergoing AHSCT. The post-AHSCT setting is characterized by a low volume of residual disease, the infusion of immune cells to a situation of homeostatic expansion, and the absence of any standard relapse-delaying therapy. These

features provide a unique opportunity to use the claimed neoplastic vaccine or immunogenic composition compositions to delay disease relapse.

[00212] Pharmaceutical Compositions/Methods of Delivery

[00213] The present invention is also directed to pharmaceutical compositions comprising an effective amount of one or more neoantigenic peptides as described herein (including a pharmaceutically acceptable salt, thereof), optionally in combination with a pharmaceutically acceptable carrier, excipient or additive.

[00214] When administered as a combination, the therapeutic agents (i.e. the neoantigenic peptides) can be formulated as separate compositions that are given at the same time or different times, or the therapeutic agents can be given as a single composition.

[00215] The compositions may be administered once daily, twice daily, once every two days, once every three days, once every four days, once every five days, once every six days, once every seven days, once every two weeks, once every three weeks, once every four weeks, once every two months, once every six months, or once per year. The dosing interval can be adjusted according to the needs of individual patients. For longer intervals of administration, extended release or depot formulations can be used.

[00216] The compositions of the invention can be used to treat diseases and disease conditions that are acute, and may also be used for treatment of chronic conditions. In particular, the compositions of the invention are used in methods to treat or prevent a neoplasia. In certain embodiments, the compounds of the invention are administered for time periods exceeding two weeks, three weeks, one month, two months, three months, four months, five months, six months, one year, two years, three years, four years, or five years, ten years, or fifteen years; or for example, any time period range in days, months or years in which the low end of the range is any time period between 14 days and 15 years and the upper end of the range is between 15 days and 20 years (e.g., 4 weeks and 15 years, 6 months and 20 years). In some cases, it may be advantageous for the compounds of the invention to be administered for the remainder of the patient's life. In preferred embodiments, the patient is monitored to check the progression of the disease or disorder, and the dose is adjusted accordingly. In preferred embodiments, treatment according to the invention is effective for at least two weeks, three weeks, one month, two months, three months, four months, five months, six months, one year, two years, three years,

four years, or five years, ten years, fifteen years, twenty years, or for the remainder of the subject's life.

[00217] Surgical resection uses surgery to remove abnormal tissue in cancer, such as mediastinal, neurogenic, or germ cell tumors, or thymoma. In certain embodiments, administration of the composition is initiated following tumor resection. In other embodiments, administration of the neoplasia vaccine or immunogenic composition is initiated 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or more weeks after tumor resection. Preferably, administration of the neoplasia vaccine or immunogenic composition is initiated 4, 5, 6, 7, 8, 9, 10, 11 or 12 weeks after tumor resection.

[00218] Prime/ boost regimens refer to the successive administrations of a vaccine or immunogenic or immunological compositions. In certain embodiments, administration of the neoplasia vaccine or immunogenic composition is in a prime/ boost dosing regimen, for example administration of the neoplasia vaccine or immunogenic composition at weeks 1, 2, 3 or 4 as a prime and administration of the neoplasia vaccine or immunogenic composition is at months 2, 3 or 4 as a boost. In another embodiment heterologous prime-boost strategies are used to ellicit a greater cytotoxic T-cell response (see Schneider et al., Induction of CD8+ T cells using heterologous prime-boost immunisation strategies, Immunological Reviews Volume 170, Issue 1, pages 29–38, August 1999). In another embodiment DNA encoding neoantigens is used to prime followed by a protein boost. In another embodiment protein is used to prime followed by boosting with a virus encoding the neoantigen. In another embodiment a virus encoding the neoantigen is used to prime and another virus is used to boost. In another embodiment protein is used to prime and DNA is used to boost. In a preferred embodiment a DNA vaccine or immunogenic composition is used to prime a T-cell response and a recombinant viral vaccine or immunogenic composition is used to boost the response. In another preferred embodiment a viral vaccine or immunogenic composition is coadministered with a protein or DNA vaccine or immunogenic composition to act as an adjuvant for the protein or DNA vaccine or immunogenic composition. The patient can then be boosted with either the viral vaccine or immunogenic composition, protein, or DNA vaccine or immunogenic composition (see Hutchings et al., Combination of protein and viral vaccines induces potent cellular and humoral immune responses and enhanced protection from murine malaria challenge. Infect Immun. 2007 Dec;75(12):5819-26. Epub 2007 Oct 1).

[00219] The pharmaceutical compositions can be processed in accordance with conventional methods of pharmacy to produce medicinal agents for administration to patients in need thereof, including humans and other mammals.

[00220] Modifications of the neoantigenic peptides can affect the solubility, bioavailability and rate of metabolism of the peptides, thus providing control over the delivery of the active species. Solubility can be assessed by preparing the neoantigenic peptide and testing according to known methods well within the routine practitioner's skill in the art.

[00221] In certain embodiments of the pharmaceutical composition the pharmaceutically acceptable carrier comprises water. In certain embodiments, the pharmaceutically acceptable carrier further comprises dextrose. In certain embodiments, the pharmaceutically acceptable carrier further comprises dimethylsulfoxide. In certain embodiments, the pharmaceutical composition further comprises an immunomodulator or adjuvant. In certain embodiments, the immunodulator or adjuvant is selected from the group consisting of poly-ICLC, STING agonist, 1018 ISS, aluminum salts, Amplivax, AS15, BCG, CP-870,893, CpG7909, CyaA, dSLIM, GM-CSF, IC30, IC31, Imiquimod, ImuFact IMP321, IS Patch, ISS, ISCOMATRIX, JuvImmune, LipoVac, MF59, monophosphoryl lipid A, Montanide IMS 1312, Montanide ISA 206, Montanide ISA 50V, Montanide ISA-51, OK-432, OM-174, OM-197-MP-EC, ONTAK, PEPTEL, vector system, PLGA microparticles, resiquimod, SRL172, Virosomes and other Virus-like particles, YF-17D, VEGF trap, R848, beta-glucan, Pam3Cys, and Aquila's QS21 stimulon. In certain embodiments, the immunomodulator or adjuvant comprises poly-ICLC.

[00222] Xanthenone derivatives such as, for example, Vadimezan or AsA404 (also known as 5,6-dimethylaxanthenone-4-acetic acid (DMXAA)), may also be used as adjuvants according to embodiments of the invention. Alternatively, such derivatives may also be administered in parallel to the vaccine or immunogenic composition of the invention, for example via systemic or intratumoral delivery, to stimulate immunity at the tumor site. Without being bound by theory, it is believed that such xanthenone derivatives act by stimulating interferon (IFN) production via the stimulator of IFN gene ISTING) receptor (see e.g., Conlon et al. (2013) Mouse, but not Human STING, Binds and Signals in Response to the Vascular Disrupting Agent 5,6-Dimethylxanthenone-4-Acetic Acid, Journal of Immunology, 190:5216-25 and Kim et al. (2013) Anticancer Flavonoids are Mouse-Selective STING Agonists, 8:1396-1401).

[00223] The vaccine or immunological composition may also include an adjuvant compound chosen from the acrylic or methacrylic polymers and the copolymers of maleic anhydride and an alkenyl derivative. It is in particular a polymer of acrylic or methacrylic acid cross-linked with a polyalkenyl ether of a sugar or polyalcohol (carbomer), in particular cross-linked with an allyl sucrose or with allylpentaerythritol. It may also be a copolymer of maleic anhydride and ethylene cross-linked, for example, with divinyl ether (see U.S. Patent No. 6,713,068 hereby incorporated by reference in its entirety)..

[00224] In certain embodiments, the pH modifier can stabilize the adjuvant or immunomodulator as described herein.

[00225] In certain embodiments, a pharmaceutical composition comprises: one to five peptides, dimethylsulfoxide (DMSO), dextrose, water, succinate, poly I: poly C, poly-L-lysine, carboxymethylcellulose, and chloride. In certain embodiments, each of the one to five peptides is present at a concentration of 300 μg/ml. In certain embodiments, the pharmaceutical composition comprises ≤ 3% DMSO by volume. In certain embodiments, the pharmaceutical composition comprises 3.6 – 3.7 % dextrose in water. In certain embodiments, the pharmaceutical composition comprises 3.6 – 3.7 mM succinate (e.g., as sodium succinate) or a salt thereof. In certain embodiments, the pharmaceutical composition comprises 0.5 mg/ml poly I: poly C. In certain embodiments, the pharmaceutical composition comprises 0.375 mg/ml poly-L-Lysine. In certain embodiments, the pharmaceutical composition comprises 1.25 mg/ml sodium carboxymethylcellulose. In certain embodiments, the pharmaceutical composition comprises 0.225% sodium chloride.

[00226] Pharmaceutical compositions comprise the herein-described tumor specific neoantigenic peptides in a therapeutically effective amount for treating diseases and conditions (e.g., a neoplasia/tumor), which have been described herein, optionally in combination with a pharmaceutically acceptable additive, carrier and/or excipient. One of ordinary skill in the art from this disclosure and the knowledge in the art will recognize that a therapeutically effective amount of one of more compounds according to the present invention may vary with the condition to be treated, its severity, the treatment regimen to be employed, the pharmacokinetics of the agent used, as well as the patient (animal or human) treated.

[00227] To prepare the pharmaceutical compositions according to the present invention, a therapeutically effective amount of one or more of the compounds according to the present

invention is preferably intimately admixed with a pharmaceutically acceptable carrier according to conventional pharmaceutical compounding techniques to produce a dose. A carrier may take a wide variety of forms depending on the form of preparation desired for administration, e.g., ocular, oral, topical or parenteral, including gels, creams ointments, lotions and time released implantable preparations, among numerous others. In preparing pharmaceutical compositions in oral dosage form, any of the usual pharmaceutical media may be used. Thus, for liquid oral preparations such as suspensions, elixirs and solutions, suitable carriers and additives including water, glycols, oils, alcohols, flavoring agents, preservatives, coloring agents and the like may be used. For solid oral preparations such as powders, tablets, capsules, and for solid preparations such as suppositories, suitable carriers and additives including starches, sugar carriers, such as dextrose, mannitol, lactose and related carriers, diluents, granulating agents, lubricants, binders, disintegrating agents and the like may be used. If desired, the tablets or capsules may be enteric-coated or sustained release by standard techniques.

[00228] The active compound is included in the pharmaceutically acceptable carrier or diluent in an amount sufficient to deliver to a patient a therapeutically effective amount for the desired indication, without causing serious toxic effects in the patient treated.

[00229] Oral compositions generally include an inert diluent or an edible carrier. They may be enclosed in gelatin capsules or compressed into tablets. For the purpose of oral therapeutic administration, the active compound or its prodrug derivative can be incorporated with excipients and used in the form of tablets, troches, or capsules. Pharmaceutically compatible binding agents, and/or adjuvant materials can be included as part of the composition.

[00230] The tablets, pills, capsules, troches and the like can contain any of the following ingredients, or compounds of a similar nature: a binder such as microcrystalline cellulose, gum tragacanth or gelatin; an excipient such as starch or lactose, a dispersing agent such as alginic acid or corn starch; a lubricant such as magnesium stearate; a glidant such as colloidal silicon dioxide; a sweetening agent such as sucrose or saccharin; or a flavoring agent such as peppermint, methyl salicylate, or orange flavoring. When the dosage unit form is a capsule, it can contain, in addition to material herein discussed, a liquid carrier such as a fatty oil. In addition, dosage unit forms can contain various other materials which modify the physical form of the dosage unit, for example, coatings of sugar, shellac, or enteric agents.

[00231] Formulations of the present invention suitable for oral administration may be presented as discrete units such as capsules, cachets or tablets each containing a predetermined amount of the active ingredient; as a powder or granules; as a solution or a suspension in an aqueous liquid or a non-aqueous liquid; or as an oil-in-water liquid emulsion or a water-in-oil emulsion and as a bolus, etc.

[00232] A tablet may be made by compression or molding, optionally with one or more accessory ingredients. Compressed tablets may be prepared by compressing in a suitable machine the active ingredient in a free-flowing form such as a powder or granules, optionally mixed with a binder, lubricant, inert diluent, preservative, surface-active or dispersing agent. Molded tablets may be made by molding in a suitable machine a mixture of the powdered compound moistened with an inert liquid diluent. The tablets optionally may be coated or scored and may be formulated so as to provide slow or controlled release of the active ingredient therein.

[00233] Methods of formulating such slow or controlled release compositions of pharmaceutically active ingredients, are known in the art and described in several issued US Patents, some of which include, but are not limited to, US Patent Nos. 3,870,790; 4,226,859; 4,369,172; 4,842,866 and 5,705,190, the disclosures of which are incorporated herein by reference in their entireties. Coatings can be used for delivery of compounds to the intestine (see, e.g., U.S. Patent Nos. 6,638,534, 5,541,171, 5,217,720, and 6,569,457, and references cited therein).

[00234] The active compound or pharmaceutically acceptable salt thereof may also be administered as a component of an elixir, suspension, syrup, wafer, chewing gum or the like. A syrup may contain, in addition to the active compounds, sucrose or fructose as a sweetening agent and certain preservatives, dyes and colorings and flavors.

[00235] Solutions or suspensions used for ocular, parenteral, intradermal, subcutaneous, or topical application can include the following components: a sterile diluent such as water for injection, saline solution, fixed oils, polyethylene glycols, glycerine, propylene glycol or other synthetic solvents; antibacterial agents such as benzyl alcohol or methyl parabens; antioxidants such as ascorbic acid or sodium bisulfite; chelating agents such as ethylenediaminetetraacetic acid; buffers such as acetates, citrates or phosphates; and agents for the adjustment of tonicity such as sodium chloride or dextrose.

[00236] In certain embodiments, the pharmaceutically acceptable carrier is an aqueous solvent, i.e., a solvent comprising water, optionally with additional co-solvents. Exemplary pharmaceutically acceptable carriers include water, buffer solutions in water (such as phosphate-buffered saline (PBS), and 5% dextrose in water (D5W). In certain embodiments, the aqueous solvent further comprises dimethyl sulfoxide (DMSO), e.g., in an amount of about 1-4%, or 1-3%. In certain embodiments, the pharmaceutically acceptable carrier is isotonic (i.e., has substantially the same osmotic pressure as a body fluid such as plasma).

[00237] In one embodiment, the active compounds are prepared with carriers that protect the compound against rapid elimination from the body, such as a controlled release formulation, including implants and microencapsulated delivery systems. Biodegradable, biocompatible polymers can be used, such as ethylene vinyl acetate, polyanhydrides, polyglycolic acid, collagen, polyorthoesters, polylactic acid, and polylactic-co-glycolic acid (PLGA). Methods for preparation of such formulations are within the ambit of the skilled artisan in view of this disclosure and the knowledge in the art.

[00238] A skilled artisan from this disclosure and the knowledge in the art recognizes that in addition to tablets, other dosage forms can be formulated to provide slow or controlled release of the active ingredient. Such dosage forms include, but are not limited to, capsules, granulations and gel-caps.

[00239] Liposomal suspensions may also be pharmaceutically acceptable carriers. These may be prepared according to methods known to those skilled in the art. For example, liposomal formulations may be prepared by dissolving appropriate lipid(s) in an inorganic solvent that is then evaporated, leaving behind a thin film of dried lipid on the surface of the container. An aqueous solution of the active compound are then introduced into the container. The container is then swirled by hand to free lipid material from the sides of the container and to disperse lipid aggregates, thereby forming the liposomal suspension. Other methods of preparation well known by those of ordinary skill may also be used in this aspect of the present invention.

[00240] The formulations may conveniently be presented in unit dosage form and may be prepared by conventional pharmaceutical techniques. Such techniques include the step of bringing into association the active ingredient and the pharmaceutical carrier(s) or excipient(s). In general, the formulations are prepared by uniformly and intimately bringing into association

the active ingredient with liquid carriers or finely divided solid carriers or both, and then, if necessary, shaping the product.

[00241] Formulations and compositions suitable for topical administration in the mouth include lozenges comprising the ingredients in a flavored basis, usually sucrose and acacia or tragacanth; pastilles comprising the active ingredient in an inert basis such as gelatin and glycerin, or sucrose and acacia; and mouthwashes comprising the ingredient to be administered in a suitable liquid carrier.

[00242] Formulations suitable for topical administration to the skin may be presented as ointments, creams, gels and pastes comprising the ingredient to be administered in a pharmaceutical acceptable carrier. A preferred topical delivery system is a transdermal patch containing the ingredient to be administered.

[00243] Formulations for rectal administration may be presented as a suppository with a suitable base comprising, for example, cocoa butter or a salicylate.

[00244] Formulations suitable for nasal administration, wherein the carrier is a solid, include a coarse powder having a particle size, for example, in the range of 20 to 500 microns which is administered in the manner in which snuff is administered, i.e., by rapid inhalation through the nasal passage from a container of the powder held close up to the nose. Suitable formulations, wherein the carrier is a liquid, for administration, as for example, a nasal spray or as nasal drops, include aqueous or oily solutions of the active ingredient.

[00245] Formulations suitable for vaginal administration may be presented as pessaries, tampons, creams, gels, pastes, foams or spray formulations containing in addition to the active ingredient such carriers as are known in the art to be appropriate.

[00246] The parenteral preparation can be enclosed in ampoules, disposable syringes or multiple dose vials made of glass or plastic. If administered intravenously, preferred carriers include, for example, physiological saline or phosphate buffered saline (PBS).

[00247] For parenteral formulations, the carrier usually comprises sterile water or aqueous sodium chloride solution, though other ingredients including those which aid dispersion may be included. Of course, where sterile water is to be used and maintained as sterile, the compositions and carriers are also sterilized. Injectable suspensions may also be prepared, in which case appropriate liquid carriers, suspending agents and the like may be employed.

[00248] Formulations suitable for parenteral administration include aqueous and non-aqueous sterile injection solutions which may contain antioxidants, buffers, bacteriostats and solutes which render the formulation isotonic with the blood of the intended recipient; and aqueous and non-aqueous sterile suspensions which may include suspending agents and thickening agents. The formulations may be presented in unit-dose or multi-dose containers, for example, sealed ampules and vials, and may be stored in a freeze-dried (lyophilized) condition requiring only the addition of the sterile liquid carrier, for example, water for injections, immediately prior to use. Extemporaneous injection solutions and suspensions may be prepared from sterile powders, granules and tablets of the kind previously described.

[00249] Administration of the active compound may range from continuous (intravenous drip) to several oral administrations per day (for example, Q.I.D.) and may include oral, topical, eye or ocular, parenteral, intramuscular, intravenous, sub-cutaneous, transdermal (which may include a penetration enhancement agent), buccal and suppository administration, among other routes of administration, including through an eye or ocular route.

[00250] The neoplasia vaccine or immunogenic composition, and any additional agents, may be administered by injection, orally, parenterally, by inhalation spray, rectally, vaginally, or topically in dosage unit formulations containing conventional pharmaceutically acceptable carriers, adjuvants, and vehicles. The term parenteral as used herein includes, into a lymph node or nodes, subcutaneous, intravenous, intramuscular, intrasternal, infusion techniques, intraperitoneally, eye or ocular, intravitreal, intrabuccal, transdermal, intranasal, into the brain, including intracranial and intradural, into the joints, including ankles, knees, hips, shoulders, elbows, wrists, directly into tumors, and the like, and in suppository form.

[00251] In certain embodiments, the vaccine or immunogenic composition is administered intravenously or subcutaneously. Various techniques can be used for providing the subject compositions at the site of interest, such as injection, use of catheters, trocars, projectiles, pluronic gel, stents, sustained drug release polymers or other device which provides for internal access. Where an organ or tissue is accessible because of removal from the patient, such organ or tissue may be bathed in a medium containing the subject compositions, the subject compositions may be painted onto the organ, or may be applied in any convenient way.

[00252] The tumor specific neoantigenic peptides may be administered through a device suitable for the controlled and sustained release of a composition effective in obtaining a desired

local or systemic physiological or pharmacological effect. The method includes positioning the sustained released drug delivery system at an area wherein release of the agent is desired and allowing the agent to pass through the device to the desired area of treatment.

[00253] The tumor specific neoantigenic peptides may be utilized in combination with at least one known other therapeutic agent, or a pharmaceutically acceptable salt of said agent. Examples of known therapeutic agents which can be used for combination therapy include, but are not limited to, corticosteroids (e.g., cortisone, prednisone, dexamethasone), non-steroidal anti-inflammatory drugs (NSAIDS) (e.g., ibuprofen, celecoxib, aspirin, indomethicin, naproxen), alkylating agents such as busulfan, cis-platin, mitomycin C, and carboplatin; antimitotic agents such as colchicine, vinblastine, paclitaxel, and docetaxel; topo I inhibitors such as camptothecin and topotecan; topo II inhibitors such as doxorubicin and etoposide; and/or RNA/DNA antimetabolites such as 5-azacytidine, 5-fluorouracil and methotrexate; DNA antimetabolites such as 5-fluoro-2′-deoxy-uridine, ara-C, hydroxyurea and thioguanine; antibodies such as HERCEPTIN and RITUXAN.

[00254] It should be understood that in addition to the ingredients particularly mentioned herein, the formulations of the present invention may include other agents conventional in the art having regard to the type of formulation in question, for example, those suitable for oral administration may include flavoring agents.

[00255] Pharmaceutically acceptable salt forms may be the preferred chemical form of compounds according to the present invention for inclusion in pharmaceutical compositions according to the present invention.

[00256] The present compounds or their derivatives, including prodrug forms of these agents, can be provided in the form of pharmaceutically acceptable salts. As used herein, the term pharmaceutically acceptable salts or complexes refers to appropriate salts or complexes of the active compounds according to the present invention which retain the desired biological activity of the parent compound and exhibit limited toxicological effects to normal cells. Nonlimiting examples of such salts are (a) acid addition salts formed with inorganic acids (for example, hydrochloric acid, hydrobromic acid, sulfuric acid, phosphoric acid, nitric acid, and the like), and salts formed with organic acids such as acetic acid, oxalic acid, tartaric acid, succinic acid, malic acid, ascorbic acid, benzoic acid, tannic acid, pamoic acid, alginic acid, and polyglutamic acid,

among others; (b) base addition salts formed with metal cations such as zinc, calcium, sodium, potassium, and the like, among numerous others.

[00257] The compounds herein are commercially available or can be synthesized. As can be appreciated by the skilled artisan, further methods of synthesizing the compounds of the formulae herein is evident to those of ordinary skill in the art. Additionally, the various synthetic steps may be performed in an alternate sequence or order to give the desired compounds. Synthetic chemistry transformations and protecting group methodologies (protection and deprotection) useful in synthesizing the compounds described herein are known in the art and include, for example, those such as described in R. Larock, Comprehensive Organic Transformations, 2nd. Ed., Wiley-VCH Publishers (1999); T.W. Greene and P.G.M. Wuts, Protective Groups in Organic Synthesis, 3rd. Ed., John Wiley and Sons (1999); L. Fieser and M. Fieser, Fieser and Fieser's Reagents for Organic Synthesis, John Wiley and Sons (1999); and L. Paquette, ed., Encyclopedia of Reagents for Organic Synthesis, John Wiley and Sons (1995), and subsequent editions thereof.

[00258] The additional agents that may be included with the tumor specific neo-antigenic peptides of this invention may contain one or more asymmetric centers and thus occur as racemates and racemic mixtures, single enantiomers, individual diastereomers and diastereomeric mixtures. All such isomeric forms of these compounds are expressly included in the present invention. The compounds of this invention may also be represented in multiple tautomeric forms, in such instances, the invention expressly includes all tautomeric forms of the compounds described herein (e.g., alkylation of a ring system may result in alkylation at multiple sites, the invention expressly includes all such reaction products). All such isomeric forms of such compounds are expressly included in the present invention. All crystal forms of the compounds described herein are expressly included in the present invention.

Dosage

[00259] When the agents described herein are administered as pharmaceuticals to humans or animals, they can be given per se or as a pharmaceutical composition containing active ingredient in combination with a pharmaceutically acceptable carrier, excipient, or diluent.

[00260] Actual dosage levels and time course of administration of the active ingredients in the pharmaceutical compositions of the invention can be varied so as to obtain an amount of the active ingredient which is effective to achieve the desired therapeutic response for a particular

patient, composition, and mode of administration, without being toxic to the patient. Generally, agents or pharmaceutical compositions of the invention are administered in an amount sufficient to reduce or eliminate symptoms associated with neoplasia, e.g. cancer or tumors.

[00261] A preferred dose of an agent is the maximum that a patient can tolerate and not develop serious or unacceptable side effects. Exemplary dose ranges include 0.01 mg to 250 mg per day, 0.01 mg to 100 mg per day, 1 mg to 100 mg per day, 10 mg to 100 mg per day, 1 mg to 10 mg per day, and 0.01 mg to 10 mg per day. A preferred dose of an agent is the maximum that a patient can tolerate and not develop serious or unacceptable side effects. In embodiments, the agent is administered at a concentration of about 10 micrograms to about 100 mg per kilogram of body weight per day, about 0.1 to about 10 mg/kg per day, or about 1.0 mg to about 10 mg/kg of body weight per day.

[00262] In embodiments, the pharmaceutical composition comprises an agent in an amount ranging between 1 and 10 mg, such as 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 mg.

[00263] In embodiments, the therapeutically effective dosage produces a serum concentration of an agent of from about 0.1 ng/ml to about 50-100 mg/ml. The pharmaceutical compositions 5 typically should provide a dosage of from about 0.001 mg to about 2000 mg of compound per kilogram of body weight per day. For example, dosages for systemic administration to a human patient can range from 1-10 mglkg, 20-80 mglkg, 5-50 mg/kg, 75-150 mg/kg, 100-500 mg/kg, 250-750 mg/kg, 500-1000 mg/kg, 1-10 mg/kg, 5-50 mg/kg, 25-75 mg/kg, 50-100 mg/kg, 100-250 mg/kg, 50-100 mg/kg, 250-500 mg/kg, 500-750 mg/kg, 750-1000 mg/kg, 1000-1500 mg/kg, 10 1500-2000 mg/kg, 5 mg/kg, 20 mg/kg, 50 mg/kg, 100 mg/kg, 500 mg/kg, 1000 mg/kg, 1500 mg/kg, or 2000 mg/kg. Pharmaceutical dosage unit forms are prepared to provide from about 1 mg to about 5000 mg, for example from about 100 to about 2500 mg of the compound or a combination of essential ingredients per dosage unit form.

[00264] In embodiments, about 50 nM to about 1μM of an agent is administered to a subject. In related embodiments, about 50-100 nM, 50-250 nM, 100-500 nM, 250-500 nM, 250-750 nM, 500-750 nM, 500 nM to 1μM, or 750 nM to 1μM of an agent is administered to a subject.

[00265] Determination of an effective amount is well within the capability of those skilled in the art, especially in light of the detailed disclosure provided herein. Generally, an efficacious or effective amount of an agent is determined by first administering a low dose of the agent(s) and then incrementally increasing the administered dose or dosages until a desired effect (e.g., reduce

or eliminate symptoms associated with viral infection or autoimmune disease) is observed in the treated subject, with minimal or acceptable toxic side effects. Applicable methods for determining an appropriate dose and dosing schedule for administration of a pharmaceutical composition of the present invention are described, for example, in Goodman and Gilman's The Pharmacological Basis of Therapeutics, Goodman et al., eds., 11th Edition, McGraw-Hill 2005, and Remington: The Science and Practice of Pharmacy, 20th and 21st Editions, Gennaro and University of the Sciences in Philadelphia, Eds., Lippencott Williams & Wilkins (2003 and 2005), each of which is hereby incorporated by reference.

[00266] Preferred unit dosage formulations are those containing a daily dose or unit, daily sub-dose, as herein discussed, or an appropriate fraction thereof, of the administered ingredient.

[00267] The dosage regimen for treating a disorder or a disease with the tumor specific neoantigenic peptides of this invention and/or compositions of this invention is based on a variety of factors, including the type of disease, the age, weight, sex, medical condition of the patient, the severity of the condition, the route of administration, and the particular compound employed. Thus, the dosage regimen may vary widely, but can be determined routinely using standard methods.

[00268] The amounts and dosage regimens administered to a subject can depend on a number of factors, such as the mode of administration, the nature of the condition being treated, the body weight of the subject being treated and the judgment of the prescribing physician; all such factors being within the ambit of the skilled artisan from this disclosure and the knowledge in the art.

[00269] The amount of compound included within therapeutically active formulations according to the present invention is an effective amount for treating the disease or condition. In general, a therapeutically effective amount of the present preferred compound in dosage form usually ranges from slightly less than about 0.025 mg/kg/day to about 2.5 g/kg/day, preferably about 0.1 mg/kg/day to about 100 mg/kg/day of the patient or considerably more, depending upon the compound used, the condition or infection treated and the route of administration, although exceptions to this dosage range may be contemplated by the present invention. In its most preferred form, compounds according to the present invention are administered in amounts ranging from about 1 mg/kg/day to about 100 mg/kg/day. The dosage of the compound can depend on the condition being treated, the particular compound, and other clinical factors such as

weight and condition of the patient and the route of administration of the compound. It is to be understood that the present invention has application for both human and veterinary use.

[00270] For oral administration to humans, a dosage of between approximately 0.1 to 100 mg/kg/day, preferably between approximately 1 and 100 mg/kg/day, is generally sufficient.

[00271] Where drug delivery is systemic rather than topical, this dosage range generally produces effective blood level concentrations of active compound ranging from less than about 0.04 to about 400 micrograms/cc or more of blood in the patient. The compound is conveniently administered in any suitable unit dosage form, including but not limited to one containing 0.001 to 3000 mg, preferably 0.05 to 500 mg of active ingredient per unit dosage form. An oral dosage of 10-250 mg is usually convenient.

[00272] According to certain exemplary embodiments, the vaccine or immunogenic composition is administered at a dose of about 10 μg to 1 mg per neoantigenic peptide. According to certain exemplary embodiments, the vaccine or immunogenic composition is administered at an average weekly dose level of about 10 μg to 2000 μg per neoantigenic peptide.

[00273] The concentration of active compound in the drug composition will depend on absorption, distribution, inactivation, and excretion rates of the drug as well as other factors known to those of skill in the art. It is to be noted that dosage values will also vary with the severity of the condition to be alleviated. It is to be further understood that for any particular subject, specific dosage regimens should be adjusted over time according to the individual need and the professional judgment of the person administering or supervising the administration of the compositions, and that the concentration ranges set forth herein are exemplary only and are not intended to limit the scope or practice of the claimed composition. The active ingredient may be administered at once, or may be divided into a number of smaller doses to be administered at varying intervals of time.

[00274] The invention provides for pharmaceutical compositions containing at least one tumor specific neoantigen described herein. In embodiments, the pharmaceutical compositions contain a pharmaceutically acceptable carrier, excipient, or diluent, which includes any pharmaceutical agent that does not itself induce the production of an immune response harmful to a subject receiving the composition, and which may be administered without undue toxicity. As used herein, the term “pharmaceutically acceptable” means being approved by a regulatory agency of

the Federal or a state government or listed in the U.S. Pharmacopia, European Pharmacopia or other generally recognized pharmacopia for use in mammals, and more particularly in humans. These compositions can be useful for treating and/or preventing viral infection and/or autoimmune disease.

[00275] A thorough discussion of pharmaceutically acceptable carriers, diluents, and other excipients is presented in Remington's Pharmaceutical Sciences (17th ed., Mack Publishing Company) and Remington: The Science and Practice of Pharmacy (21st ed., Lippincott Williams & Wilkins), which are hereby incorporated by reference. The formulation of the pharmaceutical composition should suit the mode of administration. In embodiments, the pharmaceutical composition is suitable for administration to humans, and can be sterile, non-particulate and/or non-pyrogenic.

[00276] Pharmaceutically acceptable carriers, excipients, or diluents include, but are not limited, to saline, buffered saline, dextrose, water, glycerol, ethanol, sterile isotonic aqueous buffer, and combinations thereof.

[00277] Wetting agents, emulsifiers and lubricants, such as sodium lauryl sulfate and magnesium stearate, as well as coloring agents, release agents, coating agents, sweetening, flavoring and perfuming agents, preservatives, and antioxidants can also be present in the compositions.

[00278] Examples of pharmaceutically-acceptable antioxidants include, but are not limited to: (1) water soluble antioxidants, such as ascorbic acid, cysteine hydrochloride, sodium bisulfate, sodium metabisulfite, sodium sulfite and the like; (2) oil-soluble antioxidants, such as ascorbyl palmitate, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), lecithin, propyl gallate, alpha-tocopherol, and the like; and (3) metal chelating agents, such as citric acid, ethylenediamine tetraacetic acid (EDTA), sorbitol, tartaric acid, phosphoric acid, and the like.

[00279] In embodiments, the pharmaceutical composition is provided in a solid form, such as a lyophilized powder suitable for reconstitution, a liquid solution, suspension, emulsion, tablet, pill, capsule, sustained release formulation, or powder.

[00280] In embodiments, the pharmaceutical composition is supplied in liquid form, for example, in a sealed container indicating the quantity and concentration of the active ingredient in the pharmaceutical composition. In related embodiments, the liquid form of the pharmaceutical composition is supplied in a hermetically sealed container.

[00281] Methods for formulating the pharmaceutical compositions of the present invention are conventional and well known in the art (see Remington and Remington's). One of skill in the art can readily formulate a pharmaceutical composition having the desired characteristics (e.g., route of administration, biosafety, and release profile).

[00282] Methods for preparing the pharmaceutical compositions include the step of bringing into association the active ingredient with a pharmaceutically acceptable carrier and, optionally, one or more accessory ingredients. The pharmaceutical compositions can be prepared by uniformly and intimately bringing into association the active ingredient with liquid carriers, or finely divided solid carriers, or both, and then, if necessary, shaping the product. Additional methodology for preparing the pharmaceutical compositions, including the preparation of multilayer dosage forms, are described in Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems (9th ed., Lippincott Williams & Wilkins), which is hereby incorporated by reference.

[00283] Pharmaceutical compositions suitable for oral administration can be in the form of capsules, cachets, pills, tablets, lozenges (using a flavored basis, usually sucrose and acacia or tragacanth), powders, granules, or as a solution or a suspension in an aqueous or non-aqueous liquid, or as an oil-in-water or water-in-oil liquid emulsion, or as an elixir or syrup, or as pastilles (using an inert base, such as gelatin and glycerin, or sucrose and acacia) and/or as mouth washes and the like, each containing a predetermined amount of a compound(s) described herein, a derivative thereof, or a pharmaceutically acceptable salt or prodrug thereof as the active ingredient(s). The active ingredient can also be administered as a bolus, electuary, or paste.

[00284] In solid dosage forms for oral administration (e.g., capsules, tablets, pills, dragees, powders, granules and the like), the active ingredient is mixed with one or more pharmaceutically acceptable carriers, excipients, or diluents, such as sodium citrate or dicalcium phosphate, and/or any of the following: (1) fillers or extenders, such as starches, lactose, sucrose, glucose, mannitol, and/or silicic acid; (2) binders, such as, for example, carboxymethylcellulose, alginates, gelatin, polyvinyl pyrrolidone, sucrose and/or acacia; (3) humectants, such as glycerol; (4) disintegrating agents, such as agar-agar, calcium carbonate, potato or tapioca starch, alginic acid, certain silicates, and sodium carbonate; (5) solution retarding agents, such as paraffin; (6) absorption accelerators, such as quaternary ammonium compounds; (7) wetting agents, such as, for example, acetyl alcohol and glycerol monostearate; (8) absorbents, such as kaolin and

bentonite clay; (9) lubricants, such a talc, calcium stearate, magnesium stearate, solid polyethylene glycols, sodium lauryl sulfate, and mixtures thereof; and (10) coloring agents. In the case of capsules, tablets, and pills, the pharmaceutical compositions can also comprise buffering agents. Solid compositions of a similar type can also be prepared using fillers in soft and hard-filled gelatin capsules, and excipients such as lactose or milk sugars, as well as high molecular weight polyethylene glycols and the like.

[00285] A tablet can be made by compression or molding, optionally with one or more accessory ingredients. Compressed tablets can be prepared using binders (for example, gelatin or hydroxypropylmethyl cellulose), lubricants, inert diluents, preservatives, disintegrants (for example, sodium starch glycolate or cross-linked sodium carboxymethyl cellulose), surface-actives, and/ or dispersing agents. Molded tablets can be made by molding in a suitable machine a mixture of the powdered active ingredient moistened with an inert liquid diluent.

[00286] The tablets and other solid dosage forms, such as dragees, capsules, pills, and granules, can optionally be scored or prepared with coatings and shells, such as enteric coatings and other coatings well known in the art.

[00287] In some embodiments, in order to prolong the effect of an active ingredient, it is desirable to slow the absorption of the compound from subcutaneous or intramuscular injection. This can be accomplished by the use of a liquid suspension of crystalline or amorphous material having poor water solubility. The rate of absorption of the active ingredient then depends upon its rate of dissolution which, in turn, can depend upon crystal size and crystalline form. Alternatively, delayed absorption of a parenterally-administered active ingredient is accomplished by dissolving or suspending the compound in an oil vehicle. In addition, prolonged absorption of the injectable pharmaceutical form can be brought about by the inclusion of agents that delay absorption such as aluminum monostearate and gelatin.

[00288] Controlled release parenteral compositions can be in form of aqueous suspensions, microspheres, microcapsules, magnetic microspheres, oil solutions, oil suspensions, emulsions, or the active ingredient can be incorporated in biocompatible carrier(s), liposomes, nanoparticles, implants or infusion devices.

[00289] Materials for use in the preparation of microspheres and/or microcapsules include biodegradable/bioerodible polymers such as polyglactin, poly-(isobutyl cyanoacrylate), poly(2-hydroxyethyl-L-glutamine) and poly(lactic acid).

[00290] Biocompatible carriers which can be used when formulating a controlled release parenteral formulation include carbohydrates such as dextrans, proteins such as albumin, lipoproteins or antibodies.

[00291] Materials for use in implants can be non-biodegradable, e.g., polydimethylsiloxane, or biodegradable such as, e.g., poly(caprolactone), poly(lactic acid), poly(glycolic acid) or poly(ortho esters).

[00292] In embodiments, the active ingredient(s) are administered by aerosol. This is accomplished by preparing an aqueous aerosol, liposomal preparation, or solid particles containing the compound. A nonaqueous (e.g., fluorocarbon propellant) suspension can be used. The pharmaceutical composition can also be administered using a sonic nebulizer, which would minimize exposing the agent to shear, which can result in degradation of the compound.

[00293] Ordinarily, an aqueous aerosol is made by formulating an aqueous solution or suspension of the active ingredient(s) together with conventional pharmaceutically-acceptable carriers and stabilizers. The carriers and stabilizers vary with the requirements of the particular compound, but typically include nonionic surfactants (Tweens, Pluronics, or polyethylene glycol), innocuous proteins like serum albumin, sorbitan esters, oleic acid, lecithin, amino acids such as glycine, buffers, salts, sugars or sugar alcohols. Aerosols generally are prepared from isotonic solutions.

[00294] Dosage forms for topical or transdermal administration of an active ingredient(s) includes powders, sprays, ointments, pastes, creams, lotions, gels, solutions, patches and inhalants. The active ingredient(s) can be mixed under sterile conditions with a pharmaceutically acceptable carrier, and with any preservatives, buffers, or propellants as appropriate.

[00295] Transdermal patches suitable for use in the present invention are disclosed in Transdermal Drug Delivery: Developmental Issues and Research Initiatives (Marcel Dekker Inc., 1989) and U.S. Pat. Nos. 4,743,249, 4,906,169, 5,198,223, 4,816,540, 5,422,119, 5,023,084, which are hereby incorporated by reference. The transdermal patch can also be any transdermal patch well known in the art, including transscrotal patches. Pharmaceutical compositions in such transdermal patches can contain one or more absorption enhancers or skin permeation enhancers well known in the art (see, e.g., U.S. Pat. Nos. 4,379,454 and 4,973,468, which are hereby incorporated by reference). Transdermal therapeutic systems for use in the present invention can be based on iontophoresis, diffusion, or a combination of these two effects.

[00296] Transdermal patches have the added advantage of providing controlled delivery of active ingredient(s) to the body. Such dosage forms can be made by dissolving or dispersing the active ingredient(s) in a proper medium. Absorption enhancers can also be used to increase the flux of the active ingredient across the skin. The rate of such flux can be controlled by either providing a rate controlling membrane or dispersing the active ingredient(s) in a polymer matrix or gel.

[00297] Such pharmaceutical compositions can be in the form of creams, ointments, lotions, liniments, gels, hydrogels, solutions, suspensions, sticks, sprays, pastes, plasters and other kinds of transdermal drug delivery systems. The compositions can also include pharmaceutically acceptable carriers or excipients such as emulsifying agents, antioxidants, buffering agents, preservatives, humectants, penetration enhancers, chelating agents, gel-forming agents, ointment bases, perfumes, and skin protective agents.

[00298] Examples of emulsifying agents include, but are not limited to, naturally occurring gums, e.g. gum acacia or gum tragacanth, naturally occurring phosphatides, e.g. soybean lecithin and sorbitan monooleate derivatives.

[00299] Examples of antioxidants include, but are not limited to, butylated hydroxy anisole (BHA), ascorbic acid and derivatives thereof, tocopherol and derivatives thereof, and cysteine.

[00300] Examples of preservatives include, but are not limited to, parabens, such as methyl or propyl p-hydroxybenzoate and benzalkonium chloride.

[00301] Examples of humectants include, but are not limited to, glycerin, propylene glycol, sorbitol and urea.

[00302] Examples of penetration enhancers include, but are not limited to, propylene glycol, DMSO, triethanolamine, N,N-dimethylacetamide, N,N-dimethylformamide, 2-pyrrolidone and derivatives thereof, tetrahydrofurfuryl alcohol, propylene glycol, diethylene glycol monoethyl or monomethyl ether with propylene glycol monolaurate or methyl laurate, eucalyptol, lecithin, TRANSCUTOL, and AZONE.

[00303] Examples of chelating agents include, but are not limited to, sodium EDTA, citric acid and phosphoric acid.

[00304] Examples of gel forming agents include, but are not limited to, Carbopol, cellulose derivatives, bentonite, alginates, gelatin and polyvinylpyrrolidone.

[00305] In addition to the active ingredient(s), the ointments, pastes, creams, and gels of the present invention can contain excipients, such as animal and vegetable fats, oils, waxes, paraffins, starch, tragacanth, cellulose derivatives, polyethylene glycols, silicones, bentonites, silicic acid, talc and zinc oxide, or mixtures thereof.

[00306] Powders and sprays can contain excipients such as lactose, talc, silicic acid, aluminum hydroxide, calcium silicates and polyamide powder, or mixtures of these substances. Sprays can additionally contain customary propellants, such as chlorofluorohydrocarbons, and volatile unsubstituted hydrocarbons, such as butane and propane.

[00307] Injectable depot forms are made by forming microencapsule matrices of compound(s) of the invention in biodegradable polymers such as polylactide-polyglycolide. Depending on the ratio of compound to polymer, and the nature of the particular polymer employed, the rate of compound release can be controlled. Examples of other biodegradable polymers include poly(orthoesters) and poly(anhydrides). Depot injectable formulations are also prepared by entrapping the drug in liposomes or microemulsions which are compatible with body tissue.

[00308] Subcutaneous implants are well known in the art and are suitable for use in the present invention. Subcutaneous implantation methods are preferably non-irritating and mechanically resilient. The implants can be of matrix type, of reservoir type, or hybrids thereof. In matrix type devices, the carrier material can be porous or non-porous, solid or semi-solid, and permeable or impermeable to the active compound or compounds. The carrier material can be biodegradable or may slowly erode after administration. In some instances, the matrix is non-degradable but instead relies on the diffusion of the active compound through the matrix for the carrier material to degrade. Alternative subcutaneous implant methods utilize reservoir devices where the active compound or compounds are surrounded by a rate controlling membrane, e.g., a membrane independent of component concentration (possessing zero-order kinetics). Devices consisting of a matrix surrounded by a rate controlling membrane also suitable for use.

[00309] Both reservoir and matrix type devices can contain materials such as polydimethylsiloxane, such as SILASTIC, or other silicone rubbers. Matrix materials can be insoluble polypropylene, polyethylene, polyvinyl chloride, ethylvinyl acetate, polystyrene and polymethacrylate, as well as glycerol esters of the glycerol palmitostearate, glycerol stearate, and glycerol behenate type. Materials can be hydrophobic or hydrophilic polymers and optionally contain solubilizing agents.

[00310] Subcutaneous implant devices can be slow-release capsules made with any suitable polymer, e.g., as described in U.S. Pat. Nos. 5,035,891 and 4,210,644, which are hereby incorporated by reference.

[00311] In general, at least four different approaches are applicable in order to provide rate control over the release and transdermal permeation of a drug compound. These approaches are: membrane-moderated systems, adhesive diffusion-controlled systems, matrix dispersion-type systems and microreservoir systems. It is appreciated that a controlled release percutaneous and/or topical composition can be obtained by using a suitable mixture of these approaches.

[00312] In a membrane-moderated system, the active ingredient is present in a reservoir which is totally encapsulated in a shallow compartment molded from a drug-impermeable laminate, such as a metallic plastic laminate, and a rate-controlling polymeric membrane such as a microporous or a non-porous polymeric membrane, e.g., ethylene-vinyl acetate copolymer. The active ingredient is released through the rate controlling polymeric membrane. In the drug reservoir, the active ingredient can either be dispersed in a solid polymer matrix or suspended in an unleachable, viscous liquid medium such as silicone fluid. On the external surface of the polymeric membrane, a thin layer of an adhesive polymer is applied to achieve an intimate contact of the transdermal system with the skin surface. The adhesive polymer is preferably a polymer which is hypoallergenic and compatible with the active drug substance.

[00313] In an adhesive diffusion-controlled system, a reservoir of the active ingredient is formed by directly dispersing the active ingredient in an adhesive polymer and then by, e.g., solvent casting, spreading the adhesive containing the active ingredient onto a flat sheet of substantially drug-impermeable metallic plastic backing to form a thin drug reservoir layer.

[00314] A matrix dispersion-type system is characterized in that a reservoir of the active ingredient is formed by substantially homogeneously dispersing the active ingredient in a hydrophilic or lipophilic polymer matrix. The drug-containing polymer is then molded into disc with a substantially well-defined surface area and controlled thickness. The adhesive polymer is spread along the circumference to form a strip of adhesive around the disc.

[00315] A microreservoir system can be considered as a combination of the reservoir and matrix dispersion type systems. In this case, the reservoir of the active substance is formed by first suspending the drug solids in an aqueous solution of water-soluble polymer and then

dispersing the drug suspension in a lipophilic polymer to form a multiplicity of unleachable, microscopic spheres of drug reservoirs.

[00316] Any of the herein-described controlled release, extended release, and sustained release compositions can be formulated to release the active ingredient in about 30 minutes to about 1 week, in about 30 minutes to about 72 hours, in about 30 minutes to 24 hours, in about 30 minutes to 12 hours, in about 30 minutes to 6 hours, in about 30 minutes to 4 hours, and in about 3 hours to 10 hours. In embodiments, an effective concentration of the active ingredient(s) is sustained in a subject for 4 hours, 6 hours, 8 hours, 10 hours, 12 hours, 16 hours, 24 hours, 48 hours, 72 hours, or more after administration of the pharmaceutical compositions to the subject.

[00317] Vaccine or immunogenic compositions

[00318] The present invention is directed in some aspects to pharmaceutical compositions suitable for the prevention or treatment of cancer. In one embodiment, the composition comprises at least an immunogenic composition, e.g., a neoplasia vaccine or immunogenic composition capable of raising a specific T-cell response. The neoplasia vaccine or immunogenic composition comprises neoantigenic peptides and/or neoantigenic polypeptides corresponding to tumor specific neoantigens as described herein.

[00319] A suitable neoplasia vaccine or immunogenic composition can preferably contain a plurality of tumor specific neoantigenic peptides. In an embodiment, the vaccine or immunogenic composition can include between 1 and 100 sets of peptides, more preferably between 1 and 50 such peptides, even more preferably between 10 and 30 sets peptides, even more preferably between 15 and 25 peptides. According to another preferred embodiment, the vaccine or immunogenic composition can include at least one peptides, more preferably 2, 3, 4, or 5 peptides, In certain embodiments, the vaccine or immunogenic composition can comprise 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, or 30 different peptides.

[00320] The optimum amount of each peptide to be included in the vaccine or immunogenic composition and the optimum dosing regimen can be determined by one skilled in the art without undue experimentation. For example, the peptide or its variant may be prepared for intravenous (i.v.) injection, sub-cutaneous (s.c.) injection, intradermal (i.d.) injection, intraperitoneal (i.p.) injection, intramuscular (i.m.) injection. Preferred methods of peptide injection include s.c, i.d., i.p., i.m., and i.v. Preferred methods of DNA injection include i.d., i.m., s.c, i.p. and i.v. For

example, doses of between 1 and 500 mg 50 μg and 1.5 mg, preferably 10 μg to 500 μg, of peptide or DNA may be given and can depend from the respective peptide or DNA. Doses of this range were successfully used in previous trials (Brunsvig P F, et al., Cancer Immunol Immunother. 2006; 55(12): 1553- 1564; M. Staehler, et al., ASCO meeting 2007; Abstract No 3017). Other methods of administration of the vaccine or immunogenic composition are known to those skilled in the art.

[00321] In one embodiment of the present invention the different tumor specific neoantigenic peptides and/or polypeptides are selected for use in the neoplasia vaccine or immunogenic composition so as to maximize the likelihood of generating an immune attack against the neoplasias/tumors in a high proportion of subjects in the population. Without being bound by theory, it is believed that the inclusion of a diversity of tumor specific neoantigenic peptides can generate a broad scale immune attack against a neoplasia/tumor. In one embodiment, the selected tumor specific neoantigenic peptides/polypeptides are encoded by missense mutations. In a second embodiment, the selected tumor specific neoantigenic peptides/polypeptides are encoded by a combination of missense mutations and neoORF mutations. In a third embodiment, the selected tumor specific neoantigenic peptides/polypeptides are encoded by neoORF mutations.

[00322] In one embodiment in which the selected tumor specific neoantigenic peptides/polypeptides are encoded by missense mutations, the peptides and/or polypeptides are chosen based on their capability to associate with the MHC molecules of a high proportion of subjects in the population. Peptides/polypeptides derived from neoORF mutations can also be selected on the basis of their capability to associate with the MHC molecules of the patient population.

[00323] The vaccine or immunogenic composition is capable of raising a specific cytotoxic T-cells response and/or a specific helper T-cell response.

[00324] The vaccine or immunogenic composition can further comprise an adjuvant and/or a carrier. Examples of useful adjuvants and carriers are given herein herein. The peptides and/or polypeptides in the composition can be associated with a carrier such as, e.g., a protein or an antigen-presenting cell such as e.g. a dendritic cell (DC) capable of presenting the peptide to a T-cell.

[00325] Adjuvants are any substance whose admixture into the vaccine or immunogenic composition increases or otherwise modifies the immune response to the mutant peptide. Carriers are scaffold structures, for example a polypeptide or a polysaccharide, to which the neoantigenic peptides, is capable of being associated. Optionally, adjuvants are conjugated covalently or non-covalently to the peptides or polypeptides of the invention.

[00326] The ability of an adjuvant to increase the immune response to an antigen is typically manifested by a significant increase in immune-mediated reaction, or reduction in disease symptoms. For example, an increase in humoral immunity is typically manifested by a significant increase in the titer of antibodies raised to the antigen, and an increase in T-cell activity is typically manifested in increased cell proliferation, or cellular cytotoxicity, or cytokine secretion. An adjuvant may also alter an immune response, for example, by changing a primarily humoral or Th2 response into a primarily cellular, or Th1 response.

[00327] Suitable adjuvants include, but are not limited to 1018 ISS, aluminum salts, Amplivax, AS15, BCG, CP-870,893, CpG7909, CyaA, dSLIM, GM-CSF, IC30, IC31, Imiquimod, ImuFact IMP321, IS Patch, ISS, ISCOMATRIX, Juvlmmune, LipoVac, MF59, monophosphoryl lipid A, Montanide IMS 1312, Montanide ISA 206, Montanide ISA 50V, Montanide ISA-51, OK-432, OM-174, OM-197-MP-EC, ONTAK, PEPTEL. vector system, PLG microparticles, resiquimod, SRL172, Virosomes and other Virus-like particles, YF-17D, VEGF trap, R848, beta-glucan, Pam3Cys, Aquila's QS21 stimulon (Aquila Biotech, Worcester, Mass., USA) which is derived from saponin, mycobacterial extracts and synthetic bacterial cell wall mimics, and other proprietary adjuvants such as Ribi's Detox. Quil or Superfos. Several immunological adjuvants (e.g., MF59) specific for dendritic cells and their preparation have been described previously (Dupuis M, et al., Cell Immunol. 1998; 186(1): 18-27; Allison A C; Dev Biol Stand. 1998; 92:3-11). Also cytokines may be used. Several cytokines have been directly linked to influencing dendritic cell migration to lymphoid tissues (e.g., TNF-alpha), accelerating the maturation of dendritic cells into efficient antigen-presenting cells for T-lymphocytes (e.g., GM-CSF, IL-1 and IL-4) (U.S. Pat. No. 5,849,589, specifically incorporated herein by reference in its entirety) and acting as immunoadjuvants (e.g., IL-12) (Gabrilovich D I, et al., J Immunother Emphasis Tumor Immunol. 1996 (6):414-418).

[00328] Toll like receptors (TLRs) may also be used as adjuvants, and are important members of the family of pattern recognition receptors (PRRs) which recognize conserved motifs shared

by many micro-organisms, termed "pathogen-associated molecular patterns" (PAMPS). Recognition of these "danger signals" activates multiple elements of the innate and adaptive immune system. TLRs are expressed by cells of the innate and adaptive immune systems such as dendritic cells (DCs), macrophages, T and B cells, mast cells, and granulocytes and are localized in different cellular compartments, such as the plasma membrane, lysosomes, endosomes, and endolysosomes. Different TLRs recognize distinct PAMPS. For example, TLR4 is activated by LPS contained in bacterial cell walls, TLR9 is activated by unmethylated bacterial or viral CpG DNA, and TLR3 is activated by double stranded RNA. TLR ligand binding leads to the activation of one or more intracellular signaling pathways, ultimately resulting in the production of many key molecules associated with inflammation and immunity (particularly the transcription factor NF-κB and the Type-I interferons). TLR mediated DC activation leads to enhanced DC activation, phagocytosis, upregulation of activation and co-stimulation markers such as CD80, CD83, and CD86, expression of CCR7 allowing migration of DC to draining lymph nodes and facilitating antigen presentation to T cells, as well as increased secretion of cytokines such as type I interferons, IL-12, and IL-6. All of these downstream events are critical for the induction of an adaptive immune response.

[00329] Among the most promising cancer vaccine or immunogenic composition adjuvants currently in clinical development are the TLR9 agonist CpG and the synthetic double-stranded RNA (dsRNA) TLR3 ligand poly-ICLC. In preclinical studies poly-ICLC appears to be the most potent TLR adjuvant when compared to LPS and CpG due to its induction of pro-inflammatory cytokines and lack of stimulation of IL-10, as well as maintenance of high levels of co-stimulatory molecules in DCs1. Furthermore, poly-ICLC was recently directly compared to CpG in non-human primates (rhesus macaques) as adjuvant for a protein vaccine or immunogenic composition consisting of human papillomavirus (HPV)16 capsomers (Stahl-Hennig C, Eisenblatter M, Jasny E, et al. Synthetic double-stranded RNAs are adjuvants for the induction of T helper 1 and humoral immune responses to human papillomavirus in rhesus macaques. PLoS pathogens. Apr 2009;5(4)).

[00330] CpG immuno stimulatory oligonucleotides have also been reported to enhance the effects of adjuvants in a vaccine or immunogenic composition setting. Without being bound by theory, CpG oligonucleotides act by activating the innate (non- adaptive) immune system via Toll-like receptors (TLR), mainly TLR9. CpG triggered TLR9 activation enhances antigen-

specific humoral and cellular responses to a wide variety of antigens, including peptide or protein antigens, live or killed viruses, dendritic cell vaccines, autologous cellular vaccines and polysaccharide conjugates in both prophylactic and therapeutic vaccines. More importantly, it enhances dendritic cell maturation and differentiation, resulting in enhanced activation of Thl cells and strong cytotoxic T- lymphocyte (CTL) generation, even in the absence of CD4 T-cell help. The Thl bias induced by TLR9 stimulation is maintained even in the presence of vaccine adjuvants such as alum or incomplete Freund's adjuvant (IFA) that normally promote a Th2 bias. CpG oligonucleotides show even greater adjuvant activity when formulated or co-administered with other adjuvants or in formulations such as microparticles, nano particles, lipid emulsions or similar formulations, which are especially necessary for inducing a strong response when the antigen is relatively weak. They also accelerate the immune response and enabled the antigen doses to be reduced by approximately two orders of magnitude, with comparable antibody responses to the full-dose vaccine without CpG in some experiments (Arthur M. Krieg, Nature Reviews, Drug Discovery, 5, Jun. 2006, 471-484). U.S. Pat. No. 6,406,705 Bl describes the combined use of CpG oligonucleotides, non-nucleic acid adjuvants and an antigen to induce an antigen- specific immune response. A commercially available CpG TLR9 antagonist is dSLIM (double Stem Loop Immunomodulator) by Mologen (Berlin, GERMANY), which is a preferred component of the pharmaceutical composition of the present invention. Other TLR binding molecules such as RNA binding TLR 7, TLR 8 and/or TLR 9 may also be used.

[00331] Other examples of useful adjuvants include, but are not limited to, chemically modified CpGs (e.g. CpR, Idera), Poly(I:C)(e.g. polyi:CI2U), non-CpG bacterial DNA or RNA as well as immunoactive small molecules and antibodies such as cyclophosphamide, sunitinib, bevacizumab, celebrex, NCX-4016, sildenafil, tadalafil, vardenafil, sorafinib, XL-999, CP-547632, pazopanib, ZD2171, AZD2171, ipilimumab, tremelimumab, and SC58175, which may act therapeutically and/or as an adjuvant. The amounts and concentrations of adjuvants and additives useful in the context of the present invention can readily be determined by the skilled artisan without undue experimentation. Additional adjuvants include colony- stimulating factors, such as Granulocyte Macrophage Colony Stimulating Factor (GM-CSF, sargramostim).

[00332] Poly-ICLC is a synthetically prepared double-stranded RNA consisting of polyI and polyC strands of average length of about 5000 nucleotides, which has been stabilized to thermal denaturation and hydrolysis by serum nucleases by the addition of polylysine and

carboxymethylcellulose. The compound activates TLR3 and the RNA helicase-domain of MDA5, both members of the PAMP family, leading to DC and natural killer (NK) cell activation and production of a "natural mix" of type I interferons, cytokines, and chemokines. Furthermore, poly-ICLC exerts a more direct, broad host-targeted anti-infectious and possibly antitumor effect mediated by the two IFN-inducible nuclear enzyme systems, the 2'5'-OAS and the P1/eIF2a kinase, also known as the PKR (4-6), as well as RIG-I helicase and MDA5.

[00333] In rodents and non-human primates, poly-ICLC was shown to enhance T cell responses to viral antigens, cross-priming, and the induction of tumor-, virus-, and autoantigen-specific CD8+ T-cells. In a recent study in non-human primates, poly-ICLC was found to be essential for the generation of antibody responses and T-cell immunity to DC targeted or non-targeted HIV Gag p24 protein, emphasizing its effectiveness as a vaccine adjuvant.

[00334] In human subjects, transcriptional analysis of serial whole blood samples revealed similar gene expression profiles among the 8 healthy human volunteers receiving one single s.c. administration of poly-ICLC and differential expression of up to 212 genes between these 8 subjects versus 4 subjects receiving placebo. Remarkably, comparison of the poly-ICLC gene expression data to previous data from volunteers immunized with the highly effective yellow fever vaccine YF17D showed that a large number of transcriptional and signal transduction canonical pathways, including those of the innate immune system, were similarly upregulated at peak time points.

[00335] More recently, an immunologic analysis was reported on patients with ovarian, fallopian tube, and primary peritoneal cancer in second or third complete clinical remission who were treated on a phase 1 study of subcutaneous vaccination with synthetic overlapping long peptides (OLP) from the cancer testis antigen NY-ESO-1 alone or with Montanide-ISA-51, or with 1.4 mg poly-ICLC and Montanide. The generation of NY-ESO-1-specific CD4+ and CD8+ T-cell and antibody responses were markedly enhanced with the addition of poly-ICLC and Montanide compared to OLP alone or OLP and Montanide.

[00336] A vaccine or immunogenic composition according to the present invention may comprise more than one different adjuvant. Furthermore, the invention encompasses a therapeutic composition comprising any adjuvant substance including any of those herein discussed. It is also contemplated that the peptide or polypeptide, and the adjuvant can be administered separately in any appropriate sequence.

[00337] A carrier may be present independently of an adjuvant. The carrier may be covalently linked to the antigen. A carrier can also be added to the antigen by inserting DNA encoding the carrier in frame with DNA encoding the antigen. The function of a carrier can for example be to confer stability, to increase the biological activity, or to increase serum half-life. Extension of the half-life can help to reduce the number of applications and to lower doses, thus are beneficial for therapeutic but also economic reasons. Furthermore, a carrier may aid presenting peptides to T-cells. The carrier may be any suitable carrier known to the person skilled in the art, for example a protein or an antigen presenting cell. A carrier protein could be but is not limited to keyhole limpet hemocyanin, serum proteins such as transferrin, bovine serum albumin, human serum albumin, thyroglobulin or ovalbumin, immunoglobulins, or hormones, such as insulin or palmitic acid. For immunization of humans, the carrier may be a physiologically acceptable carrier acceptable to humans and safe. However, tetanus toxoid and/or diptheria toxoid are suitable carriers in one embodiment of the invention. Alternatively, the carrier may be dextrans for example sepharose.

[00338] Cytotoxic T-cells (CTLs) recognize an antigen in the form of a peptide bound to an MHC molecule rather than the intact foreign antigen itself. The MHC molecule itself is located at the cell surface of an antigen presenting cell. Thus, an activation of CTLs is only possible if a trimeric complex of peptide antigen, MHC molecule, and APC is present. Correspondingly, it may enhance the immune response if not only the peptide is used for activation of CTLs, but if additionally APCs with the respective MHC molecule are added. Therefore, in some embodiments the vaccine or immunogenic composition according to the present invention additionally contains at least one antigen presenting cell.

[00339] The antigen-presenting cell (or stimulator cell) typically has an MHC class I or II molecule on its surface, and in one embodiment is substantially incapable of itself loading the MHC class I or II molecule with the selected antigen. As is described in more detail herein, the MHC class I or II molecule may readily be loaded with the selected antigen in vitro.

[00340] CD8+ cell activity may be augmented through the use of CD4+ cells. The identification of CD4 T+ cell epitopes for tumor antigens has attracted interest because many immune based therapies against cancer may be more effective if both CD8+ and CD4+ T lymphocytes are used to target a patient's tumor. CD4+ cells are capable of enhancing CD8 T cell responses. Many studies in animal models have clearly demonstrated better results when

both CD4+ and CD8+ T cells participate in anti-tumor responses (see e.g., Nishimura et al. (1999) Distinct role of antigen-specific T helper type 1 (TH1) and Th2 cells in tumor eradication in vivo. J Ex Med 190:617-27). Universal CD4+ T cell epitopes have been identified that are applicable to developing therapies against different types of cancer (see e.g., Kobayashi et al. (2008) Current Opinion in Immunology 20:221-27). For example, an HLA-DR restricted helper peptide from tetanus toxoid was used in melanoma vaccines to activate CD4+ T cells non-specifically (see e.g., Slingluff et al. (2007) Immunologic and Clinical Outcomes of a Randomized Phase II Trial of Two Multipeptide Vaccines for Melanoma in the Adjuvant Setting, Clinical Cancer Research 13(21):6386-95). It is contemplated within the scope of the invention that such CD4+ cells may be applicable at three levels that vary in their tumor specificity: 1) a broad level in which universal CD4+ epitopes (e.g., tetanus toxoid) may be used to augment CD8+ cells; 2) an intermediate level in which native, tumor-associated CD4+ epitopes may be used to augment CD8+ cells; and 3) a patient specific level in which neoantigen CD4+ epitopes may be used to augment CD8+ cells in a patient specific manner. Although current algorithms for predicting CD4 epitopes are limited in accuracy, it is a reasonable expectation that many long peptides containing predicted CD8 neoepitopes will also include CD4 epitopes. CD4 epitopes are longer than CD8 epitopes and typically are 10 -12 amino acids in length although some can be longer (Kreiter et al, Mutant MHC Class II epitopes drive therapeutic immune responses to cancer, Nature (2015). Thus the neoantigenic epitopes described herein, either in the form of long peptides (>25 amino acids) or nucleic acids encoding such long peptides, may also boost CD4 responses in a tumor and patient-specific manner (level (3) above).

[00341] CD8+ cell immunity may also be generated with neoantigen loaded dendritic cell (DC) vaccine. DCs are potent antigen-presenting cells that initiate T cell immunity and can be used as cancer vaccines when loaded with one or more peptides of interest, for example, by direct peptide injection. For example, patients that were newly diagnosed with metastatic melanoma were shown to be immunized against 3 HLA-A*0201-restricted gp100 melanoma antigen-derived peptides with autologous peptide pulsed CD40L/IFN-g-activated mature DCs via an IL-12p70-producing patient DC vaccine (see e.g., Carreno et al (2013) L-12p70-producing patient DC vaccine elicits Tc1-polarized immunity, Journal of Clinical Investigation, 123(8):3383-94 and Ali et al. (2009) In situ regulation of DC subsets and T cells mediates tumor regression in mice, Cancer Immunotherapy, 1(8):1-10). It is contemplated within the scope of

the invention that neoantigen loaded DCs may be prepared using the synthetic TLR 3 agonist Polyinosinic-Polycytidylic Acid-poly-L-lysine Carboxymethylcellulose (Poly-ICLC) to stimulate the DCs. Poly-ICLC is a potent individual maturation stimulus for human DCs as assessed by an upregulation of CD83 and CD86, induction of interleukin-12 (IL-12), tumor necrosis factor (TNF), interferon gamma-induced protein 10 (IP-10), interleukin 1 (IL-1), and type I interferons (IFN), and minimal interleukin 10 (IL-10) production. DCs may be differentiated from frozen peripheral blood mononuclear cells (PBMCs) obtained by leukapheresis, while PBMCs may be isolated by Ficoll gradient centrifugation and frozen in aliquots.

[00342] Illustratively, the following 7 day activation protocol may be used. Day 1—PBMCs are thawed and plated onto tissue culture flasks to select for monocytes which adhere to the plastic surface after 1-2 hr incubation at 37°C in the tissue culture incubator. After incubation, the lymphocytes are washed off and the adherent monocytes are cultured for 5 days in the presence of interleukin-4 (IL-4) and granulocyte macrophage-colony stimulating factor (GM-CSF) to differentiate to immature DCs. On Day 6, immature DCs are pulsed with the keyhole limpet hemocyanin (KLH) protein which serves as a control for the quality of the vaccine and may boost the immunogenicity of the vaccine. The DCs are stimulated to mature, loaded with peptide antigens, and incubated overnight. On Day 7, the cells are washed, and frozen in 1 ml aliquots containing 4-20 x 10(6) cells using a controlled-rate freezer. Lot release testing for the batches of DCs may be performed to meet minimum specifications before the DCs are injected into patients (see e.g., Sabado et al. (2013) Preparation of tumor antigen-loaded mature dendritic cells for immunotherapy, J. Vis Exp. Aug 1;(78). doi: 10.3791/50085).

[00343] A DC vaccine may be incorporated into a scaffold system to facilitate delivery to a patient. Therapeutic treatment of a patients neoplasia with a DC vaccine may utilize a biomaterial system that releases factors that recruit host dendritic cells into the device, differentiates the resident, immature DCs by locally presenting adjuvants (e.g., danger signals) while releasing antigen, and promotes the release of activated, antigen loaded DCs to the lymph nodes (or desired site of action) where the DCs may interact with T cells to generate a potent cytotoxic T lymphocyte response to the cancer neoantigens. Implantable biomaterials may be used to generate a potent cytotoxic T lymphocyte response against a neoplasia in a patient specific manner. The biomaterial-resident dendritic cells may then be activated by exposing them to danger signals mimicking infection, in concert with release of antigen from the

biomaterial. The activated dendritic cells then migrate from the biomaterials to lymph nodes to induce a cytotoxic T effector response. This approach has previously been demonstrated to lead to regression of established melanoma in preclinical studies using a lysate prepared from tumor biopsies (see e.g., Ali et al. (2209) In situ regulation of DC subsets and T cells mediates tumor regression in mice, Cancer Immunotherapy 1(8):1-10; Ali et al. (2009) Infection-mimicking materials to program dendritic cells in situ. Nat Mater 8:151-8), and such a vaccine is currently being tested in a Phase I clinical trial recently initiated at the Dana-Farber Cancer Institute. This approach has also been shown to lead to regression of glioblastoma, as well as the induction of a potent memory response to prevent relapse, using the C6 rat glioma model.24 in the current proposal. The ability of such an implantable, biomatrix vaccine delivery scaffold to amplify and sustain tumor specific dendritic cell activation may lead to more robust anti-tumor immunosensitization than can be achieved by traditional subcutaneous or intra-nodal vaccine administrations.

[00344] The present invention may include any method for loading a neoantigenic peptide onto a dendritic cell. One such method applicable to the present invention is a microfluidic intracellular delivery system. Such systems cause temporary membrane disruption by rapid mechanical deformation of human and mouse immune cells, thus allowing the intracellular delivery of biomolecules (Sharei et al., 2015, PLOS ONE).

[00345] Preferably, the antigen presenting cells are dendritic cells. Suitably, the dendritic cells are autologous dendritic cells that are pulsed with the neoantigenic peptide. The peptide may be any suitable peptide that gives rise to an appropriate T-cell response. T-cell therapy using autologous dendritic cells pulsed with peptides from a tumor associated antigen is disclosed in Murphy et al. (1996) The Prostate 29, 371-380 and Tjua et al. (1997) The Prostate 32, 272-278. In certain embodiments the dendritic cells are targeted using CD141, DEC205, or XCR1 markers. CD141+XCR1+ DC's were identified as a subset that may be better suited to the induction of anti-tumor responses (Bachem et al., J. Exp. Med. 207, 1273-1281 (2010); Crozat et al., J. Exp. Med. 207, 1283-1292 (2010); and Gallois & Bhardwaj, Nature Med. 16, 854-856 (2010)).

[00346] Thus, in one embodiment of the present invention the vaccine or immunogenic composition containing at least one antigen presenting cell is pulsed or loaded with one or more peptides of the present invention. Alternatively, peripheral blood mononuclear cells (PBMCs)

isolated from a patient may be loaded with peptides ex vivo and injected back into the patient. As an alternative the antigen presenting cell comprises an expression construct encoding a peptide of the present invention. The polynucleotide may be any suitable polynucleotide and it is preferred that it is capable of transducing the dendritic cell, thus resulting in the presentation of a peptide and induction of immunity.

[00347] The inventive pharmaceutical composition may be compiled so that the selection, number and/or amount of peptides present in the composition covers a high proportion of subjects in the population. The selection may be dependent on the specific type of cancer, the status of the disease, earlier treatment regimens, and, of course, the HLA-haplotypes present in the patient population.

[00348] Pharmaceutical compositions comprising the peptide of the invention may be administered to an individual already suffering from cancer. In therapeutic applications, compositions are administered to a patient in an amount sufficient to elicit an effective CTL response to the tumor antigen and to cure or at least partially arrest symptoms and/or complications. An amount adequate to accomplish this is defined as "therapeutically effective dose." Amounts effective for this use can depend on, e.g., the peptide composition, the manner of administration, the stage and severity of the disease being treated, the weight and general state of health of the patient, and the judgment of the prescribing physician, but generally range for the initial immunization (that is for therapeutic or prophylactic administration) from about 1.0 μg to about 50,000 μg of peptide for a 70 kg patient, followed by boosting dosages or from about 1.0 μg to about 10,000 μg of peptide pursuant to a boosting regimen over weeks to months depending upon the patient's response and condition and possibly by measuring specific CTL activity in the patient's blood. It should be kept in mind that the peptide and compositions of the present invention may generally be employed in serious disease states, that is, life-threatening or potentially life threatening situations, especially when the cancer has metastasized. For therapeutic use, administration should begin as soon as possible after the detection or surgical removal of tumors. This is followed by boosting doses until at least symptoms are substantially abated and for a period thereafter.

[00349] The pharmaceutical compositions (e.g., vaccine compositions) for therapeutic treatment are intended for parenteral, topical, nasal, oral or local administration. Preferably, the pharmaceutical compositions are administered parenterally, e.g., intravenously, subcutaneously,

intradermally, or intramuscularly. The compositions may be administered at the site of surgical excision to induce a local immune response to the tumor. The invention provides compositions for parenteral administration which comprise a solution of the peptides and vaccine or immunogenic compositions are dissolved or suspended in an acceptable carrier, preferably an aqueous carrier. A variety of aqueous carriers may be used, e.g., water, buffered water, 0.9% saline, 0.3% glycine, hyaluronic acid and the like. These compositions may be sterilized by conventional, well known sterilization techniques, or may be sterile filtered. The resulting aqueous solutions may be packaged for use as is, or lyophilized, the lyophilized preparation being combined with a sterile solution prior to administration. The compositions may contain pharmaceutically acceptable auxiliary substances as required to approximate physiological conditions, such as pH adjusting and buffering agents, tonicity adjusting agents, wetting agents and the like, for example, sodium acetate, sodium lactate, sodium chloride, potassium chloride, calcium chloride, sorbitan monolaurate, triethanolamine oleate, etc.

[00350] A liposome suspension containing a peptide may be administered intravenously, locally, topically, etc. in a dose which varies according to, inter alia, the manner of administration, the peptide being delivered, and the stage of the disease being treated. For targeting to the immune cells, a ligand, such as, e.g., antibodies or fragments thereof specific for cell surface determinants of the desired immune system cells, can be incorporated into the liposome.

[00351] For solid compositions, conventional or nanoparticle nontoxic solid carriers may be used which include, for example, pharmaceutical grades of mannitol, lactose, starch, magnesium stearate, sodium saccharin, talcum, cellulose, glucose, sucrose, magnesium carbonate, and the like. For oral administration, a pharmaceutically acceptable nontoxic composition is formed by incorporating any of the normally employed excipients, such as those carriers previously listed, and generally 10-95% of active ingredient, that is, one or more peptides of the invention, and more preferably at a concentration of 25%-75%.

[00352] For aerosol administration, the immunogenic peptides are preferably supplied in finely divided form along with a surfactant and propellant. Typical percentages of peptides are 0.01 %-20% by weight, preferably 1%-10%. The surfactant can, of course, be nontoxic, and preferably soluble in the propellant. Representative of such agents are the esters or partial esters of fatty acids containing from 6 to 22 carbon atoms, such as caproic, octanoic, lauric, palmitic,

stearic, linoleic, linolenic, olesteric and oleic acids with an aliphatic polyhydric alcohol or its cyclic anhydride. Mixed esters, such as mixed or natural glycerides may be employed. The surfactant may constitute 0.1%-20% by weight of the composition, preferably 0.25-5%. The balance of the composition is ordinarily propellant. A carrier can also be included as desired, as with, e.g., lecithin for intranasal delivery.

[00353] The peptides and polypeptides of the invention can be readily synthesized chemically utilizing reagents that are free of contaminating bacterial or animal substances (Merrifield RB: Solid phase peptide synthesis. I. The synthesis of a tetrapeptide. J. Am. Chem. Soc. 85:2149-54, 1963).

[00354] The peptides and polypeptides of the invention can also be expressed by a vector, e.g., a nucleic acid molecule as herein-discussed, e.g., RNA or a DNA plasmid, a viral vector such as a poxvirus, e.g., orthopox virus, avipox virus, or adenovirus, AAV or lentivirus. This approach involves the use of a vector to express nucleotide sequences that encode the peptide of the invention. Upon introduction into an acutely or chronically infected host or into a noninfected host, the vector expresses the immunogenic peptide, and thereby elicits a host CTL response.

[00355] For therapeutic or immunization purposes, nucleic acids encoding the peptide of the invention and optionally one or more of the peptides described herein can also be administered to the patient. A number of methods are conveniently used to deliver the nucleic acids to the patient. For instance, the nucleic acid can be delivered directly, as "naked DNA". This approach is described, for instance, in Wolff et al., Science 247: 1465-1468 (1990) as well as U.S. Patent Nos. 5,580,859 and 5,589,466. The nucleic acids can also be administered using ballistic delivery as described, for instance, in U.S. Patent No. 5,204,253. Particles comprised solely of DNA can be administered. Alternatively, DNA can be adhered to particles, such as gold particles. Generally, a plasmid for a vaccine or immunological composition can comprise DNA encoding an antigen (e.g., one or more neoantigens) operatively linked to regulatory sequences which control expression or expression and secretion of the antigen from a host cell, e.g., a mammalian cell; for instance, from upstream to downstream, DNA for a promoter, such as a mammalian virus promoter (e.g., a CMV promoter such as an hCMV or mCMV promoter, e.g., an early-intermediate promoter, or an SV40 promoter--see documents cited or incorporated herein for useful promoters), DNA for a eukaryotic leader peptide for secretion (e.g., tissue

plasminogen activator), DNA for the neoantigen(s), and DNA encoding a terminator (e.g., the 3' UTR transcriptional terminator from the gene encoding Bovine Growth Hormone or bGH polyA). A composition can contain more than one plasmid or vector, whereby each vector contains and expresses a different neoantigen. Mention is also made of Wasmoen U.S. Pat. No. 5,849,303, and Dale U.S. Pat. No. 5,811,104, whose text may be useful. DNA or DNA plasmid formulations can be formulated with or inside cationic lipids; and, as to cationic lipids, as well as adjuvants, mention is also made of Loosmore U.S. Patent Application 2003/0104008. Also, teachings in Audonnet U.S. Pat. Nos. 6,228,846 and 6,159,477 may be relied upon for DNA plasmid teachings that can be employed in constructing and using DNA plasmids that contain and express in vivo.

[00356] The nucleic acids can also be delivered complexed to cationic compounds, such as cationic lipids. Lipid-mediated gene delivery methods are described, for instance, in WO1996/18372; WO 1993/24640; Mannino & Gould-Fogerite , BioTechniques 6(7): 682-691 (1988); U.S. Patent No. 5,279,833; WO 1991/06309; and Feigner et al., Proc. Natl. Acad. Sci. USA 84: 7413-7414 (1987).

[00357] RNA encoding the peptide of interest (e.g., mRNA) can also be used for delivery (see, e.g., Kiken et al, 2011; Su et al , 2011; see also US 8278036; Halabi et al. J Clin Oncol (2003) 21:1232-1237; Petsch et al, Nature Biotechnology 2012 Dec 7;30(12):1210-6).

[00358] Viral vectors as described herein can also be used to deliver the neoantigenic peptides of the invention. Vectors can be administered so as to have in vivo expression and response akin to doses and/or responses elicited by antigen administration.

[00359] A preferred means of administering nucleic acids encoding the peptide of the invention uses minigene constructs encoding multiple epitopes. To create a DNA sequence encoding the selected CTL epitopes (minigene) for expression in human cells, the amino acid sequences of the epitopes are reverse translated. A human codon usage table is used to guide the codon choice for each amino acid. These epitope-encoding DNA sequences are directly adjoined, creating a continuous polypeptide sequence. To optimize expression and/or immunogenicity, additional elements can be incorporated into the minigene design. Examples of amino acid sequence that could be reverse translated and included in the minigene sequence include: helper T lymphocyte, epitopes, a leader (signal) sequence, and an endoplasmic reticulum retention signal. In addition, MHC presentation of CTL epitopes may be improved by

including synthetic (e.g. poly-alanine) or naturally- occurring flanking sequences adjacent to the CTL epitopes.

[00360] The minigene sequence is converted to DNA by assembling oligonucleotides that encode the plus and minus strands of the minigene. Overlapping oligonucleotides (30-100 bases long) are synthesized, phosphorylated, purified and annealed under appropriate conditions using well known techniques. The ends of the oligonucleotides are joined using T4 DNA ligase. This synthetic minigene, encoding the CTL epitope polypeptide, can then cloned into a desired expression vector.

[00361] Standard regulatory sequences well known to those of skill in the art are included in the vector to ensure expression in the target cells. Several vector elements are required: a promoter with a down-stream cloning site for minigene insertion; a polyadenylation signal for efficient transcription termination; an E. coli origin of replication; and an E. coli selectable marker (e.g. ampicillin or kanamycin resistance). Numerous promoters can be used for this purpose, e.g., the human cytomegalovirus (hCMV) promoter. See, U.S. Patent Nos. 5,580,859 and 5,589,466 for other suitable promoter sequences.

[00362] Additional vector modifications may be desired to optimize minigene expression and immunogenicity. In some cases, introns are required for efficient gene expression, and one or more synthetic or naturally-occurring introns could be incorporated into the transcribed region of the minigene. The inclusion of mRNA stabilization sequences can also be considered for increasing minigene expression. It has recently been proposed that immuno stimulatory sequences (ISSs or CpGs) play a role in the immunogenicity of DNA' vaccines. These sequences could be included in the vector, outside the minigene coding sequence, if found to enhance immunogenicity.

[00363] In some embodiments, a bicistronic expression vector, to allow production of the minigene-encoded epitopes and a second protein included to enhance or decrease immunogenicity can be used. Examples of proteins or polypeptides that could beneficially enhance the immune response if co-expressed include cytokines (e.g., IL2, IL12, GM-CSF), cytokine-inducing molecules (e.g. LeIF) or costimulatory molecules. Helper (HTL) epitopes could be joined to intracellular targeting signals and expressed separately from the CTL epitopes. This would allow direction of the HTL epitopes to a cell compartment different than the CTL epitopes. If required, this could facilitate more efficient entry of HTL epitopes into the MHC

class II pathway, thereby improving CTL induction. In contrast to CTL induction, specifically decreasing the immune response by co-expression of immunosuppressive molecules (e.g. TGF-β) may be beneficial in certain diseases.

[00364] Once an expression vector is selected, the minigene is cloned into the polylinker region downstream of the promoter. This plasmid is transformed into an appropriate E. coli strain, and DNA is prepared using standard techniques. The orientation and DNA sequence of the minigene, as well as all other elements included in the vector, are confirmed using restriction mapping and DNA sequence analysis. Bacterial cells harboring the correct plasmid can be stored as a master cell bank and a working cell bank.

[00365] Purified plasmid DNA can be prepared for injection using a variety of formulations. The simplest of these is reconstitution of lyophilized DNA in sterile phosphate-buffer saline (PBS). A variety of methods have been described, and new techniques may become available. As noted herein, nucleic acids are conveniently formulated with cationic lipids. In addition, glycolipids, fusogenic liposomes, peptides and compounds referred to collectively as protective, interactive, non-condensing (PINC) could also be complexed to purified plasmid DNA to influence variables such as stability, intramuscular dispersion, or trafficking to specific organs or cell types.

[00366] Target cell sensitization can be used as a functional assay for expression and MHC class I presentation of minigene-encoded CTL epitopes. The plasmid DNA is introduced into a mammalian cell line that is suitable as a target for standard CTL chromium release assays. The transfection method used is dependent on the final formulation. Electroporation can be used for "naked" DNA, whereas cationic lipids allow direct in vitro transfection. A plasmid expressing green fluorescent protein (GFP) can be co-transfected to allow enrichment of transfected cells using fluorescence activated cell sorting (FACS). These cells are then chromium-51 labeled and used as target cells for epitope- specific CTL lines. Cytolysis, detected by 51 Cr release, indicates production of MHC presentation of mini gene-encoded CTL epitopes.

[00367] In vivo immunogenicity is a second approach for functional testing of minigene DNA formulations. Transgenic mice expressing appropriate human MHC molecules are immunized with the DNA product. The dose and route of administration are formulation dependent (e.g. IM for DNA in PBS, IP for lipid-complexed DNA). Twenty-one days after immunization, splenocytes are harvested and restimulated for 1 week in the presence of peptides encoding each

epitope being tested. These effector cells (CTLs) are assayed for cytolysis of peptide-loaded, chromium-51 labeled target cells using standard techniques. Lysis of target cells sensitized by MHC loading of peptides corresponding to minigene-encoded epitopes demonstrates DNA vaccine function for in vivo induction of CTLs.

[00368] Peptides may be used to elicit CTL ex vivo, as well. The resulting CTL, can be used to treat chronic tumors in patients in need thereof that do not respond to other conventional forms of therapy, or does not respond to a peptide vaccine approach of therapy. Ex vivo CTL responses to a particular tumor antigen are induced by incubating in tissue culture the patient's CTL precursor cells (CTLp) together with a source of antigen-presenting cells (APC) and the appropriate peptide. After an appropriate incubation time (typically 1-4 weeks), in which the CTLp are activated and mature and expand into effector CTL, the cells are infused back into the patient, where they destroy their specific target cell (i.e., a tumor cell). In order to optimize the in vitro conditions for the generation of specific cytotoxic T cells, the culture of stimulator cells are maintained in an appropriate serum-free medium.

[00369] Prior to incubation of the stimulator cells with the cells to be activated, e.g., precursor CD8+ cells, an amount of antigenic peptide is added to the stimulator cell culture, of sufficient quantity to become loaded onto the human Class I molecules to be expressed on the surface of the stimulator cells. In the present invention, a sufficient amount of peptide is an amount that allows about 200, and preferably 200 or more, human Class I MHC molecules loaded with peptide to be expressed on the surface of each stimulator cell. Preferably, the stimulator cells are incubated with >2μg/ml peptide. For example, the stimulator cells are incubates with > 3, 4, 5, 10, 15, or more μg/ml peptide.

[00370] Resting or precursor CD8+ cells are then incubated in culture with the appropriate stimulator cells for a time period sufficient to activate the CD8+ cells. Preferably, the CD8+ cells are activated in an antigen- specific manner. The ratio of resting or precursor CD8+ (effector) cells to stimulator cells may vary from individual to individual and may further depend upon variables such as the amenability of an individual's lymphocytes to culturing conditions and the nature and severity of the disease condition or other condition for which the within-described treatment modality is used. Preferably, however, the lymphocyte: stimulator cell ratio is in the range of about 30: 1 to 300: 1. The effector/stimulator culture may be maintained for as

long a time as is necessary to stimulate a therapeutically useable or effective number of CD8+ cells.

[00371] The induction of CTL in vitro requires the specific recognition of peptides that are bound to allele specific MHC class I molecules on APC. The number of specific MHC/peptide complexes per APC is crucial for the stimulation of CTL, particularly in primary immune responses. While small amounts of peptide/MHC complexes per cell are sufficient to render a cell susceptible to lysis by CTL, or to stimulate a secondary CTL response, the successful activation of a CTL precursor (pCTL) during primary response requires a significantly higher number of MHC/peptide complexes. Peptide loading of empty major histocompatability complex molecules on cells allows the induction of primary cytotoxic T lymphocyte responses.

[00372] Since mutant cell lines do not exist for every human MHC allele, it is advantageous to use a technique to remove endogenous MHC- associated peptides from the surface of APC, followed by loading the resulting empty MHC molecules with the immunogenic peptides of interest. The use of non-transformed (non-tumorigenic), noninfected cells, and preferably, autologous cells of patients as APC is desirable for the design of CTL induction protocols directed towards development of ex vivo CTL therapies. This application discloses methods for stripping the endogenous MHC-associated peptides from the surface of APC followed by the loading of desired peptides.

[00373] A stable MHC class I molecule is a trimeric complex formed of the following elements: 1) a peptide usually of 8 - 10 residues, 2) a transmembrane heavy polymorphic protein chain which bears the peptide-binding site in its al and a2 domains, and 3) a non-covalently associated non-polymorphic light chain, p2microglobuiin. Removing the bound peptides and/or dissociating the p2microglobulin from the complex renders the MHC class I molecules nonfunctional and unstable, resulting in rapid degradation. All MHC class I molecules isolated from PBMCs have endogenous peptides bound to them. Therefore, the first step is to remove all endogenous peptides bound to MHC class I molecules on the APC without causing their degradation before exogenous peptides can be added to them.

[00374] Two possible ways to free up MHC class I molecules of bound peptides include lowering the culture temperature from 37°C to 26°C overnight to destablize p2microglobulin and stripping the endogenous peptides from the cell using a mild acid treatment. The methods release previously bound peptides into the extracellular environment allowing new exogenous

peptides to bind to the empty class I molecules. The cold-temperature incubation method enables exogenous peptides to bind efficiently to the MHC complex, but requires an overnight incubation at 26°C which may slow the cell's metabolic rate. It is also likely that cells not actively synthesizing MHC molecules (e.g., resting PBMC) would not produce high amounts of empty surface MHC molecules by the cold temperature procedure.

[00375] Harsh acid stripping involves extraction of the peptides with trifluoroacetic acid, pH 2, or acid denaturation of the immunoaffinity purified class I-peptide complexes. These methods are not feasible for CTL induction, since it is important to remove the endogenous peptides while preserving APC viability and an optimal metabolic state which is critical for antigen presentation. Mild acid solutions of pH 3 such as glycine or citrate -phosphate buffers have been used to identify endogenous peptides and to identify tumor associated T cell epitopes. The treatment is especially effective, in that only the MHC class I molecules are destabilized (and associated peptides released), while other surface antigens remain intact, including MHC class II molecules. Most importantly, treatment of cells with the mild acid solutions do not affect the cell's viability or metabolic state. The mild acid treatment is rapid since the stripping of the endogenous peptides occurs in two minutes at 4°C and the APC is ready to perform its function after the appropriate peptides are loaded. The technique is utilized herein to make peptide-specific APCs for the generation of primary antigen- specific CTL. The resulting APC are efficient in inducing peptide- specific CD8+ CTL.

[00376] Activated CD8+ cells may be effectively separated from the stimulator cells using one of a variety of known methods. For example, monoclonal antibodies specific for the stimulator cells, for the peptides loaded onto the stimulator cells, or for the CD8+ cells (or a segment thereof) may be utilized to bind their appropriate complementary ligand. Antibody-tagged molecules may then be extracted from the stimulator-effector cell admixture via appropriate means, e.g., via well-known immunoprecipitation or immunoassay methods.

[00377] Effective, cytotoxic amounts of the activated CD8+ cells can vary between in vitro and in vivo uses, as well as with the amount and type of cells that are the ultimate target of these killer cells. The amount can also vary depending on the condition of the patient and should be determined via consideration of all appropriate factors by the practitioner. Preferably, however, about 1 X 10^6 to about 1 X 10^{12}, more preferably about 1 X 10^8 to about 1 X 10^{11}, and even more

preferably, about 1 X 10^9 to about 1 X 10^{10} activated CD8+ cells are utilized for adult humans, compared to about 5 X 10^6 - 5 X 10^7 cells used in mice.

[00378] Preferably, as discussed herein, the activated CD8+ cells are harvested from the cell culture prior to administration of the CD8+ cells to the individual being treated. It is important to note, however, that unlike other present and proposed treatment modalities, the present method uses a cell culture system that is not tumorigenic. Therefore, if complete separation of stimulator cells and activated CD8+ cells are not achieved, there is no inherent danger known to be associated with the administration of a small number of stimulator cells, whereas administration of mammalian tumor-promoting cells may be extremely hazardous.

[00379] Methods of re-introducing cellular components are known in the art and include procedures such as those exemplified in U.S. Patent No. 4,844,893 to Honsik, et al. and U.S. Patent No. 4,690,915 to Rosenberg. For example, administration of activated CD8+ cells via intravenous infusion is appropriate.

[00380] The practice of the present invention employs, unless otherwise indicated, conventional techniques of molecular biology (including recombinant techniques), microbiology, cell biology, biochemistry and immunology, which are well within the purview of the skilled artisan. Such techniques are explained fully in the literature, such as, "Molecular Cloning: A Laboratory Manual", second edition (Sambrook, 1989); "Oligonucleotide Synthesis" (Gait, 1984); "Animal Cell Culture" (Freshney, 1987); "Methods in Enzymology" "Handbook of Experimental Immunology" (Wei, 1996); "Gene Transfer Vectors for Mammalian Cells" (Miller and Calos, 1987); "Current Protocols in Molecular Biology" (Ausubel, 1987); "PCR: The Polymerase Chain Reaction", (Mullis, 1994); "Current Protocols in Immunology" (Coligan, 1991). These techniques are applicable to the production of the polynucleotides and polypeptides of the invention, and, as such, may be considered in making and practicing the invention. Particularly useful techniques for particular embodiments are discussed in the sections that follow.

[00381] Therapeutic Methods

[00382] The present invention provides methods of inducing a neoplasia/tumor specific immune response in a subject, vaccinating against a neoplasia/tumor, treating and or alleviating a symptom of cancer in a subject by administering the subject a plurality of neoantigenic peptides or composition of the invention.

[00383] According to the invention, the herein-described neoplasia vaccine or immunogenic composition may be used for a patient that has been diagnosed as having cancer, or at risk of developing cancer.

[00384] The claimed combination of the invention is administered in an amount sufficient to induce a CTL response.

Additional Therapies

[00385] The tumor specific neoantigen peptides and pharmaceutical compositions described herein can also be administered in a combination therapy with another agent, for example a therapeutic agent. In certain embodiments, the additional agents can be, but are not limited to, chemotherapeutic agents, anti-angiogenesis agents and agents that reduce immune-suppression.

[00386] The neoplasia vaccine or immunogenic composition can be administered before, during, or after administration of the additional agent. In embodiments, the neoplasia vaccine or immunogenic composition is administered before the first administration of the additional agent. In other embodiments, the neoplasia vaccine or immunogenic composition is administered after the first administration of the additional therapeutic agent (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 days or more). In embodiments, the neoplasia vaccine or immunogenic composition is administered simultaneously with the first administration of the additional therapeutic agent.

[00387] The therapeutic agent is for example, a chemotherapeutic or biotherapeutic agent, radiation, or immunotherapy. Any suitable therapeutic treatment for a particular cancer may be administered. Examples of chemotherapeutic and biotherapeutic agents include, but are not limited to, an angiogenesis inhibitor, such ashydroxy angiostatin K1-3, DL-α-Difluoromethyl-ornithine, endostatin, fumagillin, genistein, minocycline, staurosporine, and thalidomide; a DNA intercaltor/cross-linker, such as Bleomycin, Carboplatin, Carmustine, Chlorambucil, Cyclophosphamide, cis-Diammineplatinum(II) dichloride (Cisplatin), Melphalan, Mitoxantrone, and Oxaliplatin; a DNA synthesis inhibitor, such as (±)-Amethopterin (Methotrexate), 3-Amino-1,2,4-benzotriazine 1,4-dioxide, Aminopterin, Cytosine β-D-arabinofuranoside, 5-Fluoro-5'-deoxyuridine, 5-Fluorouracil, Ganciclovir, Hydroxyurea, and Mitomycin C; a DNA-RNA transcription regulator, such as Actinomycin D, Daunorubicin, Doxorubicin, Homoharringtonine, and Idarubicin; an enzyme inhibitor, such as S(+)-Camptothecin, Curcumin, (-)-Deguelin, 5,6-Dichlorobenzimidazole 1-β-D-ribofuranoside, Etoposide, Formestane, Fostriecin, Hispidin, 2-

Imino-1-imidazoli-dineacetic acid (Cyclocreatine), Mevinolin, Trichostatin A, Tyrphostin AG 34, and Tyrphostin AG 879; a gene regulator, such as 5-Aza-2'-deoxycytidine, 5-Azacytidine, Cholecalciferol (Vitamin D3), 4-Hydroxytamoxifen, Melatonin, Mifepristone, Raloxifene, all trans-Retinal (Vitamin A aldehyde), Retinoic acid all trans (Vitamin A acid), 9-cis-Retinoic Acid, 13-cis-Retinoic acid, Retinol (Vitamin A), Tamoxifen, and Troglitazone; a microtubule inhibitor, such as Colchicine, docetaxel, Dolastatin 15, Nocodazole, Paclitaxel, Podophyllotoxin, Rhizoxin, Vinblastine, Vincristine, Vindesine, and Vinorelbine (Navelbine); and an unclassified therapeutic agent, such as 17-(Allylamino)-17-demethoxygeldanamycin, 4-Amino-1,8-naphthalimide, Apigenin, Brefeldin A, Cimetidine, Dichloromethylene-diphosphonic acid, Leuprolide (Leuprorelin), Luteinizing Hormone-Releasing Hormone, Pifithrin-α, Rapamycin, Sex hormone-binding globulin, Thapsigargin, and Urinary trypsin inhibitor fragment (Bikunin). The therapeutic agent may be altretamine, amifostine, asparaginase, capecitabine, cladribine, cisapride, cytarabine, dacarbazine (DTIC), dactinomycin, dronabinol, epoetin alpha, filgrastim, fludarabine, gemcitabine, granisetron, ifosfamide, irinotecan, lansoprazole, levamisole, leucovorin, megestrol, mesna, metoclopramide, mitotane, omeprazole, ondansetron, pilocarpine, prochloroperazine, or topotecan hydrochloride. The therapeutic agent may be a monoclonal antibody or small molecule such as rituximab (Rituxan®), alemtuzumab (Campath®), Bevacizumab (Avastin®), Cetuximab (Erbitux®), panitumumab (Vectibix®), and trastuzumab (Herceptin®), Vemurafenib (Zelboraf®) imatinib mesylate (Gleevec®), erlotinib (Tarceva®), gefitinib (Iressa®), Vismodegib (Erivedge™), 90Y-ibritumomab tiuxetan, 131I-tositumomab, ado-trastuzumab emtansine, lapatinib (Tykerb®), pertuzumab (Perjeta™), ado-trastuzumab emtansine (Kadcyla™), regorafenib (Stivarga®), sunitinib (Sutent®), Denosumab (Xgeva®), sorafenib (Nexavar®), pazopanib (Votrient®), axitinib (Inlyta®), dasatinib (Sprycel®), nilotinib (Tasigna®), bosutinib (Bosulif®), ofatumumab (Arzerra®), obinutuzumab (Gazyva™), ibrutinib (Imbruvica™), idelalisib (Zydelig®), crizotinib (Xalkori®), erlotinib (Tarceva®), afatinib dimaleate (Gilotrif®), ceritinib (LDK378/Zykadia), Tositumomab and 131I-tositumomab (Bexxar®), ibritumomab tiuxetan (Zevalin®), brentuximab vedotin (Adcetris®), bortezomib (Velcade®), siltuximab (Sylvant™), trametinib (Mekinist®), dabrafenib (Tafinlar®), pembrolizumab (Keytruda®), carfilzomib (Kyprolis®), Ramucirumab (Cyramza™), Cabozantinib (Cometriq™), vandetanib (Caprelsa®), Optionally, the therapeutic agent is a neoantigen. The therapeutic agent may be a cytokine such as interferons (INFs), interleukins

(ILs), or hematopoietic growth factors. The therapeutic agent may be INF-α, IL-2, Aldesleukin, IL-2, Erythropoietin, Granulocyte-macrophage colony-stimulating factor (GM-CSF) or granulocyte colony-stimulating factor. The therapeutic agent may be a targeted therapy such as toremifene (Fareston®), fulvestrant (Faslodex®), anastrozole (Arimidex®), exemestane (Aromasin®), letrozole (Femara®), ziv-aflibercept (Zaltrap®), Alitretinoin (Panretin®), temsirolimus (Torisel®), Tretinoin (Vesanoid®), denileukin diftitox (Ontak®), vorinostat (Zolinza®), romidepsin (Istodax®), bexarotene (Targretin®), pralatrexate (Folotyn®), lenaliomide (Revlimid®), belinostat (Beleodaq™), lenaliomide (Revlimid®), pomalidomide (Pomalyst®), Cabazitaxel (Jevtana®), enzalutamide (Xtandi®), abiraterone acetate (Zytiga®), radium 223 chloride (Xofigo®), or everolimus (Afinitor®). Aditionally, the therapeutic agent may be an epigenetic targeted drug such as HDAC inhibitors, kinase inhibitors, DNA methyltransferase inhibitors, histone demethylase inhibitors, or histone methylation inhibitors. The epigenetic drugs may be Azacitidine (Vidaza), Decitabine (Dacogen), Vorinostat (Zolinza), Romidepsin (Istodax), or Ruxolitinib (Jakafi). For prostate cancer treatment, a preferred chemotherapeutic agent with which anti- CTLA-4 can be combined is paclitaxel (TAXOL).

[00388] In certain embodiments, the one or more additional agents are one or more anti-glucocorticoid-induced tumor necrosis factor family receptor (GITR) agonistic antibodies. GITR is a costimulatory molecule for T lymphocytes, modulates innate and adaptive immune system and has been found to participate in a variety of immune responses and inflammatory processes. GITR was originally described by Nocentini et al. after being cloned from dexamethasone-treated murine T cell hybridomas (Nocentini et al. Proc Natl Acad Sci USA 94:6216–6221.1997). Unlike CD28 and CTLA-4, GITR has a very low basal expression on naive CD4+ and CD8+ T cells (Ronchetti et al. Eur J Immunol 34:613–622. 2004). The observation that GITR stimulation has immunostimulatory effects in vitro and induced autoimmunity in vivo prompted the investigation of the antitumor potency of triggering this pathway. A review of Modulation Of Ctla 4 And Gitr For Cancer Immunotherapy can be found in Cancer Immunology and Immunotherapy (Avogadri et al. Current Topics in Microbiology and Immunology 344. 2011). Other agents that can contribute to relief of immune suppression include checkpoint inhibitors targeted at another member of the CD28/CTLA4 Ig superfamily such as BTLA, LAG3, ICOS, PDL1 or KIR (Page et a, Annual Review of Medicine 65:27 (2014)). In further additional embodiments, the checkpoint inhibitor is targeted at a member of

the TNFR superfamily such as CD40, OX40, CD137, GITR, CD27 or TIM-3. In some cases targeting a checkpoint inhibitor is accomplished with an inhibitory antibody or similar molecule. In other cases, it is accomplished with an agonist for the target; examples of this class include the stimulatory targets OX40 and GITR.

[00389] In certain embodiments, the one or more additional agents are synergistic in that they increase immunogenicity after treatment. In one embodiment the additional agent allows for lower toxicity and/or lower discomfort due to lower doses of the additional therapeutic agents or any components of the combination therapy described herein. In another embodiment the additional agent results in longer lifespan due to increased effectiveness of the combination therapy described herein. Chemotherapeutic treatments that enhance the immunological response in a patient have been reviewed (Zitvogel et al., Immunological aspects of cancer chemotherapy. Nat Rev Immunol. 2008 Jan;8(1):59-73). Aditionally, chemotherapeutic agents can be administered safely with immunotherapy without inhibiting vaccine specific T-cell responses (Perez et al., A new era in anticancer peptide vaccines. Cancer May 2010). In one embodiment the additional agent is administered to increase the efficacy of the therapy described herein. In one embodiment the additional agent is a chemotherapy treatment. In one embodiment low doses of chemotherapy potentiate delayed-type hypersensitivity (DTH) responses. In one embodiment the chemotheray agent targets regulatory T-cells. In one embodiment cyclophosphamide is the therapeutic agent. In one embodiment cyclophosphamide is administered prior to vaccination. In one embodiment cyclophosphamide is administered as a single dose before vaccination (Walter et al., Multipeptide immune response to cancer vaccine IMA901 after single-dose cyclophosphamide associates with longer patient survival. Nature Medicine; 18:8 2012). In another embodiment, cyclophosphamide is administered according to a metronomic program, where a daily dose is administered for one month (Ghiringhelli et al., Metronomic cyclophosphamide regimen selectively depletes CD4+CD25+ regulatory T cells and restores T and NK effector functions in end stage cancer patients. Cancer Immunol Immunother 2007 56:641–648). In another embodiment taxanes are administered before vaccination to enhance T-cell and NK-cell functions (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). In another embodiment a low dose of a chemotherapeutic agent is administered with the therapy described herein. In one embodiment the chemotherapeutic agent is estramustine. In one embodiment the cancer is hormone resistant prostate cancer. A ≥50% decrease in serum prostate specific antigen

(PSA) was seen in 8.7% of advanced hormone refractory prostate cancer patients by personalized vaccination alone, whereas such a decrease was seen in 54% of patients when the personalized vaccination was combined with a low dose of estramustine (Itoh et al., Personalized peptide vaccines: A new therapeutic modality for cancer. Cancer Sci 2006; 97: 970–976). In another embodiment glucocorticoids are administered with or before the therapy described herein (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). In another embodiment glucocorticoids are administered after the therapy described herein. In another embodiment Gemcitabine is administered before, simultaneously, or after the therapy described herein to enhance the frequency of tumor specific CTL precursors (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). In another embodiment 5-fluorouracil is administered with the therapy described herein as synergistic effects were seen with a peptide based vaccine (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). In another embodiment an inhibitor of Braf, such as Vemurafenib, is used as an additional agent. Braf inhibition has been shown to be associated with an increase in melanoma antigen expression and T-cell infiltrate and a decrease in immunosuppressive cytokines in tumors of treated patients (Frederick et al., BRAF inhibition is associated with enhanced melanoma antigen expression and a more favorable tumor microenvironment in patients with metastatic melanoma. Clin Cancer Res. 2013; 19:1225-1231). In another embodiment an inhibitor of tyrosine kinases is used as an additional agent. In one embodiment the tyrosine kinase inhibitor is used before vaccination with the therapy described herein. In one embodiment the tyrosine kinase inhibitor is used simultaneously with the therapy described herein. In another embodiment the tyrosine kinase inhibitor is used to create a more immune permissive environment. In another embodiment the tyrosine kinase inhibitor is sunitinib or imatinib mesylate. It has previously been shown that favorable outcomes could be achieved with sequential administration of continuous daily dosing of sunitinib and recombinant vaccine (Farsaci et al., Consequence of dose scheduling of sunitinib on host immune response elements and vaccine combination therapy. Int J Cancer; 130: 1948-1959). Sunitinib has also been shown to reverse type-1 immune suppression using a daily dose of 50 mg/day (Finke et al., Sunitinib Reverses Type-1 Immune Suppression and Decreases T-Regulatory Cells in Renal Cell Carcinoma Patients. Clin Cancer Res 2008;14(20)). In another embodiment targeted therapies are administered in combination with the therapy described herein. Doses of targeted therapies has been described previously (Alvarez, Present and future evolution of advanced breast cancer

therapy. Breast Cancer Research 2010, 12(Suppl 2):S1). In another embodiment temozolomide is administered with the therapy described herein. In one embodiment temozolomide is administered at 200 mg/day for 5 days every fourth week of a combination therapy with the therapy described herein. Results of a similar strategy have been shown to have low toxicity (Kyte et al., Telomerase Peptide Vaccination Combined with Temozolomide: A Clinical Trial in Stage IV Melanoma Patients. Clin Cancer Res; 17(13) 2011). In another embodiment the therapy is administered with an additional therapeutic agent that results in lymphopenia. In one embodiment the additional agent is temozolomide. An immune response can still be induced under these conditions (Sampson et al., Greater chemotherapy-induced lymphopenia enhances tumor-specific immune responses that eliminate EGFRvIII-expressing tumor cells in patients with glioblastoma. Neuro-Oncology 13(3):324–333, 2011).

[00390] Patients in need thereof may receive a series of priming vaccinations with a mixture of tumor-specific peptides. Additionally, over a 4 week period the priming may be followed by two boosts during a maintenance phase. All vaccinations are subcutaneously delivered. The vaccine or immunogenic composition is evaluated for safety, tolerability, immune response and clinical effect in patients and for feasibility of producing vaccine or immunogenic composition and successfully initiating vaccination within an appropriate time frame. The first cohort can consist of 5 patients, and after safety is adequately demonstrated, an additional cohort of 10 patients may be enrolled. Peripheral blood is extensively monitored for peptide-specific T-cell responses and patients are followed for up to two years to assess disease recurrence.

Administering a combination therapy consistent with standard of care

[00391] In another aspect, the therapy described herein provides selecting the appropriate point to administer a combination therapy in relation to and within the standard of care for the cancer being treated for a patient in need thereof. The studies described herein show that the combination therapy can be effectively administered even within the standard of care that includes surgery, radiation, or chemotherapy. The standards of care for the most common cancers can be found on the website of National Cancer Institute (www.cancer.gov/cancertopics). The standard of care is the current treatment that is accepted by medical experts as a proper treatment for a certain type of disease and that is widely used by healthcare professionals. Standard or care is also called best practice, standard medical care, and

standard therapy. Standards of Care for cancer generally include surgery, lymph node removal, radiation, chemotherapy, targeted therapies, antibodies targeting the tumor, and immunotherapy. Immunotherapy can include checkpoint blockers (CBP), chimeric antigen receptors (CARs), and adoptive T-cell therapy. The combination therapy described herein can be incorporated within the standard of care. The combination therapy described herein may also be administered where the standard of care has changed due to advances in medicine.

[00392] Incorporation of the combination therapy described herein may depend on a treatment step in the standard of care that can lead to activation of the immune system. Treatment steps that can activate and function synergistically with the combination therapy have been described herein. The therapy can be advantageously administered simultaneously or after a treatment that activates the immune system.

[00393] Incorporation of the combination therapy described herein may depend on a treatment step in the standard of care that causes the immune system to be suppressed. Such treatment steps may include irradiation, high doses of alkylating agents and/or methotrexate, steroids such as glucosteroids, surgery, such as to remove the lymph nodes, imatinib mesylate, high doses of TNF, and taxanes (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). The combination therapy may be administered before such steps or may be administered after.

[00394] In one embodiment the combination therapy may be administered after bone marrow transplants and peripheral blood stem cell transplantation. Bone marrow transplantation and peripheral blood stem cell transplantation are procedures that restore stem cells that were destroyed by high doses of chemotherapy and/or radiation therapy. After being treated with high-dose anticancer drugs and/or radiation, the patient receives harvested stem cells, which travel to the bone marrow and begin to produce new blood cells. A “mini-transplant” uses lower, less toxic doses of chemotherapy and/or radiation to prepare the patient for transplant. A “tandem transplant” involves two sequential courses of high-dose chemotherapy and stem cell transplant. In autologous transplants, patients receive their own stem cells. In syngeneic transplants, patients receive stem cells from their identical twin. In allogeneic transplants, patients receive stem cells from their brother, sister, or parent. A person who is not related to the patient (an unrelated donor) also may be used. In some types of leukemia, the graft-versus-tumor (GVT) effect that occurs after allogeneic BMT and PBSCT is crucial to the effectiveness of the treatment. GVT occurs when white blood cells from the donor (the graft) identify the cancer cells that remain in

the patient's body after the chemotherapy and/or radiation therapy (the tumor) as foreign and attack them. Immunotherapy with the combination therapy described herein can take advantage of this by vaccinating after a transplant. Additionally, the transferred cells may be presented with neoantigens of the combination therapy described herein before transplantation.

[00395] In one embodiment the combination therapy is administered to a patient in need thereof with a cancer that requires surgery. In one embodiment the combination therapy described herein is administered to a patient in need thereof in a cancer where the standard of care is primarily surgery followed by treatment to remove possible micro-metastases, such as breast cancer. Breast cancer is commonly treated by various combinations of surgery, radiation therapy, chemotherapy, and hormone therapy based on the stage and grade of the cancer. Adjuvant therapy for breast cancer is any treatment given after primary therapy to increase the chance of long-term survival. Neoadjuvant therapy is treatment given before primary therapy. Adjuvant therapy for breast cancer is any treatment given after primary therapy to increase the chance of long-term disease-free survival. Primary therapy is the main treatment used to reduce or eliminate the cancer. Primary therapy for breast cancer usually includes surgery, a mastectomy (removal of the breast) or a lumpectomy (surgery to remove the tumor and a small amount of normal tissue around it; a type of breast-conserving surgery). During either type of surgery, one or more nearby lymph nodes are also removed to see if cancer cells have spread to the lymphatic system. When a woman has breast-conserving surgery, primary therapy almost always includes radiation therapy. Even in early-stage breast cancer, cells may break away from the primary tumor and spread to other parts of the body (metastasize). Therefore, doctors give adjuvant therapy to kill any cancer cells that may have spread, even if they cannot be detected by imaging or laboratory tests.

[00396] In one embodiment the combination therapy is administered consistent with the standard of care for Ductal carcinoma *in situ* (DCIS). The standard of care for this breast cancer type is:

1. Breast-conserving surgery and radiation therapy with or without tamoxifen.
2. Total mastectomy with or without tamoxifen.
3. Breast-conserving surgery without radiation therapy.

[00397] The combination therapy may be administered before breast conserving surgery or total mastectomy to shrink the tumor before surgery. In another embodiment the combination therapy can be administered as an adjuvant therapy to remove any remaining cancer cells.

[00398] In another embodiment patients diagnosed with stage I, II, IIIA, and Operable IIIC breast cancer are treated with the combination therapy as described herein. The standard of care for this breast cancer type is:

1. Local-regional treatment:
- Breast-conserving therapy (lumpectomy, breast radiation, and surgical staging of the axilla).
- Modified radical mastectomy (removal of the entire breast with level I–II axillary dissection) with or without breast reconstruction.
- Sentinel node biopsy.
2. Adjuvant radiation therapy postmastectomy in axillary node-positive tumors:
- For one to three nodes: unclear role for regional radiation (infra/supraclavicular nodes, internal mammary nodes, axillary nodes, and chest wall).
- For more than four nodes or extranodal involvement: regional radiation is advised.
3. Adjuvant systemic therapy

[00399] In one embodiment the combination therapy is administered as a neoadjuvant therapy to shrink the tumor. In another embodiment the combination is administered as an adjuvant systemic therapy.

[00400] In another embodiment patients diagnosed with inoperable stage IIIB or IIIC or inflammatory breast cancer are treated with the combination therapy as described herein. The standard of care for this breast cancer type is:

1. Multimodality therapy delivered with curative intent is the standard of care for patients with clinical stage IIIB disease.

2. Initial surgery is generally limited to biopsy to permit the determination of histology, estrogen-receptor (ER) and progesterone-receptor (PR) levels, and human epidermal growth factor receptor 2 (HER2/neu) overexpression. Initial treatment with anthracycline-based chemotherapy and/or taxane-based therapy is standard. For patients who respond to neoadjuvant chemotherapy, local therapy may consist of total mastectomy with axillary lymph node dissection followed by postoperative radiation therapy to the chest wall and regional lymphatics.

Breast-conserving therapy can be considered in patients with a good partial or complete response to neoadjuvant chemotherapy. Subsequent systemic therapy may consist of further chemotherapy. Hormone therapy should be administered to patients whose tumors are ER-positive or unknown. All patients should be considered candidates for clinical trials to evaluate the most appropriate fashion in which to administer the various components of multimodality regimens.

[00401] In one embodiment the combination therapy is administered as part of the various components of multimodality regimens. In another embodiment the combination therapy is administered before, simultaneously with, or after the multimodality regimens. In another embodiment the combination therapy is administered based on synergism between the modalities. In another embodiment the combination therapy is administered after treatment with anthracycline-based chemotherapy and/or taxane-based therapy (Zitvogel et al., 2008, Nat. Rev. Immunol., 8(1):59-73). Treatment after administering the combination therapy may negatively affect dividing effector T-cells. The combination therapy may also be administered after radiation.

[00402] In another embodiment the combination therapy described herein is used in the treatment in a cancer where the standard of care is primarily not surgery and is primarily based on systemic treatments, such as Chronic Lymphocytic Leukemia (CLL).

[00403] In another embodiment patients diagnosed with stage I, II, III, and IV Chronic Lymphocytic Leukemia are treated with the combination therapy as described herein. The standard of care for this cancer type is:

1. Observation in asymptomatic or minimally affected patients
2. Rituximab
3. Ofatumomab
4. Oral alkylating agents with or without corticosteroids
5. Fludarabine, 2-chlorodeoxyadenosine, or pentostatin
6. Bendamustine
7. Lenalidomide
8. Combination chemotherapy.

    combination chemotherapy regimens include the following:

    - Fludarabine plus cyclophosphamide plus rituximab.

- Fludarabine plus rituximab as seen in the CLB-9712 and CLB-9011 trials.
- Fludarabine plus cyclophosphamide versus fludarabine plus cyclophosphamide plus rituximab.
- Pentostatin plus cyclophosphamide plus rituximab as seen in the MAYO-MC0183 trial, for example.
- Ofatumumab plus fludarabine plus cyclophosphamide.
- CVP: cyclophosphamide plus vincristine plus prednisone.
- CHOP: cyclophosphamide plus doxorubicin plus vincristine plus prednisone.
- Fludarabine plus cyclophosphamide versus fludarabine as seen in the E2997 trial [NCT00003764] and the LRF-CLL4 trial, for example.
- Fludarabine plus chlorambucil as seen in the CLB-9011 trial, for example.

9. Involved-field radiation therapy.
10. Alemtuzumab
11. Bone marrow and peripheral stem cell transplantations are under clinical evaluation.
12. Ibrutinib

[00404] In one embodiment the combination therapy is administered before, simultaneously with or after treatment with Rituximab or Ofatumomab. As these are monoclonal antibodies that target B-cells, treatment with the combination therapy may be synergistic. In another embodiment the combination therapy is administered after treatment with oral alkylating agents with or without corticosteroids, and Fludarabine, 2-chlorodeoxyadenosine, or pentostatin, as these treatments may negatively affect the immune system if administered before. In one embodiment bendamustine is administered with the combination therapy in low doses based on the results for prostate cancer described herein. In one embodiment the combination therapy is administered after treatment with bendamustine.

[00405] In another embodiment, therapies targeted to specific recurrent mutations in genes that include extracellular domains are used in the treatment of a patient in need thereof suffering from cancer. The genes may advantageously be well-expressed genes. Well expressed may be expressed in "transcripts per million" (TPM). A TPM greater than 100 is considered well expressed. Well expressed genes may be FGFR3, ERBB3, EGFR, MUC4, PDGFRA, MMP12, TMEM52, and PODXL. The therapies may be a ligand capable of binding to an extracellular neoantigen epitope. Such ligands are well known in the art and may include therapeutic

antibodies or fragments thereof, antibody-drug conjugates, engineered T cells, or aptamers. Engineered T cells may be chimeric antigen receptors (CARs). Antibodies may be fully humanized, humanized, or chimeric. The antibody fragments may be a nanobody, Fab, Fab', (Fab')2, Fv, ScFv, diabody, triabody, tetrabody, Bis-scFv, minibody, Fab2, or Fab3 fragment. Antibodies may be developed against tumor-specific neoepitopes using known methods in the art.

Adoptive cell transfer (ACT)

[00406] Aspects of the invention involve the adoptive transfer of immune system cells, such as T cells, specific for selected antigens, such as tumor associated antigens (see Maus et al., 2014, Adoptive Immunotherapy for Cancer or Viruses, Annual Review of Immunology, Vol. 32: 189-225; Rosenberg and Restifo, 2015, Adoptive cell transfer as personalized immunotherapy for human cancer, Science Vol. 348 no. 6230 pp. 62-68; Restifo et al., 2015, Adoptive immunotherapy for cancer: harnessing the T cell response. Nat. Rev. Immunol. 12(4): 269-281; and Jenson and Riddell, 2014, Design and implementation of adoptive therapy with chimeric antigen receptor-modified T cells. Immunol Rev. 257(1): 127–144). Various strategies may for example be employed to genetically modify T cells by altering the specificity of the T cell receptor (TCR) for example by introducing new TCR α and β chains with selected peptide specificity (see U.S. Patent No. 8,697,854; PCT Patent Publications: WO2003020763, WO2004033685, WO2004044004, WO2005114215, WO2006000830, WO2008038002, WO2008039818, WO2004074322, WO2005113595, WO2006125962, WO2013166321, WO2013039889, WO2014018863, WO2014083173; U.S. Patent No. 8,088,379).

[00407] As an alternative to, or addition to, TCR modifications, chimeric antigen receptors (CARs) may be used in order to generate immunoresponsive cells, such as T cells, specific for selected targets, such as malignant cells, with a wide variety of receptor chimera constructs having been described (see U.S. Patent Nos. 5,843,728; 5,851,828; 5,912,170; 6,004,811; 6,284,240; 6,392,013; 6,410,014; 6,753,162; 8,211,422; and, PCT Publication WO9215322). Alternative CAR constructs may be characterized as belonging to successive generations. First-generation CARs typically consist of a single-chain variable fragment of an antibody specific for an antigen, for example comprising a V_L linked to a V_H of a specific antibody, linked by a flexible linker, for example by a CD8α hinge domain and a CD8α transmembrane domain, to the

transmembrane and intracellular signaling domains of either CD3ζ or FcRγ (scFv-CD3ζ or scFv-FcRγ; see U.S. Patent No. 7,741,465; U.S. Patent No. 5,912,172; U.S. Patent No. 5,906,936). Second-generation CARs incorporate the intracellular domains of one or more costimulatory molecules, such as CD28, OX40 (CD134), or 4-1BB (CD137) within the endodomain (for example scFv-CD28/OX40/4-1BB-CD3ζ; see U.S. Patent Nos. 8,911,993; 8,916,381; 8,975,071; 9,101,584; 9,102,760; 9,102,761). Third-generation CARs include a combination of costimulatory endodomains, such a CD3ζ-chain, CD97, GDI la-CD18, CD2, ICOS, CD27, CD154, CDS, OX40, 4-1BB, or CD28 signaling domains (for example scFv-CD28-4-1BB-CD3ζ or scFv-CD28-OX40-CD3ζ; see U.S. Patent No. 8,906,682; U.S. Patent No. 8,399,645; U.S. Pat. No. 5,686,281; PCT Publication No. WO2014134165; PCT Publication No. WO2012079000). Alternatively, costimulation may be orchestrated by expressing CARs in antigen-specific T cells, chosen so as to be activated and expanded following engagement of their native αβTCR, for example by antigen on professional antigen-presenting cells, with attendant costimulation. In addition, additional engineered receptors may be provided on the immunoresponsive cells, for example to improve targeting of a T-cell attack and/or minimize side effects.

[00408] Alternative techniques may be used to transform target immunoresponsive cells, such as protoplast fusion, lipofection, transfection or electroporation. A wide variety of vectors may be used, such as retroviral vectors, lentiviral vectors, adenoviral vectors, adeno-associated viral vectors, plasmids or transposons, such as a Sleeping Beauty transposon (see U.S. Patent Nos. 6,489,458; 7,148,203; 7,160,682; 7,985,739; 8,227,432), may be used to introduce CARs, for example using 2nd generation antigen-specific CARs signaling through CD3ζ and either CD28 or CD137. Viral vectors may for example include vectors based on HIV, SV40, EBV, HSV or BPV.

[00409] Cells that are targeted for transformation may for example include T cells, Natural Killer (NK) cells, cytotoxic T lymphocytes (CTL), regulatory T cells, human embryonic stem cells, tumor-infiltrating lymphocytes (TIL) or a pluripotent stem cell from which lymphoid cells may be differentiated. T cells expressing a desired CAR may for example be selected through co-culture with γ-irradiated activating and propagating cells (AaPC), which co-express the cancer antigen and co-stimulatory molecules. The engineered CAR T-cells may be expanded, for example by co-culture on AaPC in presence of soluble factors, such as IL-2 and IL-21. This expansion may for example be carried out so as to provide memory CAR+ T cells (which may

for example be assayed by non-enzymatic digital array and/or multi-panel flow cytometry). In this way, CAR T cells may be provided that have specific cytotoxic activity against antigen-bearing tumors (optionally in conjunction with production of desired chemokines such as interferon-γ). CAR T cells of this kind may for example be used in animal models, for example to treat tumor xenografts.

[00410] Approaches such as the foregoing may be adapted to provide methods of treating and/or increasing survival of a subject having a disease, such as a neoplasia, for example by administering an effective amount of an immunoresponsive cell comprising an antigen recognizing receptor that binds a selected antigen, wherein the binding activates the immunoreponsive cell, thereby treating or preventing the disease (such as a neoplasia, a pathogen infection, an autoimmune disorder, or an allogeneic transplant reaction).

[00411] In one embodiment, the treatment can be administrated into patients undergoing an immunosuppressive treatment. The cells or population of cells, may be made resistant to at least one immunosuppressive agent due to the inactivation of a gene encoding a receptor for such immunosuppressive agent. Not being bound by a theory, the immunosuppressive treatment should help the selection and expansion of the immunoresponsive or T cells according to the invention within the patient.

[00412] The administration of the cells or population of cells according to the present invention may be carried out in any convenient manner, including by aerosol inhalation, injection, ingestion, transfusion, implantation or transplantation. The cells or population of cells may be administered to a patient subcutaneously, intradermally, intratumorally, intranodally, intramedullary, intramuscularly, by intravenous or intralymphatic injection, or intraperitoneally. In one embodiment, the cell compositions of the present invention are preferably administered by intravenous injection.

[00413] The administration of the cells or population of cells can consist of the administration of 10^4- 10^9 cells per kg body weight, preferably 10^5 to 10^6 cells/kg body weight including all integer values of cell numbers within those ranges. Dosing in CAR T cell therapies may for example involve administration of from 10^6 to 10^9 cells/kg, with or without a course of lymphodepletion, for example with cyclophosphamide. The cells or population of cells can be administrated in one or more doses. In another embodiment, the effective amount of cells are administrated as a single dose. In another embodiment, the effective amount of cells are

administrated as more than one dose over a period time. Timing of administration is within the judgment of managing physician and depends on the clinical condition of the patient. The cells or population of cells may be obtained from any source, such as a blood bank or a donor. While individual needs vary, determination of optimal ranges of effective amounts of a given cell type for a particular disease or conditions are within the skill of one in the art. An effective amount means an amount which provides a therapeutic or prophylactic benefit. The dosage administrated will be dependent upon the age, health and weight of the recipient, kind of concurrent treatment, if any, frequency of treatment and the nature of the effect desired.

[00414] In another embodiment, the effective amount of cells or composition comprising those cells are administrated parenterally. The administration can be an intravenous administration. The administration can be directly done by injection within a tumor.

[00415] To guard against possible adverse reactions, engineered immunoresponsive cells may be equipped with a transgenic safety switch, in the form of a transgene that renders the cells vulnerable to exposure to a specific signal. For example, the herpes simplex viral thymidine kinase (TK) gene may be used in this way, for example by introduction into allogeneic T lymphocytes used as donor lymphocyte infusions following stem cell transplantation (Greco, et al., Improving the safety of cell therapy with the TK-suicide gene. Front. Pharmacol. 2015; 6: 95). In such cells, administration of a nucleoside prodrug such as ganciclovir or acyclovir causes cell death. Alternative safety switch constructs include inducible caspase 9, for example triggered by administration of a small-molecule dimerizer that brings together two nonfunctional icasp9 molecules to form the active enzyme. A wide variety of alternative approaches to implementing cellular proliferation controls have been described (see U.S. Patent Publication No. 20130071414; PCT Patent Publication WO2011146862; PCT Patent Publication WO2014011987; PCT Patent Publication WO2013040371; Zhou et al. BLOOD, 2014, 123/25:3895 – 3905; Di Stasi et al., The New England Journal of Medicine 2011; 365:1673-1683; Sadelain M, The New England Journal of Medicine 2011; 365:1735-173; Ramos et al., Stem Cells 28(6):1107-15 (2010)).

[00416] In a further refinement of adoptive therapies, genome editing may be used to tailor immunoresponsive cells to alternative implementations, for example providing edited CAR T cells (see Poirot et al., 2015, Multiplex genome edited T-cell manufacturing platform for "off-the-shelf" adoptive T-cell immunotherapies, Cancer Res 75 (18): 3853). Cells may be edited

using any DNA targeting protein, including, but not limited to a CRISPR system, Zinc Finger binding protein, TALE or TALEN as known in the art. DNA targeting proteins may be delivered to an immune cell by any method known in the art. In preferred embodiments, cells are edited *ex vivo* and transferred to a subject in need thereof. Immunoresponsive cells, CAR T cells or any cells used for adoptive cell transfer may be edited. Editing may be performed to eliminate potential alloreactive T-cell receptors (TCR), disrupt the target of a chemotherapeutic agent, block an immune checkpoint, activate a T cell, and/or increase the differentiation and/or proliferation of functionally exhausted or dysfunctional CD8+ T-cells (see PCT Patent Publications: WO2013176915, WO2014059173, WO2014172606, WO2014184744, and WO2014191128). Editing may result in inactivation of a gene.

[00417] By inactivating a gene it is intended that the gene of interest is not expressed in a functional protein form. In a particular embodiment, the CRISPR system specifically catalyzes cleavage in one targeted gene thereby inactivating said targeted gene. The nucleic acid strand breaks caused are commonly repaired through the distinct mechanisms of homologous recombination or non-homologous end joining (NHEJ). However, NHEJ is an imperfect repair process that often results in changes to the DNA sequence at the site of the cleavage. Repair via non-homologous end joining (NHEJ) often results in small insertions or deletions (Indel) and can be used for the creation of specific gene knockouts. Cells in which a cleavage induced mutagenesis event has occurred can be identified and/or selected by well-known methods in the art.

[00418] T cell receptors (TCR) are cell surface receptors that participate in the activation of T cells in response to the presentation of antigen. The TCR is generally made from two chains, α and β, which assemble to form a heterodimer and associates with the CD3-transducing subunits to form the T cell receptor complex present on the cell surface. Each α and β chain of the TCR consists of an immunoglobulin-like N-terminal variable (V) and constant (C) region, a hydrophobic transmembrane domain, and a short cytoplasmic region. As for immunoglobulin molecules, the variable region of the α and β chains are generated by V(D)J recombination, creating a large diversity of antigen specificities within the population of T cells. However, in contrast to immunoglobulins that recognize intact antigen, T cells are activated by processed peptide fragments in association with an MHC molecule, introducing an extra dimension to antigen recognition by T cells, known as MHC restriction. Recognition of MHC disparities

between the donor and recipient through the T cell receptor leads to T cell proliferation and the potential development of graft versus host disease (GVHD). The inactivation of TCRα or TCRβ can result in the elimination of the TCR from the surface of T cells preventing recognition of alloantigen and thus GVHD. However, TCR disruption generally results in the elimination of the CD3 signaling component and alters the means of further T cell expansion.

[00419] Allogeneic cells are rapidly rejected by the host immune system. It has been demonstrated that, allogeneic leukocytes present in non-irradiated blood products will persist for no more than 5 to 6 days (Boni, Muranski et al. 2008 Blood 1;112(12):4746-54). Thus, to prevent rejection of allogeneic cells, the host's immune system usually has to be suppressed to some extent. However, in the case of adoptive cell transfer the use of immunosuppressive drugs also have a detrimental effect on the introduced therapeutic T cells. Therefore, to effectively use an adoptive immunotherapy approach in these conditions, the introduced cells would need to be resistant to the immunosuppressive treatment. Thus, in a particular embodiment, the present invention further comprises a step of modifying T cells to make them resistant to an immunosuppressive agent, preferably by inactivating at least one gene encoding a target for an immunosuppressive agent. An immunosuppressive agent is an agent that suppresses immune function by one of several mechanisms of action. An immunosuppressive agent can be, but is not limited to a calcineurin inhibitor, a target of rapamycin, an interleukin-2 receptor α-chain blocker, an inhibitor of inosine monophosphate dehydrogenase, an inhibitor of dihydrofolic acid reductase, a corticosteroid or an immunosuppressive antimetabolite. The present invention allows conferring immunosuppressive resistance to T cells for immunotherapy by inactivating the target of the immunosuppressive agent in T cells. As non-limiting examples, targets for an immunosuppressive agent can be a receptor for an immunosuppressive agent such as: CD52, glucocorticoid receptor (GR), a FKBP family gene member and a cyclophilin family gene member.

[00420] Immune checkpoints are inhibitory pathways that slow down or stop immune reactions and prevent excessive tissue damage from uncontrolled activity of immune cells. In certain embodiments, the immune checkpoint targeted is the programmed death-1 (PD-1 or CD279) gene (*PDCD1*). In other embodiments, the immune checkpoint targeted is cytotoxic T-lymphocyte-associated antigen (CTLA-4). In additional embodiments, the immune checkpoint targeted is another member of the CD28 and CTLA4 Ig superfamily such as BTLA, LAG3,

ICOS, PDL1 or KIR. In further additional embodiments, the immune checkpoint targeted is a member of the TNFR superfamily such as CD40, OX40, CD137, GITR, CD27 or TIM-3.

[00421] Additional immune checkpoints include Src homology 2 domain-containing protein tyrosine phosphatase 1 (SHP-1) (Watson HA, et al., SHP-1: the next checkpoint target for cancer immunotherapy? Biochem Soc Trans. 2016 Apr 15;44(2):356-62). SHP-1 is a widely expressed inhibitory protein tyrosine phosphatase (PTP). In T-cells, it is a negative regulator of antigen-dependent activation and proliferation. It is a cytosolic protein, and therefore not amenable to antibody-mediated therapies, but its role in activation and proliferation makes it an attractive target for genetic manipulation in adoptive transfer strategies, such as chimeric antigen receptor (CAR) T cells. Immune checkpoints may also include T cell immunoreceptor with Ig and ITIM domains (TIGIT/Vstm3/WUCAM/VSIG9) and VISTA (Le Mercier I, et al., (2015) Beyond CTLA-4 and PD-1, the generation Z of negative checkpoint regulators. Front. Immunol. 6:418).

[00422] WO2014172606 relates to the use of MT1 and/or MT1 inhibitors to increase proliferation and/or activity of exhausted CD8+ T-cells and to decrease CD8+ T-cell exhaustion (e.g., decrease functionally exhausted or unresponsive CD8+ immune cells). In certain embodiments, metallothioneins are targeted by gene editing in adoptively transferred T cells.

[00423] In certain embodiments, targets of gene editing may be at least one targeted locus involved in the expression of an immune checkpoint protein. Such targets may include, but are not limited to CTLA4, PPP2CA, PPP2CB, PTPN6, PTPN22, PDCD1, ICOS (CD278), PDL1, KIR, LAG3, HAVCR2, BTLA, CD160, TIGIT, CD96, CRTAM, LAIR1, SIGLEC7, SIGLEC9, CD244 (2B4), TNFRSF10B, TNFRSF10A, CASP8, CASP10, CASP3, CASP6, CASP7, FADD, FAS, TGFBRII, TGFRBRI, SMAD2, SMAD3, SMAD4, SMAD10, SKI, SKIL, TGIF1, IL10RA, IL10RB, HMOX2, IL6R, IL6ST, EIF2AK4, CSK, PAG1, SIT1, FOXP3, PRDM1, BATF, VISTA, GUCY1A2, GUCY1A3, GUCY1B2, GUCY1B3, MT1, MT2, CD40, OX40, CD137, GITR, CD27, SHP-1 or TIM-3. In preferred embodiments, the gene locus involved in the expression of PD-1 or CTLA-4 genes is targeted. In other preferred embodiments, combinations of genes are targeted, such as but not limited to PD-1 and TIGIT.

[00424] In other embodiments, at least two genes are edited. Pairs of genes may include, but are not limited to PD1 and TCRα, PD1 and TCRβ, CTLA-4 and TCRα, CTLA-4 and TCRβ, LAG3 and TCRα, LAG3 and TCRβ, Tim3 and TCRα, Tim3 and TCRβ, BTLA and TCRα, BTLA and TCRβ, BY55 and TCRα, BY55 and TCRβ, TIGIT and TCRα, TIGIT and TCRβ,

B7H5 and TCRα, B7H5 and TCRβ, LAIR1 and TCRα, LAIR1 and TCRβ, SIGLEC10 and TCRα, SIGLEC10 and TCRβ, 2B4 and TCRα, 2B4 and TCRβ.

[00425] Whether prior to or after genetic modification of the T cells, the T cells can be activated and expanded generally using methods as described, for example, in U.S. Patents 6,352,694; 6,534,055; 6,905,680; 5,858,358; 6,887,466; 6,905,681; 7,144,575; 7,232,566; 7,175,843; 5,883,223; 6,905,874; 6,797,514; 6,867,041; and 7,572,631. T cells can be expanded *in vitro* or *in vivo*.

Vaccine or Immunogenic Composition Kits and Co-Packaging

[00426] In an aspect, the invention provides kits containing any one or more of the elements discussed herein to allow administration of the therapy. Elements may be provided individually or in combinations, and may be provided in any suitable container, such as a vial, a bottle, or a tube. In some embodiments, the kit includes instructions in one or more languages, for example in more than one language. In some embodiments, a kit comprises one or more reagents for use in a process utilizing one or more of the elements described herein. Reagents may be provided in any suitable container. For example, a kit may provide one or more delivery or storage buffers. Reagents may be provided in a form that is usable in a particular process, or in a form that requires addition of one or more other components before use (e.g. in concentrate or lyophilized form). A buffer can be any buffer, including but not limited to a sodium carbonate buffer, a sodium bicarbonate buffer, a borate buffer, a Tris buffer, a MOPS buffer, a HEPES buffer, and combinations thereof. In some embodiments, the buffer is alkaline. In some embodiments, the buffer has a pH from about 7 to about 10. In some embodiments, the kit comprises one or more of the vectors, proteins and/or one or more of the polynucleotides described herein. The kit may advantageously allow the provision of all elements of the systems of the invention. Kits can involve vector(s) and/or particle(s) and/or nanoparticle(s) containing or encoding RNA(s) for 1-50 or more neoantigen mutations to be administered to an animal, mammal, primate, rodent, etc., with such a kit including instructions for administering to such a eukaryote; and such a kit can optionally include any of the anti-cancer agents described herein. The kit may include any of the components above (e.g. vector(s) and/or particle(s) and/or nanoparticle(s) containing or encoding RNA(s) for 1-50 or more neoantigen mutations, neoantigen proteins or peptides) as well as instructions for use with any of the methods of the present invention.

[00427] In one embodiment the kit contains at least one vial with an immunogenic composition or vaccine. In one embodiment the kit contains at least one vial with an immunogenic composition or vaccine and at least one vial with an anticancer agent. In one embodiment kits may comprise ready to use components that are mixed and ready to administer. In one aspect a kit contains a ready to use immunogenic or vaccine composition and a ready to use anti-cancer agent. The ready to use immunogenic or vaccine composition may comprise separate vials containing different pools of immunogenic compositions. The immunogenic compositions may comprise one vial containing a viral vector or DNA plasmid and the other vial may comprise immunogenic protein. The ready to use anticancer agent may comprise a cocktail of anticancer agents or a single anticancer agent. Separate vials may contain different anti-cancer agents. In another embodiment a kit may contain a ready to use anti-cancer agent and an immunogenic composition or vaccine in a ready to be reconstituted form. The immunogenic or vaccine composition may be freeze dried or lyophilized. The kit may comprise a separate vial with a reconstitution buffer that can be added to the lyophilized composition so that it is ready to administer. The buffer may advantageously comprise an adjuvant or emulsion according to the present invention. In another embodiment the kit may comprise a ready to reconstitute anti-cancer agent and a ready to reconstitute immunogenic composition or vaccine. In this aspect both may be lyophilized. In this aspect separate reconstitution buffers for each may be included in the kit. The buffer may advantageously comprise an adjuvant or emulsion according to the present invention. In another embodiment the kit may comprise single vials containing a dose of immunogenic composition and anti-cancer agent that are administered together. In another aspect multiple vials are included so that one vial is administered according to a treatment timeline. One vial may only contain the anti-cancer agent for one dose of treatment, another may contain both the anti-cancer agent and immunogenic composition for another dose of treatment, and one vial may only contain the immunogenic composition for yet another dose. In a further aspect the vials are labeled for their proper administration to a patient in need thereof. The immunogen or anti-cancer agents of any embodiment may be in a lyophilized form, a dried form or in aqueous solution as described herein. The immunogen may be a live attenuated virus, protein, or nucleic acid as described herein.

[00428] In one embodiment the anticancer agent is one that enhances the immune system to enhance the effectiveness of the immunogenic composition or vaccine. In a preferred

embodiment the anti-cancer agent is a checkpoint inhibitor. In another embodiment the kit contains multiple vials of immunogenic compositions and anti-cancer agents to be administered at different time intervals along a treatment plan. In another embodiment the kit may comprise separate vials for an immunogenic composition for use in priming an immune response and another immunogenic composition to be used for boosting. In one aspect the priming immunogenic composition could be DNA or a viral vector and the boosting immunogenic composition may be protein. Either composition may be lyophilized or ready for administering. In another embodiment different cocktails of anti-cancer agents containing at least one anti-cancer agent are included in different vials for administration in a treatment plan.

[00429] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined in the appended claims.

[00430] The present invention will be further illustrated in the following Examples which are given for illustration purposes only and are not intended to limit the invention in any way.

Examples

Example 1

An efficient sample processing and analysis pipeline for HLA-peptide sequencing

[00431] In this study, Applicants develop a biochemical and computational pipeline for mass spectrometric (MS) analysis of peptides bound to HLA to identify the universe of endogenously presented peptides and improve our understanding of the rules governing antigen presentation. Applicants focused the analysis on single HLA class I allele-expressing cell lines, so motifs could be assigned to alleles unambiguously *(12, 13)*. The studies leveraged advances in instrumentation for rapid collection of high resolution data and database search tools that consider HLA peptide-binding motifs integrated with proteogenomic analysis strategies *(14)*. Herein, Applicants combine these improvements to comprehensively evaluate the characteristics of HLA-associated peptides presented by 16 HLA alleles with the goal of improving the performance of prediction algorithms for class I HLA peptide-binding.

[00432] Applicants immunoaffinity-purified and sequenced HLA-associated peptides from 30-90 million cells of class I deficient B cell lines (B721.221) stably transduced to express a single class I HLA allele (**Figure 1A**). These alleles were selected from Caucasian, Black, and

Asian populations because they were understudied or for their disease associations*(15–17)*. High quality tandem mass spectra (MS/MS) were subjected to iterative database searches where stringent criteria were applied for precursor ion purity and allowable percentage of unassigned ions in the MS/MS (**Materials and Methods**). The first search round used no enzyme specificity and no variable peptide modifications, while the second round applied an HLA-specific enzyme specificity based on first-round results and allowed peptide modifications (**Figure 1B**). The second round of search typically increased identifications by an average of 14% (5-40%) while maintaining a stringent 1% FDR cutoff. Peptide spectrum matches (PSMs) passing a stringent <1% FDR estimation cutoff from both search rounds were combined and reported for each HLA allele (**Figure 1D, Figure 6A; Table 1A**).

[00433] Non-specifically-bound peptides (negative controls) were identified by immunopurification of untransduced B721.221 cells and B cells processed with beads not conjugated with the pan-class I HLA binding antibody (W6/32) (**Table 1A**, **Figure 1D)**. Approximately 3% (σ 3%) of all peptide identifications were shared with the pool of 223 negative control peptides. After filtering for these non-specific binders, between 900 and 3550 unique peptides were identified by LC-MS/MS for each HLA allele (median 1505), with length distributions matching the expected 8-15 amino acids (**Figure 1C**). All peptides identified in the negative controls were subtracted prior to motif determinations and further analyses. For the 14 alleles with frequencies in Caucasians of greater than 1%, our LC-MS/MS-based workflow yielded a median of 49% (range 15-100%) of the number of peptides existing in IEDB. For HLA-B*54:01, HLA-A*02:07 and HLA-A*02:04, with minor allele frequencies of less than 1% within Caucasian populations, 2-, 40- and 450-fold more peptides, respectively, were identified compared to IEDB (**Figure 6D**). Variation in surface presentation of HLA molecules on B721.221 cells, as compared to primary lymphocytes, appeared to explain most of the variation in observed peptide counts (**Figure 11A**). For common alleles (population frequency >1%), 74% of peptides were not reported in the immune epitope database (IEDB); for rare alleles, nearly 100% were unreported (**Table 1D**).

[00434] A high degree of peptide overlap was observed between biological replicates (~70%) and a published B cell HLA-peptide dataset *(1)* (**Figure 6B**). A median of 92% of presented peptides were unmodified (σ=5%), while only a median of 4-5% (σ=4%) were modified. Of the modified peptides identified, most were consistent with frequently observed artifacts of sample

handling (70% with oxidized methionine, 6% with deamidation, and 8% with pyroglutamic acid at the N-terminus), while 3% contained phosphorylation, an endogenous post-translational modification (**Figure 6C**) *(18)*. There were only negligible peptide sequence biases related to the experimental procedures based on comparisons among MS peptides and allele-matched synthetic peptides that were assigned as binders by IEDB (measured affinity <500nM; **Figures 12A and 12B**). The predicted MS observability of the HLA peptides and frequencies of individual amino acids between MS and IEDB peptides were highly similar, aside from underrepresentation of cysteine (**Figures 12A and 12B**). Free cysteine, which interferes with precursor fragmentation during LC-MS/MS, is underrepresented in other MS-based HLA-peptide datasets (1). Cysteine-containing peptides were recovered when a third round of database search accounted for cysteinylation (**Table 5**).

Example 2

Novel HLA peptide-binding motifs enriched in LC-MS/MS data relative to IEDB

[00435] Comparison of MS and IEDB peptides showed significant differences in amino acid frequencies at specific positions. Assessment of entropy at each position within 9mers of LC-MS/MS and IEDB datasets (**Figure 2A)** revealed the lowest average entropy (<0.4) at the positions 2 and 9 anchors, while low entropy was also observed for positions 3 through 7 mainly in the LC-MS/MS data with variation amongst alleles (**Figure 7B**). For example, the HLA-A*02:01 data uniquely revealed sub-anchors at positions 4 (E, D), 6 (L, V, I), and 7 (I, V, A) (**Figure 2B-left)**. Likewise, in the example of HLA-A*29:02 and other alleles, evidence of enriched residues at positions consistent with secondary anchors were observed (**Figure 2B-right; Figure 7A**). More than 11% of 2340 possible changes (20 AAs * 13 alleles * 9 positions) were significantly different (**Figure 2C**). Methionine (M), cysteine (C), and tryptophan (W) were over-represented in IEDB peptide sequences ($p < 1 \times 10^{-5}$, chi-square test) while the amino acids isoleucine (I), valine (V), and leucine (L) ($p < 1 \times 10^{-5}$, chi-square test) were under-represented, especially at positions 5-7 that encompass secondary anchors. This was true for both sparsely studied alleles, like HLA-A*02:07, and for well-studied alleles like HLA-A*68:02 and HLA-B*57:01. Applicants also noted specific alleles with length preferences not captured in IEDB, such as HLA-A*31:01 and HLA-B*51:01, which bind high proportions of 11mers and 8mers, respectively (**Figure 1C**).

[00436] The 9mer peptides bound to a particular HLA allele were systematically compared to peptides reported in the IEDB database for the same allele by computing a distance metric. Applicants devised a metric that does not weight each position equally since some positions are more critical for binding HLA than others. Applicants defined an entropy-weighted peptide distance and plotted the peptides in two-dimensional space such that "similar" peptides would be clustered closely and dissimilar peptides distantly (see **Figures 5A and 8**). For positions with reduced entropy (i.e., fewer possible residues; **Figure 2A**), Applicants increased the weight of that position in the distance calculation. The distance was calculated using a pre-calculated matrix of similarities between residues, biased by their HLA binding properties *(19)*. Based on entropy-weighted distance, the peptides identified per HLA by MS were typically closer to each other than to peptides in IEDB; MS peptides were also closer to each other than IEDB peptides were to themselves (**Figure 7B)**, suggesting that MS recovers stronger binding motifs compared to a greater preponderance of weak binding peptides in the IEDB binder sets. Moreover, Applicants found multiple peptide clusters that were highly enriched in MS relative to IEDB (**Figures 2E and 2F**), reflecting unique information in the MS datasets. MS technology-related biases did not appear to underlie these patterns, as a similar analysis focused on only the subset of peptides from MS or IEDB with physicochemical properties favorable for detection by MS revealed similar distances and clustering patterns (**Figures 13 and 2A**) (Eyers et al., 2011, *Mol Cell Proteomics* (2011); 10(11):M110.003384; Fusaro et al., 2009, *Nature Biotechnology* **27**, 190 - 198; Muntel et al., 2015, *Mol. Cell. Proteomics* 14, 430–440; Searle et al., 2015, *Mol. Cell. Proteomics* 14, 2331–2340). Applicants then visualized these peptides in clusters using a non-metric multidimensional scaling (NMDS) based on the distance metric, and observed that MS data tended to cluster more closely together in a compared to IEDB peptides. For the well-characterized HLA-A*02:01 allele, the LC-MS/MS and IEDB datasets generated a high degree of overlap in peptide clusters, with similar pairwise distances among 9mers that had measured affinities <500nM (**Figure 2D)**. For most alleles, however, several peptide clusters highly enriched by LC-MS/MS data were revealed, demonstrating the extent to which new classes of binding peptides were discoverable (**Figure 8**). Peptide clustering was driven by the amino acids with the lowest entropy (i.e. anchor residues) due to the entropy-weighted distance; for example, tyrosine (Y) was determined to be a position 2 anchor of HLA-A*29:02-bound peptides, which dominated the cluster highlighted in **Figure 2E**.

[00437] To validate identified motifs, Applicants selected sequences from clusters enriched within the MS datasets but scored only within the bottom 10% when MS hits were evaluated by NetMHCpan-2.8. By competitive peptide-binding assays, 32 of 33 peptides were confirmed to be strong binders (median IC50<14 nM), despite only 14 of 33 having been predicted to be binders (<500 nM) by NetMHCpan-2.9 (**Figures 5A, 5B, and 10A**).

Example 3

Novel insights into endogenous antigen processing and presentation yielded by the LC-MS/MS data.

[00438] Applicants analyzed a large data set of 24,000 allele-specific MS peptide and found motifs in the upstream and downstream flanking sequences, as well as within the HLA-binding peptide. Applicants focused on the sequence context around each HLA-peptide within its source protein, which is not confounded by HLA binding (**Figure 3A**). Applicants systematically examined the specificity of proteasomal cleavage by determining the frequencies of amino acids upstream and downstream of the N- and C-termini of all peptides sequenced by LC-MS/MS. At both the N- and C-terminus, an enrichment in lysine (K) and arginine (R), consistent with the tryptic-like specificity of constitutive proteasome subunits was observed *(20)* (**Figure 3A**). For example, upstream of the peptide, at the first position ("U1"), arginine and lysine were highly enriched (relative to peptide decoys, consisting of random proteome 9mers matched for their first two and last two amino acids), indicating a strong trypsin-like specificity at the N-terminus (**Figure 3A**). Downstream of the peptide, arginine and lysine were also enriched in the first position ("D1"), (suggesting that peptides are trimmed at the C-terminus after a tryptic-like cleavage that occurs after these basic residues), and acidic residues were depleted in this position. Enrichment for alanine (A), particularly at the U1 and D1 position, and an under-representation or strong depletion of proline (P), extending 3-5 residues upstream and downstream, which may related to proline's regid peptide bonds, were observed. In addition, there was a strong preference for peptides arising at the C-terminus of their source protein (laelled as "-" in **Figure 3A**, signifying empty position), where only a single cleavage event is required. While HLA-binding motifs hamper the discovery of cleavability signatures *within* MS-identified peptides, Applicants determined whether the cleavability signatures observed at the N- and C-termini were depleted within peptide sequences. To this end, two indices for residue

cleavability ("N-terminal scoring" and "C-terminal scoring") were applied to each position upstream, downstream, and internal to the MS-observed peptides. Comparing against a set of 1 x 10^6 9mers randomly drawn from the genome, a significant reduction in cleavability was detected within the internal peptide sequence, as hypothesized (**Figure 3B**). Furthermore, cleavability was most enriched at the C-terminus. This pattern is consistent with existing models of peptide processing, wherein the C-terminus is determined by the proteasome, and the N-terminus is determined not only by proteasomes, but also by cytosolic proteases, or ERAP1/2 trimming *(21, 22)*. By comparing amino acid frequencies upstream, within, and downstream of each peptide, Applicants also observed depletion of "cleavable" amino acids (K, R, and A) and enrichment of "non-cleavable" proline within peptides (**Figure 12C**). Thus, avoidance of internal cleavage appears to be a key feature of HLA ligands. Applicants also considered whether protein sequence features, such as alpha helices and beta strands, might influence processing potential (**Figure 12D**). LC-MS/MS peptides were twice as likely as gene-matched decoys to arise from signal peptide sequences; other features were significant but did not show effect size greater than ±15%.

[00439] To explore whether the processing signature was likely to be generalizable, Applicants analyzed the gene expression of a proteasome and the immunoproteasome; both were expressed in B721.221 B cells at proportions comparable to those in blood and epithetial cancers included in the cancer genome atlas (TCGA) (**Figure 12E**). When Applicatns examined the HLA-bound peptide repertoires previously recovered from cells of other lineages, including breast and colon cancer cells (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673 (2015)), fibrolasts (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673 (2015)), HeLa cells (Trolle et al., 2016, *J. Immunol.* (2016), doi:10.4049/jimmunol.1501721), and peripheral blood mononuclear cells (Caron et al., 2015) (**Figures 11C-G**), all the key features observed for B721.221 cells were likewise consistenly observed for these other cell types. Applying this ame analytic approach to reported class II peptides isolated from dendritic cells (Mommen et al., 2016, *Mol. Cell. Proteomics MCP* 15, 1412–1423) (MUTZ3 cell line), Applicants observed a starkly different signature exhibiting preference for hydrophobic residues in the D1 position and a lack of the previously observed associations for lysine, arginine, and alanine (**Figure 11B**). Applicants also note that the HLA class I signature that Applicants derived only mostly resembled that obtained by comparing peptides with high versus low

NetChop scores. Applicants' analyses thus identify a common HLA class I cleavage signature that dramatically differs from that predicted by a widely-used tool.

[00440] Since cleavability determines availability for HLA-binding, this feature was assessed by scoring peptides with the tool NetChop *(23–25)*. NetChop showed a large difference in cleavage scores when LC-MS/MS-sequenced peptides were compared to 1 million decoy peptides (**Figure 9A**). However, this signal was highly allele-dependent and largely mitigated by controlling for predicted binding affinity (**Table 4**), indicating anchor residue identity as a possible confounding variable. Therefore, an independent cleavage predictor was developed that used the cleavability signatures learned from the N- and C-termini of LC-MS/MS peptides (**Methods**). This new predictor showed a significant ($p=1 \times 10^{-825}$), but modest divergence between binder and decoy peptides (**Figure 3C**) that was consistent across alleles and roughly equivalent to NetChop after controlling for predicted peptide affinity (**Table 4**). Since HLA-presented peptides have been thought to be products of aborted translation *(26, 27) (28)*, Applicants further determined the positions of all LC-MS/MS-identified peptides within their source proteins. However, there was no evidence that peptide positional frequencies were shifted toward the protein N-terminus.

[00441] Although class I HLA peptides are canonically characterized as 8-10mers, a substantial number of peptides were observed to belong to nested sets (7%; **Table 3**), suggesting the presence of a relatively high proportion of peptides binding in non-canonical conformations, such as bulge or overhang*(29, 30)*. For example, if long isoforms of nested sets overhang, then the additional amino acids need not provide new anchors. On the other hand, if both short and long isoforms bind in tucked conformation, then extensions force the binding register to shift, and only certain amino acid additions can be tolerated. To investigate this further, the binding register of the peptide segment that binds to the HLA molecule was determined by comparing the predicted binding affinity of each peptide to that of the peptide sub-sequences within it (length 7 and greater). If at least one (sub)-sequence had predicted affinity of 500 nM or better and if that was 10-fold stronger than the runner-up (sub)-sequence, then the binding register was considered known (15% of peptides). Applicants observed that long isoforms indeed gain suitable new anchor sites (providing binding potential on par with the short isoforms); random amino acid extensions of short isoforms have uniformly worse binding potential (**Figure 9D**). This suggests that most peptides bind in the canonical tucked conformation.

Example 4

Evaluation of HLA-peptide characteristics that impact HLA-binding predictions

[00442] Applicants evaluated the extent to which various peptide characteristics were predictive of HLA-peptide presentation. The impact of HLA-binding affinity was first considered by comparing the distributions of NetMHCpan-2.8-predicted binding affinities of HLA-peptides sequenced by LC-MS/MS to those of 1 x 10^6 random 9mer decoy peptides **(Figure 4A)**. For 8 of 16 HLA alleles, the distributions of peptide-binding affinities clearly separated from the random decoys at an IC_{50} of ~500 nM. Conversely, peptides identified from 3 alleles (HLA-A*02:04, -A*02:07, -B*54:01) demonstrated a distribution of weaker predicted binding affinities (>500 nM) that largely overlapped with random decoys. This result was likely due to insufficient existing IEDB data (only 90-661 peptide observations available per allele) that could be used for NetMHC training. The datasets from the remaining 5 alleles (A*03:01, B*57:01, A*68:02, B*35:01, B*51:01) revealed bimodally-distributed predicted affinities that overlapped in part with those of random decoy peptides. This observation suggested that the LC-MS/MS data captures new peptide-binding motifs not reflected in the IEDB.

[00443] Next, the impact of source protein expression was evaluated by comparing the expression distribution of all HLA-associated peptides sequenced by LC-MS/MS to that of 1 x 10^6 random decoy peptides with varying transcription levels (**Figure 4B**). By analysis of RNA-sequencing (RNA-seq) data from a representative single HLA transfected 721.221 cell line, Applicants observed that average expression levels of HLA-peptide source proteins were 10-fold higher than random source proteins (41.9 vs. 3.4 TPM), suggesting that highly expressed proteins are more likely to be processed and presented by the HLA class I pathway. To examine the relationship between expression and affinity, LC-MS/MS peptide observations across all alleles and the random 9mer decoys ($1x10^6$ per allele) were binned according to these variables, and a peptide-to-decoy ratio for each bin was calculated in **Figure 4C**. The likelihood of display was not strictly determined by affinity, but was rather a function of both gene expression and affinity. Highly presented peptides not only included peptides with strong binding affinity but also highly expressed peptides with weak predicted affinity. Conversely, lowly presented peptides included peptides with strong predicted affinity but low to absent expression. These data support the idea of expression-affinity ratio for improved peptide presentation prediction rather than use of simple affinity threshold cutoffs. This approach revealed a multiplicative relationship

between expression and affinity, in which a 10-fold increase in expression could approximately compensate for a 90% decrease in binding potential. To rule out the possiblility that this finding might be an artifact of MS detection limits, Applicants compared the peptides with the highest versus lowest MS signal intensity and compared them in terms of RNA-Seq expression and predicted affinity. Low-intensity binders had lower expression and weaker affinity, showing that MS detection is not simply reflecting underlying protein abundance but also reflects relative binding strength (**Figure 9E**). Though a simple kinetic model of peptide on- and off-rates may have predicted this limitations in expression data quality and depth and the use of multi-allelic data (for which prediction of affinity is more difficult) have previously obscured this finding. The presence of multiple upstream open reading frames in the 5' UTR of a transcript is associated with reduced presentation potential for its associated peptides (**Figure 9F**), suggesting that accurate measurements of translational efficiencies may enhance epitope selection further.

[00444] To determine whether HLA class I processing pathway has cellular localization biases, Applicants calculated the relative probability that a source protein from the LC-MS/MS dataset (pooled across alleles) was secreted or originated from the cell membrane, cytoplasm, late endosome, endoplasmic reticulum (ER), mitochondria, or cell nucleus compartments, relative to expression-matched, random 9mer decoys from protein coding genes (**Figure 4D, Figure 9B)**. Without controlling for expression, the differences were dramatic, with secreted proteins showing an unexpected enrichment. However, the expression-corrected analysis eliminated most of these differences; no marked enrichment was observed in any particular cellular compartment, although peptides from the late endosome were 27% more frequent than in the decoy set. Peptides from secreted and ER proteins were modestly depleted – each about 15% less frequent than observed in the decoy set. Lack of expression correction may help explain why previous analyses of this question have reached inconsistent conclusions (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673; Rock et al., 2014, *Trends Immunol.* **35**, 144–152).

[00445] Studies of peptide presentation kinetics have suggested that specialized pathways exist that specifically target aborted translation products and misfoled proteins (Bourdetsky et al., 2014, *Proc. Natl. Acad. Sci.* **111**, E1591–E1599; Yewdell, 2011, *Trends Immunol.* 32, 548–558). Consistent with recent analyses (Bourdetsky et al., 2014, *Proc. Natl. Acad. Sci.* 111, E1591–E1599; Kim et al., 2013, "Positional Bias of MHC Class I Restricted T-Cell Epitopes in Viral Antigens Is Likely due to a Bias in Conservation" PLoS Comput Biol 9, e1002884), Applicants

did not see an enrichment of peptides at the N-termini of their source proteins (**Figure 3D**), which would be expected if a meaningful fraction of peptides arose from aborted translation products. Applicants also considered whether peptides from proteins with a high instability index (Guruprasad et al., 1990, *Protein Eng.* 4, 155–161) or a high fraction of intrinsically disordered sequence were enriched in the MS data (**Figures 9G and 9H**) supposing that these would be more likely to trigger an unfolded protein response. The opposite trend was observed, suggesting either our measures of "foldability" were insufficient or that other unobserved variables potentially confound the signal.

[00446] Applicants considered whether pathways of normal protein turnover were tied to presentation likelihood. The count of ubiquitination sites (previously observed in KG-1, Jurkat, or MM1S cells (Kronke et al., *Nature* (2015) 523(7559); Kronke et al., 2014, *Science* (2014) 343(6168): 301-5; Udeshi et al., 2012, 2013, *Molecular & Cellular Proteomics* (2012) 11: 148-59), was positively associated with HLA-peptide presentation, consistent with the known role for ubiquitin in delivering proteins to the proteasome (**Figure 9I**). Additionally, Applicants queried a collection of 200 IP-MS/MS experiments, each profiling the physical interaction partners of a protein involved in deubiquitination, autophagy, or ER-associated degradation (Behrends et al., 2010, *Nature* 466, 68–76; Christianson et al., 2012, *Nat. Cell Biol.* 14, 93–105; Sowa et al., 2009, *Cell* 138, 389–403) (**Figure 4H**). Most of these gene sets were positively enriched in our data. Several outliers include P1K3C3, ATG12, and OTUD4, whose interation partners were most strongly enriched. Meanwhile, the interaction partners of the autophagosome cargo protein SQSTM1 were most depleted. Collectively, these analyses may help to point to turnover pathways with privileged access to the HLA presentation pathway.

[00447] Prior studies have identified the potential importance of peptide-binding stability on HLA-peptide presentation, which reflects a balance between both on- and off-rates, even after correcting for affinity *(32, 33)*. The stability of peptides sequenced by LC-MS/MS was compared against affinity- and expression-matched decoys using NetMHCStab, a predictor trained on a large panel of HLA-peptide stability measurements for 10 highly expressed HLA alleles *(33, 34)*. Of these alleles where NetMHCStab predictions were available, stability most dramatically affected HLA-B35:01 (**Figure 4E, Figure 9C**), with significant effects also observed for HLA-A*01:01 (p=1.2e-12), -A*02:01 (p=1.8e-15), -A*24:02 (p=1.1e-33), and -B*03:01 (p=3.1e-12) when using the Wilcox-rank sum test. Conversely, a negligible stability effect was detected for -

A*03:01 (p=0.15). Notably, this result was not likely caused by insufficient training data for affinity prediction because none of these alleles have poor coverage in IEDB.

[00448] To calculate the relative contributions of variables like stability and affinity, various logistic regression models were developed and scored according to their positive predictive value (PPV) (see **Methods**). Applicants defined PPV as the fraction of LC-MS/MS peptides among the model's highest scoring peptides (top 0.1%) after all *n* MS-observed 9mer peptides were mixed with 999*n* random 9mer decoys. A 0.1% threshold for positive calls was employed because this approximates the rate of true binders in a set of random peptides. Because there are approximately 10 million 9mers in the human proteome, of which each allele presents approximately 10,000, the 1:1000 ratio closely mimics the reality of the epitope selection problem. On the other hand, AUC (area under a ROC curve) calculations integrate performance over all possible thresholds. Thus, while AUC distributes weight of consideration across all thresholds (for example, calling >10% of peptides as positive; **Table 4B**),). The PPV approach appropriately focuses on performance among the most strongly positive calls, which is more consistent with epitope prioritization schema.

[00449] Each model included one or more of five predictor variables. Model performance was averaged across alleles with available stability prediction (**Figures 5F and 5H**, **Table 4**). Models based on affinity alone could achieve a PPV of 28-35% on average across 16 alleles (**Figure 5F**; *see* **Table 3** for individual allele results). A stability-only model (NetMHCpanStab (Jorgensen et al., 2014), model "S") perfrmed nearly as well; however, joint prediction (model "AS") showed minor synergism. Adding RNA-Seq or iBAQ-based (Ishihama et al., 2005, *Mol. Cell. Proteomics* 4, 1265–1272) protein expression (models "ASR" and "ASP") improved PPV to 39% and 47%, respectively, while adding cleavage prediction (per a de novo predictor trained on other MS data) provided a 7.9% boost (prediction with NetChop yields 3.1%), and stability and localization provided only minimal improved performance (2% and 1%, respectively). Other putative processing variables (stability index, disordered sequence content, count of ubiquitin sites, and sequence features such as alpha helices and beta strands) likewise showed incremental improvements less than 1%. These data suggest that incorporation of gene expression information can improve prediction, while also suggesting that the greatest gains in prediction performance may still be driven primarily by refinement of sequence-based peptide-HLA affinity predictions.

[00450] By exhaustively testing all possible predictor combinations (**Table 3**), Applicants found the order of variable addition that added the most predictive value earliest and tracked the incremental PPV improvement provided by each variable, assigning this as the variable's "explanatory contribution" (**Figure 5H**). Affinity and expression dominate the analysis, though notably, iBAQ-based protein expression provided negligible contribution beyond RNA-Seq. For the 45% of MS peptides that were missed in the full model, it was not known how much this related to the affinity and cleavage predictions being suboptimal, unknown variables, or stochasticity in the MS detection. The two genes with the most false negative calls per unit length were ubiquitin B and C, which suggests that improved understainding of protein turnover dynamics may be a key missing component.

Example 5

Information from peptide sequencing by LC-MS/MS improves prediction of HLA-peptide binding

[00451] The binding affinity of peptides uniquely identified by MS but not well-represented within IEDB were experimentally measured to confirm the quality and predictive power of these data. Binary classification models (two single-layer artificial networks) were built for each of the 16 HLA alleles (see **Methods**) (**Figure 5G**) and were used to select 33 peptides across five alleles (HLA-A*01:01, -A*29:02, -B*35:02, -B*51:01, -B*54:01) in which the predictive score for HLA presentation was in the top 10 percentile by MS-based models but bottom 10th percentile by NetMHCpan-2.8. These peptides tended to occupy regions on the 2D NMDS plots with fewer IEDB observations (**Figure 5A**). By competitive peptide-binding assays, 32 of 33 peptides were confirmed to be strong binders (median IC50 < 14nM). In contrast, only 12 of 33 and 13 of 33 were predicted to be binders by NetMHCpan-2.8 and NetMHC-4.0 respectively, based on a threshold of 500nM (**Figure 5B, Figure 10A**).

[00452] Ensemble models of single layer artificial neural networks were developed by incorporating the following types of features: 3 sequence-encoding schemes (i.e. dummy, BLOSUM62, and fuzzy encoding *(***Methods,** *18)*; amino acid properties *(34)*; peptide characteristics *(35)*; expression; and cleavage (**Methods**). Two types of ensemble models were trained, for which PPV and AUC were assessed: 'MSIntrinsic' which only utilized peptide-intrinsic features (sequence, amino acid properties, peptide characteristics), and 'MSIntrinsicEC'

which additionally incorporated expression and cleavage information. To determine the number of peptides required to build a strong predictor, Applicants carried out saturation analysis by training models with varying number of positive training examples (minimum of 15 and maximum the full set of LC-MS/MS-identified peptides) and by measuring PPV on a test set of fixed size. Performance improvement was seen to level off at several hundred peptides (**Figure 5C**). To understand why the machine-learned models performed better for some alleles, Applicants considered whether complexity of the peptide repertoire played a role. Indeed, a complexity score, defined as a decay-weighted average of the entropies at each peptide position, ranked the alleles with strongest performance, HLA-A*01:01, -B*44:03, -B*44:02, -A*29-02, as 1, 2, 3, and 5 of 16 respectively, from least to most complex (**Figure 5C**).

[00453] For all alleles, the models trained on the LC-MS/MS data outperformed both NetMHC-4.0 and NetMHCpan-2.8 with an average PPV improvement of 20 and 30 percentage points for 'MSIntrinsic' and 'MSIntrinsicEC', respectively, in an internal 5-fold cross validation with 999*n* decoys (**Figure 5D, Table 4A**). Logo plots of decoys ranked within the top *n* positions suggest that binding motifs learned from the LC-MS/MS data are stricter than those learned from IEDB data (**Figure 10B**). Conversely, NMDS visualization of false negatives suggests that they tend to be found at singleton or low-density clusters for MS-based models but also at high-density MS clusters for NetMHC models. (**Figure 10C**). All algorithms scored similarly in terms of AUC, however, 'MSIntrinsic' and 'MSIntrinsicEC' demonstrated a significant improvement at very low false positive rate thresholds (**Figure 10D**). Performance was also evaluated on 3 independent external data sources. First, a competition dataset of eluted 9mer peptides from the Dana-Farber Repository for Machine Learning in Immunology (DFRMLI) was considered. Data for both binders (average 335) and non-binders (average 1780) were available for HLA-A*02:02, -B*35:01, -B*44:03, and –B*57:01 *(37)*. 'MSIntrinsic' performed better for 2 of 4 alleles compared to NetMHC-4.0 and NetMHCpan-2.8, even though this dataset had been incorporated into IEDB (**Table 4B**). Second, Applicants evaluated a curated set of 304 HIV-1 CTL Epitopes *(38)*, which contained 52 9mer epitopes (that were shown to bound 12 of 16 HLA alleles in this study). Despite its limited size, this dataset provides a valuable opportunity for an evaluation which is orthogonal to MS-based peptide sequencing while remaining reflective of antigen processing and presentation rules. Binders for each allele were merged with all non-overlapping HIV 9mers and the rankings of epitopes provided in **Table 4C**. For 10 of 12 alleles,

the top-ranked true epitope was at the same or higher position according to 'MSIntrinsic' as compared to NetMHC-4.0 or NetMHCpan-2.8. Finally, models were evaluated on an independent source of HLA class I LC-MS/MS data consisting of 7 cell lines expressing multiple HLA alleles (*1*). For each allele that overlapped with these data, binders of other alleles were heuristically excluded (i.e. any peptide with < 150nM affinity for another allele in the cell line and > 1000nM affinity for the allele being evaluated as predicted by NetMHCpan-2.8) and the remaining hits combined with 999*n* decoys before PPV and AUC were calculated. Absolute PPV values were lower, due to incomplete allele deconvolution. However, consistent with internal evaluation results, the average PPV of 'MSIntrinsic' is 49% better than either NetMHC-4.0 or NetMHCpan-2.8, and the average PPV of 'MSIntrinsicEC' 97% better (**Figure 5E**).

Example 6

Discussion

[00454] Applicants have in an unprecedented way enhanced the understanding of the rules governing antigen processing and presentation by developing a high-throughput workflow to rapidly characterize thousands of peptides naturally displayed on the surface of cell lines expressing single HLA alleles. Although LC-MS/MS-based approaches to identify the HLA-peptidome have long been employed, these studies have typically utilized primary cells or cell lines expressing the full complement of HLA molecules, making it challenging to distinguish allele-specific characteristics related to peptide display. With the single HLA allele-expressing cell lines as source material, together with refined experimental approaches and analysis strategies, Applicants could quickly generate a resource dataset of greater than 24,000 peptides associated with 16 class I HLA alleles. This ample dataset allowed Applicants to address anew the identification of allele-specific binding motifs, the factors impacting proteasomal cleavage, and the role of gene expression on peptide presentation. These insights were then translated into greatly improved prediction algorithms.

[00455] Although strong similarities among amino acid residues at anchor positions within HLA-peptides sequenced by LC-MS/MS (P2, P9) and existing IEDB peptides were detected, many novel anchors and sub-anchors were discovered. Across all alleles Applicants found that 11% of possible amino acid positions within 9mers were significantly different than those in IEDB, and a small set of peptides with distinct motifs were validated with a competitive binding

assay. Although the analysis focused on 9mers, the present invention is applicable with 8mer and 10mer data, while at the same time, noting allele-specific differences. While most peptides fit the canonical model, exhibiting short length distribution (8-11 AA) and anchor residues in the second and last positions, Applicants observed peptides violating the length expectation ("bulge conformation" *(29, 41, 42)*) as well as an unexpected small population of peptides for which the anchors were not in the usual positions *(39, 40)*. This was suggestive of possible overhang at both the N- and C-termini, a phenomenon more typically associated with Class II presentation. While more common among long peptides, this pattern was also evident in 9mer and 10mers. These observations invite further structural analysis as they could alter methods of antigen prediction that rely heavily on the identity of both N- and C-terminal anchor residues.

[00456] Conflicting proteomic studies have argued for and against correlations between protein abundance and HLA-peptide presentation *(1, 43, 44)*. The present results, however, strongly support source protein expression as a highly predictive variable, with only HLA-binding affinity as a stronger driver of epitope prediction. Applicants evaluated the impact of expression through transcriptomic analysis using RNA-sequencing because this approach provides comprehensive and quantitative data for genes expressed at low levels that are difficult to measure using traditional proteomic methods. The observed correlation between the transcriptome and immunopeptidome supports the notion that antigens displayed by the HLA class I pathway represent the entire population of short-lived and stable cellular proteins that are processed by the proteasome, consistent with the "Proteome Model" for HLA class I peptide presentation *(25)*. Notably, C-terminal cleavability was observed to provide only minor contribution, perhaps indicating proteasomes to have a more promiscuous specificity than previously reported in vitro studies. Likewise, cellular localization played a weak role in presentation, providing evidence that HLA class I-peptides are derived from endogenous proteins throughout the cell. Applicants also demonstrated that peptide-binding stability had a varied effect among the alleles tested. These differences may be an artifact of the data used for NetMHCstab training, or they may reflect biologically meaningful differences among the unique peptide-binding grooves of HLA alleles. Although multiple variables impacting HLA-peptide binding predictions were identified, it is difficult to know with certainty how much of the remaining prediction deficit should be attributed to insufficiency of the current predictor variable set vs. inherent stochasticity of the MS readout.

[00457] While similar artificial neural networks have already been successfully employed for peptide-MHC binding affinity predictions *(7, 8)*, 'MSIntrinsic' and 'MSIntrinsicEC' performed better at identifying endogenously processed peptides. 'MSIntrinsic' appears to benefit from the unique nature of the LC-MS/MS dataset, which is more comprehensive and unbiased than IEDB for many alleles and is not subject to the same data heterogeneity. Meanwhile, 'MSIntrinsicEC' further benefits from the systematic incorporation of cleavability and expression information not available in IEDB. Recent therapeutic advances in cancer immunotherapy, such as those which activate T cells against tumor-specific epitopes, have showcased the promise of individualized epitope prediction as a therapeutic concept *(45–49)*. The high quality and large size of MS-derived datasets stand to contribute significantly to the improvement of these prediction algorithms.

[00458] The present invention can expose other features, such as protein translation and degradation rates and peptide secondary structure that contribute to the unexplained portion of HLA-peptide predictions. Further improvements in database search FDR estimations can also improve the method. For instance, the calculation of motif-specific FDRs can enable more peptide identifications by rescuing some of the high quality peptide identifications that do not match dominant peptide-binding motifs. In addition, Applicants can expand the search strategy by including less common variable peptide modifications, accounting for germline and somatic protein sequence variations, and employing *de novo* search algorithms *(50–52)*.

[00459] The methodologies described herein provide a path toward addressing new questions relating to HLA ligandomes. In particular, these workflows can be adapted to investigate the properties of HLA class II-binding peptides, for which a paucity of high quality data has severely limited prediction performance. In-depth analyses of the class II antigens could reveal novel immunotherapeutic targets because $CD4^+$ T cell activation is crucial for eliciting vaccine-induced B cell and CD8+ T cell responses and may even be directly cytotoxic [Haabeth, Frontiers in Immunology, 2014; Haabeth, Leukemia, 2016]. Applicants can also apply the workflows to enable the sequencing of HLA class I and class II peptides presented by patient-derived cell lines and primary tumor samples, which can provide an opportunity to make the observations more direct and personalized. Overall, Applicants have developed novel technologies incorporating unbiased, direct HLA-associated peptide sequencing and downstream computational analyses that yield a comprehensive view of antigen processing and presentation that can advance all

areas of immunology in which HLA-associated antigens are important, including cancer, infections, autoimmunity, allergy/asthma and transplantation.

Material and Methods

[00460] HLA-peptide immuno-purification from 721.221 B cells and desalting. Single HLA class I allele-expressing B cells *(13)* were generated by transduction of the HLA class I negative 721.221 cells with a retroviral vector to express a single HLA class I allele as described previously *(53)* (cells expressing A*02:01, A*24:02 and B*44:03 purchased from the Fred Hutchinson Research Cell Bank, University of Washington; others gifted from Dr. E.L. Reinherz, DFCI). The class I HLA identities of the cell lines were confirmed by standard molecular typing (Brigham and Women's Hospital Tissue Typing Laboratory, Boston MA). Cells were cultured and HLA-peptide immuno-purification was performed as previously described *(54, 55)*. Peptides were eluted from HLA complexes and desalted on in-house built Empore C18 StageTips (3M, 2315) *(56)*. Sample loading, washes, and elution were performed on a tabletop centrifuge at a maximum speed of 1,500-3,000 x *g*.

[00461] HLA-peptide immuno-purification of 721.221 B cells. Single HLA-allele expressing 721.221 cells were dissociated in lysis buffer in the presence of protease inhibitors and DNAse. Cells were subjected to sonication, and soluble lysates were collected after centrifugation and co-incubatd with Sepharose beads non-covalently linked to antibody. Beads were washed, dried, and stored until MS analysis. For example, 5-10 x 10^7 single HLA-allele expressing 721.221 cells were dissociated using 2 ml of protein lysis buffer (20 mM Tris [pH 8.0], 1 mM EDTA, 100 mM NaCl, 1% Triton X-100, 60 mM n-octylglucoside, phenylmethylsulfonyl fluoride (Sigma-Aldrich, St. Louis, MO) and protease inhibitors (Complete Protease Inhibitor Cocktail tablets, Roche Life Science, Indianapolis, IN) 200 units of DNAse (Roche Life Science, Indianapolis, IN). This workflow was applied to 10 HLA-A expressing cell lines (A*01:01, A*02:01, A*02:03, A*02:04, A*02:07, A*03:01, A*24:02, A*29:02, A*31:01, A*68:02) and 6 HLA-B expressing cell lines (B*35:01, B*44:02, B*44:03, B*51:01, B*54:01, B*57:01). Cell membranes were further disrupted using 500 watts, 20kHz, QSonica500 sonicator (QSonica, Newtown, CT) at 35% amplitude using 10 sec pulses until all the visible precipitates were solubilized. Lysates were pre-cleared using microfuge centrifugation for 20 minutes at 12,000 rpm at 4oC. Soluble lysates were co-incubated with 20 µl of

GammaBind Plus Sepharose beads (GE Lifesciences, Piscataway, NJ) non-covalently linked to W6/32 antibody (Santa Cruz Biotechnology, Dallas, Texas) for 3 hours. Beads were washed four times with lysis buffer without protease inhibitors, four times with 10 mM Tris (pH 8.0) and once with distilled water. Beads were dried and stored at -80oC until MS analysis.

[00462] An example of HLA-peptide elution and desalting. StageTips were equilibrated with 2 × 100 µL washes of methanol, 2 × 50 µL washes of 50% acetonitrile/0.1% formic acid, and 2 × 100 µL washes of 1% formic acid. In a tube, the dried beads from HLA-associated peptide IPs were thawed at 4°C, reconstituted in 50 µL 3%ACN/5% formic acid, and loaded onto StageTips. The beads were washed with 50 µL 1% formic acid, and peptides were further eluted using two rounds of 5 minute incubations in 10% acetic acid. The combined wash and elution volumes were combined and loaded onto StageTips. The tubes containing the IP beads were washed again with 50 µL 1% formic acid, and this volume was also loaded onto StageTips. Peptides were washed twice on the StageTip with 100 µL 1% formic acid. Peptides were eluted using a step gradient of 20 µL 20%ACN/0.1% formic acid, 20 µL 40%ACN/0.1% formic acid, and 20 µL 60%ACN/0.1% formic acid. Step elutions were combined and dried to completion.

[00463] Whole proteome analysis of single-HLA allele expressing cell lines. 25 µg of trypsin-digested cell lysate (Mertins et al., 2013) from single HLA allele expressing cell lines, for example, HLA-A*29:02 and HLA-B*51:01 expressing cell lines, were fractionated using a previously described high-pH reverse phase StageTip protocol (Dimayacyac-Esleta et al., 2015). Five fractions were collected from each cell line using the following increasing acetonitrile concentrations (10%, 15%, 35%, 55%, and 80%), dried to completion, and reconstituted in 9µL 3% acetonitrile/5% formic acid solution. Approximately half of each sample (4µL) was analyzed in a single-shot MS run as described below. Greater than 70% overlap (>4,300 proteins) was observed between the unique protein identification (>2 unique peptides per protein) from HLA-A*29:02 (>5,200 proteins) and HLA-B*51:01 (>5,100 proteins) expressing cell lines.

[00464] HLA-Peptide sequencing by tandem mass spectrometry. All nanoLC-ESI-MS/MS analyses employed the same LC separation conditions described below. Samples were chromatographically separated using a Proxeon Easy NanoLC 1000 (Thermo Scientific, San Jose, CA) fitted with a PicoFrit (New Objective, Woburn, MA) 75 µm inner diameter capillary with a 10 um emitter was packed under pressure to ~20 cm with of C18 Reprosil beads (1.9 µm particle size, 200 Å pore size, Dr. Maisch GmBH) and heated at 50 °C during separation.

Samples were loaded in 3 uL 3% ACN/ 5 % formic acid and peptides were eluted with a linear gradient from 7–30% of Buffer B (either 0.1% FA or 0.5% AcOH and 80% or 90% ACN) over 82 min, 30–90% Buffer B over 6 min and then held at 90% Buffer B for 15 min at 200 nL/min (Buffer A, either 0.1% FA or 0.5% AcOH and 3% ACN) to yield ~13 (FA)-18 (AcOH) sec peak widths. During data-dependent acquisition, eluted peptides were introduced into either a Q-Exactive plus (QE+) or Q-Exactive HF (QE-HF) mass spectrometer (Thermo Scientific) equipped with a nanoelectrospray source (James A. Hill Instrument Services, Arlington, MA) at 2.15kV. Resulting mass spectra were interpreted using the Spectrum Mill software package v5.1 pre-Release (Agilent Technologies, Santa Clara, CA). Instrument parameters and interpretation of LC-MS/MS data are described herein.

[00465] HLA-Peptide sequencing by tandem mass spectrometry. A full-scan MS was acquired at a resolution of 70,000 (QE+) or 60,000 (QE-HF) from 300 to 1,800 m/z (AGC target 1e6, 5ms Max IT). Each full scan was followed by top 12 (QE+) or 15 (QE-HF) data-dependent MS2 scans at resolution 17,500 (QE+) or 15,000 (QE-HF), using an isolation width of 1.7 m/z with a 0.3 m/z offset, a collision energy of 25 (QE+) or 27 (QE-HF), an ACG Target of 5e4, and a max fill time of 120 ms (QE+) or 100 ms (QE-HF) Max ion time. An isolation offset of 0.3 m/z was used so that doubly charged precursor isotope distributions would be centered in the isolation window. HLA peptides tend to be short, <15 amino acids, so the monoisotopic peak is nearly always the tallest peak in the isotope cluster and the mass spectrometer acquisition software places the tallest isotopic peak in the center of the isolation window in the absence of a specified offset. Dynamic exclusion was enabled with a repeat count of 1 and an exclusion duration of 15 secs (QE+) or 10 secs (QE-HF). Charge state screening was enabled along with monoisotopic precursor selection using Peptide Match Preferred to prevent triggering of MS/MS on precursor ions with charge state 1 (only for alleles with basic anchor residues), >6, or unassigned.

[00466] Interpretation of LC-MS/MS Data. Mass spectra were interpreted using the Spectrum Mill software package v5.1 pre-Release (Agilent Technologies, Santa Clara, CA). MS/MS spectra were excluded from searching if they did not have a precursor MH+ in the range of 600-2000, had a precursor charge > 5, or had a minimum of <5 detected peaks. Merging of similar spectra with the same precursor m/z acquired in the same chromatographic peak was disabled. MS/MS spectra were searched against a database that contained all UCSC Genome

Browser genes with hg19 annotation of the genome and its protein coding transcripts (63,691 entries; 10,917,867 unique 9mer peptides). A two-round search strategy was used. Prior to both search rounds, all MS/MS had to pass the spectral quality filter with a sequence tag length >2, i.e. minimum of 3 masses separated by the in-chain mass of an amino acid. In the first round search, all spectra were searched using a no-enzyme specificity, fixed modification of cysteine as unmodified, no variable modifications, a precursor mass tolerance of ±10 ppm, product mass tolerance of ±20 ppm, and a minimum matched peak intensity of 50%. Peptide spectrum matches (PSMs) for individual spectra were automatically designated as confidently assigned using the Spectrum Mill autovalidation module to apply target-decoy based FDR estimation at the PSM level to set scoring threshold criteria. Peptide autovalidation was done separately for each HLA allele with an auto thresholds strategy using a minimum sequence length of 7, automatic variable range precursor mass filtering, and score and delta Rank1 – Rank2 score thresholds optimized across all LC-MS/MS runs for an HLA allele. This yielded a PSM level FDR estimate for precursor charges 1 thru 4 of <1.0% for each precursor charge state. All confidently identified peptides for each allele used to define HLA-specific cleavage specificity. In the second round search, all remaining spectra that that were not confidently identified in the first round were searched using the HLA-specific cleavage specificity with the following allowed variable modifications added: oxidized methionine, pyroglutamic acid (N-term q), deamidation (n), cysteinylation (c), and phosphorylation (s,t,y). An additional round of FDR thresholding as described above was applied to PSM's from the second round search. The combined PSM's from each round had a peptide level FDR <2.0% for each HLA allele.

[00467] The creation of decoy sequences during the Spectrum Mill search was adapted so that the target decoy thresholding above better mimicked HLA-peptide populations. Decoy sequence generation typically involves reversing an entire protein sequence (preserves enzyme cleavage frequency), scrambling peptide sequences randomly, or reversing the internal sequence while keeping the ends fixed to enable FDR estimation within a specified confidence interval based on the levels of decoy and target matches (58). When generating decoys in Spectrum Mill for every sequence passing the precursor mass filter the peptide C-terminus was held fixed during the no enzyme search round. The second position was additionally held fixed during the HLA allele-specific cleavage round since HLA-associated peptides contain anchor residues at position 2 and last position.

[00468] Sequence properties of MS-identified peptides compared to IEDB. A curated set of previously identified class I HLA-bound peptides was downloaded from the Immune Epitope Database (IEDB) at http://www.iedb.org/ (accessed on 10/26/2015) (Vita et al., 2015). For each allele, IEDB peptides with a measured affinity <500nM were compared to MS peptides in terms of their length and positional amino acid frequencies. In addition, a metric was defined for the pairwise "distance" between 9mers (a Hamming distance calculated using an amino acid substitution matrix (Kim et al., 2009, *BMC Bioinformatics* **10**, 1–11) and inversely weighted according to positional entropy) and used to cluster MS and IEDB peptides in a 2-dimensional representation. A machine learning approach identified peptides with motifs favored in the MS but poor-scoring according to NetMHCpan-2.8; the MHC-binding affinities for these peptides were determined by competitive binding per gel filtration protocol (Sidney et al., *Current Protocols in Immunology*, (John Wiley & Sons, Inc., 2001).

[00469] Quantifying contributions to peptide presentation potential. To quantify the relative contribution of each explanatory variable, logistic models were built to discriminate hits from random genomic 9mer decoys. Several of these variables had highly non-normal distributions and were transformed. Predictive performance for a given variable set was quantified using a logistic model fit to differentiate all observed 9mers for a given allele from 999*n* random genomic 9mers. The 0.1% top-scoring peptides were considered as positives, and positive predictive value (TP/(TP+FP)=PPV) was assigned according to this threshold. The average PPV score per model was calculated across all alleles with available stability prediction (HLA-A01:01, HLA-A02:01, HLA-A03:01, HLA-A24:02, and HLA-B35:01). Variables were progressively added to the model and the increase in PPV at each step was used to assess the incremental contribution of each variable. The order of inclusion was determined by each variable's solo predictive power, except for stability, which was included last.

[00470] Peptide-Binding Assay. A subset of peptides were synthesized (RS Synthesis, Louisville KY) and tested for binding to HLA molecules (IC_{50} <500 nM) by competitive MHC class I allele-binding per gel filtration protocol *(57)*.

[00471] Machine learning. HLA-peptides sequenced by mass spectrometry along with a set of random decoys were used to build binary classifiers (one classifier per HLA allele) to predict whether a given peptide will bind to a specific HLA allele. Generalized linear models were first trained with the glmnet R package in a 5-fold cross-validation scheme. Theano was used to train

two types of neural networks: three models which incorporate one of the sequence encoding schemes with the rest of the peptide-intrinsic features (amino acid properties, and peptide characteristics), and three models which incorporate one of the sequence encoding schemes with all other features (including expression and cleavage). Scores of three models in each group were averaged together in an ensemble.

[00472] Database Search Evaluations. The validation yield (number of valid PSMs /filtered PSMs) across our HLA datasets was calculated to be approximately 9% (range of 2%-26%). This median validation yield was similar to the identification rate reported for high-energy collisional dissociation (HCD) only HLA-associated peptide sequencing (48). Applicants then compared our HLA-A*02:01 allele dataset to a high resolution dataset recently published for the HLA-A*02:01 positive B cell line, JY (1) (**Figure 6B**). Both datasets were searched using our strict filtering criteria and no enzyme specificity, as this was the specificity used by Bassani-Sternberg et al. A large degree of unique peptide overlap between our biologic replicates (71%) was observed, while a lower overlap (42%) was observed between two biological replicates of JY reported. Applicants also calculated the number of PSMs that passed our strict quality filters and 1% FDR estimation cutoff from the no enzyme and HLA-specific rounds of database searching (**Figure 6A**).

[00473] Assessment for MS bias. To assess whether data gathered via mass spectrometry may exhibit technical biases, Applicants first utilized the Enhance Signature Peptide (ESP) algorithm (Fusaro et al., 2009, *Nature Biotechnology* (2009) **27**, 190 - 198) to predict high-intensity peptides ("MS Observability Index") within peptides in the MS dataset as well as within peptides recorded in the IEDB. Fourteen out of the 16 alleles in the study were included in this analysis due to the very low number of peptides in IEDB for two of the alleles: HLA-A*02:04 and HLA-A*02. Since anchor positions have allele-specific residue preferences and more data is available for some alleles than others, Applicants considered 300 9mer binders chosen at ramdom for eah of the 14 alleles from each dataset (MS and IEDB), where for alleles with less than 300 identified binders the random sampling was performed with replacement. With the data thus formed, the ESPPredictor (available on GenePattern http://genepattern.broadinstitute.org/) was run for each peptide and the distributions of observability scores of peptides in the two data sets were compared (**Figure 12A**). To further proble for technical biases, Applicants used the same data to evaluate the frequency of

occurrence of each of the 20 amino acids within peptides in the MS and peptides in IEDB (**Figure 12B**). Similarly, amino acid frequency was also compared between peptides in IEDB and two additional external mass spectrometry data sets (Bassani-Sternberg et al., 2015, *Mol. Cell. Proteomics* **14**, 658–673; Trolle et al., 2016, *J. Immunol.* (2016), doi:10.4049/jimmunol.1501721) (**Figure 12F**).

[00474] Sequence properties of MS-identified peptides compared to IEDB

IEDB dataset

[00475] A curated set of previously identified HLA-I bound peptides was downloaded fromthe Immune Epitope Database (IEDB) at http://www.iedb.org/ (accessed on 10/26/2015) (Vita et al., 2015). The 'MHC Assay Details' option under 'Specialized Searches' was used and all 'Linear Epitopes' (under 'Epitope' menu box) associated with 'MHC Class I' (under 'Assay' menu box) were selected for each of the 16 alleles in our study. Furthermore, any epitope, which did not have a quantitative measure, was excluded.

Affinity and length

[00476] For each allele,MS-observed 9mer peptides were scored by NetMHCpan-v2.8 and compared to 1 million random 9mers drawn from the proteome (**Figure 4A**). MS peptides (all lengths) were assessed in terms of their length distributions (**Figure 1C**).

Heatmap of positional amino acid differences

[00477] Applicants tabulated the amino acid counts for each allele at each position (1-9) within 9mer peptides, first for the MS dataset and separately for the IEDB dataset (for IEDB data, peptides with measured binding affinity of less than 500nM were considered). Alleles HLA-A*02:04 and HLA-A*02:07 have less than 10 binders peptides in IEDB and were excluded from the analysis, leaving 14 out of the 16 alleles in our study. At each (allele, position, amino acid) tuple, the number of peptides which contain the amino acid and the number of peptides which do not are counted and a chi-squared test is used to asses for differences between the MS and IEDB data sets.

Sequence logo plots

[00478] To capture and compare binding motifs between groups of peptides, sequence logo plots were generated using the motifStack R package (**Figure 7A**).

Entropy

[00479] The entropy at each 9mer position (1 through 9) was calculated for each allele based on all LC-MS/MS 9mer peptides identified for that allele (MS entropy) and then similarly for all IEDB 9mers binders (nM<500) (IEDB entropy). The computation was performed with MolecularEntropy() function from HDMD R package, where entropy values are normalized by log(20) such that entropy of 0 indicates a position with no variation while entropy of 1 indicates that all amino acids are equally likely to be observed at that position (**Figures 2B & 7B**).

Peptide distance

[00480] The following peptide distance metric was defined and computed between every pair of 9mer peptides in the MS and IEDB sets:

$$d(s_1, s_2) = \frac{1}{9}\sum_{i=1}^{9} distPMBEC(s_{1i}, s_{2i}) * (1 - entropy_i),$$

where s_1 and s_2 are peptide sequences (e.g. KVLPIIQRW and HSRPIVTVW); s_{1i} is the amino acid at position I of the first peptide sequence; PMBEC is a pre-calculated matrix of residue similarities biased by their HLA binding properties (Kim et al., 2009) and distPMbEC, defined as max(PMBEC) – PMBEC, is a 20x20 matrix capturing residue dissimilaries; entropy is the [0,1]-scaled entropy at position i for the allele associated with s_1 and s_2. The average of MS and IEDB entropy was used in the distance metric computation.

Peptide distance visualization and clustering

[00481] A pairwise peptide distance matrix was computed between every pair of peptides 9mer peptides in the MS and IEDB sets as described above. Since the matrix contains relative peptide distances rather than absolute Cartesian coordinates, Applicants used non-metric multidimensional scaling (NMDS) to visualize the peptides in two demotions (nmds() function from ecodist R package). Density based clustering was then performed to assign peptides to clusters with dbscan() function from package dbscan (**Figure 8**).

Further assessing for mass spectrometry bias

[00482] To assess the possibility that MS data clusters closely together due to mass spectrometry-related technological biases, Applicants considered only the subset of peptides from MS and IEDB datasets with physicochemical properties that are favorable for MS detection. Namely, Applicants selected peptides with one charged residue (by counting the R, H, and K residues per peptide) and peptides with moderate hydrophobicity by removing peptides

which had hydrophobicity scores in the lowest and highest decile (a hydrophobicity score for each peptide was assigned with the hydrophobicity() function in Peptides R package). Analysis of the average peptide distances between MS and IEDB datasets and NMDS visualizations per allele were then carried out for this subset of favorable for MS peptides (36% of IEDB and 54% of MS peptides remained; alleles *HLA*-A*02:04 and A*02:07 were excluded due to low number of IEDB peptides), where the number of peptides was samples to be equal in the two data sets (**Figures 2E & 2A**).

Direct affinity measurement

[00483] To determine whether the MS dataset can be used to predict novel HLA-bound peptides, Applicants built a binary (bound/not bound) generalized linear model for each of the 16 only using the MS data in addition to a random set of decoys from the proteome. Applicants used these models to score each MS peptide. MS peptides were also evaluated with NetMHCpan-2.8 and those that scored in the top 10 percentile by MS-based models but bottom 10th percentile by NetMHCpan-2.8 were selected for experimental validation. Thirty tree peptides across five alleles (*HLA*-A*01:01, -A*29:02, -B*35:02, -B*51:01, -B*54:01) were synthesized (RS Synthesis, Louisville KY) and tested for binding to HLA molecules (IC50 <500 nM) by competitive HLA class I allele-binding per gel filtration protocol (Sidney et al., 2001) (**Figures 5A and 10A**).

[00484] ***Peptide Processing Analyses.*** For each MS hit, the upstream 10 amino acids and downstream 10 amino acids were determined. To account for peptides near the beginning or end of their source protein, a 21st "amino acid", denoted as "–", was introduced to represent blank positions. For the minority of hits mapping to multiple genes, a selection was made at random. Each MS peptide was matched to 100 random 9mer peptides (drawn from the human proteome) but matched according to the first two and last two amino acids (to control for confounding signals from non-random sequence patterns in the proteome). In comparing the sequence context of theMS hits to the sequence context of the decoys (**Figure 3A**), the relative enrichment for each amino acid at each position was calculated as a percent change, and the significance was calculated by chi-squared 2x2 contingency table test. Additional previously published MS datasets representing other cell types were analyzed using this same approach (**Figures 11B-G**). The amino acids frequency analysis in **Figure 12C**, which considers amino acids frequencies

within the peptide, uses a separate set of decoys comprising 1,000,000 9mers drawn at random from the proteome (*i.e.* no matching on first two and last two amino acids of the peptide).

[00485] To understand the motifs favored by the cleavage prediction algorithm NetChop (Keşmir et al., 2002, *Protein Eng.* **15**, 287–296; Nielsen et al., 2005, *Immunogenetics* **57**, 33–41) (**Figure 4I**), 1,000,000 random proteome 9mers and their corresponding sequence contexts were scored by the algorithm. The top-scoring 25% and bottom-scoring 25% were identified and analyzed in the manner of **Figure 3A** (top 25% treated as hits; bottom 25% treated as decoys).

[00486] To assess whether peptides might be enriched or depleted with respect to source protein sequence features, every MS peptide was matched to ten random 9mers from the same source gene. Then each hit or decoy was marked according to whether it intersected one of the Uniprot (ftp://ftp.uniprot.org/pub/databases/uniprot/knowledgebase/uniprot_sprot.dat.gz) sequence features: “STRAND”, “HELIX”, “TURN”, “SIGNAL”, or “COILED”. The relative frequency of these features was calculated for hits and decoys, and p-values were calculated by chi-square test (**Figure 12D**).

[00487] To determine how the relative expression of proteasome and immunoproteasome components in B721.221 cells compared to other tissues (**Figure 12D**), expression values (represented in transcripts per million) were compared against high-purity TCGA tumors (>95% according to the "percent tumor cell" field in the clinical slide review). If more than five samples were of sufficient purity for a given tumor type, only the top five were used.

[00488] To determine whether peptides were likely to be binding in non-canonical overhang conformations, 9mer and 10mer pairs were identified where the sequences were identical aside from 1 additional amino acid at the 10mer’s n- or c-terminus (*i.e.* an “extension” of the 9mer, which one might presume binds with overhang). For each pair, another 100 10mers were *simulated* by extending the 9mer with a random amino acid (sampling at proteome frequencies). This procedure was repeated with 9mer+11mer pairs, and three peptide groups – the “core” 9mers, the “extended” 10mers and 11mers, and the simulated 10mers and 11mers – were compared in terms of their predicted binding affinities. Binding predictions were made by concatenating the first 5 and last 4 amino acids of each peptide and processing it with NetMHCpan-v2.8 as a 9mer. This prediction approach assumed that anchors remain at a fixed distance from the peptide termini (regardless of peptide length), which should be true if peptides always bind in a “tucked” conformation rather than an “overhang” conformation. If overhang

conformation was common among the 10mers and 11mers of these nested sets, then the true 10mers and 11mers would not be expected to have better binding scores than the simulated 10mers and 11mers. On the other hand, if the true 10mers/11mers have similar scores as the 9mers, it suggests that nested sets only occur when short and long isoforms can both achieve a tucked conformation (strongly suggesting the overhang occurs rarely or never; (**Figure 9D**).

[00489] Quantifying variables associated with HLA presentation

Relationship between expression and affinity

[00490] RNA was isolated from B721.221 cells expressing a single HLA allele, for example, HLA-A*29:02-, B*51:01-, B*54:01-, and B*57:01 (RNeasy mini kit, QIAGEN), processed to cDNA (e.g., Nextera XT kit; Smart-seq2 protocol), sequenced (e.g., HiSeq2500, Rapid Run mode; 50bp paired-end), and aligned (e.g., bowtie2-2.2.1 (Langmead and Salzberg, 2012); UCSC hg19 annotation). Transcript expression (RSEM-1.2.19 (Li and Dewey, 2011); GEO accession GSE93315) were averaged across the 4 cell lines and adjusted by dropping non-coding transcripts and rescaling TPM values to sum to one million. Expression of each peptide source protein was determined by summing all transcripts containing the peptide.

[00491] To assess the relationship between expression and affinity, the 9mer MS peptides for each of the 16 profiled alleles were binned according to their predicted expression and affinity (NetMHCpan-v2.8 prediction). Meanwhile, 1,000,000 random proteome decoy 9mers were binned in the same manner (for each allele). Finally, for each expression-affinity bin, the ratio of MS hits to decoys was calculated (**Figure 4C**).

[00492] To understand the potential differences between observed MS peptides and HLA ligands that fail to be sampled in the MS, Applicants identified peptides that were readily detected (top 10% of precursor ion intensity) to those that were just barely detected (bottom 10% of precursor ion intensity). Expression and affinity values (per NetMHCpan-v2.8 prediction) were compared for the two peptide sets (**Figure 9E**).

[00493] To identify the potential impact of translational efficiency, the count of ATG 3mers upstream of the canonical ATG start codon was determined for each protein coding gene (per UCSC annotation). EachMS hit was matched to 10 9mer decoy peptides, which were chosen based on having similar RNA-Seq expression (minimum absolute log fold change) but different source gene. To avoid having all 10 decoys come from the same gene (which would add noise to the analysis), they were required to come from 10 different genes. In this manner, hits could be

compared to decoys in terms of the relative count of upstream ATGs in a manner controlled for relative gene expression (**Figure 11C**). The significance of the association was determined by t-test (comparing the upstream ATG counts of hits vs. decoys).

Impact of processing pathways

[00494] MS peptides were compared to decoys (10 decoys per MS peptide; each from a different gene; matched per transcript expression) in terms of various features potentially related to peptide processing: UNIPROT localization (www.uniprot.org), distance from protein N-terminus, source protein stability index (Guruprasad et al., 1990, *Protein Eng.* 4, 155–161), intrinsically disordered sequence content (http://d2p2.pro) (Oates et al., 2013, Nucleic Acids Res. 41, D508–D516), count of known uniquitination sites (Eichmann et al., 2014, *Tissue Antigens* 84; Kronke et al., 2015, *Nature* 523(7559); Udeshi et al., 2012, *Molecular & Cellular Proteomics* (2012) 11: 148-59), and physical interaction with known protein turnover regulators (Behrends et al., 2010, *Nature* 466, 68–76).

Assessing for aborted translation

[00495] Two vectors (length 30000) representing protein positions originating at the N-terminus (initialized to zeros) designated ***O*** ("observed") and ***E*** ("expected") were created. For each hit, 1 was added to the position determined for each peptide within the host transcript, and $1/n$ was added to positions 1 through n in ***E***, where n is the total number of positions that the peptide possibly could have come from (the total length of the protein minus the length of the peptide). The resulting ***O/E*** ratio, representing the ratio of observed to expected hits per position, were binned setting the bin length to 100 each.

Assessing bulge vs. overhang conformation

[00496] For each hit peptide, the affinity for each constituent sub-peptide of length 7 or greater was scored. To estimate affinity for a peptide of arbitrary length, the first 5 amino acids and the last 4 amino acids were concatenated and scored with NetMHCpan-2.8. The binding register of a hit peptide was considered a confident identification if the best sub-peptide had predicted affinity less than 500 nM and was at least 10x stronger than the second best sub-peptide. For the peptides for which the best sub-peptide was shorter than the full-length peptide, Applicants considered the position of the sub-peptide within the host peptide and the count of extra residues on the C-terminal and N-terminal side and these results were tabulated.

Affinity

[00497] Affinity for each sequenced 9mer for the HLA molecule it was eluted from was estimated using NetMHCpan-v2.8(*7*). Expression levels of peptides were determined using RNA-Seq data from four libraries (prepared from the A29:02-, B51:01-, B54:01-, and B57:01-transfected cell lines) that were aligned to the UCSC transcriptome annotation (downloaded June 2015) using Bowtie2 (bowtie2-2.2.1, default parameters (*59*)). Gene expression was quantified according to RSEM (rsem-1.2.19, default parameters (*60*)). Records for non-coding transcripts (per the UCSC annotation) were dropped and transcript per million (TPM) values were re-scaled and averaged across the four cell lines to yield a single expression value for each protein-coding transcript. The expression level of a peptide (hit or decoy) was determined as the sum of the expression levels of the transcripts containing that peptide. Expression and affinity bins were also defined for each allele by counting the number hits and decoys in each bin, and a binder:decoy ratio per bin was calculated by merging this analysis across alleles.

Localization

[00498] Localization information was obtained from "SUBCELLULAR LOCATION" records in Uniprot's curated protein annotation (ftp.uniprot.org/pub/databases/uniprot/current_release/knowledgebase/complete/uniprot_sprot.dat.gz). Uniprot's ID mapping table (ftp.uniprot.org /pub/databases/uniprot/current_ release/knowledgebase/idmapping/by_ organism/HUMAN _9606_idmapping.dat.gz) as well as the UCSC-to-Uniprot ID mapping available from UCSC table browser (https://genome.ucsc.edu /cgi-bin/hgTables) were used to sync these data with UCSC annotations. Proteins were tagged as "Cell Membrane" if the localization field contained the text "cell membrane"; "Mitochondria" if "mitochondr"; "Nucleus" if "nucle"; "Cytoplasm" if "cytoplasm"; "ER" if "Endoplasmic reticulum"; "Secreted" if "secret"; "Late Endosome" if "late endo". It was possible for a protein to be associated with more than one localization. A set of decoy peptides was constructed by matching each hit peptide to a decoy with similar expression because different cellular compartments tend to be expressed at different levels.

Stability

[00499] Stability predictions for hit peptides were generated using the NetMHCStab algorithm (*33*) for alleles available at time of publication: HLA-A01:01, HLA-A02:01, HLA-A03:01, HLA-A24:02, and HLA-B35:01. Because NetMHCStab has limited maximal throughput, stability predictions could not be calculated for the large set of 1e6 decoys. Rather, each hit peptide was matched to a single decoy with the most similar predicted affinity. Density plots

were created to compare the hits for each allele against the corresponding affinity-matched decoys.

Unfolded protein response

[00500] All proteins in the proteome were scored according to a sequence-based estimate of protein instability(Guruprasad et al., 1990). MS hits and expression-matched decoys (using the expression-matching approach employed in **Figure 9F**) were binned according to the instability scores of their source proteins. The relative ratio of hits in each bin was compared to that observed for the decoys (**Figure 9G**). The significance of the association was determined by ttest (comparing the instability scores of hits vs. decoys).

[00501] In a second analysis, all protein-coding genes were assessed in terms of their content of intrinsically disordered sequence. Disordered sequence predictions from 6 tools (iupred-l.disrange, iupred-s.disrange, espritz-d.disrange, espritz-n.disrange, espritz-x.disrange, and anchor.disrange; http://d2p2.pro(Oates et al., 2013) were available for the Gencode V19 human gene annotation; 12mers that were disordered according to three or more of the predictors were identified and counted for each gene in the UCSC gene annotation. MS hits and expressionmatched decoys were compared according to the percent disorder (disordered 12mers divided by total 12mers) in their source proteins (**Figure 9H**). The significance of the association was determined by t-test (comparing the percent disorder of hits vs. decoys).

Ubiquitination

[00502] Previously published ubiquitin-targeting IP-MS/MS experiments in KG-1, Jurkat, or MM1S cells (Kronke et al., 2015; Krönke et al., 2014; Udeshi et al., 2012) were pooled to define a set of putative ubiquitination sites, and these sites were counted per gene in the UCSC annotation. Hits and expression-matched decoys were compared in terms of their counts of ubiquitination sites, and significance was determined by t-test (comparing the site counts in hits vs. decoys). The p-value is presented as "0" since it was less than the machine precision of our operating system (approximately $1x10^{-300}$) (**Figure 9I**).

Protein turnover pathways

[00503] Results from nearly 200 IP-MS/MS experiments targeting various protein turnover pathways genes (http://besra.hms.harvard.edu/ipmsmsdbs/cgi-bin/downloads.cgi;http://www.nature.com/nature/journal/v466/n7302/full/nature09204.html) were downloaded, and the protein identifications in each experiment were sorted according to

their "Weighted D-Score", a measure of confidence that the given protein physically interacts with the bait. Each set was trimmed to include the only top 100 identifications to deplete it of non-specific binders. Then, for each set, Applicants counted the number ofMS hit peptides (vs. the number of expressionmatched decoy peptides) that could be assigned to a protein in the set. Enrichment was assessed as the rate of hits in the set divided by the rate of decoys in the set, and the p-value was determined using a chi-squared 2x2 contingency table (**Figure 4H**).

Peptide cleavage

[00504] Upstream cleavage of peptides observed across all alleles were systematically compared against random decoy peptides with the same first three amino acids ("3mer-matched"). The 3-mer matching approach accounted for non-random sequence patterns in the genome that might otherwise confound the analysis. The frequency of amino acids in upstream positions were determined for each hit and corresponding decoys. The relative enrichment for amino acid was calculated as a percent change while significance was calculated by paired t-test. Blank positions resulting from peptides from the N-terminus of proteins were considered as "-". An analogous procedure was followed where hits were matched to random decoys with the final 3 amino acids to analyze downstream enrichments. A simple logistic model was built to estimate C- and N-terminal cleavability that discriminated decoys from hits (10:1). Multi-mapping peptides were assumed to arise from the transcript with the highest expression. This analysis did not consider enrichments internal to the presented peptide because these would be confounded by the HLA peptide-binding motifs unique to each allele. A predictor that assessed the overall cleavability of a peptide in the same manner as NetChop (*23,24*) was also built using a logistic regression in which each input variable was the N-terminal or C-terminal cleavability.

Transformation of variables prior to PPV calculations

1. The log of the hit:decoy ratio was calculated for different affinity bins and the overall curve was smoothed using the isoreg() function in R (*61*). This log-ratio value was used rather than nM affinity directly.
2. Likewise, for expression, the log of the hit:decoy ratio was calculated for different expression bins and the overall curve was smoothed using isoreg(). This log ratio was used rather the TPM expression directly.
3. Seven dummy (0/1) variables were created to encode the various possible cellular localizations.

4. NetChop and MS-based cleavage probabilities were converted to log odds (log(p/(1-p)))
5. Stability predictions used half-lives.

Machine Learning Model Features

[00505] Five different classes of features were used for machine learning in various combinations:

1. Peptide sequence – 180 features. Each 9mer peptide amino acid sequence was represented as a numerical vector of length 180 in three ways 1.1) dummy (or binary) encoding, 1.2) blosum62-based encoding, 1.3) a fuzzy encoding where the each position in the vector represent the similarity between the true amino acid at the current peptide position with each of the 20 amino acids according to the PMBEC matrix (*19*).
2. Amino acid properties – 27 features. Each residue in a peptide was represented by the first three principle components of PCA on amino acid properties (27 features) (*35*).
3. Peptide properties – 8 features. The following peptide characteristics extracted from the Peptides package in R were used: “boman", "hmoment", "hydrophobicity", "helixbend", "sidechain", "xstr", "partspec", "pkc".
4. Expression – 1 feature. $\log_2$(TPM+1) expression (as measured here);
5. Cleavability – 1 feature. MS-based cleavage score (as defined above).

Linear Models

[00506] Linear models that only included the 180 dummy coding features were trained with glmnet R package. At the end of 5-fold training, the test results from each fold were assembled into the full data set and used to compute the area under curve (AUC) and PPV (as defined in main text). This was repeated with three different random initializations of the fitting procedure. The full training data set included all 9mer LC-MS/MS peptides identified as well as a set of 10x random decoys. Performance of the model was compared to NetMHCpan-2.8 on the same set of hits and decoys.

Neural Network Models

[00507] Artificial neural networks were built following the same cross-validation procedure with an equal number of positive and negative training examples: a random sample of all hit

peptides of size 10x the number of hits was taken (with replacement) and supplemented with a random set of decoys of the same size. The network architecture for the 'MSIntrinsic' model consisted of an input layer with 215 features (peptide sequence 180 + amino acid properties 27 + peptide properties 8) and single hidden layer with 50 hidden units. The final model scores were defined as the average of the outputs of 3 networks trained with different random initialization seeds. To compose the 'MSIntrinsicEC' ensemble model, first neural networks with 182 features (peptide sequence 180 + expression 1 + cleavability 1) and the same number of hidden layer units were trained with 3 random initilizations. The Final 'MSIntrinsicEC' scores were then calculated by taking the average of these networks and the 'MSIntrinsic' networks. The same 5-fold splits were used to train both types of neural networks to ensure 'MSIntrinsicEC' improvements were not due to seeing more positive training examples. All neural network training was done using Theano and code development followed the deep learning tutorial at deeplearning.net/software/theano/.

Development of new epitope selection algorithms

[00508] For each allele, neural network classifiers (one hidden layer with 50 units) were trained (using Theano (Theano Development Team, 2016); 5-fold cross-validation) to differentiate MS 9mers from random decoy 9mers using different input feature schemes: dummy encoding, BLOSUM62, PMBEC (Kim et al., 2009), biochemical properties (Bremel and Homan, 2010), and peptide-level features (D. Osorio, P. Rondon-Villarreal, R. Torres, 2014); the results of these models were averaged to obtain a single prediction (called MSIntrinsic). A second prediction (MSIntrinsicEC) was made by adding expression and MS-trained cleavability. Performance was validated on external data by measuring PPV (fraction of true MS peptides among the top-scoring 0.1%, where decoys are present at 999:1). For multi-allelic data sets, the evaluation excluded any MS peptides that obviously belonged to an HLA- or HLA-B allele other than the one in question (e.g. if predicting for A01:01 for a cell line with genotype A01:01, A02:01, B35:01, B44:02, MS-observed peptides with NetMHCpan-2.8 scores worse than 1000 nM for A01:01 and better than 150 nM for A02:01, B35:01, or B44:02 were excluded).

[00509] To determine the synergism that might be achieved with models that incorporate multiple variables (predicted affinity, expression, cleavability, *etc.*), Applicants built various logistic regression models (for each allele) to discriminate n MS-observed peptides from $999n$

decoy peptides. Since some predictor variables had highly non-normal distributions, they were transformed in the following ways:

1. **NetMHCpan-v2.8** (Hoof et al., 2009) **affinity**: the log of the hit:decoy ratio was calculated for logarithmically spaced affinity bins and the overall curve was smoothed monotonically using the isoreg() function in R(Team, 2014). This log-ratio value was used rather than nM affinity directly.

2. **NetMHCStabPan** (Jørgensen et al., 2014) **stability**: half-lives were used directly since they were normally distributed

3. **RNA-Seq Expression**: the log of the hit:decoy ratio was calculated for logarithmically spaced expression bins and the overall curve was smoothed monotonically using isoreg(). This log ratio was used rather than the TPM values directly.

4. **Protein Expression**: "iBAQ" values (calculated by summing the intensities of observed peptides for a given gene by the theoretical count of tryptic peptides in the gene (Ishihama et al., 2005)) were logtransformed (with zeros set to one tenth the minimum observed iBAQ value).

5. **Cleavability scores.** A logistic model (described in next section) was built to distinguish MS peptides from decoys (using external data sets) and applied to the B721.221 data (for more details, see next section). The resulting predicted probabilities were then logit transformed. (Logit-transformed NetChop scores were also used for comparison).

6. **Localization**: Seven dummy (0/1) variables were created to encode the various possible cellular localizations (defined by Uniprot as previously described).

[00510] All 63 possible subsets of the 6 variables were evaluated for each allele according the PPVmetric (**Table 3**). PPVs were averaged across all alleles (shown for select variable combinations in **Figure 5F**). In addition, Applicants found the order of variable addition that yielded the most PPV improvement soonest and determined the incremental improvement associated with each variable, considering this as its "explanatory contribution" (**Figure 5H**).

[00511] An MS-based cleavability predictor was developed by training on previously published MS data sets that profiled melanomas(Bassani-Sternberg et al., 2016), peripheral blood, and the C1R cell line(Caron et al., 2015). To create a set of negative examples, each MS-observed peptide was first mapped to all possible lengthmatched peptides in the proteome that *a)* have identical amino acids in the N1, N2, C2, and C1 positions and *b)* are not observed as positive training examples. Among these candidate negative examples (typically hundreds), ten

were selected at random (with replacement) using a probability weight proportional to the count of positive training examples mapping to the source transcript. This approach was taken to ensure that targets and decoys would be drawn from a similar set of source genes and resulted in a training set with 10 negative examples per positive example. Training was based on an encoding representing amino acid identities and properties (*i.e.* isA, isC, isD, isE, isF, isG, isH, isI, isK, isL, isM, isN, isP, isQ, isR, isS, isT, isV, isW, isY, and isBlank plus pKA, volume, and polarity (http://www.proteinsandproteomics.org/content/free/tables_1/table08.pdf)) and included positions U3, U2, U1, N1, N2, N3, C3, C2, C1, D1, D2, and D3 as well as a weighted average of positions U30...U4 (W=1...27), a weighted average of positions D4...D30 (W=27...1), and an unweighted average of positions N3...C3. These data were used to train a neural network (2 hidden layers of 50 and 10 nodes; 20% dropout for regularization; keras neural networks library (https://github.com/fchollet/keras)). To eliminate MS bias against cysteines, cysteines in cysteine-containing peptides were converted to serines for the purpose of forward prediction.

Saturation analysis

[00512] To determine the number of peptides required to build a strong predictor, Applicants carried out saturation analysis by training models with varying numbers of positive training examples (minimum of 15 and maximum the full set of MS-identified peptides) and by measuring PPV on a test set of fixed size. Performance improvement was seen to plateau at several hundred peptides (**Figure 5D**), with variation across alleles likely due to the varying complexity of the peptide repertoire per allele. Indeed, complexity score, defined as a decay-weighted average of the entropies at each peptide position, ranked the alleles with strongest performance, *HLA*-A*01:01, -B*44:03, -B*44:02, -A*29-02, as 1, 2, 3, and 5 of 16 respectively, from least to most complex.

Predicting external datasets using MS-trained neural networks

[00513] Performance of the MS-trained models was evaluated on 6 independent external data sources. First, Applicants used a competition dataset of eluted 9mer peptides and non-binders(Zhang et al., 2011). 'MSIntrinsic' performed better for 2 of 4 alleles compared to NetMHC-4.0 and NetMHCpan-2.8, even though most of the competition dataset was included in IEDB and likely in NetMHC training (**Table 4A**). Second, Applicants evaluated the methods using a curated and orthogonal dataset of 52 HIV-1 epitopes (that were associated with 12 HLA alleles from the study) for which T cell responses had been detected in patients (Llano A,

Williams, A, Overa, A, Silva-Arrieta, S, Brander, 2013). Applicants evaluated on the set of all HIV 9mer epitopes (excluding any that overlap with the data) mixed with a set of all HIV decoys (all tiled 9-mers across HIV proteins, excluding true HIV epitopes, ~3000 peptides). After scoring and ranking all peptides, 'MSIntrinsic' was able to predict the top-ranked true epitope at the same or higher position compared to NetMHC-4.0 or NetMHCpan-2.8 for 9 of the 12 alleles (**Table 4B)**. Third, Applicants made predictions on 9mer T cell response epitopes retrieved from IEDB (Chowell et al., 2015) by accessing PPV and AUC (**Table 4C**). To compute PPV, the top 0.1% of the model's predicted peptides were considered true positives. Applicants ruled out 0.01% because Applicants have directly observed more than 1000 9mers for some alleles, and 1% would imply that 100,000 peptides are presented per allele, which is inconsistent with previous biochemical estimates (Walz et al., 2015). Applicants thus define PPV as the fraction of LC-MS/MS peptides found within the model's 0.1% top scoring peptides. In this way, Applicants test how effectively a model calls MS peptides from a background of random peptides (e.g. for n MS-observed 9mer peptides, Applicants mix in 999n random 9mer decoy peptides from the human genome). Fourth, Applicants predicted HLAbound peptides an independent source of peptides eluted from purified HLA molecules using LC-MS/MS from 7 cell lines that express multiple HLA alleles (Bassani-Sternberg et al., 2015). For each allele that overlapped with the study, Applicants first excluded peptides that were predicted to bind other alleles (<150nM by NetMHCpan-2.8) but not the allele of interest (>1000nM), and then added 999n decoys (**Figure 5E**). Finally, Applicants evaluated the models on the soluble HLA single-allele mass spectrometry dataset generated by Trolle and colleagues. Similarly, 999n decoys were introduced to the identified peptides and PPV and AUC were evaluated. Since the data is allele-specific, there was no uncertainty in assigning peptides to alleles (**Figure 5E**). To determine whether NetMHC's weaker performance related to MS bias, a second set of NetMHCbased predictions were made by B721.221-trained logistic regressions based on log NetMHC affinity, ESP observability, and count of cysteines. Expression data from for the cell lines in the two studies was downloaded from CCLE and ENCODE.

TABLES

[00514] Table 1A: Master List Controls Removed A complete list of HLA-associated peptides identified across 16 HLA alleles with peptides identified from the negative control

immunopurifications removed. Individual HLA allele lists including peptides from the negative control immunopurifications are also reported.

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YTEGDALDALGLKRY	KLWEMDNmLI	KLYDIDVAKV	AAVAAALARLLAA	qVDDLKAKL
LTEIYGERLYETSY	ILDEMSHKLRL	VLKDLVKVI	ALLDKLYALGL	YLWDLDHGFAGV
PVEEFNELLSKY	KLYDIDVAKV	VLYPHEPTAVF	GLADASLLKKV	KLDDTYIKAYL
TVDIQNPDITSSRY	LLGELPRLLLL	KmYEEFLSKV	VLWDRTFSLF	KLDDIVQHI
ASDKETYELRY	KLIEKLDIKL	GLADLERAQAMI	YLFDVQRNNIAM	KLPWPEWMGV
VTELGPEEVRWFY	TGSWIGLRNLDLKGEF	ILmEHIHKL	KLLDFGSLSNLQV	KLWEMDNmLI
LTELLERAAFY	ILMEHIHKL	ILMEHIHKL	ALLDIIRSL	GLDDIKDLKV
VTDISDLIRDSY	ILmEHIHKL	RVLDFDPmAV	SLLSPGLLPHL	ILDEFYGPEKSL
LLEDFLEHEGYKY	KLWEVSSGELLL	ALFPHLLQPVLW	ALNEEAGRLLL	RLPAAGVGDmVM
RSEAPNWATQDSGFY	KLYQEVEIASV	KMYEEFLSKV	ILDEVIFKL	IIDELIKKL
ATDDASLLIVNRY	GILTKELLHSV	KVKDILSKV	ALVDQLWKL	ILmEHIHKL
ESEAASYLDQISRY	FLWERPTLL	SLFLRTPKIV	TLLEEIRDLAL	FLWERPTLLV
NSAIIYDRDFSYNY	ALFPHLLQPVLW	FTFPNRLLTT	ILmEHIHKL	FLDEWLYKF
ATDDATLLIVNRY	KLLDFGSLSNLQV	SLKEMVSKL	ILWEHLEIL	AIDEALAALHV
ATELGKLPAGGVLY	VLLDTANKKVFL	AMFSPPVSSGKNGPTSL	TLQEFLERIHL	FLDEKTHELL
ASAAAAAAAALLY	ALFARPDLLLL	SVISHLLRV	KLFSLQDLLLL	GLDHIVDKV
VTDGAILGKLY	KLLGELHTL	HLFDHVVNRV	KLLNLISKL	ILMEHIHKL
KSDLFFHDY	SLQEFVKAFYL	AFGGSGGRGSSSGGGY	RVLDPSMVILEV	KMDWIFHTI
ISYGPDWKDFY	YLDPALELGPRNV	ILKKVLEAL	RLFDEPQLASL	AVDWLHELL
YSEVLTDTRGLY	VLISKELISLLHL	ALKDFVASIDATY	ALFARPDLLLL	ILDEVIFKL
ATDSFSGRFEDVY	YLHDQNPDAAL	SLKmKVVEV	TLLAAEFLKQV	ILDDVSLTHLTFG
FLENVIRDAVTY	RMFDQQEIQVLI	SRSGGGGGGGLGSGGSIR	ALSDLALHFL	KIEDLIKYL
ATEIELAKQITSY	KQMEQISQFL	SLKDDLTKL	TLTSKLYSL	PKLYVKL
LSDPQTRAIYDIY	ILWEHLEIL	RLFQENLGLL	SLAEIYEQEYIKL	ILRDPLQTDTL
DSDLQLDRISVYY	KLLEVSDDPQVLAV	FIFDVHVHEV	SLLDRFLATV	RLDEPLASYIF
FIDVDDERWHY	YLFDVQRNNIAM	GLIIRKPVTV	qLLEKVPTL	HVDEIKEFL
LVDPWTPHLY	VLWDRTFSLF	LILEKQPAYV	VLQKLLEKL	SIDDVVKKL
NTIRQEEGVFGFY	LLIDDKGTIKL	GLIEILKKV	ALTELLAKI	ILDELVKSL
VTESPAKFALY	GLLEDAETKNVAL	VLYPHEPTAV	SLLPEGPPAI	ALDEVVLKF
KSDVWSFGILLY	SLLEHLSHV	KLYEKKLLKL	QLLDQIWRT	LLDELTHEFL
TLDPYRNEVSQLY	YLFERIKEL	ADASLLKKV	HVNPYIGLFFF	SLDDSAKKVLL
GTEIDGRSISLYY	ILLDERGQIKL	GLHFKIKPI	SLNDLEKDVmLL	qLEGFFLHL
PTDPDPIRGFGSY	GLIDVHVHL	HLRDFLVQI	ALLDKLYAL	KLWTGGLDNTV
LVDNSIRELQY	GLIEILKKV	YLAKVKSLL	FLWERPTLL	ALDNVDARMYM
TTDLFGRDLSY	ALYDPINPDRETL	ILNKALLLGA	FLLDPYKYMTL	FLLDPYKYMTL
TTELVNKDLDIYY	SRAQLGGPEAAKSDETAAK	KMREDVISSI	KLLDPEDVAVQL	VLDPDLRMTF
TTEQILYNIKQEY	FLAERLYAEV	ALTELLAKI	RLLGEEVVRVLQA	ILDEMSHKLRL
ADMGHLKY	FLYKEKLVSV	HLIGDFSKV	LLAELLTHL	SVDDIVKGINSS
YTDLLRLFEY	ALNEEAGRLLL	LLYPHQVPLVL	YANAKIYKL	YLDKIRDLL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
NTEGINLPELFKY	ALTELLAKI	FLAERLYAEV	SLADIAQKLQL	ILDDLFLHTL
RQATTIIADNIIFLSDQ	FLAEHPNVTL	AFGGSGGRGSSSGGGYSSGSS	RLLDWFRSL	ILDDVSLTHLT
KTDLLLEPYNKY	RLYGDESELHFWTV	YLFERIKEL	ITQERIVFL	qVDEFRFLL
RSQLDISDPYKVY	ALINDILGELVKL	NLRDWLRVV	STLHLVLRL	TIDPFWDISL
STDDYFHHQDGYRY	KLGHTDILVGV	WLKEHVEPVF	FLAERLYAEV	KLDDIFEPVL
YVDQAELEKY	LLDPNVKSIFV	RMYPFQIHSI	LLLDILEKL	KVDWLTEKM
IADMGHLKY	YLTHDSPSV	SMNTHLKAV	NLFEWHFTVR	ILDWHFANL
ASEAEMRLFY	FLLDIEDRIYQG	VLFEKEVNEV	RLLEESLLSLI	YIDRIHIFF
VTEITDDLHFY	VLWDRTFSL	SLFGPLPGPGPALV	GLTEALHFV	RLPAAGVGDMVm
ITDLPDHLLSY	SLIGHLQTL	AQRVKEV	TLEEIIFKL	ILDPVGPDGKNQL
YTFEPRTPDELY	FIFDVHVHEV	SLIKKIKDV	TLSERLWGL	RLDEIFQTGL
NSYPRFLESEFY	FASHVSPEV	ISGGGSRGGGGGGYGSGGSSY	LLLEILHEI	ILWAASKSQLL
NTEVLLSHLSY	SLLEKQQIYL	RQYPWGVAEV	SLVEIILHV	LLDEPTNHLDL
RTEIIEDLAFY	RLIAQRYLL	SLKSSLHTL	GQSELASRLTL	KAPDFLPLL
FIDSQRVWAEY	LLFDHLEPIEL	LLFDRPMHV	YLAEKYEWDV	YVIDPIKGLKL
LTHSLVLHY	KIWDLKERTNV	SLIGHLQTL	SLLDIIEKV	qLDDLKVEL
LLDDAQRLLY	KLFTQIFGVGV	TLKEYLESL	SLYPQFMFHL	TAQVIILNHPGQI
LSEERVWEY	YLSEDVFQHAV	KLGPAPKTL	ALFIRPFML	ILWEHLEIL
TSETPDYLLKY	RVLPPSALQSV	AIFDRVLTEL	TLFAGYTDNLVRV	ILDPHVVLL
ASEDATIKVWDY	RVLDPSMVILEV	YLSPDLSKV	KLLDAYLLYI	FLWERPTLL
VSDPSSPQYGKYL	KLIDETQDMLL	SLFERLVKV	GLLDLPFRVGV	VIDEIGKMELF
YSDRYIFASNLY	KLWTGGLDNTV	SLKMKVVEV	SLQEKLWAI	VLDDPKHIQL
TTELVNKDLDIY	KLLSSEDIEGMRL	AMAEPNAKFIEGV	GLTSTDLLFHL	LLDKLYALGL
ATDFKFAmY	DTNADKQLSF	RLMNLPLHSV	IILDEIHLL	YVIAYIRDLAL
LSDALLNKLIGRY	HLTDITLKV	SmKAFISKV	ALTWLIPTL	YIEDLKKFL
STAPTEPLTHWY	TLLDPNEKYLL	ALSPITKLSV	FVLPILQKL	RVLPPSALQSV
VLDPYLLKY	VLQEFGRIDILV	GLTDKVGRV	SLQQRTWLI	YIDEQFERYL
YADNQVMHFY	KLLDISELDmV	TLIGFLRSIDQ	SLFKIWLV	ALDTPVMVHM
LTEPPLNTPENREY	FLLDKPQDLSI	VLKPGGLLKV	VLYDWKERL	FLDESRSTQYM
ATANAKDLYDIFY	FLLDPYKYMTL	YLVVKIEKV	GLIEILKKV	LIDENYLDRL
ATMTIEELLTRY	VLLGESAVGKSSL	KLFPGFEIETV	SVLPESTLFRL	mVDPVTGDKL
VLDVVERSLSNY	FVFDRPLPVS	TLAQRVKEV	VLQQRLIAL	ALPPAIQEEVL
YTESWRWSAY	TLWVDPYEV	YIFPTLDKPSVV	AIMDLLLRL	ILWEHLEQMI
STDVSDLLHQY	KLWEMDNMLI	TLFPAIEKNIV	KLLNIIDLQFL	VLDGLSNILKM
HSEMYSLLIDTY	RLLDMGETDLML	KMNEKLYTV	NLFEWHFTV	KLEDVLPLAF
YLDDPDLKY	GLWGPEEEPHL	AMFSPPVNSGKTRPTTL	VLNEAAQILRL	KMPQSMPEYAL
TTDDWKDFLY	ALVDHVAEL	LLHDGIPVV	SLLTVIEKL	AVEAIVKNV
ITEKGISDLAQHY	SLIEKLWQT	ALKDFVASIDATYA	YLADIFTKL	KLQEQIFHL
YSEIKDFLSY	GLLAGDRLVEV	SRFSSSGGGGGGGRFSSS	YLLPAIVHI	KLPEPLEDGL
SSEQVVDLLRY	KLKPGDLVGV	ALAALRDVKSYL	LLKDSIVQL	YLDIKGLLDV
NIDGFLGPWAKY	RLFDEPQLASL	ALFQRPPLIA	SLLALLHSL	KLLFWVTEV
SSDVIRLIMQY	FLYQRLVVGA	ALANHLIKV	SLQYFIPAL	ILDEPTNHLDM

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
NTDRQWLIDTLY	SILHDVVEV	ALKEIKAEV	FLIQNVLRL	ALDKIFNKV
LSDLLDWKY	SLYGGNAVVELVTV	ALFQHITAL	HLFEDAYLLTL	HLDEAIHVL
TTDGVYEGVAIGGDRY	SLFKLIVKV	GLKGRVFEV	ILLDRLLYL	VLWDRTFSL
TTEILRSMLY	FLLDPVKGERL	TLGVKQLIVGV	ILQDLVKNL	ALIEAEKVAQV
YLDLKSDEWEY	RLLDMGETDLmL	ILKEISPLL	AVADHLFKL	LLDELIKSGQL
ATmTIEELLTRY	LLFPQIEGIKI	HLSDHLSEL	LLFEGEKITI	RLPPEIFGDAL
VTDIHQLSF	SLLSHVEQL	SLLDRFLATV	RLLEEIHAm	FLDDVFEVKL
GTEFLNPLISKY	YLWEHIFEGL	LVYPEELKPVL	TLIDLPGITKV	FLDENVHFF
VLDPYLLKYF	KLADFGDAVQL	AAFGGSGGRGSSSGGGY	ALFISPALI	YMEEIYHRI
qTDNLELKKLVY	FIWPMLIHI	GLADASLLKKV	GLSAFLHAI	KLDDIVQHIY
VVEQLKDWLY	KLLEGQVIQL	VLFSSHVRKV	SLQEFLRQL	VVDDIVSKLVF
LSELSNPEISKY	RLLDLENSLLGL	KQIDQFLVV	YLHDFLKYL	LLYDLADQLHA
LTDIFQHDTY	FLIEEQKIVVKV	KMNEKIASL	AILKYIETL	VLDPPTDLKF
YTEPNYWIRY	TGSWIGLRNLDLKG	GLAPHLEQI	GLLAKIFEL	KVDPLFTEL
SSEDSEKVIAGLY	FLFLDRTYV	GLAPKPVQV	ALNNLLHSL	YVDDVFLRVL
YTEQLLRGLSY	RLFNDPVAmV	KLAEKLTIL	TLNEKLTAL	FLDDGFLVPTF
FLDPITGTFRY	TLADLRVLFGI	LLSSHVRGV	GLLDRIMQL	PDIKVYL
GTEIDGRSISLY	SLYDWNVKL	VMQDPEFLQSV	ETVLWVVHV	ILDPAYPDITL
VTDKLFVIDALY	VLWKEILFL	ALKDPVHTV	AImDIVIKV	KLPEPQSFSSA
ETEFENGNRSWFY	qLLEKVPTL	AFGGSGGRGSSSGGGYSSGSSS	GLLPDVPSL	AVDEVVLKF
VSDELRQWY	KLMNVDPDSVVL	ALYFFPILTV	LLNDRIWLA	SADPFYWMRV
AVESFLRGTTSY	KLLFWVTEV	HQRTFVLEV	SLLRVGWSV	FLDPGGPMMKL
VLDVISLVDKY	FLLDKKIGV	TLYPLHILFV	YGLDKIEFL	HNPHVNPLPTGYEDE
YTDmESEDYHFY	LASPEYVNLPINGNGKQ	IIKPDPPEGV	LLQVVLPAL	VLPKLYVKL
LIDNGVTKGFVY	AMIDTEFAKQTSL	IEILKKV	QLQDYIQLL	VVDHLLLRL
PTDPKVVVY	FLLEQEKTQAL	VLFPKPGPLEPTQR	qLLEKVIEL	YLDAIKLLL
ATEDPWKTNY	LLLKGVEAV	AQYEHDLEVA	qLQEIIARL	HPGQISAGYAPVL
HSEmYSLLIDTY	KLLEVNGVAL	LLAELLTHL	FIWENIHTL	ILDESHYKELL
LLDENKSLSTYY	RLLDLENIQI	ALIEAEKVAQV	LLLEAVWHL	YLSPKLWAL
VTEEPQRLFY	LTAAKKARAGLEDL	SMKAFISKV	YLIPDIDLKL	YVDRVTEFL
LTELMFEHY	GLAPKPVQV	FAIDPHLLLSV	qLVDIIEKV	PGDSDIIRSMPEQTGEK
VTDSGRTVILY	VLLGHIFYV	FVKDSIRLV	ALTGIPLPLI	FLDEKTHEL
DVDIRKDLY	HLSVVSVTV	SLKQKILKV	ALWDIETGQQTV	VLDDPKSAGVATF
LADWVSGKISFY	FLLRVGADPAL	FLYPFPLALF	ADASLLKKV	LLDEFYKLV
YTFEPRTPDELYF	ALITRIFGV	YLLQEPPRTV	ILAELLLRV	FLDKELTGL
LSDIASLKALY	LLFEGEKITI	SLVGQHILSV	SIYPSPTGV	ILDWKFDRV
YLDNVIGHSY	SLIAHNLVHLLLL	YLFHVQEV	SMVDVVmLL	TGSWIGLRNLDLK
GTEFPNPLISKY	VLGGKAFLEHL	ALSPHNILL	FLWDEGFHQL	VLDETRTAYI
LTDITKGVQY	FLWEYGDLHLF	KLFEKVKEV	ALLPDLPAL	YLPDIIKDQKA
ITDVSWRLEY	TLLAAEFLKQV	YLFDVQRNNIAMA	SLLELPHPLL	MLDSGADYLHL
RTDSSISNLMDY	VLLRVLILL	GLTEALHFV	ALSPNYDHVVL	KLWEmDNmLI
YSAPPGDPLSTnY	VLMEKPDVVV	LLFDRHPDGVASV	RFTEWLHEV	YImEPSIFNTL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YAALHGEFY	YLDEYIARM	SLFSHLLEI	SLAEFVQSL	LLLEILHEI
ATEESFFILKY	YLDIKGLLDV	ALRDVIKAL	MEHIHKL	RVPPPPQSV
ATDIKITVY	TLYPLHILFV	KLGLKPLEV	SAMELIWNL	ILPDITKDELF
ISEQTGKELLY	NLASFIEQVAV	YLHDFLKYL	SLNDLEKDVMLL	PPAENSSAPEAEQGGAE
YTDMESEDYHFY	SIQQSIERLLV	YLHSQVVSV	KLLFWVTEV	YLDPLVFREF
EIEQRGLTETGLY	SLLPEGPPAI	YLKDLIEEV	SLLPPDALVGL	SVDDIHFLVL
FLDASGAKLDY	ALYDENTKLWYA	RVLDFDPMAV	mLATRVFSL	VVDGVHGAFI
LLDDHDYGSWGNY	GEPLSYTRFSLARQVD	SLFDIISKI	VmQDIVYKL	VLLGHIFYV
DTDHYFLRY	KLGDFGLLVEL	YIYDKDMEII	ALLELLHEL	FVDDSGRYLAI
FSEPDFVAKFY	KVLDLKINL	AVYGFKLQSL	SLMDPNKFLLL	IVDDKFFKL
HTDDPLTWDY	TLYNPERTITV	FGGHIRSV	ALLDRIVSV	KLEDFIKNL
FIAAEGIHTGQFVY	YAYDGKDYIAL	FIKDLPIRKV	SLAEVAGLQV	KVDKLYAGL
SPEYVNLPINGNGKQ	FLIRESETL	GLAPNTPGKA	FLFVDPELVSA	KLDAFVEGV
TTDLELIKY	FINIVVHSV	TLKKVSVTV	YIFEEPFTI	VGPPETSLHTV
ATEVDSRWQEY	KLDAFVEGV	YIFPLDDKAAV	TLTNIIHNL	GMDLVVKTV
LTEEINKWRLLY	YLADLYHFV	HLSELNTKL	ALWDKLFNL	LIDQKVYEL
ATDGKVLLW	FLWEYGDLHL	RLFNDPVAmV	LINVPPPFL	LVDDHFVEL
VSEIINNAIVHY	RLLILENILL	SLKDEVLKI	KLIDLSQVMYL	TGSWIGLRNLDLKGEF
RTELPQFVSY	SLLDIIEKVMA	TLKDGIImI	RVLDPSmVILEV	TVFEHTFHV
VVDPFSKKDWY	TLWNQELYI	GLAGGAGGRGELLAA	YImEPSIFNTL	YLDEDTIYHL
LVDLGVLSDPGSGLY	YLDHTADVQL	VMFRTPLASV	LRLLHIEEL	FVDRGFYSV
LTDDGnKWLY	GLVGIGLSRLFSA	KLKPGDLVGV	qLIDKVWQL	YLDRFLAGV
YSDITIFEKQEY	HLLDFPNIVI	TLIHQVLEA	NLFKWVGTI	VLWIPAFmV
FTYDPWIGKLLY	SLLDRFLATV	TVLPVPPLSV	AmLERLLSL	FLDNLHINLL
LLDPSQKNLY	SLLKEPQKVQL	ALAKHLIKI	ATMPDLYHL	FIWPMLIHI
TTENQYRLTSLY	ILLDDQFQPKL	ALKDFVASI	HLLFWGVLA	LLPEPNILQLL
ETERIYSLFNLY	KLFDRPQELKL	GIFGGHIRSV	KLWEmDNmLI	TLPTREVFLEA
ELEKVLPQTILY	SLLDEFYKL	VmAPRTLVL	mLIEVIEKL	ILDESHERVF
KSELPLVIGTFLY	VLFSSPPVILL	SLIEKVTQL	VLADQVWTL	qLDIIIHSL
ISELLTSDDMKNAY	ALWDLAADKQTL	TLYDIAHTPGV	FAIDPHLLLSV	FILEKIEYL
KSDVHLNFY	LLLAHIIAL	LLPDFLSEHSKV	LSLENLEKI	RMPPPANLPSL
RVDPAKGLFY	YLNDLHEVLL	ALFPALRPGGFQA	AVMAPRTLVLL	LLDEMKFSL
VTELHVISY	FLWDEGFHQL	SLFYRDIISI	KLLKDLPEL	SLDEPSVKTM
ISALPEDKGVDLY	FLYPFLHTV	ALKDSILKI	SLLDEFYKL	ALPEPQEAQKL
YADQLKEYLFY	RMLPHAPGV	KLNAKLAEL	SLLDILKRL	NLDKLYHGL
YLEQLILKY	ALDPLADKILI	GLREQELQVV	SLLNFLQHL	FLDSLRDLI
LTEITKGWLY	YLLIEEDIRDLAA	ILGPKPQGV	ALTGYLHTI	ILDKVLTAm
NTDPWAGYRY	KLIDETQDmLL	FVFDRPLPVS	LLYDLADQLHA	KLPDLPQNSV
YTVSREDGSFSFY	ALTWLIPTL	SIYPSPTGV	YLWDLDHGFAGV	SVDSHFSHL
FTEHEIQEWY	FLFDIPKILDL	FLNELIKVL	QLLIWIPRL	YLADIFTKL
YVDQVLQLVY	AAVAAALARLLAA	SLYGGNAVVELVTV	SLLHLGALYGI	ALPKELPLISS
LTELPDWSY	GLAPHLEQI	YLVSHPNEV	TLAKYLmEL	LLFDRPmHV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YLDWAYRSGGY	GLLAKIFEL	NLFNPSSKSSV	FLINFIHTL	KIWDLKERTNV
YSDKYFDEHYEY	KLLEVQILEV	ILSHLSSEL	SLLQTLYKV	VVDWLYTHV
NTDLWIVmEY	SLFGPLPGPGPALV	SLKTFVHTV	TLLHFLAEL	IIDDHPEVTV
RTmEIESTFHMY	KILDYEVTL	SLLGHLmIV	NLIGKIEKL	KLWQTPLHV
YTFSSIEREEY	STFDHPELVKL	ALATHILSL	ILLAEGRLVNL	AIVRSLPSV
LTELPPLDDY	SLVDGRIIDTSL	FGYPFRLNEA	SVYSWDIVV	ALDPLADKILI
YADPYRQLQY	TLLEEIRDLAL	TLKDLLFGV	VLNEYFHNV	RLDEALQGSAL
STQLPSSPFGDY	YIFPLDDKAAV	RLFENLRML	YALNHTLSV	KLEEIIHQI
TVEERNLLSVAY	YLSPDLSKV	AIKKELTQI	ALIRYLETm	FLDHVMYTI
FLDPAQRDLY	KLWEFFQVDV	SLTGHISTV	ATFARIWYL	GLLSIFTKV
FSDLNLEAHMY	RLMNLPLHSV	FIIEKQPPQV	FLLDKALLI	FLFLDRTYV
YSDFPFHEDY	YLHSQVVSV	SVFERALSSV	IIFVPVPQL	FVLPILQKL
YTDHQFTELTRLY	LLHDGIPVV	TLVDLSKMQNV	GLADNTVIAKV	KLPSTLTGL
NAFEESKDNTIPLLY	KLFPGFEIETV	GLAPAAPLQV	IIAAWTVRV	YLDKFIRLL
LTDEQIRFLY	FLWTEKFPSL	KVFDQYLNFI	ALFQHITAL	SLDDIYmIGV
QTVAWFPLYY	ALANHLIKV	SLFPHNPQFI	KLSLVAAmLLL	KILQELPSV
LTDYFLKDEY	KLQDLTDVQIMA	FLYNHGIGTL	RILDIDIPMSV	qLDELMAHL
WVDPYEVSY	YLSVKIWDL	SLNKQIETV	FLLDPYKYmTL	AVDNILLKL
LTDDGNKWLY	SLMDPNKFLLL	VLYPASPHGV	SLYDWNVKLL	FLDPPPYETL
NTEAFYKISTLYY	FLSEHPNVTL	GLAAKLMEL	GLLDPNVKSIFV	FLYPFPLAL
ISELLTSDDmKNAY	KLLEEQGIFL	YMIAHITGL	LLLDVTPLSL	ILDEADKLL
LSDILRFIY	VLFENTDSVHL	HLIHEVTKV	VLLQVLHVL	mLDPLEVHL
ESAFRKLDELY	SLVEIILHV	ILKDVIPPLE	FVLQRLVFL	SLPDHLPSV
YSEDRIGLADY	FLSTLHEVYL	KLYQEVEIASV	SLIGHLQTL	VMDSAFKVYL
ATDIQVLALTY	YLPDIIKDQKA	SLAEEKLQASV	ALEEYGPELHV	FIDKFTPPVV
TIDDFRNQVY	KMLDEILLQL	LIKSGQLLGV	ALFKAWAL	TFAPVNVTTEVKSV
YTEFVPQIPGY	RLLGEEVVRVLQA	GLTPHLTMV	KINEWLTLV	ALDPSLDNHQV
ETERFRELLLY	TLWYRAPEVLL	YIKDYMKSI	KLSLVAAMLLL	LVDQRELYL
FLDYEAGHLSFY	ALFQRPPLI	SMYGVDLHKA	TLKEYLESL	SLDPSRPVTF
TSEQLDDILKY	FLLDPYKYmTL	HVYDGKFLARV	qLLSYIDRL	YLDQVKLQF
GIDSRYFDLY	qMLEAIKALEV	SLSDHLLRA	VLQDPIWLL	FLPRKFPSLR
ETDEKDFYLYY	GLDPQGDRSFL	ALAPWGPVKV	ALLQRLEAL	FLDITNPKAVL
ILEDDKGAFQLY	SLSEKTVLL	KLYPQLPAEI	SLAELIQAL	FVLPELPSV
KTEDPDLPAFY	ALSKEGIVAL	YMFEEVPIVI	LKLDDTERRIK	ILDDVSLTHL
FSEPFHLIVSY	LLLPGELAKHAV	VLSEKVSQL	ALADFLPVm	LVDFVIHFM
LIEPHYQPWSY	FLDPNNIPKA	FLFDHLLTL	LILDEVHLL	VIIDDHPEVTV
LLEQGGRLSSFY	ILLPEPSIRSV	NLKEAIETI	SLIKQIPRI	YLDVKFEYL
DTDIVDEAIYY	ALHDQLFYL	AMFDHIPVGV	KLWEMDNmLI	KMPDFGQVTV
LTDLVDDNYFY	FLLPHPGLKV	ILFHVVAI	LLSEILHLL	AVFPHLTVV
LTETAIRALETY	FLLPHPGLQV	FLEVRVAVV	SLLTHIQNL	YLDEYIARM
ISESIKELQFY	FLWAGGRASYGV	KLMDHIYAV	SPEYVNLPINGNGKQ	TVPDTRELPSI
NSELEQQLGATGAY	KLLDPEDVAVQL	YLLPERPSYL	FLNELIKVL	KIMTEKELLAV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YIDQGRNPQLY	ALFQHITAL	NIVERVKEV	NLLEEVFHL	GLDPLGYEIQL
KTDHFIFTY	FLDDVVHSL	SMFGSPGGLREA	MLLDFIQHI	RSGGGGGGGLGSGGSIR
VTEDALIRTVSY	SLLRSIFTV	YAIHGVLEV	SLWEDYPHVHL	FLDKQGFYV
LLDLDEELRY	VLFEKEVNEV	YLAELVTPIL	TLQDIVYKL	LLDQPVLEQRL
WIDPFEVSY	FLDENVHFF	ALFPHLLQPVL	IVLDRLIEL	LTDTFYYRL
PTDVLKIVY	LLLEILHEI	FINSRIITV	VLFELKLLL	SLDEAIDMRF
YLDPSLNSLVY	ILIDWLVQV	LLGPPPVGV	SIIGRLLEV	TLEEIIFKL
KTALLEGLEVDQY	YLLQRAVEV	ALAAALAHI	TLWVDPYEV	FSDEILLHI
NTEAFYKISTLY	YLSDIPLHDA	ALKATLVES	WLTPVIPAL	KLQEFELPYV
RADPEAGLLLY	TLQEFLERI	SLFEKGLKNV	ITLLWDREV	ILDEMSHKL
ELDPLTGEWHY	ALAAALAHI	AAFGGNPKSV	SLLPYLPmL	KLPEPSASL
LTDLEIKFQY	LLFEGEKKITI	ALLDRIVSV	LLLAHIIAL	SLDPDIDTLKL
ASELVAELSTLY	SLLPVDIRQYL	HLAIKLEQV	TLIELLLPKL	VVDWLYHNV
ESEDYHFYQGLVY	TGSWIGLRNLDLK	ALNEHMTSL	YLNVQVKEL	ILDDVSLTHLTF
ITDSTMLQAIERY	YLLDQPVLEQRL	SLFDQPLSII	SAIDRIFTL	SLDSVFSDKL
FTDEEGYGRYL	FIWKSGGDLTL	SLIRNLEQL	AmIERITFI	YIPHPFLVV
LTDDHVQFLIY	FLEKLLPPV	SLRGHVVGL	LLLDVPTAAVQA	VVDPVEKTMEL
STEFLQQNPVTEY	ILLDRLLYL	GLKEGIPAL	VLNNVVIHL	YVDVVKVLL
YTELTTAIRTY	KLIDGQVIQL	HLRAAVLYV	VLWDRTFSL	qIDDLYSTIKV
FTDVNSILRY	VLAYFLPEA	KLRLYLEQL	ILYDIPDIRL	SILSLVTKI
FTEAGLKELSEY	YQLEIPENFTT	ALVDHVAEL	QLVDIIEKV	YLDEIVKEV
FVEENLQHWSY	GVAESIHLWEV	FLYQRLVVGA	TLLTAIVKL	LLDEVMKSL
LTDGHPLTL	YLFDVQRNNIA	NLRDIDEVSSLL	YTWEEVFRV	YLDIVKLLL
YSVYRTVIEYY	SLWHLPLLL	SLFGSSRVQYV	ILLKDILSV	LLDEVIQEF
DTDFYILDKY	KLLDFQEFTL	HLKQQVSGL	ILVDWLVQV	FIEDIVKLI
FSQSLQELLAEHY	KLFDSTIADEGTWTL	MLFGHPLLV	SLFDWNVKL	LLFDRPMHV
LVELRWTDGNLY	ALAEIAKAEL	VLKVFLENV	YQFDKVGILTL	LIDDILEKI
ELDPAVMDQFY	SLLEDKGLAEV	YITGHVLVV	TLSGLLWEL	HLDDILQHV
ETEEGIYWRY	KLLDTMVDTFL	YTTDRVMTV	LLSHVIVAL	TLQEFLERI
MIEIAGVKLLY	KLSEIPLTL	AVFERVLSAV	GLGEDIIHQL	VADQIVTKL
SSEELLSLKY	KTLEGEFSV	TLVYHVVGV	LQLPGLWSV	FLDSAYFRL
LLEDKHFQSY	KLLNVDPDNVVL	FLRTPEILTV	SLAPIIVHV	FVDPNGKISL
qSEDGSHTIQImY	YIYDKDMEII	RLQGELQAV	ALFPHLLQPVL	GLPDIDSKMLm
TSDTQWGWFY	ALATLIHQV	GVKQLIVGV	GLSIFIYRL	LLDTMVDTFL
ITDIQIPLDY	YLLPAIVHI	GVAESIHLWEV	LLIERILLL	SLDTALAEL
LSDLGKLSY	DTNADKQLSFEEF	LLKNPFLSV	LLQDHPWLL	VVDRFVEFL
NTEEAANTMVNYY	NLLPKLHIV	VLMTQQPRPVL	YLQARFPQL	qLPELFHKI
LLDKPVFSFY	SLLESNKDLLL	SLITRLLEV	ILLSEPGLVKL	VIDEIYRVL
NTEEAANTmVNYY	GIFGGHIRSV	SLFAQRLKTL	ILLAEVPTm	LIDKIIEYL
WVDDQRPENY	GLLGYLHFV	ALNPNEIQRA	SLVENIERLKV	SLPNEEIVQKI
AADPNAAWAAYY	LLDRFLATV	KLVEFDFLGA	LIYPWVHVVI	SVVPSPKVSDTVVEPY
DTEImTLVDETNmY	SLFPHNPQFI	RMFGGPGTASRPSSS	SLWKEVSEL	FLDTLKDLI

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
LTDFDIRFY	ALFEQKGPVYV	ALFGTLQGNTREV	ALVDHVAEL	YLEEAPKFL
STAVIENPEMLKY	KLFDDDDSGKISL	SLVNLGGSKSISIS	AmIELVERL	YLSVKIWDL
LIDSRPFVEY	RLWDHATMTEV	GMFKNLLKEV	FLASESLIKQI	FLDDVVHSLL
LLEDFLEHEGY	VLADLKVQL	KLQEFLQTL	GLLPEPNILQL	FLFEPVVKAFL
PTELPELLKLYY	FLFGEEPSKL	AAFEFDIHQV	KmSEKILLL	KLPPLPLTL
ITDSAGHILY	ILDKKVEKV	TLRDAVPATL	SLYDWNVKL	KLDWVEVGL
LTEVDNYHFY	ALLDKLYAL	ALGEEALLRYV	TIQEILPAL	LLIDLFKYL
HTDWLLDLY	ALLEDEERVVRL	FLAQHTMLTL	KLLDPEDISV	LLDPSVFHV
mTDLYPPELF	GLIEKNIEL	ILQQHIATV	YQILDGIHYL	RLPETIDLGAL
YIDSIPKTLGNLY	LLFDRPMHV	YLFDIQLPNI	SLRDLIQGL	VLDFIEDYL
STDITERSVLNLY	VLLGKVYVV	ALAPWPIVGL	LLPDQPPYHL	YLDEEFHQSL
GTDELRLLY	FLFDHLLTL	ILAAHVPTL	YLIPLLERL	KVFDPVPVGV
ETELGLYKVNEY	GLADKVYFL	HLYSRIPGLL	SLLKDLNFL	LLDYHLNYL
STESMDFLKY	SLLDIIEKV	RQYPWGVVQV	YLISQVEGHQV	SFSDYPPLGRF
VSDPVGVLY	GLWGHALLL	SLKDQLTDL	SLLRSIFTV	KLPEIWETL
ITDAIWGSESNY	YLADIFTKL	FLFPNKESLI	qLRNVIERL	LTPKLFHEV
YTEGDALDALGLK	ALADLQEAVKL	GLIDKVNEL	SVNPYIVKL	YMIAHITGL
SSEDLMKELY	GVIDGHIYAV	GLIDVKPLGV	TLYDIAHTPGV	YVYEYLLHV
TTDLSFLDKY	KLLSKFYEL	ITFSNPKEV	YLFDVQRNNIAm	FLDELGQHISL
VSDILHSLFSTY	ALADFAELI	ALAEALKEV	HLNEHLYNm	HMDTFIETF
HLDDQMTLLQY	ALLRVTPFI	RLFADILNDV	KQVEEIFNL	KLMDQLEAL
STEEARFLTY	KLADDVDLEQV	RLYPWGVVEV	FLITILDHL	IIDEKKYYL
RLEIEPEWAY	GLADASLLKKV	FLRDNLEWL	VILKILPTL	VLDSFVEKL
WVDPEDPYKGYRY	SLAELKGFEV	RLPDIPLRQV	YLITLLEHL	TGSWIGLRNLDLKG
ALDSHILDYY	SLAPLFFKL	GLASIQPSKV	AMLERLLSL	LLGPPPVGV
QSELVGQLY	KVLDFEHFL	LLKVGILYI	FVLDKVPFL	RMDELFVLI
ATDmWSIGVLTY	SLAEVAGLQV	TLNSKLLKV	FLQEAQVPFL	NIIEAINELLV
FIEESRQLLSY	HLMEIQVNGGTV	FLFGEEPSKL	GMYIFLHTV	qLDGIHVTI
LLDQGQLNKY	SLLHLGALYGI	SLKGLVKNI	GLAPAEVVVATV	SLWSIISKV
TTEESLRNYY	ALMEQVAHQTI	TLNEKLTAL	GLFAHPSLWQL	FLLDPYKYmTL
FSENLQPHISSY	YLQEVPILTL	ALASHILTAL	VLFPWQARL	KIDRLILEL
KTETEPVFWYY	FLDPGGPMMKL	HLAEHSLQV	SLLSDYDILSL	FLPLHYDYL
LSDSFSDLYSSY	KLLDFQEFTLYL	ILSEFSSKL	VLIPKLPQL	VVDWLYHHV
TVSREDGSFSFY	FLIGPKLYEA	QQRLVVVSV	ALSEKLARL	FLPPGYKIEV
YTDTGLWGLY	KIIPENDIKSLTV	AIFAFnISHV	KGFKWGFAA	YLPAHIPYQEL
VTEFEDIKSGY	KLGLKPLEV	KMFESFIESV	RLNEVIRTL	VVDDLGQKITL
ITDPDPDIRY	SILEIQKGVFEV	LLGPRGIGV	QLLEFLDRL	KLDEIYVAGL
ATDMWSIGVLTY	SLIDMRGIETV	SLASHIQSL	GLIDKVNEL	LLDHPNGDGL
FSDLNLEAHmY	YLSHNGIEVI	LSSHVRGV	SLITRLLEV	SLSQVFLHL
HLDTLINEQASY	ILDEVIFKL	FIAEHYMFL	GLLSILRKL	FVDEVHAVGL
ATDFKFAMY	KIVDLLKNL	RLYPEGLAQL	GLNEFVVKF	SLPEDFYHF
VTEGLTDVILY	TLYDIAHTPGV	SLAELVHAV	ALQEKLWNV	FIDEYVETV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YTAVVPLVY	FLVTVIHTL	SVFTETPSPVL	TLLERAFSL	GGFGGGSFRGSYGSS
LLDPAQRTLY	KIMDYSLLVGI	TTFPRPVTV	SVLGKIWKL	ALPHVVPTL
STEYIPDPERVFY	LLAEKIYKI	ALSEKIVSV	ASPEYVNLPINGNGKQ	FLDRPQQWL
WSDIWnATKY	ALLDRIVSV	ELFEGIVRQV	TLYFSYTHmV	FLFDRPMHV
NTDSLDWALY	RLLDSVEQDFHL	ALAPSTMKI	KLIDLSQVmYL	ILIDWLVQV
LSEINKPNFY	YLKDLIEEV	GLIDHQTYL	KmLDEILLQL	SLITRLLEV
WTDNRELTY	ALWDKLFNL	HQYGLPIKSV	SLQLRIQEL	FIDKQLELL
LLDTNRYLYF	FLHDHVDLQV	VLQEKIEVV	VLLPKLPQF	FLDDVVHSL
LTDYDIRFYMY	ALLDQALSNARL	ALNRSVQVV	YLLDLHSYLL	FLDKILVKL
VSDILHSIFSSY	TLLGHLDYI	GLYEFPLNKV	FVNDIFERI	IIDEVVNKF
VTDLLKELV	FLLPLLIEKV	KLYEIGAGTSEV	GLVGYYIFRV	KVDENHSEFTL
YSASINSLLERY	TLLGHEFVL	VLKGDVEKL	RLQQVLTGL	LLDAFSIKL
NVDLLGSLADLY	YLYEHNFAF	SLITLIEKV	SALPWNITV	TLSERLWGL
ATESILHFAGY	YLAEKYEWDV	FLKEFENPEV	IIQDIDDTHVF	FLPQKIIYL
FLEIVSEKSRY	qLVDIIEKV	LLKDFLRNL	KmYEEFLSKV	ALDEFATKL
MTELYDYPKY	qLDDLKVEL	NLKAHVVAV	mLAEKLPNL	HLDEVFLEL
VLDVLSDYDASY	KLLDEDEIRGYKL	SLKSKVLSV	WLIEDGKVVTV	KIPTPIVGV
TSEPKPFLYY	TLLRLLYEA	VLSDRIAFL	KLWDIINVNI	YLDSIYFNRF
LTEIKGSVY	SLAEFVQSL	HLYQQGMLSV	TLLHFLVEI	KLDEALAQYF
LVDLYILTY	VLMDRLPSL	SLSEKTVLL	GmYVFLHAV	TLDDIKEWL
QIDEIKDPSGLFY	ILYDKLEKI	ALFISPALI	ALIEKLVEL	HVDGVAVTL
FSDPNFLAH	YLLQEPPRTV	ALTSLLKTV	KLLPDTILEKL	SLFDIISKI
VLLVGYGTDSASGmDY	ILEEGKEILV	FLGPWPAAS	LLIDELNKL	HLDSMDWLEL
HLDLGILYY	ILQQHIATV	FLYAAQPELL	TVQEILPAL	FIDMPDAAHGI
DTEFPNFKY	KLQEFLQTL	FmFDEKLVTV	VLLSHLSYL	HLDPSLANYL
FVAEPDNKNVY	RLYSEDELPAEF	KLFGTFGVISSV	ILMEHIHKL	LQIDNARLAADDF
KTDmVEKALLY	FLSEEGGHVAV	SIPDFPMHLA	QLLDLMHTL	SLDTEYWKL
TSDDPWLTAY	RLMEPIYLVEI	KVAPAPAVV	GmYIFLHTV	VVDPIVSNFL
qLEDGRTLSDY	FLLGPEGQHLL	SLIRIVPVV	LLYHYWIAV	YLFEEIAKI
ETDLSIPTSPTSKY	FVHDLVLYL	KVFDPVPVGV	RLLEEGVLRQI	ALDTGWNEL
FIDHDITSQLY	SLYDQAEKLVS	FIIQGLRSVGA	SLFEWFHPL	YLDQISRYYI
YSSEYHYVGGFY	ALDKATVLL	FLITHNPTNA	LIQELIHNL	ALEDRVWEL
YTEDEIYELSY	ALVDHLNVGV	SMKENISKL	ILIHDVPLL	KLPAPLPGL
HLDDQmTLLQY	FLQEEPGQLL	FLNQFVVHTV	LLLEPGSLYIL	LLDLHSYLL
ALDTINILLY	ILAELLLRV	TLKEEVQKL	YLSPKLWAL	VLNEYFHNV
YLEREDFFFY	GMYGKIAVmEL	LLMEHIQEI	TLQEFLERI	GLDQQFAGL
VLDINSIDNLY	KLIDFGSGALL	FLPETRIMTSV	FLMDFIHQV	SIPPVLKAELL
QTETGTPYmLY	TLSDLRVYL	ALGPKPQGL	HLLPDLHAL	GLADKVYFL
ELDPMAMTQKY	ALDEVFTKV	LLREELQLL	YVVPFVAKV	ILKHTGPGILSMANAGP
LADLKVQLY	YLLDLHSYL	SLKNRIESV	ALAPYLDLL	VLPEIDPVLF
VTDPRVVDLLV	DVGSDWRFLRGYHQYA	FSSPHLVQV	SIIDWLNSV	FLWEAESHA
ILDIPNQLY	GLLPDVPSL	YLIARVMLL	VLKEFIDQm	SVIEQLFFV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
GTEASTKNIFGRY	KLFGMIITI	YLILHLISTV	ILLNIIERL	YTPPPPPTA
AIDLLKEIY	SLWSLTHLTAL	KLFPDTPLAL	ALLDWVTSV	FVDTDSDIRL
QSEDGSHTIQIMY	SLVENIERLKV	GLYPFRVNSA	FLYPFPLAL	HLDEDKHFVV
YTADGKEVLEY	SLWSIISKV	SINSRLQLV	ILTDITKGV	KLWEmDNMLI
ETnYTRIFLY	VLDDKLVFV	GAFGFQLKEV	KLNAKLAEL	LLEYHIAYL
LTDLVDDNYF	VLYPHEPTAV	FLNKEILEL	VINDVRDIFL	ALEEADKMFL
LVDLYDTTSNVY	ALFPALRPGGFQA	GLAPAEVVVATV	YLLDLHSYL	HIDSFIENL
YLEHGEYEGNLY	FAIDPHLLLSV	HLMEIQVNGGTV	YLTAEILEL	ILNDPSQSEVM
LTDTFTAYYR	ILVDLGHLEGADA	TLKGGTILGT	SISPIVLYL	KVDPLFTELL
TTSHLMGmFY	YLLPKDQGITL	YVVPFVAKV	VVLEEIPKL	VLDDKDYFLF
LTDPIQGTEY	GLPRFGIEMV	GLFAHPSLWQL	IILGKIWDL	ILDKFTEEV
DTEPPPLLVY	GLIDRQVTV	TLKDTITSV	IVIEVIPFL	ALDETGKETFL
DTETLIKAVYTLY	YLAELVTPIL	ALKDAMLEL	RTLETLIRL	LMYPYIFHV
QSDIVSTMEHY	YLLTHPPPIM	SLATRISTL	FILEKIEYL	qIDDVTIKI
VSENVTQYLQY	ALIEAEKVAQV	YLVEDIQHI	ALITRIFGV	FVmETFVHL
LVDIVKGTNSYY	KLLETELLQEI	AVIGLTKSV	AmFNDYNFVF	FLDEAAARLL
ATELLGLGGLLY	VLLFEADTITL	NLYPFVKTV	SLADDSVLERL	FLDHVmYTI
GSDVEHNPVFFSY	LLAELREYNL	FLREYFERL	VLLGHIFYV	KIIEDLGVHF
TVDPASLWEY	FLAVKPDGV	FmMPRIVNV	VLLSEILHL	KLWSETFDV
FTSPVTPEELLY	GMYIFLHTV	KLIPQLPTL	AmQEFLTRL	LIDWINDVLV
IVENVNVIISTY	KIMTEKELLAV	TLRPSLLPLH	KLLEPVLLL	RLPPDTLLQQV
FVESSTSVLRY	KLIDLSQVMYL	ALSEKLARL	YLSKIIPAL	FLPETRIMTSV
TLDLPHFDEY	RLYSGISGLEL	VMRAYLQQL	ALADFAELI	SLIEKYFSV
ITQGTPLKY	YLDQRELLL	ILFNRVLGV	LLLPGELAKHAV	ILDTMYPEL
DSEQADIARMLY	ALIDGSREGFYL	RLSPIENFL	AVmAPRTLVLL	GLDELFVQV
NLDAVHDITVAY	ILLDDHGHIRI	ALSQRTITV	VLQNVAFSV	qLSEVFIQL
YSQDYQQFY	FLDEPTNHL	KLYEAAVKKV	FLNSVTDIHQL	LmYPYIFHV
LLEKEILFY	VIDGHIYAV	LMVDHVTEV	LLSELLEHL	KmPEVIPILEV
RVDPIGPLSY	KLMELLEEI	TLIDLPGITKV	mLLDFIQHI	TLDEIIDNHI
FTDVPSIQIY	ALYSKGILL	KQFPLIISSV	SLmLLIRQL	ALDKATVLL
FTEDQGVDDRLLY	KLAEALPSL	FISAVREGSLV	NLLSDYGYHL	IVDEPTFKVLL
NSDYLALLQAY	SLLGGDVVSVKL	ILYKLKLGEI	FVLPELPSV	LLDKVYSSV
LAEWKSLEY	GLGEGFQTVRV	SLATHLQEL	TILPGLPEL	LLDSPGKVLL
WLEEGIHWQY	HLMEENMIVYV	VIKALLEVV	GLFRLWAL	RVDKITEYL
WSEITELLY	KLSLVAAMLLL	ALYEYQPLQI	ALFSFLYHL	ALDDRPQVL
FTEIGIHLNAY	YVVPFVAKV	FLYDTHQNLRNA	ALLAELEKI	GLPTRLPEImL
HSDLLGTLHNLY	ILYGKIIHL	LIFSHMLAEI	LSFSWLFHT	SVDEVLEML
LSDIGSGIRYL	YLDLFGDPSV	LLFDRPmHV	RLLPPELLRQL	ILDDVAmVL
FSEDRPFAVGY	SLYIKDIWL	NLFHYLTEV	TLAAIIEHL	KLWEMDNMLI
QTDIQGALSAY	ALWGFFPVLL	YmIAHITGL	RVLPPSALQSV	mVDTFLQKL
FADQLIAAGHY	SILSLVTKI	ALNEKLVNL	SLLDPVPEV	RIDPFVRTFL
ALDNTNIGKVANY	SLAELVHAV	GLAALKMLAV	AIIPYIPTL	ILEKYIKFV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YTEFVPQIPGYQTY	VLLHVSVLL	KLYPQLSSV	ALNDEIRQL	VLYHVETEV
YLDPVQRDLY	YLSDEGHYWVGL	RLFPGAPPTA	GLGSNIFRL	SLDRIYNmL
ASEQQALHTVQY	RLSEFIPAVF	KMKPEVTAL	GLYGAIFRL	SLRDLPAQLL
QTDNLELKKLVY	ALLAGSEYLKL	SMYPIALTRA	SILDGLIHL	FLPPEHTIVYI
VSERDVYLTY	GLTSTDLLFHL	GLAAFRAFL	SLAQYLINV	VLDDKLVFV
YLEQLHQLY	KLWEMDNmLIQI	LLFPHPVNQV	SLINVGLISV	YIDAQFEAYL
LLDPASFEY	SLLYNVPAV	SLAQLLGKI	YLRNLTWTL	YIDEGRLVL
HSDRAnPYFEY	KILPTLEAV	LLADLKTMV	GLWSGPLPRV	IMDSLFDKL
LVDDPLEY	NLWSLVAKV	ALKPQVSSI	HLTDITLKV	VLPAEFFEVL
NTDGFLLPKY	SMTLAIHEI	AMIERITFI	ALIPVINKL	LLDHDAFVL
YLDKEDTFFY	KLLEPVPVSV	SIAPRmMSV	mLLSKINSL	FLFPVYPLI
YIDEQFERY	YTWEEVFRV	SVTSHIYQV	TLLVVVPKL	NLPEYLPFVL
YTGVQILLY	YLTDRVMTV	TLFNVIKSV	TLFHDPWKLLI	YVDDTQFLRF
LLDPAQKILY	AIMDIVIKV	SLMTKEISSV	ALAEALKEVSL	ALDDFYKmL
LVDDGWILAY	FVYDPLVDWTA	SLHDAIMIV	KLLDFGSLSNL	ALFDAQAQV
NTDFWKTLRY	VLLEQPTWQL	SLIKQIPRI	SLAQYNPKL	KVDPSGVSL
QSnETALHYF	YLIPDIDLKL	ILKETVRQI	ALLELLERL	YLIPLLERL
STESmDFLKY	ALFDFTGNSKLEL	LLSEHVIAI	ALNIATHVL	LLPEGPPAI
IVDAEWNILY	ALSEKIVSV	NLFKHLAKA	GLLGYLHFV	VLIKWFPEV
FIDASRLVY	KLLQFYPSL	FIKPPVYVTV	LLLPDYYLVTV	KLQEFLQTL
KTELERAFGYY	RLLENMTEVV	VLIPKLPQL	SIAEVVHQL	YLFERTFNL
QLDLAQRTLY	SLLQTLYKV	SLKPKLIEA	TLmEEVLLL	ALDEVFTKV
STDPSVLGKY	KMYGYVDTLLT	VLADLKVQL	FmLPDPQNISL	ALDNFLDKL
NTSPLLGDARF	SLITRLLEV	VLYNQRVEEI	ILFSEDSTKLFV	ALQEASEAYLV
ETDLLDIRSEY	FLIEEQKIVV	TLNEKLTALE	ILNPVTTKL	ILDELAEKL
LSDIVIEKY	RLSPVSPAL	TLIQYIRPVF	SLYPQFmFHL	MLFGTYMKV
VVDVPEFLVY	IILEEGKEILV	FIFSEKPVFV	SLQELLIQV	LLAELLTHL
ATDITGPIILQTY	KILEDVVGV	GQIEVVPEV	SVIEQIVYV	LLYHYWIAV
MVDPLLTKY	TLVYHVVGV	ILAQQPLSV	ALLDQLHTLL	RVDPVYIHL
TIDDFRNQVYSTLY	YQFDKVGILTL	LLQEPPRTV	SLTSEIHFL	AVDDFIEKL
ESQRQENHFVEGLLY	YLFERTFNL	FLWKITNV	KLLEYIEEI	ILPLMKFLEV
YTELLAQVY	GMYGKIAVMEL	ILMGVLKEV	YLFERIKEL	YLDFIKEVGF
FLDDFESKY	LLYQEGAKMAV	RLAQHITYV	GLSGIIPTL	YLDQTVVPILL
ATEVLmWFY	RLLPQVDSV	ALNGHVEmV	HLNEHLYNM	ILPKIKAIPQL
YSDVAKGILQY	ALNSKILSV	VLSSNLRHV	ILLAELEQL	LLDRFLATV
LTLGRVEDFY	FLINFIHTL	KLGSVPVTV	LLFTWEELI	ALDEATKYAL
ATDFDVLSY	KLWDNELQYV	FLAKLIAQA	ALFPAPLAQI	ALLDKLYAL
NSYWVGEDSTY	MLLDFIQHI	FLLPIKTVGV	GLIDTKELEPL	FVDGLHEKL
ASAIYSGYIFDYDYY	YALNHTLSV	GLTGQRVLGV	KLAEFIDFL	FLPVKLIFV
STDKFKTDFY	FLYDTHQNL	IIRKPVTV	SLSFLVPSL	qLDEARGLLL
NTDLWIVMEY	ALVDQRELYL	LLKDSIVQL	SIATWGIVV	VIDKLVVHL
RLDTPLYFSY	GLYEFPLNKV	VLSQHFQTV	LLFDRPMHV	FLPLIVNTV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
RVDVFTNLGY	ILIEKEYLERV	ALFPAPLAQI	YVQDFLNHL	GLPEITPKL
LIDADPYLKY	IVMEHVVFL	FLRPMLQYV	TLSDVVVGL	KVDPVVFVTL
STDDPMQFHY	YLLEEILDKV	SLFPGKLEVV	FVmETFVHL	LIDEDVYRL
VLDRLTFDY	YMFEEVPIVI	TLFQPQTGAYQTL	KIADFGWSV	mLDEPTNHL
AVDVNNMLHLY	SLLPPDALVGL	AMKPKPLSV	KLLDIPGLEV	MLDPLEVHL
LLDTAQRALY	TVAPFNPTV	YLDGHLITTV	RLNPLVLLL	YIDDVFHAL
QVDPNYAYAY	KLDWHRFNL	LLAEHIKSL	FLFDHLLTL	FLINFIHTL
HLDFNLDKTLY	GLTPHLTMV	LLYEDIPDKV	KILSELFTV	TVDPVIVEA
mTELYDYPKY	KLMDHIYAV	WLANEGLITRL	SLWFKPEEL	YLLPAIVHI
KSDIPmDLFDFY	KLQEFELPYV	ALITRIFGV	FLLKDLSSL	KLDENSAFLQF
PTDYADImmGY	SLWFKPEEL	TVADHIQKV	LLmEHIQEI	LLDEAPGAAGGL
FSDIHAGELYF	VGSDWRFLRGYHQYA	ILAPVVKEI	LVLTQEQLHQL	TPGNRIVYLY
FSQPENQNLLY	FLVDIMEHL	FLKGFLTEV	QLTNVILHL	ALWDKLFNL
QLEWDDSTLSY	LLLESDPKVYSL	KLMDQLEAL	RLWEKLTLL	GGPGGFGPGGYPGGIHEV
HIDFGGTSVWY	GLLDPNVKSIFV	YLNEIKDSVV	FLLPILSQI	GLPEAPPFL
AIDQLHLEY	NIMDIKIGLLV	ALAKAPFAA	VVmNVVHQL	YLFDLPLKV
ATEVLMWFY	YLIGLDPENLAL	ALAPMEAAKV	YLFTFLNHL	NIDEIYKAL
YSDAFLNDSY	YVNLPINGNGKQ	RLNKVIKSV	ALASVImGL	FLLPILSQI
PTEISQSLLY	FQDPVPLTV	SVIQNLRTV	FLLPVINEm	KVVDVVRNLVF
GTDLSIFKY	ILVDWLVQV	SLIDMRGIETV	TLWEIAKAEV	YLDHTADVQL
NTEIQSAGRIQDQGVRY	YLITLLEHL	SLVEIILHV	ALNEQIARL	FIDAVYKLL
LLDPKYGMFRY	TLIDLPGITKV	AVSDHISKV	FLmDFIHQV	IIDPVALEI
mSALLLPGNFESY	YLTAEILEL	RILAQQPLSV	KLGDFGLLVEL	FVDIVKVLL
HSEYHTLLY	ILLDEEGHIKI	RLFGEAGPASGV	ALLSWVNSL	HLWAELVFL
FVELPDNHSSLIY	ALLQRLEAL	ALATIRLLDV	AMQEFLTRL	ITPENLPQILL
NTDFRYFIY	GLIDVKPLGV	KLKDDEVAQL	FVFPGELLL	KSPEGLLGV
YSEVYPGQQY	ILFSEDSTKLFV	ILKEHITQL	YLNEWLQIL	LVDEPLLKL
ELDPmAMTQKY	KLFQEDDEIPLYL	TLKPGTMSV	ALLENMEGLFL	RLPEAIEEV
SLDVGGPLRY	TLAEIAKVEL	YLITHPLAV	AVSNHVFHL	YVDEAGTVKL
AIDEDVLRY	GLLGDIAIHL	SLHDAImIV	ELIERIPEL	ILDPIFKVF
ATESPLDFTKY	LLHSFVDSV	YAFNMKATV	MTLPNLPRL	ILDESDHITm
LLDTPAQLWY	FIWENIHTL	FLFGYPKRL	VLQELINVL	SLDELIQSQQI
ILDEFLQTY	KLYELYLQL	TLKDGIIMI	YLYEEYLQAF	SLEELIKWL
LTDFIREEY	GQSELASRLTL	ALFQRPPLI	TLNKFIEEL	SVIEQIVYV
LSDIASALRYL	HLYSSIEHLTT	HLFPKLELSV	VLAQQIATL	SIDTLIFTL
NLDPLTETY	RLPEIYIQL	ILRDLINEA	YILPWESEL	NLFPPMLTV
QLDVAGRVMQY	SLFDLNFQA	AIKELLDTV	ALSIQNYHL	RLLPPGAVVAV
YTDIINIFLY	YGLPVVVKL	LLSERVSNL	FLVTVIHTL	YIDSKFEDYL
EAEPHPLWEY	FLMKNSDLYGA	SIIGRLLEV	TLNDVLAQL	FIHQHFVEV
ISEYAADIFY	SMLQKTWLL	VLFRGGPRGLLAVA	FLTEFINYI	YLEDILAKL
HSDVFSEPRAIFY	VLMDLKALLL	qLKDFITKL	FQLPIRFNL	VLDKLLLYL
ILDEVImGY	VLQRSLVTV	ALNELLQHV	SLAEVLQQL	VLDVIHEVL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
AVDPTSGQLY	ALLDVTPKAV	GLSNHIAAL	ALSSLIHAL	KmDWIFHTI
KSDPFLVFY	KLMDQLEAL	SLGPQPLVA	GLTPFVFRL	LLPEHFLFL
ETEEDKFLLLY	LSLENLEKI	HITDFNIATV	RLLPRLLLL	ILDESDHITM
RIEKQFLLY	RLYPWGVVEV	TLKELTSLV	FLLPDGLVRL	KIDDILQTL
TTDFPGNYSGY	SLQEFLAAL	AQFPLQPGKV	TLVDEVFRI	LLPELRDWGV
qLDLAQRTLY	LMYPYIFHV	QLMEQVAQL	WLmPVIPAL	PVPEEEEGFEGGD
LIEEGGLQHLY	TLAEKIQTI	TMFPGVLLPLL	NLLKLIAEV	KVFSAFITV
LLDTNRYLY	VILDIPLLFET	YLTFLPAEV	SIQSIVPAL	ALDEVIFSL
YTEmTGKLISSY	KLQDGLLHI	FLRDNQLSEV	AIIEYmPLL	KVPEWVDTV
SSDVIRLImQY	FVLPELPSV	SLIFKLEEL	VIQTEVPPL	YLWDLDHGFA
YVDPQFLTY	KLLDPEDISV	YLRIDLERL	LmNPmVPGL	AVDQVIKAV
YLDQISRYY	LLFDSVIHL	YLWLKLNQV	TLLRALQAL	ILDPVDPTNNV
IADSNYNWFY	LLYHYWIAV	ALKEKIHEL	ALLRLLPGL	FVDsPSSGTHL
NTDHQTQLLY	VLIPKLPQL	GLFRGIEDNPMVV	FLLDSSLRKL	KLLEKLYKV
KLDRSVFTAY	YLLDLHSYLL	GLIDRQVTV	QLQEIIARL	GLPEEIEELRV
RSDSYVELSQY	KMDASLGNLFA	LLADKVLKL	GLAERISVL	YLPEELRGVDF
FVDPLVTNY	SLPELVHAV	LLNPSLQKV	GLNDFIQKI	YmIAHITGL
VLDVVYLVY	VLMQDSRLYL	FIKDYPVVSI	NLHHWIDLI	FLPHELPLL
YTDNLVRVW	ALGEEALLRYV	FLYPFPLAL	ILSPWGAEV	IIDEFIYQF
YTEAEEFFVKY	FLFQAGSGIYHV	GLADKVYFL	GLHGWAFTL	LLDDIFIRL
SSEVVTVFQYY	RLLEQLQEI	ILIGRIKNV	ILQNEPLPERL	SIDRNPPQL
EVAEPSVLFDLY	FLHEESILERV	LLYDEFVKSV	KLLEAISSL	FVDELRITL
YQDPDATSLKY	FLFGEVHKA	LLYLGPHIASV	TLHGLQQYYV	HIDLPNEQARL
qTETGTPYmLY	ILTDITKGV	SLKISIGNV	VLQYVVPEV	HLPPEIVPATL
TVEELTDTFYY	KLIGDTPIDTFL	YmFEEVPIVI	YLAELVTPIL	YLIPDIDLKL
KTDDLTmVLY	KLGEFAKVLEL	FIIQGLRSV	YLQIHPQEL	FLPEALDFVGV
TVDNVQPLLY	KLYPQLPAEI	FLVTVIHTL	ILQNKIDLV	VLDAHFLVL
LTEYFLNDKY	ALLEDLGKASGL	GTKDVPITSV	SAFYWIDRV	SIIPPLFTV
YLENLEKLmY	FMDPQKMPYL	SLAEGRLYL	IEILKKV	VIDLITIKL
FMDPEMETRY	LLPEGPPAI	TIIDLPGITRV	ILQRVIDYI	YLWNLQVKL
SSDGAISLLTY	ILLDDNMQIRL	YLLGRELMAL	FmYNFQLVTL	LLDLMIAKI
QLEDGRTLSDY	TILPKVMQV	ALAKKPHII	KLFDRPQELKL	LLPHILPLL
RVEDGPSEFALY	VLWFKPVEL	GLAKLIADV	SLmSHAIEL	YVDPVNKVL
FTDESYLELY	LLFDRPmHV	FLASESLIKQI	VLPRLHQL	IVDDWLNLL
TSELIGQFGVGFY	NLLKLIAEV	FLFDGSPTYVL	KIYQWINEL	LLFDVHTTL
TTEVHPELY	FLKDLVASV	FTIFRTISV	RLYHELVGL	mLDSLRIYL
LVERLQALY	FLLPLRIAL	qMREFLEQL	VIQDFINAL	YLDAIYDVTV
VSDGIIAPGY	ALIEKLVEL	RLIESLFTI	YLSGIIVTL	LLDYSFQHL
LLEGDIHGQYY	ALNEKLVNL	KLILLITQV	LLIGHLERV	VIDTPVFEL
mTEKFLFLY	HLLDIYIQL	LLAAWTARA	LLQDIILQV	VVDDIVSKL
YIEFHSQSGFY	FMYNFQLVTL	VLKEIVERV	QLLDVLARL	LLPDTILEKL
DLDSRVLYY	ILLDYQGRQEIFL	IAYDRYIKEV	FLKDLVASV	SLIDKLYNI

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
GVDVTGPHLY	VLVDDDGIKVV	KLHYVVTEV	SLLNPPETLNL	ALDNVDARMYm
LIDQDARDLY	FLPEAPAEL	LLRQGVLGI	SLSAFTPAL	ALPRLLPAL
LSnISHLNY	GLKEGIPAL	SLAKIYTEA	TLADYLHLLQA	FVPEIFHRI
LVDEWLDSY	YMLEHVITL	TIFRTISV	ALQDFLLSV	VVDEIYFKV
mSDSYLPSYY	FLYKVVQV	ALNSKILSV	SmADIPLGFGV	FLDTLLEEL
VTDHLGVVY	GLDDIKDLKV	AMIAVVPGYI	VLQDIQVmL	IVDLIHDIQI
SSDPKVLTL	KLLEVSDDPQV	ALGHVRYV	FLLDGKVLSL	QLDIIIHSL
FIDSIIAKY	KMFDLNGDGEV	TLADRLLEL	ILQDLTFVHL	YIMEPSIFNTL
FSEEKIQYLVY	RLLEEGVLRQI	TLFQGIKTV	KLLDFQEFTLYL	YLDKTFYNL
VSDIVGPDGLVY	YLTTLRALYL	ALASHILTA	TLLNETDILSQYL	FLDSLPDVKI
VVDDWIESY	ALSNLEVKL	SMKDDLERV	ALLGILQHV	SLWPMTFGL
DSDHLTIYNAY	YLLLKTHQL	ALGPPGAAL	LVLDPPTDLKF	YLADLYHFV
ELDQRLFENY	ALFPAPLAQI	TLKRTIEAL	WLAEKLPTL	YMENFIEHL
FTEEDVKFY	AIVRSLPSV	YLmGERLGV	SLLASLHTL	FLDELAQKL
LQERNPENWAY	ALAKLVEAI	SLSDHSLGI	ALQASIVKL	FLDTISDFHL
TVDEHVWFY	KLLEPVLLL	GLMRKVPRV	FLAELPGSLSL	IILDEIHLL
ASDKETYELRYF	SLVELLVQL	ILKEQIREL	FLLDKPQDLSI	ILDDIFASL
ATQLAADLLKY	LLFEHSDIVVI	KLFDAPLSI	SLAELKGFEV	TVIDYFHQL
ATDLDVANFY	SLFEKGLKNV	NLSAHIESL	FLFELPSRL	ALPEVLAVIQV
ETFLTSPEELY	SLGRFEITV	RLFEGNALL	SVLNVLHSL	AVDEFYSKI
HSDELTSLLGY	ILHDDEVTV	SIYQFLIAV	FMFDEKLVTV	IIDDVMKEL
NSLFLTDLY	RVDPNGSRYLL	ALKEFNEDGAL	TVIDQIPFL	ILDEVDVHI
DTDISLIRY	GILGIQPPSV	RLQESVmEA	ILLPYVSKV	NLPLPIPTV
ELDPMAmTQKY	KIADFGWSV	LMKQYIEFV	RLYDPASGTISL	YGLPVVVKL
LTEEFRLNY	KLYDGFQYL	KLYESLLPFA	ALTPVVVTL	FIWPmLIHI
YVDAVLGKGHQY	TLADLVHHV	YISDINPRSV	KLQEFLQTL	YIDHGDPQV
VLDIPSKY	GLIDKVNEL	ALIEKLVEL	QLLSYIDRL	ALDDFYKML
EIDGRSISLYY	SLLDGHFVL	SVYKNVILQV	HLLmELREL	ALHGRADLI
QLDTRVSEFY	SLLPFLKAV	SVYSRVIQV	KLYDIDVAKV	FLDLPEPLL
YTDAPPAYSELY	TLWYKIFTT	YLTEVFLHV	SLMGTLSKL	FLMDFIHQV
LSDIGSGIRY	ALAQRLLEV	HIIENIVAV	TGFPWAFKV	ILDDTAKNLRV
WVDSDQLLY	YMIAHITGL	KLSSKLSAV	VLAHTILGV	ALDPPGPTL
YTDTGLWGL	HLSIINEYL	FLRSLLGSI	GLVPFLVSV	ILDEAHERTI
FSDYPPLGRF	KLGSVPVTV	MLSDRLTFL	TLADVLYHV	SLLELPHPLL
VTDRFGIWTGEY	KVWDLFPEADKV	VLRPQVTAV	FLNGEVIRL	TLLDPNEKYLL
VTEGLVDVILY	YLWLKLNQV	RLTDYISKV	TLWYRAPEV	IIFVPVPQL
YSDKYGLGY	GLYDSQNPPTV	SLKQELEQL	RLQDILWFL	RIFQTLLEV
YSFLDKMSFY	ILSEVQQAV	SLKEALQKA	ALIEAEKVAQV	TLDKIMILF
TTDFIYQLY	FLTEIENLFL	YLMEGSYNKV	FLYAGHIFL	VLPPEPVQL
ATDIFSYLVEY	HLINYIIFL	ALNGHVEMV	YLTEVFLHV	YVWPNVFET
YQDLLQLQY	ILWSHLELL	KISDFGLATV	LTAEEIFSL	FVPPTFKSV
NSEQVVQSVVHLY	KVIDYVPGI	ALAPAPPQV	YGLPVVVKL	LIDESVHALF

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
SLDAPHSTYNLY	YLVEINKILL	SLAERSSLL	ATYVFLHTV	RLDDLFLESF
YSDEFGNLDF	ALAGHQDGITFI	YLADIFTKL	LLGDLLFHI	DVGSDWRFLRGYHQYA
ITDFINILHRY	YMVHIQVTL	SLKPLLFEI	qLTNVILHL	NLFEWHFTV
LTEILDRY	ALMDEVVKA	WLIEDGKVVTV	SLFDAVSSL	SLPRFQVTL
WSERLMTAY	TLLHLAVSL	GLAEWVLmEL	YIMEPSIFNTL	YLPPGFLSA
YTEMTGKLISSY	FLQEKSPAV	ILRDALSDL	AMLTVLHEI	ALIEKLVEL
YTMKEVLFY	KLLDQMPSL	LFNKQLESI	HLLLFLQQL	ILDPFQYQL
ATDLVVLDRY	VLFELKLLL	KIKEIAVTV	SILEDPPSI	LLDSSHSEL
EIDHAEYYLY	FLPETRIMTSV	RLGPVPSGL	VLAFLVHEL	VLDPSHRDISL
ILDEVIMGY	HLAELIAEL	SLINVGLISV	ALFQRPPLI	FADAVQELL
LTDTFYYRL	RQLEEEGITFV	SLKKTISQI	SLIFKLEEL	FLFDHLLTL
QSEDGSHTIQImY	YLDVSVGKIVA	VLYEPPPLSA	VIQELINTV	SLDAIIEFL
TLDAGKFQIY	YmVHIQVTL	LLAELPASV	VLQEWLSHL	YLDNLLVRF
mTDEIFHDVAY	ILSWVSFWI	LLPAHPGAEV	KLLKQVDFL	YLHDFLKYL
KLDSLLLFY	YLIDRDPTYF	TMYPGLPSRL	NIFRWETTI	LLLEAVWHL
NLDFQMEQY	HLSDAIVEV	FLPEAPAEL	TLNNLVEKL	LLPDPRELIEI
VLDSEGYLLFY	SLLGHLMIV	GMYPNLVHV	QLLTAIVKL	VVDHVFPLL
FSEFTGVWKY	ALDPAAQAFL	VLAPRVLRA	SLLEDLSHI	FVDGVSTVARF
DTEKELQALY	ILLKDILSV	YLADLYHFV	SVMDRLSYL	HIDTVINAL
LLEELPILY	KLLEYIEEI	FLINFIHTL	TmLELINQL	HVDEFIDELL
IVDEAIYY	YVYEYLLHV	YTYESKMAFL	ALATLIHQV	ILQERIEEM
ATDRWYDEY	MLFGHPLLV	ALSDSIHTV	QLLFSLPKL	KIDDVLHTL
NSEVTVQPSPYLSY	RLIESLFTI	ILTDHILET	ALFEEVPEL	LLPSRPEVPNI
VSEQELLRY	RLLDEEISRV	mLKDEVRTL	GLQDLLFSL	MLPPVLTHL
IVDEVNGLISMY	SLWKEVSEL	TMAKESSIIGV	NVQVVIPFL	VLWKEILFL
FLNDSYLKY	ALLDIIRSL	SLFGGSVKLALA	TLIEDILGV	ELPKYLPAL
LTDPAIVKV	HLYDIHVTV	VQYNEPLKV	ALFPGVALL	FLmDFIHQV
LTDYDIRFY	LLmEHIQEI	FVRDMIREV	ELIPTLPQL	FAIDPHLLLSV
LLEIAQTHYY	SLYEGIDFYT	LmVDHVTEV	ILQTLIQRV	LIDDLKSEL
PTAVVPLRY	YLSKIIPAL	SLAWKPLSA	VLGKIWKL	RVDEVFEDAF
HSDTIQWLY	FLSTLEHHL	VLATTVGKV	ALLSDLHAF	YLPQLFYHL
mSDLLSPILY	KLAEFIDFL	RLNEAAVTV	LLGPPPVGV	IIPPLFTV
ALDVVNLVY	LLLDAKLLV	FLLDGFPRTV	LLTEQIHSL	VILESDPQQVV
SADLVALSY	qLLEKVIEL	HLIDFmSEI	SQVDRLVAL	FLLDPVKGERL
AAEDIINYTEPKLGY	SLAEGRLYL	KLVGEFLEV	TLNSFIHVL	SLDRFYEMF
FSEPRAIFY	SLPDIKVYL	TLPERPLTEV	LLYQGPHNTL	ILDRVADGMVF
LLDEAQRLLY	SVIEQLFFV	VLKDDILEI	SLQEFINWL	KLPDGTWNL
VTENLRLSLY	ALLAGPLRPA	SLKSLILTA	SLSSFLERL	RLDAMFRAF
KTDDLTMVLY	FLFSKFIEL	VLTNKLLTV	FLWDVPSNWTL	NLDPLVYLL
ILEVDLKNGY	KLIGDPNLEFV	VLVDRTIYI	VLMEQIKLL	RLDWPIERL
ISDRLIGIY	NLLIDDKGTIKL	YVTEKVLAAV	VmAPRTLVL	SLPRHTFGL
LTDPMFRGIY	LLSDTKLEL	ALFVKTKEV	ALQRIISTL	ALLDRIVSV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YSAAWAEYY	HIIENIVAV	ILFPDIIARA	AmASIINRL	FLFEPVVKA
AVDPRFLAY	HLLSELEAAPYL	SLKLFAKEV	YLQNWSHVL	FLQRFIDPL
LTFVPSAEDFY	NLYPFVKTV	WLKGEFVTTV	HLGDFLVFL	HIPDVITYL
KTLLRTWSELY	GLMEDLLKL	ALKEKVTSL	ILLKALTNL	KLFDTQQFL
NTQPIPILY	FLWPKEVEL	ILHDVVEV	RISDVHFSV	LIDELNQAL
TTEFLYNLY	FVDKTVLPFV	KLIEELETL	RLLEEIHAM	LLEPFVHQV
FGEKNGSWLY	ILINDAGEVRL	ALWDIETGQQTV	TIIDLPGITRV	FLFGEVHKA
ISDPFYGPWY	KIGDFGLATV	FLKDLVASV	YmIDNVILLI	SLDQLVQAL
LTELLALEPGVAY	SLLGHLmIV	LLRPGGILAV	ALLDQLHTL	YLEQKVVEL
LVDLAPLGY	ALKDFVASI	RLKAELARL	YLLQRAVEV	YLPPEMIEGRM
DIDIRKDLY	KLMELYERL	RQIDQFLVV	AILTTLIHL	ALDSAYKEL
QSERQLLLY	KMYEEFLSKV	TLIEKTMQNV	ALAAALAHI	KLDQVLSKV
TIDKATGILLY	RLYDPASGTISL	TLKDPIVSI	KLILLITQV	YMDTLNIFm
VLETNLTGTFY	ALYDVRTILL	RLVPSVNGV	TVLDFGVLASI	ILDHEVPSL
HIDLGIKY	SLIRNLEQL	SLIDIVTEI	ALHDQLFYL	LLDPNIYRTM
MTDPIRILV	FLRNINEYL	YLITSVELL	ALLRSLVGL	FLDKPEDVLL
SSDYVEIHY	FLYPFPLAL	YLKEILQDL	ILVSWLPRL	GLWPVYEGV
VTEKDLLLY	YLGLLENVRV	GLKDGVALL	HLINYIIFL	HLDRTMYLL
YSNGVINGAELY	YLTDLQVSL	GLSEEKPLSV	ILSEVQQAV	LLDDPTNAHFI
WVDVAHLVLY	GLIEDHFDVTV	ILHGLVAAV	LLSDYGYHL	SLLDIIEKV
TTDFIFNLY	HAVYRDDLKKL	LLIGHLERV	TAMDVVYAL	ALDKITASL
LSDSFSDLY	KILQELPSV	SVKPQILSV	YLKEILEQL	ILDIIFQDF
SLEIRALLY	LMVDHVTEV	AQIDHYLGL	IVLPAGALHQV	TLDALFNIMM
YSEDHIIGAY	FLDHVMYTI	FLAAHIPLFL	SVLELIPEL	LVDNIQQHF
YTDFDGTRVY	HTGSWIGLRNLDLKGEF	FLWERPTLLV	ISERYGPVFTI	SVVESVFKL
ALDNTDLVFGQY	YLFDIQLPNI	FVAKHLKTI	NLYPFVKTV	TINIHKRIHGVGF
TADTLMGLRY	YVIAYIRDLAL	HLYGLGSGSSYV	GLADKVYFL	YIDSIPKTL
FAEMIQPEY	AIMDLLLRL	KLGEIVTTI	LLWDYVYQL	YLDGVHTVF
FLDYDAGEVSFY	ALQDIGKNIYTI	NIVEKLREV	SLIEKYFSV	HVPSTDLILNV
GVDLTGPQLY	SLIEKYFSV	ALLAGPLRPA	TLVSWVALT	HLPPTFHAV
SSDEVNFLVY	FLASESLIKQI	HLAELIAEL	ALLARFPNL	MLYEFFVKV
DSDLQLDRISVY	FLAEDPKVTL	MLFGGVPKTT	LLLTLLPQL	NVDYIIQEL
FIDAQFEAY	FLLEPGNLEVLL	mLNVLVRAV	SLLESVQKL	YIFEEPFTI
ETDEKDFYLY	FLYFEDHGL	MLREQVAQL	ALADFLPVM	FLDFLWHNm
VADLHLYLY	FmLPDPQNISL	YLFKVVLI	ALIRYLETM	GIMKKAYEL
VTDHATTALLHY	ALGFYPAEITL	ALKDLINEA	ILAAHVPTL	GLDPNKPPEL
ILDIPNQLYY	GLAPAEVVVATV	TVAELRTVESEA	ILGLIWTI	IIDTPISEMGF
LLDSSQKNLY	GLLSIFTKV	YIAGHPAFV	LVVDWLESI	KLPDVYGV
LTDIHGNVLQY	RLLDKWVEL	FLHWYTGEGM	TLmSLPTKI	KLPSNLPQL
VTEEIFLEY	ALLADEFAL	FLIGPKLYEA	FLAQRAVEL	KLVGEFLEV
HTELDTAFmY	ALLDWVTSV	GLAKAVASV	YVYEYLLHV	YLDQGTQIFL
ISEYAADIFYSRY	RLVEIQYEL	ILKKSIRNL	FLFASTILHL	DMEKIWHHTFYNEL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
QTETGTPYMLY	SILTIEDGIFEV	QLVRDLLEV	TLLDFINAV	FVDPVLNQL
LLDPGQRNIY	SLAETDKITL	YLIDVKFNGT	ALLSALHWL	KVDFIFEQV
FLEQVHQLY	SLFKIWLV	ALYPVLEKA	GLKDGVALL	LLDADMNIKI
LIDGSREGFYLY	VLLSEQGDVKL	FLADPSAFV	GLSDLRLEL	SIVDLPVHQL
YSDAFLNDSYLKY	VLNNVVIHL	ALAELTKRL	GVLPNIQAV	YLDSIPPGQYM
YTSDYFISY	SLYKGLLSV	KMAPALRKV	ALLQALmEL	YLLDLHSYL
YLFEPHSGEEY	SLYREILFL	SLAQYLINV	AALFKAWAL	FLDQHPFSF
LVDHLNVGVAQAY	YLIGQHVTAAL	VLYDQPRHV	ALIVLIHLL	FLPDPSALQNL
GTDNPLSGGDQY	IVLPAGALHQV	ALRDQIPEL	GLKEGIPAL	IVDPTGEEEHL
LSDFGLERY	RLIDDEVRILI	KLHDFGYRGV	LLAAWTARA	KLYELYLQL
DADYPLRVLY	TLWYVPLSL	SLIRFPLmTI	RLLDALEFL	LLPSHPLEL
YSQYPVPDVSTY	YLQEHAQEVVL	TLSPLLLFL	YmIAHITGL	KILPVMVTL
LTETIYKNYY	FLFDTQHFI	YIMDLRTESLI	NQNPEVFFL	KIVDFSYSV
VLDFGDLTY	ILADIVISA	YVFEGKMLEA	FLLEQEKTQAL	SLPSSKEVAEL
VLDSLLVQY	NLFEWAKNSPL	FLNNQIKEL	SLNHLLNYV	FIDGHFVEM
VSDVIDImENLY	RLLEGYEIYV	KLASKYLHV	ALSPHNILL	FLDDLSQKL
TAEEMYDIFGKY	SLLGDDALVQV	KLFnVTSTL	IEVIVILML	FVDDETKLTL
VLDILLEQY	KLLDFGSLSNL	ILTDITKGV	SLmEILYTL	MLPETREIYEL
VVDIQGVGDLY	LLLEPGSLYIL	SmFGSPGGLREA	VLIPKmPQL	RLDIVHENL
FLWPEAFLY	VIIPLLHTV	TLFPKDVQLA	TLIEELKAL	GLPSDFHTA
YTEIDWKAY	VLFRGGPRGLLAVA	ALATKLLSL	TLIRSIPTm	NIDEIYKALSR
DIDIRPGLY	YLMDINGKMWL	GVFGVKISVV	FVHDLVLYL	TMDDFRWAL
LLDPSVFHVKY	ILQNKIDLV	ImPAFIFEHI	LmYPYIFHV	FLADPSAFVAA
WSEAFDELLASKY	LLSKVLIYL	KLFTQIFGV	SLLPAIVEL	GIVGVFVKL
YTGTPDWLY	RLAVYIDRV	AIFQQPPVGV	MmLDDLLQL	LLDMSLVKL
YTFGTKEPLY	TLWYRAPEV	SLAEVLQQL	KLNDLIQRL	LVDHLNVGV
HVEEISELFY	VLADQVWTL	NIKPEIVSV	RLYPEGLAQL	QLDEVVSENQRL
ITELLYKDGRY	YAYDGKDYIA	FMVDRVVDL	SmVDVVmLL	RMLDQTLLDLNEM
LLDPASFEYL	YLDKTFYNL	KVGPVPVLV	TLVYHVVGV	YIVDLLTHL
ASEPLNSYKYDAY	ALSPHNILL	LIFPAEPAQA	ALATHILSL	FLDTIATRF
VTDTGALYLY	FLLEKGYEV	GMKSIVGEI	GLWEEAYRV	IIDTPISEmGF
GSQSYEDMRGILY	FLMDFIHQV	LLRQEVVAV	RIASWLPSFSV	KIDHILDAL
ISDLNELLK	FLMRVMDIPYL	LmKQYIEFV	SLADIAQKL	TLDNILSHI
ITDSSLGRIAQY	KLFDAPLSI	mLYPKLISL	GLQNDLFSL	FLDDPSTAETVL
LSDLGRLSY	KLLEENETEAVTV	SLKAHVQEV	TLADYLHLL	KVDDVVKRLL
SVDPHGFISY	KLMDLDVEQL	KLFSGVLMDL	FLVDIMEHL	VLDEVDQML
VTDHLGVVYY	YMDQWVPVI	LMRPLVVTA	LLLDVPTAAV	YLDWTIERV
YSGYIFDYDYY	FLLDKALLI	SSYSRFSSS	NLLPKLHIV	YLIEPDVELQRI
YTFPNGAKY	FLTEFINYI	VLFGQVVRGL	TLSDLRVYL	ALPEIFTELEI
AVLLVGYGTDSASGMDY	KLLDIPGLEV	GLKDHIKEI	FLETNVPLL	FLLEKPFSV
QVDPLSALKY	SLADVHIEV	IVATKPLYV	HLAELIAEL	ILDISFNLL
ALDSHILDY	MLPPPPLTA	VLTEHVAAA	RLQTWWHGV	LLDSQSHHL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
FVDNPVGTGFSY	SIAAVLPKV	ATFPVAPRYA	RSNPKIWNV	FLPPITPPEKF
YSLHGSSGEIESVDDY	SLIKQIPRI	ILAELLLRV	LLNKAPEYL	SLQEKLWAI
YTEEFDFKEY	TLTNVIHNL	LLALHVLEA	GImKKAYEL	SVVDVFAQL
MIEPRTLQY	ALFKAWAL	LLHSFVDSV	ILmGVLKEV	ALDTIRPEHVL
QTESQQIRYF	SVLKSIQEV	QmISRIEYI	ILNPEVVTV	FLPTLLHQA
SSESLNHLLY	ALLVRLQEV	ALCEENMRGV	SVVSWKTGV	LVDVIEDKL
VLDYINGGELFY	MLNEHDFEV	ALKELVSTI	TLSDIMVSL	ALDRPSETHADYL
LSSLPTQmDY	FIIEKQPPQV	mIAGKVAVV	YLRIDLERL	GLIEKFYVI
LLDTTEKYLY	KLTDVGIATL	RLKPALETL	ALGKSPFQL	KLPEKWESV
LTDTWAGSHSLRY	LLSHVIVAL	SLARIFTSI	SMLNRILAV	KVIVRFLTV
RIDLIPSLY	FLDGNELTL	SLKEVMTHI	TLLTKPVEI	ALDHMVEYV
TEPPPLLVY	SLmSHAIEL	VLmTQQPRPVL	LLIENVASL	KLQEKIQEL
SADVPLVVEY	YLLESVNKL	KLVSFTLSDL	SVAFKIFEL	SLYEMVSRV
SSDVLVFDY	YLVEDIQHI	ALIRVISKL	YLRTLINEL	HIDNFLEQL
KLNDLFGDAALY	ILAPVVKEI	FGYDHLILNV	FVNEIISRI	LIDSPLHNTFL
RIEEGTYGVVY	TLADVLYHV	LLSERFINV	ILNEIVNFV	YVDEVMTRL
IVDDFFIGRY	YIMDWMDEMKVL	YLKDGPYITA	VLIPKMPQL	SVDEVYEFIP
YLWSAIEIFRY	VLFEGRTVQL	HLKDILTSV	VLLPGLQKL	VVVDPIQSV
YSESSQLLYL	YLFHVQEV	QLVDIIEKV	GLLEARGILGL	YLDEEFVLRV
FTENDKEYQEYL	FLHDNMVEI	VLRDNIQGI	IVIGVLHQL	FLPRKFPSL
GSDEPAFMYY	KIMDATNILV	AVANIVNSV	NmLDVNGLFTL	FQDEINWRL
FADGFVLVY	PLLDLHIEL	FLFRITQV	QLSEVFIQL	GLDISHISQRL
LTDILGIEDY	VVAEFVPLI	KLVTTVTEI	ALADKELLPSV	KIWAPTAEA
LSDIGLEY	ALAALHVTL	SLAGIFTRL	FMLPDPQNISL	LLDDNMQIRL
TTDFEDDEFVVY	KLFNEFIQL	LLHFSIVSV	SLYDWHVKL	SLDDLLQRL
HIEESFAEHLGY	YmLEHVITL	ALTDFVRSV	NLNEKINHL	YVDDTQFVRF
LLDEHHISY	GLAKLIADV	ALYGKLLKL	QLSPVLLYL	LMVDHVTEV
VVELDLLEY	SLTRHQFYL	FIINGIEKV	QMREFLEQL	VTDEVFNFL
ETEREYFNRY	KVLEVTEEFGV	FQRPTIYYV	VILPTVHEV	FQDPVPLTV
FLDTNETPYF	RLNEAAVTV	ILYPKPKAC	ALMEEILKL	LIDEGETDWKL
YSDKYFDEHY	YMAELIERL	KLNTAVRQV	LLSEHVIAI	LLDEAIQAV
EVDPDTILK	FLAKLIAQA	SLFLQTPKIV	QLNEQLVTL	RLDDVSNDVRM
YSDNQPGVLIQVY	SLMPHFKSMYL	LLKnAKYSL	TLLPELHLL	SMDFVLLNF
GLDDKLLHY	TLMEEVLLL	YQYMHETITV	TLWPEVQKL	YLITLLEHL
YTmKEVLFY	IIFVPVPQL	TLADLVHHV	WLVDHVYAI	RLPEIYIQL
TADHNLLLYE	LLFPHPVNQV	ALFSDILSGL	KLFPKGTIFTA	ALDRIVEYL
ELEKSVYWDY	SLIDILVAL	ALLDVTPKAV	QLLTQIHLL	FLDEPTNHL
QTPIVPLLY	VMQDPEFLQSV	FLPLIVNTV	QLQDTLIHL	LLPDQPPYHL
SIDPGADLSQY	YLPHAPPFA	GLFHFPTPL	GLSPEIHTL	YLPEADSILFL
FIDFLIDTY	KLYNPENIYL	TLVEAIKQV	FLLPTGLSSL	ALDEIAWLF
LLDKGVYGLLY	SLLESVQKL	YQPDWRFMES	YLYPDITRL	ALSDIFQAV
LLENDVSTLGY	YLNDGLWHM	AQIEVVPSA	VLLTWKYLL	KMPEVIPILEV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
NLDPSNVDSLFY	GQIEVVPEV	GLSSHVEVV	YLLPLLQRL	LLPDPLYSL
NTDPSIVmTY	KLWSETFDV	SLFRVITEV	YLTDRVMTV	LVDPHFAQV
ASDPYQVHV	VLASLIIRL	SLFSGILKEM	SLFRVITEV	ImDDEFQLL
DSEGYLLFY	FLLPKVQSI	VLYTGVVRV	SVFAGVVGV	KLFGMIITI
LTEYLSTHY	TLMEEVLLLGL	FLYKVVQV	FLAPWATIA	LIDDLHSQML
EAEWQTRWFY	VLYPASPHGV	ILQDRLNQV	RLIESLFTI	RLDEALRLYL
GTDLTDEQIRFLY	WLIEDGKVVTV	ALSQINTKL	SLLGDDALVQV	ALADKELLPSV
ITDYALIAIGRY	YLHTNVALV	MLAKHVITL	SLSDTVEKL	FLPEVIYKm
PEYVNLPINGNGKQ	KLWDIINVNI	mLFENMGAYTV	qLNEKVAQL	ILWDTLLRL
RTDSSISNLmDY	YLADVTNAL	QLVPALAKV	RLLEFELAQL	KLLEPVLLL
ATQPIPKGHEIFNTY	FLLPIKTVGV	VLKPVVELL	SIIEYLPTL	LVDEVmLTL
qLDTRVSEFY	LLAEKVEQL	YLNIKLTDI	TLWYRPPEL	MLPPPPLTA
SVDSQILYY	SIIGRLLEV	YMIDNVILLI	LLASEVPQL	SLDAFLVAL
ELDISDSKIRY	VLLEYHIAYL	KLKGEIAHL	SLIRNLEQL	FLTEFINYI
ITEKWEKYWNEY	YLLDQHILI	LLFEGIARI	SLVNEIFRL	HTGSWIGLRNLDLKGEF
RLDAVTLLY	YLNHLEPPV	LLYSEIPKKV	SVITQVFHV	LLDELVQSL
STDLQDYTYY	ALLEADVNIKL	TLAPKTLSV	VLLSTIHEL	QLSEVFIQL
LSSPERDVERDVFLY	GLDPLGYEIQL	FLSEKDSLL	VLNLVLPNL	RLDDAIHVL
YLDSIPPGQYM	SILKKVLEA	ILSPWGAEV	YILGKFFAL	ILPDITKDEL
KTDEYLEKALEY	YLIARVMLL	LLNKSIIRV	NmVDIIHSV	GLPRFGIEmV
LLELLHELY	FLFVDPELVSA	SLKGDIVEL	TLLAYLEGL	KLLPQLTYL
ITDDQFDFHTY	FLLPKVQSIQL	VMAPRTLVL	YmAELIERL	RISDVHFSV
DIDTRSEFY	FLVQNIHTL	VLAHTILGV	ALQALVVTL	VLWSVLQQI
RLDINTNTY	NLFDLGGQYLRV	VLYENPNLKGV	ILIKGLAKL	FLVTVIHTL
VTFPEFLRY	NLFHYLTEV	FLFGYKFSGL	SLFPGKLEV	GLPTRLPEIML
YLEDKVYLTGY	SLAQYNPKL	GLSDLRLEL	TLLDWQDSL	LLQDKQFEL
YVEKFALNY	ILLPYVSKV	SLYDNKIQSL	FLQKLISQL	PEKFQHI
FLDTQLESTY	GLADNTVIAKV	ALSNHLNAV	AmLLEIPYM	KIDSILEVV
FTDSLITRNFSNY	SLQEKLWAI	KMPDFGQVTV	AVLPRLHQL	NLFPPmLTV
WTDILSHGRY	ALNELLQHV	MLRQIIGQA	KLVELPYTV	SLFEEMLQV
YTDIVGLLL	FLIGnDSYPIPIAL	RLYEALTPVH	KTIDYIQFL	TLDGLTKIQV
RTDAILLGHY	GLVDQLVKA	YIFTTPKSV	QLLPLLEKV	VIPEPSKLPYI
GSDYGnGFGGFGSY	VFEKKDKNEDKKIDFS	ALHDILTEI	SLLSHVEQL	FLIEPEHVNTV
LLDFADVTY	YLSGIAHFL	LLKNFVELI	YVNLPINGNGKQ	FLVPTFEQL
ITEGIYGSTFLY	YTIGKEIIDLVL	LMNAVVQTV	YVTEELPQL	GLDDmKANL
FTADEARDLIQRY	ALLDQLHTL	VQIEEVRQV	SLAFADLLVSV	KIDDTIRYL
NTDSPLRY	VLLSEILHL	AVFPFQPGSV	GLAPKPVQV	KLPAELQEL
VSDFGLSRY	ALTGYLHTI	AVRDGLRAV	SLPDIKVYL	SLDDIYMIGV
DSEEGQRYIQFY	KLLDISELDMV	GLTGQRLLGV	VLAWGLLNV	TLWEIAKAEV
ISDAAQLPHDY	TLLNVIKSV	RIFGESImIGV	VLGELVPRL	YMDPEGDWFL
SSEQTFmYY	HLGDFLVFL	SLITPLQAV	GLFPWTPKL	ALWENPESGEL
TLDPNFLDAY	KLFNESHGIFL	YLHNQGIGV	KLLAVIHEL	FIDGHFVEm

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
VLEHVPLLLY	SLLSQQPFL	SVFDYSINSV	QLFEDLVYL	ILPKSLISV
ETEYAFSLDSKY	TLYERGFENI	YLIPLLERL	VLWFKPVEL	LLDTMVDTF
VTEGGEPYRLY	ALLAELEKI	AMFGKLMTI	SImDYVVFV	TLNEKLTAL
ASEAEmRLFY	SLIPEGPPQV	KLAENIDAQL	VLKVFLENV	YVDTAVRHVLLRQGVL
LADIYRELY	TLWYRSPEV	RQFFTAPATV	SLKETIEEL	FLDPDmYSL
LTDRLWFKSTY	YLHSGQVAL	SLNKQIAQL	YLFDVQRNNIA	SLDAVMPHL
LTEGPHLYY	YLISQVEGHQV	ALADLLLAL	YLHLDYNFNL	HLDSMNVSL
qSEDGSHTIQIMY	AMFGKLMTI	ALATLIHQV	KLFDTQQFL	KLDFANNVQL
DSETRSMVEKMMY	GLLPEPNILQL	GLAARMSQV	LLNSEVHML	NLNDRLASYLDKVRAL
LTEINRSFKEY	SLAEKIQAL	KSIARVLTV	YLINEIDRI	FLFDTQHFI
VLDPKVGFY	FLFDGSPTYV	YLHSYLTYI	ALGNIVHGL	FLPPVLLKL
VLDLSHNKLDLY	FLDHIIASV	FLAEDALNTV	YMIAHITGL	HVDEFIDEL
YTELEAIMY	GLFPTSHSV	FLMEFQVKNV	YLLESVNKL	NLDYAILKL
FIEYPTGSGNVY	RLAQEGIYTL	GGLPERSVSL	AmLTVLHEI	TISPIIKLL
ITDPSLSKTDSY	VLIGEFLEKV	HLFSWIPLSA	LINPNIATV	TLDENHSIWQL
LASPEYVNLPINGNGKQ	FLPRKFPSL	RLQDAIAKV	SLLDEVLNV	ALAEALKEV
LSEAFHEEY	FLWVGATPHL	SLFQGVEFHYV	GLATDVQTV	LLDEVLHTm
LTALGKLLY	RLIEESVTV	ALKDEVQEL	SLYDYNPNL	SLDEPLDLKL
LLDTFIGEGKEY	TLHSIIISL	FTVPRVVAV	VLLEPFVHQV	YLDLILNDF
SSDFDPLVY	AMFDHIPVGV	GLTPHLTmV	FLLDKKIGV	YLNHLEPPV
RIDTRNELESY	KLLDEAIQAV	NIKPDImAV	FTNDKIINL	ALPDIKVLTL
RTmEIESTFHmY	RVMEELPLMLL	TLFPVRLLVA	HLQEYTSTLLL	LIDPFHKAI
WSEPFYQETY	TIIDLPGITRV	NLNSHITGL	SVLVSPPAV	ALPKELPLISSH
YLQNWSHVLSY	TLSDImVSL	QLIDIIHTA	ALQSLLHLL	GLDRLNVTV
NTDSPLRYV	VLQNVAFSV	SLFGLGGEPGGGAAGPAAA	ALTRVIYNL	KTDVVVNSV
qTEIRLRLHY	YLAKVKSLL	KLNPGIAYV	GILLRLPQV	QLDDQYSRF
PSDLTVGQFY	YLQDQHLLLTV	SVHKGFAFV	KLADIQIEQL	AIPGVVEKV
ITDLPIKL	YmAELIERL	FLAVKPDGV	RLAQHITYV	FLVDIMEHL
FVDDQQTFF	ALLPSSPTL	LQKYIEIYV	SLLSQQPFL	FLWDVPSNWTL
ISDLIRDSY	ALNGKLYIV	SLAEKIQAL	TLLEISDLNEL	TPGNRIVYL
TADHNLLLYEA	FLIEPEHVNTV	YVSPRILTA	RVmEEIRNL	FLDNERHEV
WLESVRLEY	KLGEIVTTI	QQIDRVVEV	SLSEKQYFL	YVFPGVTRL
HLDEAQRLLY	LLYQGPHNTL	SLKKLILEV	TLMEEVLLL	FLDHIIASV
LSDPmWPQY	TLLEDGTFKV	VLHEGTNFV	VQIEHISSL	KLPPLPAV
WKICGLSPTTTLAIY	GLLDLPFRVGV	VQIEHISSL	LLNPHLRQL	KMDEVLYSIAE
AIDRLVNIY	LLSAEPVPA	YLAPHVRTL	SLHFLILYV	LLDNTDIHL
TTSHLMGMFY	KIFTEDLPEV	ALPHHRVIEV	KILQELPSV	YLSPTFKEV
FSEIDLEKY	SLIFKLEEL	ALYPNVVQV	NILELLHRL	ALDEGDIALL
LIDTLLDGY	SLSHLVPAL	VIAEILRGV	VLIETLVTL	FLDTNETPYFm
FTETEALEGRIY	VLQDIQVML	VMFGGKQVVV	TVNPIIYAL	YVDDVFLRV
STELNHLGY	RLLEIDPYL	ALMPVLNQV	GLAPQIHDL	NMDKIYIVm
FIDLNYMVY	TLLTAIVKL	GLAPFLLNAV	RILDIDIPmSV	QLPESAYMHQL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
HTDVGLLEY	VLVQVSPSL	VLYDRPLKI	SMYDKVLmL	HLMEENMIVYV
TTDFPSESSFEY	KISEVVELL	AIKTELTQI	TINSIIYGL	KLDDLYQQKI
LTWDGFPLHY	KLNVAPLAV	ALFPEFLKEL	VLSEKVSQL	LLDAYLLYI
YTIYRPDEGY	RLQEDPPAGV	ALFPGPGNA	HLNmFIQNL	SLAGLGAYQL
YSDLHAFYY	SLAQYLINV	HQIQNVVTV	LQVEEVHQL	KIDSVAVNI
FSDIHDFEY	TLTGKTITL	FLHDHVDLQV	GLYQEILAQL	LLPEPNILQL
LLDPSVFHV	HLWEVDVQGSKA	FMFDEKLVTV	RLLPPGAVVAV	VLPNIQAVL
YSDSGLFGIY	LLGPPPVGV	ILADRILLM	FLYDTHQNL	MVDVIFADV
LTDRLASLY	SVIEQIVYV	SLHDTVTTL	HLFSGHLSTL	ALPDLTKVIQL
YLAQDFFDRY	ALLGKLDAI	YLTDRVMTV	ILSGVVTKm	FLDFAPHYF
ASDSIVLFY	GLDELFVQV	FLMDFIHQV	NLFDLGGQYL	TIPEILPKL
DLDYGFLSNY	FLFEPVVKA	NLKQAILQA	ALSSVIKEL	APEEHPVLL
NSDLNNLLF	FIDEYVETV	FLVQNIHTL	GmYPNLVHV	FLPEAPAEL
YLEETSIRY	VLLTDILVFL	SLFEGKALGL	mLFDYKDQL	FVDLLDGENL
LTEIAGVSVSQY	ILLQGRLYL	SLFGGSVKLA	SLFERLVVL	HLDMVLPEV
LADVNNIGKY	LLTDILVFL	SLRDGSVLQTV	TLASSLHTL	TLPEASDVGSITL
ATELDAWLAKY	QLMEQVAQL	YLKPYFLEA	GLLDPGmLVNI	YLHETLETI
FSEEQLNRY	RLFADILNDV	YLSPDLSKI	ILDQKINEV	KIDDILQTLL
RSDFFTSFY	SLFQGVEFHYV	FLFNKVVNL	ILNPIFRQNL	LLPAVKVFL
LSEPEEAAALY	FLGIHVFLV	GLAGPVRGV	LLLDImPGL	SLDDPNRISL
YSERVGAGAPVY	GLAPPQHLIRV	KLREDLERL	QLQGYLRSV	SMDSSHVSL
DLEKEAPWEY	KLIDLSQVMYLV	KTMEDTLMTV	YmLEHVITL	ALDVPHAEL
ETEKLYQLLTQY	RLTDYISKV	RLYPEVPEVL	qLQDIVYKL	FADGVYLVLL
KTEYISTEFNRY	SLYNDDRNLLRI	AMINRFQFV	RLFEVPHEL	HSFDPFADASKGDDLLPA
VSnLKPGVnYY	FMLPDPQNISL	HLRRFILSV	RLLEIDISSNKL	LLPPEPDYSL
ILDVLKQGY	GLMDTVKKV	AVFDKTLAEL	SLLELPHPL	LVDAIHNQL
MTEKFLFLY	QLIDYERQL	FIREHIEEL	YLAHFIEGL	RVDRIILLF
NIDNFLSRY	SLNELRVLL	IIYPTPKVV	SLQEEIAKL	YLDLRSFQM
STDHIPILY	ILENPPEEMKL	ILYPSTLFLL	SmLNRILAV	YLDPDAQKLDF
VIDEELLGDGHSY	ImLEALERV	IMFQKPVEV	YAITTLHNL	KILSELFTV
HSDPSILGY	KVLPQELV	KLIFSVEAV	FLFDNDFPAL	KIVPVEITI
YTADGKEVLEYL	LLLGERVAL	RLFYSNIQTV	SLLPFLKAV	FLLPVINEm
ELDGFGLYLY	SLWGTHVVV	TLISRLPAV	KINEAIVAV	ILPTLVIKL
FSDNDKLYLY	VLQYVVPEV	TLSEVTNQL	SILTIEDGIFEV	KLPEDIMKL
LLDELLQKGY	HLLEEPIYL	GLMDTVKKV	TLAETLVNL	VLIPKLPQL
VLDSFLQGY	ILGIQPPSV	YLFEEIAKI	YLHNQGIGV	FLPPDPTYTL
ASDYFDQLY	LLLSLLPAL	FVRDGQLQPVL	GLMEDLLKL	FMNPHLISV
ASEFPGAQHY	QLLDQVEQI	GLATDVQTV	HLSIINEYL	FVDDVSEEELL
FSDVISFILY	RLYEITIEV	KLFIGGLNV	SILTQPWRL	VLDQVEARL
QSAVWVDEmNYY	LLASEVPQL	FAYDGKDYLTL	SLTDLLNQL	ILDDVAMVL
ESEFEMKVYY	LLFGKIGYYLV	LLIENVASL	SIMDYVVFV	SLDEAYLNITK
nSFIHILmY	QLVDIIEKV	RLQEEINEV	VLNALLPTL	SVPHIYIQV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
FLDDGHTFNY	ALVEKLESL	YLSKIIPAL	ALHDILTEI	ALDVMVSTF
KLDQLIEFY	FLYPFPLALF	ALKAIVNVI	KLGSVPVTV	MLLDVMHTV
DSETRSMVEKMmY	KLWEmDNMLI	FLKDISTTL	SIYGGFLLGV	LLDYGFYLL
STAVIENPEmLKY	LLAEPVPGI	GIKDDVFLSV	TLFPGKVHSL	MLDEPTNHLDL
EIDIPHVWLY	YLDGHLITTV	RLFDEPQLA	LLNPAYDVYL	SIDSLFEGTWYL
LSDDRSNILIY	ALAEALKEV	KLADISINYV	SALFWADKV	SIMDYVVFV
LIDLAIDTY	FLIPKFFEL	KLTAFVNTL	TLADLVHHV	YLDHNALESVPL
qLDVAGRVMQY	KMDEVLYSI	FLVEKQPPQV	VLWGETVHL	FIDFTYVRV
SMEQAQAYVMRY	LLYGHTVTV	GLKELSEYV	FQRPTIYYV	FVEETVYLL
ASEFGNHYLY	GLSDLRLEL	GMYVFLHAV	RIAEYAFKL	IIDDVmKEL
FTEIKVGVAY	SLLDPVPEV	ILFSEGLIKA	RLTPKLmEV	SIDDVDSKL
qTDIQGALSAY	VLLFERELHSV	RLFEMGFAEQL	ALNSKILSV	VLFELKLLL
LTDYDIRFYmY	KLADISINYV	YMGEEKLIASV	VLLGKVYVV	AVDGVIFQL
SSDSVGGFRY	RLAQHITYV	FLKNELDNV	SLLGKLVSm	SLDRPFTNL
YADLSLKY	YQYPVIIHL	NIFPYPVGV	ALSLYLFKL	VIDAVTHAL
QTVFYmEDY	ALLGILQHV	LLYGSIPKAA	GLAPHLEQI	YLNETFSELRL
VTEIRQYFY	FLFRITQV	QLQGYLRSV	KLGEFAKVLEL	AVVEFLTSV
FADFDGVLY	KLMDEVAGI	YLVTSIAKA	LLEPEVFHL	FLQPELVKL
FIEEYVTAY	MEHIHKL	AIRDGVIEA	GLLRIIPYL	GLDEVIFSYV
LLYESPERY	NIIEAINELLV	ALKKEVGDI	TLMSLPTKI	IIDDVMKELNF
LVDPSVYGY	TLAFVSPSL	FLGEKIASV	AVLHAIYSL	ILDEPTNHL
ALDESFLGTLY	ALLERGYSL	SLKELITEA	KILEDVVGV	YLHSQVVSV
GLDEVIFSY	FVDDYTVRV	GLIENPALL	PPRRSLERL	YVPPPFAAA
TLDPQTGLFY	ILLSEPGLVKL	RIYPFLLmVV	VLLAEGRLLNL	ALESFLKQV
LTDHTVTFLQY	KMFESFIESV	YLPVKIEQV	VLQPQVQSL	FLDSPNKYSL
LLDISGVLY	YLDFTNPKV	ALAPLLSSL	ALVEDIINL	KMPEINAKV
MAELGPLNKY	ALLGGNVRMML	FLFRLINI	GLAKLIADV	LLDSTQKYL
NLDPEIDEKLLY	ILMGVLKEV	NIRDFLVEI	ILNSLYNENL	RLDEPLASYI
VIDVNKVVEY	ILWDTLLRL	RLKGQIPEI	KIQEILTQV	RLTEEFQNV
LVDSKGFDEY	NLFEWHFTV	SSKGSLGGGFSSG	ALAPLLSSL	VLPDSGHLHPL
YSGLLLPDAQY	YLSAKVEAL	VLSELAARL	GTIGLIHAV	YIDAHPETI
ATDLAYYLV	YLTYILLHL	ALKGDGILIV	IIQEFLSKV	YLPPGVIAL
ALDAAVLAY	HLWSYLITL	ALRPSVVSI	mLLTKLPTI	FADGVILLL
ATDLAQHLY	ILAAHVPTL	YVYEYLLHV	RLMmDPLTGL	FVDEILTSLIGF
GSDEPAFmYY	KLAPITYPQGL	ALHDHLATI	SLLDQIPEm	FVDQLVEGL
PTDYADIMmGY	RLLYQLVFL	ALSDHHIYL	VLSDIIQNL	GLDEVVRLL
SADQVALVY	SLIPTSPQV	GLAPGGLAVV	FLLPKVQSI	KILPTLEAV
SSELFTLTY	SLNGLEVHL	GLKHDIARV	RLLDYVATV	TLDSFYEML
YIDPIAMEY	SLSEKQYFL	RLVEFNITGA	KLQEQIFHL	LLDMPLWYL
PLDQTPLFY	VLYTGVVRV	FLTDSNNIKEV	LLAEPVPGI	LLFDSVIHL
YSFLDKmSFY	YLFAVNIKL	LLRDQVLGV	RLIDIFIINL	MLDSLRIYL
ATAPTRGSARAAGYDLY	YLLEEKIASL	RLMNDMTAV	TmQDIVYKL	TAQVIILNHPGQISA

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
NIDYPVLY	LLDHAPPEI	SLFAGGMLRV	AIMDIVIKV	FLDDLGLKF
EIDILRTLY	KVFDPVPVGV	TLAEKIQTI	ALANQIPTV	LLDATQHTL
FLSFPTTKTY	YLMEGSYNKV	ALADGVQKV	ALLSGQLNTL	NLDPAVHEV
ISEELVQKY	HLWAELVFL	ALYTVIETV	ILmEQIKLL	ALPEILFAKV
RTMEIESTFHMY	LLSEHVIAI	VLFLDAVREV	IQHDLIFSL	ALPEMEIHL
VLDIQNNLY	QLFEDLVYL	GLVGALMHV	SLQDEIQRV	HLDGVHVVF
ELDPmAmTQKY	YIFEEPFTI	NMYGKVVTV	ALYSELLAV	ITDDLHFYV
TDDLTTWLY	FLFNKVVNL	AIPGFTINRV	AVLAVLPRL	LLDEFTTKL
YSDSLVQKGY	LPKLHIV	RLPEAIEEV	SQAPFIVAL	YLNVQVKEL
YTELEAImY	ILFPLRFTL	RLKNEITRL	VLQQHLETL	FIDEGVNIGL
FLDNPDAFYY	LLLEAVWHL	TLIEELKAL	KLTNGIWVL	ILDKKVEKV
FSEPSFITESY	VLLSTIHEL	SMIDPPRAAV	SVAVWSGVNV	QLDPLVVEL
LVDAFVEHRY	FLITILDHL	GLAEWVLMEL	TLSDImVSL	FLAHIYTEL
RTDPIPIVV	YTSPVNPAV	KLKEEIRGL	YLLDLLRLP	HLDDLFFTL
SFQTQQAKLIY	FLYAGHIFL	SLFVFIPmVV	KLLDILSYL	VLDDILEKI
FTDTSIILF	RISDVHFSV	SMAPYVLnV	LLNQAPDmL	VLDEFYSSL
YLEAVTQGHGAY	RMGGFGSIIQL	YLGIVELLV	QLFDQIPEL	YIDNLLVRV
mSMVANLLY	YLLDHLHLEL	ALKAVLVDL	TLNNLEIFL	FSDEIRHNL
RLDSLTTLY	YmFEEVPIVI	HLNPSLLQNV	HIHLWISYI	GLPRFGIEMV
LLDTPVKTQY	LLLPETQSLPL	VLADALKSI	KIAPNTPQL	NLDPIALKL
FSEEHYIFY	FLWDVPSNWTL	VMIAGKVAVV	RLLEELQRL	TLPNIYVTL
GTELLSLVY	GQFPSYLETV	YLKELIEPVL	SLVNVVPKL	VVPPKFLGDSL
ISDSYFPRY	LTFPVRDGV	ALFGAGPASI	RLYPWGVVEV	FLETNVPLL
LLDAVLIDY	QLLTAIVKL	KLAEALPSL	AILLEIPRL	ILFVITKPDV
LSELFmSSFQSY	VLIRDLNFEV	LLANKVPAA	ALAQRLLEV	KLLDPEDVAVQL
VIDPESGNTLY	ALWGFFPVL	RLPPDTLLQQV	ALTVNLHLL	RLDELGGVYL
FSDAQTIEAGQY	ILSEIKEAV	FQHGVIAAV	FLRNINEYL	SLDEPYEKV
NSDTNIRWNNY	SLAEVLQQL	NRKDIENQYETQ	LVLESLLHL	ATDDSLHQL
VSELAGLLSAmEY	SLSAFTPAL	ALKPDLVNV	TMLDILQTL	ILDTLVFAF
YSEYPPFSHRY	FLFEPVVKAFL	ALYNHISEL	qLQGYLRSV	LVDSVLDVV
LSDLGLISY	GLFTLSHITQL	ILADIQSHM	YTTDFIYQL	AIIALFHLL
NSESGYILFY	ALLQQPLFL	ILYPEIPRKL	ALADLLLAL	FVHDLVLYL
YTELQLIEEALQKY	FAIPMIHAV	NLKLKLTAV	GLLTEIRAV	MLDEMKDNL
YTDIPKIIY	FLDKQGFYV	ILPERFLAV	KVLNLVLPNL	NMDSVFKELL
ATDYTFAmY	FMIDASVHPTL	LLFPSDVQTL	LLWWLQPRL	qLDDQYSRF
QAEILLSNHY	KVIEINPYL	LLKSKLLVL	TLLPQGLPGL	RMLPHAPGV
LAELNQILY	SLHDAImIV	SLPPHILEV	NLIDLDDLYV	SVDDIVKGINS
HSELLEDYY	YLMEGSYNKVFL	PVKRSIITV	ALADGVPVAL	FLPNAPKAL
VGDLAELLY	SLLDDLHSA	ALHHRILAL	ALKDFVASI	KLDNLMLEL
VIDFTGHALALY	SLPDHLPSV	FLRSDLIEV	LASALAGLIA	RVDDIFSDL
QLDVAGRVmQY	ALFPHLLQPVL	YLFPGIPELL	LPAIVHI	THAVVTVPAYF
ASAITGYLSY	SLINVGLISV	KLNVAPLAV	qLLFSLPKL	QVDEVVDIMRV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
ILDNADVLSQY	SLLPFWYTL	NLARALQQV	RQFLFHWTV	FLPLPVVQL
ATEGTDRKDVFFY	FLLGKEVSL	SmAPYVLnV	SLASLLVSV	HLDVQPAAL
KLDNTVQDAGLY	VmDSKIVQV	ALIFKIASA	FLIPKFFEL	YLDQVKIRF
QSDPWQQELY	ALWDIETGQQTV	YLLPERPATL	FLWKEPATm	ALWEDEGVRA
RVDFQGMEY	FLADPSAFVAA	LLYPREILIL	GmYGKIAVmEL	LIDDVHRLF
YTDATPLRV	GLYGAIFRL	SLREQLEGV	ILQSLLETL	LLPHLLPAL
NTDHLTTVLY	LLAELPASV	VLSTRVTNV	KLNVAPLAV	SMDHIQAEL
ELDDTLKY	qLIDKVWQL	ALAPGLPTA	SIAAFIQRL	YLWLKLNQV
GLDEPLLK	SLAWDVPAA	TmKNPSIVGV	SLASHIQSL	ALPKIILAV
SVDSNLLSDY	SMYDKVLML	FLPIHLLGL	TLTGKTITL	LLDDRHDSGL
VIDWHNYGY	VmQDPEFLQSV	VLMEKPDVV	FLFRPWDV	LLPQDVHLL
DTDRFVLLV	ALTGIPLPLI	YIMDNKLAQI	ILLDDTGLAYI	NIDSIFIVL
ESQLPEKVEY	FLDLGPPGI	YLGKVLEL	KLIPFLEKL	YLPHAPPFA
LSEWQKELY	FLTKQEILL	LLKEYLVTL	LQWDKVLRL	FLREYFERL
RSEFQLGESVKY	IMLKGDNITL	SLASLLAKV	VLQQHINSL	IVDEAIYYF
TADHNLLLY	KLFSELPLA	AIKEILTQV	FLGKIDEL	KVVDVDVKL
YTEDSPGLKV	KLLDLSDSTSV	AQAGIKISSV	GLIDVKPLGV	TLEEVFIEV
FMEKETPLRY	SLVDTVYAL	LLFSKQPSQA	ILLAEVPTM	YmDTLNIFm
FSENTLQFY	FLFDRPMHV	GLQGRVTTV	AAKSWVFGV	GLDEAKEILL
YMELYTHVY	FLIPIYHQV	MLKSNIVTV	ALGQILPQL	LLDSGAFHL
ELDPAVmDQFY	GLATDVQTV	SLYIRPTFI	SmLTYPFLL	MLPGFLHRL
RTDPSETKPWAVY	KVGSFKFIYV	YMSEHLLKA	TLSSLVFQL	SIIQRLLEV
FSEFLINTY	LLYVNVIGL	KLFGMIITI	RLLsPRPSLL	TLPTVRMIVDV
VTEIMSmGY	TMAKESSIIGV	SLIAKVATA	SAMEVVPAL	VLFGVETHV
ATEQAPLWAY	FMLKDMLYL	SLRPDLLTV	ALYVAVVNV	KINDTIYEV
MTHNLLLNY	FQWDSDNIYL	FLLPHPGLQV	ILQVGLREL	GLIDKVNEL
QTEIRLRLHY	HLFDAFVSV	RMKLSLTKV	SVYPNGHFV	SLDQIFETL
AADLVEALY	LLYDDKGVGL	TLADVLYHV	VLASLIIRL	AVDNVAHTI
FTDADDVAILTY	YImEPSIFNTL	VLRPAVLQA	ALQAEIAAL	GLWEEAYRV
LSDSLFLEV	GVAPSRAIYFA	GLSEKLLAYV	HVNPFLPYI	IIDDPNLVVKI
SLDSPSYVLY	RMFDMGFEYQV	KVIDYVPGI	SLLSDIIAL	SVDVADLIGL
NTEEFITVY	ALSQDIPEI	NLASFIEQV	FTLSHITQL	YLFIVKNEL
FVDILTNWY	ALYPNVVQV	TMKDHLVRV	LLAEKVEQL	ALDTINILL
HSALLALRY	KLEDLKL	VIIPLLHTV	LTNDWEDHL	FAPAVGPALG
ITDIVNKY	KLVNILVQL	YLFSGSRPPSQV	YLADVTNAL	LMPDQTAMHEV
KSDVEAIFSKY	KMDDPDYWRTV	SIAAVLPKV	ALRDQVPTL	NLDDIYHFM
LIDYDMVHY	LLIDHRFLL	ILVDWLVQV	ILNYVLVRV	NLDHVYNRL
FTAEFSSRY	RLQEFIDEV	KLYHQWLSTV	AImDLLLRL	YLDDLLPKL
IIDYLTDHY	VLLSHLSYL	SLFPHNPQFIG	ALSDIFQAV	FLEKLLPPV
ETELDGLRY	MLLKTVLLL	YLINFEIRSL	KLIEVDDERKL	NVDGHLYEL
LADQIFAYY	TLTNIIHNL	AIVDKVPSV	LLQLDVPLL	VLDNIKAVF
YTDKIMTYL	FAYDGKDYI	ALAQRLLEV	VIFPDWTEENKV	ELDKIYETL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YVDPQFLTYM	KVLGIVVGV	FLSPLLPLL	ALYPGQLVQL	FLDQQAILF
FIDIFTSNTY	YLTPLILTL	RLIDDmVAQV	NMVDIIHSV	HLDSmDWLEL
LSDHLINQGY	FLLDGFPRTV	ALQDFLLSV	RVMEYINRL	ILDDLFLHT
NLDFLDLGY	FMFDEKLVTV	FLLPILSQI	SLASFIPAV	ILYDERSVHKV
VSDKVmIPQDEY	LLAETHYQL	SVKEVISAV	TLLDAGLPQKV	KILPDLNTV
VSELAGLLSAMEY	KLWDLLYKL	TMFRVEYA	AmQEYIAVV	KLYNPENIYL
LTDDELFQY	KmLDEILLQL	YLSPKLWAL	AVLEEIYLL	KmPDDVWLV
TTSHLmGmFY	KIGDFGLVTSL	ALRVVVALV	FLLPVINEM	LLPVDKAFYEA
YADPVNAHY	KIWDVSVNSVV	FLNKEITSV	FLLEGIRSL	QLDSVRVWL
EADGAAWVLLY	RLLDGAFKL	QMISRIEYI	ALLSAVTRL	SLPLFIVTL
NSELPTAKEYFRDLY	SLLGGNIRLLL	TLSELKTVL	AMLLEIPYm	ALFASGLIHRV
SSDTADFRDLY	ALFEGKVQL	GLAPNtPGKA	FLGIHVFLV	GMPDFLEKL
FLDLVNYVY	KLAEGVLDV	GLNEEIARV	FLLPIKTVGV	ILDEDKESTF
QTDINLPYL	LLQDIILQV	LLNDHIYVV	ILQDRLNQV	TLDELGIHL
WTEmNTIVY	ALHDILTEI	LLQDAIREV	LLAGVVPLL	FLEEEVYPL
YSQELSLLY	KLnATNIEL	SLSKITTTV	SLLGKLVSM	KIDEHHFVAV
YTSNLAYSFY	LLPPAPPHA	YVFDGKPPQL	GLLEIVTSV	HLDLPSNNNLV
WTDLALQY	qLFEDLVYL	ALMAHAmEEV	RLTDYISKV	YMDSPQSIGF
YSSPYPQEY	ILLAEVPTM	YLPTRVTAI	TLYFSYTHMV	YMPPPYASL
NIDLVSKLLY	KLNATNIEL	KLMDEVAGI	TmTGWVHDV	YVSEILEKV
RTELAIKLLEY	KMMDVTVTI	SLYALHVKAA	GLEEKLPSL	FLDPEIKAFL
TTEETLTMLY	LLLDVPTAAVQA	FLIGQGAHV	HLLPKIENL	FLVDKYEIL
ALDGGFQmHY	QLVPALAKV	YLADVTNAL	ALWAGLLTL	YLADVTNAL
LSELFHSRNYY	YLLEQDFPGM	ILAFLVPFV	mmLDDLLQL	HLFETISQA
ETEPVFWYY	FLWQEGHSAFA	YIKTELISV	SLLDTLVLL	KVDEIFGQL
YIDDVFHAL	SLHFLILYV	RLINQVLEL	TLYEAVREV	KVDsPTVTTTL
YVPEHWEYY	TLHGLQQYYV	SVATKLTAV	AmASLGALALL	LLDPNIYRTm
SSEELPLYY	ALFASGLIHRV	AIAPIIAAV	AmNISVPQV	NLDVPHSYSV
AMDVYKNLY	FILDISPVAHRV	FLFPHSVLV	KLQDQIFNL	KLMDHIYAV
VVEQGPSFAFY	FLLPDVIRI	FMKKYIHVA	qLLEFLDRL	NIDEIILQL
KTELQFSDYY	KLDTVSSKIEL	QLFKKPRQV	VLmDRLPSL	RLDEVLRTL
LTEFKFIWY	KMGLIFEV	QLSPRLLEV	GLSEPIFQL	SRSGGGGGGGLGSGGSIRSSYS
TTEETLTmLY	KMWEEAISL	RMFDMGFEYQV	KLLPQLTYL	ALSEKIVSV
YIDSKFEDY	VLVDRTIYI	GLADNTVIAKV	LLVEEIHRL	AVDEAVILL
GLDQPLLK	AIVDKVPSV	KLFGmIITI	MQISFIHQL	EYVNLPINGNGKQ
VTDQNKIVTY	ALRDVSEEL	SIMDRILQI	FLNNQIKEL	GIDPPRGVLM
FTDGDAALEF	KIWEELSVLEV	VAPGKDLTKT	FQNPFRSEL	ILPPLLQL
STDTSLKIFY	LLLDRIASV	GLYPNLIQV	LLAETHYQL	RLQEDPPVGV
YIEEFLQQY	mLAWINESL	LQKEGVIGV	mLLSSLVSL	SLDLIYRDL
KSDGSFIGY	RLINQVLEL	SISERLSVL	VLmEQIKLL	ALPQTLPEIF
IVDEFAMRY	SVMEVNSGIYRV	SMFGAGLTV	HLSVVSVTV	ILDKYPLAV
LSDHSIRSF	KVLETLVTV	VLKsGNPRGL	QLIDKVWQL	KILPVmVTL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
VSEYVDAVLGKGHQY	SLSFVSPSL	SLIRAMLQV	SLLGHLmIV	LLDERLVTL
NTDLVFGQY	TLVEAIKQV	TLAELLVLL	ALLENmEGLFL	LSDPIVNTL
SSEYHYVGGFY	VLWGETVHL	TLKEILRYL	HIIENIVAV	qLIDKVWQL
VTDDSPKYnY	FIDKFTPPVV	TLKPAIEEI	IQIMKVEEI	YMAELIERL
NLDIERPTY	ILISVDGKVYL	WLYGEDHQITEV	SLLSEIQAL	YSDDIPHAL
QSENPWDNKAVY	ILSVFIPSL	YLEERRVKEV	SLSHLVPAL	AVDSVLVKL
SSDYSIFDNY	KLLDVVHPA	AmAEPNAKFIEGV	GLIENPALL	LmDEVIKSM
DLDEIVARY	AGGHKLGLGLEFQA	GMAPHSMAVV	QLLPSIPQL	SLPDIKVYL
FTENDKEYQEY	GLLTEIRAV	RVIGTLEEV	YLNDGLWHM	FLDISRPKM
YLEELPEKLKLY	SLLRVGWSV	SLIPIISGV	ALYPNVVQV	ImEDIILTL
YTLLDVLYY	VLLEEGEAQRL	VLFPKPGPLEPTQ	GLSNHIAAL	KIAPNTPQL
FLEDAIAVTRY	YLAHFIEGL	FLHETGGAMV	KIISALPQL	LLPEDTPPFL
ILDLDDELYLG	YLINNPNQISL	HLASIHGYL	AALSWQYLT	YLDNFWPDL
RSDDIYNQVSAY	ALIDRMVNL	RLADFNIYQV	ALTPVWVLI	LIWPLLSTV
VSDYLRQSY	ALSELIILT	YAFAHILTV	GQIEVVPEV	LLDDKAQAL
GSEYLKLGY	AMWEHPITA	ALNPKLTVI	KLmELLEEI	LLKDSIVQL
QLDAELLRY	LLAEAKYYL	GLIQGVKSV	NLLTHVESL	RLPWVNPYM
TTEILRSmLY	RLLAETHYQL	ILSDNLRQV	qLLETLNQL	VLDFGRPIAM
mTDEWFSEY	RLWGEPVNL	SLGQKISTV	SLLSmLQSL	NLLKLIAEV
NIDIPEGNWY	LLIENVASL	SMYGVDLHHA	SLMLLIRQL	SRSGGGGGGGLGSGGSIR
NTAIVGSTTGSNYY	LLSSIVEEL	FLVEHVLTLI	RLLEGYEIYV	HVLDVIHEV
DVEQLGIPEQEY	RLFEVPHELVA	RLYSNDIHAI	RLQTQVFKL	LRDEFLVKI
LTLSILDRY	SLLQLHDAEIVRL	SLASLLVSV	TLQEITFSF	NIDEIYKALS
YADTFGDINY	YILDLQVVL	HLLPTAPTTV	MLLPGPLHSL	NLPDIVSKV
ATESSHFYSASAIY	ALLPLLERV	ILKAPGTNV	GILGIQPPSV	QLFEDLVYL
QTDQmVFNAY	SLLQVLISI	KLKETSPLTA	KLVNILVQL	SVDEVEISV
VLDEAFQRY	VMFEDGVLMRL	SLRDLIQGL	SIFKAWAV	ALDPSFPRMNL
FVEVGRVAY	YLINEIDRI	FLLGHEIAHA	SLAADIPRL	FLDPITGTF
FVETESVRY	FLLEDDIHVS	GLVGIIVGTV	ALTSEIALL	KIDPDLGYSF
YIDAQFEAY	ILSESLHSL	HLKDGlmNL	ILVDTVWAL	KIFDEILVNA
TIDIGVKY	KLTDQTLIYL	KLKKELTGL	QMISRIEYI	LLMDRVDEM
TSDELQFGY	RLAEVGQYEQV	SLAQYNPKL	SLGLIFAL	LLPPLESLATV
HTDHHmFFDY	SLIRIVPVV	VLFENQLLQI	TLIGLSIKV	SLVPVYVKV
MSEIEAKVRY	SVITQVFHV	YLSDIPLHDA	SIQALIHGL	IIDGVKVQV
MVDFAMDVY	TLNDREYQL	AVKPSVTCV	VLmVNIGSL	TVTTLVENKKAQL
NLDFQmEQY	GLWHGMFANV	FMNPHLISV	GLQKmVALL	YLVKIFEEL
YLDYDDTRY	KLYGKPIRV	LLAEKVEQL	RLLEFLVAL	HLDPGPIYM
YVDDASWMRY	KQVDFLNWEV	RLAHYIDRV	FLLDGFPRTV	LLVPTSGIYFV
GSDPLGLIAY	KVGPVPVLV	SLSEILSNI	FSLENNFLL	SMEEIFQHL
RTEFTVEVY	LDTNADKQL	YIRGGIVSQV	IILDALPQL	YLLEKFVAV
ITDHGSLIY	SLLSHVIVA	YVSKYINYI	YLYFFRVLV	GMDDIFSHI
ALDGGFQMHY	ILLAEGRLVNL	AMFLTDSNNIKEV	YMAELIERL	RLPPATLTL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
HIDFAIQY	LLQDKQFEL	KVASLLHQV	LLWHWDTTQSL	VIDEDYRGNVGV
NTDRGNDNWLVRY	LLQDRLVSV	LLGPRLVLA	mLLSVPLLL	GLDEAFSRL
ELERLTSLY	LLWPGAALL	TQILSVPKV	YLLNDASLISV	KVPEIEVTV
LLDFQEFTLY	VMAPRTLVL	YLSFLPLQTV	GLLQQPPAL	LVDEVMLTL
RLETELDGLRY	FLIQDQQGLITL	FIRELISNA	GVLENIFGV	RVPPVPPNV
VTDSGPTFNYL	FMLETVDSVKL	KVMGTFSTV	KLLDLIEDL	SLPEILKEV
LSDEHVQFLVY	YVMEYRELFL	SLAWDVPAA	PLSKPLPEL	TLDEPIWRTEL
LSDVDAFIAY	FLHEATVRL	ATIGELAQV	RLLLHLEEL	VVDAIPVFL
LTDGVSQIHY	KLVKEVIAV	SLANIIRQL	SQAERLFNL	YLHSYLTYI
LTEQRALLY	RLLEITEGSEFL	TLINLLLKV	ALLETSLLHHF	ALDEQLVQV
LTHWEQLDY	FLLQLHWRL	VLREWLVAV	FLFDGSPTYVL	FLDYQLDEL
FVDDYTVRV	VLADALKSI	VLRGALEmV	ALNEVGIYKL	FVDDQQTFF
ATDLIRISQY	AIRNDEEL	YLTAEILEL	ELVEYLPQL	LLPVDIRQYL
ETALLVDRY	ALFTKVLENV	ALANQIPTV	FINIVVHSV	YLPPEMIEGRm
FTADGDQVFAGRYY	GLLYPTEDYKV	FImEGTLTRV	GSLNWGYRV	ALDYRPLYL
ITDIHIKY	ILDDIGHGV	FMKPGTLYV	ILAAIVNHL	FLIPKFFEL
QLDHLSLYY	LLDIIKSTV	GLFGKTVPKTV	ILSVFIPSL	NIPVHLPNI
qSEEARRLLGY	NLLDLNQKLQL	LLNPHLRQL	KLLEVSDDPQVLAV	YLLESVNKL
YLDQISRY	TLWRGPVVV	RLFNDPVAMV	NLAPVILQL	YVDNRFFTL
DSDTEKELQALY	FLLALEPEL	SLARILSLL	QLLPGGLQGL	GLPWRFEEL
HTDAVWGLAY	FLLLPDAEAQL	SLKETIEEL	AIASGIYLL	MVDPVTGDKL
TSDVPGKLIY	ILVDTVWAL	SLKPEVAQV	LVIVSALTFI	FLDLGYNRL
KSDSGKPYYY	VLMEKPDVV	FMSSHIKSV	SLmDLTLLL	ILDSHAATL
DLDLSPLEY	ALANQIPTV	HLAEIFGKV	SLALGLPHL	SMPDFDLHL
LSDPQERAWY	QMISRIEYV	SLFFHVPAGL	TLQEQIEAI	YADQLKEYL
AADIFYSRY	SLMALILFL	TLKDFVTVL	ALVSSLHLL	YLDPPNERLIL
YLDRGTGNVSFY	FLFASTILHL	KLKDDIRGL	LLSPVVPQI	YLDTLYRYA
YIEDRPLHMLY	FVLPVATQI	SQISRLQNI	AISGVPVLGF	ALDEDFAPAKL
FLERIHLQEY	SLLPYLPML	SVANHNSFL	GLFSNDIPHV	LLDENLLKM
mLEAGILDTY	VLSNVEVTL	ALKPQVSSIF	GLIEDYEALL	mLPSILNQL
EYVNLPINGNGKQ	YLGIVELLV	TmYPGLPSRL	HLSSLIAQL	FIDVGGYKL
GSDITSITERY	YVLEGLKSV	VLIETLVTL	RLWTPPEDYRL	GLDIITNKV
TTDGYLLRL	KLYESLLPFA	GLVPFLVSV	ALLAGSEYLKL	FVDEGIKTL
RTSLPTVGPSGLY	NIMDFKLFL	ALRPGVTGA	ALmHALTDL	FVQEVVQSQQV
MSDSYLPSYY	RIIDIWILL	ITQIEHEVSSS	LTLDTTSIPLRL	KIDDFPNEL
IVDNPADFY	VLMTEDIKL	SLSSVLSHV	RIAEFTTNL	ALHDILTEI
VTDDYIGDNTTVDY	FMQDPMEVFV	TLFYSLREV	SLAPLFFKL	FVDPAQITM
ATALFSFLY	SLMEILYTL	GLAAGGIVAV	TLAELLVLL	IMEDIILTL
GTVYEDLRY	FLQEGDLISA	RLKDIIFDV	YLLQEPPRTV	NIDDVVRFL
LIDPDLTQY	GLNEEIARV	SLSSFLHGV	HLLDLLARL	RLQEEINEV
TLDAVKFSQY	mLFPGSIAL	YLYSNKLQSL	LmVDHVTEV	TLDDLIAAV
VSDSKQFTYY	RLLKSKLYL	FLSELQYYL	FLLPKVQSIQL	ALYPVLEKA

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
TTSHLmGMFY	RLQEDPPVGV	HLVPFVGKV	GILSFLPVL	ILDVTVVYL
GSDPVFRFY	RVMEEIRNLTV	ILYDKLEKI	YLLEEKIASL	KIQEILTQV
VTEKVLAAVY	ALALIYNEAL	LLIPGLATA	GLLEKLTAI	KLPMSIIIVGV
VTEQLDAGVRY	ALKDLINEA	ALAEALRLL	RLYGDESELHFWTV	MVDEVSGKVL
ASAVIGLLY	FIQEIEHAL	GLKKVIQKV	SLLDmSLVKL	RIFGESImIGV
AIMELDDTLKY	GLLDLPFRV	LQFDKELRSL	VLLDAPIQL	VmDSAFKVYL
AVDPGLLGY	LLAELLTHL	YLFITPPKTV	ALNGKLYIV	FLQEQLVEL
HTDILKEKY	qLTNVILHL	ALKEITRQL	ALQWVVVEV	GLDTVVALL
ISSENLLDAVY	RLFDWLVSV	ILKEIVEML	GLAVILPPL	IIDDKPIGL
LSDTKYLEmIY	SLLDELLEV	MLNVLVRAV	RLLELLTKL	ILPDGSIFSRV
FTEIKNLLV	TLAELHISL	SVKNGILTI	RVFENIVAV	KLDEFGEQL
IVDHIHFQY	KLWSFFIYL	GLAGSVRGL	ALSYILPYL	NLDRFYQQV
ASEIQIKQQSTSY	MLDEILLQL	ILASLLRNL	SLIEKPPIL	RLDEARQML
QTENLGVVYY	RLLEVPVmL	qLIDIIHTA	VLFNKLTYL	LVDNITGQRL
VLDNPSPFY	VMDSKIVQV	TLNFPGRTV	YQNIWNINL	MMPPPPAAM
QLDRISVYY	ALTPVVVTL	YIYDKDmEII	SLSEYVSRM	qLDRIIAKL
VVDGFNVLY	SILSLLIKL	ILRAILLSL	VLHDVIYVI	VVDGAFKEV
ELDIGDATQVY	VLAFLVHEL	LLSPHSQVL	GVVDGIYRL	AVDEFLLLL
VVDRIYSLY	VLFTGVKEV	SLFDAVSSL	ILVDWLVEV	AVDELFTSL
AADLNLVLY	FIMEGTLTRV	ALANLKVSQI	KLLGELHTL	GLPPAMQKV
RVDELLEKY	HLLNESPML	SLADVHIEV	ALMPVLNQV	ImLEALERV
TTDnQTGVRY	ILLTEPGQVKL	SLVELLNQI	ALWGFFPVL	ITPENLPQI
YLESSEALYNQY	ILSELAPSL	VLASLIIRL	FVMETFVHL	KLFGmIITI
HLDAELDAY	KLFDLDEKLML	VLAYFLPEA	GLIDENPGL	KLPSTLTGLYV
LVEEVQLNFY	YLYESGETEKL	YLRLPEVQGV	LTMEVIRQV	LLDKLLIRL
FVLFDSESIGIY	ALQDVPLSSV	SLTAHLRSL	VLAPLIALV	LLTDILVFL
LSELAPSLPSY	TLAELLVLL	TLSSQISRL	WIQNKIPYL	ALDEADRMIDM
mSEIEAKVRY	YVLDLAAKV	ALKLVITAL	YQEEAIPAL	HLDYITEKL
LLDESRPLFERY	SLLPTSPRL	VIRQITATV	ALQELISEL	LIDIFIINL
PSDIFmVmEY	TLSDVVVGL	ALASEPLKV	ALFGIPmAL	LLDQINSTF
QTDINLPY	TLVDFPLHL	ALYVAVVNV	ALSDHHIYL	RLPDPFTPNL
QTDNIIYVY	YLIPLLERL	AMNGHVPAV	FLADPSAFVAA	FVPDTPVGV
FTDNFSFNTY	YLWHIPLSYV	FVKPAVVTV	FQLEHIMDL	GGFGGRGGGFGGGS
LSEEGLLRLY	YmDQWVPVI	LLKELRHGV	KLIPQLPTL	HLDQIIPRM
YSETLLSYFY	YLSPKLWAL	SLFVFIPMVV	SISDVIAQV	ILPEIIPIL
DTDFMGLFKSSRY	ILTKILYLI	VLIDYQRNV	SLATSLPRL	IMDTPGHVNF
VTDAVALRV	NMYEGVGRMFI	VLYPHPPLA	SLLPTSPRL	LLDEVLNVM
YTSYPMHDFY	SMAPYVLnV	ALFTFSPLTV	AmLGVNPRF	RLDPHPELL
LMEEVQTLYY	qLSEVFIQL	ALSDLEITL	GLSPVTNLTV	TIDDLEDKL
mSDVNLKY	RMFDGKFVVA	GLFSNDIPHV	ILTNVVPKm	YLPFIMELL
mTNPAIQNDFSYY	FISEFEHRV	NLIPILKTV	KIVNTPEVIRV	HIPEVYLIV
QADPTKLELLY	ILFDHMVPLV	SLKEDIQKA	YLSSLQPRL	VLDEADKLL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
YTDHLQSYVIY	KLIPQLPTL	SLYEmVSRV	ALNAVRLLV	ALITRIFGV
VSDYYSQLIY	VLLPDERTISL	FIMEGTLTRV	VLREWLVAV	KIDDKPVKI
EPFLFNFLY	VMIAGKVAVV	IIRDILQDV	ALMPQLVQL	LLPDTAKQQEL
RADQELLMY	KIMDYSLLL	KLIKSLEAA	ARFEELLLQL	NMDKIYIVM
YLDTVPEVY	SLVNQVPKI	RIKATVMDV	GLLERPVLL	RVLDPSMVILEV
VADVHQYFY	GIMKKAYEL	SLFGYSPAAA	GLTEGIWQL	VIDDLVYSI
WSDGHLIYY	KLMTALVNV	FLQPIYLKSV	LLNPSLQKV	VLDLSWNKL
FSDPFTGGGRY	AVMEQIPEI	ILREDPAYL	SLKGTLDNL	WLPEVmILV
HTDSLHLLI	FLDNLHINL	ALKDTIGKL	TLLPTLYEI	FLHEATARL
RTEPFQDGY	GIWGFIKGV	FLFDGSPTYV	GLKEILPNL	QLPDIYPDL
SSEEQKQLmLYY	ILTESEIKL	FLFEPVVKA	TLAETIQGL	VIDEIGKMEL
VLDELSVTY	FIIQGLRSV	ILKQVVNQV	VLFNFGKEKFEV	YIDDPDKYHQGF
TADEARDLIQRY	GMAERIPEL	FAFTNKITSV	LLMPSPSHL	YLPAVFEEVL
ALDTLIIEY	GMFKNLLKEV	ALARPGLTI	GIAPQIQDL	EVISKLYAV
YLEmGHDITRLFY	ILLNPAYDVYL	ALKNDLVEA	TMLELINQL	FLNNQIKEL
NSEAARAANNGALPPDLSY	KMFQEEGYIIAV	GLAPGGLAV	GLYELVWRV	SLDRIYNML
LTDDDLLRY	RIADGLPVAV	LLASEVPQL	YITRYIASL	SMDPLPVFL
LTEKNWFHY	FIYHGEVPQA	LLSPLQPQL	AmVPHYGGINRV	FGPAKLPRL
YTDVSTRY	SIAEVVHQL	SLADIAQKL	NLITYDDRFNL	KIDDMMFVL
ITEEDFKRLFERY	VLLESKILL	SLAEFISERV	TLHSIIISL	YLPEWKENI
FSEKLEAEY	VLTNKLLTV	VQVQQVRSV	FLFQEPRSI	FLPEVIYKM
ASDAAPLQYL	YLDIINLFL	AQILQILTV	TVFEHTFHV	FmFDEKLVTV
FAEAHYLSY	FLYDHIQPVRA	FLNDSYLKYV	YLRELLTTM	LLIPGLATA
QADIARMLY	GLAAFRAFL	IIFETPLRV	AIMKIISAL	MLQPYMPTV
DSDmQTLVY	ILLNNSGQIKL	STAAKIMGV	FLGDPPPGL	QLDQVTAKL
GTELGNELFY	KLTENLVAL	KMMDVTVTI	SLSDLLVSL	YIEEAIEKL
KTnESVSEPRKGFmY	RLLEVTNTIRV	FLVPVLEAL	YVSPKQFSV	FGVPLIVHV
GTDFLTAIKNRY	SMAELDIKL	HLFSGHLSTL	RVMELFFTV	LLPPLLHTL
FTELAILY	ISERYGPVFTI	HLKDGVPGL	YVAELIQQL	LVDDLVDSL
FIEEKSSFEY	LLMATILHL	TMKNPSIVGV	ALGPGVPHI	VLDEVDQmL
LAEEITLHY	NLASFIEQV	GLAKRPGALL	GLAQTLEKL	YLPSAILQL
ATSKVALVY	VILPTVHEV	ILADIVISA	LQLHEIPSL	KLDDLTQDL
DVDHGNFFTY	ALADKELLPSV	KLMELLEEI	VLLSPVPEL	KLPGNISSL
LAEYDLDKY	AMLENASDIKL	MLSEHTSKL	ALFASGLIHRV	LLDSGAFHLL
VTDFIAPGY	KILSELFTV	TMVDRIEEV	ALLETVNRL	WLDEVRLTL
GTEIAASLLY	TMADQIVTV	ALRSFLQAL	ALSEKIVSV	GLDNLYKKV
ITDDLHFYV	VLLDHLSLA	GLYGLIVALI	GLLQQPSAL	LVDENFTEL
ATEQVSWGHY	ALAPGLPTA	LLYQGPHNTL	HLWNSIHGL	RVDDLYTLL
YLETVAAYY	ALLTGIISKA	ALNGKLYIV	LLTNVLETL	YIDDLVVIL
ETELISTTANY	FLLFEGEKITI	IMKEVIPFL	LVLDKLFQL	PVFQAKM
ISEVGTIRY	FLPLIVNTV	LLFWVTEV	AImKIISAL	TAQVIILNHPG
LADLNNVRFSAY	GLSSLSIHL	YVFPGVTRL	AmFGKLmTI	FLSEVFAQL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
LSDIERQIY	KImDYSLLVGI	FIFPGKLGTL	AmLRLIPSL	IMDSLFQSF
PTDATLNRLLY	NLMPQMKTLYL	KLFEPYVVHV	GLNEEIARV	NADAIVVKL
VTDGSLYEGVAY	YQFGEIRTITV	RLSNHISSL	YLSVKIWDL	NLDLAVLEL
YTSYPmHDFY	FLLPMFERL	SLIEKIPTA	ILGKIWDL	NVEIDPEIQ
YVDPSTDERLSY	KLSEVLQAV	VLFQEALWHV	KILPTLEAV	TIDGILLLI
VSDVIDIMENLY	RLFDDSTVTTV	MIAGKVAVV	LLQEPPRTV	FLDTIKSNL
FTSMTRLYY	RLQEEINEV	VIKEDVSEL	RILDILEYI	ILDIPTHTI
LTAELIEQAAQY	VLLKARLVPA	AVITKVKGV	RILDYVINL	AQYEDIAQKS
MIDPSGVSY	YLDRFLAGV	NLKEKIKEL	YLADLYHFV	FILDFYEKV
LLDSDEPLVY	ALVHITLIL	QIVRDHWVHVL	YLNETFSELRL	KLDDYVYYV
IIDLAGDTVRY	FLADPSAFV	QLRSLVVAL	YSVDRLYEL	KMDPIISRV
DSDLLDSQVQY	GLSQVAVTV	TLASIIKEV	ALLAKILQI	YIDLPPPRL
ETEVYEGALLY	TAAKKARAGLEDL	FTAAIISRV	FVIDLQTRL	GLDDLLLFL
NSDWHLVNY	TLFDHAPDKLSV	SLAEFVQSL	GLYPNLIQV	NVDKVFFDLM
FSDPGQPMSF	ALQDFLLSV	ALIDRMVNL	KVPEWVDTV	SLDEAQFVL
FSEDGEYFAY	FLLALGHFL	AQAPGVITGV	SLLDSVVGL	VLMDRLPSL
SVEDASTQVLLY	FLQPELVKL	KVAGFNLLMTL	AASDFIFLV	VQDEFLEKL
YIDAQFENY	KLAENIDAQL	LLHVQPSMV	AVQEKVFEL	YLFAVNIKL
NLDQATRVAY	KLmELLEEI	SIAPRMMSV	LLQAFISQL	AVDPGLPSV
ISSEELPLYY	QLSEVFIQL	SLKEIISSA	SLQETIQSL	GILNPSQPGQSSSSSQT
YLDFINHY	ALLEGVKNV	VQIGDIVTV	VLFDDELLmV	HIIENIVAV
LVDGYNVHY	RVMELFFTV	FVYFIVREV	FLREYFERL	ILDTmYPEL
mTHNLLLNY	VLNEYFHNV	YQFGEIRTI	GLIRYISGI	ILDNPVVQL
ELDVVREIY	ALVDQLWKL	mLAKHVITL	KIIDEDGLLNL	NVDRVFQEV
ESEFEmKVYY	RLFPGAPPTA	TLAEHQQLI	KLFIGGLNV	SLVGLGGTKSISIS
YMDDYIFTY	TLDDLIAAV	VLKPELQTA	RLFENLRmL	VMDKLSSIRL
ASPEYVNLPINGNGKQ	TLTEEGVIKV	YmAPEVVEA	RTLPKLYSL	KLPWPEWmGV
VAETEEGIYWRY	TVFEHTFHV	KLHPGLLEV	FLAEHPNVTL	LLDSVLVTL
IVLDPMVGYMY	KLLDLQVRV	YMAELIERL	ILLPLINQL	VVPNAGILPLV
LLEGLTVVY	SLLENIAKA	LIKDIISQV	qLLTQIHLL	FLDWPQGTF
LSEEGLLVY	FLLPVAVKL	SLFGGKIAVL	SLSSEFKNITV	FSPEDSPSV
YESINYIF	KVWGNVVTV	GLADLERAQAmI	YLQDVImQV	GLWEIENNPTV
ATEFIMNEY	SLHDAIMIV	ILIPNVETI	FIINGIEKV	SVDNLFVVV
LLDPKYGmFRY	FLPDPSALQNL	NVAPIISKV	LLPDNVHYV	GLPPVFGL
ATmILTVGGTAY	LLVDVEPKV	ALATSPITV	RIADGLPVAV	ILDDSHLLV
QIEEAGWSY	NMVDIIHSV	RLLDYVATV	YLTNEGIQYL	LLEEFVFQV
LLDPSITLGQY	PINGNGKQ	SLAQMVSGL	LLINQLWQL	VTDAVALRV
SADSFQSFY	RLAELTVDEFLA	TLRPALVGV	SLFEGTWYL	GLDAIVTQL
ASDPNSSIFL	SLLMSIHNI	YAFDEAFVREV	HLSDHLSEL	HDISPQAPTHF
ESSSVVLRY	ALQTIQLFL	FLAEAARSL	FLSTLHEVYL	ILIDPFHKA
PSDPQVILY	ARMLAQE	FLFASTILHL	SLmHVPPSL	KMPEGTFLV
QTDNLELKKLVYLY	SLYEMVSRV	IQIMKVEEI	VLIANLEKL	QLPPVIKNMAF

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
FMDHVLRY	VLFQEALWHV	RLAPAVLLTGL	GLFIPFSV	SMDTLLATL
TTEIETLLL	ILAQQPLSV	TLHSRFLEGV	SLHEWQDINL	FVPPVFVV
EIDNELFQFY	KmDDPDYWRTV	FLFELPSRL	SLQSLIISV	ILTDITKGV
TYEEQLVALFGTNM	RLLNFDTEL	qLMNLIRSV	SMADIPLGFGV	qLVDIIEKV
FSTTPGGTRIIY	TLLVVVPKL	RMANRDLLSSV	AVASFVTQL	RLPPEGILHNV
ASDmLQLEY	ALQSLLHLL	RVFIGNLNTL	LLSQLIAEL	TLYEAVREV
KLDDLHTLY	FLDGHDLQL	SLAELKGFEV	SLIHGLWNL	YTWEEVFRV
TSDQATLLLY	FLWERPTLLV	ALAEIAKAEL	YLQEIQTQL	ALDNVDARmYM
KSDVETIFSKY	KIVDFSYSV	FLYTGRQPRPEEA	ELSEKNFQL	FLPQIEAAL
QSDYFRALY	LLIPGLATA	RFFDGELTKV	GLWGPVHEL	LLPEGPPAIAN
SVEESVLLY	MMLDDLLQL	RMFDGKFVVA	ILGIQPPSV	RLPPPFPGLEP
STDKAEYTFY	YLLEKSRIV	ELRAQVmEV	LLMEHIQEI	ALDESHNQNL
NVDAILEEY	FLLGPRLVLA	GLFRTIAL	SLFQGVEFHYV	KLPPPPPQA
ESDIRYLLGY	KLFQGQLVL	ILFDYILSQI	SLQTRLIFL	KLPPVLAIQL
FTDPGQVAY	SLFGGSVKL	RDWLRVV	VLQDIQVML	LLDNDHYAM
mSELISSIADYY	SLIEKVTQL	RLYPELPSQL	LLHDGIPVV	RMDPLEAIQL
VGDHQFLLY	TLIGLSIKVKL	AVLQGKLAEV	SLSGYINYL	FILPIGATV
RIEINQTGTTLY	SLIDIVTEI	GIYIFIPQNV	AAMPRIYEL	KMLPTLGGEEGV
FSAGLIDDNDLY	SLQETIQSL	RLFEWVVNRI	AVmEQIPEI	LLEDYFVPL
RAEDAMRLYY	TLFTKELVL	AmKPKPLSV	qLNVVIHQL	LLPLFLAQL
LIEEALQKY	VREIAQDF	FLIGGLLRI	GLIDFAIQL	ALDKWTNQL
TLDTKPGLY	ALFEESGLIRI	ILVEHISGV	YIIRIYQEL	FTDGITNKL
YLDSIPPGQY	FLLDPVKGERLTV	SLAPIIVHV	YLLTHPPPIm	KVDLAVVEV
FLEPLGLAY	KISTITPQI	SLRPILNTL	FLDPNARPLV	KVDTVWVNV
FSDLPLRV	PEYVNLPINGNGKQ	VLKPDLIDV	FLYQYSTRL	LLPDDKLTL
HSEFLTVPAGSY	KLQELNYNL	YLKGRTIIGV	ALILEPSLYTV	SISDVIAQV
TTDIGTELAmAF	LLAHVTLEL	ALKALLRSL	LLSQSVHYL	KVGPVPVLV
QSEEARRLLGY	YLYTKEQLL	LTKDMLLEV	YLLDYPNNL	LIDESVHAL
ASEGGANVFTVSY	ALFDAQAQV	YMADRLLGV	ALLTYLEQV	LVDTSYKTL
HTDQLVLIF	SVLGKIWKL	FISEPARTV	ALSEELVQL	mVDERTDYL
QTDQLVLIF	FLDSAYFRL	HLSNILSEV	ILQHAVEAL	RLPAAGVGDMV
TSEDRFIQY	KLFnVTSTL	LLYDDKGVGL	QLMEQVAQL	SMPTQLHSL
ASDPFFRHY	QLVDFQWKL	TLHPQVATI	RLQEEINEV	YLDQLNHIL
ESESSPGQRSISLRY	SLNLAPPTV	ALNEQIARL	RQLEAIVRI	ALPEAIAAL
VIDSAELQAY	FLTELVISL	LLLPDYYLVTV	SVmSILPKI	AmPPPPPQGV
LSDVFPGVQY	GLSTEGIYRV	ALRETVVEV	SVSSVVHYL	FLPPFPAHL
NTDYLRQRALY	LLLPDYYLVTV	ALAPLAIPSAA	YLTDLQVSL	KLDGLIHRF
ALDLGTFtGY	RLLDSEIKI	ALKNDLVEAL	GLLDPSVFHV	LLDEEGTFSL
DSERFFIRY	SLLEVNEESTV	AMRKLVRSV	ILEPSLYTV	RIDEINKEL
QMDLLQEFY	TLLGGKEAQALGV	GLKEILPNL	SLADLQNDEV	SYELPDGQVITIGNER
KLnDTYVNVGLY	WLTPVIPAL	KLFGHLERGV	TLQEVHFLL	FIAAEGIHTGQFVY
LSDPAGAIIY	YIGEVLVSV	SLRPAVLTGV	VLAPLGFTL	FMDDVGQTLL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
ISEAGKDLLY	YLVVKIEKV	VMKLDLITV	ATLSVVPQL	SLEGIPLAQV
SPAGHHPHVLY	SLMDHTIPEV	FLKADVVFL	FVmEGVKNL	VIDEIGKmEL
FSDNIEFY	FLFNTENKLLL	FLPPEHTIVYI	GLQVKIQRL	YGPGLTHGV
LLnTSFPGY	FLPPLPTSV	FVNEIISRI	RLLEGVNQL	YIDAQFENYL
ELnNTYIFY	LLGPRLVLA	KLREGEITHL	SVMSILPKI	AVDAImLEL
DTELKQVAYIY	TLSDEHAGVISV	LLADLLHNV	TLSEALLQL	LLPPAPPHA
HSEVLIDLTEY	YIMEPSIFNTL	ALRDQVPTL	AmLLEIPYm	SVDPQFLKL
nSFIHILMY	FLVEPQEDTRL	ALYDYmPMNA	SLLSSVFKL	SVLDLVVAL
SSEQLFLRY	GmYIFLHTV	RLMNETTAV	SLSDSLFVL	VLPNPPQAV
ADTLRYWASIY	KIYEGQVEV	SLLGHLMIV	AGLYWGYTV	YLNDGLWHM
FLDPASAGIGY	LMTDVLVFL	SMSADVPLV	ILNNNLNTL	FLNDIFERI
SSKISSEFTY	QLLPQGIVPAL	FLIGILLREV	SISCCIDPLI	PSKGPLQSVQVF
ASEmILVLEY	VLMPWIHEL	FLSQTGHGV	ALLDSAHLL	VLPNIHPEL
FTDIDGQVY	YLNDRVDEL	SIYGGFLLGV	SLLGGDVVSV	FLPSYIIDV
ATESFASDPILY	YLPYPIHQV	SLIDGIKRA	TVTGFIPLL	ILYDKYFSL
HLDPSQRALY	FLTDSNNIKEV	SLSQHNDFL	FmNSVIQSL	ITPQTIHGV
AVDFAERHGY	ALLQQVHSA	YLKDFFSNV	TLWNEIERL	LLPDKWFDI
LPFNPAAFGEIVLY	KLmDLDVEQL	ALNEHmTSL	ILAETQPEL	RLDNLKAHL
YLDIPNPRY	KLWNVAAPLYL	ILAAIVNHL	LVFICFYIKKI	TLPPPPSGL
QLAMLCSPCILLY	ALQEAIDAIFL	TLNNWLATV	VMQDIVYKL	VMPHTTPEL
VADRLGSLMQY	FLDNGPKTI	NLAKCIVSV	HLTEVLTLV	KIISALPQL
MVDIIETVY	TLMNLGGLAV	WLREGEFVTV	ILLPYLQTL	KLLDVVHPA
SPEPTEPQPY	ALSDHHIYL	ALHGMVALV	mLQFYIPEV	WVDEMQVQL
ASEYDQIRY	GLHSYFITV	ALVEKLESL	RLLDRLPSF	YmDPEGDWFL
FLDSKGLEY	LLSPVVPQI	HLISTINTV	ALFEAAREVTL	TmDDFRWAL
LSLARGLDYY	AImDIVIKV	MLFPKFLKGL	FTLGDIAQL	VQPLELPMV
FADDMYSLY	KLDDYVYYV	RVADILTQL	GLLQINDKIAL	AVDTIVAIM
FSEEDFRLY	NLNSIVPSV	SLKADLQKL	LMmDPLTGL	GLPGPEGIVGI
YTDHVWTEVY	FILPYIHKA	FLFGSIRGA	mLANDIARL	LIDTSRHYL
NLEEISNYY	TLLPGEGPFL	FVIRNIVEA	RLFSSIVTV	TLDVQIQHV
YTLYRPEEGY	VLWPESISV	HMHIHISTV	VQIGDIVTV	VAPPKAHEV
ASEDSVLLY	FMFQEALKL	KLAAVVNNL	NVFDWGAKA	ATMPVVPSV
KIEEGHIGVYY	SMVDVVMLL	SLIDKPTNL	RLLSIKEAFRL	GLYELVWRV
ILDDFREAY	ALLGKIEKV	YLNALVHLI	RTMPRIPTL	HEKIWFDKF
LSEDVRFYY	ILADKSSFISV	GLYPAPLKI	SLHVWKIVV	RIPAYFVTV
LVEVEGDNRY	LMVELLKVFV	KLAEFIDFL	TmLDILQTL	VLDNNSVRL
MIDVTKSYY	LVLPVLVFL	SIKDGVMVL	ALMHALTDL	KQPEDYFYL
NEIEDTFRQF	TLSDIMVSL	SLYEMVSRV	RLNKVISEL	QLPELFHKI
qLEHLQSKY	FLGSFIDHV	ATKGRILTV	SMLTYPFLL	RLPMSIIIVGV
SVEEFVERY	NLLEEVFHL	ILYGKIIHL	AQIFAIYQL	VVDEKLPGL
TLDENPGVRY	TLSEVTNQL	TLYKEILTRA	AVAEQIPLL	AVDEDRKMYL
YIEITGAGGKKY	AMLTVLHEI	ALFAGELNPVAPK	IQLPSVNTV	FLDPPYSRVI

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
TSDHFETIMKY	GLIDTKELEPL	FLPSHSLDTV	KILDIGLAYI	FVNEIISRI
VSDRYRFLY	KTFNLIPAV	GLFPGAPKGA	RLVPFLVEL	MVDPFHTLF
TSDHFETImKY	LLFTWEELI	YTYEFDFSKV	SISERLEMK	SISPIVLYL
FTERNQFELmY	SISPIVLYL	AMIDQVLEL	SLLEAVSFL	SSDAVFIQL
ASETGFLTY	YMAPEVVEA	HQVPAVSSV	SLQDVVKGLFV	WLEENVHEV
ESDLDYIQY	ALSDSIHTV	KLLEVQILEV	KLSDLQTQL	FLDHLYVGI
ETTFLVDKY	ALTSVVVTL	FLRDYTQINV	LmmDPLTGL	ILDESHERV
LTDFIQKY	ALYVAVVNV	GQYDQPVLAV	RLALVISEL	KLPDTTSIFAL
LSEPGDGEALmY	KVLEPSETLVV	NLQGKILSV	AMASIINRL	LLDQLHTLL
VTETNVFFY	SDPFTHLAP	QLVQRVASV	AVFDKTLAEL	RLPPGFNDV
NSEILSIDLTY	ALIENLTHQI	RIKATVmDV	SLYEMVSRV	YTDKIMTYL
NTEVLKNmGY	ALYAVIEKA	FLFDRPMHV	ALTSVVVTL	AIDAIFLTT
STDPREALQY	FLNNQEYVL	FLKNYLTNL	KVQEVIFGL	ALPNVYEVI
LTmEFVEEY	GLTPHLTmV	KLISDINKA	YLHSQVVSV	FLDHEMVFL
qTmGnsLLKERAIY	HLLHTVPAL	KLNFIVTGL	AMIELVERL	NLDVPHSYSVL
RTMEIESTFHmY	HVYDGKFLARV	QMISRIEYV	FLDDVVHSL	SMPDVDLHL
IVDSLTEMY	RLLPDTINSINL	RLFSSIVTV	GLLQQPSALmL	ATDAILATL
QSELFRSRLDSY	VLEDLEVTV	SLLEHLSHV	IVAPGTFEV	FLPPLPTSV
LTEPTGLLY	FLIGILLREV	FVRDmIREV	TLQEVLTLL	IVDAVIEQV
SIDVAGNLDY	FMQDPMEIFV	RLRELQLQEV	AmLAVLHTV	KIIEYSVYL
ATMILTVGGTAY	GLLESRLDPYL	SVFAGVVGV	AVAPGIPAL	KLPGLQATV
GTEFTTILY	TLYGSQIKL	YMAPEVVEA	VVLPAPPAV	NLDNPIQTV
QTAAVEFLLY	YLHSYLTYI	ALIQQATTV	ALSGLAVRL	RIDQVNQLL
YSDTKGDVFVW	ALAEEVEQV	ALKEIQAEV	FLGAIFQL	SLFRVITEV
ALDYLIGGLY	ALHHAVIFL	FLFPSGPGSL	GLLTRLLQV	GLDALKVTV
ASETVKYLNNLY	TLFDYEVRL	ALRAAVAEL	KLFVALGPI	LLDSHLPEEAL
TSDELEDLRY	FILEKIEYL	ALSELIILT	qLLQILQSL	AVDGISLHL
AGECAAEYLALY	ILNYVLVRV	GVIAEILRGV	TLSEVTNQL	FLDKPTLL
GTLDSVLRY	FLNGEVIRL	RLAAFYSQV	ALYDNVEKL	FLDPVIKTSF
ITDQGIEFY	KLLPSVTEL	TVFTDHMLTV	RmLEDRDLFVm	mLDEILLQL
PVPEEEEGFEGGD	RLPEAIEEV	YLKEILEQL	SLLHMPFTI	MLEEVFHNL
RLDVLVNNAY	RLVPFLVEL	TLRLGALVAPVV	VLLPWImNL	RLPDGFTQL
LADWPLWY	SLSSLVVQL	YAIKNIHGV	mLIGEIFEL	VIDQKVYEI
QTDFGmYDY	AMFESSQNVLL	YLKEAVTTL	mLLPGPLHSL	YLTKKFAEL
YLERGKLFY	GLLNRPNPLL	ALRVLLVQV	mVLPVIYEL	FIPLPFAEA
YSDVSGLLANY	VLIETLVTL	LLGPKPFPL	YLFTIINSL	qLFEDLVYL
YTEHSVQEKNW	YLFPGIPELL	TLTERLLGI	YTFSEPFHL	FLHEVLWEL
ILQGyRVVY	FLTDREVRL	YLPPATQVV	LLQRIIVEL	FVEGVVKKV
YSTDENFRY	SLVHINIFL	ALFMYKPKKV	AIIEYMPLL	KLPELWAL
MLLQWPLSY	TAMDVVYAL	IMPAFIFEHI	GLIDIENPNRV	KVDFPTAIGm
LSEPSSLQY	GLAPLHIQL	KLYNWLRVA	KLLDLmPRL	SLFSVIVRV
mSEIADLTY	SLFDARVHL	QLADGLQYI	KVFGWVHRL	ALDDHHALHL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
TSETGSYDGVLY	SLFRVITEV	qLFKKPRQV	LLNQAPDML	FLLEPGNLEV
qTDHLFFKY	TLLKQLKEA	SGLHETLAL	RLLDYVVNI	KLLEVQPQV
STDWHVVNY	VVWGTVIRV	YmGEEKLIASV	RLQSIVAGL	FLHEATVRL
TVEDPVTVEY	YLATFALKV	GLAAFLKAI	SLRSVLFGL	FVDEILTSL
FMDPASALYR	YLFEIRDWRL	KIADFGWSV	VLLGHILPGL	LLPDDKLTLF
QTEDNMLFY	FLWPGLNVPL	RLAELEGREQV	YLGNINPQM	SIDEIVQRV
SLHDTVFDK	FmIDASVHPTL	ALRELVAEA	SLLQAPARL	VLDDKDYFL
FVEPYFDEY	KLILLITQV	SLALLLNYL	YLLSYIQSI	KMDDPDYWRTV
NLDPKITEY	ALYHLAIKL	LVKLRILEL	FLSEVFHQA	LLHEKLYEL
DSKVQEARKSF	GLIEWLENTV	MEIERILGV	LGKIWKL	LLLDRIASV
LAAIYEEKEAWYREE	NLLEIAPHL	RLFTDPLALL	SMLDDLRNV	QIDDLYSTIKV
PSDPRYHEVHY	SVLDLVVAL	SLKAPSIATI	TLLEDGTFKV	VLDEADEML
NVDESLLGY	TLIAAILYL	SLVGLGGTK	YIWDRHYNI	VLDEQLNEF
LVDHFMELY	VLIDYQRNV	TLREIVIGV	FQIRNLPSL	LLDDIFAQL
SMDEKVELY	ALADTLVLL	ALRNWVFQV	HVLSVIWQL	VIDPVPAAV
ASDALDKIRY	FLPQKIIYL	ELAERVPAI	KLFDLDEKLmL	YLPDIQERL
YTLEQQDGmDRY	FLVEHNLVL	FIQSIISTV	IMLEALERV	FINIVVHSV
KLDLLEQEY	SLVESHLSDQLTL	FLIPFETRQL	QILFWIQEI	GLDSFYEYL
LTDPRGAQAHY	FLLPHPGLKVA	LTIKSYGML	QQVQRLPFL	NLDKVVEYL
ATDSLPGKFEDmY	FLLQINDILL	SmYPPHPLTA	VLFDVTGQVRL	YVDTLLTmL
LSEGVTISY	KLWEMDNMLIQI	SVRPAVLQV	FLLHIQQQV	KLPGVYEV
QVDNSLITKY	LLDPSVFHV	AMKEALVQV	ILYGEVEKL	KVDWLTEKm
ILAVFTCAESCSLGTGY	QLWFREFFL	FQRPNALAV	LmKQYIEFV	QLDVPVVKV
PTYKGLLMSLQN	SLLEPFVYL	HLAPRTPEV	TLNSFISVL	QVDEFRFLL
KTEEAIIYSY	KmYEEFLSKV	LLIKQVVEV	KSLDWQIDV	VIDSLTVKI
VLDKDDRRLLSY	VLFDVTGQVRL	SMYPTRIEGA	NLASFIEQV	YLPEDFIRVG
YTLPLVLLY	FLLEGIRSL	TLIEELKTL	SVIEALKD	ILPHSPINV
EIWNGGIDECTLY	QLVRDLLEV	YVYPQRLNFV	YLNDLHEVL	LLPPPMKELRV
HSDLHILDF	QMISRIEYI	ALRETVNAL	YQYPVIIHL	TADEVHYFL
LTDDGRVFLW	QmISRIEYI	GLNGHLTKL	FVIPVVQAL	YIPFYGILGA
RTEYTITMY	TLSPRPPLI	HLFDTLPLEV	YVLEGLKSV	FLDSQTATF
TLDLIDEAY	YLASLIRSV	TLQEVVTGV	ALYNWLIQV	FLPPGDFLV
ATELPKKTEVVIY	FILPHISTA	TVMGRIATL	TIGKEIIDPVL	ILDNVIQPLV
ATESVSLYYY	FLFDGSPTYVL	VIKESVVSI	TLFPSKIGV	KVDSPtVNTTL
YTFITEDQARY	SLSPIYPAA	SLSQHINWV	GVIDGHIYAV	LVDDLSDRVYL
DSEQADIARmLY	YLIPLLERLDL	VVKGTVLTI	AMLLEIPYM	RVDNLAVVM
NTDPSIVMTY	HLANIVERV	AIKDNVVIV	RLLEVTNTIRV	VLDNVKMNL
ALEDEKKKTDTLLY	HLFTATINL	LLADLKTmV	STSPWIPQL	YIDDLGHLHV
TGSWIGLRNLDLKG	SLLDTLVLL	NLYNLPLKTL	TLLIQVPRI	FLPSHSLDTV
QTDHLFFKY	AILGITESFQV	ALPEIFTEL	FLREWVESM	IVDQVmVTL
SSDALDKIRY	FLAELPGSLSL	FLKIDVPTA	SLLNWRTKL	LLEDVTWKYTA
RSDTVLSDVHLY	GLAKRVWSL	YLYTKEQLL	VLQGAVPTV	LLPVITKEL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
LADHTVHVLRY	NLLEQFILL	FLFGEVHKA	YVMEYRELFL	LVDSTVVHI
ANAAFTSELLYRT	SVLVSPPAV	RLKELLTmL	AVADILFLL	RLPPGPAGL
LLDPRSYHTY	ALDEVIFSL	FLSGIINFI	FLRELVITI	IIEQLDPVSF
SLPnSRAPFAIKYFF	ALLSLHFLFV	GLYPKVAKI	KLQNILSQL	NLDAAVYQV
FLDKVVGLQK	FLmDFIHQV	AMKDVLLPL	RVLEmLEAL	TLDPEPQHL
FGDTLHIHY	RLPPPFPGL	AQYEDIAQKS	VLQVHLNGL	FLLETVVRV
	AILTTLIHL	KVKDGQLTV	ILWSEAIFL	LLLPDYYLVTV
	TLFPSKIGV	LMYPYIFHV	FLLPLRIAL	VMDLLVLGL
	TLSNLWIFL	QVLSRLSTL	RLLGYVATL	VVDPIVSNF
	TQILSVPKV	TMIGEIAAA	HLSDmLQQL	FIDNLDERL
	KLLPETVTI	IQVTKVTQV	LLSDVRFVL	TFFPALQGAQTKMSA
	ALMELFPKL	NVIPNVANV	MFTAMPPLTLG	VLWPESISV
	GLYPNLIQV	YLAPFLRNV	ALLLPTGVFQV	ILDEVDAAL
	TLTSKLYSL	FLFQEPRSI	HLFDAFVSV	SLDPTLPSV
	ALLPVDIFL	LLFRNAFTSV	KLGEIVTTI	WLPEVMILV
	SILRHVAEV	RLAALGRQV	RmFADDLHNL	FLIPIYHQV
	SLLGGDVVSV	SLKSNVTSL	VLFTGVKEV	FVDESHIRM
	ALYDNVEKL	TVFTDHmLTV	ILAQLLPLL	KLPEISHRL
	ALYGQPLLL	VLIEILQKA	RLLHEVQEL	RLFPVPGSGLV
	HLISTINTV	YLFGKEMYQV	SIHDVTFQV	RLPDMEMVINV
	ILGDFLVAV	YLIQSVPAEL	YLLDMPLWYL	VVPDTSRIYV
	RLIPIIVLL	SLQESILAQV	YLVYILNEL	ILPPDIGKL
	SLAQYLINA	SLVDIYSQL	ILAPVVKEI	KAIEVLLTL
	KLIDtIPDDKLKL	KLFKAPAYI	RLAPTLSQL	RLDDFWSLKL
	TLLTKPVEI	QLHAGSLVSV	SLIKWILIV	TIDPIPHQL
	TLSDGVVVQV	QLYQDPRNV	ALGFVYKL	ILDAVVVVV
	VLAWGLLNV	RIKDTVQKL	RLWGIPDQARV	ILPEVENDRL
	FLETNVPLL	TLFPGKVHSL	SLSEELAKL	KLDQVLVEF
	KLLnITNPVL	VLNGKLLLV	VVWGTVIRV	YLKDFFSNV
	RLLPPGAVVAV	FIYHGEVPQA	SLNIITVTL	KLHGVNINV
	RLLQETMYMTV	ALQEKVQAV	ALYTGFSILV	mLPETREIYEL
	SLSSFLHGV	FLHETGLAMI	LLAEVIENL	MVDERTDYL
	GLMTTVHAI	MKAFISKV	QmLELITRL	QLDDVFRQL
	RLFNDPVAMV	SLPDHLPSV	RLFNDPVAmV	SPEYVNLPINGNGKQ
	YLSDNVHLV	ILSGHILSV	RMLEDRDLFVm	TLPEAIHFL
	QLVEQVEQI	LLIDLSRASTL	ALHWFLNQV	YIDQGIAEL
	VLFHNLPSL	VLPNFLPYNV	FLLPHPGLQV	FLEDLVPYL
	AVIDVGINRV	YLNSILQHA	QLYDLTLEYL	IIDETmAQL
	FLDGNEMTL	LLHAGGLARA	RMLPHAPGV	KLLEVYEQL
	FLVEKQPPQV	TLSTVISKV	ALFDAQAQV	KVFDSHPVLHV
	ILDVTVVYL	FLAPWATIA	FIFSYITAV	LIDYTLEFL
	YLITGNLEKL	QLRNEVAIL	VQTDYVPLL	LLDRVITNV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	RLGPVPPGL	YLSEKVLAA	ALTDYITRL	LLPPDESLHSL
	TLIGLSIKV	YLNFIRGV	EVGLSLEPV	RVPSDPFTGV
	ALKRQGRTLYG	ALPEERLSV	QLQDIVYKL	SMVDVVMLL
	GLMRKVPRV	ALVESLITV	ALASVIMGL	YIDKDMIHI
	LIKEVDIYTV	SLGKVFGV	KLLNAINTL	ALDVSHNLL
	LMNAVVQTV	SLRPTVAEL	AQAQEVFFL	IIDEFEQKL
	ALLETVNRL	FLmDFIHQV	AQFGYYFRV	IVDGVVQSI
	FLLPILSQI	ILISKLLGA	LLmRLLQQL	KMPDVELFVNL
	FLVDGPRVQL	RIKLGIKSL	QILDGVHYL	ALDEAQGVGL
	LLFGKIGYYL	RMVHILTSV	QLmNLIRSV	NVDKVFFDL
	RLFEGNALL	YLPYPIHQV	YLKDLIEEV	QLIDKVWQL
	FQLPIRFNL	ALKSLLQEA	GLPEAPPFL	ILDGIIREL
	LLDEHGHVRI	ImTEKELLAV	LLQNNLPAV	ImPAFIFEHI
	ALAERLDIV	LINEIKPQSV	GLLTSLFmL	NIDELITFL
	FLLHIQQQV	FLREWVESM	TLNDIMTRV	QLMEQVAQL
	SLADIAQKL	GVKFNVTTV	VLQEEPPLL	RIFGESIMIGV
	SLMDPNKFLLLV	LLKNELLGA	qLNEQLVTL	SLPHQLPEA
	TLINLLLKV	ALNENINQV	SLYDELRNL	YLPRHSIGL
	SLITPLQAV	RVFSDIIYTV	TVAPFNPTV	ALWSLPLYL
	VLWDLVDRIGI	SLKVDVEAL	VLFDVSImAV	FADPIYQAGL
	RLAHYIDRV	TLAGDVHIV	FLFGYPKRL	FLPDEPYIKV
	RLLDYVATV	FAPYNKPSL	IMKEVIPFL	KLLDILSYL
	SLINVNDLSFV	FLKLGGLQV	SQPGPRLPFI	SLVNLGGSKSISIS
	WLPEVMILV	FLKSPELVQA	TVLGKIWKL	YLDIINLFL
	ALFPGVALL	RLQEVTHSV	ALHSWFQTL	YLDSPLVRF
	FLFGYPKRL	EQYEQILAFV	FLLGGIGEL	YLNDFTHEI
	FLFQEPRSI	ILFPNDPLYA	ILFEEYQFQA	YVVPFVAKV
	KLADIQIEQL	VLRVVIPEV	KLREDLERL	FVLDKVPFL
	KLTVVLEAV	YMFPDTmLQA	YLLDQHILI	GLDTILQNL
	VLFNFGKEKFEV	KLFSILSTV	KLFGmIITI	ILDVSVKTV
	FLHAVDVVL	SLAGSLRSV	ALFETLIQL	ILPDGEDFLAV
	ILDGNQLHI	AMIEVNINKNLV	ILGVLVPRL	LLPEYVVPYM
	KIFDEILVNA	FLAGAVTSV	RLLAYISQV	VVDPNQVNV
	TLWNEIERL	FMTTNVPNV	YLNSILQVL	ALYVAVVNV
	FIMDDPAGNSYL	GLYTGEVTEI	ALLQALMEL	FLGDPPPGL
	RLDELGGVYL	SLAEPRVSV	FLNDEVWNL	FVDLEPTVI
	SVIDHIHLISV	SLKTLLVQL	LLFPHPVNQV	HLDDQMTLL
	YQVGQLYSV	YVFEGKmLEA	RIFKAWAV	ILPEMVGSMVGV
	YVLEDLEVTV	AVKDGILLA	RLLAEIGAVTL	KIVPIAIQL
	ALLDPEVLSIFV	FLKPGILTG	VLASPWLIL	LLDTTQKYL
	FLSELQYYL	TLFPEEVIATI	AQRDIIFEL	mLYEFFVKV
	GLWEDGRSTLL	TmFPGVLLPLL	SLASVIFLL	SVVGPVKGV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	FLDSLIYGA	KVFSGALQEA	VLFSSPPQM	YLVEDIQHI
	FLLQDSGRILQL	LLYQEKIRYA	FLHEATVRL	IMDDEFQLL
	QLYSVDVTL	YVAGIIPLAV	LmMDPLTGL	SLHFLILYV
	SQTFVNPHV	ALTRALALA	AILPHLRSL	VLDGVKAEL
	GLFQGKTPL	GQFPSYLETV	ALVDLIYNM	KVVPTFEAV
	mLFGHPLLV	SLHTELNSV	SLSFMNPRL	TLDGVYPTL
	TLNEKLFLL	YLYPSTLVRT	VLSELLWQV	GLPELVIQL
	VLDSVDVRL	FLAPRLLSL	VmQTLLSQL	LLDDAKARL
	ILDQKINEV	FLTEFINYI	YLNDGLWHm	mMDSLFLKL
	LILEKQPAYV	KLKDVLLQV	FLADPVSNm	TLEDIYNQV
	LLTEIRAVV	GLALALTLTmL	YLASLIRSV	FLDISRPKm
	ALSDLEITL	ILANGALRAV	AALSKFIAV	FLFDGSPTYV
	FLPQVVVTV	SLKQTVVTL	AVIEHLERL	SMPPVYPSV
	RMFGIPVVV	SLLGGDVVSV	FLLFINHRL	VLDPDLRmTF
	ILDSRLIAA	YCAEIAHNV	FmIKFPWKL	YLEEILVRV
	RILDILEYI	YLWHIPLSYV	SILASLHAL	ILPPQDLSHYI
	SMVDVVmLL	LLREKVEFL	YLINFEIRSL	KIDDmMFVL
	TLQDIVYKL	SLVEQLTmV	YmVHIQVTL	NLPAPHIMPGV
	VINDVRDIFL	YLKGFLEDL	GmLDPLEVHLL	VADLVGFLL
	YLVSNVIEL	FLNEIQQSI	LmEHIHKL	LLPDERTISL
	SLFSHSLISI	FLYQILRGL	LVLRALDTL	SVDSHFQEV
	YLLREWVNL	ILGTEDLIVEV	SLLPSVPAL	VLISKLPYI
	ALFEEVPEL	ILYEHQLGQA	TLLAGITGV	FIFSDTHEL
	VLYENKVAV	QLNEKVAQL	YVQALIFRL	FLDDSTLRF
	HLIHEVTKV	SIFELDPTTL	ALLPELSVL	NVDQAVATL
	ILFGHENRV	TMITKRLAQV	LLQmGLHVL	QLDDLKVEL
	KLLDTmVDTFL	ILIDPIRVV	TTVGWDHQV	IIDQIQDAL
	mLANDIARL	NIKPDIMAV	RLNPINTTL	ILPPFIWTL
	PYHWPLLV	FQFPSHVTDV	SVVESVFKL	LVDFVIHFm
	RLYHITDQV	FLIPAVELI	ILEENIPVL	TIDDLIDKL
	SLASLLVSV	GLAWIVGRV	LLQDKQFEL	VLnLVLPnLSL
	FLDPHTTQTFV	YLRNLTWTL	NIIPIIISL	ILPVPAFNV
	GLTGQRLLGV	ALLEKPGEL	SLHEFLVNL	KVLGIVVGV
	HLFEDAYLLTL	GLVAFEPHAL	FLSELTQQL	LLPEDSQKL
	LLLDVPTAAV	VLYDRIQAA	LVELALPQL	LLWKSGPVV
	VLLTMIARV	ALPARLTQV	ELNNQNFYL	YLTDRVMTV
	VLmQDSRLYL	APRVLRA	FVNFRLYQL	FmSEYLIEL
	YLTAEVLEL	GLAQFVREI	LIGEIFEL	ImDSLFQSF
	GLFHFPTPL	IITDLLRSV	SLLDGVVEKL	LMTDVLVFL
	SLLTAISEV	RVFGSQnLTTV	LASPEYVNLPINGNGK Q	SLIKYFLFV
	VLAHTILGV	YMKSEDPLFV	RLmmDPLTGL	VLDEGKMKL
	ILDHEVPSL	VIFDLPTTV	ILQAELPSL	VVDEIAAKL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	ILLDDTGLAYI	ILNYVLVRV	RLLPALTVL	ALPDQGIAKA
	RLLEVVTSI	ALAPGVRAV	ALSmIIKSL	AVDAIFTRI
	RLLQAVALV	ALFQPHLINV	KTLGKLWRL	KVDMQWVQV
	RVLDFDPMAV	KLFDRPQEL	SLQSTIQGL	ALFVKTKEV
	SLLGRSLEL	KLIANNTTV	ALSDILINF	FLDDPIWRG
	VLIKWFPEV	QLREYQLEGV	KLIPGLNNL	FLDLTQLEL
	YLMQNWEHVL	SMKSELSYL	RLQEDPPVGV	FMFDEKLVTV
	ALDDFSISV	WMNINLREV	QILDGIHYL	FVDIVDAKL
	ALYPGQLVQL	YIIDVSQSV	SLHPSLPLL	ImPTIFNLI
	EVISKLYAV	GVYQGRVSAV	GLLDRImQL	KVDTVWVNVGG
	KLNPGIAYV	LISESFLTV	GVIATIAFL	YLDPVQRDL
	ALFSFLYHL	SIKDGVmVL	KLLDLMPRL	ALDTGFSLNL
	FLLQHQTFL	KLFSELPLA	ALNPAALTAL	ALDVSFNKF
	FLSEVWNTHTL	ALAEFHVQRV	FLQPELVKL	FVDEFLTYL
	GLLEEAYTL	AVINRVQKV	NLNSIVPSV	HIDTILHVL
	YLYPDITRL	FLKEQMILV	GLGPTFKL	FIDSVLVKI
	FLYAAQPELL	FLYPFLHTV	TLGQIYYL	GAPVYLAAV
	ILNKQEFFV	SLRDFTVTV	ALSDLEITL	HLPEQAFYM
	SMYDKVLmL	VLYSPGPKQA	MLSPFISSV	KIDKFFKQL
	NIFPYPVGV	ALFSDTPANA	QILEGVHFL	mLPHYEPIPF
	NLFNKYPAL	FMASQMLKV	KLTAFVNTL	VLPPSALQSV
	RLFNDPVAMVL	LLNPAVLSTA	ALKSLIPTL	AVDAVEEFL
	TLLDGKLVLL	YLFERTFNL	RVADILTQL	FLPFPLPLF
	YLDPAQRGV	FIMEGPLTRI	TLVLTLPTV	GLDIPTVQV
	FIFEKILQL	SLRGVVQEL	ALtPALHKL	ILPQHLYNI
	FLDENVHFA	VMLESPPKGV	RLLPVIFLV	IVDQVMVTL
	MLTGISPFL	ALNEITESGRI	GLIDEIYGI	NLDNAFAHV
	SLAPIIVHV	RMFGIPVVV	ALQAQITAL	SLFEGTWYL
	FLYSDEVQI	TLIEDILGV	GMASVISRL	YMDTLNIFM
	RLDDSLLYL	ALIPIPLAVI	LLLAAPAQA	ALQDVPLSSV
	SLLPSVPAL	SLVEQLTMV	SINGVIFGL	SLDALLSQV
	SVMSILPKI	VLKSGNPRGL	TLWYRAPEVLL	YLDAIRSGL
	VMFGGKQVVV	FMYNFQLVTL	YLIEPDVELQRI	AIMDIVIKV
	YLHNQGIGV	KYEELQIT	ALLNLLPmL	ALLEADVNIKL
	ELIEEEVAKLLKL	ILKDVIPPLEQL	VLISVLQAI	ALPTEAAILTL
	GLIPIHADPRL	NLRDGPITI	ALSPINIQL	FLDENVHFA
	LLLDIMPGL	SIKAYVSTL	GmSEFLRAL	FLDQVAHKL
	AVLQQHHVKL	VLFEHAVGYA	TLQQQTFKI	FLEEYTSQL
	FmFDEKLVTV	MLFENmGAYTV	TQILSVPKV	FQDQVLDLL
	GLDDLLLFL	PYHWPLLV	AVAPQVPAL	KMPDVELFV
	RVFENIVAV	VIVEKPLSV	SLLPPTALVGL	SILQTLILV
	ALVNVQIPL	KLAEGVQLL	NIVEKLREV	AAPPNFHFV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	FIWPmLIHI	TLKEWTLQV	TVTAVDLDEGTNK	FLSELQYYL
	RLFSSIVTV	TLSSIPTAL	VLQDFYLEL	KVDSPTVNTTL
	SMTLVNVLV	ALGKILSV	GLLNVLSQL	LLPDEDALPFL
	YLVAEKVTV	ELANKLITV	GLWEIENNPTV	RLLDYVATV
	ALDRQTATQLL	RLTPKLmEV	KLLPGIEVL	TLDGLPPLRL
	HLVPEVPTV	RQYPWGTVQV	RLLEPAQVQQL	YLDPAQRGV
	TVLPFVSTV	RVFGSQNLTTV	TQLATIWTL	FIREHIEEL
	VLFGLLREV	ALISQVLEA	YLQEVPILTL	HLPDVCVNL
	VLSELAARL	AMAPGTVTV	SLLGHLMIV	KVDILYNNI
	WLMPVIPAL	NLKPWVLEV	FILTHVDQL	NmDKIYIVM
	FLPPPFPPP	SVASSVKGV	GLQKMVALL	RVPPVVPAQTV
	FLREYFERL	TLPSFSPSAA	TLSDIVVTL	SLPEVLNHNL
	HLLGDQISL	ALKRFVNLV	YLFPGIPEL	YMDQIIEYL
	KLSDIGEGIREV	FVYNLPHTV	ALPLGILYLLALVGnVTIL	FIDDANYSV
	YLMEVTHDL	GLQFPVGRV	FLFDGSPTYV	IMDDPAGNSYL
	KLTDNLVAL	GVYAGRPLSV	ALALWKELL	KVDKIITPL
	NMYGKVVTV	RLIPTLVSI	LLTGYLEYL	LLPDYYLVTV
	SLGEFHVRL	GLWHGMFANV	ILLPDNVHYV	FIDIVVENL
	YLWQGVRVA	ALNLYMHQV	RLNDFASTVRI	KLPSAVIAL
	GLIDEIYGI	GLREFVVIA	TmADQIVTV	SLPDDISVVKV
	ILAAVETRL	RLSDVQIYV	ILADLLPSL	VIPGMFKEV
	KVLDVLWEL	TLRGHLAKI	QLLLEPPKL	VLDKEIIQL
	SmAPYVLnV	AmIAVVPGYI	AVTGILVQL	LLDNILQRI
	YLAPHVRTL	FLKINVSEL	RQADKVWRL	VLDNPTPEm
	ALMPQLVQL	ALFPGLPSPVAN	YLDFTNPKV	ALDSLSWLLL
	RLFESSQYL	ALKPEVDKL	ALmPTLEAL	LAPSHGLVSV
	SLTSVVLTL	ILNEIVNFV	RLQQELMTL	LLPENLKEGL
	LLLPILVTV	KIKIYISQV	SLLEFDRI	NIDSIIQRL
	YLDPRLAFTV	LLAKLLSQL	SmLPGFLHRL	YLSAKVEAL
	GLFDQHFRL	LQKPDVVGI	SLVDTVYAL	ILDKVILPQL
	GLFDQQLAL	ALFPHLLQPV	SLNQDIPAF	IVDSVFVNL
	SLYDYNPNL	GLFWANIRAA	SLWPmTFGL	NELRVAPEEHPVLL
	FIINGIEKV	TLAKPPSVV	TLFDYEVRL	SAQGSDVSLTACKV
	FLYWHLEDL	qLSPRLLEV	SVLEALSGV	SLDDLTNLVV
	GLLENIPRV	YLmEGSYNKV	TmIEINPmV	AVDAFFTAV
	SLAVLGGKLYV	AIPESSPPSGI	HLSDMLQQL	ILHDDEVTV
	SLDPTLPSV	ALIYGTPRAA	KLNPGIAYV	LLDKLQTYL
	ALWDIETGQQTT	FLKANILGL	LLVSSWDTSV	LLPEEIKSSFL
	FILPKEIAV	FVIAELVNV	ALVNELYSL	LLPLLIQTV
	KLLPQLTYL	GLSETILAV	RLQDEIQRL	SIIEYLPTL
	KQVSDLISV	AQQAAKLQGI	SLQKEILYL	ATPMPTPSV
	RLLGYVATL	ALAVIVPEGV	SLKKFIYAL	KMDEVLYSIA

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	TLFPVRLLV	VQSNRILGV	SLRQLLHQL	LAPPASPGI
	ALLPDLPAL	AQIGWIQTV	NLFHYLTEV	VLDGVLMEL
	FLSTINVGL	GLKNGVPAV	NLNQFLPEL	GLPDIDSKmLM
	QLFQGVLTL	TLFSGLLLGL	KVLGALLFV	KIDPDYSVYV
	SLLRDVPLA	FIFEKKLAQA	LLSPHNPAL	NIVEKIDFDSV
	YLVPELDGV	KPVLDIPHL	MmMALLVPL	ILPDDIGAAL
	YLWNLQVKL	RLFEVPHEL	YQNQEIHNL	NLFHYLTEV
	GLYELVWRV	SMAKAITGV	ALLYGILQL	NLPDEEIFQQL
	GTIGLIHAV	TLAAAVPKI	ILAPTVQEL	SIAAVLPKV
	SILEDPPSI	VVFQKPSGV	KLIEELETL	ALDEAAAAL
	SMMGPSPGPPSV	GLELLLSQG	KVLGIVVGV	FIDEAYVEV
	VVLPAPPAV	ILKEGDLVKI	VLFGKPmVV	FLDNPGILSEL
	YLVTSIAKA	YLKEFIHIL	WIQNKLPQL	FLPEGQDIGAFV
	GmYGKIAVMEL	HLKVHIERV	ALMELFPKL	LLDENGVLKL
	RMDELFVLI	KLSDLQTQL	GIGLALAAAV	RLDESAFVGL
	SLLSELQHA	KmNEKIASL	SLNLAPPTV	SLPPVIDKMNI
	YLTNEGIQYL	SIRNFLIYV	SLSTVFVVL	ILPEHSVLQNI
	YLYPIKNLEM	KLINQVNTI	AImATIPLL	ILPKYVQQV
	YMIDNVILLI	KMFDLNGDGEV	QLIPNVQQL	LLDGFPRTL
	ALDKLNEAI	VLKTGFLFV	QQYQWLEKV	QLPEQPLFL
	GLSVIIPHV	GLTDIRTLV	SmLDDLRNV	YLPVKIEQV
	KLQDQIFNL	ILKPSTIIGV	SVIEQLFFV	FVDEGKATV
	LLPIKTVGV	SLYRDLLRA	ALVAVPLGmTV	RLPDPFAKI
	SLQEEKLIYV	YLIPNIKHL	FLFNAIETM	SLWEDFSQSL
	YLFGKEMYQV	qLISKIPHI	ImTVPPPSV	YLNDGLWHm
	FVDEFLTYL	SLKSNVLNV	LLWGNLPEI	ILDDIGHGV
	SLLSVSHAL	VLHSSPLNV	YLNHLIQGL	ITPQKLPSL
	VLFGFVPET	ALVDHLNVGV	ALLETNPYLL	MMPTRFEDL
	VTTDIQVKV	SVYGKLRKV	ALmPVLNQV	SLPENTVQV
	YLINFEIRSL	TLKQGIERV	ALNFIISYL	ALFEEVPEL
	ALLDGRVQL	VLMPNVGEI	GLSEQIREL	ALLTYLEQV
	ILLDQTVRV	FLANIGTSV	SLIKQIPRIL	AMPGEDLKFNL
	NLLnHSSMFL	QVFPGLLERV	FLLPHPGLKV	ILDYSWEKL
	VLMNQPPQIAP	FLAEHPNVTL	NLIDAGVDALRV	ILPEPGSETPTV
	YLLSEKDLILA	FLIPIYHQV	SIRNFLIYV	AVDAVIAEL
	KLIEELETL	RMVGQVLGA	YTFDPVTKV	ILDAGGHNV
	MIRKEELEI	RLTDYVAFL	NLAAYVPLL	IVPKEEGVISV
	YLYSNKLQSL	SLKEIVINV	ILSPNLFQL	SVDPVLSIL
	FGLARAFGV	TVFTNPTQV	YLFQLLQGL	AIVDKVPSV
	SLQDEIQRV	YLNENPLRA	AALSKIFAV	LLPAVVMHL
	YLAGLHANIAV	GLTKQYLRYV	SLIEDLILL	LLPDLIQKV
	ALADFLPVM	RIFGESIMIGV	LFLGGLDAL	NIDEVVNKI

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	SLDWQMVFL	RLFHKDLTSL	TLLQNIPSF	NIPEITPFL
	SLVDASWEL	TIKENIIKV	KLNPQQFEV	NLNEKINHL
	HLTYLNVYL	ALAELESVL	QLIPKLIFL	QLDPLFERV
	LLSGQLPTI	FLIEPEHVNTV	YLGIVELLV	RIDAVTPTL
	RLAETLAQIYL	LLYNRPGTV	KLFDIFSQQV	VLDHTYQEL
	IREADVDQDGRVNYEE	YLPSQVSRV	ALQPSIKFV	KLYSISSQV
	MLANDIARL	ALINNIVEI	GLAELYVmV	LmVDHVTEV
	SLGKVFGV	KLPMSIIIVGV	SmVDVVMLL	VLDEADEmL
	GLLDRIMQL	LLFKILSSV	ALmPQLVQL	VMDETHVINQV
	VVVGDLVEV	TMADQIVTV	GLTWGFGVA	YVDAGTPMYL
	FLLQQHLISA	ALAARLLQPA	QmISRIEYV	AVDLYKSL
	ILNEVDISV	VLRDNIQGIT	HLKDGImNL	FLFEDFSKA
	ALSDYDLVL	FLANLHITA	QLLANLARL	KLILLITQV
	FMSEYLIEL	YLSDNVHLV	ALQGSAWQV	NLDVPTFVSF
	SLASVIFLL	ALFPGVALL	NLINNIFEL	RLPGSGAVQAA
	TLGDAHIYL	ALRSNLRTV	TLLPVIQFL	YmEEIYHRI
	QLWNNYFHL	KLTENLVAL	VLFYAITTL	ALDTLYIMGL
	TLTSNIPEI	KMAEMLVEL	GLGIVFSL	AVPEVAVYL
	GVLEMERLHYI	NMVAKVDEV	ImKEVIPFL	KIDYFLEYF
	ILLLPLHTG	AQKKLISQV	ALSHILTAL	SLIGHLQTL
	ILMSPNSYIKL	MLKDEVRTL	FLQEYGLSV	VLDPPVGNTRL
	SLAERVDRL	RIFQTLLEV	GLSSLSIHL	ALDKATVLLSM
	TLSQVIPMV	ALYSELLAV	QLRNVIERL	FVDAITELL
	TMLGVSHVV	FLREKNLLVT	QmISRIEYI	HIDVITAEM
	ALYSELLAV	KLREMLIRV	ALTAHLYSL	NLPMSVIIVGV
	FIFSEKPVFV	NLFDISQSAQT	YQILVVTRL	RLPGGNEIGMV
	FLGKIYQI	SLSAIFNNV	IIADNIIFL	TLDQTLNEL
	FVDGLTFKV	TIKEILGTA	VLIDVGTGYYV	YLDSIPPGQYm
	RLLELETRL	AARPQVVAV	ALMEALVLI	ALDGFVmVL
	ILAQLLPLL	NAKLLQQIQEV	FLmNEVIKL	ALPPDLSYI
	KLFGmIITI	NLIPQITSI	mLSPFISSV	FVPAPWLSV
	RLLPGDIILKV	SLSGYINYL	VmTLVSTYL	IMDHVEESL
	VLIKNLLVSV	VLKEYLDNV	LLNKSIIRV	KLPSFLANV
	VQIGDIVTV	WLSTSIPEA	ALFIRPFmL	NLDEVFKVM
	YLIPFTGIVGL	YIMSYISRV	DmFHWQATI	ALDDLIDTL
	YLSNVDVYL	AMAASPHAV	ILVSQLEQL	FGPPIPKGV
	KMYEKIDLTLL	GLMTTVHAI	VLQGLTFTL	FVLPVATQI
	YLMNLNIMTV	ILKSHVEKL	VmYDLITEL	KLPTPTSSV
	KLPEKWESV	LQFNSSLQKV	YLAPHVRTL	KVIDEIYRV
	KLWEmDNmLI	qIKDNLREV	KVFDPVPVGV	NIPLPLGTV
	KQLDDLKVEL	ALRSKLVRL	LLFHHPNILEL	VMDHVSDSFL
	LLLEEGGLVQV	GVRESVFTV	LLLPTGVFQV	YLIELIDRV

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	SLAPDTRLFV	TLKPGTmSV	YLVVKIEKV	YmNHIMVSV
	TLGVIPESV	YIFGGYNARL	KVLGPNGLLKGK	IIVDIFHGL
	SLLQTQHAL	ALGNVRTV	NmLPQIFRV	SLDFLIELL
	SMSADVPLV	GLISGILRV	LMEHIHKL	TIDDLEEKL
	YLPVKIEQV	ILNGIVAAL	QLPNFAFSV	FLGIHVFLV
	FQHEENLLQQV	ILPEKVARV	YLITSVELL	KVIEINPYL
	YIYKDTIQV	NLIRSVRTV	ELSDVLIYL	SVDDIVKGI
	ALVESLITV	SLQDEIQRV	HLQGQLQTL	VIDRILYKL
	GVQDFVPFV	SLREKIQFI	SVMNSVVSL	VLSELLWQV
	ALFETLIQL	AmNSQILEV	ALmELFPKL	YIDEVIIEQF
	SLFPGKLEVV	GLAERISVL	ALTEYTLYL	AVPSWFVRV
	TMFEFAFHL	KLKDSLRQL	KLFEPYVVHV	FLDDFESKYSF
	VLMWEIYSL	RLKENQISV	TLLGKVVAL	FMSEYLIEL
	WLVDHVYAI	RMFHIRAV	QLLEKVIEL	KLWPEASKV
	ILNPEVVTV	MVAPAVASV	SLLNEIAFL	QAPDIDVQL
	RMLEFDPAQRITL	NMKTVYVSV	GLLQNLQHL	LLPKAMIEV
	YLSGIIVTL	QIKDNLREV	YLHSYLTYI	TMDEFRQHL
	KLINSQISL	TLGNVLVTV	TLQQQIQTL	VLEELYKKV
	NMLEAVHTI	AMFGKLmTI	LGLYRSIFR	VLWIPAFMV
	AIWDGLILL	NmYGKVVTV	TLQEKIHRL	FLDGNEMTL
	GLSETILAV	SLNPRKLIEV	ALPEAIAAL	FLPDLQITM
	SmSADVPLV	LLHFIALTV	TLIEELKTL	MLPEFYKTV
	YLmEGSYNKVFL	SLISGIIRA	GMSEFLRAL	RLDEAFDFV
	ILLAEVDKV	WLRLQPLTSA	ALLAYTLGV	RLDLIAQQM
	MMTFDPQDILL	YLFDLPLKVL	GLLDLPFRV	SVDEVARQL
	SLAELDEKISAL	YLAPHVRTLY	QLQNWFTIV	VLDPDEGIRF
	VLVSFAYKV	SLIARLERL	AVANIVNSV	YLQDVIMQV
	YIYDKDmEII	TLANVVTSL	GLQEAQYRL	FLDMNFQSL
	HLIEPLANA	YLRSMIPHL	mLFGHPLLV	ILPMSLLSV
	KTTTIAVEV	HLAAILGETSTV	RLAVYIDRV	SIDEAYVDL
	LLAPIVFVL	KIADFGLARV	FLSSVIQNL	AQPPWLPGL
	TLDAGNIKL	YLQTILKEL	LLLNELPSV	RMDEEFTKI
	FLFDNDFPAL	AMNDILAQV	NLQAVINEV	SIDFPLTKV
	FLMWFIETA	FMmPRIVNV	RLLEVPVML	YLLDRLPEM
	ILISKLLGA	RLAPTLSQL	TLFSVLPEL	AMINRFQFV
	LLDVVHPAA	SLAANTFTI	YLLPYENLL	KMPSRFPPVVF
	LLEPFVHQV	SLLNQPKAV	FLVPVLEAL	SmDFVLLNF
	TLFPGKVHSL	AMYTLPRQA	mLHSVTLFL	TLPHSSAFTPL
	VLMEDRLTNRL	GLHAFIVPI	SLLHTLEEL	ILDLIQVFV
	YLYDLNHTL	GLmRKVPRV	RLLFQLAQL	LQCNPPPGL
	KLLEVNGTKGLSV	GLYQGQVLVI	SLNKWIFTV	NMDSVFKEL
	SLASFIPAV	RLALVISEL	FISEFEHRV	TAQVIILNHPGQIS

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	SLLPAIVEL	IVKEELALL	KVADYIPQL	GLPHWVPAL
	SLVAILQSV	LLQDIILQV	FLIEYGPAQL	LLEEQYFEL
	ILTNVVPKM	MEHIHKL	SLHDAImIV	LLPDVFDDL
	SLAGDVALQQL	LLYEDIGTSRV	FLSHIPITL	NLPTFLVEL
	SVLDLLVQL	VLMEIIAKV	FLANIGTSV	NVDEIFLKL
	VLYNEIEYAQA	FLYWHLEDL	SVLGAITSV	SDLHAHKLRVDPVNF
	ILLQENGHIYV	SLASHVKNL	YLLPSVVLL	YmDAPKAAL
	RLmNETTAVAL	ALAKLVEAI	ALLEQVNAL	ALDVANKIGI
	SLLQALNEV	KLAEVSQNI	VmIPTLPSI	AVDPLLALL
	SLSDTVEKL	TVKDFVAKV	YQVGVHYEL	FVDENLPDGTHL
	YVLKYLFEV	YMLEHVITL	KLWSETFDV	IVLPAGALHQV
	ALILEPSLYTV	ALALSVKEL	VLmDHILNL	NIIPRFVQV
	GLAAGGIVAV	SLSGELREV	YLGPHIASV	QLPEPLPGL
	SLSSVLSHV	ALLDWVTSV	IVMEHVVFL	SLKDMDLVEV
	ALLENMEGLFL	KLLAGFMGV	HLISTINTV	SQPPVFKV
	FLFNYDYTL	NLAENISRV	KLLEIDIDGV	IIDEADRMI
	KMDDPTVNWSI	SLFDGFFLTA	SLSQVFLHL	ILDQPYDVNL
	YLEEILVRV	SLREALSFV	ALINNIVEI	KLPNFGFVV
	GIAELVPGV	SLSSLELFL	LLIDDKGTIKL	LLIENVASL
	mLDSLRIYL	VLAEIPQQV	LMNPmVPGL	LVDDIGDVTI
	ALSQINTKL	FLSSVIQNL	GYLAVAVVR	VLPDQEMLMKL
	GLAHFVNEI	FLTKKLREI	ILSQYITFV	ALPEVLAVI
	KILDIGLAYI	GLVGIVVGTV	VLQYQLQHL	FLIEEQKIV
	YLLNDASLISV	ILNNNLNTL	SmTNFISGL	LLPNAVYKV
	ALLDFLWDL	LLNDRKVFV	QLLQILQSL	NAPKWVPSL
	GILSVRDATKI	QIADIVTSV	SLLNLHLHAL	QLDGVRTGL
	GLLPSKIRINL	SLVAILQSV	YLVPELDGV	SLPAKFKKL
	SLLSLLPLFL	VIAPKITSV	QLMNLIRSV	ELDNMFVHL
	YTLPIASSIRL	GLRDILAVL	WLLPYNGVTV	HTGSWIGLRNLDLKG
	ALQALVVTL	MIAQTVTAV	ALLFYLEQL	ILDEQLYSF
	SIHDVTFQV	SLSELQISYV	GmASVISRL	ILPDDLPEL
	SLDAKEIYL	LLPDIISRL	KLQELNYNL	KVDPMAIVV
	SMLPVPPAV	SLSERImQL	ALSSLAVVV	LLPPPMKEL
	LLATEVVTV	VLREILTTL	AVSNHVFQL	LMPMPSLGF
	LLDATQHTL	LMRFLPTEAEV	FLFNAIETm	MLPKDIAKL
	TLAAIAVHL	RLFDDVPQV	LVLVPAQKL	AVDVVAIGL
	VAFPPEV	YLGEGPRMV	RVVDYLTKL	AIEDTIFYL
	GLSPLRPPSV	YLKHRLIVV	SLHSVIIQL	FIDDVVSAVL
	KIGSIIFQV	YLSRSGGGGGGGLGSGGSIR	SLNQAALYRL	FLLQHQTFL
	MLAEKLPNL	YMVSKELRNV	TLGHILPTL	ILPPSAHEL
	YLLDYPNNLL	SMIPALREL	TVLnLKEPL	KVLGALLFV
	LLAILPEAARA	ALKDQLLAA	HLFDTLHAL	mVDSKPVNL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	SMHQILLYL	AVYGFMPAKA	ILYGKIIHL	VIDQIAETL
	VLMEMSYRL	FTFPNIASA	AQLDPEALGNI	FLFSKFIEL
	GLWEIENNPTV	GLYSDRISEL	KLLDQMPSL	LLDYPNNLL
	TVPPVFVSV	ILRLQVTNV	KLYPWIHQF	LLPEEQVYL
	ALQEMVHQV	KmILDELQI	AmIAVVPGYI	LLPEIMPGL
	AVMAPRTLVLL	qLKEFDGKSLV	YLQPFLAKL	MMPPPPMGM
	KLDDLTQDLTV	SLYPKPEAL	MMLDDLLQL	NLDRLIQNV
	NLVEKTPAL	LLAEALNQV	FLVEHVLTL	NPDDITQEEYGEFYK
	SLFPGQVVI	LLKYIVIQV	GLNEEITKL	RIVDVYENL
	TLSPLLLFL	LLmEHIQEI	KLIQNVFEI	SLDKFYKQV
	FLHAADVVL	SIYDAIKEV	AmFDHIPVGV	FLFDKVVIV
	LLMVLSPRL	AMKKVVQQL	ILYDLQQNL	ILDISEHTL
	FVFPGELLL	ALLSAHDTI	NLLGmIFSm	LAPELFVNV
	HLDATKLLL	LLPIKTVGV	RmAGLKVLQL	qLPNFAFSV
	RLTDYVAFL	MMHPGPSAL	GLLRELRYL	VLEEFVPEI
	YILKIVPTV	SLFHTPKFV	GVISGLFEL	YLLDMPLWYL
	AVVEPYNSILTT	VLKEQIREL	RVLKELWKL	FLDEPTNHLDI
	KLFPQETLFL	YLRDYSRTI	HVQDIVFQL	NIDTIYDRF
	KLHGVNINV	GMAFRVPTA	QLLETLNQL	YLPYPIHQV
	YAFNMKATV	KLYFPELHMV	ATLGVALLF	FMDPGPEGKL
	LLYGKYVSV	VLAERMSTI	LLAEWLIQT	FQDDDQTRV
	SLLPAQYNL	WIVDRTTTV	IIEENIPEL	ILDQVWNIF
	TLFGLTPTL	YMFPDTMLQA	AmFGKLMTI	ILPEELQTL
	FLLDGKVLSL	SVAESLLQV	AILHLLVSL	FLPEAFDFI
	QQLDSKFLEQV	YLGQVTTI	TLTSFITSL	ILPEAQDYFL
	SLFPAELAL	FLRERLFEA	VLAHEIERL	ILPIKFPHL
	SLLDEVLNV	KLHDVELHQV	YLAPFLRNV	RLFTLYEQV
	STLHLVLRL	SLFPHNPQFIGR	IVADVQISV	YVPETVYRV
	YLPEDFIRV	RLAVYIDRV	YLIKDIRFL	ALDGFLFVV
	KISVIVETV	ALKLFLREL	QmLDVAIRV	ALDLKTLYL
	SISDVIAQV	VLAPHLTRA	LIMELINNV	ALPGKPPFL
	SLMSHAIEL	YLIKDIRFL	FLISRLIKL	IIDPADTRLVL
	VLMDLKALL	KLYRPGSVAYV	KIGSIIFQV	LLPPAFHL
	KILEDIGLYL	RLAVYIDKV	NLLEIAPHL	mLPDPQNISL
	LLANKVPAA	YLGKIKRV	TVRQGnSLLL	NIPSFIVRL
	RLQDAIAKV	SLKEmVSKL	LLLPEYHQRV	VLDGVLmEL
	SLDGFTIQV	GLFGKELHKV	YGDIIAFPL	LLDENNVSSYL
	VLADQEVRL	ALAEFLQRKL	ILNSDLANL	LLDKYFGSV
	AIAPIIAAV	KLNDMEPSKAV	KLHGVNINV	SLADLYFRA
	ALPPVLTTV	KLVPFLKKV	QLLPLIVNL	YMNHIMVSV
	ALWDIETGQQTTTF	LSRSGGGGGGGLGSGGSIR	SLWPMTFGL	FLDEHHSVNF
	FLFQEVLVI	ALYPGQLVQL	AGLSWYHGV	KMIEDLQNEL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	NLDNPIQTV	FLSELTQQL	EIGQVPALL	KVVALVHAV
	ILSEFSSKL	SLGGKPLVGLEV	SVAHWEAQI	MLFGHPLLV
	KLIQESPTV	KLSFIIRTV	VLFEHAVGYAL	TVDLVINQL
	KLSDLQTQL	YLGAKPRSL	AmYVHAYTL	FLDDLGNAKSHLM
	KLVELPYTV	LSVDLYSGAL	FmLPDPQNI	FMDSVIFTL
	NLAEVVERV	KLKPFLKSL	ALLSAPWYL	FMDTLSDLKM
	VITETVVEV	TMINAIPVA	ALFEESGLIRI	LLDEEGHIKI
	KmFESFIESV	ALREVSIHTV	AGEDLLAPPHDT	LLVGFVHYL
	YLYDRLLRI	FQIGPVAGV	GLYGLIVAL	YVDRVFHAI
	ALAPAPPQV	ALASVIMGL	HLQAAVAFV	HPGQISAGYAPVLD
	ALLAKILQI	LINPNIATV	RLFRDLVSL	ILDRVADGmVF
	IAPPVPLKA	FQIGKMRYV	VmNPVIQAV	LLPPDALVGL
	ALLGKLDAINV	VLGVVTGV	VVLNATWLV	mLDNSFERL
	FLLPTGVYL	GLKYDVKKV	YmIDNVILL	NLDIVIIGI
	NmLDVNGLFTL	HLRTAIEHV	LLKEYLVTL	QLVDIIEKV
	SLLPYLPmL	RLRDPSGDFSV	SLAEMIATL	RLPPPFPGL
	TLFHDPWKLLI	VALELLASN	SVNGFISTL	SLDQPTQTV
	YLFPGIPEL	YLGQVTLT	VIWEHDYTSV	ALDWVTKKL
	KLGDLMVLL	HLRQDLERV	ALYQSLPTL	LLDEEISRV
	SLAERVDRLQV	LLKEYIQKL	FLMNEVIKL	MLIEVIEKL
	AAAPVVPAV	YVYKVLKQV	PNLNLRAVTPNQ	SVDEEFQKL
	ALAKEIDSV	ALWKGRPLSV	SLMMTIINL	TLIDLYEQV
	AMFENFVSV	FLKNEVERL	AVNPHLFSL	VLDEIDAAL
	GLIENPALL	GLNHWVRAL	GLSLEIGENRL	VTPRQFFNV
	ALINNIVEI	ALYASNVRRV	KIQAKIPGL	ISSHVDLGL
	mLNEHDFEV	VLHEHIQRL	qLSQVLHRL	KLEEFVNGL
	MLSPFISSV	KIADFGLARI	SIQLHGAKLL	WLPEPGLGL
	PLGYEIQL	HMKSFVTRV	SLVTGITAL	GLNEEIARV
	RVAPEEHPVL	KINNEIRSV	QLLDTIRSL	LLPPVVWLL
	SLAANTFTI	RLYTVVPRLV	AmSSKFFLV	TLPVAFKVV
	SLFKHDPAAWEA	SLVDKTKQV	FLQDYTLLI	FIVEETLPL
	ATMPVVPSV	FLHARLRTA	ALGSVVAV	YLDFTNPKV
	FLSLINVGL	FIIGRVIKA	KLQKILRQL	YLNETFSEL
	HVLDVIHEV	NLKKIFREV	ALKPDLVNV	ALQEKLWNV
	ILLSEEDLQML	GLFNRIIRKV	AVQDFLHEI	GLFPTSHSV
	RLLEQKVEL	GLREDLLRGI	RLLDEEISRV	LLDHLSIVYV
	SLIEVVIGL	KLKTALLDI	IIKLnIPEL	WLDDVEERL
	TLADYLHLL	KLRDELVKL	MLIGEIFEL	ALEEELAGL
	YLHDFLKYL	SLAQYLINA	QINAVSLYLL	FLDEEVKLI
	GLAPFLLNAV	YLNHIEPLKI	RLQDAIAKV	HLPYLFHVV
	RLMNETTAVAL	FLKDKFVEI	SLFEEMLQV	KLPAEPPAL
	VLIANLEKL	SLMEKISKL	VLNDYKWFA	VLPESLPVL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	KLIQLPVVYV	YLATVTGI	AQQLQIFNL	VMDAALLLI
	SLWGGDVVL	YLHHILRQL	FINELITEL	ALDWVSREQSV
	FLYIRQLAI	ALRSILRQI	INDQLRCTTWL	LASPEYVNLPINGNGKQ
	ILVGLLHMV	FLKIIHTSV	LLQLPEPLP	LLPPVVWL
	MLHSVTLFL	GLHSGNFSRV	qmQGSLLPRL	LLPQILENL
	VLFGAVITGA	ALFNLDIRRA	RLTPKLMEV	NLDSIIGRL
	ALDPNIATL	FLRQRLQAL	NLSNFLIHL	TLDVITVmL
	LLIGHLERV	LLRSIVKQV	AmLPSITNV	VLDSAFEQL
	LLQESLAQA	RLFENLRmL	RLLNILmQL	FLPPSFPIV
	RLLPEKLTIYTTL	SLFVKLHNV	FLSDGTIISV	LLPVPVPAV
	SMMALLVQL	YIYSSKIVRV	SILETITSL	MVDDRLVTM
	AMSNLVPPVEL	FVADRLRAV	GLAATLYSL	SLASFIPAV
	KLAAVVNNL	LLFERELHSV	SIIENLAIF	SLPESTLLQAV
	SIGKPSLFISV	RLLDEEISRV	TVRIWVPNV	VLDDSTAKL
	SLFAGGMLRV	FMKPGKVVLV	ALGEQVIAL	VVDAVVTQV
	SQLDISEPYKV	GLALLYSGV	GLSPSIQTL	ALPEIFTEL
	YLVYILNEL	ALFRHEVGYV	ILQDDIESL	ALTPVVVTL
	SLFPGKLEV	AQYEDIAQKSKAEAE	LLQMGLHVL	FADGVYLVL
	SLSFMNPRL	SLVENIERLKV	LTQEQLHQL	FLDSEVSEL
	LSLMLVSTV	ISISKRSIL	qLAQFVHEV	ILDGNQLHI
	RMFPGEVAL	SLKTAIYRI	YLYKYLWRL	ILDMTAVLL
	SQYDYILPQV	ALSGTLSGV	ILHGLVAAV	LLDTVLVNL
	GLLEIVTSV	YLYDRLLRI	LLGPGLLATV	ALDEEYLKV
	ILSESANRIFL	FLISRLIKL	AIMNVLAEL	FLDPGGPMM
	SLASLLAKV	SLKKQLTRV	ALARLVLRL	FLEEISPHL
	ALLSAVTRL	VLYDPLKRV	YLKDFFSNV	GLPTRLPEI
	FVMETFVHL	FLYKEKLVSV	ILSPTVVSI	LVLPVLVFL
	GLVPFLVSV	VIVHRLLAV	ALMNLIQYI	KLFsPSKEAEL
	RMLEDRDLFVM	LLKPELLRA	KLLDLQVRV	LLPQIFVKM
	TMLHLTDIQL	KLYGKPIRV	RLLESFETm	VLPAVSLEV
	YLFTIINSL	RLPMSIIIVGV	FLGTFILKV	FLIGQGAHV
	ILGPPPPSFHL	ALAGGITMV	RLAHYIDRV	FLVEPQEDTRL
	VLLTRLENV	NLKPHIQGI	ALLNTINYL	FLDPGGPMmKL
	KLLNnLTSI	SLPDFGISYV	ILKETIEIL	ILDIPFHQV
	SLAELIQAL	SLVSFIPLNI	QLEQWEFRV	LVIDVIHEV
	SLDSTLHAV	ALRKEIKQL	YLGNINPQm	VVDSImTAL
	SLFDAVSSL	YIKAAVKNV	KLQELVRKL	ALPPPPPAA
	VLHRNLIYL	GLRESISKV	TVTTVILEV	FVPEPSSTMGL
	FLFPVYPLI	GVKDKVTLV	LLASIPAAV	KLPEDFAVVF
	NLLTHIENV	HMKNFVTKV	VFEKYPETLVR	MVDDVFYIV
	QLLAILPEA	KLREmLIRV	GLFDQHFRL	RLGPVPPGL
	VLLDAPIQL	SLASFIPAV	NLLEWPFARRV	YVDDVISRI

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	YFPPGLP	RMYSYPARV	TLAYDKGWRV	ILDDFRMHF
	ALLELVPWRA	FLKPEKFTKV	FLFGLLnEDRV	LVDMVNDGV
	GLDSNLKYILV	KLADFGLARA	RLFDmSGVRL	MLHSVTLFL
	KVGNFKFIYV	SVASTITGV	GLYEGLTWL	RLLEPAQVQQL
	NILDFVVVV	ALGSVVAV	ALYHLAIKL	RLPDLIKEV
	VLYSIAEKV	RLHEKVNII	AVLEKRVEL	YmDTLNIFM
	FLTDMPDILL	RLPPEGILHNV	ALWnLRSNDTGL	FLDSLIYGA
	NMFDPALIGDKPKWYA	QLRAVIVRV	AIIPHVTIR	FTDIVTVQV
	QLLEKVIEL	ILADKTRQL	SVIDHIHLI	LLVDEFLKV
	SLHSVIIQL	KLMDKVVRL	VLYDRPLKI	SLIDQFFGV
	SQFQQEFPSL	YLNQHVNRI		TLDSILFLL
	WLSTSIPEA	RMFDRIFGQA		YLDPLWHQL
	AALPNVYEV	HLANIVERV		AIFAVMSRV
	HSLGGGTGSGMGTLLIS	ILKEKLRQL		FLVHNVKEL
	ILPERFLAV	ALRAQLHQL		LIDGQVIQL
	KVMGFGLYL	FELRHEIEI		LLPPPPCPA
	SLWPMTFGL	RLAEVVHEL		MVDGLRITF
	YLLDLLRLP	YLKPIQRTI		NLPSILLKV
	ALLALLPEL	ILKDNIKLL		SLPEVGTKL
	FLVEEEDLFL	ALAGGPLAV		ALDHmVEYV
	KLLDELPIAKV	GLKAFYKGV		ALPEDLVEV
	RLIPTLVSI	KVKEPPILRV		IIDSLFNTV
	SLEGIPLAQV	QMIPFQPRHL		VLPESNSDVDQL
	SLLLLQLLL	SLASLLTIA		YVDSEGIVRM
	SLLDNLLTI	GQISEVVVV		AIDLIVQHV
	YLIEPDVEL	SLKHTLLSL		FLPPAQVTV
	YLPPATQVV	GMIDRQGLLHV		LLDEPTNML
	GLLEGLVEV	SLTSGLLTI		WLDNIIDLV
	QMLEAIKALEV	SmFGAGLTV		YLPSSFPVL
	SLLPTEQPRL	AIHRIIEV		FLDHIGGTRL
	TLSDIVVTL	RMKKLVSIV		HYGPGWVSM
	GLIDFAIQL	LLQPHLERV		KLMTALVNV
	KMADIEYRL	GLYEGLTWL		MVLPLLIFV
	LLLAAARLAAA	VLNARIQKA		VVDALNQGL
	RLAVYIDKV	ILAEGITIV		ALDGAWLMV
	LLMEHIFKL	ALIPRIKNA		GIDDLHISL
	LTIEDGIFEV	ALKSGKLVTA		HIDETYLMF
	NIFPNPEATFV	LMEHIHKL		ILDPFILVF
	FIADLVVGL	AMREEVRQL		LLPEIMPGLI
	GSDWRFLRGYHQYA	MLIERIVRL		LLPTGVFQV
	LLLDENGVLKL	SLRDKVLQL		LLQDIILQV
	NQFPGFKEV	YLKKEIGQHV		MLDNSFERL

HLA-A Alleles

A01:01	A02:01	A02:03	A02:04	A02:07
	SLIEDLILLL	ALRNLPPLRA		NGPELLPRV
	FLYGGELVL	ALSELATAV		RVLDPSmVILEV
	LLLSVLPQL	FLFDMLNGQDP		AIPESSPPSGI
	GLVNYQISV	ELAKTRLQL		FIDQQQFYL
	ILMEHIHKLKA	VMFKKIKSFEV		GLIDVHVHL
	ALIEVPDGFTA	GLFHHISKL		ILDEVIMGY
	ALQPGTLQLI	GIVGGLSTV		LIGEFLEKV
	ALRVFVESV	IVADVQISV		LLVDYYVKI
	FLYDDNQRV	SVYGSLASV		SIDPVTVSI
	ILSKDGVLYV	TMIVSLAAV		SSSKGSLGGGFSSGGF
	LLQEVEHQL	VVAAIAISE		YLEPYLKEV
	SVFAGVVGV	TVTTVILEV		FVDMVARPSM
	TLAGDVHIV	TLAVSGLGV		VVPSYIPLV
	FIYQGKIPIA	GLAESVSTL		AIIEYMPLL
	RLGDAILSV	mLAGFITTL		ALNEQIARL
	YIWDRHYNI	ALAVNISAA		FLDLLQERI
	ELFPHSLLSV	ALTGAILAA		FVEPFVILL
	GLIDENPGL	SLIGGTNFV		FVIDLQTRL
	LLFHHPNILEL			GLDDMKANL
	LLPDYYLVTV			KLDEDVKMI
	TLWGGLLRL			KLEELIGIGL
	KMVSIQITL			RVDNLAVVm
	NLAENISRV			ITPDEFHFV
	TVLDAIYEV			SLPPHILEV
	VLPNFLPYNV			TTPPIWHL
	ALKRQGRTLYGFGG			FLDPIMSTL
	NLMNNPQIQQL			FLPPYTFQI
	RLSDVQIYV			LLPGLLKTI
	TLLDFINAV			LVNEKFWKV
	VMVNQGLTKHMTV			mVDVIFADV
	YVYDKDIEQI			RIIDVIDKELI
	ALWAGLLTL			RLYDTHITV
	GLLRDEALAEV			TVDQVLSEV
	KLISELQKL			LLEDTNTFRGV
	KLLGNIKNV			NLDAVHDITV
	LIYSGKLLL			SLSAIFNNV
	TALGYGQAFVGGL			TLMIKFEEA
	ALEPIDITV			VLPPDVLTRV
	ALYLGAKAIQL			VLPYLVPKL
	GLLDNPRVKAAAL			VVPPPFEQEAL
	ILIRPLVSV			YLSGIAHFL
	ILNEFPGHGL			AADEVLAVL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	LILGKLHYV			AIYHVImSV
	mLLTKLPTI			FVNDIFERI
	NMVAKVDEV			RLDNITQVM
	SLIEKPPIL			VLLSTIHEL
	ALFTFSPLTV			NIVPVIAKA
	GLLRLAIRL			TIDVKFNGSHVVGSPF
	GLYSGVTTV			GLDESKAKL
	KILPVMVTL			ILVEKFPFV
	KMVEDLISV			LLDHVLLTL
	GLFSAKLFL			RLDWPVRTL
	RLLEVNQQSLL			SLPAGPPGV
	SLFSVIVRV			TADPLSLLRNV
	SLVQGELVTA			VLVDAFSHV
	VLmDLKALLL			YIFQPQQSV
	GLQEYVEAV			MMPEEKLVEAL
	KVADLVLML			TLPDLVPQL
	RLASTLVQV			KMWEEAISL
	RVIDDSLVVGV			IAPPVPLKA
	FLAPDNSLLLA			KVIDYVPGI
	FLDSTSPLL			KVWGNVVTV
	FmQDPMEVFV			LGPPPPLRV
	GLLPEHFLFLA			LLYENITFV
	ITTDVLYTI			LSPGLLPHL
	VLFTITKTV			MTLPVDAVISV
	WMLEQLRQV			QLWNNYFHL
	ALLDVSNNYGI			QQPDLLPSA
	LLLDERQDVHL			VLPNFLPYNV
	NLLSKVLIYL			YIDKDLEYV
	RLLDALEFL			YLHNQGIGV
	ALSGLAVRL			LLPIKTVGV
	RLPDLIIFL			QLDEARGLLL
	SLLVHNVSV			QLWNIFNQV
	TLAETLVNL			FIDPSSGLAFF
	ALDAGAVYTL			FLLPVINEM
	FLQENTHVRL			LSDNIFTHF
	KIWDLKERTNVA			mLDKLVDGL
	NIWNINLQL			YIPTELDQV
	VLLVEHALSKV			YmVHIQVTL
	AVLGFSFRL			IMPNGDHIVSA
	LMDHTIPEV			LLLPGELAKHAV
	WLLCFIFTV			VLEEQIERL
	GLAVILPPL			VMDLSIVRL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	KLLDLETERILL			AVVAHAYYL
	TIMPKDIQL			LIDELHRHL
	VLLSHPDPLHL			LLPSRPEVPNII
	VMFRTPLASV			mLPEFYKTV
	ALSSVIKEL			MmLDDLLQL
	mLTGISPFL			QMDDLRAQI
	QLQDFDWQV			FLSELTQQL
	ALLKGLAAV			NIDSIIQRLL
	FLEPVNPRL			AVPGPGGIWSV
	NLLELFVQL			MLFGTYmKV
	TLLGKVVAL			MVDVIWRQL
	ALSNSDVIRQV			NVDEGIYQL
	GLHNVVYGI			QLDELMAHL
	SLIKHKIML			FLDGNELTL
	AVMLHSFTL			KMPDDVWLV
	FLTAAIILL			NVPEGLLATV
	LLDEIENIKQV			RVIDDSLVVGV
	QMFQYFITV			YLDDLNEGVYI
	RLFDEPQLA			ALPEEVQEL
	SLISTILEV			IIDPNHEIEF
	SLLSSVFKL			NIPDVVPGSHL
	ALLGDLTKA			RIDEFIVKL
	ALSSLIHAL			YIPSVLHDV
	FLLENSSKV			LLPEYVVPYm
	LLIGHLERVTV			LLPSEGIVHL
	SIKnYLQFL			NLPTIFVYL
	SLIARLERL			SFPDSLPEV
	ALFGIPmAL			SLPPVPPRL
	MVLPLLIFV			VSDNIIAKL
	SMLTLPLSL			AVDMVVTEV
	FLIILPKELQA			SLDAIVASV
	ILYDIPDIRL			HLDNISNNL
	RMLYMIEQV			IILyFYVLSL
	YLDQGTQIFL			VVVGDLVEV
	YLNLIELFL			FLDNMFHVL
	LLQDHPWLL			FLDPGGPMm
	NLFAQTYGL			FLLDGFPRTV
	SLASVFVRL			HLIEPLANA
	VLLEPFVHQV			LLVEPSRNDLL
	VLYTGDFRL			NLPWKFEHI
	ALLNAILHSA			NLWSLVAKV
	PVEQYLGVP			ALRELIQGGEYF

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	SLASFIPAVNDL			ILDSSPEKL
	FLANIGTSV			KIGSIIFQV
	LLDDSLVSI			ALDNGLFTL
	GLAEILVLV			ALDQEIIEV
	QMLPLNTNIRL			KLDAILKNV
	SILQTLILV			PERSIFSAI
	SLADLYFRA			VLDHSLESL
	TLLADQGEIRV			YLPTKLAAV
	YLQNWSHVL			YLTEVFLHV
	IVMETVPVL			ILPEVKVEGEL
	KLMDEVAGIVA			SIPELQNFL
	KLWADRISL			YLISQVEGHQV
	SLAELDEKISA			ILPKILQDV
	VLTESPPSL			KLWEVSSGEL
	YVFENTVATV			VLDEVVTVL
	ALYNWLIQV			ALDTTRHEL
	FLLEIRQTL			ALPMVLVLL
	LIQYHEPEL			HIWDPLTNV
	TLLPTLYEI			HVDPGPTPI
	TLSSLVFQL			KLIEVDDERKL
	FLAHDQAVRTL			RLISKFDTV
	FVIDLQTRL			SAPPPVVSV
	LLYEDIPDKV			SLPSVPVFLEV
	SLLDENNVSSYL			YLDEAYPGKKL
	GVLPNIQAV			YLDEELmVL
	KLFIGGLNV			YIDTFFEDL
	NLMELLImI			IVDAFLQQL
	VMFKKIKSFEV			KLQEVLDYL
	ALINNIVEIRV			SIIEYLPTLR
	ALMEEILKL			YIDIADRSQVL
	FLHESLILL			AMPPPPPQGV
	LSLDALLTV			FLDmTNWNL
	RLIQGDQILSV			FTDERIFML
	RLNDFASTV			IMDRIYKNV
	AIQDKLFQV			KLFEKVKEV
	FLLPLIIVL			SLDWHPNNV
	ILWSEAIFL			YLDEGFLL
	YLLDMPLWYL			LLDEPFLQF
	SLIAKVATA			SVDELFAEI
	SmLQKTWLL			VmEDLYNYI
	YLGQVTTI			WVDEINRHV
	YLILHLISTV			FLPEPmGTANI

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	FLSHIPITL			FLPETRImTSV
	FLNDEVWNL			LILDPIFKV
	GLVKEGLVMV			LVPTSGIYFV
	SLLENLEKI			FVDGLTFKV
	SLLGFVATV			MLPDPQNISL
	YLITSVELL			NVPDVYTQI
	ALFPERITV			QVIPVLPQV
	ASPEYVNLPINGNGKQ			ALDLVYGNAL
	GLWGQSVPTA			FIQSIISTV
	ALAKPPVVSV			ILPDMLKNA
	FLSnDTVQL			ImDILNIKI
	YAFPKSITV			KIDAFHYVQL
	LLWERVEKL			KLDVQFSGL
	QLIDKVWQL			LADTHLTEET
	SLSSLELFL			LLSEILHLL
	WIILCYIWL			AIDDVDIDL
	VALFKGKQI			FVDDYTVRV
	YLLEKFVAV			HLPEQAFYMV
	ALVLGPLKSV			KIVVVTAGV
	AQFGYYFRV			TLIEDILGV
	LLAEIGAVTL			FLLEQEKTQAL
	YLSEKVLAA			FVEEEEHFL
	SLIEKIPTA			IInSFmCGAIL
	YLQDYTDRV			IMLEALERV
	AILKYIETL			KDYPFYLTV
	FLFELPSRL			LLPEEEQLWAA
	GLHGWAFTL			NIDEAYKIL
	GMDRYLIYV			VMDEIHTVL
	KLFSLEHFL			GLDDIQTLI
	KMLEKLPEL			qVDHVFREV
	YLFKVVLI			RLPAWQPIL
	FQDENYLYL			ALPmVLVLL
	IMDATNILV			LQDDIPTTF
	YLNALVHLI			LQPDEDTIFFV
	FLDIVELLL			AIDEISKSL
	FLDPRPLTV			FLPFSFEHI
	FIFEKKLAQA			LLWDVVTGQSV
	FLSDIPETV			LVYEAIIMV
	VLMENIVYL			MLDAAVIKM
	VLYENALKL			YIDEEGVRYV
	LLFERELHSV			YVDTAVRHVLL
	RLFDDVPQV			LLDNIIQHM

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	TLQPTLVAV			MLGERLFPL
	TMTDSFLTGQMLL			NVnYSLASFL
	ALGDKFLLRV			VLIDYQRNV
	FLLPTGLSSL			YLTAEILEL
	FLVGERVTL			LLDRILPKL
	FLYQYSTRL			NLPWYLPSA
	GLFPWTPKL			TLPTVIAEL
	GLYGLIVAL			TVDDLVAEI
	LLWWLQPRL			FLPAGIVAV
	LPINGNGKQ			GMDEVYNLF
	LQLDKEFQL			TLPVSFAQL
	RLQETEGMVAV			VMDVVVKSV
	SLFSSPPEI			FLSSVIQNL
	SLLEKELESV			HLDPGPIYm
	LQCNPPPGL			KLPAFSPLM
	YLYKYLWRL			KLPDGFSQL
	ALLDSAHLL			LVDDNYFYL
	FIFSDTHEL			SLDEKQNLV
	SILADRILL			SLDERIYVKM
	SLIHGLWNL			VLPPVPTEGL
	SLSTVFVVL			ALDDYRGQFPEL
	IMLEALERV			ALWDIETGQQTV
	LLWGDLIWL			GLDAIITQL
	MLYDIVPVV			KLFnVTSTL
	NLVAIPVYV			RIFPPETSASV
	NMLPQIFRV			TLIGYFVGL
	RLIDDMVAQV			YLDDPDLKY
	TLISELVQA			ALPENPPAI
	FLIDLNSTHGTFL			FLIAQLPKL
	ALQESIPDI			FVDSPSSGTHL
	SLIPIISGV			SLIDIVTEI
	FVIRNIVEA			VLDELDMEL
	GLISFSDYIFL			VLDELPPLI
	HLLPGDELYL			YMDNPQNLAM
	ILMSYDHVEL			FLPEALDFV
	KLLQLQEVF			FVDTDSDVRL
	SLLNVVMDL			LLDYIDKEII
	SLQELLIQV			NVDSLITRLL
	GLDSYLPEL			YIGEVLVSV
	FLSSVIQNL			FLFELPSRL
	LATWTIQGAANALSG			GLDQQYDIYL
	LLLPGSHYL			GLLEIVTSV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	VLFEVAWEV			GMYIFLHTV
	HEQLSVAEITN			GQIEVVPEV
	NLIDAGVDALRV			IIDEITPKL
	RILDYVINL			ILPIMFPSL
	AMQEYIAVV			FTDDQWLNV
	YLEPYLKEV			MVDSKPVNL
	FLVLDVVYL			RLPGIPITV
	KIWDVSVNSV			VLDDVPVQGFF
	QLSPVLLYL			FISEFEHRV
	VLYPHPPLA			GADAIYDHI
	SLVQRVETI			HLPLPGPTL
	ALSEELVQL			QLEGFFLHL
	FLFQFIPYM			VLYELFTYI
	ILHDAVVFL			KIVETIEELKV
	LLLDTEGFVK			LLDGKVLSL
	FLSPQQPPLL			LVDEImMTL
	SMLEEGKEPWTV			MVDGKPVNL
	KLHDINAQL			nLDAALFELI
	LLDVPTAAV			QLDQPSWSGRL
	FLQEHNTTL			SLPDPNLITFL
	LLVPTSGIYFV			SLVDIYSQL
	RLLDYVVNI			YLPDKLPKV
	AVLQGKLAEV			ILNEIVNFV
	FLPPEHTIVYI			RIDGVLIRM
	KLSFIIRTV			RLFSSIVTV
	RKSLKIIYI			TLPEDISQL
	GLDIPTVQV			TVDDLQAKL
	IKGNFHAVYRDDLKKL			VVPQQLLTV
	ILSQYITFV			AIFAVmSRV
	LLREKVEFL			ALNELLQHV
	RLFEVPHEL			FLPEGVNKL
	SLLSDIIAL			NIDNVPLLV
	VLFSVADRLRL			SMDSFYKVL
	FLFVDPELV			STGGAPTFNVTVTK
	ILAQIMPFL			VADTVYRAL
	KLMAPDISL			VLWEALRKMGL
	LLAEVIENL			YLPTLWVKL
	SLLPVKPVEI			LATWTIQGAANALSG
	ALYTGFSILV			LLPPWVIYL
	NLFKLEVRL			MLPSILVLL
	DRDNNRVGFAEAAR			RVDGLLHQL
	ILGPKPQGV			SLDGFTIQV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	LLADVETFV			ALPNVYEV
	SMLLEIIFL			SLPEELNRV
	VLFGKPMVV			YVYKVLKQV
	ALWDIETGQQTTT			FIDEELEKM
	RMVHILTSV			HLDYVDTERI
	ALLAYTLGV			VmPGEGDLPQM
	LLYDLADQLHA			YLPEDFIRV
	MLLTKLPTI			FLLPKFHGV
	SLIKYFLFV			FLPQVVVTV
	FVQPFGPQYEV			LLLPILVTV
	QLEEEGITFV			NIVERVKEV
	RLWEKLTLL			RLPPDFFGV
	TLIEDILGV			TVDDPYATFV
	ALAGVSFEI			VLDSIIWAF
	ILLSGASPFL			FLPESYLLL
	YLSVKVWDL			GLFTVFTGV
	ALDILITNV			SLSTVFVVL
	GLFDTAISL			SSVEVRSDWEV
	KLYAGAILEV			ALDVmVSTF
	YLIDIKTIAI			AMPSWFDII
	TTFPRPVTV			LMDAIQTNF
	SLVGLLLYL			RGPPQPLPAV
	QLHAGSLVSV			SVDDLVEKL
	VMFKTPVSI			SLAEFVQSL
	YLVELSSLL			ALDDFSISV
	SLMDLTLLL			LLDLSFAYm
	SVLGAITSV			TITDIISAL
	LLMPSSEDLLL			DLDDLYVHL
	LSFPCSLKI			FLDELEDEAKAA
	QLVDTTVEL			GLSAFLHAI
	SLADLQNDEV			LLDDSLVSI
	SLLEAVSFL			SLPDFGISYV
	SLVSPASFENV			TLPELTFLL
	RLLATIVML			KLFNVTSTL
	YLLDKETLRL			KQPPIDNIIRA
	ALAEGQLRL			NIDTFIEHL
	ALLELLHEL			IQDEIVDFL
	ALPEIFTEL			KVDsPTVNTTL
	IQVTKVTQV			RLDEAAQRL
	TLLHFLVEI			WLDGSPVTL
	RLLENMTEV			KIDGVEDML
	ALWKGRPLSV			LLDSAPLNV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	FTKTEEL			LLPEEFISL
	LLQNNLPAV			NIFPYPVGV
	SIYGGFLLGV			RLPEPTTRL
	VLVPYEPPQV			SLVAILQSV
	ALARLVLRL			ALDEPTTNL
	ALASVIMGL			ALDPMSVLL
	ILDDSHLLV			IVDVIDQNRAL
	ILQDRLNQV			LLDAGFLFL
	RLWDLTTGTTT			QVDAQLLTV
	TLLDASEKLKL			SLDEVDHKI
	TLLSNIQGV			VVDNPQKFALF
	YLQPKLLGI			YVPTSYVEV
	ALLPQNHKL			AINPKLLQL
	ALYEYQPLQI			ALPVKLIGM
	FLLDHGASL			HLDATKLLL
	GLVTWDAALYL			HVDDVSSAL
	GLTEALHFV			LLDLALEGM
	ILTEAIKAA			SLPHNIIEL
	TLDEKIEKV			TVDALVLRF
	LLLTDQHLYKL			YLEDFITNI
	SLFEGTWYL			AVDPVFQAKM
	SLLTSTVQV			FADPIAANL
	VLFGWPSLVFV			MMPKYLNFV
	YLPPGFLSA			YIDQRIHEL
	MLQDSIHVV			VLDNPHHGF
	SLLPPQDPHL			ALDDMISTL
	FVFSFPVSV			ALDEPPYLTV
	GMASLNLPAV			mLDEPTNHLDL
	KVLRESGLKYV			NVPEIMPKL
	ALQEKLWNV			VAPALAPKV
	FLSGAKIWL			YLDWDVSEL
	LMWELEKKSAVA			YLFTIINSL
	MLIGEIFEL			FLPEPMGTA
	SMLNRILAV			FVDTDADTRL
	TLWQIVINI			ILWSEAIFL
	FLIRNIPVI			LLDELLQKGYGL
	KLFEEIREILL			LLDQVQTVL
	QLLGLIQRV			LLNEPDGTFLL
	SLLGFVYKL			MMPPPVGMV
	SLPDFGISYV			SLPRAFPAL
	TLIGYFVGL			WLDSVHQLL
	VMTLVSTYL			TLDEQVLSF

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	ALLNVELEL			AAPDIVPAL
	ALSSLAVVV			AVDYVIRHL
	TLIDLPGHESLRL			KLFNEFIQL
	YQDPLDPTRSV			LVDDNYFYLF
	ILLDHEKEWKL			MIDKLTLTF
	NIASIGSTIFL			SIPIFLPEV
	ALTDFVRSV			VLDEGKmKL
	KLFnVTSTLRI			VLFDVTGQV
	LLLDVPTAA			LLWGDLIWL
	ALAKIEIKL			QLAPVFQRV
	ALMADMVYV			QTHSVFVNV
	ALWNEEALL			FLDEVSRQQEL
	FLMQYPGRSL			IQPDNIVYV
	KLLDIRSYL			TLDGKVQYL
	MLFGHPLLVSV			VAPESFEYI
	QMLELITRL			ALDnYTITF
	SLLSNDLKLNL			LLDGNPFRV
	YLSLLNQQL			MLDAIPMML
	ALPEDLVEV			NVDQAFHEL
	GLLDAVTYL			QVPDDLPNV
	QLMPLPVKV			VVDNLLFKL
	TLMEQTLPVTV			YLDRKLLTL
	VMLQINPKL			LQDDFYLNL
	LAQLRVLYL			VLPDLVVEI
	LLGPKPFPL			WVDDAIWRL
	SLMLVSTVL			KAPDEETLIAL
	GLLDGGVDILL			LLPYVLENV
	KLIDYIYTA			NLPGVLPAL
	TMLELLLRL			SImDYVVFV
	FLASILEEL			AILEKMPLV
	FLTGVTTEL			KVPEIISSI
	GLKNGVPAV			LLASEVPQL
	TLAEIAKAEL			SMPPAFPRL
	VLFESQFSV			ALDPADQHL
	FLLEKPFSV			AVDPVADIATL
	TLLDNTDTISI			LLFDLIPVV
	TLNNLEIFL			TIDDVVYVI
	YLIKYIAIV			ALDEGDAQKTL
	AMIDQVLEL			ALPELYFQKV
	TLYKDVRDLLA			ILPPTILTL
	ALIPIPLAVI			KLDEAFEFV
	ILLDNDHYAM			LLDDTTVTL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	ALLSLDPAAV			LLDGFPRTV
	KLLAGFMGV			mVLPLLIFV
	ISTEVNPKL			SLPLYFVSA
	LLDSAPLNV			SQPWEVPFV
	LLGQVFQV			FLPSANEHL
	QMMQNPQILAA			FLTEINSTV
	RLLEIPAVSHV			IIDDALVRL
	FQFVGIENIHV			ILDDSPKEI
	ILWSERPTKV			LLDGVPVAL
	LLLYEEGLRVV			LLLNELPSV
	MMMALLVPL			VIIPLLHTV
	TLVDNISTMAL			VmPGEGDLPQm
	ALLRLLPGL			YLDVSVGKI
	FLFPHSVLV			ALDPASISV
	FLLQLQEEL			ALMPVLNQV
	VMDAALLLI			GLVPFLVSV
	ALAPGVRAV			LLDEVLHTM
	AMAHVAGFTV			FLPEPMGTANI
	FLGENISNFL			IIPDPVVAPSI
	EIQYLKDLI			ILNPEVVTV
	FLSPWPPAV			ILVDTVWAL
	WLLPYNGVTV			KIIGImEEV
	RMLDMGFEPQI			KmDPIISRV
	ALLTVVSQV			LLPGSEAGVSV
	HLLPTAPTTV			VLDNPTPEM
	MITDVVPEV			YIIPVVLFL
	YIALKLVAV			ALLPYFVYV
	GLIDHQTYL			KGPPALNIAV
	GLTLAPGLSPA			KLDHVVTII
	VTEGVIVPE			YLPPEFTAGL
	LLDNTDIHL			AAGPPISEGKYF
	LLPNAVYKV			ATDPVYKTV
	RLPDIPLRQV			KLPQPEAVVAL
	SILPVILRL			LLYGKYVSV
	FMTTNVPNV			LTDKSCQSFIS
	MLDMSVPAV			TLPFQLSSV
	SLFSGKPEV			VVDHLLDIYI
	SLWKGLVGI			YLPPTVITI
	YMGEEKLIASV			YVDSEGIVRm
	FQIGPVAGV			ALYAVIEKA
	KMAPALRKV			AVPPPPAPL
	ALDEQLVQV			FLDENIGGVAV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	FIFDGLHKA			HLFDAFVSV
	LLSSVSIAL			LLPTIVEKV
	QLLEKVPTL			LLYDNVPGA
	QLNDVAHLV			mLDAALATL
	QLTDLNVQL			VIDGHIYAV
	RLHDVLMEL			GLDDVITDL
	ALFPVAEDISL			IIEDKTFGL
	TVMGKIFAV			ILHTLLTLV
	FLGEKYIRRV			LLDVPTAAV
	YQFDSALLPAV			QLDRIFNVm
	FLQPGGYHV			RLAPDYDAL
	RQYPWGVVQV			VIPEKFQHI
	FLMEEVHMI			AAPPPSVTV
	IIIDSVPEV			ILPSNLLTV
	LLDHVLLTL			SAINEVVTREY
	LQWDKVLRL			TIDPIPHQLL
	NLAGENILNPL			YLYEVSQLKD
	SLIDFLRVV			FVIAELVNV
	YQSELELRV			LLPDEIADV
	FLWDPAKRTSV			TIPEIIIKV
	NLVPMIIHL			TLWVDPYEV
	YLIDEPSAYL			VMYDLITEL
	KVLGALLFV			ALDPNIATL
	SLIDQFFGV			AVDYITVAL
	TLVDEVFRI			FGPEEDTAYL
	ALLKQIQEA			NQPPEDGISSV
	GLFGYLVFL			NVIGEPFLNV
	VLIDVGTGYYV			SIAEVVHQL
	FLIVAHDDGRWSL			YVDEASKKEI
	GYFDERYVL			YVVKETIGV
	IIADNIIFL			LLDPCAEMEL
	KLFDRPQEL			RLQDAIAKV
	QLIDYKILGL			SMDEINKQL
	RLIALSFGL			YVDPSTDERL
	GLLNNIAEV			FLDSTSPLL
	TYKDPNNLAF			IVFCFLCYF
	VLIGHSYGV			LVPGHLDQV
	YLAIVWPVV			SLPELTHAL
	RQFLFHWTV			VLPAVLTRL
	YLISELEAA			VLQSVFTSV
	AMLPSITNV			YLPEDFMESL
	FLPSYIIDV			YMSPHPSPL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	GLWGPVHEL			KLPIPDPGV
	KLLTEVHAA			KMPSGEFARI
	RLLNFQRQL			VLDSLLLTL
	TLLGKEIKI			VLFGLLREV
	KLNLPDYYKI			VLPGLIHKV
	KMMELFIRL			FLPESVAVV
	ALLEEVKAL			IINEPTAAA
	LIDPNTLQV			ILPAQLLEV
	LLIDTQGVPYTV			KIPGTGALASA
	SLLEFNTTV			SLPEFQESV
	VILDPDTANAILL			AVDGVIISL
	VLITTLITA			AVHLYISAL
	FLLEPGNLEV			QLPNFAFSV
	VLSDIIQNL			SLMMPAVFHTV
	YIFTTPKSV			SLPSSPPPQL
	ALWVSQPPEI			YIDGILIKT
	FIFPASNVYL			IIDGVIQMV
	IFVEAVLR			ILPNEDDKFTV
	LLPGVDVLLEV			KVFPSEITDTV
	RLAEALPKQSV			LLPPPHQGL
	TIPDFIFANV			LLYEnITFV
	ALLAGSEYL			YLSDNVHLV
	ALLPGNFTV			ILDQKINEV
	FLPPSFPIV			ILPDDPRQMTL
	SMADIPLGFGV			LMNPMVPGL
	KMAEMLVEL			TLPEENYQV
	LLAGFAFLTGV			YENEVALRQ
	ALYTVIETV			YLPSQVSRV
	KIFSGVFVKV			ALDDmISTL
	LNGFDDVHFL			ILDETQHLDI
	ALMPVLNQV			ILEENIPVL
	KVAPAPAVV			KLHYVVTEV
	NLMEMVAQL			LLPSKLASV
	SLFSEETPVVL			LMPQLNAIIAA
	TLSTVISKV			TIPEAWVGQEV
	YLIASIDHL			YLDQLTQIL
	DIETGQQTV			YLEEPLTQV
	FLSNDTVQL			YVDDFGVSV
	KLWQTPLHV			FILGPSHHV
	NSIIDVYHKYSL			FVDKLFESL
	RLSSVNAEV			LMDTLFNTKF
	TLQEVVTGV			NLPVFQPGV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	TLSDVLDRV			SSIPPVFQL
	VLHEGTNFV			YVDTLLTML
	IQIMKVEEI			FLDNLHINL
	LLIPIHLEV			FLPEEQDRL
	LLWGNLPEI			KLDDVTDEYLM
	TVMDEIHTV			LSPEFFTSV
	ALLEKPGELSL			VLDFCYHLL
	SIISNLDEV			YQPYEIPAV
	ALLEGLTVV			YVDTAVRHV
	FLLGEHLLL			FMPVSSLIVGV
	FVARMIPKV			ISDGVIYSI
	GLYEGLDWLA			RmDEEFTKI
	RLLTVLPSL			SLDQKLFQL
	ALWEDEGVRA			VIDEPVRL
	FLAEEGFYKF			YVDKLIDDVHRL
	LSLDKLEAA			NVPGLYIAV
	VFGGIGDPVTCL			VQPEEFVAI
	ALQTKLETL			SVDEDYDLRL
	FLANLHITA			FAPGDLPEL
	FLIEEQKIV			NIDEAITLL
	SLAGFLLSV			ALDKIDQQYL
	GLFERDKLIFL			LLDFVKPEF
	SLYGGTITI			FIPLPSAVVQA
	RLPMSIIIVGV			LLDNVTVLI
	SLLEQGLVEA			QIDSIHLLL
	ILSGIGVSQV			FMVEKGPTL
	SPPAILVTV			FVMETFVHL
	YLGNINPQM			YTDHQFTEL
	SLAQVVMKV			YVDDGLISL
	TLKDTITSV			YVNLPTIAL
	ALSSLLVFL			FLDGHDLQL
	FLIAALDVL			FLDYTTDNm
	LLLNELPSV			IVDQTIEKV
	QLLDLMHTL			LLYEQYAIV
	YLHEDIPGL			SVTDTNVILSm
	FLEGQIHPEL			YVDPQFLTYM
	SLVNVVPKL			ALDGFVMVL
	SLLDPRVGIRSV			FASPTQVFF
	SLMEDQVLQL			FLDmNFQSL
	ALDIMIPMV			GMPGALPSL
	ELFSSPPAV			LIFDQSGTYL
	KMLGIPISNILMV			MMLDDLLQL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	LLIGTDVSL			VMPGEGDLPQm
	RLIDIFIINL			YLSKIIPAL
	YLDRLIPQA			LLPESIPFL
	ILIETKLVL			VMEDLYNYI
	FFMERSWSV			YLDEAYPGKKLL
	GLDNAVSLFQV			KVAPAPAVV
	LDTNADKQLS			mVDDVFYIV
	TLLGVTVTV			YVEPLKLYL
	VLLSEETKRIFL			GGGGGGGLGSGGSIR
	YLDNGVVFV			SIDKTGENFRL
	ALVESLEYV			YLVNDIYEL
	RLPNRALLVNV			YmAELIERL
	SLYGGNAVVEL			ALDNVLPSAQL
	YLSSVITTI			GIIDAFHQI
	ALFGIPMAL			IIIPEIQKV
	LLPDEIADV			ILMGVLKEV
	FMATIAEGL			LADGIFETL
	SLQEEIAFL			MLPVRLATA
	SLYHVESTV			QVDHVFREV
	TLLESIRQA			SLDTQYSKV
	EAVPYLEFI			GLIEILKKV
	NLFSREFRA			LLDSCTKLL
	SLLASLHTL			LLPGFLQAV
	FIMEGPLTRI			SINPDKHFTV
	ILNEIVNFV			SVVGIPVFRV
	WLLQKNPQL			FLDLIPQDTL
	YLDASLITV			FLDNSLDTV
	YLDFRNNSL			ILPKPLTKV
	YQLEEIQRV			NLLDLLTEV
	AILPTSIFL			NLPPDLVNV
	AVANIVNSV			RLFDDSTVTTV
	LLSGFVPLL			VLPAEFFEV
	LLYDFQLINV			LLPEYLPYA
	SLMKDFPGA			SQPPVQVSV
	LLDEPTNHLDL			ALDKVIEIV
	NLQVTQPTV			ILADKSSFISV
	VIFDLPTTV			ITPENLPQIL
	KIAPNTPQL			LLDmSLVKL
	LLLPGLETV			FVDDVTIEDL
	KLFSTETSLQV			qLDPLVVEL
	SILEHQIQV			RIKELPELWL
	ALPEVLAVIQV			TFFPALQGAQTK

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	FLLIQLSCYF			AVPDEILIEAV
	RLGEAEGLMKV			FLDGIYKTI
	VLDDKLYVV			NVDAVISKI
	VLLPQETAEIHL			YLSELSEHV
	YLVNDIYEL			GLMRKVPRV
	LIFDLGGGTFDV			IIPDKVWAV
	NMLNLAVHL			IQVWHEEHR
	VLTSVTEAL			SLYHVESTV
	IVVDNVPQV			YLDKMNNNI
	AIFSAIIFL			FVnsYTPIF
	ALGFVYKL			IIDGINIAKIGL
	ALAWLDVTL			KLDSPRVTV
	FLSEVFAQL			LVDEIMmTL
	NLPAPHIMPGV			NMDFVFDRM
	LFNENPYP			SVVEQAWKL
	LFKNAERML			VLPWVLLTL
	ALVQITLPTV			SAPAVLLYV
	VLFLGELYL			FLEENISEV
	YLTSQLPPL			ILDEPTNNL
	FLDMTNWNL			ILWQLTGSAA
	KLLEIPDPDKNWATL			YIPDFLTLL
	FLPASLRSV			ALDQFLEGI
	KLYEAVPQL			FLDGNEmTL
	SVAPFALPTV			FLDHPEIYRS
	ALLEPEFILKA			IIEENIPELL
	AIIEYMPLL			RLDNGQVGL
	ELSDVLIYL			RVVDLITNL
	FLIPAVELI			YGDEIAIEL
	VWRHGSYGSAD			FLPVGFVTL
	FLSPFNMIL			GLDPVGRIQM
	FLAEDALNTV			LGLPPTSPA
	GLLQQPSALML			SLQETIQSL
	LLSSVTAEL			ALDILITNV
	LLYYQTNYL			ALPGGAAVAAV
	VLISVLQAI			SLDEAYLNI
	FLSEKLERI			VLDIMPLTL
	SLSFLVPSL			YLVVKIEKV
	FLADVDKLKL			AIDEISQQL
	YLGPVSPSL			GVDDLDFFI
	ALMDLDVKKMPL			SVPGKDAIYSL
	LLADLLHNV			VILDPVHSV
	AVLPFSPAL			YIDRIIVAI

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	GLAEFQENV			TLDPVEKAL
	TVLGKIWKL			TLSDLRVYL
	ALMDFAYTA			AMDLIISTL
	TLLHAGGLARA			ILNTIYEKV
	VLEGKELEFYL			KmPEINAKV
	YLLEQTPEQQA			LTDNVMITV
	GLTSAIQAV			SLDDVMDYL
	VLFDVSIMAV			SVDETTQAM
	ALDVQGIYRV			TIPDFIFANV
	LLNPVVEFV			TVPPPPAAA
	NIMDIKIGL			FAIPMIHAV
	KLFGETTLV			QTPQRLLEV
	YLFGRNPDL			ALLELLHEL
	FTWEGLYNV			KLDTAYDDL
	SLAVSSPRL			TLPSTVAVTSV
	ALTSLLKTV			ILPDDPRQM
	FLYSLLMKL			TAGREADDIVNW
	GLPELVIQL			ALQEMVHQV
	RIADLSYTV			SLPEELPLL
	SLAPIIVYI			TLADVLYHV
	TLYSGLDEV			TLPASLPPVNMY
	YLIQSVPAEL			FLLDKKIGV
	ALLDGRLQVV			FVDPAQITm
	ALSEMVEYI			IVDNVNQAL
	FLIDNGVSL			KIYEGAYHV
	LPAIVHI			MIDPPRAAV
	TILKRLFRV			RVDEEPTTL
	NLDPAVHEV			SLPALLFKA
	SIIDWLNSV			TmPDGQQVLTV
	YLEPKLTQV			VVDPVTSEHEL
	ALLDLDSLKKKLFL			YVDEVmTRL
	TLMAEMHVV			QISPFFPLV
	FLDGYVSQL			SIDDLPTVL
	GLMDEKLLHNVL			SmPPVYPSV
	KILPDLNTV			YLPSFFTKL
	NLIANVLYL			LLDTVNNVF
	ALYASRLYL			QIEDRIFEV
	FLLFINHRL			TTEGIPVLIV
	KLFSILSTV			ILPQDLERA
	NLMELLIMI			LIDEGHAATQL
	SQLDISDPYKV			LLDGSNVVF
	TLNDGVVVQV			NVDGLLVQL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	ALAHNLLVK			QLPEKVEYV
	FAMEIDPSL			RLPELARV
	GLLRIIPYL			VLMEIIAKV
	HLLSGQLPTI			LLDSITVPVAR
	ILQEREYRL			LLPHPGLKV
	SLFSAVHKI			MMDRIVTGL
	SLMWTLLK			SLDSLGDVFL
	SLYHIYVAL			YRSGGGFSSGSAG
	VILDPVHSV			YVDKFYRSL
	ILASIFETV			ALDPAAQAFLL
	IMEDIILTL			ILVDWLVQV
	SLFGSPPTSV			KMDYPEMGL
	YMFEAREFL			NLPTILVEI
	FLQEYVANL			VMPEAVPEV
	FVIAELVNV			LMDNPTLYL
	VLMGQLYVV			QVDSLIMQI
	IVWNGPVGV			SLHEFLVNL
	LLLAATPGL			VLDGLEFKV
	YIAGFFLTV			YLVPELDGV
	KILSGVIRSV			ALDYLQVSL
	KLLDLKKQLAV			FAPPQPVAA
	RLSDAQIYV			FMDKYYLEF
	KLLSSEDIEGmRL			ILPPPVHV
	GLVGSLQEV			KVVIFLPQV
	KLYEIGAGTSEV			LLPELLSAL
	FVQSFDRSLSCHAGYVA			MVPEDVPRL
	WPEVLLLLT			QMDIIVSEV
	LLLDVTPLSL			YQVGQLYSV
	QLVQRVASV			FLPTILNQL
	YLSELSEHVKL			GAPDFLAHV
	NLANVVLLL			NLDKAFEKL
	YLNDLHEVL			SLDNLKASV
	LIWPLLSTV			VELVDESLFD
	GLLGNVAEV			YLLDQHILI
	LLLSAEPVPA			ALPGVGPKM
	LLPTGVFQV			KMPRLIAKV
	SMLDDLRNV			ALDENMDLL
	QLPNFAFSV			ALPQFFNnV
	SLDEGIEQV			FLDDGVDEQV
	KVLDLRINL			IQDEEFYTL
	QILEAIPQV			PYLGPALLL
	SLIDADPYL			TLFNVIKSV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
	SLIGNLHLA			KIFSGVFVKV
	KLLEGEESRISL			MAPTLLPEL
	SLLPPTALVGL			SIISNLITV
	ILNTLNITV			FLNDEVWNL
	SLYPSAPFL			RAPEFLPEV
	VLQEKIEVV			VLDFPSSATGL
	LLPAIVHI			ILPDTYQHL
	LLYYGVVTL			KLPmSIIIVGV
	YLLPSVVLL			KLWDPFSLEE
	APGNLSLPIP			QLVPALAKV
	LLPPVTLAA			SLPDISAEI
	AQILELPYA			ALDNDNYNL
	KLLDLMPRL			FLENEHQQL
	ALYGKLLKL			LLPDIISRL
	FQTDLIYNL			LVSDLLSEL
	KLVEFDFLGA			mLIGEIFEL
	TMLSLEFHL			SIPGFVERL
	YVINDLTAV			ALEAVVISV
	SLMEKVRNMAL			AVDDIMVTL
	RIAGIRGIQGV			KLDAFIEAL
	TLPTKETIEQEKRSEIS			NIDLVVKEL
	VTEMLRAALLKVL			AVDNLVERL
	KMLEIDPQKV			IVDSFDDMNL
	SLISIKRLTL			MLPGILSQL
	YLQQVNHKL			ALDDVTLPRL
	KLITKAEKIRL			ALDSGFNSV
	WVSLYCVLSK			FIDDVVSAV
	AGGHKVGLALELEA			LLNPAYDVYL
	IRKLPFQRL			NLPAATFQV
	YKNGYSANHQVIQWF			VMDSKIVQV
	PPYFPRFGQKITV			ALPSVLLEL
	GLKHDIARV			GHGLGDALSEGVG
	LLNKSIIRV			IIIDSVPEV
	SLFAQRLKTL			TMPSDVLEV
	TRDGFDLDLTYV			YLLHIFMEA
	KLLDMVGKVQI			LGHGYHTLEDQALYNR
	ILLNIEHRIML			LLPDQIEKL
	LEGLLPRLLSL			RSGGGFSSGSAG
	LLFDEYHKL			SLPNTTPTI
	YLAHLAHHL			SmDHIQAEL
	YTPSELEGNAVVSYSRPT			FLDAPAVRV
	KELLACSHPFSKSATE			NILEDLETLRL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				QmPETTETVL
				RLVSLITLL
				SLDSDPWVL
				GLDLISVRL
				GLKEGIPAL
				LLDmSYEQL
				SVDDTIVAL
				ALPQEFAAL
				KVLEPSETLVV
				FVDNPVGTGF
				ILGPKPQGV
				KLFSILSTV
				LTPPPATHL
				VADAIRTSL
				AMDPIAELL
				FLDGYVSQL
				FLPEAPAELL
				KIDGVEDmL
				LLPDTNVLL
				LMDEVIKSm
				mIDPDIYLL
				TVNPQDPSYV
				VAPDGHIFLEA
				KVDSPtVTTTL
				TLISRLPAV
				YMPPSTVLQQI
				FLVDImEHL
				HVIEKMHHV
				IMDATNILV
				RLPDGWSQV
				RLPPTPLLL
				SVDELFQKV
				AIYHVIMSV
				GLDNETHFL
				LLDVVHPAA
				TLDEVTVTI
				LIDKTTAAF
				LLDsPGKVLL
				LLPEDFLML
				LMDSNLPRL
				RIDGVLIRm
				SGGGGGGGLGSGGSIR

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				VLDSEYLVTL
				YLFEPVAKA
				ALDDFSISVL
				KVLELQTEL
				SVNGVFKEV
				TLQEKIHRL
				LLDMSYEQL
				LLPIYAVTV
				RVAPEEHPVLL
				VLDPKPPPL
				YIPSYFDFV
				LLLAATPGL
				LMDESVLKF
				VSPPKFVFV
				MLIGEIFEL
				SLPSVAVGV
				SVEEVLKTV
				KISELTTEV
				mMDTVISLL
				SVPPPLTSV
				VQPEATQVPLV
				VQPIKLARV
				ILIRPLVSV
				YTPPAGAKV
				ILDEQGRTV
				YLDEDTIYH
				YLQEIQTQL
				AVVAPTSTV
				AGDPVILYV
				LLPQQSYSL
				LLPPVFNI
				QLRDFYFSV
				TIDIQHPPL
				AmDLIISTL
				ILPYDFSRV
				SVDEVLEmL
				SLDEAYRFV
				VLDDPKSAGV
				ALPDTDVLYMT
				LLPKEIVKV
				RIPAIFSPA
				SGPGVVLYL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				FLSMYLCMHI
				NVPDSFNEV
				FIDDLPQEI
				FLPDQDQRSQL
				KLDEILKEI
				LIDDLQHCL
				LLPDNVHYV
				AVDYFFVEL
				KLPDVYGVF
				VVDSSNTAL
				VVPAALKVV
				LFLHAGIVLP
				MVDGTLLLL
				SLVEIILHV
				FVDKYSISL
				LLDANFTVV
				MmDRIVTGL
				YLQPFLAKL
				EVDDILAAV
				LAPEIVIKV
				NLPEETNEL
				SLDSVHLQM
				TLSDIFLLF
				YENEVALR
				FAPVNVTTEV
				ALEVLVKGV
				GIYYIPVL
				KILEDVVGV
				LAPGQPRSLDSSKHRL
				LVELALPQL
				NVDSLITRL
				VLDELGLSL
				ALPTLIPSV
				GVIATIAFL
				IIDEDGLLNL
				LLHELLTHV
				YLDHFSRAL
				YLPQLIPHM
				AMPQTVYGV
				SLPPLLAAA
				IADNVFLFL
				VLPSPGPAL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				YVDDVISRIDR
				SMPSFTARL
				TLPEPVGTQV
				FIDTAQHML
				QIDGLISQL
				TVDELMMRL
				FINELITEL
				FQVDEIYTV
				LLPHPGLQV
				ALVHLKVAAL
				FLDQVTGFL
				LLWDYVYQL
				QVDSINALL
				SVDGVIKEV
				VLDGTIEYm
				KVPAEEVLVAV
				LLPGVIKTV
				NIPAFLPNVL
				NLDDIYHFm
				QLDGDPKEV
				LVDDSVNNV
				FLPLIHVYL
				ISFDEFIK
				LIPEVFTYF
				SIPPPPPPA
				SLDGRPPSL
				VLDGLLYVV
				AIDEISLFL
				MVAPAVASV
				QLDEVRQAM
				FLDDNQIIT
				YMDAPKAAL
				AIAPIIAAV
				GLDNINVFL
				GLPTSVPQI
				VLPSIVNEV
				ILPDEDPEL
				LLQQRLEEL
				SVNPYIVKL
				TLDAGNIKL
				YMPPTSEAA
				FmLSISPRL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				IDEPLEGSEDR
				LFVATGSSEVLV
				LVPDVVNEV
				YLEAIHNFV
				ALDATHQQL
				ALDNVDARM
				FLDPPHmL
				FVPPPLDQEEM
				HLDSmNVSL
				QLDSAVKNL
				SLDKDIVAL
				VADWVYNEL
				ILSQYITFV
				TVPKPDVVVQV
				YLPGGTTGL
				KLSDLQTQL
				LLPAASELAHV
				NLPNTNSILGV
				YLPDAVKGL
				ILDESGKKFAM
				HMMPDLPNV
				KmPQSMPEYAL
				NMYGKVVTV
				YLRGGAITEV
				LmPMPSLGF
				MIIENFEAL
				MMDTVISLL
				SLSDTVEKL
				SVPATVPSI
				VLIETLVTL
				ILVGLLHMV
				KMMDVTVTI
				NLPEETNEM
				NLPELKTAV
				NVPYPLPKI
				SLQEFLAAL
				WLPNHVVFL
				YMNHImVSV
				ILDGISNIKL
				TLDTIYPVL
				VLDEGSASV
				YLMEVTHDL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				NLPAPHIMPGVGL
				SLPEFQQFL
				SVDGQLELL
				LLDPASHKL
				LLDTVTMQV
				PASGTIFIDEV
				TLDMPDEEFRF
				YVDAGTPmYL
				GLDPARVNV
				SVLEALSGV
				VLDImPLTL
				VMDKLFDEL
				AQYEEIAQRSKE
				IMPPHSITQTV
				KAEGVLLDYL
				MLPLLLTAV
				SVPDVTHHL
				VLDDLLYAV
				YLLPSVVLL
				YVDAAYKPGM
				FIPYLVVKV
				FLDNSFEKV
				VLPLAFTRL
				YLDVAEAFL
				YVDAVGQFL
				FLDHVMFtI
				KLISSYYNV
				QLDELmAHL
				ALPNGVPKA
				RVDDVYSVL
				SFYEHIITV
				ALIQQATTV
				RSGGGGGGGLGSGGSIRSS
				YDNEFGYSNR
				ALPPAYGPPAHL
				ALPPDVTTQSV
				GIPTVFVAV
				IIDDTIFNL
				SLQEEIAFL
				SYVWDPLLI
				TVVAVGSGSKGKGGEIQPVS
				VmDKQYEIL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				FIPDQPFRV
				FVDGLNFSL
				ILDSQTVVL
				LIPEYLNFI
				YLQEVIDVL
				FLDEDDMSL
				LLPPVTLAA
				LVDNNFQHSV
				ALDTVWREL
				FLMNEVIKL
				ILDSVISAL
				LVDENQFTL
				KmFEFYERV
				YLPGLFYRV
				FMDDTSRSIIR
				SVISVVSYL
				ILnNNLNTL
				KLDPYVQRL
				RLPGPLGTV
				SSGSVGESSSKGP
				ALWEALLNT
				KIPDSYQL
				TVFSHAQTVVL
				YLDEAGRGHSF
				AIDEALAAL
				GLPSFLTEV
				LLYPFSWAH
				ALPPVLTTV
				SLLEHLSHV
				VLDAMFERI
				VVDFVAATL
				FIIENTDLAV
				LIDNHQVTV
				LIPPPLAPI
				MmDTVISLL
				qLDGVRTGL
				SLDAVmPHL
				YMIPSIRNGIL
				HLPPPPKLL
				ILDSVGIEADDDRLNK
				LLGEVLTQL
				TVLPFVSTV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				HLDEDQQEL
				SLDDVEGMSV
				LLFDPLGGV
				RSDDIYNQV
				SmPLSFPSL
				TMPDLYHLL
				VQPFFDNIFV
				APGNLSLPIP
				FLKDKFVEI
				FmDDVGQTLL
				ILGMWIPEV
				YLHWLLTNI
				LLPLPFEEL
				RVDnITDQF
				RLDDVSNDV
				AVPPIWSV
				LLMEHIFKL
				MLPEKLRPL
				RMDPVNNINV
				SLWEAPRGQNM
				VMPGEGDLPQME
				AVDVEGLYTL
				IAPPGTPAV
				LLDSPGKVL
				RLPPLLSPL
				KLPGLLMTI
				LLPLLLPALA
				LLPTAPTTV
				NIDDVVRFLDS
				FLWRTVLVV
				VLDDVGHGV
				ALDDPTPDYM
				LLDEAQVTL
				SVDDVLSHF
				VLPELDDLTV
				YLPERQKYEML
				SmPSDQYEL
				TLPPALAAL
				YIDSSINNV
				AVVPGLLEV
				IIPASIPGSEV
				NLHEVYETA

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				RLDLIYPMV
				SSRAGLQFPVGRVH
				QLPNKAVEV
				AmPDSPAEV
				IIDEKGPVM
				LVDHAYETYF
				LVYEAIImV
				MMPLKVWEL
				SLPGNFFYL
				VLDNIPKLL
				YLPVGSHNL
				ESGPSIVH
				ILPGLSVMGV
				LLPPIVKL
				ALPENVILV
				AMFENFVSV
				LLDTADVAL
				VMPGQVMRV
				ILPEEITNL
				KLPKPLEKV
				VLMEMSYRL
				FLDLLKDAGL
				KLLEYIEEI
				SVPDPELIDLI
				YLPDCPEGNKV
				ILDDSFIEGV
				LIDEMVNTI
				FLDFLTRPEL
				IIDQHTFEVL
				LLPDNFIAA
				SVDGIPARL
				YLYKYLWRL
				LLLEMALSV
				VVPDTDVLPSF
				IAPPTGFTV
				NLPDEIYHV
				PLWESGPTV
				SMPEQAHKV
				TIDEGYVYGL
				YMPTEMELIEI
				FTDEEVDELYR
				ITPEPFHHV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				NLPEETNEMML
				QAPGVITGV
				QEAIQDLWQWRKSL
				SVDSVSNNL
				LVPPTPAEI
				ALEELTKAL
				FLPQEEPVV
				MVDELFAEI
				FVDPAQITMKV
				QLNEKVAQL
				ALPVSLPQI
				FLYNPLTRV
				IVDEVNGLISM
				LVDDYTFNV
				QIDDVTIKI
				ILDVNPQAL
				QVDKVNFHMF
				RLPEQPVDV
				VMPGNIVFV
				VVDEKISAM
				FLNKEITSV
				MLNEHDFEV
				SVPMPLPTV
				AIDEKYDVAI
				NVDTVLMEL
				TLVLTLPTV
				VLDGKIVAL
				FLDDAFRKNL
				GIPDALPTV
				QIDNLATEL
				TVDPYFHDRV
				ALPKAGKFGPA
				RIWDPVLSV
				TLPPESTQV
				YLTHDSPSV
				MLDEMKDNLLL
				SRSGGGGGGGLGSGGSIRSS
				ALPHAILRL
				LIDEPSAYL
				SMPTSGALDRV
				FLDYTTDNM
				LFSAFKAL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				PPTDLKF
				VIDDLVYSIID
				VLDLTYNNL
				VLDGTIEYM
				FLDDLFVFM
				NVDEAVLHF
				PEYVNLPINGNGKQ
				QVDDIRSFL
				GVPQALFGV
				QVPEPPPKV
				TMPTSLPNL
				VMPGEGDLPQM
				SIHDVTFQV
				YVINVTTHL
				MLAEKLPNL
				WPEVLLLLT
				YVLPVVSYI
				IVDEPTFKV
				LMEHIHKL
				VAPGKGILAA
				VLDEADEMLSRGF
				AIDDIYFQA
				LMPRPLPYHL
				WIDDTSAFV
				ALLNILSEV
				IVVDNVPQV
				LSRSGGGGGGGLGSGGSIRSSY
				MLFENMGAYTV
				MTDEIFHDV
				QLSPVLLYL
				LAPNIISQL
				FLHEESILERV
				SEPFWEDDL
				FHASTLHRL
				LVFEGIMEV
				QLDGIHVTI
				SGGGFGGGGFGGGRFGG
				TLPGHIQAV
				VLPAGALHQV
				ATPHPFPAV
				SMPLSFPSL
				DYFEQYGK

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				QVDEVVDIM
				AVPAVLPSF
				KIFNPVLNV
				TIDDIAQSL
				YIIDVSQSV
				ILDETVNSV
				LQNDLYITV
				SLNEYQPKL
				VLDNLLAFV
				VLPSNTPNV
				YVPVHFDASV
				FLPDANSSVLL
				KLLDLQVRV
				NIDETYGVNV
				VLDEADVMI
				YLFTSPQRV
				FIDGNVESL
				LLDEQFAVL
				LMDWIEAQI
				MVVDIVQEL
				SLPEIVPPM
				TVVAVGSGSKGKGGEIQPV
				VLDTGASIHL
				VMPSSFFLL
				FLYSGGHRV
				GVIELYVKL
				ILPNIEAVSNV
				SVPDTLPTA
				YVDSIQRKL
				ILDDIIASV
				IVDELKQEV
				ILDSVASVV
				KMPEVITIHL
				LLPDLAAKA
				KLDDNSIQLF
				RVDAVASKV
				YLYVRAHGV
				YVTEELPQL
				ALDVPNTML
				AVDDVPFSI
				IISNPRDIQM
				LLIAPMPTA

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				SLEDFLCDFG
				GLPLRPFPAA
				TVNPIIYAL
				GLDISSPGM
				LIPPPGEQL
				RLPNRALLVNV
				VLDAITQEL
				ILDNVQVVL
				VIFDLPTTV
				ALPGPPAQL
				NVDAIVVSV
				VQPSVIILL
				KMDPVAYRV
				LITAILVKV
				RIPIAVSGV
				ALPPDIGTLGSL
				TAPPNAYTV
				ALPHNTHRV
				FLENETWEL
				QGTAAIWPSL
				QIDSIVELV
				KLDDDMNLL
				KMYAVDTRV
				QVPEKLDVV
				SVDSVLTAL
				HIFLNNYQL
				TMDALLARL
				VmDKLSSIRL
				LLDEVALEGL
				VVPQLFITV
				QLDLVVKYL
				TLSDVVVGL
				REYSFEYV
				VLMENIVYL
				VVFPTITLV
				IVDRPVTLV
				FLSTINVGL
				KILEIRDL
				ALYTVIETV
				LLDTSSVLV
				QLPEGASAV
				IIDNSQGFYV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				LIDEGSHMV
				FLPDGMEARL
				ILPEELQAWV
				LMSSDVFPLL
				YLPPATQVV
				AMPHSIMRV
				IQDDAVHTL
				IMDDLTEVL
				ALDELENLI
				FIPPDGEFEL
				NIIPYITNV
				SLDAKEIYL
				QMPSFLQSV
				VFRTDLITA
				LLMEHIQEI
				FLPPEVNQL
				LLPEPLVSI
				FLNDPGHLL
				LIMELINNV
				PIEHGIITNWD
				LLDSVEVGL
				LLPSPTPGL
				YMDNDYAKL
				ALATLIHQV
				FQDIIWVKL
				HLPDMHSEL
				IILPEMVGSMV
				QLDPLPTTL
				FVDYVAVEQL
				GQNMDVIMVIGGV
				NLPSPSPTV
				SGGTTMYPGIADRM
				NMVAKVDEV
				QLAELLPSV
				NMPVSFEVI
				SLVEQLTMV
				LLPPPPQML
				ALWGFFPVL
				FLPNPVAV
				QMPETTETVL
				SLQDEIQRV
				MQPWALPTV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				RIIEAAHQV
				KLLEPVPVSV
				MDEGRKQLAASAGFRRL
				VADQIPILG
				VRAVLHLLLSVP
				YIGPVLVSV
				AVVPPVNGV
				IVDPVDSTL
				FLLHIQQQV
				QAPGVLPSA
				FLPDHPIVL
				KSPLNFSTV
				LIPDIATEL
				EMPSVFQNV
				VIDPPAVNL
				YLNDLHEVL
				AVDALIDSM
				AVPELPGPSV
				FMDGIQISL
				KVTTSASKKGKQLVLDPVV
				ILPEQGLQV
				SLPDSGVVEYL
				SQPEKVYTL
				KIVQFIVTL
				AMDVVYALK
				IIDEQPLIF
				KLPNWQMEV
				FINPPIGTV
				YVDGSTLQL
				NMPPVPHGM
				FADGVILLLL
				GLPSNISSV
				KVNSVYVLV
				NLPEELRKV
				YVPDVTGRYTI
				ALPTASPGL
				ALPTIAFAFV
				AVPATLPEL
				KLLEAISSL
				ILDEEKFNV
				KVDDARALL
				VLYSVMTLV

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				LLVTWKQV
				PYFIKLMGF
				SVVPQLTGGSV
				PLGYEIQL
				VVDGNFEEV
				ALMADMVYV
				ATDNIILTV
				QEVAVKEQLT
				VVDDSNEHML
				YLPDTLSPADQL
				ILDALHQAL
				LLDEQTSLL
				MLPSILNQL
				SVPESTVLKKV
				VVDDLLDQI
				KVPDVLPVL
				VLDDVPVQGF
				YVPATKVFL
				ALGNTGHEIGR
				FLDNLTEEL
				QVDPDTHLL
				ALDDEFITV
				SVDEVYEFI
				QVPSSFESV
				TLPPFPTRL
				KKPAASPHAGR
				KVDELTTEI
				LLDPEDISV
				NVVDVFHAV
				LAWDPPQELQAD
				LVDIVDPKQV
				VKLPDYN
				AAPGGLIGV
				AIYDFTDTV
				ALPKELPLI
				PKRIITYNEAMDSPDQ
				SADTLWGIQK
				SIYYITGESK
				SLSELQISYV
				TLDQINQEL
				ATMFRATL
				ALPESGSSLAL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				FLDSSGHLNL
				GLKLETELL
				LGFQVDPAL
				LLDDSLVSIF
				LGPEVFQAYDP
				FFDDPIPK
				ILDAAGANL
				LLQNHLGND
				ALDDIIYRA
				ALDEPLARRF
				KLPVPLESV
				WVLEPQEGV
				ILDDDTIITTL
				FIDETSDIENL
				YLPEELAAL
				KIDAFHYIQL
				QLDDSILNI
				FIEDYLKRV
				FVDGSAIQV
				IVPHLVPLL
				LLEESIANL
				LmEHIHKL
				ELPDYYLTI
				RLPDQFSKL
				GVDNIFILV
				SLPDPVLGA
				IYVDDGLISLQVK
				AAPPAFPEV
				FIGEDENVHS
				LVDTNFINF
				SDVVVGLESFI
				LLPEEPVSQL
				IQQPSGPGEVKLPSGP
				RLPPEYASTV
				FIGHALQWTI
				LLPELTNPDEL
				FLPPEPTYTV
				SLDIPATYL
				TLLSLQPQI
				ALPPKPRFL
				GLPDAPRNLQL
				GVDEKGPQL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				MVDIPPPFD
				QLDDLYLIAI
				SLDLVAAAL
				VLVAELVGV
				FLPEFAGTQL
				KLDDYQERM
				NLDELSMGL
				TGMDSGGSLTISL
				FLPFLTTEV
				FVDEGKATVRL
				RLPESVERL
				TMDDLTTAL
				GIDRIISQV
				SLPLEKVLPPA
				ILDDPGKKV
				QLDSVMDWL
				FLDDPQAV
				VIPTNVPEL
				YVLDLAAKV
				ALANQIPTV
				MIDPDIYLL
				KLPENQAIQM
				KLWDPFSL
				AIEDLVKFV
				SLPELSASAEL
				SMPDVDLHV
				ILDEATSAL
				ILPQESPAL
				KVDPVYETLRF
				LILNDFPSV
				TLPVDFVTA
				TPVQTVTIVQ
				YLGRLAHEV
				SLSSFLHGV
				FVPEKNFRV
				MMPAVFHTV
				SVPIEIPTI
				GLDGPPPTV
				KAAKPKKAPKS
				VLPGVDALSNI
				LMPQVLTTL
				LEEDVKIYL

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				VMPHANMNV
				FIDTLHHTL
				FLDAVHQNRL
				ILLEAGAFVNV
				MVPAQRGASP
				NIYAVKTAV
				VLPPPPTTL
				VMPAGVDKI
				VVDTFDIRI
				YLPPSVASI
				YPDMVNRDTKMA
				HNPHVNPLPTGY
				KSPPDQPVKH
				KVVPVSDPP
				MLDEPTNHL
				ALPGVAVSM
				VIHATVTSV
				VMDNLLIQV
				LAPPPPPGL
				VLPDSVEIGL
				VVPDKISEV
				ALFGALFLA
				KKAPTMPKPQ
				SLDDVGEKL
				GLVRPPPGL
				KVLPQELV
				VVDPETDEQL
				YLPDSIVEL
				ALDEAAAALTRM
				KLLAVIHEL
				FMMPQSLGV
				SIQTLAPAGGTLL
				SVDPLPAGL
				VIDEADRIL
				VTEGFIKDV
				SLDGLAVVNV
				AIIDKYIKL
				LDNICPVNI
				QIDKVFNNI
				YVPFGANQLN
				LVQDILLNV
				NLQIDPSIQ

HLA-A Alleles				
A01:01	**A02:01**	**A02:03**	**A02:04**	**A02:07**
				SLDNGGYYI
				KVVDLDPCLS
				TEADVYITF
				ALNENINQV
				IQDDMHLVI
				MLDSTFSIL
				VLDSVDVRL
				KLVNILVQL
				TLMDILPRI
				YMPQNPHII
				ERVETLRF
				FLYKEKLVSV
				KIWESFPHQAL
				TAHLTFVIDCT
				NLPPHIIRL
				DPRLSANLHL
				SLPKKLALL
				KVKAYLSLHPQVL
				MLFDKFRSV
				EMQVLVSRI
				VHSLLSRLMSI
				IMLSEKHLISV
				NLPILKRAV
				FLTAVAHRL
				RLWEKLTLL

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
KTVTAMDVVYALK	AYVHmVTHF	DATNVGDEGGFAPNILENK	HLEINPDHPIVETLR	HRHPDEAAFFDTASTGK
qIYAIRQSISK	IYDTSTDRLLW	LLHDRSFSY	HSQAVEELAEQLEQTKR	ADSGEGDFLAEGGGVR
KTYGVSFFLVK	KYLDVKFEYL	AAEDDEDDDVDTK	RMLLAHVDLIEK	SSGPYGGGGQYFAKPR
KTVTAmDVVYALK	KFIDTTSKF	IAAEGIHTGQFVY	ATLTSKLYSLLFR	SSSKGSLGGGFSSGGFSGGS
RLYHELVGLAK	GYLPNQLFRTF	FFPASADRTVIDY	SYELPDGQVITIGNER	HGYIGEFEIIDDHR
KLLEPVLLLGK	KYFLWEEKF	FYDPDVGNFHY	IFVGGIKEDTEEHHLR	AVSEGTKAVTKYTSSK
RVYSPPEWIRY	TYARNLPAF	KYFDEHYEY	KHLEINPDHPIVETLR	PGDSDIIRSMPEQTGEK
SLYDQAEKLVSK	KYFLWVVKF	VYLRTLAPGLF	RAAEDDEDDDVDTKK	DSGEGDFLAEGGGVR
SLYSPESIQAIAK	VYSEAARVLQF	FIAAEGIHTGQFVY	RQAELAQWQKVLPR	GAVHDVKDVLDS
HVLEAQDLIAK	PYLFHVVTF	GYLHDFLKY	RTMPLLSLHSR	SGGGGGGGLGSGGSIR
ALYFPKNGDPSGLAK	AYPPAPFMHIL	YFIDSTNLKTHF	KEDLVFIFWAPESAPLK	TVFPKEPVEL
KLISEEDLLRK	AFLEINRQLLF	SFIDVDDERWHY	RIFDFDDDGTLNR	SSHHPGIAEFPSR
TSPFPSVASSAPPLTGK	RYVLYPNNFQF	SYELPDGQVITIGNER	RVKEPVKELLR	SLAELGGHLDQQVEEFR
GSLLDSCTKLLQK	KYTKIFNDF	HVIDVKFLY	ISLPGPLVTNLLR	PPAENSSAPEAEQGGAE

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
KLFQSDTNAMLGK	SYLERHGLINF	TFMDHVLRY	KWQDLSEKVVYR	SGGYGGLGGFGGGSFRGSYGSS
TIISEQQAKSLLK	IYDPNLAFLRF	mLLPEKLISKY	qVLEALNVLVNR	AEQNRKDAEAWFNEK
RLAEWKATKL	YFIDSTNLKTHF	LTHSLVLHY	KTIEDDLVSALVR	SYELPDGQVITIGNER
KLLNYAPLEK	RYQQWMERF	FYLFDLKAFF	SVVSWKTGVFR	FTKDVTVIEGEVATI
RVFSGLVSTGLK	VYIESRIGTSTSF	GFGFVTFDDHDPVDK	ATmVPSVLWPR	HRHPDEAAFFDTA
RVQEAVESMVK	LPKLYVKL	VAFTPDGNHFLY	TLHPDLGTDKDKEQWK	PPQYPVVPVHLDRII
KILDVMLKGLFK	KYQEVTNNLEF	FYEVFKVLY	RYSALFLGVAYGATR	DTFVHIWKL
RAFHPDLEFVGK	VYLDKFIRL	VAYWRQAGLSY	KHLEINPDHSIIETLR	FVNDIFERIAGE
SLWDRLIFH	KYITDWQNVF	AYWRQAGLSY	LEKPAKYDDIKK	KVEEAEPEEFVVEK
RVAPAHGLFLK	AYPDLNEIYRSF	NYLHDFLKY	APGTPHSHTKPYVR	ADSGEGDFLAEGGGVRGPR
RVINEPTAAALAY	RYLNSQQQYF	KIYPLPHMY	SVTPEGVIKQR	SSGSPYGGGYGSGGGSGGYGSR
RSFPWQSLEAK	VYQLRFQFL	IALEPEQILRY	LVFPSEIVGKRIR	KEDLYLKPIQR
RTLTIVDTGIGMTK	AYVHMVTHF	AFFDPSLLHLLY	RVYSPPEWISR	KVPQVSTPTLVEVSR
KVLDTIMATKL	AYDTVRWEF	HYFSDPFLKY	AVVPGTLLLFR	HSTFFPALQGAQTK
VLYDRVLKY	RYFKTPRKF	TFmDHVLRY	SVYSWDIVVQR	EVIHGIFKAYI
HLLETPLVVK	VYISEHEHF	NFVRLLmLY	SLLKKNWQNVR	KVSFLSALEEYTKKL
RVYYVSEKIMK	LYWSHPRKF	NTIPLFVQLLY	SLKGVDPKFLR	FTAPKEIAEIKA
RVYSPPEWISR	VYKAFVMETF	SFVWHALDY	APEPHVEEDDDDELDSK	GFGFVTFDDHDPVDK
VLFGKGNSPLLQK	FYVPAEPKLAF	RNFHVFLEY	HSNDIWISNIVTR	YPVEIHEYL
qVFGGGANSLFLEK	TYAELMQTLRF	KFYVHNDIFRY	SIIGGGVKAPR	SVIYVPPPFAAA
qLLGEHLTAILQK	IYDHINEGKLW	NKESKDPADETEAD	ATMVPSVLWPR	SEGTKAVTKYTSSK
RLLDSEIKIMK	AYAELIKQMW	VVINYSIVKGLKY	IDASKNEEDEGHSNSSPR	SSKGSLGGGFSSGGFSGGS
KLFDHAVSKF	GYYNGKWEFL	FYVHNDIFRY	KYLDEDTIYHL	ASGLIHRV
GLFEVGAGWIGK	KYIDKTIRVKF	FFIDPNERPVTLY	RYLAIVWPVVSR	FVNDIFERIAGEA
RLLLETHLPSK	VYMDWYEKF	SFYTPEIPGRYIY	RPAEDMEEEQAFKR	HNLLEGGQEDFESS
GLmGFIVYK	TYNDFINKELILF	GTFLEGVAKVGQY	KSLEDVVRAYLKM	HSFDPFADASKGDDLLPA
KTIEDDLVSALVR	PKLYVKL	VLFEHAVGY	HGFPTLKYFPAGPGR	FVNDIFERIAGEAS
GVADKILKK	RYFDPANGKF	YFDEEMAVKY	SIYGEKFEDENFILK	GLPGPPDVPDHAAYHPF
KLYTKHGTLKY	AYGELRAMVL	NNLDEDLIRKLAY	ILKSPGSVVFR	LSRSGGGGGGGLGSGGSIRSSY
IDHIFASK	YYLQHPPISF	IFTDVALKF	SVWPFLVQR	GGFGGGSFRGSYGSS
HLFEHILNGY	LYIGWDKHYGF	AFYNSQKFEVLY	RIFPAGSIPLTR	DNIQGITKPAIR
KVAPAPAVVK	VYmDWYEKF	HFEVPFIAFY	AGMDASFKAFR	SAGEEEDGPVLTDEQKSR
ALAIKVLNK	VLPNSDFLVHF	YFEEIKQFYY	QALPSQAFIYR	DVAPTHILYAV
RVQPGLLQWVK	SYLSHSEQLVF	VLYDRVLKY	AGGDWFTSR	HVYDGKFLARV
AILPALKQTPK	IFKPPDPDNTF	VFLSIKGIYY	ALRALEGLVYR	EVFGVTDNPRELQV
ALFPLLPKVLQK	VYTDLTPLSKF	ALLDTTEKYLY	ALWDRYMGTLR	TVKDVNQQEFV
KLISSDGHEFIVK	KYWDVPPPGF	NLFQEAEEFLY	VQYEINLLELIQR	SYFEKSKEQLTPLIK
RVFIGNLNTLVVK	KYISPETMVAL	LFKPFVESY	KIPDWFLNR	GFAFVTFDDHDTVDK
RVYFGMQDGSVNMREK	VYQHLFTRI	LLWDRILGY	RYMDAWNTVSR	ILDSVGIEADDDRLNK
AVLTKQLLH	RYLSPKYIKMF	SIFHMSDSY	LGHGYHTLEDQALYNR	VSFLSALEEYTK
KMYEEFLSK	SYFDLLGELMKF	GIADFVLKY	AVIDKETIDLLAF	GGPGGFGPGGYPGGIHEV
RLINTQAIFAK	TYSPALNKMF	mFPFFDIAHY	SVKEISDIVQR	LVSPITGEKI

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
GSYGAWYPLLK	RYVFQSENTF	SFYDANSKQLLY	RFIDTSQFILNR	HTILIVEKV
SLFSRLFGK	SYIEHIFEI	YLEQLILKY	TYFDFFNYAGLQR	ETAQAIKGMHI
GVLAWVKEK	YYLWPAVQLANF	FFRDPLPSAELY	LPVLSPPRWPR	DVAAVVVPILF
RSLSEDVRFYY	SYLEKQVVTF	GTISQPRILLY	HQAFEAELHANADR	FAIDPHLLLSV
KLLDVTGGLGTDELRLLY	HYMPPPYASL	VVLDDKDYFLF	SSGPYGGGGQYFAKPR	AVmDDFAAFVEK
ILFAVVARGTTILAK	RYLSPKYIKmF	FYPFPVPPLLY	TYLTKFIAR	DEPPQSPWDRVKD
LLAEKVLAGK	KYLTQVDILL	RVFSIVIPFLY	AILPKELQTWVR	NLNDRLASYLDKVRAL
KLFELDPLTGEWHY	VFHPSQDLVF	HFPATPLLDY	KLLASLVKR	ASGNYATVISHNPETK
AVFGPDGTLLAK	RYMPFAPAIQTF	GLLTTPQLHY	AYLAWRLAR	EFHLNESGDPSSK
HVIETLIGKK	VYVWIYDPVHF	ALFPHPHIHEY	QEYDESGPSIVHRK	FTQALDRQTATQL
KLIDFGSGALLK	IYIDSNNNPERF	AIAEIWPKY	RLIGLPEGRAR	GGSGGSYGGGGSGGGYGGGSGSR
AEWKATKL	TYIHALDNGLF	LFWDQTQQHSY	IVVPKAAIVAR	ETVSPDKDWYV
RIYDIFRSK	RYFLPPYTF	FYVPFAKALY	FPSIVGRPR	EVYTPKEIFV
KIADMGHLKY	VYGFQWRHF	YFYDPDVGNFHY	RLWDLTTGTTTR	HNPHVNPLPTGYEDE
RIKPPWVVK	KYIENLDNITF	IFIEDYLKY	KVVEDGILKLR	GSGGGSYGSGGGGGGHGSY
RIIEETLALK	IYMVHIQVTL	TVADPSVISHLF	RLLPLAPGRLR	VSEGTKAVTKYTSAK
LPALKQTPK	AYTLLLHTW	RVINEPTAAALAY	SFLPRKFPSLR	AVSEGTKAVTKYTSAK
VTYDLIKDALLK	RYSSAFTNRIFF	VAFKKTFSY	RTQLYEYLQNR	IVFGEAKIEDLSQQAQLA
KLLDIRSYLEK	RYPTSIASLAF	YQTFLQLLY	AVQEFGLARFK	FASGLIHRV
KLIDIVSSQK	IYSPLLFKYF	FFVYEVTSTKY	KLNVTEQEKIDK	KAEAGAGSATEFQFR
KVLFPLLTKL	PWLFDAPKF	FYNLIHPEY	RSLDETTLRPLAR	SVSPVVRVAVE
RLFTSEKMVK	RYPPDIRATF	YLWHIPLTY	ASIDWLAQR	DVAHSDLILHV
RIFAPNHVVAK	SYADQMFLL	GAAGVHFIY	KGLEISGTFTHR	ELAEIVFKV
RSIPAYLAETLYY	LFLPRTDYSF	KIADRFLLY	STARHLYLR	SEKAKPALEDLR
SLmHSFILK	VYAEVSRLLL	LFIDIFHEY	SVNELIYKR	HVAQFQEFL
QSFDKEWVAK	HYSFYIETF	YFIGRIYLY	RSMVQFIGR	RSGGGGGGGLGSGGSIR
ALLRVTPFILK	VFRLQFDEF	VAISEELVQKY	STFIHAEDFAR	RSGGGGGGGLGSGGSIRSS
SVASAAAVLSH	IYAAFKEVL	VALATGEKGFGY	TVFDAKRLIGR	FPANVAHSVYV
KLYSLFLKY	VVFHPSQDLVF	YFEYIEENKY	TYSPFGDSPLFR	VSFLSALEEYTKKLNTQ
RLLPGNATISK	SYMGHFDLL	HNPHVNPLPTGYEDE	RSLNPPLTIVR	LAAYHPWVV
SLAEILLKK	TYSPALNKmF	KVFDGIPPPY	EGIPALDNFLDKL	TTAELNYGLAHF
qIFVKTLTGK	KYVKIFDNF	HVFPLLLSNLGY	RVAQDWLKEAR	TSAAIYHVL
RLMNETTAVALAY	VYITGKEVFSF	GTDELRLLY	LFRPVASQLPR	EVFPDQFIHL
AIIDHIFASK	AFIEKHWTF	YLLPHILVY	RYLEVEPVSR	FVNDIFERIAGEASRL
SLYTYPQGTWQK	KYISKPENL	GIVNILLKY	LAMQEFMILPVGAANFR	MTFPGERIYEV
ILFEITAGALGK	VYGNERFIQYL	LWIDRQWQY	RVLEKLGVTVR	RHGVQELEIELQ
RLNITYPMLFK	VYLDRGTGNVSF	LTFPHPVYY	TIMPKDIQLAR	mTFDSEVELMKV
RILLDIHIFMK	IYIKHPHLF	VFNDPKVLKSYY	AVKVHSFPTLK	YARSIFGEDAL
RLYGLEPAHPLLY	RYISPDQLADL	FVNKFNVLY	RVLIGVGKLLR	DTFVHVTDL
RTINVYPNFRPTPK	KYLEHPLLL	FFHDILHTKY	LVFPSEIVGKR	EISRIFHYI
RTIHTDVLFGLLK	TYKDYVDLF	FLLDRLLQY	GFGFVTFDDHDPVDK	FTITPPTAQVV
KLPKQPVIVK	GYIERPQLI	MPVGPDAILRY	VTLEVGKVIQQGR	PTKETIEQEKRSEIS

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
LLREAESLIAK	KYLSGIAHF	YLWHIPLSY	AVMGAYVLLKR	FTAKVFAKL
QVFGGGANSLFLEK	RYQDAIRVF	STLEHGTSLKTLY	KYLGINSDGLVVGR	SRSGGGGGGGLGSGGSIR
KLDVDAPRLLK	KYIESPVLFL	KVLQKFLTY	HFNAPSHIR	TAQVIILNHPGQI
KLLDVVHPAAK	HYILHNSFF	FLNDSYLKY	VVAPPGVVVSR	NPDDITQEEYGEFYK
GLFSGDPNWFPK	KFIDPIYQVW	HNLLLNYGLY	SMIRLSEAMAR	FSYGRALQASAL
KLNPYAKTMR	SYDPLRIYLF	YFVKFLDAY	KQWGWTQGRWPK	DTVQFAEYI
VSFPIGIYK	VYSPHVLNL	YNFTLADILLY	KTRYIGEVGDIVVGR	KESYSVYVYK
RLMEFNSLINK	RWFTIQSNQLVY	AILSKFLYY	ATWAVPTVR	DTADQVIASFKV
TVAAGTMTGMLYK	IYADNQVMHF	GVISSEELPLYY	RVKGPGISKF	SPVVRVAV
SVLPNQVSVITK	FYQRFPLSF	IIHDFPQFY	RYKLLGGLAVRR	GGGSGFSGGGFGGGGFGGGRFGG
ATAAVIFLH	KYLNENQLSQL	SFAEIImGY	FHHTIGGSR	mTIAPGLFGTPLL
FRVPTANVSVVDL	HYNWLIYHL	FYYLEQLILKY	SLADELALVDVLEDK	VTFAPVNVTTEVKSV
KLIGEYGLRNK	IFLDYEAGHLSF	LYINFRHLY	STYEFGKSFFQR	FVYEQKLNEYV
AVmAESAFSFK	VYERELQTF	TFEGWPALLY	GTLQPPFTAR	TVFEHTFHV
SVFDFQKAYK	KFSPNTSQFLL	LKNSPLVSRLTLY	RTmPLLSLHSR	VVIAHDVDPIEL
KVGEVIVTK	LYIVHPTMF	LGLAVRLEY	VQKPPLNIQR	VVYALKRQGRTLYGFGG
KLAYTLLNKL	NYSDVMSKLGF	FFPVIYDVKY	RYVLPDEAARAR	STESLQANVQR
RLFVGSIPKSK	VANAIIHLF	HVLIDVGTGYY	TSWVPLVSR	KLDPGSEETQTLVR
KTLRDEINAILQK	IYLRLLVKL	NLLEKQLEY	LNFSHGTHEYHAETIK	NTFPAQDIVHTV
GLTDVILYH	TYTDRVFFL	IYSPLLFKY	RYIPPIPVHR	ILKHTGPGILSMANAGP
KIADRFLLY	YYFAQQNSGHFL	FVANLFNKY	PSIVGRPR	MTIAPGLFGTPLL
RTGKPIAVKL	IYVHDLLTF	AFLGPKDIFPY	AWKSWTALR	MPAFIFEHI
KLLDTMVDTFLQK	AYKYIQELW	VTFEKQWFY	SLLPVDIRQYL	MTFDSEVELMKV
SLYDSKIWTTK	SFHNIHNTF	SIGDIFLKY	LIYDFANFGVLR	RSGGGGGGGLGSGGSIRSSY
HTLEPLIPR	RYLEKNVKL	IYIKHPHLFKY	MYRNEFTAWYR	mVAEILHHL
GTFVSPEVFLK	AYLESFYKF	YYIRFFITY	RIMDRFNLPR	qVANVRFNV
ISLNPEQWSQLK	KYTGVLTEL	AIDQLHLEY	ASGDWFTSR	FTIDAKDAGEGLL
RVRAGDTLQGIALK	LYELHVFTF	WLPALFTDLY	RSNPKIWNV	HAVSEGTKAVTKYTSSK
GQFSQAEALLMK	AYPPAPFMHI	AFDEIVALGY	GFAFVTFDDHDSVDK	SPEYVNLPINGNGKQ
RVIEGDVVSALNK	IYGNFFPYGDASKF	MFPFFDIAHY	AQFPRFSPVLGR	HAVSEGTKAVTKYTSAK
RVLDFDVKRK	KYLAILGSVTF	SVFEKYFQF	AVVGAVVFQKR	EVFRIGNVEISQV
SLFSPAFYTAK	LYNPKITSEL	SFATLFPKY	YHTINGHNAEVR	EVMKIKAEI
AVFGVIGSQK	VYSPKSPSL	YYIFIPSKF	ATIALMIQR	TVSPYTEIHL
GIADFVLKY	VYTGIDHHW	APEPHVEEDDDDELDSK	AVLDFIEDYLKR	EVFRIGNVEI
KLAPAMKTQKL	RFAHGTAGLVF	KQSQILLVY	TTFTWNINHAR	ESFSDYPPLGRFA
KIFSGVFVK	VYVAIQAVL	HYSPIYLSF	RTFTWLVGKINR	SLVGLGGTKSISIS
GLFQGKTPLRK	KYLDEDTIYHL	LFIALITDSY	VFDAKRLIGR	EVFEDAAEIRL
ALFSRIFGK	LYADVGGKQF	SVYHPQLAY	SFFSPSPARKR	YLADIFTKL
ATLPVLYMLFK	YYNPHLLLNTL	GTVTEVLLKY	ATLKDITRRL	GGFGGRGGGFGGGS
KMQYATGPLLK	AYTLLGHEF	VILKLLLKY	RVNIPKVLR	TVADVVLWSV
VVYTSHLQLK	SYLDQVKLQF	HYSQELSLLY	KYFNSYTLTGR	ETAFIHYRL
SLLSGALAGALAK	TYMGHTGAVW	LHDFLKY	IYLPPEASSQR	VTTDIQVKV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RLYQHAVEY	AYINRASLL	FYPELKLAY	SVLWPWINR	YSQKEDKYEEEIK
ALYKKILKY	IYNGDMEKILL	KLFDKLLEY	ILRPEELGFLR	FVNDIFERIAGEASR
IVLGLPLWWK	RFEEAHFTF	KLFELDPLTGEWHY	mVVPAALKVVR	GFAFVTFDDHDSVDK
KLFDKLLEY	SYEYRFLEF	KFFFIPLSY	ILDSVGIEADDDRLNK	YEDIAQKSKAEAE
RISDVHFSVK	TYLPREILNLI	IFAIPLQIY	LQFPVGRIHR	SLGGGFGGGSRGFGGASGGGY
HLISPLIQK	PYLWWKKYI	SFEQFHLFY	QQLYWSHPR	GGPGGFGPGGYPGGIHE
RLFPGLAIK	KWNPTAGVAF	AALQRYLFY	GFAFVTFDDHDTVDK	FTAQVIILNHPGQI
KAFNQGKIFK	TYGEIFEKF	SLEHLPANLFY	KINLIIHQR	HTMSSSHLFYL
KLYRPGSVAYVSR	SYHSEWNLF	STVSRFFLY	RTMVDKLLSSR	EAFHVFKVFV
WDRLIFH	FYLLISKTF	SVFVATFLRY	ASRPPVTLR	SVSPVVRVAV
RMFAPTKTWR	VFIRGGEEF	AFDIPRFVY	IVNENLVERF	VPVHFDASV
ALVNQDILENK	AYLKAIVLF	YYLEQLILKY	AVFPSIVGR	KHPDASVNFSEFSK
AIFEVNTDLQK	TYTDVTPRQFF	GFAFVTFDDHDSVDK	GVVPAGVILER	HVADPVEAVL
KLAGHWEVALYK	IYPELQIERF	HFDSPYLLY	VYITNFHVR	EVFNYIHNI
KVADMALHY	RYSNLILNLF	KFFDVSKLGTKY	SFRYNGLIHR	EIAHIALETL
RLFAYPDTHRH	SYQRAFNEF	FFNYIEKLKY	KWYEKFFGR	QVIILnHPGQISAGYAPV
SIWDYFIAK	TYPQLEGFKF	KVADMALHY	MVVPAALKVVR	VSISEGDDKIEYR
KIGDFGLTK	VYVIEPHSMEF	FLVHESFLY	STKPPGTFLLRF	TAQVIILNHPG
RLWGDIYFNPK	IYLPYLHEW	GFYFAKLYY	HVYDGKFLAR	HTAEILDFAL
RSYSDPPLKF	RYPDNLKHLY	ILAHLTGTEF	LQFPVGRVHR	EVFEFRPELV
KVIILEEGSLLY	AYMPHTFFI	RVNDVPEEFLY	SGLSIFIYR	IVFGEAKIEDLSQQAQL
RLMNDMTAVALNY	FYAELYHII	FIDASRLVY	FDAKRLIGR	PPGQVAASPDPTT
KILDMQQTYDMWLK	IYTVKVEDLTF	KLLGLPEDYLY	GVMPSHFSR	EVLGFVAKL
GVSSIFIYH	VYNENLVHMI	MVLTIFIKY	RVYHYFQWR	YTRNTKGGDAPAAGEDA
RIFNPHLNK	KYDPSIGIYGL	FFNIPQIQY	VLNEGMPIYR	TITLEVEPSDTIENVK
SLYEMVSRVMK	TYLDLLGTWVF	SFTTVWLIY	TVLIIKSLR	SGGGFGGGGFGGGRFGG
KLKAWNDIKK	AYTPFHAVL	FFPDKPITQY	SGGSTMFRDFGR	QAWSPAQNHPIYL
RLLDMDGIIVEK	LYVMVNAKF	SVIEQILHY	SVFDFQKAYK	HVANIVEKL
RLmNETTAVALAY	PYKVTQDEL	GFYEVFKVLY	RVITALVER	VGGTSDVEVNEK
SIYFPYVLK	VYLDPLVFREF	FFNRINLIY	LQNVNITLR	ETSPHTFQLDLF
ASFDGTFLWK	IYHNPTANSF	VVIGHVDSGKSTTTGHLIY	RYREDLDFVLR	YALKRQGRTLYGFGG
ILYAPYNPVTK	IYSPDHTNNSF	SFPALAPLTY	IQNPDITSSRYR	TVTAmDVVYALK
SILNWVKFK	LYTPEHHLI	IFSDLNATY	GTVKWFNVR	DVAPFTTKI
ALIEELLLYK	NYITPNPIFF	KWTDLALQY	RVIWGKVTR	GIYAYGFEKPSAIQQR
RIYLDLPQNFK	AYSAAKSWVF	LLTDIIAAY	FSGWYDADLSPAGHEEAK	ELAEIYAKL
HVIETLIGK	EYPDRIMNTF	LALGHFLSELFVY	GTLSPAFSTR	SFSDYPPLGRF
SIFDGRVVAK	KYLSVQGQLF	TALAAFLSY	RYKLLGGLAVR	ETFPANIQV
TLYRIFNNK	TYQHVPVESF	ILNDmVWKY	AAEYLYFFR	EIIGRDMSQISV
SLFYAEATPMLK	YYIRFFITY	LFQHFLDSY	TSKLYSLLFRR	TEELNREVATN
LLFPYILPPK	YYVRAWVVF	VFTFIPGVLY	RYIEIFPSR	HVFDHPWETV
GLLTKPIVK	LYRQYFEEI	NFLPLHYDY	AGISFIINR	EEANNDLENKIQ
RLYQVEYAFK	VYIDKVRSL	VLLGFLYRY	RYLPTEQEVRFR	EVAPPRLLEEV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RILSGVVTK	RYFPTQALNF	YFSDPFLKY	SIQEIQELDKDDESLR	DSSEIHFKV
KLVSFPIGIYK	IYILDPELL	DVYNHFLLY	SSRAGLQFPVGR	KASGPPVSELITK
HLMVRGVQELLLK	LYLKVKGNVF	GTAPPTLALHY	RFKIDLGIFR	FLSALEEYTKKLNTQ
KVFDGIPPPY	SYTRLFSNF	LVFPFRTFY	RYRPGTVALR	EIYQKPFQTL
VLGQFLVLK	PYLGQAPFL	TAFGGFLKY	LLLPAASRPPR	EVIEKFDYV
KLFDYSKPSAK	SYLEKVVTL	YIYIRGEFY	HGYIGEFEIIDDHR	TTFKNLQTVNVDEN
KLFSELPLAKK	IYIKQIKTF	RVLDLSENFLY	AGFQRDLGSLR	EAVELPLTHFEL
VLFSYSFSYK	SYIQRLVQI	KLFGFLLEY	HYLPAEILQKK	ISGLIYEETR
RLPLISGFYK	NYATRIVTL	LVIPGHLIFLY	RFLDRFVYR	SAIRRLKELKDQ
AVISYDYLTSLK	IYISKIVVEF	IFWTLPHEY	RMFAPTKTWR	KLVAASQAALGL
LLFPSRPGLLK	SYQKVIELF	HLDEAQRLLY	KTLAGDVHIVR	TVFTDHMLTV
AVRKPIVLK	HYFDPQYFEF	SFTAFANSHY	NGRPLEMIEPR	EIYKEFFEV
AIYELAVASFPK	KYIHSANVL	IASNIWAAY	SPPRWPR	ETSPLTAEKL
KTLYPIIGK	TYQRWQFTL	YHIGIPLTY	STKPPGTFLLR	EVFASLFHKV
AVYVPFWQK	IYKDLPFETL	HWIDLTFGY	ATRLGYFGR	DISIIPPLFTV
KSLDQAISRF	KYQAVTATL	LPLDIQIFY	IVNENLVER	VEVTEFEDIK
PAHGLFLK	GYNVKFDMF	YFEDQPLLY	GVMTVLIKR	EVFEKATFIKV
GIFPGTPLKK	HYIYIENQFF	VFFNIPQIQY	RFLPVFDIVIHR	YSAPVIHVL
RVQEAVESmVK	KYIDFDHVF	SFmDPASALY	ASQGFDFNKVFR	EAIGVIFTHV
HLEDIVRQK	KYISKPENLKL	FLSFPTTKTY	LQFPDRSVQR	HVSDIVGPDGLV
AIAQLNYADMLK	VFNDVRLLL	IYLDIIHTY	AVKALWNLR	GLSEDTTEETLK
KILDLMEGRLLY	KFFTISPIILYF	FFPSIYDVKY	HSMDFVAYR	FVNDIFERIAGEASRLA
qIFKPIISK	qYMEEIYHRI	VLLEYHIAY	IQVWHEEHR	TSSTSYNRGDSTFESK
RLKAYASPAKL	VYGSFASKL	HLSSLQLFY	ATVQQLEGRWR	YVVPFVAKV
RVLDALVAREK	VYNPELDKW	WVFEHPETLY	KVQTFPFLGR	ETAYIRVKV
SLPDFPAAAK	PYMDSPQSIGF	SLPHVGYLY	RLFPPLRQR	SVVPSPKVSDTVVEPY
ALAQARLLY	VYIKHPVSL	IFTDVNSILRY	KLNIDSIIQR	EVSPVSFHQV
LLFRYPFQR	RYPDSHQLF	YIFNHVDIKIYY	GGYRPVWNR	NVFFKNYEI
GLNSPVLIGK	AWAPKPYHKF	VLFLKFLEY	RTKRLVVFDAR	LTSELITHI
HLINAFHTPK	IYISTLKTEF	FVAKFMALY	ALVAGIDRYPR	SKQEYDESGPSIVHR
RVLELVSITANK	SYLTPDLWKETVF	SLLHLGALY	NVGDWLRGVYR	SLVNLGGSKSISIS
SLLGKDVLFLK	VYSPHVLNLTL	YAFQDDRYLY	QLMPALVQR	FTAKVWDAV
AmYDKGPFRSK	IFTDVALKF	IFMDVLFVY	RYFDPANGKFSK	GGPGGFGPGGYPGGIH
AVFPSLLTNPK	LYTEAIKFF	LFPLFAQLDY	KIWPLSDFGFLR	ETVDFWLKV
RmFAPTKTWR	RYIEFHSQSGF	SLLERLLTY	KVKDLRQYLILR	GAFGKPQGTVAR
RVLPSITTEILK	VFTLKPLEF	VFSEVSPLY	RSLQLQEHRL	VYALKRQGRTLYGFGG
LVFPSEIVGK	LYQDKFPFF	VTFPEFLRY	AFWIPFIYR	EVDETYVPKEF
RLYFGERNVK	KYIDQKFVL	YVIQKFFEF	SVSVQGIIIYR	ETFQRPYQYL
ALLPWPFKQK	NYIDIVKYVF	AYFYDPDVGNFHY	VVNPLFEKR	KYEELQIT
RAYPHVFTK	SYLSRLQYF	VWKIPAILY	ATFQFTVERF	DIVNFVHTNL
KLWDNELQY	VYSQIPAAVKL	HVNDLFLQY	NPDDITQEEYGEFYK	EVVDFIQSKI
RQVIPIIGK	KYISGPHEL	IFHDISLRF	GTLDYILQR	ITIHLPSPV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
SLSPVILIK	KYPSPFFVF	GVFFPVFAY	KGPGLYYVDEHGTR	YLADLYHFV
VLRDNIQGITK	KYITQGQLLQF	LFSRVIPEY	ADKDYHFK	ESSPFVERLL
AVLYQPLFDK	VYHILKVLF	RLmELHFKY	ATLGAILNRL	EIYQKAFDLI
GTLSSWNLK	KFLTITPIVLYF	SFGELALIY	AVYDFFIGR	FVNDIFERI
LLAKVFITK	LYSSKLYRF	YYKNIGLGF	RLFSIVRPR	NVAPIISKV
VLSSFVLAEK	SYTHIQYLF	FFLPKGAYIY	RVFAAESIIKR	DTFRAGAFDQL
RLFEGNALLR	FYNLLTRTF	YLWKSEKPLYY	VLSPPRWPR	NTSHILEAI
RVYNTDPLKEK	IYKPVTDFF	ILNDMVWKY	KIWDPVHRVAL	FTAGIVEAVL
RTLGSDSVILK	IYLEKLKTI	VVKEIFFHY	RLLPSLIGR	AQYEDIAQKSKAEAE
SVIGFRILLLK	SYASLQQNKW	HFLDRHLVF	SVLKELQNR	EVFHFFNVL
AVNSIFLSH	ALPYFWEHF	TLLEKQLEY	VVQQLRLEAGLNR	HSGPNSADSANDGFVR
ILGPMFSGK	KYQIINEEF	RYVEFNLLY	IFVGGIKEDTEEYNLR	RHVFGESDELIGQK
GTLSGWILSK	VFIPYRESVLTW	PDVGNFHY	KVVNPYYLRVR	EGSPIKVTL
MLLAHVDLIEK	IYQEVWNLF	TVLSIPELLY	SYFSFSRNR	HLEINPDHPIVETLR
GTmTGMLYK	VYNENLVHmI	YFIPFLPLEY	KVRPRLIAELAR	HVVDFFNRV
HVYDGKFLAR	KYLVIGDLLF	YFEEIALKF	GIKPEWMMIHR	IYTRNTKGGDAPAAGEDA
MLYQTINSLK	YYVWLQHTL	YTAVVPLVY	HQQLYWSHPR	DVFVHQTAI
VLQAADILLYK	AWYDRFWLF	SYFRTLLmY	SYRKFLNLR	DVTAIIFVV
RLSFPNLFK	IYPVDLGDKF	YLHDQFWSY	LQNEPLPERL	ITAAVIEHL
AVAVDVAVPK	KYMTAVVKLF	TFYFPVGPGTGFLY	SVNSLLKELR	SGDGVTHTVPIYEGY
RVLPYPFTH	IFIDPGYQTF	YYINKISSTLY	KLLESIFHR	SIYGEKFEDENFILK
TVYAFSIENFK	IFLPILRTGF	AAFKIFLKY	KSKVPAFVR	HNAGISFSV
AVLSWKLAK	RFLNDPGHLLW	MVTEIRLKY	RHVFGESDELIGQK	HSFNTDPEVFI
AILSKFLYY	VYNENLVHM	AIIPSHLAY	VVKPDQLIKRR	VTFAPVNVTTEV
ALLPWPFRNK	FYLFPNRLEW	KVLPQTILY	RTIAPIIGR	TSVTPVLRGQPIYI
AVMAESAFSFK	KYTEITATYF	SLIDILLAY	TTKPAIIFR	AEPAVQRTLLEK
AVYSMVEFNGK	RWSTISENLF	TVTEVLLKY	KTLPKIVGR	EIFDGNVAHI
SIWSHQmYY	VYIDFRDGAGLL	SYEQLmQLY	SYISVYDHQGIFKR	RTTDIVIRI
LLWDRILGY	IYANFNRIIL	FLTVHDAILY	RMFHIRAVILR	DTAQIFRVNL
RLYVPLYSSK	IYKIDFVRF	LFGTVILKY	MPKDIQLAR	DVAEFLYQV
RVKGPGISKF	LYQDQILEKF	STFFPFHEY	RYISKMFLR	ETADVIAKVAF
SLFSNVVTK	EYALWNYLF	FIANHPFLF	TYFPHFDLSHGSAQVK	EVISLGLPFGKVTNL
RLVQGSILKK	KYIEGVSDF	YAIDNPLHY	HYYDGTIFHR	TTYEGIFKTL
KLPLPLPPRL	VYLAKLGNFF	AYLDQYLWY	ALNGKIYFR	ETFAFQAEI
ALYPHFPAH	RYLPTGSFPFL	SFFTPLLLF	RVHSIFVLRL	YVSEILEKV
KLFNPPEESEK	NYTEWLQDL	FLPFPLPLF	HLTGEFEK	TINIHKRIHGVGF
RLFVGSIPK	SYLnFTKIVEW	mLYPLSHGF	KHPDASVNFSEFSK	SVVDVFAQL
RVYNYEPLTQLK	VYTEGERLYLF	ALSDLALHF	RILKSPEIQR	PEEVHHGEEEVETF
RIRDQLSAVASK	KYMVYPQTF	LYYDPNSQYYY	RVFSVAELQSR	SGRDYVSQFEGSALGK
SILPAIFQK	TYPEGLEVLHF	SLFHAQLAY	KTIDPELLGKMNY	HQEGEIFDTEKEK
ISFGAFVAK	LYLPQEQLTHW	VGLPVHLLF	SLNPKTWGR	MSIYPSPTGV
KLFQSDTNAmLGK	KYLDEFLLNKI	DLSLEEIQK	VMKDFEEMR	QSAEIWEKL

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
SLWQFYLSK	VYIYRYFFL	GLATQAFHY	SYLDKFFSR	ESYHVPELI
GIYPPGSPGK	KYPENFFLL	SFIRLLLNY	IYMDTLNIFMR	EVVAGRFIEV
VVLYPLVAK	RYKGPGFEYF	IDEPLEGSEDR	NKDQGTYEDYVEGLR	YSFYLPIAA
SLAERLLSH	LYQDGVFKF	GLLAGLVLLY	RSAALSWLR	YVPPPFAAAAI
IIYDPKLQTPK	PYVNNVPHL	IANQVQLFY	ATGSIPITVR	FVNDIFERIA
KVSDWQVLY	IYPHGLVLL	SVLDSFLKY	IWHHTFY	YENEVALRQ
LASPEYVNLPINGNGKQ	LYPNIDKDHAF	VYIVLDKAEY	ELQEMDKDDESLIK	ASGPPVSELITK
TLAAWLINK	EYFRVPDSATF	KLFPYALAF	ATSPIIIHRL	EQIVPKPEEEVAQK
KLFSELPLAK	IYYTGKYQSL	LVIFPEGTRY	RQYAKDIGFIK	EVISRQATINI
AVFPKPFVEK	VYITNFHVRM	SFLHPSYYLY	STFSGIKELAR	EVAPPPPVEVPIRKA
SVLLPLVAK	RWFQPAIPSW	AWQDWPLTQVTFY	ATLLIVNR	YAARIWDGV
RLSGVSSNIQK	VYHNMPLIW	AFLNDSYLKY	RLFEWVVNR	DVYDKVDYL
RVLNKLGGVK	FYPPHPDYTW	AIIDILTHY	RYFALVERRL	VEQATKPSFESGR
SLLTSSKGQLQK	SFmPNSPRFLL	FIDSFRPLY	KYVDLGLGTHR	ELERPGGNEITR
STFQQMWISK	SYGKINILL	NIQYLFLEY	SVQGIIIYR	EVISKLYAV
SVAKTILKR	IYSWFTRTF	VFLIIKLLY	RYIEIFPSRR	AKDPFAHLPK
KLYEKKLLKL	KFAEEFYSF	FIPFLPLEY	SAWYPFFR	DVAPLSLGLETAGGVM
RTLGAIVRQK	SFFKISYLTF	VYSDLHAFY	IVIPATYYLWPR	VVFGYEAGTKPRDSGVVPV
ALLTYMIAH	SYVWRTYHL	YFEEIKQFY	RLKPFGVQR	EVIRLKGLVSI
RLIESLFTIQK	VYPPPHQVFTW	HNLSANLFY	RVLDPFTIKPLDR	FTITPPTAQV
STYEKALGYF	IYMDTLNIF	SFAARSFYY	RFNDLRFVGR	LVAQIVTKV
AVIPSSIVLPSQK	KYFEKQFEL	HWIDLIFGY	SVINPGAIYR	MELERPGGNEITR
RLIAQRYLLQY	SYIRPEDIVNF	LFPDPVVQWLY	AVKNLVDSSVYFR	VLSPADKTNVK
TVYRNPESFK	VITPVLLHF	LFWEQHDLVY	MQIAWSREFLK	YVTSVILHI
VVINYSIVKGLKY	SYLELVKSL	ALTDAYLLY	RYLTVAAVFR	EVAGLWIKI
AVYGMLNLTPK	HYPPVQVLF	ALLTLLLVY	AYVPFGAGRHR	HTANIQTLI
KTYQVTPMTPR	LYIDRPLPYL	EVLGLILRY	HWPFMVVNDAGRPK	DSGRDYVSQFEGSALGK
ILGPNLGDK	YVHMVTHF	IFmDVLFVY	LKGDDLQAIKK	DVVDPKQLVTNA
SLLGKPLSY	LYISEAEGLKF	GLmGKPSILTY	RLFGFQVGGTFR	EIFQKPFQTL
KLFLIDFGLAK	KYMDVVKERI	AFKEmFLDY	RVLPPSALQSV	EVVVGDLVEV
RLPAFTLSHL	RLPAWQPIL	VYIDIDPLLY	FHVEEEGKGK	SVITQVFHV
VVYQYWNTK	EYVEKFYRI	FYEFFNEQKY	VLYDRQGIGR	DSHSLTTNIMEILR
KLPDLERLLSK	LQPERYELW	VLLDYHLNY	ATYPYQVVR	ETFPIPKAFV
FLYQQQGRLDK	IYQEIILANHF	FLPRTDYSF	MTILQTYFR	EVFAPPAEAYA
RMKDPTFLGK	VYTTTVHWL	TFADFDGVLY	VVKDITNAFR	ITTDVLYTI
KLYASHSQFIK	FYLNQSTAYHF	SFVDPLVTNY	IINEPTAAAIAYGLDKK	SGYRSGGGFSSGSAGIIN
SIGDIFLKY	RYIDRIHIF	AAAAAAALLY	AQKALDDIIYR	TVFSHAQTVVL
LLNGKVGSFK	AYLEAYKEF	AVIEDTWHY	GLKQVIIPR	EVKPSLVIDYL
AQYSPQQLAGK	IFSQKLGYLLF	NFYLVPLHY	RKVDWLTEK	SSSKGSLGGGFSSGGF
GTAIIQLPSK	NYMMDWKNQF	AVIEDTWHYF	RLSDIWAKTPPITR	WAKGHYTEGAELV
RLTTPVFGK	SYLENVDHF	YYPEYKLLF	TSYLDKFFSR	LVNEVTEFAK
RMFLSFPTTK	IYIDRFEDL	YLPVLPGDY	RSMDTIVGMLHNR	RLDEEEEDNEGGEWER

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RLMSLPIAK	IYFPEGSGVKI	AVIENPEMLKY	STYYGSFVTR	EAFQGTKVFV
AVMGAYVLLK	VQPSKYHFL	YIWDVTILEY	SFLNFGFANR	EVFPLAMNYL
YLYTLVITDK	DYLRDPVTI	AFFAERLYY	RQINWTVLYRR	DSSEEKFLR
RQYDKFLTHF	HYSPIYLSF	ALAQARLLY	KYYKYILTR	LVFPSEIVGKRI
QLLGEHLTAILQK	RYLPEDFMESL	WLEEGIHWQY	VMKPPQVVR	DVINVFHRL
RLMEIYQEK	FYQPDLKYLSF	YVAEILPKY	ALAALIFRR	FVHIWKL
TVAVPLVGKL	TYELRYFQI	ALVSGKLALRY	RVLDALVAR	EVPHFHHEL
RVFQGFFTGR	YYNGKWEFL	LILEEILAY	HTMDPQLRLLLEV	EVTEFFVTL
YIYDGELVSK	VLPSVLNKF	FVTDLLLHF	KLNPYAKTMR	SEGTKAVTKYTSAK
QLYWSHPRKF	AWQDWPLTQVTF	GLIDLVFLY	ASMPWGDPNYR	DVATITKTVV
MHSFILK	AYIERMNYI	LFLLVFPAY	KYFLGQSVLR	SQLQKVPPEWK
GLIPANYVKILGK	KWFFQKLRF	AVQHFSLLY	TYYGSFVTR	VTFAAmVGAGmLV
ILFPLRFTLK	LYTPVLIRF	FVYPGNPLRH	VTLPVYFRER	YDAEISQIHQ
KLFEKKYSVK	IYPSIFHVL	SFHVIFVLY	YFQFQEEGKEGENR	SVIYVPPPFAAAAI
RLYDVPANSMRLK	KYPHYFPLL	FVALATGEKGFGY	RFIDTTLAITSR	HTVGFILQL
VVYEKQMLY	TYQVLAVTF	GVSGIFMKY	RVHSIFVLR	EAFSLFDKDGDGTITTK
AVAAFVLYK	AYLEALSHL	FFGDVVLRF	KVFPEDMAKYR	EVGGEALGRLLV
STMYPGLPSRL	FFLIGPPLLI	GVLDTELRY	RNMEIPKGLIR	EVIGKGPFSV
SIWSHQMYY	SYSDPPLKF	SYPNVFLVF	KYPVWLWKR	TPGNRIVYLY
VLYQPLFDK	TYINHVVSV	LNLPYFLRY	LYISEGLHPR	SSSKGSLGGGFSSGGFSGGSF
VVLPLDERAFEK	VFLPREDHLF	VFVATFLRY	NLNDRLASYLDKVRAL	THLAPYSDELRQR
SILRNPVTNK	RYPDTIALTF	LALHYLLTY	GINSILYQR	EVFALIHEL
SLLSPLLEK	RYPTSIASL	TMLDLFFHY	AIVPIGYHVPR	FLSALEEYTK
ILNTWISLK	TYNPNMPFKW	VVFEGNHYFY	GAIRDIDLKNR	APIRLPEHVTV
IVNGHTLLV	LYTPHSWLL	YLPPLFWRF	TVNTSLNVYR	EVTLIHSQV
AVFQANQENLPILK	RYVPRASYF	FLLNHSLEY	VVIIVRAPR	GHQQLYWSHPR
RLVQGSILK	VWFNIGSVDTF	FFISLLESY	GTYYPPPRLR	YTFSEPFHLI
IQNDRQLQY	MYMTVSIIDRF	LFLDLLQSY	KLKWIVSGR	ALAAAGYDVEK
SLAPVNIFK	YYMKDLPTSF	YFDEEmAVKY	LIKPPTILR	EVFFKEIFL
RmFLSFPTTK	LYQHEINLF	YYDTDPFLFY	RVLSKAFSRL	ESFPHAVDHILQHLL
KLLGLPEDYLY	SYMGLDQIKPLKL	FVPDWAEILY	KYLQEEVNINR	EVAELFQRL
RLKMQYATGPLLK	TYQDIFRDF	NILPKVFHY	LYQEVFGRLR	EVSFVIHNL
KIIAFVLEGK	HYALNTWLF	VFFFYPLDF	KYLAFLRKR	SEETKENEGFTVTAEGK
RVLIGEGVLTK	HYSQELSLLYL	RLLLLLLRY	RVKTVWLVGR	QVFPGLLERV
TIMPKDIQLAR	DYILNVMKF	IIIDKEYYY	ATFARIWYL	FVNDIFERIAG
TVATFILQK	EYTRALFLL	VLYNIAFmY	ATKPLYVAL	EVFGSDDDHIQFV
RVWDISGLRK	KYQYWAVVF	HVFGDELSLVTLF	KLISDINKAWER	HRHPDEAAFFD
GLFALPFGR	RFIPYTEEF	ILDSVGIEADDDRLNK	RLFDIKPEQQR	FVEWIPNNV
VLFEHAVGY	YYEEQHPEL	AFIHISTAY	RTmVDKLLSSR	FVYPLDFART
IQFSMKLLY	IFHPTQPWVF	AYIDPIAmEY	RVNVTGIYR	SRSGGGGGGGLGSGGSIRS
ITWERIISHF	KYVNSGTVTLLSF	IFSEQVAmGY	SLLPLTEANLR	SLGTADVHFER
LLREQVAQLK	EYVDDTQFLRF	TNMPAVKAIIYQY	RLRELTSIVNR	HSFGGGTGSGFTSL

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
ALWSPGLAK	NYAWVYYHL	VYQAVQALY	AVFPFKPPQR	RAADPLVGVFL
KLLGPVLVK	NYLDPRITVAW	SYWKEVLLRY	GTGWGENGYFR	GGFGGGSFRGSY
KIFNVAIPRF	NYKDLNGNVF	YLPALKVEY	SIMKWNRER	DATNILNKL
qLFQLPAKK	VYEYVVERF	IFLDSKGLEY	ISDPYKVYR	FTVGPLGEGGAHKV
AVFPFKPPQR	VYQSLANLIRW	SYLDKEDTFFY	SILLWATQR	mTFPGERIYEV
KLYSKHFTLK	IITPIHEQW	ALLDSQFSY	ALFNTRIPR	TVIETVADQTV
YLGEFSITYK	VYLQNWSHVL	GSLALFLIY	KYVDTNLQKQR	YLSRSGGGGGGGLGSGGSIR
AVLPSVLNK	IYLLIHNNF	YLEQLHQLY	KYIERIITR	DTSDIKELI
IQFNPPLSEK	LYKFSADEF	GLDDKLLHY	NYKPLDTIWNR	FAEEGKKLVAASQAALGL
KTYHALSNLPK	RYLDLILNDF	ILNHPGQISAGY	RLLSDEDVALMVR	SGEGDFLAEGGGVR
RVFIGNLNTAIVK	VYSRTFTWL	ITSSNFLHY	TVRVWDISGLR	ETINTRLISGV
ALFKNLLLKK	TWFTAGAKLLF	SYSDLVLFF	VTIVNILTNR	DTAHVLFTL
AVmGAYVLLK	LYTEKFEEF	YVYPKYLKY	AVRPKVLMR	FTIDAKDAGEGL
SLLAKVFITK	VFMKPGLPTTF	ALYKKILKY	KAIDYYLKALR	SLAELGGHLDQQVEEF
SLMHSFILK	RYLEAGAAGLRW	SVFEVFVLY	ASQGFRFLR	DVTDFISHL
VLSAQQILH	AYSPRFLYI	YFGEIALLM	KHPDSSVNFAEFSK	EAMNYEGSPIKV
ALLEVLSQK	EYPRSLFPSL	ILFSGVHFY	AGLQFPVGRVHR	EEAPSLRPAPPPISGGGYR
RIFDLGRKK	QYLDNLLVRF	YFLGIKSLVY	RVFSVAELQSRL	FTIFRTISV
RLFPPLRQR	NYKNPDQVYL	GIKNFFTDVY	VSLPSFFER	EVAPPTPLTP
RLPPPTILK	IYFPKKEAVTF	LLTAVQLLY	KFLDPITGTFR	TTFEHDIQAL
RVYIGRLSY	YYMELTKLLL	mFTELAILY	ILRDFFELR	YVTDVLYRV
ALYFPKnGDPSGLAK	TYLDQVKIRF	LFLWPEAFLY	IQQEMDLLRFR	ETFMNRVEV
RLLEYTPTAR	VYPDGIRHI	GYFDEEmAVKY	RVIIEKYYTR	THLAPYSDEL
SILDYISTSK	YYSPHGHILVL	HTYQSPLLY	RVYNWDVKR	EAAPLLVHV
KLFEAPNFFQK	TYTSYLDKFF	QYHLQQLFY	SSLNPILFR	ESAPIGIRV
RTFMIKFPWK	IYFEYSHAF	AFQFLQLYY	RLMKVFVTR	EVIDFSHGL
SLGVAALYK	KYMPNVKVAVF	FLWPEAFLY	RVNPALAELNLR	YAFPKAVSV
HLYSTILGH	MYPYIFHVL	VFRFNLDLY	VKWFNVR	KALAAAGYDVEK
mLYQTINSLK	PFIDSQHVI	NAFEHGGEFTY	VAIPPDVLKSR	SLAPIIVHV
VISPPTVPK	VYILKGGYERF	FYPNIGGIIRY	ASKEPFYVR	EIFDKIHSL
LLDIQSSGRAK	VYLPTHTSL	SFAEIIMGY	LYFPDFIVR	ETLFPSKIGV
ATLSQFYINK	KYIETTPLTI	IISEFALEY	RVNFRGSLNTYR	FTIDAKDAGEGLLA
GLLEKIATPK	NYFLWTEKF	TISPIILYF	STNFKLIYR	FVIHNLPVL
GVIPESVILLK	RYLNEFEEL	GVFLLPQLFLF	KTLLDKALTQR	NTATIFHEL
KILDTERMLAK	VYSPFVLLNTL	TLITQFLVY	RSLVPQLR	EAMNYEGsPIKV
RTFQEVLAY	EYIKFLRSI	DQLKEYLFY	RTVLVIAHRL	ETFLHIYQYV
TLWDRIGGSFK	KYPDRVPVI	FILSLILEY	RLLETLFVHR	GYDVIAQAQSGTGK
YVYKVLK	KQALKYFNL	NFEHFLLQY	RTNIFQIQR	HTTISGGGSRGGGGGGYGSGGSS
ALFTPWKLSSQK	VYNPVRAEW	NYGmQPLmY	TVLGYFIGR	LVSSLFFHV
QIFVKTLTGK	YYIFIPSKF	SAITVFLLF	RGFQRDLSSLR	MSVHLPFAV
AIMDAGIFITK	RYLPTGSFPF	TLIEQQFTY	SVLDYFSER	TVFSKSFEQV
AIYPFLDSPNK	AYNPVTHQL	DYLGIPLFY	VGMNFKTPR	HPGQISAGYAPVL

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
KIADmGHLKY	IYGEKTYAF	SFVEFILEPLY	VFLPQAIRHLK	STFGYVHGV
RLYFSQQTY	SYIDVAVKL	FLPPTTVAGATLY	RVFQGFFTGR	DVAEVLWEI
ALFDGVVSK	VYLEKFMTF	SLLSQMLHY	IQPGSTVHVLR	ETFDFVHNV
KLFPGSPAIY	SYLESFYHM	SLFFVPLSY	KMIDRIFSGAVTR	DQVANSAFVER
KLYEPVVIPVGK	VYVVGTAHF	TIFTARLYY	HFIDVGAGVIDEDYR	EASFVLHTI
AIALPVTMK	AYMQEPLFVEF	FFSQIGELY	HTLEPLIPR	TSATIVYHL
RLPSSTLKR	KYLEESTIRHF	FYVEDLKARY	YVFPKPFNR	EISGIVEVV
VLWMAPDGLYAK	NYTDRIQVL	LFSIAPLIY	ADHGEPIGR	REQLGPVTQEFWD
IILFDRLLK	ALPSKLPTF	SFIDVDDERWHYF	HSGNITFDEIVNIAR	VSEGTKAVTKYTSSK
LLWHWDTTQSLK	AYQHAFLYI	SVTEQGAELSNEER	RSLPFFSAR	ETIFGEWTV
RLNDRYPKKL	LYDIVFKHF	VFYPYPQYF	SYLHENQIIHR	EVVNIVKHL
VVNKVPLTGK	LYIPPTHTF	AVAALQDLRY	AIFLWLITR	ETAKLIEKL
KLWDYIDGILIK	TYNKHINISF	VFLDSHFVY	RQIDQFLVVAR	EAIQLIARI
RIRDGDFVVLK	DYIDTIWKI	ESKDPADETEAD	RAFVPQLR	SIAGIFKEV
KASEVFLQRL	KYSVINEINKI	IFLETELFY	STYIRLYGR	MIILPEMVGSM
KMADKVLPQRI	LYLKLWNLI	LFIHFANVY	RVSDLQMLLGFVGR	EVFDKTYQFL
RLDQPFIPR	VYTPVASRQSL	ALLQLGLKY	RVYNIYIRR	HSTFFPALQGAQTKMSA
ALFLDKMGSLQK	YQTPRLWLF	VVFVTKFLY	RIIVPLNNR	SLLALYKGKKERPRS
RVLKYVDTNLQK	YYASIAKAF	ALLSLHFLF	DKDGFGAVLFSSHVR	FSWEGAFQHV
KVSSINSRFAK	RYPNSHTHYF	NTYPIKLFY	KYITDWQNVFR	EVADEKMLSGL
ATWTYSPLLK	PYLISGSKF	AFLEPLGLAY	KGLEFVLIHQR	NIIHGSDSVESAEK
AVRLLLPGELAK	MYGFVNHAL	SFISGLFNFY	LDHKFDLMYAK	DVAQIFNNIL
STYISILNQK	SYNNFFRMF	SYLPVLPGDY	ATLSSIRHMIR	HTISVPYSV
YLYITKVLK	VYIHPSSALF	GLLEEALFY	GTQPTVLRTFR	HSFGGGTGSGFTSLL
RLFEWVVNR	VYTTTVHW	AASFINLLY	RIGVITNRER	HVFGESDELIGQK
RTAVPSFLTK	GYLADPAKF	LYLKGGVADALLY	AIWSGAALRAR	MTPEIIQKL
LAYFPYFITYK	KYLGQLHYL	VVFDKSDLAKY	AVKDLASPLIGR	DVTPHDLITGGII
RLFFHCSQy	KYTDWTEFL	HYYSITINY	RYYDILKKR	QEAIQDLWQWRKSL
RTQmPDPKTFK	RFFPYTSSQMF	NYSHLVSVGY	KLMDVGLIAIR	ETFNTPAmYV
GLMGSGIVSNLLK	LYDIILKNF	RVFPYSVFY	KLLEVWFSR	EVGDSKKLFFHV
KTFNPGAGLPTDK	PYNAPTVKF	YTTDFIYQLY	KVMVQPINLIFR	TTFPRPVTV
AIYATIPVYK	TFTFSHATF	YFLPITPHY	RSFSLGVPR	GSGGGSYGSGGGGGGHGSYGSGS
RTFGHLLRY	VYQEPIPTAQL	RVYDIPPKFFY	QNLFQEAEEFLYR	SLVNLGGSKSIS
SVFDVKSGSAVHK	DYVEGLRVF	SVLPAYLSY	RVLDVGFVGR	HEKEDGAISTIVLR
IIAFVLEGK	LYIVEPLKF	YVPEHWEYY	RVQPIKLAR	LKGEATVSFDDPPSAK
IIQSPSSTGLLK	SYmGHFDLL	ALLSIFSRY	SALDFLHNKGIAHR	YFQFQEEGKEGENR
RVFPVRPGSGR	FLPFPLPLF	EVLNFLLRY	MVKYFLGQSVLR	DGQVINETSQHHDDLE
RLmNDMTAVALNY	NYPETLGRLLI	FLPLLNIEF	VVKLGDLGLGR	THAVVTVPAYF
AVIPEKQLVEK	RYFKGPELL	VQLTFALRY	SMLEYFINR	ESFSDYPPLGRFAV
ILFGGYVAK	RYMPQNPHII	HILGFELKY	STLNKLIKR	ETAGVVSTNLI
AEVNADRITWL	DYLEWPEYF	NFDKLSFLY	VQVSPLIKLGR	NKDQGTYEDYVEGLR
RLFPYSQYY	KYFHPPAHL	YFGSNIAHmY	DLEAEHVEVEDTTLNR	EVLDFITHL

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RLYLNGDGTGK	VYVQNVVKL	IAFGFHQLY	HYGGLTGLNK	mVVDIVQEL
GLLNGKVGSFK	AYLEAHETF	AVALSLLLY	HSEAATAQREEWK	AVFPSIVGR
RTFSWASVTSK	AFFEGPPFKFKF	GALETLLRY	KSFQKIQVR	HGGGGGGFGGGGFGSR
RLSNLALVK	MYIARQLSF	GTLDSVLRY	EESGKPGAHVTVK	MTFDSEVELmKV
KTFDAPPALPK	PYmDSPQSIGF	TILDIPNQLYY	KEVVEEAENGR	DLSNIINKL
KVLPLLKIIKK	RWSPVRPLVF	IPLFVQLLY	VMFDKITSR	ELISNASDALDK
ALFGDEVSPLLK	VYITNYRLYL	VLAFIILNY	SGKIIFVGR	EVSNIVKEAI
RLVDLPISK	YYDDLKYRYF	VLLDVAYAY	GYGFVHFETQEAAER	FAARPQVVAV
RLYQHAVEYF	IYNPAFFKY	FFIDRDGFLF	EQLEEEEEAKHNLEK	SYFVELGTQPAT
RLYTKFSAR	NYPDEFTKL	FYAFQDDRYLY	VIIEKYYTR	EVFAQGHGIIQV
FTFDNVLPGK	SYIELPAYL	KVLPVGVLY	GSLTRLLDSVR	TATPQQAQEVHEK
RLKGDAWVYK	DYLDSIYFNRF	SIFGLGLAY	LSLPGITNR	DVAAVVVPIL
SVVGLFLRH	ILTERGYSF	VLFPTQILY	QLYDKGLVYR	MVAEILHHL
KMLRDTLYY	SYLHEPAVL	VTVAIPLKY	RVSVVWVER	EAAFFEGHFL
SLFDRQGFLK	TYLLGSDAAALLF	LIWGKFVLY	AVVDVRIGMTR	ETFmNRVEV
KVNIIPVIAK	KQLTWFYTF	SFKSFEGLFY	VLDFEHFLPmLQTVAK	ETIPGPDAKV
RVRNATDAVGIVLK	GYSEHFVEF	TVLGEPLIY	VQVGPLPSRLR	EVFmIDRDNSVFHV
SLYQPLQNSSK	KYMLKANLI	SIAWFTVFY	KVLSDDMKKLK	HTVDQVLSEVSRV
LLNYAPLEK	LYFLKPSYW	HYPPPVPFGY	QVIPRTPSSFR	NSSQVVVAV
RLAEVIKNRF	EYMLEKSFYQF	VFNEKGWNY	GIYAYGFEKPSAIQQR	NVEIDPEIQ
GSYDPQQIFK	LYIDFGGKF	ILSDIGLEY	ATRWPLAVR	DEAGSEADHEGTHST
KMYEEHLKRM	SYVMWKAGF	IVVKLNSGDY	AYFVPLVKR	DTFFRPLNV
LISPIILKK	YYPEYKLLF	ATYGSIALIVLY	HIYYITGETK	GSGGGGGGGRGSYGSGGGSY
RLYFSQQTYY	HYKPTPLYF	QVDPLSALKY	SFMPYHIQR	SDIIRSMPEQTGEK
SVYVYKVLK	PYNDYFEYF	AFIEKHWTF	SVKEQELQFERL	ELHYLEVYL
GTMTGMLYK	EWSPYTKIFQF	YVYPLQLKY	EESGKPGAHVTVKK	ESFSDYPPLGRF
RIYDYDPLYK	GYASRFIVI	FFAKIPYYY	KFGYVDFESAEDLEK	ETVLILEEL
SLFNTGFLK	HYAALAHYF	VTYNYPVHY	RIFPVDKSRSR	nVAEIVIHI
ATVAVPLVGK	KYSEVFEAI	VVYPWTQRF	RSINQGLDRLR	TDYNASVSVPDSSGPER
IIFDRPLLY	VYVDLGGSHVF	FYLPIAAAmY	TVMGAEIRHVL	TVSSVGALHAL
VILFWFPLK	HYSLFPLLF	YYLPKLLSY	KYQIFSGTSKR	EIFDSRGNPTVEV
ILGPmFSGK	AYAPQGWIAFF	mYYYNGKAVY	AYKSILQER	KIQVLQQQADDAEER
KTFTIKRFLAK	LYPEVFEKF	RWIDFDNDYKTLY	KVWVPKQK	ELFTGFIKV
YTFDWTMLK	TYPENWRAF	VFIVNSEDYmY	LTKVLKISD	IASPVIAAV
HISPNAIFK	YYLTHGLYL	GYPEVALHF	QYIQVNEPWKR	mTPEIIQKL
KLFGFLLEY	HYNSDLNNLLF	QVLGRFFLY	MLRLPTVFR	TLVTYVPVTTF
RLRELTSIVNR	VYPESIPRKF	LIFSVPIVY	GADFLVTEVENGGSLGSK	EAAEVILRV
VIWKYPTMAK	IYPSPTGVLI	SYLEPGSIRHIYLY	RVIAIRPIR	EVADFLIKA
GTFQLNSKDQGLQK	QYTDLLRLF	LFmSSFQSY	YQSTYYGSFVTR	SIHSFELDLL
AAYNVPLPK	RYPNKLDTITW	YYRAWQEYY	ILRTEQWPR	HSAEILAEI
KLYAGQVGY	VYPEKLATKF	ALAGTFHYY	ALLGGRWLQPR	NTVFVDRALI
RVWQVTIGTR	IYPEVVHMF	AFFEGPPFKF	FALITWIGENVSGLQR	ETSKLIYDFI

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
KIYHISLEY	TWLVNSAAHLF	LNFHVFLEY	GYFEYIEENKYSR	GGFGGRGGGFGGGSSFGGGSG
FSRIFGK	TYMDAQLFKKV	SFDFLELNY	IMSSPLSKELR	GGGGGGGLGSGGSIRSSY
RVLSKAFSRL	EYLSKQDLLFL	NFPPPLPALY	RTFPSNPESFITR	AEFAEVSK
VIFTGGVGK	PFAKPLPTF	SFLTEFINY	VFDKDGNGYISAAELR	TGSWIGLRNLDLK
QIYAIRQSISK	SYMPTVSHL	AVLGETLIPHY	WIGLDLSNGKPR	VKQIESKTAFQEALD
ALSTPVVEK	LFPGKAFSW	AYIRDLALEY	VFKEEGVLR	EIVDFAKQV
AVALPLQTK	YYTWTDGYRF	KLLDAYLLY	ATQTQFFHV	ETVDLIKFI
ALYGVVNVK	EYmLEKSFYQF	SLSEYVLLF	ATNILTATR	HAAHIISEL
KLIKDGLIIRK	RYFILPYVI	YYYDGDVGNYYY	RYQDILVFR	YVPPPFAAA
ALFKNLLLK	TYAPAIHQI	NFLHPVIYYY	SVHLQPITR	DIFDAMFSV
IINPFPASK	VYAILTHGI	FLFAPTLIY	STMYPGLPSRL	EVQAILAFL
KLYRPGSVAY	TYISWKEEL	KILDIGLAY	KFKFPGRQK	YVNLPTIAL
SIFVPGTQK	YYFDSYAHF	NVFIQGFLY	VNVEINVAPGKD	ETSPVLQKL
SLSFKVLKH	EYLDRIGQLFF	TFHFLLGSIY	KIRVPFLR	GPSSVEDIK
AIPGFTINR	FYLPLDAIKQL	YLGEFSITY	KISAIIEKR	LVAEIITHL
IIGTIFIIK	KYLEDMKTYF	SFELIVVQNY	STVARIQFR	EIFNGTKmFV
ALPALVMSK	SYIDRLISVF	SLLGKPLSY	AVQEFGLAR	FTTHILEVI
ALLDGSNVVFK	YYmKDLPTSF	VVISPPQFY	FYEEVHDLER	AHGGYSVFAGVGER
TLSGWILSK	VFPDKGYSF	LFWFGDLNY	LFVGNLPADITEDEFKR	GVGEFEAGISK
TVLRVDQIIMAK	AYGLVSATF	SLSLENVLYY	RLLEITEGSEFLR	YRPGTVALR
VVYSGLENIKK	EYLRQIFRL	SVLPFQIYY	WKDSDEADLVLAK	DIANFQVLV
RIFANTESYLK	SYISDGKEYLF	YVLDINSIDNLY	qLYPRNFLR	LLFEGEKITI
TLYFNTQEK	YWPDVIHSF	FVLSLGVAALY	RPPPEHFR	TVSEVIQGLL
IVFNGPHLLLR	YYIEGIENSVF	GLLDVGLRY	RNLIPVSR	ETAPAKLIVYL
SLLGYFPNK	AYTSQFVSL	AVITVPAYF	GVFTKLINR	SVIEQIVYV
ATYPYQVVR	LYDPVISKL	ALVSKGLATVIRY	GLQLRIATR	APVNVTTEVK
FLSAVFFAK	RYTVGGLETF	KTPEIYLAY	NPDDITNEEYGEFYK	HAANIVTAI
RVKVSQAAADLK	AYIPKLLQL	VVNPFIYAY	GSYHPGVFR	DKVIPLAIPQ
VVLGQFLVLK	KYIESPVLF	ALAPAGFSY	MLYGLIHAR	EVFPVSKTLVL
KLREPnFTLK	KYVHLFPKL	FFFPLLQRF	RFTGSIFIGR	SESPKEPEQLR
RTGPPMGSRF	YYNAAGFNKL	FFNRVNLIY	RSKYDYLMILR	DAVEDLESVGK
SLGQVVITK	RYLNKAFHIW	SFWAYKIYY	RTLPAWIREGL	EAAPMSLAIHST
KVLSIDQRNFK	SYLKQLPHF	HTLPDSLVY	SLGLKFNK	ETHFLDEEV
MQYATGPLLK	SYNPSFEDHQTLL	SFEGNVFmY	AAEDDEDDDVDTK	ETVSIEVKEVVKPLL
STYYGSFVTR	LYIGHLTTL	FVKPSFDQY	ITVKLTIQNR	EVSEIHIKV
GLMGFIVYK	VYAHFPINVVI	LALSHPYLY	STKDTVVSRSW	EVFPVSKTLV
RVTPFILKK	VYWKIYNSI	LYTSVVVKY	TAYLLCKAFGAPV	FSAEIIYHL
SVLNLVIVK	TYMKDLYQL	QLLPFLVRY	TTLTKIALR	ETAGIGASAHLV
IVVPKAAIVAR	PYYSKFILI	ALEKIDLKF	AVIPRPEPMLR	FVSGVIVKI
RLFYDISEK	SFMPNSPRFLL	SLFGIPLWY	RYYTPTISR	ETAAPAVAETPDIKL
KMMDVTVTIK	YYEKQFPEI	TFLIPGFYSY	RQTGIVLNR	STEILLR
TVSRFFLYR	EYIPDLYNHF	GLIHLAIHY	RVQEILDNVQVR	TVFEGRIYV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
VVWPQPATTK	GYPEVALHF	HAIRLLLEY	AQWQKVLPR	mTFDSEVELmKV
GTFALNLLK	KYEELFPAF	KNFGIWLRY	IGQSKVFFR	SISDVIAQV
VLYTSQTALLLK	RFLAEEGFYKF	KLWKVALHF	YKDAIHFYNK	EVAGILEPVGL
SITSVFITK	AYMELQQKAEF	STISENLFATTGY	GLFTGLTPR	SYFVELGTQPATQ
RTYGVSFFLVK	KWYDRRDYVF	YVFLYYYEY	ILQILSLNR	VFTAYGKPSESI
VILPPLSPY	SYAQYVHNL	ILYNIKQEY	VVKPDQLIKR	EIFSRGPYSV
AVFEFNGQSGYLLK	VLPDADTLLHF	MTHNLLLNY	AQIFRVNLR	GGILPGSYHYL
ILYGPPGTGK	YYTDImHTL	QVLEPQLTY	ERQEAEEAKEALLQASR	NTCPYVHNI
ALNSKILSV	IYQDWHSFL	TLFDSRHLLY	LVKPVTINVGR	STSAVIGVRV
AmLDTVVFK	IYSIDFTRF	FFLIVKTLY	AQFGGKILR	QPEFHIEIL
GTSHLPGLLK	KYKNSEINFSF	IIFDRPLLY	LDPHNHVLYSNR	DVFGHFILI
RTIPRSEWDILLK	KYLPYNHQHEYF	YTSDYFISY	KTNGKFLIR	FTSDRGFQFV
STFNQVVLK	VWWVEPGAGVFQF	ATLSLFNTY	RALPGLLEAR	EAFYNVITV
ALYDLAVLK	KYLTEGLLQF	DLEAEHVEVEDTTLNR	MDAKSLTAWSR	NVFGHFILI
AMFESSQNVLLK	TYVKEIEVW	TTLDIITRY	RLFEQNVQR	SATSRGVAGALRPLVQ
RVYHYFQWR	IYGEKLQFIF	VFLPIHITY	RVIEGDVVSALNK	HVYFGDPVSL
HTRTPPIIHR	KIKYPENFFLL	VYSDLHAFYY	KVFLKYPESLR	DVINVFHHL
ILFSEGLIK	KYPENDLFRKL	LVYPGDPLRF	VQKDIQPYMRR	FTVDSSKAGLAPLE
IVFMPVIGK	IYIDRGVVF	AVISTILKY	LIRKLPFQR	qTHGFIIRV
RLYSVSYLLK	IYLPIANVARI	LIMGLILRY	AVANFIRQR	SAAFVIAYI
TLGPALLQK	NYISFYDHL	NWKVPAILY	KTSDFLKVLNR	TLADVLYHV
VTAVPTLLK	RYLVISEKL	IMLPGVLRY	LGNDFHTNKR	ETFPANIQVV
RLLDmDGIIVEK	TYGGSWKFLTF	ANVSLLALY	NTPSQHSHsIQHSPER	ELSAVARVEL
RLFGTTVTFK	AFLKVSSVF	LSLGLVLSY	RTPELTWERVR	mTFDANPYDSV
RVFPYSVFY	LYFHINQTL	EVMDVFLRF	RVNKPPYPKL	EVSRVLEQV
TLAVNIIAK	YYGEHLFML	AYFPYFITY	VVLTLLSIFVR	YPASIVHQV
HLLELNKLImK	RFLDDLGLKF	FFYPLDFTF	KAKQGYVIYR	EVFDVIAEI
IIAKVFLAY	VYSYFEKETLTF	KLKNVFLAY	RLAVRTVIR	TVSEVIQGL
AMYDKGPFRSK	YFFDAAKLMF	LFVDEFLTY	TVQQLEGRWR	EGLELPEDEEEK
KLYQFNPAFF	YYEYNHDLF	YTMKEVLFY	RLFVIRPSR	ETVQVIPGSKL
SIFKQPVTK	DYYPEYKLLF	WVPPLIGELY	NQTAEKEEFEHQQK	TVIRPFPGL
KIPDWFLNR	IFFGGLVFKF	SYEQLMQLY	RYLDSLKAIVFK	DTAPVIIFV
KIRQDSVTKL	IYVNPANTHQF	YVYSHFLQF	HTKAVNVVRF	QLVDIIEKV
YVFPKPFNR	KLPDVYGVFQF	RLLETVLGY	QLVHELDEAEYR	EVVDIMRVNV
RLMNDmTAVALNY	QYSPLLAAF	RNADVFLKY	QLYPRNFLR	HTAWIEHVHV
ILAAPGILK	IYSVFRNAASF	KVLDKLLLY	RLVYLNEAWKR	EIFNLKFAQA
KVFEVHVRPK	QYLEEAPKF	VLAGTQLLY	VLSAPGLRGFR	nTATIFHEL
AQYGNILKH	RYVKKLGDF	VYLHYLPSYY	RYFNSKVPITR	DVIDIMENL
KTLDQAKAVLK	SYLSSILRF	RVIGSELVQKY	LYVDFPQHLR	SRSGGGGGGGLGSGGSIRSS
GTYQPLSTR	FFKDRHWLF	STFDTQITKKMGY	MVKPTPGLTPR	FTQALDRQTATQLL
KLREIPSVVY	KYNLINEYF	FLPFPLPLFAY	RALGVRDLSYR	qVTGVTRVTI
KVLQKFLTY	RYQFIEEAF	IQLVEEELDR	ATIGHVEKFLR	EVMEPTWHI

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
FVYPGNPLRH	VYGFVREAL	AFYKISTLYY	HYTEAIKR	IAAEGIHTGQFV
KLPPLPVVEK	RYIYNREEF	SFTDVIGHY	ALKEIGDVENWAR	EIFTEQVVTA
KTFLFSATMTK	SYELRYFQI	TWNPLKLHY	AMYPNIILTNR	SLVNLGGSK
RTIAPIIGR	KYPDYEVTW	YFINSKGIPRY	AYIAGFVLQER	TADPLSLLRNV
VLFDTQLIIEK	NYIEKVVAI	GFTAIVLTY	FPVGRVHR	TTFDKEFLL
ILSGGVFNK	VYKPAQNSW	YYDPNSQYYY	FSMGNEVLQNR	HFNAPSHIR
SVYVDAVGQFLK	FYTVIPHNF	HFGLFPANY	NSSYFVEWIPNNVK	MTALVNVAL
VVFVIDPGFAK	NYmMDWKNQF	IMKFINDQY	RQQPFAYGTLTVR	DLILPVPAF
KLFDSTTLEHQK	SYILRLEEI	LLANMVYQY	RVLDALVAREK	QTVGVIVRL
RIIPHLPAPK	KYPGHLAAITL	FVNDYILYY	SLQNAESWINR	SSKGSLGGGFSSGGFSGGSF
STIPPELVKQK	TYHPGVPVF	DQVANSAFVER	FPVGRIHR	EKVLVEGGPAP
FLYAFIGVK	VHILQVPVW	GLHGVTFGY	SAFSILFNR	KQHVTEAFQFHF
VLLGSLFSRK	NYFFDAAKLMF	YFGEIALLL	RGEAHLAVNDFELAR	NVAEIVIHI
KLLDEVFFSEK	IYKPVTDFFL	nFTALLIEY	KYLEESNFVHR	SHTDIKVPDFSEY
RIYKGVIQAIQK	SYMFVDENTF	AVAGGVVNSALY	RVPELFANR	NQGGYGGSSSSSSYGSGRRF
SVFNHAIRH	TYNYPVHYF	FILWRHLEY	RYIEIFKSSR	TVTTVILEV
GLFTHTIFY	FYPPKVELF	IFIEDAIKY	VFLLWKNWR	EIASFPIYKV
KLWLDAYLHK	SYSHIMALI	KLWNEELKY	RSSIPITVR	EVIRDVINV
RLNITYPmLFK	LYRDVMRETF	FLLPIVVRY	RTLDPSWLR	YALYDATYETK
RTQMPDPKTFK	RYGLPAAWSTF	TAQVIILNHPGQI	VSEIDWLKRIR	ELFPENVYSV
VIYPLAVPK	VLPKLYVKL	YALPPPPQFY	MVNVPKTR	EVIELPLTNPEL
AVNPYFDIPK	VYQHGLTGF	VVPQFVVFY	SFMDPASALYR	HVTMVVAEL
LLTAVQLLY	IFSIKPLQF	SVLGFFIQY	KTRDEYLSLVAR	DVAQIIIRI
AAFVPLLLK	RYLEQLHQL	WIGDKSFEY	SVLSRINQR	NVSEIIATI
LIYKHTKLLK	YFLKGVLVF	KFYNGLLFY	SLNLRTFLR	SSGSVGESSSKGP
ALWGGTQPLLK	AYGHFSYEF	YATFIVTNY	RVQVVGTYR	EVFFSEKIYKL
AIAQAESLRYK	YFINRSWEW	SLISQVFYY	SVLNFATNR	EVIWLTQHV
QLFYLPAKK	KWLEPLKNLRF	VYNHFLLYY	VSWKTGVFR	DVFHmVVEV
TLLGFFLAK	RYPDNLKHLYL	YILKDYVSGKLLY	KYLSVQGQLFR	ETIGTGGFAKV
AVLGFAMYK	TYGDAGLTYTF	WYVDDPYQKY	KIIETPGIRAR	EVAPVVTTEHI
IIYPTAPPR	LYPHLSTYW	IYFQPPSFY	KTRDAILQLR	HVSQIFNMI
ILYIATPNK	KYGIVQEFF	MVQPINLIFRY	KESYSVYVYK	GLPGPPDVPDHA
KLLAEVTLK	LFLPFPLPLF	HFLLVDGSSIYLY	RLFEWVVNRI	ITIHLPSPVTA
AMHGVFLYH	LYSLKQYFL	IFIHLNDIY	ATFSGFTKEQQR	KKLVAASQAALGL
AVANIVNSVK	PYTDVNIVTI	AFVVAVGAEY	AVFDKTLAELKTR	SVTQIYHAV
LPWPFRNK	AYKPGALTF	YYFFTPYVY	AYLTLPSYR	QSVDLVFPV
RTLTIVDTGIGmTK	EYLIKVNEI	NLPLFAFEY	IDEPLEGSEDR	EVDEQmLNVQNK
VILEVQSNPK	IYYFKANVF	SFGINSILY	LVKSTSQLLSR	ALAEKERTI
AIVAYGLYK	TYESIFSHF	ALIEELLLY	RLWDFIENR	ALTDMPQMR
IVSSLRLAY	GYLRSVFAL	ALLEYHLSY	RYQKSTELLIR	EAIDRIFAI
KVANIILSY	NFLSRSFYW	YFLTSFYTKY	TVRTAMSLIER	SASKIIVFV
LVIPFTIKK	RYSTGLAGNLL	YYYDPTTGLYY	ATVDIQNPDITSSRYR	EAAAIHVLV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
KLNPQQAPLY	FWIPYIHNL	STLEVTSLKY	RVTVPLVRR	ETTGVDITKIQV
KMKEALLSIGK	KYIQRQETI	YLTKFIARY	KYLNPFFTR	EVAKMIQEV
RVWDLPGVLK	SYMEVPTYL	AAIGLVIYY	RITVKLTIQNR	LTADINWAV
TVAGGAWTYK	AYLPVNESF	FIALITDSY	SGYPPFVGR	IFVGGIKEDTEEYNLR
VLFPEGGFLRK	IYAPPLPSL	HFLVTRLLY	KFFLSHPAYR	GHVFEESQVAGTPMFVVK
RVYIASSSGSTAIK	EYIIEYPHF	YWGEIISQQY	AFKPILSTR	MAARIIAKL
GIYAYGFEK	EYDLIVHQL	AFLSQELLY	RMLPPLTKNQR	DVTDFISHLF
RLSQLKQLLK	IKYPENFFLL	YYYDGDIGNYYY	GTFANIRLLNR	nVTWVIVNL
SIFSKFTSK	LYGRHFNYL	AILHHLYFY	KTKADGSFRL	DVSNVIEKV
AMADTFLEH	TYAPVKSFL	WYPDLESKY	GGFGGGGSFRGSYGSS	HLGYLPNQLFR
SVATKLLLY	VYSDLHAFYY	FFITYIPFY	HPGSFDVVHVK	FTFYHQGHEL
SIGQVFLLK	AYAIIKEEL	VTLTSEEEAR	RNLVPVQR	TTFESSHYLL
TVTAQILLK	KYVENFGLI	SLLALImAY	RSVAGLLPR	EVIDLKAEI
KLFDFVNAKK	LYPDRELQSQW	TFVWPAHFKY	KILDSVGIEADDDRLNK	SSSKGSLGGGF
RIIDLVLQK	RYLSKVLEL	TLADILLYY	KGLEISGTFTR	ETIDINKDPYFM
RLFDEGTISK	RYPVGRFPSL	NDEELNKLLGK	RQAGLSYIR	MVVDIVQEL
RIREPALLSK	KFSPNTSQF	LFAPFIVYY	AFRNLVPVTR	EIFPVSFHV
LLFAPDTPFTRK	LLPGKTYSF	LFFYPLDFTF	LGIHEDSQNR	FTAAIISRV
LLFSATMPK	NYQRLFDFF	NVIAESVVKKTGF	KLYSLLFRR	HRPELIDYGK
SLLSQMLHY	TYLEAHRIVKM	GYFAGKLSY	TAYRPPALR	HTYHIKNYI
SLSVPSVSK	VYAILTHGIF	FLPLLKAQEY	ALNRITVWR	NQTAEKEEFEHQQK
TSLPPLPFK	LYEPVWHVW	HYNNImALY	SVIPHQKLFTR	EVFYPGETVV
YVLGYKQTLK	EYLIVFPKL	FLPGWNLIY	DLFEDELVPLFEK	FVNEIISRI
ATFTVMGLK	IYQKAFEHL	YFPELIANF	LYRPGSVAYVSR	ALLSSGFSLEDPQTHSNR
AIYGRGIAY	VYSIVPQSW	YLFTEAYYY	SVKFGATLR	EAVEVIHKL
KLEDGPKFLK	EYLKLLHSF	ALFmPPTYY	THVDSHGHNVFK	FTSQVIRNL
KLFSEGLFSAK	KFYPPKVELFF	PFLGIGLLY	VYIEKFVRR	TVFTDHmLTV
AVNAHSNILK	SYPSAFSKL	QVHNLLLTY	KTIDMELVKR	IDEPLEGSEDR
IVLDSDITAIYKK	AYKDFLWFF	FFTGDVFGY	RINELPSTMQR	ETIRLEATL
ALAEYVIYR	FYHEAVVLF	GLPGVFVLY	RFDDAVVQSDMK	DDNPNLPR
ILNNKLISK	NYPPQYLILKL	IFLILTTTGHY	RYRLPVATR	GSLGGGFSSGGFSGGSFSR
KVNIVPVIAK	qYILFPLRF	YFGSAFATPF	SQKPVMVKR	LLSSGFSLEDPQTHSNR
ALYHFSSSELMQK	RYPDRITLI	YFLRPmLQY	TIRLLTSLR	MTIAPGLFGTPL
GTYVSSVPR	EYIPKWEQF	IFKDFVNKY	NELIYKR	SDLHAHKLRVDPVNF
TIAPALVSK	IYHTGTFAQI	LFVFIGTGATGATLY	GTMNLGGSLTR	DAVGQISVHV
KLLAHPLQR	IYNFPIHAF	QFTAmRDLY	SVLRRFVVR	YTTDFIYQL
TVLGGVYILGK	IYQRDPLKL	SGLPLILHY	QSWVPLLSR	DVFHMVVEV
SVLPVLDNPLSK	SYGDILHVI	GVDVTGPHLY	ILNLIPSTR	EVGPPLPPLL
AVFEWHITK	VWFPDMMPTW	YVPAEPKLAF	IYLPEVVKPPR	LVTSKGDKELR
RIYNMEMARK	LYLDKATLIW	YYYDPLAGTYY	RQKLVSQIEDAMR	TVTAMDVVYALK
RLFKDQLVY	RYQDGVYWAEF	TMVGKTFTY	HRLDLGEDYPSGK	DAANVmVYV
SIFIGGSFILK	YYIKYNTIETF	GLPSQAFEY	RAKVEVNIPR	EVIRYAVQV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RIFEPPPPK	FYGKYTAEI	GTVYEDLRY	RALSAEAALARAR	ETFFGVQWV
RLLGEEVVRVLQA	HYTYILEVF	TTNFIKAEY	AYVQLMPALVQR	HLGYLPNQLF
KLYTLPASH	NYTLVSHLI	DWIDQAIVKSTQY	GIWLRYDSR	ILGADTSVDLEETGR
IINSSITTK	VYAALQRQLL	MFTELAILY	TVLQYVVGR	DIATILSKV
KQSQILLVY	IYLTFPVAmF	NYNHLMPTRY	IFYTAIVNR	GTIGLIHAV
LLYGGLLVK	NYYAFFKLL	ALINTVLKY	RIFTSVPKR	HTSPLTQIRL
GMFDTLVKIYK	SYIALPLTL	GFAALQLEY	ALGAFLNHR	NVPEGLLATV
RLFGNILDK	VYIVPVIVL	HYLNLNLFF	KISGFPKNR	STIFPLDGV
TVMELVKIIYK	VYLDEPIKI	GLTVTLIKY	TTLPDDMITQR	AIAPIIAAV
KLFGPFTRNYY	QYLTFKPQTF	VLLQLVLRY	KVRGISEVLAR	EVFSSFAHAQV
KVDAGKLHY	RYIDRIHIFF	IFLFLDRTY	SLWHIQISR	TTIAIPFGTALV
TLYSNNITKLLK	RYQGVNLYI	NSLPGNFFY	ALGGGAFRGLPALRS	AVTEQGHELSNEER
TVLGGVLGQK	SYTPVGLIQNL	RLFGISLSY	SLQQLVSQR	EAIEGTYIDKK
KLPTRPGLNK	VYAVIPAEKF	YYYDPQTGLY	ALHHGIDLEK	EIAAVIETV
IIFSPVAPK	AYGKDFHLI	FLPGNFHFY	GGYPYSFWIGR	FTFYASEDKLENRGNY
VTFVPGLYK	FYVRGLFSF	VLREIAEEY	IFVGGLSPDTPEEK	SIYYITGESK
AIYLVTSLASK	IYPPKLHQF	TLNNLAVLY	RVFNETPINPR	SVYAHFPINV
HLYNSLTRNK	PWGIKQAGF	ILLPVSSLLLY	KTIDPKVAFPR	EIYRYIHYV
SLYPQFMFH	RFILNLPTF	TLSDIFLLF	SINLLLAQR	FAVYIHALL
SIFRTPISK	RYMDQWVPVI	GVSQMPLRY	VLNPTPIKR	ETFHDIAQV
KTYIQLLIREK	QMPDPKTFKQHF	GYYLVKREDYLY	ATLGAILNR	HTIDTILTV
KLKEGGLIDK	NYAGRWDVLI	NVADLHLYLY	GSHIPGWFR	LSFFVGYGV
SLYRNILmY	RYLLTQELL	VFMFPVGLYY	LLNAVIVQR	EVVGLIFRL
RVYNWDVKR	IYYVDVQKF	LVFHLPVNY	RAGLQFPVGR	KAGNFYVPAEPK
SIAVPIVLK	LYGKIAEAF	GFIDSFRPLY	STKPGSYIFRL	EASDLLERL
KIADFGLAR	RLPLRLFLI	SVLALVAYY	AVLDVANHFSR	ETVAGIPNKVGV
RVYDPASPQRR	VYVKDLSSF	IFHEVPLKF	GTATRWPLAVR	EVFEKATFI
GLFGGAGVGK	AYALLLQHL	AVTEQGAELSNEER	FAQHGTFEYEYSQR	ITSELVSKI
IVISSAELLQK	AYGWVSATF	FFEAVGVTY	AIKSVKIYR	EASDLIIKL
RQIPYTMMK	MYMENFIEHL	FVVSQPLNY	KFKESFAEMNR	ETFISHLEV
RVIPRITIEMK	SYIPIFPQLYF	RLLSLVLVY	AVKSQGAITERL	SALRPSTSRSLY
KMLEENTNILK	VFGYHGYTF	VINDGLFYY	FGHEFLEFEFRPDGK	SGGGFGGGGFGGGRFGGF
SLWESSQELLK	YYNKVSTVF	YYSHLEGARF	GVNQLKFAR	SIRLVPNMTPEVV
AVYLLPVPK	KLPDVYGVF	GSWDKTLKF	KKVHPAVVIR	TAQVIILNHPGQISA
KITVPASQKL	RYLTVAAVF	SFLPVHLGF	LYWSHPR	EVVGLIFRLT
RVWDVESGSLK	SYLTIHHRI	EFFDSNGNFLY	VLKVIVVMR	NAANIFERL
ATFRFPGALQH	VYTLDIPVL	KLADQIFAYY	GILVVGGVVWK	DVVSLFITV
ILFVPGEYSLK	LYQFNPAFF	VFmFPVGLYY	HLQDLSGRISR	EVIALLHSL
KIMKDILEKK	VYNIHLAVNF	IVLPGNFLY	AGISFIIKR	DVIYPmAVV
KVNIIPIIAK	IYGYVAEQF	VFmFPVGLY	KVNIPFVRL	FVNVVPTFGKKKGPNANS
IIDEQPLIFK	IYTSSVNRL	SFFEIYNEY	QTRSLPATPSK	SSTISSNVASKA
ILKPTDENLLK	LYSTIRPYL	YYDPSTGIYYY	QYIRPVFVSR	EIAQVVEKV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RTTQILLEY	VYFSAAHAL	VFIGTGATGATLY	TILIILTGR	ELSNVLAAM
SVYFPTLRH	VYWTQLNMF	AFGDLALFF	HRDYETATLSDIK	EATKIWAEL
TLLDYTYTSK	EYSKQMQRF	LFIILTVGHY	QFFYVPVKR	FTNQGTVIHF
ATPLSTLSLK	FYAHIIPFL	SFTSIMGYLY	RVKVFGWVH	YDALDVANKIGII
ALYQPLFDK	FYISPVNKL	SYINFELRY	ATWLPQRR	YVSDAFHKAFL
LTGPVMPVR	YFSSGKYYW	TLAGLALKY	HTRTPPIIHR	ETFEKSRLYQL
SLFHAQLAY	IFTDIFHYL	YWKEVLLRY	GPRPPIR	FTSDIALRL
SLMPWFHGK	KYGALVNNF	LLIGAPLFY	SVLENFVGR	RISGLIYEETR
SLYQYFLSY	NYPTKFQYL	YLAVVHAVY	GKLEEQRPER	EVNEAFAPQYL
ALYSVPRNH	QYLPAIRALW	FFDKVIEKRY	SFKDYIQER	SEDIPLNLSR
RVWIQGKFQK	TYTDVTPRQF	ATALFSFLY	SIADRPLYLR	SSHFVPVFV
GLRPGPELIQK	FYIDKDMIHI	STYLVAFAY	TVKWFNVR	KVANIIAEV
IVYLGDYLTVK	KYMSVIAEL	mFFGLTPLY	KLYPLPSAR	SVQLTEKR
KLVGQSIIAYLQK	LYPEIFEKF	AQVQVLLYY	KQFLPFLQR	KGVAINMVTEEDKR
NAHSNILK	qYVSAFSKL	PFLDNPDAFYY	SFSDYPPLGR	ELYPYQERV
KVLSILLKH	NYIPYLTKL	YLVIFPEGTRY	SVLNMVVRR	FTTDVQLGI
RLLTSITTK	YYFSKLIEF	HFAFYAYHY	KTKEYIFLRL	GALEPHINAQI
SLYFPRSPSANEK	VFYPYPQYF	ALHmLFLLY	RALESELQQLR	MKPVPDLVPGNFK
SVLEPPLFLK	QYLQDAYSF	AVYTIALRY	RQKFQILGR	ESFSDYPPLG
TIIDTKGVTAL	TYTSYLDKF	TFLNPALPPGYSY	IGGIGTVPVGR	ELPDFGGNVL
VVLSWVLCLGV	SYFEKGPLTF	YLFHPLAY	LTGPVMPVR	ETHFGFETV
RVRDVFEAK	SYYGPLNLLTF	FFSLPHVGY	RTKLETVLALR	FAADIISVL
HIPLNLSGK	RYISDQLFTNF	NPDDITQEEYGEFYK	RVKEYFVFR	NVKVDPEI
ATFPLSVQK	RYNSQLLSF	YFYEAFEGY	SLEDALSSDTSGHFR	HNIYVDALL
SMFPAAPAPK	VQPRNWLLFA	FFEIYNELLY	SLLQPLNVEID	FAAGIIAHL
KIYNGLFAISK	VYAPPVGGFSF	LYYQPGLLY	SVQTALLNRL	FSTSLVHSI
KLREPNFTLK	AYQLMTDVF	ALNALILAY	TVIGDTVTGLLER	GYGFVHFETQEAAER
RLYEFIVRH	EYLTKVDKL	DLWPNPLQY	YEELQITAGR	MSYYFLHVV
KLIAAQTGTRWNK	RYMLTAGLTAF	SIADLVFTY	RYQQFKDFQR	MVFKPSDVMLV
QIYTYFVYK	VFFKELIQEF	IYADLSLKY	RVVQQEEGWFR	LVYQHSIIPLAL
RLFLFQIQK	EYIQFVPLL	ALARsAFSY	RLKIGFILR	DIFYPGDQQSV
RTSPALKTTRL	IYVISAETF	TYLNDFFSY	RTLLVADPR	ETFFLPLVEL
ATGDMSGLLK	LLPHILPLL	FMITFPYGY	AVRDILEGIQR	ETVHLFMEA
IIFQGQSLK	RYTFYVLEF	NVMGEQFSY	EVVQITWNR	KNLQTVNVDEN
RLLLPGELAK	SYLDRTEQL	FVITKPDVY	LHPFHVIR	ELPDFGGNVLL
VLYHYVAVNNPK	YYMTPRDFLF	FFGmHVQEY	QIVSVAARMLK	LSTLSEKAKPAL
RILFFNTPK	qYLTFKPQTF	VYIGVHVPF	RAVFPSIVGR	QVANVRFNV
RLVPREIIVEK	RYLDEINLL	SFIGAFLTF	RLRAVDFAER	ETFNVPAmYV
SILNNPIVK	TYGGSWKF	SVSDVLLNF	SGFAYHLFPRSR	VVVDRKHVPEEV
RLLLEQILNK	AYVKGGLSTF	ALFTQGLGY	SVITQVFHV	DTFGKINFL
SLAGGIIGVK	EYTRYLFAL	TTTGQVLLY	RQLWRVIER	EAFPIRDPNLHAI
TISPPLQPK	IYTDMGRFTI	KLADQIFAY	SESPKEPEQLRK	ELSDVLIYL

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
SIAAKILSY	SYLQRLEVL	VLLQKVLLY	TYFPSFLSR	MVAPVWYLV
NVGKKTVIWK	RYSGVNQSMLF	YYSGLIYTY	KLASALDLPLLR	FTIDIKSFL
RLLTSLRAK	SYPDLLPTF	YIPLKVALFY	RLQQLRELR	QTYFFPIHL
KVISKDLVIER	KYQELQVLF	FVSGVKIFY	SVLTPLLLR	VELQELNDR
LLFSATMPKKI	qYPFHVPLL	TTIDIGVKY	KIHPQTIIAGWR	FITTVKTAWL
RVFNIMREK	RYDNVTILF	VEVTEFEDIK	KVVNPLFEKR	YVTSILQSL
SVSNVVITK	RYLDELMKL	GAAAIILTY	VIFVKSVQR	DAAAVNFQL
DINTDGAVNFQEF	SYPELVKMVW	LLANmVYQY	YGIPQRALR	HTGPNSPDTANDGFVR
GLLSWTLSR	VSPYTEIHL	SLASVLAQY	AYVDMRKIGSSR	MSWIPQETL
AVNGVQLHY	YYLNDLERI	RLLEIQADY	HELLQPFNVLYEK	SLHTLFGDK
GIISSPLTGK	YYQNYFEKL	SLLVSVLEY	TVIPATVVTSR	TVADFFIKA
KLDGRSLIK	ILSPLLLLF	SVLQFLGLY	HSQDLSGRLR	EVFIKFIQV
VIYPALPQPNFK	VYNNIMRHYL	VVLQDLLAY	KVVEIVDEKVR	NPDDITNEEYGEFYK
VVFEKAIQRT	VYTDILIGL	VVSNILLAY	LENGELEHIRPK	ALEESNYELEGK
FPGTPLKK	EYLERAPEL	FFGDFGFmF	QTQSIYIPR	APPPISGGGYR
SLYRNILMY	AYAKFYTLL	GLLNLSLLY	KYIDYIFNV	ELFAVIAHV
ATFPDPNVK	PYSEPMPLSF	SFAYPAIRY	GHYTIGK	EVFMIDRDNSVFHV
RLFEYILLY	VFIIVPAIF	VALPPGYYLY	SVSDIIRLR	SVTEQGAELSNEER
RIHPVSTMVK	YYLHQNNIVHL	FYAGGFAIVY	TYTSYLDKFFSR	ALAAAGYDVEKNNSR
RVKTNLPIFK	AYLPTGKQF	RYLEmLLEY	VVINYTEQLLR	QVAEIVATL
SAFGQAFSK	HFLDRHLVF	TVGAAAWWFLY	KVITMFVQR	QTIALITYL
AIFKPVMSK	HYTIVFNTF	ETIEQEKQAGES	SSFYVNGLTLGGQK	LASPEYVNLPINGNGKQ
ILFTEDPRVFK	KYmDINFDF	FFAAITNKY	YVQHTYR	LVYQHSIIPL
ALYETPTGWK	RYIPHPFLV	GVLEMVKIFRY	KSIANLIER	PVVFIDGHYL
KQYGNEVFLAK	RYLPTGSFPFLL	MVLDLRAFY	KYIERIITRF	SIQEIQELDKDDESLR
SVFFPESGLAK	VYKYPFELI	TAQVIILNHPG	TVLPKDILQER	DEPPQSPWDRVKDL
VVRDLGFFGIYK	VYPLMKEYF	YYMNQVEETRY	QQFGSRFLR	ESKFFEHFI
KLRQPFFQK	IWLPFPVLL	AVYPVFLFY	KIRDLIAIER	HVFTGEKVAV
TIFVPNTGK	NYIPRFWTF	FALVFPLMY	SVREGQGFAFR	LVAASQAALG
ALKNPPINTK	TYINPFVSF	YLHYLPSYY	AVKGYFTLR	MTTAILERL
VMHTPPVLK	EYLTPEEmVTF	GLPFLALIY	QVYVPPILR	YVPVHFDASV
KLIENPLLRY	IFLDHIGGTRLF	ALLNFVVKY	RTWEKLLLAAR	KDDEENYLDLFSHK
SMLEYFINR	IFSKIVSLF	GVLKDGFTY	VVTDPAFLVTR	nTLmSLR
KLRETQGIEKL	IYLNHIEPLKI	RVYSDLHAFYY	IALTDNALIAR	QELKQQVDSLL
KTLDEILQEKK	QYVTQINRL	RSIPAYLAETLYY	TEGGFVEGVNKKL	EIFSKNYRV
ALYPEGQAPVK	TYLTIFDLF	TLTKIALRY	ALQLIVTAR	SHFEQWGTLTD
AVILPPLSPYFK	DYSSILQKF	LFFASGGGKFNY	DIISIAEDEDLR	TVAAILLGL
PLYSSPIVK	AYLQLFTKL	GLLGVDKLFSY	KLKDLGNLVLR	TVVEFPIRGL
RTAPLLLSY	EYVSQHLVF	TVFSQAIHY	RALAMLQRFS	DTSSLFDKL
RSYDEAILRL	qYLHRFAAYF	NFFPGVFEY	TQLEELEDELQATEDAK	HIPNIFQKI
SVLDMEAITFK	TYQDIQNTI	NYNHLmPTRY	RGEEGHDPKEPEQLR	qVIKPPLIFV
RVLDVGFVGR	IYPLHELALW	WVILQPLFY	VVYPKVIER	SLSAIFNNV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
SLSLPLINR	RYPSLWRRL	WLTDNTYKY	KLLGGLAVR	DVTQIVEIL
GLYEFFRAK	AYPTVKFYF	SVGNFYLLY	KSLPGVVTR	EVFEVVERV
SLYFSTGQNPK	LYMVNGPPHF	VAYQHAFLY	RVGDVYIPR	NVANLPFPL
VISQEPFVPK	QYEPLFHML	ILAQLNAKY	YSNKEIFLR	NVPEGLLATVTV
RLYGSSLTRF	AFNPEPLVL	KLFPGSPAIY	GSRYFALVER	SVFDAYVLPKL
ALDEAAAALTRMK	LMSLIINTF	VYLPPEAFTF	KQKSILYDER	GEFVSETESRGSE
MLYGYQVGLFK	YYRPRFFLL	FVPFLPLEY	LSKEDIER	RSGGGGGGGLGSGGSIRSSYS
KVLENIELNK	RYLTGAWRL	LFQHITALF	TLLGDGPVVTDPK	EAAMAFAYL
QALDRQTATQLLK	AYHNSPAYL	SLFPHPHIHEY	QVVGEATFIAR	ETFNVPAMYV
RLQDQHMFY	NFQIEHHLF	TYFAVNANY	KLYELIITR	EVAQHLGESTVRTI
RVKEIVINK	RYPSNLQLF	ILFKGDLNY	KPFSQHVR	DVSKIFQVV
ATLKWILENK	RYSPVLSRF	FFKEEELEY	LVFVPSLR	GYFEYIEENK
LIYEETRGVLK	VYLTIKPLNL	IALNPTGTFLY	WHHTFYNELR	TASPVIKAV
RLPKGAVLYK	HFHPSVALF	DVLPFALRY	GTQSFVFQR	ESMDILFRI
SLGHFENLQK	IYHNGVLEF	YFVKVVPTVY	VVYALKRQGR	EVFRVVDTL
AVFPFKPPQRI	KYGIVLKEF	LFWGGVmFY	HANPRLWLR	DNAAIIMKV
GLNLHTLLY	KYIDKTIRV	AFFYFEGTFY	ALLPFVDERRLR	HTIFPSEYL
KAGEVFIHK	RYLEVMRKL	FILDVITYY	KQQGVLALR	KHPDSSVNFAEFSK
KTLAYRGFIFK	RYVASYLLAAL	FLPPNLGRHY	AVIQVSQIVAR	MSSSVVVRL
KVYENYPTY	LYQILQGIVF	GWAPTFLGY	FTDEEVDELYR	STSSVFRLV
ALYLPENQVLPHY	NYLPAINGIVF	QMLEFAFRY	AVIDVGINR	EVYQQQQYGSGGR
QIFNGTFVK	RYLEYFEKI	TINPILLYF	AWFEAQVVRVTR	DIAGFIHKI
GVIGQDGLLFK	YFLDKIDVI	NWNEVVTQQY	VSNKWLHER	TAVLKFAAEE
IVYDIAQVNLK	RYISQPPLL	YYmNQVEETRY	KTILKRLFR	REEAPSLRPAPPPISGGGY
IMFDVTSRVTYK	RYSAGWDAKFF	MTIPDWLQAIQNY	RLFGALLER	TTAEVVVTEIPKEEKD
TVIRDVEQQFK	VYKAFVmETF	SVSDQFYRY	SMKSPLYLVSR	EKQPVAGSEGAQYR
VSPYTEIHL	EYTSILHLF	GLPDLVAKY	VTLIPAFR	YTYYYPHYL
KLYQSIIGY	KYIERIITRF	VFVESVLRY	RVVsSVSSSPR	EAMTQIIRV
KTFTWPSILSK	AYLPPLQQVF	ALFTSVFLY	ELVnELLTSWLR	KGVNLPGAAVDLPAVSEK
LLRVTPFILK	IYLTFPVAM	FISGLFNFY	VSIGLTIRNRG	DTAWISSILL
SLFPGSLKPKL	KYIQEAEML	FVNPTSFVY	AYVPGFAHIPR	EIMRNQFSV
ILTCTLLLLY	VYPLKFFFL	SFGLYGLLY	GTLDFYMARL	KVLPQELV
RVINEEYKIWK	VYSFGFERL	RNFDIPKEMTGIWRY	KFFTESRLLQR	EAFFVKEYI
KLTDQTLIY	AYLDALQTL	YFPTVPGVY	NAYAVLYDIILK	LVSNVIELL
FINPKPITY	IYFKNSENLW	AVASDFYLRY	RSLGELYFLPR	VAGQDGSVVQFK
GTmTGmLYK	NYAIFDEGHML	FQMAILLQY	RYYPQILTNK	DVFVVRGAGAYI
RLPLRVVKH	RYMSPMEAQEF	VYSAAILEY	AVFAGFEGR	ETFGMVVKM
SIWDETLYK	RYSGNQVLF	QHITLFLKY	APDFVFYAPR	EVFDKFSNKVYV
SVYDHQGIFK	VFDTAIAHLF	ALLDLSFAY	RAAEDDEDDDVDTK	LVIDVIHEV
AVLGETLIPHY	AYGEFLSRL	SAALIIQKY	RYIHLENLLAR	FASTILHLV
RmLEKLGVPK	GYIKGIFGF	SVAGIFNYY	TYLNILLQTR	FTIFLPASV
SLATVILVK	IFTDLSSRF	ALmATQTFY	VLFDVTGQVRLR	TTALAIYHV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
qLYWSHPRK	TYLEKAIKI	ATSKVALVY	STMTAAIKDLQVR	DVANKIGII
RTMVKTLEY	YYTEFPTVL	IIAKVFLAY	HSQFIGYPITLYLEK	YTQLELYL
KVFVGRFKSR	VYINTAQEF	LYLPSFFTY	TVLDPDLRMTF	FTADVRSVL
AMFALPAEK	KFIWTNHKF	SVTAITVLY	IQKESTLHLVLR	ELFPQLISV
QTYVGITEK	KYVKGLISI	NFEVFTETTY	RFVDFQKVR	EASEFIVYV
RMLEKLGVPK	YYTDFLITL	QYLLVTALY	VYVNYTILKPR	EISDIHTKL
HLLITNSIK	EYSLFPGQVVI	DLATFILLY	YHTINGHNAEVRK	ELVNFIERV
ILFPHQPLSR	KYLVIGDLL	FAYDPSNYEY	AVEDLRWFR	NVAHILQTL
QVLNADAIVVK	KYMPSVKVSVF	SVFGMQARY	DKHIEEVR	EIVNISSGYV
RIFDSPEELPK	LYQRAFQHL	LLNDILLTY	RQLFRILFR	NTTDIFQTV
SQYPNQPTRF	VYPANERFWYF	SNSQLMAVQY	FLEQQNQVLQTK	qAWSPAQNHPIYL
AVMDNKNPTIK	VYSPNMRWII	ALNFSVFYY	STERHRAEVR	ETAFVVDEV
GTFNRAMLRL	YYQDTPKQI	YTLDVPDAFYY	GREEYEGPNKKPR	QTVDIRAQL
GTFQQMWISK	IYTMIYRNL	FFPLPLTPTLY	SQNSLFTFR	EAVDLITRL
ImLPWDPTGK	LYGPKYTFF	GTADITLRF	VTmQNLNDR	EVAAIGQLAFL
RIRNISNTVmK	RFMDGHITF	KLIENPLLRY	RSRYQDILVFR	ITQIEHEVSSS
KLFGETTLVK	PQPDVFPLF	GLLEKLLDY	SFAAFLASR	MTTKLISEL
TSALPIIQK	VLIPKLPQL	SQIDQAIVKSTQY	ALLEVMRMNR	VNLGGSKSISIS
AVPTNIIAAK	EYLPIGGLAEF	VFmHVSTAY	IYLDKMITR	ITTVFSHAQTV
KVKAPPSVPR	EYRPEFSNF	YLPFPIIQQY	SFISFANSR	RDNIQGITKPAIR
RLDQSRTWLVK	RYNPNLNTW	NLGIPTLLY	VYFGGFFIR	THLAPYSDELR
HINGRVLYY	SYLPWFEVF	WYPLWGGImY	IKDIAWTEDSKR	EEVDGKADGAEAKPAE
LILEPSLYTVK	VFSTVVIHF	FIPSAYPYY	RMLERVIGR	nAANIFERL
SVHWFPVQKL	YYSKSVGFMQW	SVLGAFLTF	SHSAHFFEFLTK	EAFHYIFNV
VIYYLAFSAK	EYISTVKTL	SFARLSLTY	SLNNFISQR	EAMAAIFKI
ALYFITPTSK	RYAAQLPAL	AAAAAALLY	FLFVPPQFR	EAmAAIFKI
IVYAVDFNHK	AYIERMNSI	FVADLHLNY	TTFVPMLHR	EIAPHALLQAV
KILDIGLAY	LYIQSHYQL	GLSALLLRY	VKEGMNIVEAMER	EVmKIKAEI
KLIAWERTK	AYLQLLNLF	HFGGKRLSLLY	AYRDAVFLAER	KMEISHLTQEL
SLSSPLNPK	IYQDVTLKW	NAFDVFAAY	EGVHGGLINK	DTFPTAMHI
SVFSGNPSIWLK	LYIQTDHLFF	IVSILYLKY	DTDSEEEIREAFR	DLMAPQPGV
VLYLKPLRI	LYQEHMAYI	VYNYNHLMPTRY	GTWNWIWRR	ETAAFIERL
KTIHAELSKLVK	PYLLYSVHM	FIGYPITLY	RTAALPTFR	ETIALLFEL
KVWSDPFGRK	VYAHIYHQHF	FVAGVVTFY	KSFLPLIRR	EVITKFINV
RSYPVTEQRVK	VYPWTQRFF	FFASGGGKFNY	GALPGFLLKGR	MVMEIRNAYV
IVAGSLITK	AYLITLGKF	LVSPLVYLY	GIPHLVTHDAR	QTAEIFQAL
RVLPAPILQY	IYPTGLFTPEL	VFEYINNTDF	KTYDTSFLDFLRR	STSDIITRI
RVLPAPMLQY	KYLGQLTSI	DFIYLHLSY	RVFPEKGYSFVR	DSSNVVQLI
RLLDTLSDQIRK	LYQDHMQYI	SFAGSFLEY	IYSGYIRNR	NVYPEEmIVAL
RVSTEVTLAVK	RYLDVSILGKF	AVVGIGLVY	SNLPAKAIGHR	EGLELPEDEEEKK
SLLGTWIGK	TYIIPRSVLF	YFLSNLKQLY	AFKDIPVQR	STVSIQIKL
ALFHAQLAY	VMAPRTLVL	ALLSKQDIVLTTY	KSLPSEVERLR	VVAPVTHVSV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
RIFQEPTEPK	VYPADVVLF	SSLVKSYLY	QFFQRILER	EASDVVLEVL
RLLDFSYEQYQK	AYAENIALL	LLLWLLSY	GLFSGLIPR	EVFSSFAHA
qIASFILLR	AYVPGFAHI	YFFGEGYTY	ILRKILGKFY	AGVGEFEAGISK
RIAGEASRLAH	EYQIKTNQL	FTDVNSILRY	SVKEQELQFQRL	HTFYNELRV
RVFAAESIIKR	TYFEKNFNL	FYLPIAAAMY	SVLGSLLYYSR	DLAAVILHV
ATFPVAPRY	AYMDAPKAAL	SFTSImGYLY	KAMENLFINR	ETVGILHKV
GLFGKTVPK	DYIPQLAKF	QFIQDYGmRY	RLIPDFPVAR	EAMKQILGV
SVLNIPMAK	EYLRFLQTI	MALGLALRY	AVFYTFVFR	EVFDFSSGQITQV
RMKLPSSVGQK	IYRWFNISF	QLDDLKVEL	KAFDRITTR	SVAQVKAMI
EEVPADILTQILK	NYLDWLTSI	SFVDPGERLY	GQKPGGSDFLR	VFVDNGSGAVLT
KTYTGPFVYY	KYMDINFDF	TYAPVAFRY	RVLPGLKVPHAR	EAASLFNRI
KISLPPVLK	qYEPLFHML	YFISHVLAF	ATFKDLLTR	HTVMIQETV
RQIDFVLSY	SYITKPEKW	ELISNASDALDK	DYFEQYGK	HVIDVQILI
SVAVRVLSY	SYTDVWEKW	NVTELNEPLSNEER	GTILIILTGR	SLVGLGGTK
KMAEVIGSKL	KFILALKVLF	VLLPVALEF	HSFRPAYR	SQYEQLAEQNRK
LSFDRILKK	KYSDITImF	WLHDIILGY	SYSLFTALR	TTVEIFNKL
RVFEVMLPEKL	EYIQKNVQL	RILPVAASY	LAQFHFTNR	YLAEVAAGDDKK
SIASWFGLK	NYIDKVRFL	VLFSYSFSY	QGVDADINGLR	EFIDQELSRFIA
GLWHMKTYK	TFLPFIHTI	LYIDRPLPY	GTRLPLVLR	EIAPINFKV
ITDPHSPSRFR	TYLPAGQSVLL	FFKYACGGWL	AGALFLHQR	LLPVLESFK
GTILIILTGR	LYSHINQTL	VFTFGSRLY	RLFNAIIHR	NTSDIILVGL
LTGPVmPVR	LYSILDEVIF	FIYHLPQEF	RSGPFGQIFR	EVFGTADLYRV
RIDKPILK	VYTVVDEmFL	FLPGmAIGY	RTLKLSVQR	TVTSVLEYL
HIRESLPALR	YFISHVLAF	AVAFGSFFQGY	TMYPGLPSRL	GDEELDSLIK
RIHFPLATY	KYFAQEALTVL	AFISIGFSY	ALAPKFPEYR	EIYNGKLFDL
RMVEMFLEY	QYAHLEWLL	NNLPDRFKDFLLY	GDEDEEAESATGKR	ESAKIGGIITV
RTGIPTLGK	RWLAQPYYLL	YLIPIVVRY	KLFVGFLNR	ESFGNEIYTV
AVLLAEAARTLEK	RWPKKSAEF	FLIVPFGLLY	KVESLQEEIAFLKK	ILKHTGPGLLSMANSGP
AVVNKVPLTGK	VYLPRVLDI	SFEGNVFmYY	AVTAFVTFR	EIASLDVKI
ALYPEGQAPVKK	TYNIFAITF	SVSEVIEGY	GSRSFIINR	EIIQRIENV
AMLDTVVFK	VYKKSIFVF	IFSNWGHPEY	RVFNSEEFLKTR	qTALVELVK
AVFGAGGVGK	DYPRYLFEI	TFVSIFSLY	KGVDPKFLR	STVHFIIFV
KLFIPWTNQK	IYIINVHSM	ILAEESYLY	AARDFLQTFR	MTTEVLKSL
AVLKHVLTPR	qYEPLFHmL	VFANILLY	TNAENEFVTIKK	TASKVIVAV
GGLPERSVSL	IYQYIQSRF	FILASFLTY	SNINAETIIGLVR	YTSHLHVSL
QAADILLYK	RFLESHWFVW	GYDIKLLRY	SVFSKYFER	NQFQPAAGGYFV
MIASHLLAY	FYSISQERF	RFQFLPHAYY	VHLVGIDIFTGK	NVIHNLATYV
ALIAADYAVRGK	GGLPERSVSL	LLKNSPLVSRLTLY	ITTVPPNLR	TISHVIIGLK
ASNPAMLLY	IFGVIIDTF	LYIQTDHLFFKY	SVLRGAALVPR	TTIDLVAFL
VTFNPKYDTLLK	KYPGFLLNNF	NWSKILLHY	FHDFDHR	DFTVSAMHGDMDQK
ATFFGEVVK	IFTPKPTLF	KEVVEEAENGR	HKLDVTSVEDYK	LAPLAEDVRGNLR
FLVPWFIPK	IYLPYLQNW	HAISRYWYY	KDDEENYLDLFSHK	ESVKIAFAV

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
KTAEDAKDFFK	YYLNLIELF	DKHIEEVR	RLKDSWVER	ETITRVLYEV
RIYIPLPTAK	AYIDYLSHL	FLIDLKTRY	SHEGETAYIR	EVVNVWTHL
GVMSPPLSR	AYQKQPTIF	VLQKLPVGtTATLY	AAVPSGASTGIYEALELR	NTIEHLLPLFL
IVALILSTK	PYSVYLFSF	SFsYQFTSPGIHY	SLMSALAAR	TTVsFLLLL
RLFGISLSY	qYMERLQLL	FTWPDGHVTKY	AYAEYVIYR	GHYTEGAELVD
SLFGSPVAK	EYNSDLHQFF		EIVLADVIDNDSWR	HVIRINKmL
TVAVPLVGK	KTNHVFFLL		ILIDPFHKAIR	IWHHTFYNEL
IVTSVLLLY	RYLRELPLLF		RALQFPPEGWLR	PSKETIEQEKQAGES
KVFERAVQY	SYLEPTSVTNF		RLLDFLQKR	VMLGETNPADSKPGTIR
RLRFSEIPMK	IYTRLLPAL		RVMEVFLAQLR	YTSDLHFQV
SMYDLDGNGYISK	VYVPKEEQLF		STVPSILNR	GGFGGRGGGFGGGSS
AQWQKVLPR	YYIIYRNVF		TVFSPTLPAAR	EVVDHVFPL
GTMPVSLLK	AYATFIVTNYW		TVRDIDPQNDLTFLR	EAIHNFVEV
RILSGPFVQK	RYSDSTFTF		VREEEIEVDSR	GGFGGGSFRGS
SVFALTNGIYPHK	TYVSGTLRF		YVKEQFAWR	RAGELTEDEVER
RIRELTAVVQK	IYWDGPLAL		GVLGSFIHR	WVTEIFSQI
KTYGEIFEK	VYISYLDSVHF		RTLTPISGGQR	FVGYFPATV
RTLLGFFLAK	IYPWVHVVI		SSGGILNNAIASIR	GVQVETISPGDGR
ALAGTFHYY	TYVPWPLML		AVYPIDLVKTR	AKVQPYLDDFQK
RVWDVRPFAPK	AYLKEVEQL		IGLGIYIGR	EVFQGVEKL
AIFKVLNEK	RYEGFFSLW		SQRQAIQQLR	EVMEHRFFL
ALMPQETQALK	VLPGHFNTF		RFINPLKNLR	DVAQIFNNI
KMSSSVISY	AYLSKAMEI		RVNLKFLTR	MVVGWVKEI
LVNQDILENK	HYLNVAFDL		RVVSSVsSSPR	AALRPLVKPK
ASYGLALLH	IYAGAIKSSF		SYLGYSVGAGHFR	MTFDANPYDSV
SIAPPVPLK	SYPTFFPRFEF		RTMALPVGR	NQGGYGGSSSSSSYGSGR
RIGNFIVKK	KYGSVIQLL		SSLPALLFKAR	HVGDIIKEV
SLADFQIEK	NYGRVFSEW		TVLPVPPLSVR	HVTEILADI
RLFGLTKPK	RWLAQPYYL		HRPELIDYGK	EAIDWLLGL
GSYNKVFLAK	AYSPAIQMF		LYIDRFLGGV	ETARIAQLV
SIRRGFQVYK	LYVLQVLTF		SAIHIRVFR	FVRSVHPYEVAEV
VLFFHTMRY	IYNSINGAITQF		VLLGALWTSP	SASPIFTHV
VVYTSEMALK	QYSNNIRQLL		GTLGFGDKFKR	SNSDVIIYV
AVLDQQIHLEK	LYQLQVNTL		ALMDRGAIVR	DVVNILVYV
LSSGAVLYK	RLDLPPYPSF		QTYEKFLHR	SVFGFSFKL
RLKQQTIPLK	VYQYMHETI		RVMGIRVLR	EVTNVWINV
SLmPWFHGK	LYMDKFEEF		GVNGFGRIGR	GVVDIFQTV
RLLQDPLGLAY	LYPEGLAQL		IYFDGDFGQIVR	IQDKEGIPPDQQR
SSFSGLLRK	NYIVPDKQIF		KQRDDILINR	PVPEEEEGFEGGD
AVISPPTVPK	SAPYGRITL		QEFGLARFK	FTFGIESHI
RLAEVALAY	SWMELPGLKF		SYVELSQYR	EAAQILRLL
RVLPEFKKK	qYFDSRGMFI		TYYGSFVTRA	ETVSGLKGYV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
SVLQFLGLYK	YYMDYLAAL		YALYDATYETK	YTFFTPNNI
AQYQFTGIKK	FYITSRTQF		GQQPANQVIIRER	EAIDPLNLGNI
ASYEFVQRLLK	MYIIPVVLF		GYLHWVNER	ISVYYNEATGGK
RVMKALVNR	SYLPISPTF		LTKLPAFAR	DTAEILSRL
SIYPLGDIK	VLPILPLLF		GTLNLDRVTR	EDTEEYNLR
VILPPLSPYFK	RYIHPQQEAF		HHTFYNELR	ETFNHANGLTLV
RMFESENKILSK	RYSGVNQSmLF		SRFPRVAGPRGSGPPM	TSAAVAGIYRV
SVMGVYVGK	RYVELAWGF		HEKEDGAISTIVLR	DIFSDLYYV
ATADVVILY	YYNKVSTVFW		VQNPALRLVTR	DTISTIKDIAV
ALWPQIIQK	GYVVWQEVF		AAWYSGVNR	SSSYSKQFTSSTSYNR
RVPDVVLIK	KYLQSTISF		ATSPALFNR	DVAGGALTHSLL
ATWHPAAGMLNK	RYLWATVTI		DHQYQFLEDAVR	QAADVLELL
KLNGQVLVF	YYLDHSILL		FSSSSGYGGGSSR	VREEEIEVDSR
VMLGTQLLY	YYLNEIQSF		GQASFEAMASIINR	ETVPFIKTI
IALWPPVREK	AYMKSLLSL		HGGVIHIYVDK	ETFGQYPLQV
RLFTVPWPVK	IYDSVKVYF		KAFPYSSHLIR	FLATEGDHLQ
RLYLNVLNR	LYQHAVEYF		KTKGGSKYLIYR	VVTDTDETELAR
ILYVGSMPLK	VYLHDFQRF		mTDQEAIQDLWQWR	EAISRDLSSQLL
RLMEQQGALLK	VYTYIQSRF		RTIALLIGR	HSASIPGILA
RSFIPSLVEK	IYQDRDQFAKL		SLKALIQSR	ESSYVFLHV
VLAPVIDLK	RFLPSPVVI		KADIDLTKR	NEEGFFSAR
ILYIRNLPY	YWKIYNSIYI		VKEVLPHVPLG	YTIPPGHQV
SIAWFTVFY	RYIANTVEL		KLNIRPLLR	DIPHMDIEA
ALAGHQLIR	MYPFQIHSI		RVQELQQGAFGR	DTIAGLSVHV
HVYVGNISK	QYSNAFDVF		SVSPFLLGR	ESIFFNSHNV
QLYSTILSH	NYVKKFQSF		SYNYEIVNR	ETYHGVFVNI
RLHIEALLH	RFIGATANF		ATIELKALR	RSGGGGGGGLGSGGSI
ALSGFTIFR	TYVRWYTQL		RTKLSLIMR	DTTVIIWQV
KTSNLLLSH	FYSQPDHLF		SVPPVPGKPRQV	EVADVGIEV
RFWTSFFPK	qYPGRSLVF		DVGAQILLHSHKK	EVMmLTERV
RLLETVLGY	TYVPWPLmL		GFVFITFKEEEPVKK	GLDVEDVK
HVYVGNISKK	KYLYEEYLQAF		SVVLLPAGR	NVVDVFHAV
RTYDLYITY	MYNLFWRHF		KSKDFVQVMR	ESAAINQIL
KTKEAVLLLK	RYTNGHLFTTI		KYLNWDAVFR	ETFNDFVRL
ITFDVAPSRL	VYPPIQVHVTL		VSSGGKQILFPK	EYVNLPINGNGKQ
ILTYKYLQK	SYMEVPTYLNF		GYAFIEFASFEDAK	FQNALLVR
TLLEKQLEY	IYSTKLYRF		LRQFSDLWVR	NISQVIAVV
RLDSRLWPK	RYSVFFQSL		RTLLYGHAVLLR	NSSRPSQVVAETR
RQTGIVLNR	SYSSTFHSL		SVLAFPNGPFTR	nVPPPFLGL
ADYHRQLQAK	VQPRNWLLF		VTWIHPVTR	AVIHSENFQTLL
HLLELNKLIMK	YLPHLFPSF		VSYPFDTVR	DTFRGVAFV
KMAEVIGSKLNIS	IFIRNVLLF		YRPGTVALR	EVGGEALGR

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RLSSKLIQH	YYDKHFTEF		RYIGEVGDIVVGR	EVYEKPVQV
KLPEYFFENK	HYFNTPFQL		SFFGERRIPR	SGGGFGGGGFGGGR
RLFIGGIPKM	IYIAGHPAF		SVYIPAHGR	FTADFVRQL
RSIPYDQSPGPK	AYNDNWFITF		KLWEISTGR	TATDIRVTL
RTAHVILRY	KYGPVFSF		QVLEALNVLVNR	AAQTSPSPKAGAATGRIVAV
GLFAHELFY	IYRGPFADENF		QVRSIQQTMAR	DSSLPQNQPFV
SLLYGSIPK	KYSDITIMF		SVSTITRIYR	EAmNYEGsPIKV
IIYPTAPPRF	EFLTKTAKF		RIIEKVIHR	FTVVTRDSSIHG
NVYPNFRPTPK	IYTHGLALL		RVLDLGPITR	DAANVMVYV
KVYHLASVRL	RYPPKSGNYF		RVILPALSR	TSEVKQLIK
LVYSSNFQNVK	RYTLQASTF		TVSRFFLYR	VHLTPEEK
NINNPFVFK	RFQEKFFIF		RALLQQCLHAR	AKPALEDLR
AIKVLNK	TFSDVEAHF		KVMGILINR	ETIGVVHLVL
RVLSERLLHK	TYRNVMEQF		VQKPSYYVR	HVFPTPAQQPVATPL
STLPKSLLK	LYVDFPQHL		WGTLPPEPNLV	TVMGKIFAV
VVFDTSLQVKK	YYLTPDGQRF		KIMLPPRNR	AQYEEIAQRSKEEAEAL
ALIGFPSVGK	AYGDIILTF		ATNAAVTVLR	HRHPDEAAF
SVIVQPFSK	IYLTADNLVL		AYIHIVFSR	MTIGTDSALHRI
KSFDTSLIRK	LYLEPQGTLF		RTMWFAGGFHR	TVSDVLNSV
QICRQAGLVK	SYKPIFSTL		ATTPIFANR	AADAEAEVASLNR
GIKDWVTPYK	KYLPALDEF		QYKFPVVITR	SIAPIVIFA
ALARQLLLY	VYIAPLKAL		RTLKPEGNILR	ELFPLIFPA
ALFAKPLKGK	EYPRETFSF		LGRDFTVLAGAR	ESSYIFVSV
NAPLVHATL	KFVETHPEF		ATATVYFKR	EDLYLKPIQR
GVIGFPNVGK	LYIPPTHTFL		KMKEALLSIGK	HSVYIPNKV
RLLEFELAQLTK	VYLPPEAFTF		KTFSEILNR	LSADIFQQV
SVFGTmPLK	VYPASKMFPFI		QYWAFSDIQTGR	NVFPNHISV
VVGAVVFQK	VYTDFAFRI		RLIDVLENR	ESSDVIRLI
GLAPVRSSR	PYQNGFTFHTW		FQLYPRNFLR	ETYPDAVKI
YILSPLSYK	EYLTPEEMVTF		HALLEADVAAHQDR	EVYGGENVEL
AVFGVPASK	VYTQHQPFL		LYRKMEIYR	SIYGGFLLGV
KVSASPLLY	YVIQKFFEF		SLVNLGGSKSISIS	TVANIPEKI
GVMDYYLKY	RYVLYPNNF		LHDEKEETAGSYDSR	ETFGVTTTKV
RTEYNLRLK	VYLSNVVLF		ERHPSWR	NQGVTDFKFAL
ALLVPSLPR	AYISGLDVF		GSMVPFSMR	EAANLFQFL
KLQDFKSFLLK	IYATEAHVF		KVLNLLWNL	LVKPGNQNTQVTEAWNK
TVLRVDQIImAK	KQPEDYFYL		TVFDMSGQGRYR	mTTKLISEL
ALLPKFLLR	qFVPKSHLF		RAPFDLFENRK	EAAGLALGLVmL
GLLAAQKVISK	RYIPTAAAF		AGNYAWVNR	EAFDRSFEV
RKSESKSSISSK	TYVENLRLL		RVHLPSSIYR	EIPEWVHQL
RLASLGLKFNK	VFPRLHNVLF		FSSVFQFLR	LSRSGGGGGGGLGSGGSIRSS
VVYPKVIER	VYGPLPQSF		LKDVLLQVDDERR	ETIAIVEHI

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
KTPDFILQV	AYPEYLITF		KYVTDVGVLQR	EVMPFIDEI
RLLSGVPLYK	GWYDEEHPLVF		RVNILSDMHLR	IWHHTFYNE
LGSTVIKEVLK	YYWQTSAKW		RGMNVPFKR	AAPGAEFAPNKR
LVSSRILSR	IFPKPPLYTF		FGGPVHHQAQR	EVIPVPIEV
RLFSVIFKY	KYPNVFKKI		KQPFKDLGNLR	ITTEILKSV
TLALWPVSK	MYADPNFVRTF		QVKTWFQNR	MVVSDFHVFV
KTLSIFMEY	ILGPPPPSF		RLGQFLTKR	NIPSFIVRL
RTTSHLLRY	KYQPRIAVF		YEKDIAAYR	NTAPLTDYFL
TVYSVFGFSFK	SYLDSIHFF		QVKIWFQNR	RVADILTQL
LLPSHPLEL	IQERAFFLF		RSIPPLFSGR	STFFQETNI
RLEETQALLRKK	QLPQPDVFPLF		RSLDNFFAKR	ELSDIAHRI
RLWQTTEEIPK	VYNSWKNNKF		VGRPPGPYTR	mVAPVWYLV
SLLSVLIPK	FYGDKMNLF		KVLRPFLLR	TTFAHLDATTVL
KLYSILQGDSPTK	HYSSRLGSAIF		RLYTKFSAR	VTVNQSLLSPL
RTLMPEKLSHK	NYGVLHVTF		DYGNSPLHR	HTTDFYFNI
ALPALVmSK	NYLDPRISIAW		HTGPNSPDTANDGFVR	KATGPPVSELITK
AVASEDSVLLY	NYSPVSRIGLF		KKVEAQLQELQVK	EAADVLIKA
SIYVYKVLK	RFPEELTQTF		KYIEGVSDFNLR	EVYEHVYETV
RVYVGSIYY	RYFENPQVI		VQKPSYYVRL	SVYEGGVFFL
TLFASPLAK	VYSAGVYRL		KLKDQNIFVSR	VNDNEEGFFSAR
RLNAPLSQM	RYRPRAPII		RGQVVSLIRMR	YTSEVQAIL
ATIYPVLPK	SYPKIIEEF		RFYDRRFLK	EVFLKAFAV
ALIDYENSNK	VYFQARLYHTL		KVIPPIRSR	EVSKAIINI
RLFGLTKPKEK	AYGSLFNTI		MLRNLLALR	GFEKPSAIQQR
AVAIKAMAK	IFIKDSNSL		qLFVInMKEIVR	QTHSVFVNV
MIYASSKDAIK	IYLPEADSILF		RFWNKNIGSNR	YSFTTTAER
RLAEPSQMLK	KLPSNLPQL		SYVRWEGVFR	ATVYVDVLKD
RLSNIFVIGK	TWYPVSIPAF		AFHPQPVSR	DIFDAmFSV
SVLPFQIYY	AYFPELIANF		SFYQFQHYR	NVYPEEMIVAL
VLTTPWKFK	IYPEYILPGI		VVFHSTVIAKRK	STVEVIFHV
RLFKIDKEYLLK	NYKKFYEQF		LDQELKLFVSR	WTSAITVAI
VTFEKIFSQK	YFIPEFNLF		AVLKWNREMR	EAAAVFKTL
VVLPYLVPK	EYLYFFRVL		RSWQGLEPRL	DVASIFLQV
AISWPLLQK	VYPSSLSKI		RSFSLGVPRL	EAAENSLVAYK
ASLSRPLNY	YYLQGGFNKF		RYFYLFPNRL	EVSWISSIML
GLGEPLALK	YYTPITPHL		VFPSIVGRPR	GVTIKPTVDDD
RTMPIYPTY	AYLPVNESFGF		ATQPWNRIQR	YSKEGWEYV
SLSSPLNPKL	IYPRTQLPTW		ITFPAMVHR	SVALVIHNV
TIFTARLYY	KFFEEVLLF		SAPKINLEIEL	DHAVVVGVYRPPPK
AQATISFPK	LYAFIGVKF		RARPSLTVTPR	GSDQSENVDRGAGSIR
SAYYPSSFPK	AYSAKIALF		VHFEESSKLEDLLR	EAADIIQKL
KSSAISLHY	SYNNFFRmF		RSQVFNILR	ESAWVLTNI

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
SVIDRKDLIIK	TYHEVVDEIYF		GFGSDKEAILDIITSR	EVPPPFTLV
TVSDAILRY	AYAPQGWIAF		ILKEILQKR	VPQVSTPTLVEVSR
KLIPRNTVVPTK	IYELAVASF		KLKDIVSLVPR	ADAAPDEKVLDSGFR
RILKHILTQR	IYLDTHFRL		NKHEAMITDLEER	ETSELWQIKL
TLADILLYY	KYLEESNFV		KTKESLDVSRL	MTYWHLLNA
AISFVLGEK	RYPNKLDTI		RIEQHYFEDR	mVSDLSQVTV
SVSPFLLGR	SYVRSLPFF		SHGIDLDHNR	SVTDLAFKV
RIFVYFITK	VLPQRFPQF		SSLLRTSIMSK	FAAATGATPIAGR
AVREEVEILK	VYNDHSIYVW		ELISNASDALDKIR	TLDPERLGR
IVSAQNLLK	KYGPIRQI		RVVIKQIITSR	VVGEPLPLPQ
QIFSEFLLK	SFYFFFSSF		RYKPTGEYVTVR	EVFPTQHVV
IVFSLTFFK	TYLVDMQRF		VVLGSVPVIIAR	ELSRIVLEV
SAPYGRITL	VYMGLLAVF		HYASEEIKEK	ETFKNSFVEA
QLYWSHPRK	GYLTLVPLL		LLWKDKKIG	TVFAPVIQAGM
TLFASIILK	IYADYIAPLF		HNKPEVEVR	YEDIAQKSKAEAESL
VVFRDPYRFKK	QYVSAFSKL		RLFWPFSKR	GSGTAEVELK
GIKSGRMIFK	SYmEVPTYLNF		YLQHHHFHQER	GVEEEEEDGEMRE
LLFQPLDLLK	TYLPAGQSVLLQL		GTMSDVLRAER	AATEIVERV
QITLPTVQK	DYLEHITSI		VGQYPRFLR	DTATAHSWFV
RIGQVGKFK	LLPSHPLEL		EHIKNPDWR	LTSDIIESI
RVADLVHILTH	QYWEAQGWTF		AMYPDYFAKR	SGGGGGGGLGSGGSIRSSY
TIFGKIIRK	DYAELLQHF		QTMSDTTFKALRR	SLENVPNVGV
VLSLGVAALYK	EYTAKIALL		ATSPIIIHR	EQFGGNPFASL
KIKEIAVTVK	TYFSTPLLL		GTKQLQVLRF	ETIQALETLV
KVAVVLIQK	AYLSEAMKL		KVLQLLRLR	ETSPHTFQLDL
YVNLPINGNGKQ	MWKEGNRIHF		TYYPPPRLR	ETYQFSGVYV
HLLDIQGLPK	NYFPGGVALIW		DtRmGPLINR	NVAKILELV
VLNNSLLLH	YYEDNKQFF		IVRPFSIETK	NVTWVIVNL
GQYGNPLNK	HYIPRAVLL		KIQLWDTAGQERFR	TNADIIETL
AVYSGISLK	PYQSQIAVF		KTIEDDLVSALVRS	QTSQLIIQL
VLYDRQGIGR	YYSLIKMVF		RQADFEAHNILR	ETFVGDYTL
ATGDmSGLLK	SYPNVFLVF		LEYLYLQANLIEV	AGELTEDEVER
KLLESIFHR	DYLQEVPIL		SLKIPNVER	DTFSYTVRI
ALYSVYRQK	RYQNIWNINL		DGQVINETSQHHDDLE	EVFKSEDALGL
AVNEVVAGIK	AYPHNLMTF		GISHVIVDEIHER	EVTPVTGASL
LIRKVFNLY	EYNSDLHQF		RVLSIGLPVAR	EVFDPSGVASI
LSLGVAALYK	KYPDIISRI		SLRLLTHQR	VHTIVISVQHD
QLFRGDTVLLK	RYFIDSTNL		TLYTQIRNR	EIADLVTSV
RTYYSPVYR	SYmFVDENTF		VTKPNIPEAIR	ETWIGIYTV
SLWQVPYFSK	VYQYGSALAHF		FHHTFSTEIAK	IDTIEIITDR
SVLDTVLLRPK	IYTEMTGKLI		SMFDVHVKR	NTSELAKDFI
RLLSTPSFWLY	KYGMVTYLL		AIKIQSVYR	SSRAGLQFPVGR

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
GSWDGTLRL	NYPSAFHSV		QTFLRVQER	LQSIGTENTEENRR
IIFVGTPVQK	PYVDNSYKW		IVKGPRGTLR	TTSVIKIAV
RLYKPILWR	AYGNVFSAF		RVLTAPTLR	VKSPELQAEAK
AILEKSRLK	LYNKDAVIEF		RVVSsVSSSPR	EIIHDLPVL
KLSDILNEK	SYIGFPVEL		THHNDTELIRK	ELFPAPILRA
KmLEENTNILK	LYQEVFGRL		AAQEEYVKR	SLGGGFGGGSRGFGGA
KVIDGERVIGR	NYFIPSHYF		ASIPHVIAR	DPAGIFELV
ELYVILNQK	RYFKGYFL		FSHEEIAMATVTALRR	ITALnLFTRAI
GTWSTGLPK	VYLPEAmPASF		KYLDKELAGR	ITAQIFSYL
RLFPNSFNDK	YYDANQSMYVF		RSWKVFNER	SQVDENDVTL
RVFPWFSVK	GWLPPELLGLW		TSSGIKVPPR	DVSSALDKL
ATSKVALVY	KFMPVSSLI		VQKPGFGVGR	TVAEISQFL
LIYVSVPGSKK	NYIEFTRIL		RLYDVPANSMR	ETIGVVHLV
TVAAGTMTGmLYK	qYQFLHHTL		CSHLPRPPALQPCQGQA	ETSHYVAFV
AVLPAVIPK	VYNIHLAVNFL		FATHAAALSVR	ESIDIITRA
KFKFPGRQK	KYPQLLPGI		SLKGIPTLVYR	EVAKVIVSM
KVGFFKRNLK	KYVKVFDKF		WSRINPNKAR	AELQEGARQKLHELQE
LLPWPFRNK	SYQDFFEAI		VYLTLVEPILKR	AVTEQGAELSNEER
GLTVPTSPK	TYITSVSRL		ITNHIHVR	ETADVIAKV
SGLTVPTSPK	VYTRHMTWI		RLLLPHNR	KSDVEAIFSK
RLFDLRADQELMTY	PYSDKLFEMVL		GILGLGRIGR	TVDQIRAIM
ILAGLGFTPK	RYMGGFAKSVSF		AALPGIVHR	NAGVEGSLIVEK
TLQGPVSFK	RYTPEQDTMTF		YSPHLLANSK	SVFGGKNIHV
VLFFDELDSIAK	AYSVEHNQL		YYLPYYKRER	DNNRSLDLDSIIA
ATLEVILRPK	NYAAALETF		HSVHTLVFR	EAFVHVVTL
GLRGFPNVLK	RYALIMHKL		VSMGGWAARKALR	NVYETTEFDQL
ALNVPISVK	RYLERLIKL		RVFSWGFGGYGR	ESAGGLIQTARA
RSDTPLIYK	TYmGHTGAVW		SMRPPIIIHR	EVFGLAVVV
KIADMGHLK	ILPEIIPIL		KYFIRDEFLR	NTVDFFNQI
KLNVGGALYY	LYAANPGQLF		SLQHANHEKR	DTAEIIKTL
KQLNIKLTSFK	NYNEKIYEL		ATYPYQVVRAR	ETYPDPVRV
KVLGTEELYGYLK	VQPPHLFLW		RLWDLQQLR	ETATMHILV
FLAGVPTPK	YYGILQEKI		KVDENGKISRL	TTAGILATL
RLFIGGIPK	EYLENALKL		SFITKVFRSR	TVIGSGPGGYVAA
VVYMPALSDMLK	FYTAIAQAF		ELLRPIDVATS	GTVFIIQGL
ALASRFLKK	NYLHLDYNF		RSFGHFIARL	RQLEEAEEEAQR
QIFIPMVNK	VFLPIVVLI		QIILEKEETEELKR	ETFYIGKLI
RLFEGTGARL	LFKNDPLFF		KVIRVPPEK	KFGYVDFESAEDLEK
RLKPFYLVPK	KFSNVTMLF		KFYSVNVDYSK	LTPEEEEILNK
KLYPLPSAR	MYTVFEHTF		KLQIWDTAGQERFR	PEYVNLPINGNGKQ
KTYQDIQNTIKK	VYADQPHIF		KVHVIFNYK	QVTDIVVLV
GLYYIHRNK	VYLLPTGEIVYF		IYLSCTSELDRL	TTVDAmKLGV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
LIISSMITGV	YFIADLPHL		KVWVKLIGR	FAQHGTFEYEYSQR
AVWDVGSHFK	RYSVFVNEL		IGWMVSLRYR	QGRTLYGFGG
RIAEFAFEY	KYPASTVQI		AGKPAFMGR	EVFSYHQGL
TLLPMPLSGR	RYVALTSLL		ILKHILTQR	NNAAIIMKI
GQFSGFPFEK	KYIDYIFNV		MSRFLNVLR	SGGTTMYPGIADR
ATEESFFILK	IYADNQVmHF		AVWPVLRER	VQVEYKGETK
VVNSYPLAH	KYLATLETL		QKHKDHFRL	GGGSFRGSYGSS
KLLPDTILEK	RYLMDPDTFTF		ALDPAKMNR	LSSDVISNI
KLDRPRFER	SYRIIYNLF		QLGQFLQHR	TPGPGAQSALR
LVFATMITK	IYNGDMEKI		GLANGEVRIYR	STSDLYNFQV
RIHFHTLVY	VYPFPTFQPAF		SSFRFWQAR	YVNIQLYL
RVMQDIVYK	VYPTAVHVL		AVADTVYRALR	EVIRLAQDAEV
SVLLFVTKK	ALSSVYLLL		KLQPPPLGR	HTAKNAVITVPAYF
KLLDIEGLYSK	VFPSMPIKLQL		AMFPKLNNQER	RTRGAIIQTPTL
KQFDAVLPGY	IYPVNAISF		DHYEATAMHR	SFGGSYGGSF
KTYEVSLREK	VYVAAVREF		EHQHEEIQNVR	EVAEFVQSL
LLGPVLVK	QYFDSRGMFI		QLLKKEWLR	EVFPTAGAGTDL
VVFPFPVNK	MYSDVWKQL		IGSLQHIKSR	ASPEYVNLPINGNGKQ
KLLPQFLLH	RYLVEVEEL		NTTAVAEAWAR	ETFNTPAMYV
RIMENVFQH	TFLNHPALI		FVNDIFERIAGEASR	ETFSQHTFL
RIWEPTYTIMY	IWISKLPHF		ASMPSRTIGR	HTEFIFTTI
RLADLTGPIIPK	TYLPTSPLL		YGKLLKLPTCW	EVIPNSNFYV
RLAEVIKNR	VYLPLTSHI		ATNILNKLRAR	HTALITDIGL
DAPLRDPALRQLL	EYYDKAFDRI		IVKPVKVSAPR	DVIEVIEKA
GIGDVTPGQGLLK	LFIATSQKF		LINNKIANR	NVADVVIKF
KLATTILQH	KYNIYSPLLF		QVAIKVIPR	SSSYSKQF
RmVEMFLEY	AYmQEPLFVEF		ENKKHHSTIVY	AKVQPYLDDFQKK
AVADKVHLMYK	DYRLGAIHSL		VYFKRFYAR	ETVDFKAPL
RIIEKVIHR	KYNSEWWVL		RFKEPLPEYVR	EVIQSDSLWLV
RLLDSEIKImK	LYSGVFVAF		RTLESKLVLFGR	GEFSITYKPVK
VLFHNTIYY	IFHDISLRF		ATRPFQLVTGR	ITAPIEAQV
KmQYATGPLLK	KYMEDVTQI		GTLAAQALRAR	EIADFFTEL
SLNSLLLPK	SFLHGNASLLF		SSKPLYLAR	ETAPRTIFQRV
VVGPVSLPR	SYSHImALI		ATLKDITRRLK	EAAPGALGQVKA
KVHAYIISY	IYREFREEESL		RVYSPPEWISRH	ETSSLSHTLF
RTLKEILRY	LYVGKIPGF		KAQIWDTAGQERYR	MTAAIKDLQV
SLMSVLIPK	QVYMDWYEKF		KISLIQIFR	SVTSTFSKL
ATLSQFYINKL	SYPDNFLHI		KPGGFDISLFYR	HLANIVERV
HVGISFVPK	YFISPTGHSL		LEKHELIEFR	LTAPLELATVLA
RLIDLHSPSEIVK	KYIKDDFRF		QEAEEAKEALLQASR	MVALPmVLV
KLFKPGQEAVK	KYTPPPHHI		RVYVGFTVNTAR	AFLIEEQK
RVFTTVGSAEK	VYTVVDEMFL		IENALITQSR	SICPAAATFQV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RIMSETYMLIK	YYFPVKNVI		RYMTPEDFVQR	SVVADTPEL
ALKTGIVAK	KYIDQGIAEL		QVFNKLIRR	LVAGGVSQTPSYL
AVSLQQLTY	LFIDNIFRF		AYAAPAPEVGRTL	NIDEHANEDVER
RLLPSLIGR	qYPVYWDHLEF		VLDPFTIKPLDR	SVTFVAEQV
RVSGLVPSRF	TYTYEKLLW		ASSYIAHLR	EAANFIMKV
GLPLSPGLPK	IMPEKFEFW		RGLSYIHQR	HYGPGWVSM
QVYISSLALLK	RYQKSTELL		SHGSQETDEEFDAR	EISSILQEL
ILYAQFEIRQK	VYSTPTPFFHTF		QGNRLFVGR	nTIPLFVQL
SLmSVLIPK	LYGMQVLLF		KPHTLLQR	PEEVHHGEEEVETFAF
ALPVLERLIYK	MFQTAVGHSF		YARVRAVVMTR	SGVSLAALK
SLSGISLQK	EYQKVWNLF		RTLIPRYFR	EVIAEAVGV
ALFLDKmGSLQK	IYNQVNVVL		KSLESINSRLQL	DVIYPMAVV
QLFQLPAKK	PYNPIIGETF		LSKDITQLLRKA	EVLQTHSVFV
IVLYFKLRSK	RYQEVIQEL		LYFSWFNVAEGRTRGR	GIVGGKNTVVAIAV
YVYFTNELK	TYIQNFRFF		RLSPVPVPR	TVTDLVEYSI
AVYDPYKPYQLK	VYITRAQLM		QQQIVRVLR	EISPLISYAGEGLES
KNTRIPISK	EYIRSLNQF		SHTGRIIPAIWFRYD	EIIDIFKPV
SIAAAVAPK	IYNGDmEKILL		GYDDRDYYSR	LPPEHVQEL
AILLPQPPK	LYLTIARQL		THNDIIHNENMR	TSHTTISGGGSRGGGGGGY
KLNIRPLLR	QYSRFSLENNF		TAKDFADIPNLR	ESFPHQALL
KLNIRPLLRL	ILPGSLFRF		GTADVHFER	ESSPFVERL
KVCDIYINY	AYIPTPIYF		GHDFHEGVR	MTTAFIHAL
AVLPYELRFK	LYINKANIW		RQKFGYSVNR	YTSRIVVRL
KILPVGGIKEK	LYPHIDKQYL		KVGKFPFAANSR	EIAQmmVYV
MLYPAYYSYK	TYLDIFRDF		QYLDPAQRGVR	EVMQAVARL
VIYIQAIFRGK	VYSETVDLIKF		RTLGLLVKR	FGQGGAGPVGGQGPR
IIAATFLFK	YFPPKGYAF		KMFDVGGQRSER	FKDLGEENFK
RIRNISNTVMK	HYVDLKDRPFF		QSLDKDIVALMVR	AHVDALR
VTISIELKK	VYVGFQVQL		AERRQLLPR	EVMKYITSL
AMWTTALLH	SYKPAPFFVL		SSPQPKLKTAPV	GHTDSVQDISFDHSGK
AVASVPImY	IYQKPFQTL		KHEAIETDIAAYEER	QTAPKIFGGEI
IVYPPPPAK	RYGLVTNEI		GSYVPPRRL	SSQSSSQQFSGIGR
SSFGRGFFK	RYLENGKETL		KVFLFIRNR	KYEEIDNAPEER
RSYSDPPLK	NYSNIRFQF		RVLQPGALPDR	HGGTGFAGIDSSSPEVKGY
ALFASGLIH	YYIQNGIQSF		ATVPRLAER	ESFSDYPPL
NVEIDPEIQ	YYLTFVQEL		RIWQSPRFIAR	EVIKELAQI
QIASFILLR	IGVIAYILL		KVKVGVNGFGR	NSVFVATFL
QLRAQIMAY	KWFTETSIILF		QWLDEQLSIARQR	ALAAGGYDVEK
KLYPVASLFTQK	VYSQFITQL		QFPVGRVHR	HTAEILDFA
LLLAPAVSK	WYPFFRGVTI		VVLPTFILEKR	NNASTDYDLSDK
GLSDIILGK	FYNPFQFEI			VNVVPTFGKKKGPNANS
GTWKTPSFPK	MYIVGQYPRF			EVSQYIYQV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
KLPLYLRLK	MYPRLGGFVM			HLGYLPNQL
SLMNVPLFK	PYISNIYLI			RTLYGFGG
VVQDGITLITK	RYTPAIDVW			ALFPHLLQPV
ALWGRTTLK	TYFDKNYNL			EDLRLPEGDLGK
IIFGPPGTGK	YYAEVETRI			HAAGVLLHV
KLIDFGSGALLH	NYQKRFQNL			EVFQDLFTEL
AIFPSPMMY	SYGSVFKAI			EVVDIIRVNV
AIYNIFSLK	LYAQLVQQRF			DAVTYTEHAK
ALYNIGLTY	DYSRIIQSW			HHPGIAEFPSR
QLRAQILAYK	LFQHITALF			SLGGGFGGGSRGFGGAS
RLYGLGTGVAQK	NYFIPEFNLF			FAWGNGEKVNI
RVGDVYIPR	RYSPSFQGHVTI			GKVKVGVNGFGR
KmKEALLSIGK	ILPKELQTW			KEEDEEEDVPGQAKDEL
VmLGTQLLY	NAPLVHATL			SVSSVVHYL
ITSPVVTQK	TYPNTYIFDLF			EIAQMMVYV
KTTAQVLIRF	NYKLTSITF			EISSLVKYFI
SLYGPGTNRTTVNK	QYQPPAPAL			EVmMLTERV
TISAARLYY	IYQQIIQTY			MTSNIVQCL
RTISGNVYILK	SYSEWLQRL			MVAPAVASV
ALFGQPPFK	VFAGVFNTF			SGYRSGGGFSSGSAGI
AIYGGTYMLNK	VYSEVAAYEF			FTITPGSEQI
ATATLIIEH	IYAIHVEGL			DTFSVQVLV
RLPAFTLSH	KYIDYLmTW			SIIGRLLEV
SLDIPSQFRSK	LYTVVVYDF			ETFAFIQQL
VLYNGFTGR	MYTPKAEVW			FLFDGSPTYV
LLIENVASL	RYLELISSI			QTQISETNVI
NLAIPVINK	RYVDQVLQL			ETAPLVVVV
GLAGLPGSPK	AYLKWISQI			ETGAFFFLI
TVFQYLKMLQK	SYKNGFLNL			ETVGDLRDFV
HIAENILSY	TYPSQDVFLVI			ETVLWVVHV
HLFEHILnGY	LLPSRQFGF			HVALVLFEL
RIAEIFmRH	VYTTNIQEL			ETSPHVIQAV
RLYGNTPMRR	AYLVNTYAL			QTYSTEPNNLK
ATFTNVFGK	RYIFAKNLF			EAFVWEPAMV
SLFTASDYK	VYNTVSEGTHF			EIIDREAIQEL
SVYFRSVEGLLK	YYNPDLLLHTL			EVFDKTYQF
ISSIPINLR	LYLPTRVTAIHI			SVSDISQYRV
GLAAFLLQH	FYLPKDAVKHL			IVIGAPLEDDHGGAV
VVNEPRIFK	IFPLETPAF			LAFPGTHTGHVQLV
ALLTGIISK	IYLDLPQNF			MDSTEPPYSQK
LLYSNPTVK	RYASINTHL			EIAQDFK
VLAGTQLLY	RYKQDVERF			KKPAGPSVSELIVQA

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RIFIGTFK	SMTRYFYLF			LTRTPIVTL
TLFGKAILR	SYLLPAIVHI			GDVYVNDAFGTAHR
GLSEKIFAK	YYGDVIWVI			mTALVNVAL
KLVENILAK	AFIQKSNLI			NVIGEPFLNV
RLATSLVEKL	QYPVYWDHLEF			PASGPIRPIVR
LSYLKYRSP	RYLDLFTSF			SAFGQIYKV
MILPLPLRK	VYLTPESKSSF			SKEQLTPLIKK
SISGPISTSK	IFFENHPYF			TIPDFIFANV
ALRNINLIVQK	LYPQFMFHL			NTFFVLVRV
SLVNLGGSKSISIS	RYQDIIHSI			RMEPRAPWIEQEGPE
AVLDLSWNK	VYEEILHQI			FSHAQTVVL
TIIGELGLDPG	VYPERTPLL			mVVSDFHVFV
ATIEETYSKAMAK	RYTDIDYQVF			VSFELFADK
KTLYLIMEY	SYMWTINNF			EIVTIWDSV
LLLAEPPLK	EWASRFWLW			DTSPVFQRL
ALFVAFLLRGK	EYAVMLYTW			ETSALKFEI
QQLNWKQDSNPLYK	IWPPFQPPAW			EVFPLAmNYL
VVFFTRNGKIIGK	KYQDILNEI			SAAFIISYV
RIQLPVVSK	TYAEKLHRL			EAINIIQGI
TVFDAKRLIGR	EFLRDQPQF			EVIKSLGKDGSL
SVFGGLVNYFK	LYPLTNYTF			IQVLQQQADDAEER
ALSNPILNK	MYINDKLPYF			MSVDLGSESMKV
SLAERSSLLQK	PYRGWFPVI			SEPILPSFSTFAS
AVLAVLAAAKSK	RYQESLGNTVF			TITDIISAL
IVHGDVLTFK	SFLDGRQRVLLF			ETIPLTAEKL
VLADVILLK	EYDNFFQHL			SLYQSKYEEL
FQYDRFFEK	QYMEEIYHRI			GGGGGGLGSGGSIR
RTLPKILSH	VMLGTQLLYKF			HNALESVPL
AILEYILHQK	VYTLDIPVLF			STIALALGV
ALANVSIEK	TYFPTWEGLFW			TVVNFLIRV
RLQHQQLYY	TYLDLLGTW			DVAPLNLGMIAA
RTFPFSLQY	AYLSGMLRF			SRSGGGGGGGLGSGGSIRSSYS
RVRFNLMEK	KYGLGFQII			EAAmAFAYL
TLLGKPLLGK	NFTNVAATF			EAmTQIIRV
KIGYHLLYY	RYLDLLTTW			EATPIVRVAV
ILSNDNQTATC	SYLPHAPPF			EVSFIVQLV
RIRVSQPLTR	YLPPLFWRF			FVYGGPQVQL
RLFNAIIHR	KYLLHSLVF			SSKGSLGGGF
SILSVLKGLT	LFFYPLDFTF			EITDINENI
KLLQEAEQRLK	NYLSIFRKF			IPIPTTQVP
QISEVVVVK	AFFGDVVLRF			MSVPLVHQV
QLFEVKVFK	KYDDNVKAYF			QTISLLAHL

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RTLPVLLLY	LYYTWTDGYRF			YTVQFTTMV
SLWHIQISR	PYAKPIPAQF			ETFGHLVSV
AVSLWAKLK	qYSRFSLENNF			DTSNIITVRV
TVTSYVFLK	RYAEAVQLL			IVAEIIKKV
ALFRALALsR	SYISRTNQL			TYFPHFDL
TGSWIGLRNLDLKG	LYPFLGIRF			DTDSEEEIREAFR
ILNSPTVTSIK	NYIHVGAQL			EVARIQLQI
KmYEEFLSK	TYADIGGLDNQI			MTQDKVFRL
RIFTLKPVRK	VYPLmKEYF			EIIDFFLGA
GVFRGPVLPK	YFFDAAKLmF			LDELRDEGK
VLPTFILEK	VYFEGSDFKF			RSGGGGGGGLGSGGSIRS
ALYEYARRR	VYLTDPQGLVL			DTSRIYVAL
ATRILFFNTPK	QYSDALEHLL			EIMQRTGAHLEL
ATSVITIVK	RYEGILYTI			ETVIPVDVM
GLVDVILYH	RYLEKPmEI			FTFPGNLVTSV
RLKLSTWKV	SYMWTINNFSF			IETIEVMEDR
TLSNQPLLK	TFPSLLLVF			DVASFATKL
ATISNDGATILK	LYANMFERL			ALKRQGRTLYGFGG
ALLDITVTK	EYMEHVYLI			NLEKETEGLR
RTLSESFSRIALK	HYATLYFVF			VETGVLKPG
KLMENTFVSK	LQPFIYYRF			DVSSILTSI
ATLLIFANK	TYAPLFSLPSF			ETVIIPEQV
AVYLRALVR	VVPSGGFFPTI			EGDFLAEGGGVR
GILPPLMQK	KWFTDTSIILF			NSASIFNTL
KVAIKIISK	LYNKIREDF			SDLHAHKLRVDPV
RMFDmGFEY	NYYPGSLFLTW			ELSHVQIPV
SLNNKILNR	SYLKEFIHI			GGGGGGGLGSGGSIRSS
AVFQIILRR	MYLLDQPVL			SAAFIFSYI
FTAPPVLGK	VYPLYTIVFI			DLAPINAFI
MAYLGTITK	AYIGFIQSL			EAmNYEGSPIKV
SVAQLLLSK	AYTTEHWLV			SPPPPPPQAPAE
AVDSQILPK	KYFQLDVTL			TVAELFTRI
AVLDALLASK	KYNFPLVTL			TVVDLHFPL
LVMTHLILK	TYTEFVPQI			EAVSVVGFGV
VSFPAGKFTIK	EYIPEGEILVI			EVYAQVARL
IIRVAVLDK	IYLLENGLNLF			YVNDIVIGI
KMTDVQIATKL	RYPSTGMLVLF			GGVPTDEEQATGLE
AMYSRKAMYK	RYmGGFAKSVSF			mTADLPNEL
APLRDPALRQLL	SYTQFLLPTNAF			STGQWHSESGSFR
GLINFGIYK	NYLPQISHL			AVSDILEKL
KLPNTVLGK	YYQTPRLWLF			TKPYIQVDIGGGQTK
TImPKDIQLAR	KYKKTTPEYVF			AVRmPSPFR

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
ATLAAVLQR	KYLMELTLI			EIANILQEL
HLIRAPLAGK	RYEIPESLL			EVADLQPQL
KVYNIQIRY	RYLEKPMEI			EVIRGWEEGV
RLSSVSVTY	VFTPVVQRI			EVSGNVSPGTRR
VLYPHPPLAR	IYFDQVLVNI			VNVDEVGGEALGR
ISWEALRWKA	RYVEIVSQF			EVMEWMNNV
KLNIPAILR	TWSADSKVLLF			FAIGIVGDAGV
RLIELVDRGLVEK	VYSIRLAYL			GGGQIIPTAR
RTLADIIMEK	VYVTSPLVNNF			NDENEHQLSLR
KTLEGVITRTK	EQPETYYKW			SVAEINVLI
ILFDGIPLEK	EYSKYLQQAF			EVSWISSImL
qIFNGTFVK	RISLPLPNF			GTAAVFNAV
GTIPGNPYPK	YYPELAFQF			HGGVIHIYVDK
KTLERSYLLK	IYLDGIITI			PVEQYLGVP
KTNFRLLKR	MWSPTHPALF			YLMEEDEDAYKK
AVNFPFLVK	QYVDFHNQL			EVYPFGIVGM
RIVFPSRAK	VYVQELQKL			KDSGRDYVSQFEGSALGK
RSAQPLPLKI	IYYIDMQKF			MIFDHEFTKL
RTVLKNLSLLK	VYmIRVYLL			NTAYIQAIV
TLWVIDQGLKK	IYPPINVLPSL			TTVDAMKLGV
ALFGVVFPH	IYTHGLALLGF			EASYLITSV
LVANFFPKK	RYLPQCSYF			ETTPVHPLL
RLQEALNLFK	VYFGDPVSL			EAFGDTKFSAV
ALFEVPSLK	AYmPHTFFI			ETSDILQRV
MVFGAPVPK	KWFDFKLFF			qTVGVIVRL
SVLSALTNK	RWFTHASPTL			FSFGGKLVTF
KILGPQGNTIK	TYGKIDLGF			LESSVIKLE
STAAFFLLR	IYGLIVALL			ESIDRVYSL
TLYSNNITKL	IYTDQAGQWRI			KTVYFDFQV
KEGLPTRALQK	LYIYPQSLNF			LEGEGSSGGGGRGGGSF
mLKLLRSAK	EYVKQTWNL			QTVDIPENV
ISQEPFVPK	HYIYIENQF			GGLGGFGGGSFRGSYGSS
KECARKPNKKICRKGGSG	NYKSIFLQI			TVVAVGSGSKGKGGEIQPV
QLGALFILK	RYmDQWVPVI			YAAELIERV
RLMHIQPPK	SYLSSLSHL			EAAGImENI
SVISSPLLK	IYLRDPVQV			SYVGDEAQSK
KLPVVGIGK	YYSHLEGARF			YTSHLRSLV
RTLEPLAKK	KYMAEALLL			YVVSVIEQI
SLPTVIMRNK	EYMRSGLYSTF			DVIDImENL
qLYSTILSH	LIPEEFFQF			ETFQNSVFV
KLLNILADYTTK	RYPAIIYNI			ETILISNNQV
MIYASSKDAIKK	VYKDSIYYI			NVAPIINRV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
VDKAIYLSGY	SYmPTVSHL			SGGGGGGGLGSGGSIRS
KLLPNGFTK	AYNRIVDAL			SSRSGYRSGGGFSSGSAG
KTMNIYFPK	TYQTIIELF			ADGYEPPVQESV
TIYSISSLK	FYVDTVRAF			DVAPQAPVHFL
VTYRNLINKL	RYQETFNVI			ETSSLFQISV
AIMPYGVYK	SYMGHFDLLNY			MLAWINESL
FFKEEELEY	AYDDKIYYF			EASYVNLPTI
SVFAGVVGVK	IYVGIESNHLL			GGSAVISLEGKPL
RTAVYSLHK	LFLPYSHFL			HSTFFPALQGAQTKMS
RVLSTPDLEVRKK	NYIFRLSQF			IGGIGTVPVGR
SIYIAYGPNGK	ELPKHYFSF			ISYFVAEFI
ALFKDSEILRK	IYLTFPVAMF			QVTQIRIMV
AQKFPFNTPK	KLPNFGFVVF			VHLVGIDIFTGK
KVSDLTIPK	RYQEMIQKL			EAADIVESL
QLFSFPIKH	RYIPSLPDRI			ETFNVPALFI
RLRELVPGVPR	YYISPRITF			ETMPSITKDMDL
RTLNPQMLQKK	KYHPRVLYI			HVTmVVAEL
GLmGSGIVSNLLK	KYVGAVQmL			DSGEGDFLAEGGGVRGPR
LINPSLIGSK	RYFDVGLHNF			TVIQnSIPQTGV
LPINGNGKQ	AYILDTLVF			TVTDVVRFI
RVFTGVVTKL	IYEPNFIFF			ETTPLTIEKL
mIYASSKDAIK	SYANYFIRL			KKKAPAAASEE
RVVSYQIRY	IYSRIDRLEAF			VNTLIRPDGEK
MAAAAFAEK	KYGIQMPAF			ELAALFYSV
RIYLDMLNVYK	KYQILNNEVF			ETINLTHTAL
SMLPGSGSVPK	LYIGSSKTF			TAmDVVYAL
GLFNRIIRK	NYLPFIMEL			VTVnQSLLSPL
KTLDSALFY	RYVQQLQRL			YIDQEELNK
LMAISATFK	VWLEEELKTF			HTISPLDLA
HTPQFFIYK	GYTPDWIFLL			MVLPFEPVPV
KIGGIFAFK	QLPELFHKI			VTFAPVNVTT
QVLTLPLmLK	VYFIGAHNI			YTIPPMEKAVV
AMFSPPVNSGK	VYQIFDTFF			DSPSVWAAVPGK
KVMAGSLLLDK	NYIMKIHNF			EISHIVNRI
ALVFPPLTQR	YYLNDLDRI			GFSSGSAVVSGGSR
EIYDPRNPVNK	RYVMTTTTL			LATDILMGV
MLMKNTIIAAK	AYLALFLKL			LKRQGRTLYGFGG
LTYRRRLSY	TYNQKHSLF			LTAEITSKI
SVANADIINAAKK	VWTPIPVLTW			VAFTPEGERL
QIFKPIISK	VYAEIMAVL			GGGGGGLGSGGSIRSS
RMFQDIGVSK	VYYPELFVW			ESADLIHWL
ALALGVTLLK	LYTELFTGF			FHLNESGDPSSK

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
GTMTGmLYK	QWPQPDKPMFF			LSSNVILHV
RIYPYAAISY	SYmEVPTYL			SAINEVVTR
RLSPVPVPR	VWIYDPVHF			ASSEGGTAAGAGLDSLHK
SVFLLEKDRLVK	DYNFVFTSF			TTYYIHQLL
AVLGPNVSIGK	KYLLTPVNFF			EVFGVIRSL
RLQEIFTEK	NYSGAAEYLYF			HTFESHKDEIFQV
AVYSmVEFNGK	PYAQPPLGRLRF			HVLVTLGEK
LSGPRLLFK	RFLAATFLL			NSADISITL
GIWPEKSFCL	VYLGLPIFRF			qVFPGLLERV
KLWDEVLSHL	NYPVWDTQF			TVAEVTSIQL
IVNENLVERF	RYKYIFINI			SIFGEDALANV
TLFQLKFTAK	TYDKGYQF			LVFPSEIVGKRIRVKL
GIFPLSFVK	VQPKQDAFANF			TAGREADDIVNW
AVATFLIRH	VYSGGVYLF			GGNQEIGPLPPT
SIFFESMPYK	qYEQVKQLF			IQVWHEEHR
VLFVSVLPF	QYFPKAPEF			WKDSDEADLVLAK
KSNSIIVSPR	SYLEKVVAI			CGVHQLATL
GLSNESVNLLK	IFIQNSKLYF			DAHTVLALI
RLmELFPANK	NYmPGQLTI			DVSIINITV
RLNEKMITK	RYIIKKDFF			TVmGKIFAV
RVFTQLGSVLK	YYGLYRDLF			HIADIVHTL
KLPHRLIEK	VFPFRTFYL			DIAGRDITRYLI
RmFDMGFEY	VYAGMITVF			ETVEVVNSL
IVGTVLIIK	VYPGIAVFF			HQPFQVTPTP
RILYIRNLPYK	YYINKISSTL			HVIRINKML
YLYYTGRIK	IYTWIEDHF			YSIDLSERV
TLFNLGLTK	RYILEPFFI			EVYDPRSLYERL
VSLGTPIMK	SYISKVDVL			MTVQILLKL
AAPAWAALPL	SYPTFFPRF			QTISITKAGV
GGFGGGSFRGSYGSS	TYIPSTQNPAF			RVAPEEHPVLL
RLYERLFQH	AYMRSLFDYF			EIVDKSGVVRV
STDnKAEIILLK	EYLQLLNLL			ETFPGVTALF
AVLTESMIQNLIK	LYSEVSHLL			ETYLNISQV
MVYVGIPK	NYISGIQTI			FTAGIVEAV
GVFGFPLGR	VYLPGSRQTL			EASAVIQGL
SIGSPVGTPK	YLPTLWVKL			EATDIALLL
MLILGFIIAF	FYLRDPIDL			EVFGFISLL
SLYGPGTNR	KYMGIPQIRQL			ATPRYMTYN
AIYKQVLR	QYASAFHFL			REYHTEKLVTS
ALAQGVLEH	TYTNAFAFTQF			TATEIAINV
HTLDSYRILQK	IYLPAAQTM			EVYPGQQYL
RQPEFFFYY	LYVYPQRLNF			EVFGHAIKA

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
ILYVGSmPLK	VYHSDIPKW			NLQIDPSIQ
AMGDVVIFK	NYATGQWTRF			QTALVELVK
EAGHQKVVFY	SFPHPLPSL			SLVGLGGTKSIS
KVnFVPPH	RYPDNLKHL			EAMNYEGSPIKVTL
SLMQIDDNVMRK	TYIRLYGRKF			mVVGWVKEI
KVLPGHSVPLFK	VFLNLHTLKF			YAAPGGLIGV
SSNKQILINK	VFTEVANLF			EVSGNVSPGTR
KLDSVRVLR	AYLIDIKTI			MSSPCHIEM
RVLTFLPAK	AYNPMARDLF			ESTAIIAVV
TVALLPNGK	MYLKQILYL			LVFPSEIVGKRIR
AVRTLNKVAMK	NYGDYFNVFF			TAPERCLSDTPPKAC
IQNVPLSEKI	RYVWWKKSL			ETASVVAITV
RTIFPLFMK	SYLEPGSIRHI			ETFVMRLTV
RVASVMQEY	YYVRAVLHL			ETVNALISDQKL
IVTSINFSK	TYNEPGSQVF			EVAPSFGTL
TLLDLMIAK	IYSTLLQNNI			GGPGGFGPGGYPGGIHEVS
ALLGTSGLK	IFPPSMHFF			SDYPPLGRF
KTQSEKYTTSF	IYFRSYKLLL			SGGGGGGGLGSGGSIRSS
RLYQRALQKL	IYPYVIQEL			EIFRNLASV
KAFGRRANLFK	LYRDVTLETF			AADPPAENSSAPEAEQGGAE
LLYKHIVGK	VYPNWAIGL			ETSPHTFQL
RASPFLLQY	YYGPLNLLTF			IIAGVIYQA
DVVRSGASLLSNMSRH	KYLADLPTL			NVASSILSHIKA
FPEILLIVLK	RYIQWVEENF			TVAEITGHQL
AIFPRAFPK	AYVGDLQTL			SSLLEKGLDGA
KMALPmPTKR	IFPPVVnITW			AEKLGGSAVISLEGKPL
TTVPRRLGPK	IFLSQPILL			DTFSGQFVL
VVLTRVKEK	VYRNKDALSHF			EVISFVPPPL
ATYKGVPFEVK	DYVPPELITLF			SVEDIFSEV
FAPYNKPSL	PYVGGLEEF			ETFPGVTAL
WLRQKVGEK	RYAEEVGIFF			EVAALIRSL
ALNALILAY	TFTDHVmLF			EIADKIYNL
KLYGKPIRV	EFLPFHFLL			LKYENEVALR
KVLAIQARK	MYLPEAKESF			MTVAIVKAL
WPRSLTLLQSN	AYGASFLSF			QVTGVTRVTI
HTFGGPLLK	AYLPEWKENI			ETVAQIKAHV
ALPEIFTEL	EYGFYHDFF			NTQGLIFVV
RLRQIFNGTFVK	IYPEVVHmF			STKAVAGQGEL
QLLAPLPGLLQK	KYMDVQFDF			AQYEDIAQKS
ITPCKPIDIK	KYLNWDAVFRF			DQSYVISFV
KLMENILLY	PYSSIDQLL			EIFFHPEFA
SVVLVYVKI	QYEQVKQLF			FAFGDVDGVGINA

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
AMMAIAIMK	SYLITSVEL			TVDGSSMSLAVD
ALYYPELYILK	TYIPGTQITF			AVVGVVAGGGR
KPRKPATSSKP	VYWEGYVRF			GGGGGSFGAGGGFGSR
LIYVAGGLTK	IYAPTLLVF			FTAPTFTGSFL
RLYDWGLRGY	QWPELLLRF			YTLVTYVPV
RALDIPLVK	RYAVEILTW			nVAPIISKV
RVFANNADQQLVK	SFMPNSPRF			HYVVSEPLGRNSY
ILNLKVIDK	SYAQGFMLL			KGSLGGGFSSGGFSGGS
ILYENPNFTGK	VYTVVDEMF			NVHAAEFVPSFL
AVLPTPVTK	IYATIMDFF			TLPYIKQEV
AVYPVFLFY	MAPERVASL			SAAGVLIKL
QLYPRNFLR	AYARIGNSYF			SLVNLGGSKS
ATQVAVSVPK	IYVQALIFRL			EIVNIARQM
RLLSPPLRPRL	KYPVLFQRI			AFHNEAQVNPER
SFILLEIIK	LFHSGGKFIL			DDEVQVVR
KVLDTIMATKLDF	SYLDMSKVIIF			TEVLKTHGLLV
RLLLLLLRY	RWFTHASPTLF			EMVDIIETV
KGFLTRRLM	VYLDRKLLTL			FTAVVITGV
RVLPSSLMLPK	YYPSTPGRYSI			SRSGGGGGGGLGSGGSI
VTFRPLFFKL	AYSLNFPLL			DTIPVVHASI
QIRPSGNLPLATK	AYVTVLEGF			GKVKVGVNGFGRIGRLVT
GLLSEKAASKI	IFLTKANLI			QVIKPPLIFV
VIYVPLTDK	IYMEDGLIKQI			TAMDVVYAL
MAPLKMLAL	SLPKFYLLF			YESLTDPSK
AVLDYENRESTPK	qYNTYPIKL			ETVPAVPTV
ALAGIVMTK	KYGPVVSLL			NTDEMVELR
IIWLPTGAGK	RWLDGSPVTL			TTIENISVSV
SMNIPALVGK	TYLEKAVEV			SVTSIIFLV
RIRDLNDEINK	SYRSVQEFL			ESFGFTADL
IITSVLRIS	TYLLSVYRL			SYSVYVYK
RLLGLTGLLSK	AYVGDVPIL			NASPVISSV
IVNIIVPTK	DYIDGILIKTF			EAAALLIRL
KmALPMPTKR	IFTDLYYLTF			EGAAVFWNV
AVLRIPILY	KWFNVRNGYGF			ETSALHIVV
RLLSLEGRTGMAEK	RLFDPINLVF			FKLAQAY
ITNPKSLLY	RYAALRELI			YTAEIKQNL
PEYVNLPINGNGKQ	SYINPDHLKYF			DVAPPLIVHNI
RKQFTAGSYDILTI	TYGVSFFLV			SFVNDIFER
RVLKPGGLLK	VYVIEPHSmEF			SIIAEVKAQ
SVAQQLLNGK	LYEQAFQLL			KVEYTLGEESEAPGQR
QIFNGTFVKL	VWGVPIPVF			THINIVVIGHVD
RTRDYASLPPK	AYTPVLNQF			YHTINGHNAEVR

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RVSPQPMISRL	EWLNKFNTF			ERPGGNEITR
RLQDQGLILYH	IYTDIIYIF			ELISNSSDALDK
GLYAGDPVSK	RYLMENTFF			EVISGFYLV
SVHWFPVQK	AYVVFVTTL			GYAFIEYEHER
TVWNKPTVK	KWFTGPQLI			TGSWIGLRNLDLKG
ILFYEnRLK	KYLHPPPHL			EVmPFIDEI
RLNIPVSQV	IFQDVLLQF			LHVDPENFR
KTIDYIQFLHK	LFQRTAWVF			RSGGGFSSGSAGI
VLPLFVLSK	QYQVQFWKM			SKGSLGGGFSSGGFSGGS
GLRDPLIFK	VYISNGQVL			EIIEDLEAQV
LADLLVPTKA	IYSEVATLI			EVYEGEVTEL
KSFPGIPLHH	SYALLTYmI			VLPYFPPGL
LAYRGFIFK	KYINTDAKFQVF			LVANIIQNV
LEDLLTSLLQR	VYAVVRGLF			SQFVPPFKGNSV
STYEKALGY	RYAVVLNATW			YEELQITAGR
KTRTGELINRL	TFQMKFFYI			EAAEIHLRL
QTLVRILSH	LYIISVKGI			EIPEFLFGEV
SMFTAILKK	QYDGIFYEF			ETIGLQHIKV
ILPYPVSPK	AWHPHTNKF			EVAGLRQLL
RIYSYVVSR	AYIAVGSISF			VSDVVST
RLLQDVGLVSK	DYKNTFPKW			DVIPPLEQL
KGIVPLAK	TYLNYVVHL			EATKINLSL
LILPTIQKS	AYVVFVSTL			GSGSGWSSSRGPY
QLYDKGLVY	IYQRHVYNL			EIEIDIEPTDKVER
IVLSAVITK	LYANmFERL			ELHYIPIRV
NLATPIAIK	VYLDGHLITTV			YTGIVNIGV
GTLAEFIQK	WYGWHFPEL			ETADITHAL
SIYRPSKNLDK	IYFASVSETF			ETASILMHA
ASYVSPVLK	VHMVTHF			ETTSEELGAVTV
AVLSFSLYR	FYLPGLAPVNF			NSNPALNDNLEK
GTSSLFIYK	KYSNMEQSLF			EAAGFTDFL
RTIQMFLVY	LYKELGEYF			YTFSEPFHL
AVVPSYIPLVK	TYLRDQHFL			ELQGFIARV
RLYPVFFLK	TYPDVNNSI			EVFIHKDKGFGFI
RVRDVVTKY	FYQPKIQQF			EVPFFPARV
AVSNSFLAY	TYRPLNDVHI			LTSGIVIQV
TLRNIQGLFAPLK	IYPRAPDLF			EAAFILQNL
STFSAPLNK	AYSTVPGYYSW			EVFEDAAEI
VVYAPLSKK	EYLKNVLLQF			VMAPRTLVL
GVFLSLIQK	VYSIINGIVF			YYPTEDVPR
GVNPYILKK	SFSTVTNTF			LARITGIGLGGRAP
HSIDGRVVEPK	TYVTILPEL			DEPPQSPWDRVKDLAT

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
GLYEFPLNK	FYLFDLKAF			ILASIFETV
RIMKKTSLY	SYSMIVNNL			MTLPASSVPHITV
ATIGFSLVAK	TIAEIKNLF			ETTDNVFTL
AVFVTSEASLK	TYIQKIFRM			EAIDFIDSI
FLFELPSRLTK	VYIGKLNMI			TVIGSGPGGYVAAI
VVDPVVREK	VYIRGSKIRF			ETFGMKLSV
VGQLGTVLRNLKL	MYQEHINEI			EVFGFVQTL
AVQEFGLARFK	IYSDDLGVTW			ATFFLPYLL
KISALALLK	PYFNAPVYL			EVSALINKL
KLAEILYYK	IYFKNSENL			EVAYIDGQVLV
TVAKIILIH	RYNERLDRLFI			LAPLAEDVR
ATFRLKDGVLAY	IYMDTLNIFM			SYFEKSKEQL
KTNGKFLIR	LYIPSVDLL			DVVGITYDHV
SVLNFATNR	VYSAAILEYL			MTAKIVGDVFI
SIPGGYNAL	KYNETFQFI			TVMDSKIVQV
TTVPHVFSK	VLPSRFLNW			KQTALVELVK
LTYLPHGCPKTS	YYIDDVFHAL			EQQIVIQSSGGLSK
ALLAYTLGVK	YYIDKLEYL			HTmSSSHLFYL
GLSEVQLNH	AYYPAQGVQQF			IVKDWNDMERI
GVDIRVRVK	FFIAGRYEF			EIAtRVVV
QLSQIPLLGK	KYPDLFQVNL			RVAPEEHPVL
KMHIPLEVRL	SYLIIHQRI			TVVEIILQA
KMmADYGIRK	EYNQWFTKL			ELFPIQMEGV
ILTSVLLLY	FYQKEHWNYF			ESIHVTLNV
LSLSSTPPGKEAK	VYVDFEGINF			MTASVLRSISL
PVEQYLGVP	GHNGWVTQI			SVFTFVAEV
SSYSLKLRATDSGQPP	LQPKQFPFL			HTKFVRDMI
VTFGETSGAAICLP	RYGPVVKVVF			EVSSVVQVLL
SLLHLTLPK	YYLSYIEEW			IIKFPLTTESA
ILFIRIMPK	FYTKDLIVM			ITAEIyTL
SLDIYSRLR	AYIKGGWIL			SVIDIINGEA
YAPGARLAL	SYNPLWLRI			TVADMLHVV
QLYEKGLYY	TFLTAFCLPSF			EHALLAY
SKEIIFLPSK	VYAFNLDTF			VDIINAKQ
VLNGNPLLH	VYSTPTPFF			ESSGILNVLI
TLPTSTLQY	EYTDVYPEI			LVSQYFQTV
AVLRNQIHVK	NYLVRINEI			PLLEAVPKTGDEKDVSV
KVYEGERPLTK	VYALKVRTI			NFYQEHPDLAR
AIYKTPPGIQK	LYNDRMFRI			GPLAEVRDLPGSAPAKE
KVYDQmPEPR	YYLIMLPFRF			KPKAAPEGAGALA
RLLAEPVPGIK	SFLFVHPEW			TIAQVLVHL
GTKLPGLLK	IYNGKLFDLL			EQADIFERV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
SLLPLQPTK	NYITAALKL			DISQLFDFI
ALVGSYGTSPEGIGGY	QYSYIDFKF			ETSGFVDKLF
ALMTIFTIK	RWLPQKNAAQF			ETVLIETQL
LLWKLAGLLRESG	IYDIVRNSW			IAnSLPnVAL
VLFSATLPK	VFTYVGALF			YLYTLVITDKEK
RLLAFERDR	HYIDDLVVI			GPEETLPGQDS
PTYKGLLMSLQN	LYLPSFFTY			YDDVKKNSG
RLNHYVLYK	SYLVQYMQF			TTVDLSVHV
TVDGSSMSLAVD	VMSATFAKF			MVDVLVFASS
HSPTPVAPHPVTVPT	ALPSKVPAF			MVSSIIEQL
LIYKLFTLK	NYKSEEEFIHI			NTFGAINYV
LLNPFQPSPK	SYFIEPVQW			QVIILNHPGQI
TVTEVLLKY	KYIVQVDGKIGLF			ETSNVITESL
RVASPPIKY	SYADNILSF			GDSTFESKSYK
TSYVKVLHHLLKISGG	SYSDLVLFF			SVIDPPAVNL
KLFNGTFLK	VYLKPSYAF			ETWLnGK
ATFMEVLTK	KYHTHLLQF			MVAHLAINV
ATFIKAMFK	RYKLYQEMF			NRGDSTFESKSYK
LLFNPSGPYQKK	TYLGKYWAI			TVAQIKATV
QIAVIAIFK	TYSPFGDSPLF			VSAGAERVPVAL
QLFTDGITNK	VYANGIRNI			EISAFHTLL
TVRAGLTPK	VYPAGFVYI			GGGGGGFGGGGFGSR
RINFYKKTYK	VYTVVDEmF			LIEVDDER
RNLVSYLKQ	IYVGRVKSF			YAASSGQKK
RIMDPDVITGY	NYVDLVSSL			EVFDEVVQI
RTYGVVAQY	TLPFQQFEI			AVISPHYDSLL
VVPEPGQPL	VFFKGFKW			DVGDIVHSV
VHEGPCGISY	LLPPVVWLL			FVPSLPSHSL
KLRGIVSEK	SYSmIVNNL			YVSSIVVSL
SVSIPSITK	KYIMDLERL			PAYHSSLMD
VLLGPPGAGK	LYIPIFSTF			SPPEISAG
TLADIIMEK	FYIPKIQDL			ESAPGDFSLSV
LLYEKNLVK	PYQATIDGVRF			EVVAVRQEL
PPYFPRFGQKITV	KFMGVQMETF			LPSDSQDLGQHG
KLLPSALQK	AYLDKKHTIF			EAVSVIQSI
SVPLPISHK	LYFHENQLI			YAFNMKATV
LREFAPGVP	NYIPYLTKLKF			EIGNILAFL
SIFPYVTTK	NYLLESPHRF			EVADEKmLSGL
IQATPLELK	PNLAFLRF			HGDSDLQLDRISVY
TSILQALLK	TKGECHVPIL			NVVGFVMGL
AILDYLITK	YWIDIQLRW			TSSGVVWEV
ALLSPGSPK	YYMELTKLL			DEAAVNWVFVTDT

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
KIFSQANTPLK	AYFTETEKF			DSVLIIETV
RIRSFPLSSPISK	KYFEVPSVL			ELERPGGNEI
RVILAGNLLSH	DYAYLREHF			STEAVFHTVVL
ATTLKNRPL	NYIPVKNGKQF			YTFDMVFGA
TEEMKSLIRLP	RYPNSLPAL			DLKVEDIPLAR
RLMDFLLQR	IYPTAPPRF			ESFNVPGLYI
TIARPTIGNK	DYFVPLHHF			MTSTIGFRV
SVQNRQNFVVK	PFYRGERITF			EVYAGNFVEV
ALFKHILLY	KYNDNFFGL			YLYEIAR
RTFFSVQKE	RYFFLFLL			ETIHIRGGVFS
RLGNSLLLK	TYLDNGVVF			RGGPNYQEGLR
LLWKDKKIG	TYNLLSERW			EVISTPGVVA
HIYDPENRLTPK	VYTEAIADI			mVFKPSDVmLV
EARLLTQFPN	VYIPVLPPHL			QTQISETNVILS
KTLVAELLILK	LFMPRSTEF			ELYDLRQHFV
SRFGILEFISIAV	RLPVSIPLF			KSTEILLRKL
AIMSGRDLIGIAK	VLPDTKGKSYLF			LTSNIIAWL
AVFLGLARK	VPMSLSYEEL			EVIQLEDTLAQV
KLEDILDPIIK	ILPQFLYQF			EVSEIIDGL
RLLGNLVVK	RFSLNTVEL			HTYDRFFLGV
MLAPPRELFK	RYGSDFYSM			LAELEQER
RIYEQLPEVQK	KFSPRPLKF			nTVDFFNQI
TLPSPDKLPGFK	LYVIGGNHF			QEVAVKEQLT
PIGKGKPVSVP	HYIGESASRLLFL			STGDNIREFL
RVASYKKGTLEY	TYTDLLSVI			TVAEVTEVSV
RVGDKVLRLLLE	TMLGKFYHF			AVANIVNSV
AVQAVNAHSNILK	AYGQVVFRL			IIHDPGRGAPL
KLLQPLVPR	VGAYILYFF			REYHTEKLV
RLMDRPIFY	VYKTHIDVI			TYFPHFD
KLVELPYTVK	FYTKRFQEL			VTINQSLLTPL
RSMDPFPWQQK	SYLDEGFLL			ETAKIRPFAV
LLYPKSLSR	EYNNNFHVL			STASILASV
KVRPPVGGISVK	KYGSVAFPNF			IDAPGHRDF
TVSLIGAYKTGGLDL	PYSPRFLEVF			VNDIFER
RQGNFFASPMLK	VYADKLLNI			ETANADIVTLL
AVFTGALIY	SYLLPGMASF			MPADIATLL
KSFLSQGQVLK	SYLQSLLLF			AFGGSGGRGSSSGGGYSSGS
FSPVGSVL	VYDDMAFRYL			DIYFIPRNV
VLNLVIVKK	KYLEDFITNI			EAMEDGEIDGNK
KVCNPIITKL	FFIDQANYF			EISPLISYA
SVSLPVRKK	NFIEGDyKTI			GIAEFPSR
ITFGIREDLK	RYLDSLKAIVF			MTFDPQDILL

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
RLSNPSLVKK	RYVEARNIILAF			PPYTKKMSSKGL
	NYALKMFLY			TTPTYGDLNHLV
	WYMDNPQNL			TTVLSRAIAEL
	KYLEDRGEVTF			FVALPGVAV
	PYMDAVVSL			EVISKTPTL
	QYGIFPDNFTF			LPIPDPGVSV
	VYVATRPTI			TTYLVLDEADR
	QYLGQIQHI			VSYLGSFLPDV
	IYHDLEQSI			SEETLDEGPPK
	GYLPLAHVL			STPNFVVEV
	KYPLNLYLLF			AENTGVELDDV
	RYLGKVLEL			DLTEFQTNL
	IYSPDHSSNNF			EKYIDQEELNK
	THVGKVNIF			EVVDHVFPLL
	VYTPVDSLVF			VTLADFKNV
	YYHARVYEF			DVQIGDIVTV
	NYLGAIESW			NIAPIIQKV
	PFHPPLQLFF			PAGKADLPPI
	VYILPAAYFW			PGHLQEGFG
	EWIPLAWKW			LPGPFPPQS
	AYSIVAGVF			MVADKFTEL
	SYGIVLYEL			ATEHLSTL
	TYKNFFYLI			NVIEWTVGV
	LYQGLLPSL			FTITPSTTQV
	VYIGVHVPF			HIAImDRSGQLEV
	YYISAnVTGF			LTIFVSAKL
	IYTEVRELV			AAAPTLSPES
	KYAMmFAEL			ASYKSYSSTFHSLEEQQ
	VYPSRAVITTM			ETTSISKITV
	EYHTPWYLF			ETYEAKRNEFL
	SLPEDIPVF			EVTDFAGQYV
	TFAVTDELVF			KPLLESGTLGTK
	VYKKFDPVGEIL			MIPSIRNGIL
	VYPAVMVLL			VARGGGRGSGFGGGY
	RYFISHVLAFF			EAMELIVKL
	TYGPSFPAF			EVmmLTERV
	VLPIRVHTI			FRVPTANVS
	QYLRVETQF			GGGGGGGLGSGGSIR
	AYNEGIINLL			DRDYSDHPSGGSYR
	EYSIVIQQL			EIFADPRTV
	TWFNQPARKI			ITFGRMVQV
	YLPSSFPVL			DTTAIDVQV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	YYRAPELIF			SAADIPINI
	RYMNHMQSL			YGGSSSSSSYGSGRRF
	DYAVVLNQL			YSLRIHMLK
	DYMNLLGMIF			EAIGFIDWV
	FYNQVSTPLL			NNKFASF
	VYTLLTTHL			SAADVVLYGV
	DYAAIRDNYF			SEHEFDPDSY
	QYAVLLNRF			GFIDNVVLA
	MWLPWALLL			MVALPMVLV
	SYMPARVVVF			ESFSDYPPLGRFAVRD
	VWNPRSHEKL			EVFPPPVAML
	IFHEVPLKF			NDLAVVDVR
	PYKADILYF			GYGGSSSSSSYGSGRRF
	KYMQKSLEL			ETSGISIYRL
	KYPLNLYLL			IEAMFRGGIFQPELLS
	YYGEKIGIYF			LAAAEAPGAGLGR
	LYGIHDIFF			EVMMLTERV
	SYLPVGSVSF			FLVHNVKEL
	YYYINYTTI			IEDVTPIPSDSTR
	AYFKRYQVKF			ESVSLLWKV
	KYNANFVTF			ETFISLVSI
	RYDGQVAVF			HRHPDEAAFF
	NYTARFSRF			ETARLTSFI
	TYPNTYIF			EVIDKNSGGWWYV
	LYGTIPQIF			NYGPGGSGGGSGGYGGRSRY
	EYGFISQTL			VEYSEDQQAMVK
	PWFAGNKITF			EEQLQQIRAE
	SYIPYNPQQF			qTSDITEYL
	YWPVIPLKF			DESGPSIVHR
	HYmPPPYASL			HAVVTVPAYF
	IYAGVGEFSF			FVASHPWEV
	LYLPPMRKID			RVADVIAQV
	RYSTPHAFTF			SKEQLTPLIK
	HYINMPVQF			DETNYGIPQR
	NYKPPNAEEF			GGGGGGGLGSGGSIRS
	NYIHWVEDL			ELMNILNKV
	RYTERVDYL			KPQMSEDLLL
	SYIQQINNL			KQEYDESGPSIVHR
	RYGGSFAEL			NLQTVNVDEN
	TYENLIHVW			YADELPK
	IYLPEVRKI			SVMSLAEAGKLY
	LYLTGVVVL			TVARVHIGQVI

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	qYQIIMTMI			ESPEPLSQ
	NYMPGQLTI			ETVVIFYDV
	VWLPYLYTL			EVANAVAFI
	IYTmIYRNL			EVSPVALQRL
	QYFDSRGmFI			SSLLEKGLDGAKK
	QYILFPLRF			SVAYHAQnnPPV
	VWLPASVLF			EVRDIKEFL
	IFIsMPPLF			LEVNSSRER
	IYTDITYSF			EIGHILHHV
	AYIPLNNYLVF			FSAEDIAKI
	PYTGPFNLL			GGGGGSFGAGGGFGSRS
	YYQTDLVNI			GGGGGLGSGGSIRSS
	IYPSKWIARL			EISSIISKM
	KYNDFGNSF			SISTQQEKETIAK
	LYQEILAQL			GFSSGSAVVSGGSRR
	NYLDVATFL			GIPHLVTHDAR
	VYDPSLKTLL			EVVDIFQVV
	EYNSALPLL			HNPHVNPLPTGY
	GLNDTMRYILI			EGVDIILGV
	RFVNVVPTF			ETSHVTMVV
	SYVHYVFRL			IPAPAPKP
	VYIPAHGRL			DVSVTIS
	TTYPNTYIF			DVTALLGRLAELRQRLQ
	YYGEHLFmL			TIDDLEDKLK
	LYPQFmFHL			APGNLSLPIP
	NYYEVHKELF			DTITPQQVFV
	VYLKTALGL			LAPGQPRSLDSSKHRL
	AYPDFAPQKF			LVVSIIHHV
	GYIESVQHI			SVTSILKTL
	IYTIINSI			TTVDINTQV
	LYSAVKTLL			EAAFPIAVV
	IFPPVInITW			ELFKGKKGVLFGV
	IYPDSFTVL			EVMSVIAQV
	SYIHYVFRL			SSSKGSLGGGFSSGGFSGG
	FYPIYFRPL			YQAVTATLEEK
	SYLGAFFSF			GGGGGSFGAGGGFGS
	IYPATIASIDF			PGRWSPFVA
	IFLPPLQGDFGAF			EADVHVAVV
	QYPVIIHLI			SLGGGFGGGSR
	YYTKVYQEI			EIDCTEEEMLI
	NYSTVPQKQTL			HSAGYILGSVNV
	QYGSALAHFF			ETSSWVNLV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	RYYFEGIKQTF			FNFFAPPEV
	LYTPKPQVI			EAADVWYNL
	QYmEEIYHRI			EISTVLQYV
	RFEEKHAYF			EVAHFMNAL
	RYMDAWNTV			EVPPGSAIIHI
	VYLPTAFLL			ETFQVTGQQI
	AYSYPIATL			ETFTALSVLGV
	VYAVPILIF			EVMQEVAQL
	YYITTRAQF			PYGADDFLP
	LYMAALGATLF			FTDEEVDELYR
	SYMVRELLIQF			FVAPPTAAV
	TYSYSFFHF			GTMTVTLHSSRELPSRPD
	NYFFDAAKLmF			IGGIGTVPVGRVE
	SYLKGDNFFRF			PGGSGGSGGYGGRSRY
	IYTPIFNEY			GGSGGGGSISGGGYGSGGGSGGR
	QYNTYPIKL			VFDKDGNGYISAAELR
	RYTTEFHEL			ESISPALLSYL
	FSPVGSVL			EVFNMKTMRV
	RYYGNISRF			HAAKVILQV
	AYDVLFHQW			EVAGMLIGL
	FYINGQYQF			QVSQICIQV
	KYFEVPSVLL			qVSRDLPVMIWI
	SFVNKQPTL			DIISQVDAKV
	YYIDADLLREI			EVFHQAFLL
	TYIRQDNERVLF			MTADLPNEL
	VYPGDPLRF			SLCKKIEQCDYPPL
	GYADIVQLL			KAPKKFAETDM
	IYGRMWYF			NQEVNKGVKEE
	IYSEMIHNL			TYVPKEF
	VYPPGGQPLL			AQYEDIAQK
	RYLDLFTNY			EDFCYVFTV
	FYIESISYL			GRMHAPGKGLSQSALPY
	IYMFNMTGL			EGSPIKVTLAT
	VYPPPHQVF			EVPHFHHELV
	AYIERmNYI			TTSPITYTL
	mYPYIFHVL			GNVGFVFTK
	RYLLKFEQI			GVAALYKFRV
	VYPKKELPFFILF			LPVSRIIVHPQ
	FPGEAERVAF			AEAMNYEGSPIK
	VYVPGSKGAPSF			ITLDNAYMEK
	IFNGFSVTL			ITPAHDQNDYEVGQR
	RLPPTPLLL			LIFPKEFETA

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	YSKILPSLI			SRSDFEWVY
	VSAAGLVQGL			TDEMGSKYSAFGKMF
	DYPSKMEYF			DEAAFFDTASTGK
	ILPPQLALF			ETAQAIKGmHI
	VYFGHWVVM			SFSDYPPL
	VYIDRVRSL			SIRQTYTLDVL
	PSAQEHLASL			EKYEITEQR
	RLPEEWSQW			EVAPVAQVAL
	HYSENMFSF			ETAHFFEEI
	SIPGGYNAL			GIPAEVPHIRESVmR
	TYLNDFFSY			EIASITEQL
	VYIPNKVLI			ELVFKRADI
	EYKFQYAYF			HQEGEIFDTEK
	IYGHWSImKW			TTAAFIRVV
	KIISFVACGIQIF			EVMQVLSHV
	FYRSYFSQF			TTKFIKSFL
	LLIENVASL			IGPFPVE
	LYIPKDAYF			KRPEILTDESLSSLA
	PYFPIPEEYTF			EAAGIMENI
	qYSPLLAAF			TVFPGAVPVL
	TYCLDEELVW			ETVNIWSHL
	TYMDRVFKQF			YIISVKGIKGRL
	IYSTAFDYF			YASGINVNL
	LFLDSNGLFLF			KEEELQAALAR
	SYTALFPQL			SHALQLNNR
	YYQSSVQYL			YAYNPLAGGLL
	RYMSINTHL			IDGICERVGCDNVLGSDAV
	NYRDTFFNL			SYFNKVGVAQ
	VFSPDGHLF			TLSEKAKPAL
	TYPAELNNI			VNFTVDQIR
	GYNVKFDmF			ETVEDIAARL
	SFKRVRINF			GGGGLGSGGSIRSS
	VFTPLILLI			GGPGGVGGL
	ALPEIFTEL			AVYFCFKSEPWIT
	KMPKMKMPTF			DPEPEDENL
	SYNHFAAIYF			ETSSVVRKI
	NYMmDWKNQF			MVIVPTREL
	NYNDRYDEI			TLADLVHHV
	VYALPTIAF			EVFEATDIKI
	AYMAAFNSI			NIIFLSDQTKEKE
	QYAKDIGFI			AVSDVIQQL
	RFRPVPLGQTF			ELTQIIADV

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	KFMPVEGMVF			SPSPVLGSSLL
	FYIPDGSFTNI			TVTTLVENKKAQL
	IYIPSYFDF			EVGGEALGRLL
	LYLEPQGtLF			EVIKPGDLGV
	QYNTYPIKLF			DTANDGFVRL
	SYIAHLRQI			EAAGIDWGI
	ALPAAFHTW			ELPDGQVITI
	DYmNLLGmIF			DSYESYGNSR
	RYIPDAMNL			GSGGGSYGSGGGGGGGRGSY
	IYHPNVDKL			GSSGTGGTATWKPGSSGP
	SYLPLAHMF			LDSLIGGTNFVAPPTAAV
	FYHKYFNYL			IDKVRFLEQQ
	PYSEPmPLSF			PACGLEIPPT
	IYHGLATLL			SAADLQFAL
	VWVPFIYSF			ETVPSWMVAVI
	AYGGAFYAF			EVINTVAQV
	TLPSRVFHPAF			NTQEMPWNV
	EYTGYSFKF			VADVVTP
	RREYIAAF			GSNMDFREPTEEER
	VYTSVVEEL			ETVRVPEQVFV
	RYASINAHL			FVVKAYLPV
	SYFGSFSSL			VSLQALPGDV
	SYQFILNLF			EVFDKLARV
	MYLGITPSI			PELLQSHFIP
	RYLPQTYVV			MDEGRKQLAASAGFRRL
	NYNPYIGGLGI			EISDIGAKI
	VLPESLPVL			FVSPVAKAVI
	LYPGSVYLL			KEDQTEYLEER
	IYIPTLAVL			DISSITEAV
	YYLSKIEEL			ELFGKFDQI
	RYLDFKVTEGSF			HPGSFDVVHVK
	VYLSTKKPPSH			HVIDSIVGDGI
	VYTGDALRI			SLRPAPPPISGGGYR
	AYPHRLNLF			ADEGISFR
	IYNYPEQLF			ESCEQIAVQV
	RQPSLFYHL			GGGGGLGSGGSIR
	AYSEAIFEL			EVSFINIKT
	DYSDIVTTL			LGHAHLFTVARY
	LYPSKSIIL			YIYDKLsV
	RYMDLAENARF			TISHVIIGL
	SYmPARVVVF			AFGGSGGRGSSSGGGYSSGSS
	TYAPVAFRY			DIDIHEVR

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	EYGKFFVTI			YKITTVFSHAQTVVL
	YVRDLRSIV			ETAAIFHYL
	IFLDPHTTQTF			EETQPPVALKK
	TYEKFFGLL			ESFYIQTLL
	VWDTAGQEKF			HVVDVSVAV
	LFLSSSSLGLF			DNEEGFFSAR
	ARLQQLLFVIF			KTSLNAYVKS
	FHISRLFYF			DFLAEGGGVR
	TLSDIFLLF			EVGSLVEKLKPQFVtK
	VYMPASSYQSL			STLFLPHYA
	VAPVTHVSV			SVGPPGASGLKGDK
	AYVGNLPRI			YVLFYRRRnSPVER
	FYIPPLATHTI			EVYPHVSTIINI
	RYLIKLLLL			NSLESYAFNMK
	VYPDTVALTF			SVIDHIHLISV
	LYPDHFHLL			TTAYIHQVTV
	PYHPHPHVF			FPGHLPLP
	LYQVVSQRF			ETTSIDVDL
	SYTYLSLGF			KAKPAKAANR
	FYQILIYDF			LVLLIFSYNVV
	IFSTITSKMNL			YGENFNK
	LGSGFPHLQLL			KAKAAPKDCFIEVNsK
	KYGRIVEVL			ETTRLVTSL
	QYmERLQLL			DLNPLTFVP
	VYKPPGLKW			EVAKLVNTL
	TVPVRLSSL			MLPGILSQL
	RFGYCRRLL			NTIHLISQV
	EYKIAFPYL			SASSGAEGDVSSEREP
	VYQNIFTAM			VSSDIIEAV
	EYASVLQLL			DTSDVVLEL
	IYEIIDNSQGF			DVAKVNTLI
	QYFSSGKYYW			TGYQVDKNKDDELTGF
	LYPEVPPEEF			EVFGLVQQL
	RYVDRVTEF			NVTSIMFLV
	VYTHEVVTL			LVHNVKELEV
	KYLSVQGQL			RPAEDMEEEQAFKR
	ALPKELPLI			DLGEENFK
	IYAAVTPEL			ETFSYPDFL
	IYTFPHASF			KLEQMDAENKELEK
	VFINVPTVSF			LDGPVLSNIDRIGAD
	LFIPSSKLLFL			EYTVVDESSVAKI
	VLPNRPFGLF			YVAVPPMLNP

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	VYFEGSIYEI			EAAGLALGLVML
	IYITGSSII			ELSEISERL
	VYGGNIKPTPFL			MTVQAQPQI
	YYQHIVTTL			SPTDDSEKEASHS
	YYFEGIKQTF			TTAEVVVTEI
	VFTAFTEEF			STLSEKAKPAL
	IYSEVMEALKL			VGGSTRIPK
	KAVSLFLCYLLLF			LVSPVVQNI
	TYGSIALI			EASAILVHL
	AFMVNGQKF			ETSQAGLFRL
	YLWPFWLF			GGYGGSSSSSSYGSGRRF
	FYARAKLF			MTMNVIQTV
	GYPETLVNLI			EVGPKFRGV
	VFVEATHVL			AIGSASEGAQSSLQEVYHK
	VYTIDFNSM			ARAHVDALR
	FYGDKmNLF			VESLPVASSSTLLPLAPSN
	NYPLLLLTL			IVADVQISV
	KYQEYTNEL			SRILKSPEIQRAL
	SYAASGmCLLF			AAAVGAFLI
	IYELMQTEF			ELSKIIQKV
	TYMPHVHIL			AELIRCIVPTGNG
	VFIDKQTNL			ETIDLLVQI
	NYSPYVNYF			QVFDYVTGV
	EYGRILTRL			ETIRNIPHL
	VFVDSVPEF			LEVDIDIKI
	AYAGARFVF			ETFVPHVTL
	VYVLCYSLIL			YTVQWPGTWCFIsTGR
	QYPVIIHLIW			VGAFYFPTL
	SYPLNSYEL			EIYSFSESL
	EFMPQGAVF			ELGGHLDQQVEEF
	AFHPTAQLL			EQASILSLV
	PLPESVPVF			QIADIVTSV
	RYLDWRALM			SLQNLSQYP
	SFISGLFNF			EASHLVTDRI
	FYLPSSPNL			FTSLSVGLPETL
	LYPDGVFYDL			SVGEIITNI
	VMPSSFFLL			KPAARSVQE
	SYLTSASSL			QVANSAFVER
	VYMNRVKEI			WAnITWKHnFGPGTDFV
	IISSVIQKF			ALLSSGFSLEDPQTHANR
	LRQYFEEAF			EVAPSFGTLL
	SYNPAENAVLL			EVSSVVQVL

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	VMADIRELI			FATEVRAVI
	EFPPGTPRF			YPFPGRL
	IQVRYLKII			EVIEGLENNV
	QYLMDNPTF			DTYGFPVDLT
	VPFVKYEFI			SLNPSDTPPSVVNEDFL
	TYIRDFQKI			TQLPYEYYSLP
	IFITEKHGNYF			EISHVLNFL
	NYPDRNLPTI			EVIEGYEIA
	VLPPSVPFF			GGSTSYGTGSETESPRN
	LYMKNGQGF			KKPPPPVPKKPAKSK
	YQCLFSAHVL			YENEVALR
	NYAENILTL			ITSSIHFEA
	RFLDPRNKISF			DVPGDKLLEPV
	YSLEMKMSFF			EVYGSLPAFL
	EALCKYGFVF			LSPDAILDAI
	IYSYGFATI			KAPKKHLQNG
	PFPPPGGLTF			MTTEILRSM
	VYAKYWIYV			KCKLELLV
	RYFPDRNVALF			DKTLEQQENF
	VYAFSIENF			ETANKIFMV
	VYQVGGVTAYF			ETFRLHVGV
	VYSIISVQL			KPAPPKPEPKPKKAPAK
	LYPPPPHTL			EAFGQSFSI
	QYNPKFQTL			ETVSDVLNSV
	VYIHHFDRI			KPAKASMMQQPA
	AYPYNFSNL			TSSPINIVV
	DAASGGLLAAF			VAWQPVVIGI
	SYSTSLIGLTF			FFDDPIPK
	VFMFPVGLYY			DRNLPSDSQDLGQHG
	VYGVVPISL			EAIFILARA
	RYAKIVEIPF			NMFDHPIPRV
	RYLDELmKL			YALTGDEVKK
	YALVVPFSQVVC			FSPFHASVL
	HRLTWSFLW			NVALVLERL
	NYKSHHLQL			SFAPKTATLNGLMYFV
	PPYFPRFGQKITV			EVTSINSFL
	TYLIQHQRI			YAFAGMYHV
	RYNPRILFQL			EVFPEFAAA
	RYNGLSFVYL			ETAGVVSTNL
	RYVPSTPWFL			FEQEMATAASSSSLEK
	SYIQSIPVV			GSSSGGGYSSGSSSYGSGGR
	FSEDDYTALI			GTGSETESPRNPSS

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	AYFYGPIFI			EGTDILVYV
	FYPEEVSSMVL			EYHAKATEHLSTL
	RKQGLDRLF			QTSDITEYL
	GYQRRWFVL			ESGPSIVHR
	RYSEAITQSVL			EISTIASNYHL
	VLPKQGPLF			ESFIKAIGV
	AYIQESATF			FRCPEAIFQPSFLGIE
	VYTPVGKAEQGKF			ENAVPFSLD
	EEDMNNGSF			TSVFSFSPV
	PYYQPPYTL			QDPLYDVPNASGGQAGG
	TYIKPISKL			DLWVTLHSMG
	VYITPMEAL			QSAAAATGSYGAAAAY
	HAPFTATSL			DLPSFTQNV
	SYTSVLSRL			DAGQLVSCKK
	EYAVLTSTI			LYQTPDSL
	EYVANLTNL			SVTSTFSKLRE
	GFYPAEITLTW			KPPAKKIMMSKEE
	ATAPVVALF			EAFGRLWQV
	TYPLIFASI			QNEVRQWSGGL
	VYFPALTSLL			TPTKASVPPD
	RYRDRLQYF			VRMVLNG
	LVLYGDVEEL			EVASFSGQILA
	VVPEPGQPL			TEHLSTL
	IYPKLLDNF			FTAKVNIEV
	KYILVVPLI			HSAPPFPAAV
	TYIPPLLVAF			KKAPPPPKRA
	AYTLIAPNI			FEGSALGKQL
	KFYTDPSYF			LFALVMLGNTLYGLSV
	PYGPPLPSL			SFNGAPSSSGGFSGG
	QYIDKLNEL			EISSVPTFL
	TYVKRLHLL			ESVSIFSSA
	KYAPRPIFI			ETMQATIHV
	NYTDQWERW			NVTRVIIHV
	EYLQEVARI			PPSIVPSEKLF
	IYSDTQFPSL			YTASIPALL
	IYGPNVISI			INEGKLAVV
	LYPGQLVQL			GGSTSYGTGSETESPR
	VFVQGPAWQF			ETHDLIVDL
	YYNTAVKL			LSNFIKAMV
	FYTFPFQQL			QTASILKQL
	YNILRGIGKL			STIAILNSV
	TYLEKFQNL			FAIDARDAGEGL

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	NFLHPINTIF			EAFYYIHNL
	AYNDKIVAF			EVANLLQGV
	RYLPDTLLL			PLITAVAQPGI
	YYPAQGVQQF			FTAPATVSL
	CCPVFACIQEF			SLLKDLKHANIV
	QYNPKFQTLF			GSTGTWNPGSSER
	AFMKGVFTF			SKAEAESLYQS
	AYMEDAPLL			DNGFLIVDL
	FYINVEREEW			EVAFFNNFL
	VYVLTVTEI			LDINDNHPT
	MWPTRRLVTI			TIPSIQLLGLE
	SLPESVPLF			SRIRYRCSDIF
	YYVNGTYRL			DPVLSEPVY
	KAPEPLSSL			ETFGDYPQPQL
	KSFCVKSNLI			EAVAVIENI
	LYFGSAFATPF			PTKALPCLPPWEG
	LYNRTMVQL			VFHFMQSL
	LYQTCQQNQF			ESSDLFTNL
	NYNFDFRSW			YPIEHGIITNWD
	NYTEFTQFL			LDVDIQFSL
	SYAAPDRKAF			LERLGAGVAGV
	SYVAGLPRF			LPGPGDLS
	ASCWNSQEFI			EVSRIINYNV
	GMELQSWYPVI			TGYTLDVTTGQR
	VYVDAVGQF			FDDGAGGDNEVQR
	RYQTLYARF			QVTSVLSRL
	LYPFAISLI			AESPKTPSSPLT
	YYLPDGSTIEI			DNFTLKEDGME
	YSITKKSMKGCE			EAVAVVRAL
	KYIDQKFVLQL			FAYDGKDYI
	NYNPAQQAF			PFLLGLLTNE
	EYVANLTEL			KPEPKPKKAPA
	AYLPLRLLERL			ETIKLVRQV
	SFHLKGRKLEQPMN			IIKTNVLSKDCK
	AYTPVVVTL			SLVSMDYAI
	QFVPKSHLF			STVSVFTFV
	SFLPGLHLLTF			SLTTHKAIHAGEKL
	VYDTNPAKF			VVTFAPVNV
	TDAEGDDFELL			AEGGQGEQQPL
	LYITLPLAL			FTWEGLYNV
	PTYKGLLMSLQN			ESISLVTQI
	SSFTSSLSLRYF			ETQKSIYYI

HLA-A Alleles				
A03:01	**A24:02**	**A29:02**	**A31:01**	**A68:02**
	IYKSFSRQLDQL			EVFFDGVRV
	QYPNPLPVL			HVVEILVET
	SYPQEVIPTF			ELGGIIAEV
	KYSEIQQLL			KGEIDEPPL
	YYLGKILEM			ETFSSVSQL
	RYTIVQQQI			NQEEGKLVEE
	VYVAALKTL			ESMNIFETI
	YIKHPHLF			KKPRTKAPKI
	VYPGYYLTF			ALSEMASEQL
	YTIYSTCGAFYI			ETFPNDYTL
	QYQKVPVLF			VAGGGGGFGAA
	SSGCFQEQQE			YAVNILENI
	IYKEDFNEL			GNYDEGFGR
	YFAKFEEKF			TVAEFVAAV
	YLDNVFDVGGLL			HTFEDSTKKCADSNPRGV
	DFNWRFIF			SVPAPYISV
	LYPAAIVTI			VVSDILFKI
	SYPGSSYIF			
	FPIEACVTML			
	LYGNIIDNL			
	LYPFPLALF			
	YSHCVDVYI			
	SQPLGPRII			
	TYPELNSSI			
	AYGLDFYIL			
	LYPPGIELI			
	RYLSKATTL			
	SSAFLGYVLY			
	FGAYVACASLVF			
	PYQCPECGKSF			
	YYDPHQATF			
	IYLGQLECFS			
	LYAEIRDKNF			
	SYYKDALRF			
	YLSYDSSDPCPGQF			
	VYPEESLVI			
	YAPGARLAL			
	DYIKFLRSI			
	VFHPRQELI			
	NYIPQGSIDSL			
	EYMKVQTEI			
	QYSQHFAFI			

HLA-A Alleles				
A03:01	A24:02	A29:02	A31:01	A68:02
	PVIDGPRYTF			
	FSPQMVGFYI			
	SYIPSTVFF			
	FYPYGLQTF			
	PTPTPFTNAVQLLLT			
	VFLRAINKF			
	ACELHVAGFDF			
	YYSAVTPHL			
	WSFVPSTRIL			
	PLVLFGFINF			
	MGIYVGAKVF			
	VIPVRIHTI			
	IYQDSFEQRF			
	NYLGLTNEL			
	RWLKDSSLLTL			
	GPGSAGWQQEF			
	TYLDIPLVI			
	YACLKFSEDL			
	YLTADSPNVMTTF			
	DYGIVADLF			
	GHKDQTRTYF			
	MAYQLCHAL			
	VFTPVTTEI			
	EYMPGGDLVNL			
	IFFPGVSEF			
	RYTNRVVTL			
	GRLYVEAAF			
	QYLNKNALTTL			
	FWEIRYMYF			
	FYLEVGGLSKDTD			
	YYLKKFIME			
	SEKVYTIMY			
	VFPDDMPTL			
	ERSSFSSFDF			
	IPEPEAAVLF			
	SYPEETYPI			
	IYAPQGLLL			
	NYLAPYQFL			
	AYSSILSSL			
	VYTASIPAL			
	KVNIEPYQKFFNF			
	RYAVIGADL			

HLA-A Alleles

A03:01	A24:02	A29:02	A31:01	A68:02
	LFACLLGAAF			
	MSNKYPQAVF			
	DYKQALKYF			
	YAMKSLSLL			
	YTVLGPWFF			
	YYPSIVANRW			

HLA-B Alleles

B35:01	B44:02	B44:03
LPDEIYHVY	EEVDLSKDIQHW	EEVDLSKDIQHW
DLEAEHVEVEDTTLNR	SEQSLGQKLVIW	IEVDGKQVELALW
FPEIDLEKY	AEIAAQRTINW	AEAQLRFIQAW
LPLFPEPLHVF	GEIQEIVKTGLW	SEQSLGQKLVIW
YPFKPPKVTF	SEQFLTELTRLF	SEFIDSQRVWAEY
DATNVGDEGGFAPNILENK	SELIAKIPNFW	TGSWIGLRNLDLKGEF
YPFKPPKVAF	AEDLNSRVSYW	LEWLPDVPEDIRW
APEPHVEEDDDDELDSK	AEAQLRFIQAW	AEDLNSRVSYW
mAWLVDHVY	TEADVEEALRLF	SPEYVNLPINGNGKQ
IPNEIIHAL	EEINKIIRDLW	AEFEEPRVIDLW
FAFEHSEEY	HEQVLDLGLTW	TEADVEEALRLF
mPLVLPPELELL	AEDLNTRVAYW	GEIDGNKVTLDW
FPFFDIAHY	VELTEKIAQLF	SELIAKIPNFW
FPNAIEHTL	AEFEEPRVIDLW	AEDLNTRVAYW
FPSIYDVKY	SENITQKVVW	AEDASTLIVGHW
YPVTLDVLHQIF	LEWLPDVPEDIRW	AEIGEGAYGKVF
AAEDDEDDDVDTK	TEAAYTLLLHTW	EEINKIIRDLW
LPAGWILSHLETY	AEIDVIFKDF	AEIAAQRTINW
FPWGDGNHTL	RELLEIVKKNF	GEIQEIVKTGLW
YPETLGRLLIL	TEIHNEPFLTLW	SENITQKVVW
FPLLPQDVHLL	SPEYVNLPINGNGKQ	EEIDTSRLFEW
YPVFPWIIHDY	QEAIPDEVIKKW	TEQSQIKGYVW
FPASPPKGYFL	EEIDTSRLFEW	DELEIIEGMKF
KREPEDEGEDDD	IEISELPVRTW	EELAENILKW
YAWRPVFDEY	KEIELIGSGGFGQVF	QESLPPVQFDW
NKESKDPADETEAD	QESLPPVQFDW	AEDALHNLDRKW
SYELPDGQVITIGNER	AEDASTLIVGHW	AEIDVIFKDF
VPVWIIHYY	AEGWIWRWGW	IEISELPVRTW
YPNVNIHNF	EELAENILKW	GELKIADFGW
LPWNITVHF	QELDSTDGAKVF	SEIDQLFRIF
qPWEEIKTSY	AEFSRFFDAW	ALAPILDDGW
MAWLVDHVY	TGSWIGLRNLDLKGEF	REIFLSQPILL
YPAQITPKM	AEIGEGAYGKVF	EEFDARWVTY

HLA-B Alleles

B35:01	B44:02	B44:03
FPSNFIKEL	AEKEPEQPPALW	AELDPHILAVF
FPWEVPKKLKY	SEIDQLFRIF	QEGDLPNAVLLF
NPDDITQEEYGEFYK	AEIDFRLVSF	AEALLSDLHAF
FPWGDGNHTLF	IEDPQIQAHW	EELDPESREYW
LPFFDPDTNIVY	AETPDIKLF	QEWYDAEIARKL
LPSPVTAQKY	AESEEGPDVLRW	AEVLSEEPILKW
LPSEIEVKY	AEALQLPVVSQEW	QEFAPLGTGGGLYHF
SPFFERSGLAY	EEFDARWVTY	AEIDFRLVSF
IAAEGIHTGQFVY	EEALQTIFNRW	EEIAIIPSKKL
FPNIVIKGSEL	SEGEDLIRFF	EEWLPRELW
GADFLVTEVENGGSLGSK	AEVLSEEPILKW	SEVDLTRSFSF
YPVDLGDKF	AEVDKLELMF	SEEDLKVLF
HPISSEELLSLKY	AELSEEDLKQLL	TEIDGRSISLYY
TPTPFFHTF	AEIQDGRFNLF	AEPLEIILHL
YPVEIHEYL	AEFDTPGHTLSW	AESEEGPDVLRW
DAWIEHDVW	TESLLRLEW	HEAFIEEGTFLF
IPLPLIKSY	SEALGDNVKQYW	AEVDPDTILKALF
mPVGPDAILRY	AEWASRFWLW	SELALESQTKTY
DAWLEmNPGY	TEFRNFIVW	SEPDFVAKFY
LPWVGKELY	REFWPQEVW	LATWTIQGAANALSG
HPTLGPKITY	TEIERLITW	SENLLPQNAPNYW
LPDTLKVTY	GEIDGNKVTLDW	SEIDLVQIKQMF
DLWLEREVF	VEFFRVVSEY	DEYIERLVW
FPAKVTAHW	KDEIFQVHW	AEYIQKNVQLY
FPDFPTPGVVF	EEIAIIPSKKL	SELDLISRL
RAAEDDEDDDVDTK	KETDLLILF	AELAIFRVF
GFGFVTFDDHDPVDK	MEFLFNKTGW	AESSPDPQALWF
IPAAVKLTY	AENPFQEPRTVVW	KEDLVFIFW
GAAGVHFIY	QELPGLSHQYW	VELPIEANLVW
LPFFPIATY	TEFQMRLLW	EEAQFETKKLY
TPALVNAAVTY	AEALLSDLHAF	EEEGNLLRSW
FPAGSVHVNVY	AELDPHILAVF	NEIKDSVVAGFQW
APEEHPVLL	EEAQFETKKLY	RELPEPLLTF
LPHQPLATY	GEIDYEAIVKL	KEYIPPLIW
LPSSEVVKF	KEDLVFIFW	KEFEPLLNW
YPYNAPTVKF	AEQDFISKFF	QELDSTDGAKVF
LPWSADRAIQQF	REIAPGLTGSEW	LASPEYVNLPINGNGKQ
FPRHIEPEL	TEIERLITWY	EEWEAEFQRY
IPYEGFASL	VEGFWSKDQSQW	SETVLNLAF
DPFKDIILY	KEFTGIDNLW	KEVDDVLGGAAAW
LPQEAFEKY	SENPNEVFRFL	MEIDIPHVWL
FPIEYHDIW	AEKDLFISDFW	SELLGLLKTY

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
ILDSVGIEADDDRLNK	REIQDAYLQLF	TEFRNFIVW
VPRIQLEEY	LELGFSKVF	IELEETIKVW
MPLVLPPELELL	AEFIRELGF	AEAPWLVGGQPALW
SPEGRLYQVEY	SETSQAGLFRLW	EEFDARWVTYF
IPFDPKFITY	VEMPLTGKAYLW	YEFDFSKVYW
SPIDVVEKY	EEVFETIIHSY	IEVFDPDANTW
YPDPVSIIQKY	AESLVRNLQW	AEWASRFWLW
DAYPEIEKF	SEIDLVQIKQMF	QEYPDLIHIY
FPNIPGKSL	SEDGLLKLW	TEIERLITW
LPQPDVFPLF	TEADYYHTELW	AEIKAIFPNGQF
AANPHSFVF	EELDPESREYW	AEAGVAVFAW
FPAPAKAVVY	MEITEELRQYF	DEVRLDPNVQKW
LPQDVILKF	QELQEINRVY	QEAIPDEVIKKW
SPVDVLQIF	GELERAFSYY	NEVDPGDWQKF
SVDEVFDEVVQIFDKEG	SEFDSISKNTW	SEFIDSQRVW
YGFQEKEAF	AEAEPFTDSSLFAHW	KEFSEENVLFW
mPFEIRLPEF	SEFLYDKALTF	QEHIDLGIKY
FPEELTQTF	SELERVFLW	YEFDEQGHSTW
HAFVELHEF	AELRYDLPASY	AEIPEGYVPEHW
FPEAYKPTVY	AELLQKVITLY	KEFEDGIINW
SPDATIRIW	SESLFVSNHAY	FEVEEADGNKQWW
LPHGLIESF	EEQTSEQIFRLY	TENDHVLLFW
HPTIISESF	YEVEIDGKTY	YEVEIDGKTY
MPTVHYEF	SEIADPTRFF	QELQEINRVY
DPFPDHVVF	AEILEVLHSL	AEIDVIFKDFVNKY
NPENLATLERY	MEIDIPHVWL	SEFENQGSRPLF
YPLEDATHIAL	SESLLRGIYAY	AELPAKILVEF
LPIGDVATQYF	KELPQGTSGQLW	AETAVQLFI
FPVIYDVKY	SELDLISRL	EEIDENFKALF
LPLTHFELY	QEYPDLIHIY	SELLDKFTW
SPFRFEISF	AEIIRFLTNY	AELLQKVITLY
FPDKPITQY	AELAVILKF	NEVFLAKLI
FPVAGQKLIY	AEIPEGYVPEHW	EEGEIPWLQY
TPWPHIVEF	QEMFPQVPYHL	EEVAELFQRL
FPFNPLDFESF	AEQELANLEKW	IEIAGVKLLY
LPPGVHISY	AEGWFEDQVF	EELTLEGIRQFY
RAAEDDEDDDVDTKK	SEDDRLPVIQMW	EEVFETIIHSY
LPVDLAEEL	AEYNSDLHQF	KETDLLILF
YPLDLLLKL	KEINTQILFW	TETPLEGDFAW
ELISNASDALDK	EEIDLRSVGW	EEIDLRSVGW
FPEPNPRVIEL	EEMPATKGGFSF	TEITDDLHFY
FPLIEVNKVYY	AEALSRGWALW	SEIDVSSEGVKGAKSF

HLA-B Alleles

B35:01	B44:02	B44:03
SLADELALVDVLEDK	AEAPWLVGGQPALW	SEIELFRVF
DPFSFDGPEIm	VELPIEANLVW	AEFDTPGHTLSW
MPAVKAIIY	AESSPDPQALWF	SESTNQRVLW
NPDDITNEEYGEFYK	AETHIVLLF	EEIITKEIEANEW
LPVEEFNEL	SEFIDSQRVW	EEIIVKAMSDYW
YAQDEHLITF	SEPDFVAKFY	AEFKEAFSLF
DGQVINETSQHHDDLE	GEWIRQNGGW	EEFELLGKAY
SDVLELTDDNFESR	TEQSQIKGYVW	QELNFLLRY
DVNFEFPEFQL	AEQLQEIIARL	QEIDILRTLY
FPEHIFPAL	AETAVQLFI	PTVIKKY
FPVYVLPKVEY	KETIIAFAW	AEQQVPLVLW
MPYLEHESF	QELYFFHEL	KETIIAFAW
LPRTDYSF	QEEAVLAAYW	AEAFVRAFL
VTLTSEEEAR	AEAGVAVFAW	AEFKEAFQLF
HPWEVmPDLY	AELAIFRVF	HESPALILLF
LPLLSPVTF	SEIRSISVNQW	NEITIPVTF
NAVNLAIKY	AEAELGTFPRAF	VEGDPIVALSW
FPFFNPIQTQVF	SENAIVWKI	SELKDFFQSY
IPIHADPRLFEY	EEWLPRELW	AEVFPLKVF
FPIPGEPGF	NEQPNRVEIY	AEWAIENPAVF
mPEDVKNFY	QEVNFQEYVTF	AEPLPSNILEW
LPAKILVEF	EESRIQIWF	TEYGLTFTEKW
YPVEIHEY	FEVEEADGNKQWW	AETDLSQGVARW
IPFPEGmGGSVY	SEGELVELRW	EETPLTAAQLF
TAWLEIMTKY	EEHPLVFLF	DEFSEAIKAF
IPFEFPLHL	TENDHVLLFW	EELDVLKFL
mPYLEHESF	AELRYDLPASYKF	EELNDLIQRF
HPWFGmEQEY	TEITDDLHFY	EEFKDVLLTAW
DAFEFHEAF	NEIEDTFRQFL	EEDAALFKAW
LPHAPGVQm	EETPLTAAQLF	AEVFPLKVFGY
TAWLEImTKY	EEDAALFKAW	EEIYPPEVAEF
VPVPPNVAF	QEAIQDLWQW	TESLLRLEW
EEAENTLQSFR	SEAVSHLLQDW	AEQDFISKFF
YPFKPPKITF	AEWLFPLAF	QEGLIPGSQFW
YPSETTVKYVF	SEIELFRVF	LEELYTKKLW
LPYKITAEEMY	AEGDLYLHFF	QEAIQDLWQW
TPLDFLHIF	KEFEDGIINW	NELDLKLVSF
HPVDFLDAF	SEDNRILLW	EEMPATKGGFSF
FPSPIRLEF	AENSGVKANEVISKLY	EEMPLNVADLI
FPNVSSFEW	GELFPDRALSSW	DEQTPIHISW
LPFLPSTEDVY	LEIEAENHYW	SEFKEFSQSF
LPLPNDKTLLY	AEDEELVLHLL	AEVLGLILRY

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
LPSHVVTmL	IELEETIKVW	QEAIGFIDW
YAFPKEFPY	AEEKPIEIQW	AEDFLEKLAF
IPYPLPPNY	GENLPPLTY	AELGGLLKYV
FPVEIKSFY	AEALRLPYEQW	QELYFFHEL
YPGPGNHFW	AEQMFQGIILF	AEGEVVQVKW
YPLEVTKLIY	AEIKAIFPNGQF	QEALNLFKSIW
MPVGPDAILRY	EEIREAFRVF	TETQVKIWF
TALAAFLSY	EEYLRLVIFW	EEFQILANSW
MPEPDAQRFF	EEFELLGKAY	QENEHIYNLW
LPFDKETGF	EEVFLIGKNF	AETHIVLLF
YPFLLVGDLm	GELQLIKIF	SEPDFVAKF
DPFIDLNYm	SEIDVSSEGVKGAKSF	EELDLPAVF
mPEPDAQRFF	SEFGLKISF	SEGELVELRW
LPFPDETHERY	AEQQVPLVLW	TEAEARIFW
TVFDLVEEY	KELLYVPLIGW	SEEENVVLKF
TVTEVLLKY	SELLGLLKTY	AEFLQKLLPGY
GFAFVTFDDHDSVDK	EEFQILANSW	EELTLEGIRQF
IPTPPLPSY	FEAPNFFQKY	SEEPILKWY
QPWEEIKTSY	SEFNFSSKTY	EEYEREGITW
HAVIDINAF	AENPFLTHLI	SEDGLLKLW
mPLGARILF	SEEDLKVLF	GELQLIKIF
GFAFVTFDDHDTVDK	KDEIFQVQW	ASPEYVNLPINGNGKQ
HPDVLPFAL	EELFRDGVNW	AESLIAKKI
SPFQPHVPY	NEQPRQLFW	AELPLRLFL
EAIEQILKY	EDWIRGVEW	GEVLIDTHLF
ALTVPELTQQVFDAK	DEQTPIHISW	HEGDIILKI
LPTFQSPEF	QELLTIAERW	SESPIVVVL
TPmFVVKAY	QEHVSRIPDYLW	SEVQAILAF
IAMDLILKM	GEVPTLRQLW	EEARPLVEFY
MPFEIRLPEF	EELDVLKFL	FEIVLNDYKW
SIYGEKFEDENFILK	VERPFYDLW	EEAIIEPVIKW
TPFVDPRVY	SEFQRLLGF	QENHFVEGLLY
FPAAPAPKM	AEVFPLKVF	AETPDIKLF
SPIPFPPLSY	SEIDQINKVF	EEFVIVKALY
SVTEQGAELSNEER	SEDGSLWHW	TELGRPDAEYW
NPFHWGEVEY	SENYISDPTILW	AENLFRAFL
FPYQDKLVGY	AEAFEAIPRAL	SELQVLLGY
ESKDPADETEAD	SESPIVVVL	TEVSLLRVGW
HPTDPLTSF	SESTNQRVLW	AEIWEKLNF
EAFSLFDKDGDGTITTK	SEQRDYIDTTW	EELPHIHAF
VPWHEEVVQF	EETHTNEFITW	HEFPLILIF
EAmRIGAEVY	EELTLEGIRQF	AIIPSKKL

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
HPTVVISAY	HEQDLGPALEW	EELDSLIKATI
APWFDPAIF	AESPAGHSFLSW	EEADQLRALGW
FPYPFQVVY	AEQTPILLLF	QELDDILKF
SAANIQPIF	IESVIKELW	TEAPVLNIQF
ELISNASDALDKIR	AEAFLVHLF	EELNKLIQEF
IPLALEGKDLL	KEGDLPPLWW	EELNLKTTW
LPAEFFEVL	SEEPILKWY	EEVPTQESVKW
EPIYPEVVHmF	DENSVIKSF	GEWTPTLQHY
LPYNHQHEYF	QELFPSPELW	EEDRFYLVF
LFIGGLSFETTDDSLR	SEFELLRSY	EEVHDLERKY
NAFKEITTM	QEIDILRTLY	NEVYEAVKNY
FPEPLIIPVLY	AEVFPLKVFGY	EEAEWQTRW
FPEEVIATI	SELKDFFQSY	AEDPLGAIHL
mPSPVSPKL	QEAIGFIDW	EELTLEGIKQF
FPFKPPSIY	SELRLDSVVQW	SEAVVEYVF
EFHLNESGDPSSK	AEYPFSSEQKW	NEFIDASRLVY
NPWDDKLIF	GELDQRALQLF	SEDNRILLW
SPmDIFDmF	AEHPTIKIFW	AEYPFSSEQKW
LPLDIQIFY	QELFLAHIL	SEDGSLWHW
LPTEPPYTAY	SENFGSIHVYF	EELDLPAVFLQY
DPNLEFVAm	AELDPSIAVGF	DEIDAIATKRF
FPYYPSPGVLF	AEWEERISAW	SEWQPTNVDGKGY
NVIHNLATY	AEIVEGENHTY	SELRLDSVVQW
DLSLEEIQK	AEVLGLILRY	QEDPEAFLLY
NPWDNKAVY	HEEPESFFTW	SEIRSISVNQW
FHHTIGGSR	SELLDKFTW	EEVTLQTGIKRF
YPSEFATYL	AESHIILVL	SEELLSLKY
YAFQDDRYLY	QEGLIPGSQFW	KEGDLPPLWW
MPAVKAIIYQY	AEFKEAFQLF	SENAIVWKI
DAWLEMNPGY	AEKLEQVLQW	EEWNDPPAVKW
RPVNVVNVY	EELASWGHEY	QEFDSGLLHW
HPLGDIVAF	GEIDLAKLKKF	REVSVPTFSW
IDTIEIITDR	AEEALKYIGF	EETPVVLQL
EGDVLTLLESER	KETNIAVFW	AEWKDGLNEAW
FPWELDPDW	QEALNLFKSIW	EEVLIHGVSY
VPLEImIKF	QENEHIYNLW	YEWSVKLNW
FPEDVVRVIF	AELSEQIKSF	AEAFLEHLW
RAFDQGADAIY	HEGPVWQVAW	EEAALEQAVKF
FPVSIPAVL	QEQHVPFDIHTY	TEIQLVQSL
SPVDSVLFY	SEALALTQTW	NEIEDTFRQF
HPEKLATVL	EELNDLIQRF	EEISNMIHSY
mPAVKAIIY	GEDTFVHIW	EELPTLLHF

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
QALEILFTY	AELYINEHDY	LEIEAENHYW
qPINLIFRY	AEIKELFQYI	AEIEIVKDL
DASKVVTVF	QEFDSGLLHW	SELDKLLSSF
TAmDVVYAL	TENDIRVMF	NEFPEPIKL
FAKSVSFSDVF	QENGSLVEIRNF	AEDLVANFF
LPmGALPQGPM	SEFVIPSVYW	DEHEGPALYY
WPLVAALL	SEFSEENIEFW	QEVDASIFKAW
LPPKIVIGY	SEDNIMQIW	DEFSHQVQEW
FPAGKVPAF	SELLDQAPEGRGW	FEAPIKLVF
VPVDLQHQF	AEDPNLNQPVW	IESVIKELW
DASPVQAVF	GESKAILLW	QEIDILEDW
DLFEDELVPLFEK	SELVPIATQTY	QEVNFQEYVTF
ETIEQEKQAGES	AEGINLIKVF	SEALALTQTW
YPLsPTKISQY	AELNKIFAL	VELRILTNW
DPFIDLNYM	QENHFVEGLLY	FEVESLFQKY
MPAAQEGAVAF	IEIFRYSFY	LESFIDTQKF
FPSEYVPTVF	IEMPNISYAW	AEVDKLELMF
FPVTPVSTL	GEIQYLIKW	EELGLVTHL
HPLPETAVRGY	HEQEAILHNF	KEINTQILFW
NVIRDAVTY	AQLRFIQAW	EEIDLEGKFVQL
YPQEVIPTF	EEAYNAVVRYF	QELKLIGEYGL
SPAPVPVTY	NEIEDTFRQF	EEFDRLVKEY
SPASDTYIVF	EEQPKNYQVW	FEADSTVIEKW
KESYSVYVYK	NELERNITI	SEGLIKALF
mPAVKAIIYQY	AEWQLDQPSW	NEVVAGIKEY
VPASLPVEF	EEIYPPEVAEF	GETELREYF
APFDWKILY	AELEPDQLLAW	NETLIVSKF
LPLLLLLPm	EEIIRGQVFF	QEVLWPLPAY
YPFSSEQKW	SENLLGKQF	AELELQRFLY
QPAQDIFSVY	EEMPLNVADLI	EEYLVIIRF
YPLDLEGGSEY	EEQPQGWVSW	GEDTFVHIW
DVIRLIMQY	QEVDASIFKAW	SEIDQINKVF
KFGYVDFESAEDLEK	QEFAVDLEHHSY	SEFSEENIEFW
EAMRIGAEVY	EEFEKLYASY	AEALGIVPLQY
FPGPIFHL	EENPIVLEF	EEIAQLARQY
EPWPENATLY	RELQPSEEVTW	EEQLIDGILY
mPIREGDTVTL	GEMIIVLHF	AELDPSIAVGFF
EGLELPEDEEEK	EEDRFYLVF	EEVNLNGSGKLL
SAmEVVPAL	TELQPVKTFW	DEIENVAKQF
DAFLEQAVSY	AEVKSLIQYF	LEPEELYQTF
FPHPVNQVTF	EEVLAVFKSY	SEFVIPSVYW
mPLHTIIPLL	AEIIKEDLW	AEINNIIKI

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
SPWADNTAL	EEQRLVQQAF	WEVDVTGKEAW
DPFVDRIGYF	MEIDIPHVW	WEVEVGDRTSW
FALVFPLmY	WEVDVTGKEAW	EEHPLVFLF
SPVSFIATY	AETDLSQGVARW	EEAIIYSYGF
FAVDLEHHSY	AELDPSIAVGFF	EELTVQVARVY
TAAAVVGLLY	EEVLIPDQKY	AELYINEHDY
SADQVALVY	QEVFRFAYY	GEVLISRVY
IPDDLKQLY	AEALPRPNWEL	EETHTNEFITW
IPHMDIEAL	SESFISRLL	EEVLIPDQKY
LPADITEDEF	EEEGNLLRSW	LELGFSKVF
AGELTEDEVER	AEGIHTGQFVY	EEFRHVIAW
HPQIIIRAF	EEIAQLARQY	YEWDVAEARKIW
ADHGEPIGR	GEQDQAVHLW	EYVNLPINGNGKQ
IPYHSEVPVSL	IENPALLRW	EEFPAFPRAQVF
NPDDVFREF	AEDPLGAIHL	EEIKQIWQQY
FPGPSKPF	NEITIPVTF	EEVDVTPTF
EALLSSAVDHGSDEVK	QELFFFHEL	IETILVQSW
LALEPGVAY	QEQNIKPQFF	EELGELLQQF
YPASTVQIL	SEAFVQRLLW	QELFLAHIL
TLEEDEEELFK	SEIVWSIKSF	QEVPIIIVF
FPmTHGNTGF	AEYLILHLI	FENEIILKL
SPLAFEHVM	REVSVPTFSW	AELDPSIAVGF
VPHSIINGY	FEYEYSQRW	EEFDFHVRW
FPEIHVAQY	QEIDILEDW	SEVESILNQSF
HPFKFSDHY	AEEFLYRFL	AEAFLVHLF
IDEPLEGSEDR	SEIEDSTKQVF	EENPIVLEF
LPFPIIQQY	EEAEWQTRW	EEVTELLARY
LPLLPNVSY	QEALNLFKSI	SEDLPLPTF
IPAESYTFF	IENEVVQITW	SEFQRLLGF
LPNDVISSL	AEAEELKPFF	QEDLRTFSW
LPVIIFTTF	AEDLVANFF	SEFDSISKNTW
IPFLPLEY	AEMDERFQQILSW	AEVGFVRFF
LPSHLNISY	AEQDIVIITY	TGSWIGLRNLDLKG
LPDVSLQEF	GEWERYIQW	AEGPPRLAI
FPLPGLPDF	IETILVQSW	EEFQKELSQW
IPVTIITGY	MEQVIFKYL	AESGFPVFAW
IPYSEPMPLSF	SEKAGIIQDTW	GEHLPVGGFTY
EALAGLLVTY	AEFKEAFSLF	DENSVIKSF
ELDALDANDELTPLGR	TEIQLVQSL	RENLPLIVW
PTFGAADWEVF	SESQDQVFLRW	EEGPDVLRW
YPIDPVTQEF	AENPFVVSMF	SEVDMLKIRSEF
IFVGGIKEDTEEYNLR	AEGDTGLPRVW	EELDLPAVFL

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
LPQEGDVVGITY	TELPKAEKW	SEDFSLPAY
DPFVDRIGY	AEIEIVKDL	AELVHFLLL
IPIALSGRDIL	IENSFITKW	NEIPSLILW
LPYRATENDIY	AEINNIIKI	LEAHETFNEW
mALLVPLVY	AEAFLEHLW	QEGDIILVL
HPSQTVELF	RENLRTALRYY	EENTNILKF
TPTGIKVVM	EENSAIIIQSW	AELAVILKF
VEVTEFEDIK	HELWPGVPYWW	EEVLLDPYIASW
SPLPAQLVY	NEIITGATVGDFW	AEVPIIAIDW
FPANNIVKF	EDAALFKAW	KELNIDVVGVSF
HPDEPLYSF	AEAFLLRLY	IEFDIPITY
IPEGEILVITY	NEILDFFHGY	AEFEVPKLVQY
TAEGIILLF	DINTDGAVNFQEF	AEYLILHLI
IEEELGSK	SEILRTLTVW	REELQQITW
LPIVTPAL	LESFIDTQKF	TGSWIGLRNLDLKGE
SAVDVHINm	SEFEIVKAI	YVNLPINGNGKQ
TASELKILY	QELKLIGEYGL	EEMEAFPEKF
LPTEEEWEF	SELEKTFGW	SEDGTVRLWSL
HLEINPDHPIVETLR	AEIIKGELW	AELSEQIKSF
LPVEQGFTF	EEALRDLLAGW	EELRELAESW
FPDQVAIQL	EEEKYAFVNW	EETHSIFLWY
LPAPGVPAW	EELTVQVARVY	SEGPPLTSF
TPADVFIVF	TELGRPDAEYW	EEIQTVFNKY
YALEEGIVRY	EEQDLVWKF	AELEDDFKEGY
NAITLPEEF	NEINEVLSW	EEFEKLYASY
FEELNADLFR	SEGPPLTSF	EEVTEFLKF
FPTYPVPHY	YEWSVKLNW	AEALLHPFF
LPREELWIY	AETLIFVKY	AEFLPDPSALQNL
MPNSPAPHF	GENHLTVTW	DELEIKAYY
VPDSSGPERIL	PEYVNLPINGNGKQ	NELENFTKQF
LPYPDPAIAQF	LEPEELYQTF	AEFFEPWVY
ATADTVIIY	SDWVRDVAW	EEIYAPKLQEF
LPVLERLIY	DEFSHQVQEW	AEIIKEDLW
YPGPASLTQIY	AEKDNFLEW	FEYDGKINAW
SPIEFLENAY	QEFVRALAAF	NEVEQLLYY
MPLEDmNEF	NEIQEALSRSY	AEEFVNVYY
YPIDLAGLLQY	AEQTLNNIKQF	EELYTKKLW
APWIESQDWAY	SELSSDINVRSW	NEDPQLKSLW
DPNLEFVAM	TELERAFGYY	HEIEALKSF
IDIIPNPQER	SEFPEIDGQVF	AEADLRALL
APAPTAVVL	AEGEVVQVRW	MEQPIKVTEW
NAFEELVAF	QEFLTDMKQVF	HEGPVWQVAW

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
ADEGISFR	QEVDLQQLI	SEEDQAAELRAY
LPAAGVGDmVm	GEWASGGVRSF	TEHDLLGTEAW
YPAEITLTW	SEPDFVAKF	AEAFEAIPRAL
FAGDDAPRAVF	EEFDSFRIF	SESQDQVFLRW
LPAYPTENF	SEVPGSIPNSW	SEQPFLLVTY
TPIKDGILY	AEGLPTPIIYW	WEVDVQGSKAY
FPVPKPIDY	KELDSPFRLY	SEIYIHGLGL
VAAPLFELY	AESGLWQSF	NEINEVLSW
YPVTPELLERY	EEFDFHVRW	QELDLSKEAFFF
HPQPGAVEL	AEMLRSISF	EEIEILLRY
TPFAFVIDL	EEASSLNSLHLF	EEPESFFTW
VFDKDGNGYISAAELR	EEVPTQESVKW	SEFGLKISF
SVGDGETVEFDVVEGEK	HEFPLILIF	AELPLIRLDF
SAAALDVLANVY	NEPYIFKVF	EELFFDYRY
VPSPAQImY	QEDLRTFSW	SEDGTLRLW
LPIDPNEPTY	HELWPGVPYW	AEGIHTGQFVY
YATFIVTNY	AEIAALRFL	AEWQLDQPSW
DIISIAEDEDLR	AEALLHPFF	AEKLITQTF
IAQLEEQLDNETK	AESGFPVFAW	VEQSFFNDW
IPWLNEPSF	GEIETIARF	EEVSIEVLKTY
SEDFGVNEDLADSDAR	AEVGFVRFF	NEDNGIIKAF
VPVTLIGEAVF	SEGLIKALF	QESSGIAGILKW
FPTISLEF	AEQYDAFVKF	NEVEVQEGFLRF
FDIAVDGEPLGR	AEDALHNLDRKW	TEMLPSILNQL
NAAFPFLAY	EELPTLLHF	MEQVIFKYL
EAFLNNQEY	GESVTFHLF	NELPGLKW
EPIYIVTEY	AEGDLVRLL	AEYTEGDALDALGLKRY
NVADVVIKF	IEIENFKSY	EEFAAALYHF
IPFAVVGSDHEY	EETPVVLQL	EEVSPQLFTF
EPFLFVDEF	AEQYESFVKF	QEIDLTGVKL
TPHSEIIFY	AEVEHVVNAILF	AENSGVKANEVISKLY
TPTGIKVVm	NESIIVALF	FEYEYSQRW
FPEVYVPTVF	GEPPGFLHSW	NEPYIFKVF
IPISPISPAF	EELPHIHAF	QEVERILYF
FPFHEVIQEF	SESELTRLL	SEPFHLIVSY
TAMDVVYAL	AEMDARTILL	MEVEVDGQKF
FPEGSVELY	QEGDIILVL	AEQDIVIITY
NDEELNKLLGK	AEPLPSNILEW	EEFGQAFSF
VPNFIFDEF	AESLIAKKI	SEFDFFERL
YPTSIASLAF	EEAGIFKLL	AETPDIKLFGKW
IPFNQALVF	EEFQKELSQW	EEIPLIKSAY
LAWLDEHTL	SEAPEAPLL	SEEGPDVLRW

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
NPADITVLF	SEDNIMQVW	EEFYNLVRF
TAFDIRFNPDIF	EELTIDHVPIW	EELQHLLQW
YIDQEELNK	KEYEGEAILW	SEIGGITIAW
EPWHLDIFEF	AEVPIIAIDW	MEFLFNKTGW
LPALPLAEL	LATWTIQGAANALSG	AEIIKGELW
FPNKQGYVL	AELTEEINKW	SEILLKEFL
HPLSVLGINY	LENDKTIKLW	SEFEIVKAI
GAAAIILTY	QEDFGIFQAW	EEFQYIGESQGY
YAWESSAGGSF	VEIQFPAEHGW	AEILLSNHY
EAWLEmNPGY	EEIARDFNPNW	EEFETIERF
FPATPLLDY	AEELSILKW	GEWASGGVRSF
SPFDIADTSTAF	EEFGQAFSF	EEVFLIGKNF
FPFPKPDLIF	EEYRGFTQDF	TELLLKEGF
DQEGQDVLLFIDNIFR	AEAEIIQLL	HEIIETIRW
MPEDVKNFY	EEPESFFTW	TEALPVKLI
TAFTLAHIHY	YEFDFSKVYW	VEINIDHKF
MALLVPLVY	AEADEIFQEL	AEIRSLVTW
DAVAIVLTY	FENEIILKL	VEFSEPTIILF
FIDASRLVY	KEEQVIQVW	YEILATHPTW
FPAAPAPKm	NELPGLKW	SEEPLGRQLW
LPNNIVDVW	SEDLPLPTF	SEFTGVWKY
HPDPTRLLLF	EEEPPPVKIAW	AESHIILVL
qPMSFVLEF	TEWTIYQDW	AEIQNVEGQNL
IDFYFDENPYFENK	AEPVNLFQHL	EEYQSLIRY
LPMGALPQGPm	AEQDFISKF	KEIKDILIQY
LPMGALPQGPM	NEPDEAHLIQRW	SEEGLLRLY
IPLDFDVSSPLTY	SEDGTLRLW	QEDFGIFQAW
FIWVDGSHVDY	SEELPLASSW	TENDIYNFF
mPLQLLLLL	EEIKQIWQQYF	AEADEIFQEL
NADTLALVF	AENGFLPIHLL	EEAPKFLAF
TPFVEGLSY	EEVTQEFTQYW	QEIRSLFEQY
YPAAVPQAL	SEITYDKLNKW	SENDVIRLI
NAWNNLEKY	WEQGFSQSF	EELFHLLNF
LPmGALPQGPm	EEQLIAAKF	EESRIQIWF
APIRPDIVNF	HEAFIEEGTFLF	SEFELLRSY
FPQIEINKm	AEALAAAQQHF	AESLVRNLQW
mPQFSTIEY	AESLYEIRF	EELASWGHEY
FPFYGKPmRIQY	QEVDFFQRY	QEIEVRPGI
VPPLFVIEF	EEGPDVLRW	AENIPENPLKY
HPEASIQAVF	KEVDDVLGGAAAW	TELELKWQHW
LPTIAFAF	QEPKALVSEW	KEYEGEAILW
APLKLQmEF	EELGELLQQF	EEALILDNKY

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
LPFHFPGSF	TEALYPAFW	GENLPPLTY
VPWLSSVRY	YEILATHPTW	IENPALLRW
DQVANSAFVER	SEVNLSKLF	AEGVIVGHW
MPLGSAVDIL	LENDIRTFF	SELEKTFGW
NALPALLIY	SENPNEVFRF	DEVIIPHSGW
NAYQELLQHY	AEFIVAKAI	EESFFILKY
FTDEEVDELYR	KESSIIGVTLF	GEWIRQNGGW
LPFFNDRPW	SEVILHHEY	AEWLFPLAF
FPALPGSSY	TEQELNQIF	DEFHLILEY
LAQQYYLVY	REEDAALFKAW	KEFSIDVGY
APWEVLVTY	AEGLLSHYL	QELADLFVNY
TPSSDVLVF	LEQDPEGLHLW	HEINGLLVGF
TPFLYDLVM	SEAPFLHYL	TELDLHKRL
LPHPYAIAVF	EELPGLDSQW	SESTNQRVLWW
NPVSWVQTF	SELDRINAQY	QEQFLELSY
LPYSEYFEYF	TEHQQLEGWRW	SEHLTYLEF
VPYPDDLVGF	AEVGLNALEEW	TENDIRVMF
LPPPVHVDY	KEAFVVEEW	AEQDFISKF
NAFWTIPVY	VEQSFFNDW	QELPGLSHQYW
NPVQALSEF	SDTSDIVHIW	EEYRGFTQDF
VELQELNDR	AELPKLQVGF	GENHLTVTW
YEWDVAEAR	EEAPKFLAF	SELDLAVPF
FPVEVNTVL	EESQIRIEL	EELPGLDSQW
FPSLQRLVY	EEMEAFPEKF	REFFDSNGNFLY
HPIDGFLQSL	RELDAVEVFF	TEIDHWLEF
APSVVKISY	SEVDVSDLGSRNY	TENDIANFF
MPEGGGALAEGF	NEAVKIIHDF	AENPSIQLL
QPLEEIITY	EEFAAALYHF	DENPQQLKL
NPFEYYIFF	NEIGIPMVF	EEFFYEKAILKF
SLEDALSSDTSGHFR	AEINENNVREF	EELDGLFRRY
YPFESAEAQLL	EENPSLNIQF	SEFVIPSVY
DYFEQYGK	SENDVIRLI	AENPFLTHL
FPALAPLTY	AEFERLVAEF	EEDPNTHILY
MPSPVSPKL	EEWGKLIYQW	TEHYDIPKVSW
MPSVKVSVF	EEYLRLVIF	AEFIVAKAI
NPYHVVILF	AEIRSLVTW	AEVLNFLLRY
SPVALNVQY	NERDLLGTVW	AELGGLLKY
IPQNFIADY	SELDPAVMDQFY	AEDRFMLLF
VPVEEPIAF	TELELKWQHW	GEWERYIQW
IPHmDIEAL	GEQELFVQF	AEQAVFILF
FPEPLIIPVL	EEIIDAIRQEL	QEFNLPVRY
LPVPVIPSF	EETLLDQSF	SEAGSHTLQW

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
IPFPEGmGGSVYF	TEQDLKEYF	DELQIPVKW
TLLGDGPVVTDPK	TELLGYLQVF	SELTAEKLGF
HAIQDLLVFY	WEVEVGDRTSW	LEHVPNSVRLW
LPFRATENDIANFF	EESRLLQLL	AELPGVSRW
LPYNDYFEYF	AEQRIGPLAF	EEVFPLAMNY
HPILNDPIY	PPPPPPPPPPLPGGV	EEIHATGFNY
SAADFFSHY	EEIFSLHGF	GEADVPFYY
SVSEVIEGY	EEALKQLAEW	EEMDLKVLQF
DLEADIIGDTSGHFQK	EEISNMIHSY	EEQVFHFYW
HPWFGMEQEY	NEDYPVEIHEY	EEYQAFLVY
NAAKVFNLY	AEAGVPAEFSIW	SEVPDSVYQHL
MPQFSTIEY	AEAQPPSHPPSF	TEIDQDKYAVRF
AVTEQGAELSNEER	SENPSDVFRF	AELIISEVF
EAFQLFDR	EEMGDYIRSY	EEWGKLIYQW
FPEGLFYEF	EEVHDLERKY	AEFKEAFQL
HPDGVIPVL	GEALPFIQRVY	EEAHLNTSF
ILGADTSVDLEETGR	SEAQVQKFL	NEFGLTSLRW
LPIGDVATQY	AEGVIVGHW	SEVVTVFQYY
mPAAQEGAVAF	AETFSPDVW	SEAFVIKGL
YPQDWFQVL	AEEESLVLNKGRAY	SEDDPILQI
AVHDITVAY	SEDGTVRIW	KEAFVVEEW
NAWADIERF	EEFETIERF	TEILLRKLPF
FPAAPIPTL	EELGFRPEY	KELWAVLNGW
GFGSDKEAILDIITSR	EELTLEGIKQF	EEFPGGLTI
SPFHDIPIY	LEAHETFNEW	NESAIFHGW
YPDTDVILm	HEINGLLVGF	VEIQFPAEHGW
FPYDYSASEY	AETDAIRFL	EEVGDFIQRY
NPLDEQHIF	ASPEYVNLPINGNGKQ	NESEPIVVY
IPIGGGTSVSY	TEVDNYHFY	EEYFGFIEQY
EAIGAVIHY	AEIDAHLVAL	AEQLFHLNF
LPLDLEDIF	MEQNTEGVKW	EESFAEHLGY
LPLEEAYRF	NEVFLAKLI	AEIDAHLVAL
DALVITHY	QEAASLLGKKY	EELERILVY
LPHFFPWSF	SEPDNLVITW	SEIDLFNIRKEF
LPLPVVQLL	QEIEVRPGI	AEIPGLSINF
FAANVYEAF	EELPLDYHQY	EEALQTIFNRW
YPFPTFQPAF	QESSGIAGILKW	KEEQVIQVW
HPNLVVGGTY	SEEPLGRQLW	QEFAVDLEHHSY
EGNPEEDLTADK	SEQPFLLVTY	AEFVGVSHL
HHTFYNELR	AEKAVIDLNNRW	IEFNKPQYF
EVLGLILRY	AENAEFMRNF	QEHTQGFIITF
MANIPLPEY	GEVLISRVY	EELDFQKNIY

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
EVFEDAAEIR	SEEGLLRLY	TESQVVITL
FPHSMEPQL	KEPEQPPALW	EEIPNLENSNF
LPAPPESSSILY	AERQLQVQW	TEIDGRSISLY
LPFSSMPTAY	TENDIYNFF	AEWEERISAW
FPVFATVIL	AELSFEHDAW	LENDKTIKLW
IPIWGTLIQY	AESSPFVERLL	AEIEIVKEEF
FPSEDILLV	QEFVLEMRF	AELLVKGYEI
FPASFPNRQY	AELQEALWHW	GEIDPDQADITY
FPFEDITQH	RELSAPARLY	AEHDQLLLNY
IPLPPPPAPETY	AEEEFVQRF	AEFRDPLGY
NAMDVVVQF	AEKGDGAELIW	SEFPKPQIL
HPRIITEGF	EESLLSLIRNW	TEHQQLEGWRW
IQLVEEELDR	NEWARYLYY	TEIELAKQI
KEVVEEAENGR	EEQILDHLAW	EESLNIVKY
mALAVRVVY	GETSYIRVY	VEVDLEHEW
APFTEGISF	EELNKLIQEF	AENPFQEPRTVVW
EVDEQMLNVQNK	SELDLAVPF	QENGSLVEIRNF
HPLTGGGMTVAF	NEATMVLVSW	AEEESLVLNKGRAY
NALPDTLKVTY	VELTVVQRF	AEGDLIEHF
SPVYIAIFY	GEIWLAIHHF	RENTQTTIKLF
LPGLPAPSm	SEAGSHTLQW	SEIDQLFRI
ALELEQER	AEALAHGADVNW	TDLAKILSDMRS
IPNENELQF	AEIDARNDSF	EESFIPLTI
SALPTVVAY	AENPSIQLL	LESTTPGAAFLL
DEAAVNWVFVTDT	IEFNKPQYF	QEFRELLQY
MPIREGDTVTL	REGAITFTW	QEFEEKSGRTF
SVLPFQIYY	EEAEIIRKY	AETDLPVVF
LPIPDPGVSV	NEILGSLRW	LEADVNIKL
TPSPPEVVY	QENLTDLHQY	EELDFQKNI
FPEEVIATIF	EELERILVY	TEALHFVAAAW
DPFPAAIIL	AEDFTIKLI	AEGEVVQVRW
TAFYLIENY	EELFIVSKLW	EEVSPNLVRY
FPVPGSGLVL	AESALQLLY	AEQELANLEKW
LPGGPTLTF	SEFTGVWKY	KESTLHLVL
FLWPEAFLY	TEVSLLRVGW	AEEEFVQRF
LPAEHQFSF	QESLRIQAQF	EEIFSLHGF
HPIEGSTTVF	AEADKIGLLL	TEADYYHTELW
FPVGDVNNF	AEGITFIKF	AESLYEIRF
IPVIVTEQY	EELDLPAVF	EEVEAKFKRY
EAGEQGDIEPR	LELSEAVLPTMTA	EEIYPPKLHQF
TAAVAAFVLY	EEADQLRALGW	REEDAALFKAW
IPWKHIDYF	NEILSQQLF	AEDELFNRY

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
EAFDELLASKY	AEIEIVKEEF	AEPDFVVTDF
FPIEYHDIWQmY	AEVPFFETW	EESDIKWASRW
HAVEWPVVm	AEILLSNHY	SEVNIPLSL
DAFPLAFDY	QELASLLRTY	EESRLLQLL
LPYTVVIHY	VEQESLLTAF	REFKLSKVW
MPADIATLL	AEFPQPPGAARW	AEALPRPNWEL
MVVDIVQEL	AEQIIFDHF	AEIQDGRFNLF
TAISLFYEL	AESSPDPQALW	EEFGRFASF
LPADWAPLF	KENSDVIALW	EEINLQRNI
NPTDAFTVF	QEEAQFETKKLY	TGSWIGLRNLDLK
LIEVDDER	AENFAEHVL	AEIDSIHQL
FPQLDSTSF	SELDNVTFSF	AENPFLTHLI
HVFGESDELIGQK	FEQLLSGAHW	AEARLLLDNF
TAIRALETY	SEQDWSAIQNF	AELKAPGISY
TVFGSLIIGY	MEVEVDGQKF	IEFPGGKETW
LPAKVEFGVY	QEFIRVGYY	AEFAISIKY
TPVDFFFEF	EELGLVTHL	EETLLDQSF
IPVTIMDVF	GESSFTYRAY	AEAEIIQLL
NAFAEPGRVPF	NELIRFEEF	DEAPVLDVRY
FPLDVGSIVGY	NENPLRALY	REGAITFTW
LPKNDLITY	SEEDQAAELRAY	AENNIQPIF
LPLPAPHAQY	SETGDIYIW	EEPDVIFQNF
APALPGPQF	AELFLDTVSTF	EETTDLLAHW
FPNALFVVY	AEQQITEVFVL	KEFSAENVTFW
VALNFIISY	EERAALLELW	NEIGIPMVF
qPmSFVLEF	SEAFVIKGL	DEFPLLTTKRVFW
DPFRDLHSL	EEMDLKVLQF	SEAPFLHYL
EIEIDIEPTDKVER	LEHVPNSVRLW	TELDQVRKW
TQLEELEDELQATEDAK	AEGPPRLAI	SEFGAPIKF
SAWSFITTF	TEAFLADAKW	AELLNSKLPRW
mPADIATLL	AELELLRQF	EEPTVIKKY
YPLPPPVGEQVF	EESFFILKY	EEDQAAELRAY
EALDHmVEY	KEEDLLQAW	EEPPYAIKAGW
FALPSELERSY	SLSTFQQMW	EEVLIKNGEI
IAEFTTNLTEEEEK	NELVSTHGY	HEGEILQAF
NVVAVIVAF	SETSVPDHVVW	NEPDEAHLIQRW
NYTDEAIETDDLTIK	RELPEPLLTF	SEAYIDARTL
TAAPVVPEL	RENEDRIFVYF	VEVSPATERQW
EGLELPEDEEEKK	SELLSDVRF	HEAEVLKQL
LPAGIVAVL	AEQDLIREL	DELKIPIRSW
NPISTVTEL	EEMDFPQLM	EELYGLALRF
FPHGDLTEF	KEEELLLFW	AEQDLVQTL

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
NPVGGLLEY	DEEQVFHFY	SEPDNLVITW
SALPLYNLY	AELNFFQRI	EEFTDPLSF
TAWDEADVRF	EELLGDGHSY	QEALIRTVF
mPSSDTTVTF	EEQLPLGKASF	NEFPVIVRL
FPLEAITAF	TENKLYLVF	AEVALATGQFL
ELISNSSDALDK	EERQNIVLW	TELPKAEKW
FPLEPDDEVF	AENQGLVLKF	DEVFFSEKIY
HVIDVKFLY	AEQDVVVQETF	LEHEYIQNF
FPHLPGKTFVY	NEISERVVQHF	AEHSTVITFLDY
QPMSFVLEF	REQGNIEEAVRLY	EEIPKIFQI
FPEYELPEL	QEFDFIKSY	QEYEEQFKF
FPLAPLLAL	AENNIQPIF	SELDRINAQY
IAMALEVTY	AESQELIYTF	EEAPLVTKAF
NPVDIVSTL	GENPIPIFF	FEFEYASRW
WPAEYIIVF	IEMPYVIEF	QEVTHSVRIGF
LPSDVSILY	QEVPIIIVF	AEDGLLFKFL
HPNIVSLQDVL	HEGEILQAF	VEELFERKY
IPFPEGMGGSVY	REIENLPLRLF	AEGDTGLPRVW
IPHSFALISY	QEFQPSIAKKY	SESQLELNW
IPFFFPTQGHDY	NEDNGIIKAF	AEMLESVIKNY
HPFYADLmNILY	RETDLQELF	AEVEAILNSGARGY
LPDPNLITF	AEEKAIVQQW	EETQVILREY
LPLPLPmAL	EELEQFARTF	SEALLAVAQNRW
YPYPPPPPEF	EEVLLDPYIASW	REHDIAIKFF
HPLDLRVQF	AEIIKNDLW	AEVISVLQKY
YAFDFARQS	NEDGALAVLQQF	NEDEPIRVSY
TVSDAILRY	QEFERNLARF	RELQPSEEVTW
LGHGYHTLEDQALYNR	EEPHYIEIW	NESGVLLHF
SLVNLGGSKSISIS	SEANLIVAKSW	GEIDLAKLKKF
FPGPLLVEL	AEPDFVVTDF	TEVGPRFELKLY
FPQTALVSF	AEHIAQGLRLY	AEKAVIDLNNRW
MPSDVLEVT	AELGALHSAW	HEIYTVGKRF
FPWDIDEAL	AEQDLVQTL	QEARNIYQEF
FAFFDPVmY	EENQKIFLL	SEGSLQEGHRLW
FPELDSPQL	SDVVLLNHW	NEQYEHASIHLW
FPFLSGDNQHY	SESRIFNEL	AEIRYEGILY
SAVDVHINM	TENDIANFF	PEYVNLPINGNGKQ
LPNFGFVVF	AENDFLHSL	AEVAGQFVI
LPYNDYFEY	QEQEIDGKSLLL	SEVILPVPAF
MPSSDTTVTF	AETQILTDW	AEIDLQELQGY
NAIVAVISY	EEYLKVDAQF	GETEVLKVI
EDGSGDRGDGPFR	NESAIFHGW	EEISTLVQKL

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
NAFEHGGEFTY	REQEYYLVKW	AERQLQVQW
EPFHLIVSY	AEIDSIHQL	mPKVYIIIF
HALALAWTF	EEVFRSYVF	AELGTFPRAF
FPMEIRQY	QEGPQYWEW	EENPSLNIQF
FPVEIKSFYm	GEAVVNRVF	HEQEAILHNF
IEEELGDEAR	NETLIVSKF	EEAEIIRKY
IPWDDLIAL	SEEAEIIRKY	EEHPLVFLFL
LDPVLQNPL	YEWDVAEARKIW	EEIPVHEEF
LPALPTQAL	AELGTFPRAF	EEQLIAAKF
YPLEDLPSLLY	QEAFILRLF	NEWARYLYY
LPNGLDVTF	SEDGTLKLWNL	SEFNFSSKTY
TPSPIIQQL	LEINDVTRAW	AEHSPVPAGF
HPLPTVHPQVTY	EEIEILLRY	NEFLLPPVF
LPLPLPMAL	SEIEYYAML	NEPILYGRSY
FGYVDFESAEDLEK	AEFLERLHLF	EEDKFLLLY
ELAEDGYSGVEVR	AELTTLLEQW	AEFEVHEVY
FPEFLGMMAR	AEVIDTPVF	AEAELGQGRQPLRW
YPLEDLPSL	RENDIKSYF	EEIREAFRVF
NPVSWVESF	NEMPISQLL	AEDGLLFKF
NPVEYSIVM	VESKDPQEPI	DTALSLKDMV
DGDILGK	EEVALVQLF	EEFPAEDW
HAVVNLINY	AEFLYQVLI	QEVNISLHY
LPINDPLQTVY	HEIIETIRW	RENYDIIKTY
AIEENNNFSK	AEDYSVDENGQRW	EELGLIEQAY
MPAPEIVSY	AEFKEAFQL	EAWGTEEAPAPA
FPEHMANVEL	AEGKVIGLQIF	QELELRSLGY
IAIPVTVAF	AEVLQSTQRF	AEGDLVRLL
DVDLEFLAK	EENQELVTRW	NEEGFVRLY
VPAEVTVIL	QEWDEFPNGRW	NENDIITHF
FHVEEEGK	REQDFTLIF	EEFLNGRAVY
QPAIIDGELY	RELDGFGLYLY	VEATHVLPLHW
LPFPKIDPY	AEGDLIEHF	NEILGSLRW
NIPEIVAVY	QEPLYPALRLW	SEVPGSIPNSW
NPADSISHVAY	SEIEGIQSL	EENQELVTRW
FPIPLINRL	EENRNSLFFF	EETLNILIY
LPFSAGSLLVY	GELLGEARYY	REFSPEEGLYY
MPDSAAALL	AENTLSKLL	RETDLQELF
IQVLQQQADDAEER	SEGSFLLTTF	VEFHEPETW
VPVDVVVNM	EEASLLHQF	AEVDKVTGRF
KTEELEEESFPER	SESQLELNW	EEYPLTRAF
TVLELVTQY	AEQLFHLNF	NEVSVIKEGW
VPSGLIVDY	NELDAVQREY	AEFEVVRTI

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
DITSDTSGDFR	QEELARSFFW	AESDLDYIQY
TASPVAVSL	AEAEPFTDSSLF	AEFAAERDWEQF
HPLGIVQGF	AELLNSKLPRW	AEINENNVREF
HVGPFIDSY	QELDDILKF	EEASIDFRF
APAFLYDIY	AENLFRAFL	EESQIRIEL
AVTEQGHELSNEER	RENYDIIKTY	QEQLIRSLY
DPGSVIVAF	AEIPGLSINF	AEDTDSIGLALF
FIIPNVVK	LENGVFPRW	SELVPIATQTY
LPHDPDLAY	EEAVTSIQQLF	EEVVSVLHVF
mPDDLLTTL	SELATEVHFY	AELTKVFEI
MPTDVLEVT	VEMYDPTRNEW	EEFIKSIFY
QPINLIFRY	AEDELFNRY	AELDRQIKSF
ETIEQEKR	EEALILDNKY	EENIYKIDF
RPFADLLGTAF	AEMEHLLERSWY	EEQTSEQIFRLY
mPQGAPRLY	AEGDLYLHF	AENGLTVRL
VPTELALLY	EEDFPSLREY	AENQLALEL
YTSQFVSL	EEVDVTPTF	AEVDYLEQF
YPSEFSTYL	AEVLDLRRLY	EEGHDFIQEF
FPIAEVFTL	SEAVIAQFY	AEIPDQLVSY
mPLEDmNEF	AEAESFAIQF	AELAVGSRW
IPAATTIAY	AEEHLTVDARVY	EEDFPSLREY
SLHQAIEGDTSGDFLK	AEFQRTDLGAW	EEENVVLKF
TANPFPVPSL	AEMTGYVVTRW	EELIVVTSY
GDEELDSLIK	EEIQEEAERMF	SELDLTYGNRY
mPTVHYEF	EEIVTYDRVY	SEVDVSDLGSRNY
EPIYIITEY	LEEEGNLLRSW	VEITELPVRTW
ELTDEEAER	LEISAEDAERW	AEFEDTLKTF
FPGQLNADLRK	NEQYEHASIHLW	EEFSRAAEKLY
GYFEYIEENKYSR	SENVLQVHL	QEVGYTIRF
IAFFDVRTF	TELGPEEVRW	SENSLIILL
LPAAGVGDMVM	VEVSPATERQW	AEIAALRFL
MPQVAPDLY	AELIISEVF	LGCDHILVI
SEDDESGAGELTR	YEIQDIYENSW	SEDGTVRIW
SPEELYRVF	AELAEIQEKW	TEADVKIVI
STGEAFVQFASQEIAEK	EEIHATGFNY	AEEKPIEIQW
TPRIELEEm	AEIPDQLVSY	NEFPVPEQF
LPTGVYLNF	SELFMSSFQSY	SENAERILF
FPPDAILFY	SENLLPQNAPNYW	REGEIAQFL
FVSESIISY	AEAFASLSLF	AENGFLPIHL
KVEEAEPEEFVVEK	LESFIRQDF	HELGNVFLKF
TPLVDPSVY	QEHSGIFGF	VEFGTILVY
VALPGVAVSM	TEHWLVRIY	EEMDFERGIW

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
MPVLEQSVL	ESLWSFMGLL	FEIEELNRKY
LPLHVLPLY	AESPPRFYF	SEGGPPLRI
TPLSLFGDTY	AEMPDSAAALL	HEILIGYLEY
DAIPAVEVF	DEVIIPHSGW	LEEPTVIKKY
HPSNVLHFF	EEIPFEQSF	QESNVQLKL
MPQGLVISF	NENSLFKSL	SENELGVGGTSQW
APWQVVPEL	TEALILQLF	GEAVVNRVF
IQALQQQADEAEDR	AEVSLMEVRF	QELLTIAERW
FAFDPSVNY	LEILDDTVQRF	QEIPGEFIY
MPNVKVAVF	AENSLLAKVF	AETDAIRFL
VADPYVVIm	EELVTISSFLN	REFNLNELY
FPAELGIVF	KEPLTIVKLW	QELLIYEAF
MPTIQITAL	SEIYIHGLGL	SEGSFLLTTF
FPPEANYLF	EEMDLFTKY	AEVDASVVREI
LPFDLRIPF	ENPEYLSEF	NELGVGGTSQW
VPLEWYDDFPHVGY	MASHPPIPI	NELEGRDAIFKQF
HPVWALIYY	REAFLQEVW	MEIDIPHVW
NVTELNEPLSNEER	YEFDEQGHSTW	QEALNLFKSI
FPAEPLEL	AEDGLLFKFL	EEMDLFTKY
GAHGIIVVY	AEELLRIGL	SEALPGDNVGF
LPAVVVETF	AELAVGSRWY	EEYMNKPTF
NAmDVVVQF	AENGLTVRL	MENVNKPQLW
QPYAPPRDFAAY	YEMEVSQRL	NEAVLHLRF
YADFTLLSI	AEWEWKAGF	EEFIGAGEQARY
HIYYITGETK	GEIDTRFSF	EEIFGTIGM
NEEDAAELVALAQAVNAR	QEATADVEWRW	SEHVFQILF
SPVFMQPVY	AEITHEIIGF	AEFQGYNVLL
TAFQEALDAAGDK	EETQTLVREY	IVEPPTDLN
TDASSASSFLDSDELER	EEVAELFQRL	LEWARNTSLAPGAWP
YPIALTRAEM	MEITEELRQY	SENVLQVHL
mAYEPQGGSGYDYSY	EEIIRGQVF	EETVFYGLQY
AAIGLVIYY	AEVEAILNSGARGY	AEFIIDTRDAGY
QAIEDmVGY	EELYTKKLW	QEFGVPHQY
TFTQQEIEF	HEAEVLKQL	EDAALFKAW
LEEAEKAADESER	HEVPYTTSF	EEVLAVFKSY
LPmGVVVDY	QEAPLSLAEGW	NEIQEALSRSY
RPSVLIVTY	QEARNIYQEF	GETSYIRVY
LPHEIVVNL	READLDFARQY	DELIQQSQW
LPLNSVYVY	AELGGLLKYV	EEIRNIILKL
LPVPAFNVI	QEQEIEQRLL	MEVPTYLNF
NAISVTTSY	AEALGVPYEQW	AEHSPVPAGFGF
FALITWIGENVSGLQR	TDLAKILSDMRS	AELDIPQSV

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
NAFASVILF	EEQVFHFYW	EEHVIIQAEF
PAAALGRVEAAHyQL	AELSSLPAF	SEVVVNSVF
TALASVVAm	EEFRHVIAW	EELPEKLKLY
FPASPPKGY	IEVNGKQSW	NEISERVVQHF
VREEEIEVDSR	AEVNNFPPQSW	AEGKFWTHW
FAYDGKDYI	NEIVQSNLF	KELFEGVQKW
EDAANNYAR	EEIPNLENSNF	AEHIAQGLRLY
DGYDYDGYR	AELPGVSRW	QEFEESLRL
mANIPLPEY	EEFGRFASF	SEQEYQLYL
MAAMPQTVY	EEIPKIFQI	EEIDEKIGF
VPFDQFIQL	QEIYGGSDSRF	EEQQDILSKF
EPQHWPVQY	SEDGKVFFW	GEIDTRFSF
EDMAALEK	EELAILGKGGYGRVY	ESYLLQVL
VPQVSTPTL	KENAAYFQFF	QELLTVSERW
MPDDLLTTL	RENEVLEAW	SETSVPDHVVW
QPFQVAEVF	AEIIASHW	QEEAQFETKKLY
TAAAVGAVF	AEINYGIRF	QELASLLRTY
FPDLFSEQL	EETQVILREY	AEDPNLNQPVW
PSSVVPMGQNVTL	EEVVSVLHVF	SEDEVKLAL
LPSLSAHEL	EEDYRTLTNY	ELATSRTAPAAKNPC
VSFELFADK	EEGDTLLHLF	SEFALRPTF
NPTDISYVY	AEIDARLKALQEY	SFGQLPLALVTWV
IPIPFYLSVY	SEKGVIQVY	QEYLDTLYRY
LPLPSPALEY	AELYVERAKWLW	LDVEPSSPAALA
SSFPTVVIY	QESNVQLKL	EEDRVVVIRF
LPPEIFGDAL	AEIQNVEGQNL	EEIEGFRY
QPLLIIGKGAAY	QEFEEKSGRTF	EELQKIYKTY
VALPGVAVSm	AEIPQQVVGYF	SEISQVFEI
EQFLDGDGWTSR	REHDIAIKFF	SEYDQIRYI
FAADIISVL	SEINFSFSRSF	RENDIKSYF
GATQQILDEAER	AEESAIRVGF	SELLSDVRF
HTGPNSPDTANDGFVR	AEIEDIRVL	EEIPKNYSI
IPFAAPTAL	AELAVGSRW	DELPQSVLKW
SSFYVNGLTLGGQK	AELEADLPRSW	FEDETVRKF
YPDINFNRL	AENPFLTHL	DEEETYRLW
YPNIGGIIRY	EEAFTSEHW	DEIDAIGGARF
DAADIRFVY	EEAPTDLRVF	EEASIYSRW
LPFHPYVENG	EEYLVIIRF	GESSFTYRAY
FPQFEPQRY	LASPEYVNLPINGNGKQ	LENDIRTFF
DAIRSLASVSY	LELETDENRIY	SEEQYLAAVRKF
LALFSETAY	RDFLGTNW	TEFYFAQARW
LPTELDGGDQE	REDQDAAFFKAW	VEMYDPTRNEW

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
SAFPYAHRF	REGEIAQFL	VCNRFHAFLLY
LPFATPEEF	GELFLTKEF	IEFQPPEAKKF
LLDPEDISVDHPDEK	SEIGGITIAW	AEIEDIRVL
ELNYFAK	TEIMPGINNW	FAPYNKPSL
RPIFIITEY	AEGLGFSY	QELLQTQDF
TPTEISLVL	NENDIITHF	AELMQTLRF
LPMVPIVAL	EEFHQSLQW	EELLGDGHSY
HAmVILLTL	KENGADIFLY	EEFFGDLNNF
LPAPPTQNM	DTALSLKDMV	ENPEYLSEF
TPRIELEEM	LEHEYIQNF	EEASLLHQF
SAAPFFVLF	SEGSLQEGHRLW	AEIKQIVSEY
DAGPLLISLK	SEIPSDPKLF	TENDHVLLF
GLAITFVSDENDAK	EQRQLQQLL	GQPNYLLS
LPAPPFIAF	QEDDLQHLQLF	AEDAMRLYY
VPLGMTVTF	EELKETIKKLL	SEADFSIHF
IPNGVQIFF	QEYLKLETTW	EEIANYRPTL
LPMGVVVDY	SENFGSIHVY	GEIDQQYSRF
MPQGAPRLY	SEALPGDNVGF	HEILLHPRYF
EPSFITESY	QEIGVLDQREY	QEIGVLDQREY
FPSEYVPTV	AEGKFWTHW	RELLEIVKKNF
VPVPPILGF	AFFGEGAGPVWL	SEINIAPRI
IPSELFSSF	EEGHDFIQEF	QEFVKAFYL
QLEEAEEEAQR	SENNRIFTL	SEEEFLRTY
QSGEAFVELGSEDDVK	EESKVLPIIQRW	EEEPHLVEQF
LPLQDELAF	QEQEIEQRL	EEFHIYTQY
APFSKVITF	SEMILVLEY	GFSMLDFLSER
SADLRsPVY	TEFPIIKMY	PTYKGLLMSLQN
EPDFVAKFY	LEAYIQQHF	VEDERGNVFLW
NPFELAFSL	AEFEVVRTI	GEIRLLQSY
VPVmLTEQY	REAVTHIGRVY	QETPLPRSW
LPIGIPYSISF	SEFALRPTF	QENPFFRKL
NAVDALIDSM	AEELPHIHAF	SEEAEIIRKY
TANGYILFF	DENPQQLKL	WEVEVGDRSEW
QEVAVKEQLT	QEHFLIVPF	DEALIGKKF
FVSGVKIFY	AEFAISIKY	EEFIGKIGI
LAIPITNTY	AENMIQLQF	EEFVPGVKRY
VPVEDLPYT	AEPIDIQTW	EEVGVEHLL
AILVDLEPGTMDSVR	SENSLIILL	DEIGLPKIF
FNVWDTAGQEK	EEIFGTIGM	EENIQTLLI
GDVTAEEAAGASPAK	QEISSLVKYF	HEFLVKPSF
TDTESELDLISR	REHDIAIKF	EDLEKKYANET
TDYNASVSVPDSSGPER	WGSEAALLLVC	AEAEQTLRF

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
GLGTDEDTLIEILASR	TEINFTQKL	LEADLPRSW
QAITLVTQY	EEMEWFNNY	QEVGYSIRF
SAESKAVQEL	QEYFIPNKEF	EETFQLSRW
MPNQIVQIL	SEFIINNRNY	TEAGLKVVGY
NIITILESY	AENILQQDF	QEVFRFAYY
FPEALARLL	SDNLARLW	EESLRNYYEQW
FPQHTIASL	QEDAARLQAAY	REDQDAAFFKAW
EAIVTVIM	RESDQLFKQY	AEFNLRHDW
NPSPYHLYY	TESQQIRYF	QEIFTEKVL
DVFTVVISY	EEIEELLRSQW	AESFVNVKRW
LPSHVVTML	IPGAEVL	AEQDLIREL
LSQEFEAFFQ	SELDQIQRY	AETDFEKRDF
VADPYVVIM	VEITELPVRTW	SEPVGIYQGF
HPLTGGGmTVAF	KELFEGVQKW	DDQENTLKY
LPYPDLETY	EESDIKWASRW	QQSSLSLRW
LLTDIIAAY	HLLFWGVLA	SEAQVQKFL
VSTEVDAR	SEFSEPSFI	EEVIFPNNF
FPFAVANQL	TDFIDTAGAMLQ	EEPQHVLLRY
TAVPTLLKY	AEFNLRHDW	EETVVPKTF
TPSPDIIVL	AEVDLERVRVW	EHVLIPTLPPH
HPELHDIPIYY	EETFQLSRW	AEINYGIRF
AADAEAEVASLNR	SESIIEVLRF	EVDLVKGGHW
DVLSVAFSSDNR	TEAPGNLRLY	REIEELLNNF
EAWHELAELY	AEADLRALL	AEAVVLTLL
EQISDIDDAVR	AENQLALEL	QEVYAQVARLF
ESEAVEWQQK	NEFGLTSLRW	LEQDPEGLHLW
QAAmPQVSY	EACSLPEHNLI	AEEEATRANASRR
TPYDLPGNLLRY	VEINIDHKF	QESFIWVRY
IPWVIEPVY	EEGITFVPRW	QEAASLLGKKY
LVYNGVYQY	AEVGAAGKGYLW	EEMSVPLKEL
TAIEAQHLL	AEYLIKEGY	DEFHNPLAY
FPVPPLLY	AEAWPPGVCL	QELNKILRSW
EQLAIAEFAR	AEVKGVYQF	QETREILHF
LPPEELVPY	AEADKIYSF	PPTTFLLFSQKSAI
MPNENIPEL	QEFNLPVRY	KEIFLRELI
AAVQESARI	READRLLSLW	
EALSLAHTY	REELQQITW	
KTVEDLDGL	MELPDYRQW	
SPmDIFDMF	REAEFTKSI	
EAASVPVVY	GEQGYIRLI	
LPSTTIVSm	MENGIVRNW	
YPLTIATLL	QEELITQYL	

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
EAIKILKGEY	EESWFPKYI	
LPNWLINSY	NEIEALETSRLY	
LPIPSKLLEF	QEFLVTDNSRNW	
VAVGELTDEDVK	RENTQTTIKLF	
VVTDTDETELAR	SEHWLVRIY	
YPENIVPSF	FEVYDPLSKRW	
mAVELPDSF	RENLPLIVW	
ERQEAEEAKEALLQASR	YEIDKTLGI	
LPASGQIALLEm	AEPLPSLEYW	
LPAAGVGDmVM	SEQEYQLYL	
NAFPEENMNY	AEAEQTLRF	
FPDAIRLRF	SELNPNAEVW	
IPEELEFQY	EEIPVHEEF	
qPLLIIGKGAAY	EEQIKDIFYI	
LPLLLLLPM	EEQQDILSKF	
mPSVVGVLVF	AEMAQNAVRL	
QAAMPQVSY	DELIQQSQW	
EVIPYTPAM	DQPEPQISF	
GIEILLERHQEHRADM	QELLQTQDF	
QPLEDLASF	AEAEAVREVY	
TQAEDMLVSY	NEDPQLKSLW	
EPFRLGIRF	QEQEALVNRLW	
EQADFAIEALAK	QEQLIRSLY	
SSEEIESAFR	QEQLPDLHSHF	
AVFLLDDK	SEELISEGKW	
NAFsANLNF	SENKIVGIGY	
ELPDGQVITIGNER	REFPDRLVGY	
mPELVDFRQY	ICHALLDPDKGTR	
GLEDEVATPAAPRPGFP	QEQFLELSY	
PFDREHLLMYLE	AENSYVETLF	
SESPKEPEQLR	TEAYIAQRF	
AFADLCIGIY	QETPLPRSW	
ETDLLLDDSLVSIFGNR	NEIIEPVYF	
GAMGImLVY	SEWSHPIHW	
EATTEFSVDAR	AEGEVVQVKW	
LPADVQNYY	EELPYSEYF	
HPVYILKGGY	NELGVGGTSQW	
KSPIFTPSSGRHEHG	AAQDFFQRW	
EPFnRPSTF	QEFEHVNGRW	
DLLDHISSP	QEIFKTFYL	
EKVESELR	AESGLSFITF	
QPNPLPLRL	GEDSTYKFF	

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
GTIEILSDVQLIK	LAQKDIRIRQ	
DSGTDDQEEEPLER	EEASIYSRW	
AAAALLGSAPY	REYQLEGVNW	
mAVIDGNVM	SEINERVVQHF	
VPHSLETLY	EEFISNTLF	
LDPHLVLDQLR	EEGALSVLQQF	
MAAALFVLL	GEDLGVAFW	
SPMDIFDmF	SENPLPTVEI	
TAHLTFVIDCT	SENYITYKNF	
SITHDIEEK	SESLVHESW	
	AEQAAQLSRLL	
	AEYHYLEAQEW	
	HTGSWIGLRNLDLKGEF	
	QEITDETRIF	
	TGSWIGLRNLDLKG	
	AEIPQQVVGY	
	ESLDLSHNGLTALP	
	FHGEIEDLQQW	
	GEVEGHPVW	
	DEEETYRLW	
	EEDPNTHILY	
	LAEQGYEVAQSNAAFI	
	AEENLFKLI	
	QELDLGSAGGRF	
	NEPILYGRSY	
	QELEAGVGGRF	
	AEISDTIISGTF	
	AENNLAGGVLRF	
	AEYTGPKLF	
	EEIYPPKLHQF	
	ESLDITIVR	
	READQPLRTY	
	RENFLQQLY	
	SEFIDSQRV	
	SELDQIQRYF	
	TEFYFAQARW	
	EEYLLRQVF	
	QEFGVPHQY	
	GNKTECALLGF	
	LNGFQWSLEV	
	EELGVMGVY	
	AENPFVVSMY	

HLA-B Alleles		
B35:01	B44:02	B44:03
	EEMDFERGIW	
	AEDKENYKKFY	
	DTAPVLEGLK	
	VCNRFHAFLLY	
	SEANVREIF	
	QEAIDIYKRI	
	AEASALYGRAL	
	AEDFADQFLR	
	AEQFRLEQI	
	EEMLEIRQL	
	EEQYLAAVRKF	
	NEAQAIETARAW	
	SENPLITLREF	
	EEFVYKVWEGRW	
	ESYLLQVL	
	SESNGEFFF	
	AEIEETYANF	
	AEKAPTNIVY	
	QESALIRKL	
	SEPVGIYQGF	
	KEAELTEI	
	SPNPAPDDLPW	
	QENPFFRKL	
	AEEHEILTKSYME	
	GAYLLAQACVSSCPQGT	
	AERSIEEVYYLW	
	AESFVNVKRW	
	AEVLIQQGGL	
	EEIPKNYSI	
	TEAEELRKLW	
	QEFIDNPKW	
	MEPSTAARAW	
	AEIDLRQGRLL	
	AEQSVLFKSL	
	KEPAESSFRFW	
	QEMPWNVRM	
	AEMEIIGQF	
	HEIEALKSF	
	QQSSLSLRW	
	QEVIKAYGF	
	EDNGIIKAF	
	QEALIRTVF	

HLA-B Alleles		
B35:01	**B44:02**	**B44:03**
	QEQSFVIRALGF	
	RELDLQRNY	
	SEMRFVQDL	
	IEKPEEQWW	
	QDLIYGVFT	
	AEQEVARLL	
	EEQDILQRL	
	KEIDMLLKEY	
	QEISDETRVF	
	EELERGIRSW	
	EENIQTLLI	
	AEEEIGTPRKF	
	FEIEELNRKY	
	QELNDRFANY	
	HCVLAQDPENQ	
	AEESLFRVF	
	QETSFTKEAY	
	SELTQVFRW	
	DENGLIIVW	
	QELQEVVEF	
	QEVGYTIRF	
	AEAERVGLHKVF	
	NELISQDSDSDS	
	SETVLNLAF	
	AEPGSVISW	
	AENIQPGEQKY	
	AENNPGKFWF	
	AEVKLLRQY	
	QEIDGRFTSI	
	AEDTDSIGLALF	

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
SLADELALVDVLEDK	TPLLLRGLTGSA	HLEINPDHPIVETLR
YPYPYPHTL	MPNPSLAQVKI	LIALSIDSVEDHLAWSK
DAWKLPKI	MPWGDPNYRSA	SLADELALVDVLEDK
DLEAEHVEVEDTTLNR	MAFSPDGRWLISA	RVLPPSHRVTW
APEPHVEEDDDDELDSK	mPWGDPNYRSA	AAVPSGASTGIYEALELR
DALDKIRLI	FPFKPPQRIEA	SVSKDHALRLW
DALDVANKIGII	HALEWPSLTA	SAGPVGDDMFHW
AAEDDEDDDVDTK	VPFPTPLEA	SALGITAGAHRLW
YPFINSRIITV	LPASIPHVIA	RSLPHITDVSW

HLA-B Alleles

B51:01	B54:01	B57:01
YPASPWSHI	FPSEYLSSHLEA	IIGATDSSGELMFLMK
LPSELIVHI	LPVWLENHTA	KVPQVSTPTLVEVSR
GFGFVTFDDHDPVDK	mAFSPDGRWLISA	TAGAHRLW
DATNVGDEGGFAPNILENK	FPWPQPLST	KTVDGPSGKLW
DLFEDELVPLFEK	YPFSSEQKWmA	qSLQIFRKW
LPLEGWNHVV	LEKPAKYDDIKK	VLNNMEIGTSLFDEEGAK
LPFEVLQHI	MPWLLSAPKLVPA	KTIEVFDPDANTW
HPPSHWPLI	LPWSNPLKV	ITAGAHRLW
DPFIIIHSI	MPWFKGWKV	ITIPDIKKDRW
DALAKVTKI	FPVSVGVHSA	FSIPDEKETRLW
TPYQSKWTI	LPNQSFPHSV	KSWVFGVHF
DPFAFIHKI	GFGFVTFDDHDPVDK	LFIGGLSFETTDDSLR
YPDRNLPTI	FPKVPEGGEGISA	KSVTAFFKW
IPYQDLPHL	APmPPIIHA	NSSYFVEWIPNNVK
LPEDKPRLI	FPRAPSTSDSV	RSLKDALFKW
IPWEVKASI	LGHGYHTLEDQALYNR	EISLWFKPEELVDYK
HPDSHQLFI	YPFSSEQKWmAV	KSIPVEDNQMVEISAW
HNPHVNPLPTGYEDE	YPFPLSHSV	RSLPDPNLITF
LPWSNPLKV	IPFSVVGSNQLIEA	ITKADAAEFW
DAYALNHTLSV	LPYLFHVV	KTLVNPANVTF
SYELPDGQVITIGNER	APRQPGLmA	YQVFFFGTHETAFLGPK
LPFRVLLV	LPFRVIPLV	VIHDNFGIVEGLMTTVH
YALNHTLSV	FPmEIRQYLA	GTYGVRAAW
LPLAHVLEL	mPWFKGWKV	VSDSGAHVLNSW
IPFFREIIV	LPLEGWNHVV	SAASPHYQEW
NKESKDPADETEAD	FPKETFEGP	TVYPKPEEW
LPNAPKALI	LPLSLLKTA	SSATDAAIRVW
FPHLQLLDV	YAKYLPHSA	GYAFIEFASFEDAK
IPTLKISLI	RSGGGGGGGLGSGGSIRSS	ATYSEDGLLKLW
LPASIPHVI	FPQVPYHLV	AVTALAARTW
LPFRVIPLV	KEDLVFIFWAPESAPLK	VGLPAAGKTTW
FPWPKVLKI	LPVLPVAAA	ALESPERPFLAILGGAK
FPDPNVKYV	HLEINPDHPIVETLR	VTFPFKPESW
LPRPIQDILTI	LPFFGFSEPLAA	RSIPAITRYWF
FPLDPQLAKmVI	LPLPPPPPP	SALFAQINQGESITHALK
TPINRIPIM	WPFVSDPAPTA	VVVPAEWIKNW
SPLDSIHTI	FPMEIRQYLA	IAQDLEMYGVNYFSIK
LPLLRVLSI	FQRPPLIAA	KATPIKLIW
PFKPPKV	YPWHRFPVT	RSFLDPGSGGYSW
DVFPHLPLI	HGGTGFAGIDSSSPEVKGY	ASLDISRKW
RAAEDDEDDDVDTKK	FPSIFIYGHTA	SYELPDGQVITIGNER
LPLPHFDTI	FPHFDLSHGSA	SSSPEVKGYW

HLA-B Alleles

B51:01	B54:01	B57:01
LPSPPAVAV	MPNPQLNIKA	QTVQEDLRTFSW
YPWLTnHTV	LPNFLDHIIA	LYIGLAGLATDVQTVAQR
VPYEIQKGQALI	MPHSIMRIDIA	RVFPHEVNW
YPYEYEGGHI	IKDPDASKPEDWDER	GTIEILSDVQLIK
YAFPKAVSV	FVNDIFERIA	KSKLDAEVSKW
DAPHPPLKI	FPTLKFFPA	RSIPAITRYW
YPPWPGKIV	LPSPPAVAV	ITYDDPIKTSW
VPLLVKVI	YPFKPPKVTF	ASAGFDRLILLW
LPPNHILEI	HSFDPFADASKGDDLLPA	KSSDIAKTF
LPHHRVIEV	MPILIDFHA	AAEDDEDDDVDTK
FPSPHILQI	FPVQGVHTV	RALEAEKRALW
YPFKPPKV	VPYRLLPGIF	FALITWIGENVSGLQR
DAVKILKL	SPIENIQRV	HTAKISDFSW
YPYVAVmL	mPTLPPPSV	LGFAGLVQEISFGTTK
FPAAIEHTI	SPFGPSPNGPRSGLISV	qSLPSKTKVAW
LPYAMKPIDY	FPATVLFRGGPRGLLAVA	ATLGNFAKATF
LPSSVLHII	HPSPLSFFSAGPATVAA	GLGTDEDTLIEILASR
DGLLRVLTV	LPGELFHVV	GFGFVTFDDHDPVDK
LPFSHPLFI	RAAEDDEDDDVDTKK	SASPDATIRIW
YPEAITRLV	TPWPRGRLLTA	ATIKDIREHEW
LPWPFRNKV	MPSRFPPVVF	KLSPEELLLRW
DAHIYLNHI	FPLPPLsPGGGAVAA	LALPPGAEHW
LPIRVLLV	FPFSQDINSHLA	YTDNLVRVW
LPDGRIIKV	FPFDPPFVRV	RTFPQILAPIIF
FPWSEIRNI	LPAPPHIDV	RVWQWDEKW
FPLDPQLAKMVI	MAAAAAAAAAVGV	SATDAAIRVW
ILDSVGIEADDDRLNK	FHHTIGGSR	AVAAVLTQVVW
FPYAFKEVI	IALWQFLSA	FTKPPIGTW
FPVQGVHTV	YPASPWSHISA	ASYSGKAADVW
FAYLRDLLI	VPFLHWEA	ATADVEWRW
LPHVVPTL	FPNEFIVETKI	VSFPDVEKAEW
FPIDHFTHI	YPLLLKELA	TLAQLNPESSLFIIASK
HPYRLILTV	SPFFPLVSA	VTVPANVQRW
IPYPRPIHL	YPSLPTmTV	VTKKTYEIW
YAFNmKATV	LPLSAHGIVV	HTAPVLDIAW
IPAEVPHI	MPTLPPPSV	IINEPTAAAIAYGLDKK
FPFPKPALI	HPVHPFLAV	KIKDYLEELW
DALLKFSHI	IPTPIVGV	VSAAADSAVRLW
YPLERGFIYV	YPVEIHEYLSA	GADFLVTEVENGGSLGSK
IPVEFKLVI	FPLPPLSPGGGAVAA	ISMANDLKEVW
mAPLALHLL	LPLHPSWEA	AAYRNLGQNLW
VPYPVALHV	YPNLQVIGGNVVTA	HSSGILPKW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
LPWQIVQI	LPLQWVDIA	VTYKNVPNW
TAFSRLILI	HPYRLILTV	TSSSSVRVEW
YPLDLLLKL	FPFGKIGTV	LAKGWAPTF
LPPPPMQYI	MPRWAERLFPA	AAADSAVRLW
LPYYSKFILI	LPWQGLKAA	VTFLFSKENSVW
VPNNKITVV	FPIHAITGV	STGEAFVQFASQEIAEK
DALLIHDTV	HSFPTLKFFPA	SSLPTVEKW
LPFSPLVI	SPKQILDPA	KLIDVTNIYW
LPDGRTLIV	IPFGITEEA	KSFENISKW
LPWGPALLI	mPFTASPASSTTA	AALENDKTIKLW
LPPPPQQKI	IPISPISPA	HTAVVEDVSW
VPLIIPVSV	SPFPDIPKV	VAAPSWLHRF
TPHDFIEHI	LPFYLIPPSA	VVDPVHGFMYW
LPFTPKNI	LPRLIDMSA	NSIKPQELLEW
LPSSLYLKI	FPFIPDQPFRV	LVFPYTHQNW
IPPIQVTKV	FPLPPLSPGGGAVA	LTGPWKLW
LPWISILTV	VPWMPPGKSSA	LEKPAKYDDIKK
DPLGYIAKI	FPHLQLLDV	ATTPSAVFRVW
IPWLQYNEV	YPLEDATHIA	VSAEGVLHVW
FPFYGKPMRI	WPFSIQDVV	KTYSYLTPDLW
LPPLHVAKL	TPTEFFFHA	IIMKDVPDW
YPAPAGLHI	FGPGKPPPPP	LSGPFVQKW
PDGRIIKV	LAAARLAAA	ETIDWKVFESW
VALDKVIEI	HSFGPMPISA	LSEEASQALIEAYVDMR
VPmTPLRTV	LPYDIPHRA	YTKFQIATW
YAFNMKATV	APIWLEHAA	HSGPVVAmVW
IPFEFPLHL	IPAALPVAA	KTSELLVRKW
VPAALKVV	FPYPVGVHA	KTWFESVPGKQW
VPPEWVPII	GFAFVTFDDHDSVDK	VTWPEEGKLREY
DALSKMVII	WPELPVLSA	LGIPKDPRQW
LPLSSLTHV	SALALRWEA	ASLPLRVSF
YPVIIHLI	SPLYLAHEV	ALTVPELTQQVFDAK
IPWPGTLAI	MPRFTEQVEA	KSFVKVYNY
YPESLVRVV	YPLDLLLKL	RSFFTDGSLDSW
DAFRQPSLFY	FPLDPQLAKMVIA	TVYTGIDHHW
LPFRALLQI	LPSRFIESA	RVHPETYEW
VPYLVGQVV	LPTKDLLSA	KEDLVFIFWAPESAPLK
LPQIAAKI	FPLHPMMITNA	LSLGVAALYKF
LPYLVPKL	FPAPILRAV	ITTKAISRW
VPRQNVPVI	FPYLIAGKYA	KSFDFHFGF
YPIEIDPHRTV	SPVVPQISA	HSGLVHGLAFW
YPFKPPKI	MPVPAQPKA	LGITAGAHRLW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DAYSFSRKI	IPLYLKGGVADA	HSGPVVAMVW
DPYKVYRIV	IPFYGILGA	ASADGTIKLW
YAFPKSITV	LPFVPPPAV	KLNVTEQEKIDK
HGGTGFAGIDSSSPEVKGY	HNLLEGGQEDFESS	IAKIPNFW
IPYTGPFNLL	LPQEIKANVA	TSFEQHVLW
SPFPDIPKV	TPLLLPLAA	LTVRNLPQY
VPIFPQPLI	FAIDPHLLLSV	LALVKPEVW
LPWKPVFI	YPFELImA	VTNPHTDAW
FPSEIVGKRI	FPYYPSPGVLF	ITYDKLNKW
YPDSHQLFV	FVIRNIVEA	ILDSVGIEADDDRLNK
VPYPLPKIDLI	WPKDVGIVA	TALPLLKQF
LPPPFVPTL	YPLLLPKGV	GTYMGHTGAVW
DAYHNAELFF	QSVLQRIAA	IVDPNGLARLW
EAWPALQI	HYTEAIKR	GALPNLRELW
SPLDIYPKI	VPFLPVNPEYSA	AGRGPLDLAAVW
NAYEYFTKI	YPIAIFIKP	GAYKYIQELW
WAYPRQVFI	APEPHVEEDDDDELDSK	GLDVDSLVIEHIQVNK
TAIHNFPTV	FPLDPQLAKMVI	VSKPSAPVF
VPKALEPYV	IPHLVTHDA	EGIPALDNFLDKL
YPFNPPKV	LPAAmPITA	HTFQNDIHVY
LPIQPAQHI	LPWDPTGKIGP	KSKDVLSAAEVMQW
IAFEFPVLV	HAAAATYILEA	VVALVHAVQALW
DAIRSLASV	FPLQFGREV	ASAIIIQRW
LPIAPSHVI	QEYDESGPSIVHRK	ISKFDTVEDFW
TPFPYNPLI	LPALLFKA	RSWDQQIKLW
FPRHIEPEL	LPYSDFPRP	GSWDGTLRLW
FPNIHPPQI	FPAGGDGLHLVV	AFVAIGDYNGHVGLGVK
VALEHFVLV	MPFPELPRP	ITNKYQLVF
LPYLFHVV	SPLHLAVEA	VTIRLLETI
LPYLPHYI	TPIIIIPAA	ATLELTHNW
YPWGVAEV	APMPPIIHA	KTVTAMDVVY
SLDMDSIIAEVK	LPRPVPLVA	SADGTIKLW
WPFSIQDVV	MPNGDHIVSA	VSLRLGDLVW
DGWPAMGI	mPLSTIREV	HSGNITFDEIVNIAR
LPNNRELYI	LPWQGLKA	KAIEKNVLF
VPFPEGFVI	VPWmPPGKSSA	RTLDNQLFFF
VPPLATNTV	SPRPPLISV	KAFDSGIIPMEF
MPVIPMNTI	YPYELFQSGV	KALSMPEKW
qPLPVILHV	LPVLPWSEVTF	EAFSLFDKDGDGTITTK
DAYVLPKLYVK	HSNVNLTIFTA	KGWPAVAQSW
DAYVLPKLYV	MPQLNAIIAA	GSWDQTVKLW
IPLLVQGV	TPmPPISSV	RVINEEYKIW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
YPFKSPSI	FPYEKDLIEA	VTFPIPDLQKY
IPYKTILL	LPLPIPTV	STAKEIIQHF
LPFTPPVV	LPVQLQRAMA	FQDGDLTLYQSNTILR
TPVRLPSI	FPAAPLLTV	ITFPNKEIAW
DPLDKSIVI	LVKDVFISA	RTIQTPIGSTW
FPYVTmDI	YPSLPTMTV	VAKPNIGENW
VPPLVPKVL	IPLYLKGGVA	IGAQVLGKILW
DAFKIWVI	LPLLQPRGASA	KSYPGSQSQLF
DAENAMRYI	TAFLVQISA	RALELEARRW
VPLEmLEI	VPISGWNGDNMLEPS	IFVGGIKEDTEEYNLR
DAFRQPSLF	HPLLRPPPSA	LVQAFQFTDK
DAPVALVVHM	FPVRLLVAA	ITKEIEANEW
DGLTVHLVI	FPYKIPAVVV	SVTEIQEKW
DPFFmPEI	NAFNRFLHA	KSLGVQDLLQF
YPIVDGKLSI	MVFPKPVTA	LSQEQLRQW
DALRSILTI	KPFKEFVEA	LALSPVPSHW
LPYLIDGAHKI	LPELLGLEA	GSMGLRSLW
LPNRALLV	FPSPILKV	ISLIPPEERW
VPLIIVNSI	FYEEVHDLER	KAVDIVKQVW
FPYMTHPSV	HSMRYFYTA	LSKGGELFAW
DPLLKVSII	VPEGYDFVFRPISA	KTVYTGIDHHW
FPFPTPPSV	HPEEFYNLV	VTLTSEEEAR
FPYSATPSGTSI	YPFSSEQKWMA	RAAEEFVNVYY
FPGLAIKI	LPLGAQIPAV	HSFLYQPDW
DALSKmVII	IPIVGIVAG	MSLPYRLVF
DAYALNHTL	LPHWLSWLP	KSYLGSEADVW
VPLDKQITI	IPNSImTILEA	IIVDTYGGWGAHGGGAFSGK
YPYVGILHV	FPKGTIFTA	ITSSIHSKETF
DSYINVQEI	FPFGCPPTV	VVQVSAGDSHTAALTDDGR
IPISNILmV	IPVLVPGIIFS	DSVESARREIALW
LPNAVITRI	LPFPLPLFA	RVKSVNLDQW
VPLDPMEHV	LPWWGAIAA	AVNPRDPPSW
DAPKAGQLEAW	MALRYPMAV	IALPPIAKW
LPADWAPLF	FPFNPLDFESF	ITTEGKLWSW
DALRPPLQNI	YPLLLPKGVVL	HSmLDINALF
FVNDIFERI	MPFTASPASSTTA	LATKIQAAW
TALNRFLQV	IPIVGIVA	EFHLNESGDPSSK
VPIEIPTI	FPWNKNVEV	LSLGVVKEF
IPYLPELI	EALPSDIAAEA	VTSIGTAIRYW
LPIDDVLRI	FPTVLDITA	KSAEKEISLW
IPWIAIPLV	IPRVPSLSV	KTFLHDPLVEW
YPRQLESLI	LPYKWVVEA	RALAHYRWW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DAFKTLFV	FPAPSHVVTA	VVLDDKDYFLFR
FPSPILKV	MPHSImRIDIA	TSVPDHVVW
IPYPLSENNQV	MAFKGWSA	ATLGIVQVFW
IPTDKLLVI	FPKPYPNSEA	RVIPYDVLPDW
DPLRVIILV	LPALGFTGAGIAA	ISFHNIHNTF
LPKEPQGII	LALAPPPEA	KSALVFITF
YPYPYPHTLY	ELQEMDKDDESLIK	VTFLLPAGW
FPFPGVmLI	IPADLRIISA	GTFTNQIHKW
LPWTAEQVV	LPSLSPLSA	KSFETDTNLNF
LPYRWQmLI	TPWIPVIAA	SSSSVRVEW
FPNVEIVTI	mPHSIMRIDIA	GTFEYEYSQRW
MAPLALHLL	TPLLMQALP	ITSQVTGQIGW
QALEVLKI	IPITVLQPA	ATDAAIRVW
VPWPVDIVI	FPFNIHEN	ISRPIVNLF
VPYEPPEV	IPYHSEVPVSL	ASFDSTVRLW
YPNLQLREI	LPHEILEMT	AVSEAVRQLW
DALDHVIDI	MPFDPSKVVA	LSLPAEFPDKVF
FPAEFYPHI	FPLLLPmA	QTDPSGTYHAW
LPYPIHQV	LPLLGLHEA	HTRPVVDLAF
VPFERPAVI	LNFSHGTHEYHAETIK	SDSVESARREIALW
DTFRIPLI	YASAFHFLSA	KSLNIFGSSW
TIRYPDPLI	mAFRVPTA	KTRIIDVVY
IPDGGVHIV	YPISIFIKP	RALDIPLVKNW
IPFPVEKI	DPFERLISA	ATNVNNWHW
LPVAFKVV	IPLPDMPHA	FSLPNIPRW
DAVKFFVAV	FPLDPQLAKmVIA	ATSGDYLRVW
DAYLQSLAKKI	MAFRVPTA	KSLKISGIKDFSW
IAFLMINAV	TAYKPKYFTSA	RVFEDESGKHW
DAMKYTIVV	HFNAPSHIR	KSRLSISGW
YPFEPPQI	FPLQLEPSA	ASAGNLKPVW
DALRSGLTV	MPQNPHIIA	KVFESWMHHW
LPHLEAVVI	HPLDPIDTVDF	ITREEGVLTLW
DANPFLQSV	HPTEDLVVSA	KSFGSAQEFAW
IPYESPIF	IPYDQSGFVSA	MAAAVLGQLGALW
DAWKELTIV	TPSIPVLTA	RTVFPSREFW
YPFHVPLL	HELTIPNNLIG	ASMDKTMILW
LPHPGLKV	VPYPPLLRA	SANEILGSLRW
TPYWMAPEV	FPNRLNLEA	LAAVRGEQW
LPLDQRLLI	YPVLLDGV	RSLSTTNVF
VPLSSPLKV	FPFQPGSVAEV	KAKYPDYEVTW
DAFPNIEKV	FPHLRVLEA	RMLDPSIKGTF
VPFSVPKI	TPYNYPVPV	VSKPDLITW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
FPFGKIGTV	SPLDMKDGFLA	ISVPIFKQF
DAYTVLTRI	VPYGTPLSV	KSFVLPSW
DAFPNIDKI	FPHELEVPAL	ITYQHIDRW
DAFRQPSL	HPRVGDLILA	KAGIIQDTW
YPFQIHSI	MPGFIQKQQA	TSSKPDPSQW
DIFEFLNHV	HPYLFPVAAM	VSMIFPFHW
HLEINPDHPIVETLR	LPFQRLV	mAFQNDVYEW
LPYVGmVTI	TPLPAIVPAA	RTILVDNNTW
YPLLLQSI	LPALGFTGA	AAALPAAALW
FPAAPLLTV	LPYPIHQV	LKEIVTNFLAGFEA
LPHLPSLEI	FPWQSLEA	SSDNTIRFW
LPLKTLESI	FPFPTPPSV	ADLINNLGTIAK
DALIVLIHL	FPFYGKPMRI	RTKDLIIEQRF
DVNFEFPEFQL	LPTKVFWIA	HAFDGFEVNW
TPFHIATI	mPFPNIRSA	KSVTLGYLF
DAFPSIDKI	VPFLNPYTV	ATFPDPNVKY
IPHIHKSLI	IPVILDGKDVVA	STGGAPTFNVTVTK
VPYPLPKI	YPGFNPFRA	SSKPVLPTSGW
DALGKLISI	MPLSTIREV	LGTLPPEIQAW
FPEPNPRVI	YPLERGFIYV	QSDPSGAYFAW
LPAPAPVI	HPVEIFYTP	KSIHIVVTM
SPYPGLRLI	YHTINGHNAEVR	SSLDAHIRLW
IPNIFQKI	KHLEINPDHPIVETLR	HTFFDHQDQVW
YPFKPPMI	MALVASVRVPA	QTIILDDELIQW
SPAPPLLHV	IPVLVPGIIF	VSLPAPGVPAW
YPLHILFV	FPSHDLPSV	KAEAGAGSATEFQFR
GADFLVTEVENGGSLGSK	NPDDITNEEYGEFYK	LTRPGSSYF
DALLIIPKV	FPTDPKVVV	ELISNSSDALDKIR
IPYHSEVPVSL	IPQVmAIA	GSSDGTIRLW
DGLRDLPSI	LPNSHLTEEAL	LALDPSLVPTF
GFAFVTFDDHDSVDK	LPVEVPLWLA	RVAHFGYHW
LPFLTDTI	MPTNILGEIVV	GTWIGKGTERW
TALAIYHVI	qPFYPLPAA	KAVFLVPKW
LPVSPLGSI	DALYPVVSA	STYVIRDEW
SPIENIQRV	GGPGGFGPGGYPGGIHEV	VTNKSQIRTW
YPFTLRVV	LPASEIAKLLA	QMAEIAVNAVLTVADMER
LPYPFASEI	APHYPGIGPV	KTQGPRALW
DAFRQPSLFYHL	DPASALSNMVA	IDTIEIITDR
FPYAFKEV	DPTDIPVV	SIYGEKFEDENFILK
LPEPSIRSV	KPFLLPVEA	TAKISDFSW
SPFALQNTI	YPIGTNAIVAV	GVSQVLNRLTF
SPYPWPLNHI	FHVEEEGKGK	AALTNKGELFVW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DSQILPKI	mPQIPVASV	KVYEIQDIYENSW
LPHLVVSI	APALLLIPA	SASPVDAAIRVW
VALARALFI	FPFRFLNA	VTALAARTW
VPFSHVNIV	FPYEASTPTGISA	ISFIEDPERKY
LPYAVGKL	SPVPSHWMVA	KTLSDIFLLF
LPHVPLGVI	IPNSIMTILEA	KATDILPKW
VPVEPVLTV	FPGIRPYLA	KSTDVAKTF
FPDNFVREI	FPVGVFVVAV	RVIPHDVLPDW
TAKLPAPSI	LPSDIAAEA	VEVTEFEDIK
YPmLIRTI	MIKTQSSLVPA	KSFGWPSFITY
DAIRVFANI	FPVGVFVVA	SSKPDPSQW
DSFLHLAII	LPLPLPmA	VQASLAANTFTITGHAETK
IPYLVVKV	FPDFPTPGVVF	VLQATVVAVGSGSK
LPRIFTSI	FPYGGVLAG	VSKTLPSTW
IPYIPTLI	LPFLYLGSAYHA	HSMLDINALF
LPFQKGYLV	MPYQPFSKGDRL	MTAGVDGHSW
DALVTKNLV	LPVDAVISV	RSFIFKGEDNW
LPLKVLVV	IPFDLPSA	MTLKDIYTW
DALKVTFL	SGKKLEDGPKFL	KHPDASVNFSEFSK
NPDDITQEEYGEFYK	YALNHTLSV	RTYTYEKLLW
VPFPDTYEI	LVAPPLPAA	LTIDHVPIW
IPYEGFASL	LPRDVLTRA	DQVANSAFVER
MPAVFHTV	IPLQDLVAA	KTLPDILTF
MPRPSVPPLV	SPFHFQPSA	RAAGALSKRYW
VPAKLPEI	YPFINSRIITV	KSFSDTLKTY
DARWWAVVV	VPLLVLIEA	KSLEEIYLF
IPIPLAVI	DPFELFIAA	SESPKEPEQLR
IPVHLPNI	HATIIPKV	STDRHIRLW
LPFPTVLRV	IPLGFGVAA	VTRSMEDFVTW
LPPLVPAI	YPASIVHQV	ASKEAALANQEVW
TALAQIMTI	HPYPPGPGVAL	RAIDSIHQLW
IPFIGVVKV	LPLLPAPGAAA	RVFPEKGYSF
VPLEIMIKF	MPMFIVNTNVP	SLHQAIEGDTSGDFLK
FPYVLKEI	SAYGTQPAYPAYGQQPA	TLLGDGPVVTDPK
IPVSQISTI	SRSGGGGGGGLGSGGSIRSS	LTKQGGLVKTW
DAYKGLFEV	YAFNMKATV	SSSAAVKDTLW
LPPPVQTQI	HPTLLENLVFF	STLRELGQTW
TAYIHQVTV	MPLLKSEVA	AANPHSFVF
LPYELIQLI	FPSDKIFEA	RTVRIWRQY
YPLPAVKV	FPATARGQLGIRNAA	LLFPGKAFSW
SLVNLGGSKSISIS	FPTHPYFSV	ISKALVAYY
LPFPFPSKLYI	FPPTFAIPQA	LSQPKIVKW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
VPLEVFEYI	HPFDLGLYNEA	RVKAEPFIKW
LPFDHSRVI	LPVWLENHT	RVLISTDVW
MPVIPmNTI	MPNLLQQAV	TSYRDFLGTNW
LPRPVPLV	HPTWALKEA	KTLDQAIMKF
TAYNLIHTI	LPAAMPITA	RTSIETNVRF
YPYIPAHI	LPNLTPLSV	FHHTIGGSR
EGIPALDNFLDKL	QVRDVIIAA	RVDPAKGLFYF
LPFEPVPVI	FPANVmDVIA	FSEKFPTLW
VPFLNPYTV	LPAAKGFVA	RTVENMSIIGW
YPLEDATHI	IPVRFIEA	VTKITLESF
YPFPVPPLL	LPVSVFESV	RSLPEPLMTY
YPSLPTMTV	MSTPHVAEPA	KSFSDLFKRF
IPIAVSGV	LPLTKITSA	GALRVLNSYW
LPFPAQPPVV	DPASALSNmVA	KAGQVVTIW
SAFPFPVTV	SPLKHFVTA	MTNGFHMTW
VPLIIFTI	HPHNLLWLV	QTWWHGVLAW
YPLLLKELV	TPHFSGLAA	KSITIIGGGF
DAFQKLLIV	IPWVQKPIIFD	AAKPEQIQKW
FPFQPGSV	FPHFDLSHG	ASmLIKALW
IDTIEIITDR	HPSPLSFFSA	KSFPDTGSLNL
DAPIQLSKI	NATWLVNSA	ADEGISFR
YPYHYAPFL	LPAEYLLSA	KIQPDTIIQVW
MPFFAKTV	LPNFLPYNV	AAFPAEKESEW
PFKPPKI	ADKDYHFK	KAFEESLSTLKW
DGFTPLAV	YLAEFATGNDRK	ELISNASDALDK
IPYITNVL	LPLsPVKTA	HTADVQLHAW
LPNIPVQTI	TPLPAIVPA	ITAENVAKKW
VPFPISLI	TPNRATFVV	RTLDNQLFF
DALRLYLI	HPYFYAPELL	ASRVLISTDVW
IPFLGAGIKI	KAINVFVSA	ISTPVIRTF
IPFVAPPLV	LPIPDPGVSV	ATLKNPILW
TPFEGILII	LPLGFIVFLPA	KAFPFHIIF
YPKEADIVI	VPMTPLRTV	RTHPDQFnLW
LPHPIIVSI	YPSAPFLAA	GSSHLISTSSW
DAFRTLGL	FPLDAILNA	HSYFWPLEW
DAVLYLLEI	FPLELTQKA	LVHAVQALW
FPFNPLDFESF	FPSSAFLRA	EGDVLTLLESER
TAPLAPTI	IPFDLPSAA	KTLPADVQNYY
VPLPNVPSI	FPHFDLSHGSAQVKG	VSNTASYLRLW
IPFILDEI	MPLQPSILREV	SSSPTHSLYVF
TALAQlmTI	LPFSSmPTA	FSYRDVNSW
LPFPFPSKL	FPAHHGFVAA	ETLVYLTHLDYVDTER

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
VPYPPLLRAMII	DSFHHNVAA	FSHEEIAMATVTALR
TPLHLAVI	FPFSAVVPAAL	KTTPDVIFVF
mPYEFDIRV	FPQETLFLEA	TTKGSSISIQW
VPPLVPKV	SNLTSLLVQPISA	VSLPSHLNISY
VPYIGIVTI	HPVAKILHA	YTHEVVTLW
YPSPTGVLI	mPRWAERLFPA	DAGTIAGLNVLR
LPWPFQGTI	LAVLLQAAEA	ISLLPKTSW
VPYGTPLSV	YSFYLPIAA	NSLPALPGIRKW
YPPAPFMHI	LPYTVNFKVSA	LSVKEPQLVW
FPFHFVEV	mPAFPLPYA	ISWGQGHFW
mPISQLLmI	LPYKPYFYIA	TTIPHALLTW
LPWVVAEV	YPSETFTRV	HSRPIVTVW
LPRVTPFYAV	FALAKGFTAA	FVKKLEHSW
LPVGNKPLI	FPVEFLIQV	HTGPNSPDTANDGFVR
TAYLFSRFV	IPYHIVNIV	qTWWHGVLAW
FPFYGKPmRI	SPFLSPLEA	VTFPDIIRNY
FPYIQKGL	PLELKEAF	KSFEGLFYF
LPYQVVEV	GFGFVYFQNHDAADK	LAALADQWQFLVQK
YPLQGPGLLSV	SAFPFPVTV	AVLQKVALW
VPIVEPEI	FPGEQFKPA	KVLPPLEQVW
VPYAGINI	FPFFNPIQT	GSADKTVALW
LPAVSLEV	mAFWGWRAA	KSWGLILLF
VPMTPLRTV	NPISSWFTA	KTRYIFDLF
LPLMKFLEV	LPFEPSKKLYVV	ASAILFREW
DALKVTFLI	FPELmGVFA	KSFMDFGSW
LPLQENVTI	MPFPNIRSA	KTRDDWLVSW
FPWNKNVEV	DAIRLFAA	RAYPFHWAW
LPGPILQSI	HFDLSHGSAQV	VTLKNKYLDW
SIVEPKDEILPTTPI	SSGPYGGGGQYFAKPR	YTKIPDPSTW
EAAEVILRV	EALAYFITV	RSWLTAASTSW
DPLVPPQLTI	HPLPIWTPA	KSFSKSDLVNW
YPYIFHVL	LPAPPAVSA	ESLRSHFEQW
VPLETIVII	LPDIKFFPnVYA	YSIRGQLSW
DSYPVVNLI	LPHPYAIAVF	LASTLVHLGEYQAAVDGAR
LPTILVEI	IPLPDEKSRVA	HSAVVEDVAW
SAFDHFASV	EVFPEFAAA	LSALPADTQAW
VPLDPmEHV	SSSPEVKGYWA	ASLNLPAVSW
IAMDLILKM	FPSEITDTVAA	FSFQIDRSW
LPPTVITI	LPVGQHIYLSA	DGQVINETSQHHDDLE
LPYPEAIFEI	MPFYNPAQL	KVRAESFDTW
IATIALmI	YPLESKNNRLLA	QSLPSKTKVAW
VPAATFQSI	IPYAVLLEA	HSKENPKEFFW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DGVAVLKV	VPNPYIISA	TPAQFDADELR
DPFPWQQKV	IKGEHPGLSIGDVAK	VVDPVNGWMYW
DPTDIPVV	MPKDLIYIN	HSGPGLLQLW
TGYLNTVTV	MPYLIGVHA	KEVVEEAENGR
DAYVLPKLY	YARSIFGEDALA	KTYNEPGSQVF
VALPVYLLI	YPSEHLIQA	RSLINSNVGF
DAAAFFKSV	MPKWINATDPSA	RSMQLDYTTW
DAARFPII	IPFYLQPHA	KAGQTVTIW
YPYPYPHTLYL	LPFDRFSEV	IQLVEEELDR
VPYVINVTL	IPQQVFQEV	RTFTDHVMLF
SAPAVLVV	FPAPILRA	KSQDLELSW
VPILISEI	FPQLFPVSA	FPGQLNADLR
LPYLVSNVI	HARDFTVSA	ASFNDNIIKW
TPLQIKSVV	YPVYQPVGP	KSGELLATW
FPWSGLIYI	MPRWYFLLA	GTVRPANDFNPDADAK
HAFSFPLLI	YPFKPPKVA	LSDPDEVARRW
YPPGAFVSV	YPREMLGPVTF	MIAGQVLDINLAAEPK
LPFAAAGAL	APSGGWNGVGASLWAA	VASEHFYFW
LPFEIKNFV	mPTLLLWLV	KVKPNLQTF
AAWLQVLPV	NPYSEFILA	ISAIPEQRW
MPTLPPPSV	SPYDGLFIA	SSLRVPSQW
LPYQPPAL	FPHFDLSHGSAQ	LEVKLGELPSW
FAQAPQLSV	LSHEVIVSA	RTFTDHVmLF
LPFTPLSYI	FPQEFVWEA	VGINYQPPTVVPGGDLAK
LPYGLERAI	MPFPVNHGA	LTMSDVQIHW
YPDRVPVI	EAFGFKVNA	RAALSDTVALW
VPPSPANFI	FPDVSGVSRIP	RTLPVLLLY
DAVKFFVSV	TPQSIFIFA	GFAFVTFDDHDTVDK
DPYEVSYRI	VWVPSEKQGFEAA	FTLREVQERW
QALPWVRYI	mPQPVPTA	IDIIPNPQER
DLSLEEIQK	IPFYLQYLA	LSSPDYQIRW
LPAADVKNI	SLVNLGGSKSISIS	AALTIIRYY
LPLDRYILV	IPYGMRFIA	VTLRTGEVKW
SVTEQGAELSNEER	LPNGKPVSV	mSLPYRLVF
DSKEIFLTV	NPVTGLLSA	RSIEEVYYLW
LPFQLSSV	MPRDILIVV	KSFPVNSDVGVLKW
LPPPPPPHL	SPLFSQHTA	ITSSAKVDMTF
IPAVELIV	LPQIAAKIAA	EQADFAIEALAK
MAFWLPTI	MAVVIPEA	SAIRYQEVW
mAFWLPTI	LPNIQKVEV	ATFIVTNYW
SPLPQYVTV	NPLDLPERIAA	KTNTFQGVIF
YPFVVLNI	IFVGGIKEDTEEYNLR	RALESGDVNTVW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
FPFIPIQV	MAFWGWRAAAA	ATKKEITFF
SIYGEKFEDENFILK	VPLIAImA	HTFWGVVFF
DPFQYQLVI	mPHSImRIDIA	TSLPEGLKDW
DPYLLPHI	WPFLGIVA	ATSQLIGTIFF
LPIHTVETI	MPFLSQEHQQQVA	KSFDNIRNW
VPYLKIFTV	TPYGYFLISA	mAAAVLGQLGALW
mPNTRPPII	HPSQELLASA	QTLSLEADKW
LPVEVQEV	IPFDIFITA	IDEPLEGSEDR
mPYGWLTEI	LPFSQPKV	KALEVFPEF
DPYKVYRI	LPYHHVIHA	KSFSDTLKTYF
EGDVLTLLESER	FPHFDLSHGSAQV	RSVLHHFHF
FPFPKPDLI	MPIYVTGI	ITYTFHSTW
VPPPSGFTV	MPLSVFPYYA	LFVGNLPADITEDEFKR
IPHEVPQI	FPSEYVPTV	VTNPHSSQW
IPLPLGTVTI	HPYLFPVAA	KTLVLSNLSY
LPYPVKIKV	SAFEFLSSA	RSMEDFVTW
LPYTGAETRI	SPLLLFLPP	KTRTNVPTF
YPAGFMDVI	FPNIHPPQI	KTYGEIFEKF
DAWQDGAVLQI	FPSEYVPTVF	RSLVPAAVVW
DPTVLPLL	TPFEKGLHVV	VTFEDNSKYW
EQFLLPVI	FPVILYEV	GTMPLRNIF
LPIPESQVITI	HPLASFSFTSA	LSFLGGIRW
LPPNLYPTV	YPFSSEQKWMAV	KSGPVVSLGW
LPKLHIVKV	EGLPPILNA	MTRPDLPVGF
LPSPISPDI	FPMPLPRKA	RTLDEAVGVQKW
DAFRVNVI	MPLVAPVILP	ATNRITVTW
YPVPKPALI	FVRDMIREV	RVREDGDSPVFW
DALDVANKI	HVYDGKFLA	RSFPGFQAF
LPYVGMVTI	MAFWGWRAA	KAIGLFISF
EPFADFHRV	LPVDVVVNA	FPGQLNADLRK
LPPDLSYIV	MPQIPVASV	HADINLLYW
DAQGLQLLV	FPFAPPAAA	KTVEPLEYY
VAGPVGLLSV	EAAVPQLAA	GTVITPDTW
FPYPFQVV	MPTDVLEVT	KSSEVFTTF
TAPPPLPRI	MAVVIPEAA	DLEAEHVEVEDTTLNR
FPHLQDAQV	FPFLGRVA	ISNPVTKEMLF
DADYAIKI	KPANVFITA	LAQANGWGVMVSHR
HAFWGGSVV	LPTEAYISV	QTVSPAEKW
MPNTRPPII	FIKAVHVKA	GSSTFHTSLYW
TAPLVVVV	LPLLLTHEGVLLP	KSFGDPAKPRAW
DAGLGKLI	MPTPLVPSV	LGRPDAEYW
VPDQPHPEI	PITPRAAPL	LSFPTTKTY

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DARIGSFTI	IPFWRNTAV	SAARLYYYW
FPVILYEV	NPYTIFHQA	KSRDPIIFSVGW
LPRNLPVTI	FPNEFIVET	KVSDLPRQW
LPYLALLTI	HPWEVIVGTV	RTMELLTQNW
MPLHVAPLL	qPFGDHIISV	RTLPTNTLMGF
LPFVGKESI	FPFHFVEV	VSRIPVSF
VPDTSRIYV	MPQVPVFTV	GTHKVTVLF
SPPTVLVI	HPVLLTEA	LSLPEDFYHF
YPAGFmDVI	FPFDQQFNIL	AHGGYSVFAGVGER
DAYVLPKLYVKL	FVEILIPVA	ATSKYLIGW
VPVEQVLLI	NSFPLLLPMA	KAMGIMNSF
YPLGDIKIV	VPSAVLIVA	KSLENAIEW
DANVQIASI	PYLFPVAA	LTYENVERW
LPPHILEV	LPIGTLPLA	RAAEDDEDDDVDTKK
DAFPVGEV	LPNLQTVTV	RVIDVGSEW
mPYEDGIYSVI	RPAEDMEEEQAFKR	FSFRSFIW
FPPPVADFI	SAFGLTDDQVSGPPSAPA	ASFIGGIRW
LPHDPSFAI	YALPAGLSA	ISASSLTSKW
LPKSIYSQI	YPFILPHQQV	KSFPAAIEHTIQW
mPWLADLV	YPNTYIFDLF	QTIRLPAQSIW
LALPAIAVI	MPLHVAPLLAA	HLTGEFEK
YPFILPHQQV	FPDRATLYVTA	KAIEEGVNHMW
LPYNPmmV	FPFGGVGSSGMGA	RTWVAELVF
LPLRLFLII	FPYEEHLEMA	AQAALAVNISAAR
qGKADAPVALVV	LPRHIYPAVEFL	MAFQNDVYEW
IPFAGKVEV	LPYLAAVYA	RMFAPTKTW
KEVVEEAENGR	DAISNIFQAA	HSGPNSADSANDGFVR
LPRPLPAV	HPWETVTTAA	ISAPDKRIYQF
IAFLmINAV	MPVIPALWEA	QTFLSEIRW
LPAGILPMV	YGYQFPGFPA	RVFLMDPAW
DAVSGMGVIVHII	HPYLPINSA	ATIKEIVVW
IPYFSANAVI	VPFPSIQAV	VTYVPVTTF
LAILRLSL	YPQQIFIQI	FSLPAQPLW
YPLILKEL	mPVDLELVA	IARDFNPNW
MPKPDPTVI	YPFLLPVIQL	YEEVSVSGFEEFHR
LPLSAHGIVV	FPISLLQA	ATNGVVVTW
mPMNVADLI	SAFGYFITA	KSYVQGVTW
NALDKVLSV	FPRPVTVEP	RVQEFDSGLLHW
VAWLVAHV	IPIFLPEV	RSGPFGQIF
AALEDTLAETEAR	EAWNGFVAA	VQGGALEDSQLVAGVAFKK
KREPEDEGEDDD	FPLTKVYVV	WTHFLPTW
DPMEILITV	HPIEPVLITA	HTVWESEEW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
VPPENIIYI	LPRNIGNAGmVA	RtYSLVGQAW
VPFSHVNI	YPALIGNLV	ISVYYNEATGGK
GKADAPVALVV	EAARVAEQLRA	RTAPFHLDLW
HPFHVIRI	FPAEFYPHIV	RTVPPAVTGITF
LPVDAVISV	FPTPPSVEA	KAIELLQEF
FPFKPPSI	FPVLFVSA	LAALKLDEW
IPYHIVNI	IPFGIFSRA	RTNPNSGDFRF
VPLEMLEI	MPYEIKKVFA	RVHAFLEQW
YPLLLREI	DPFQILVAA	AAEERPWLW
IANHQVLII	FPMEIRQYL	KLKPFIDREWW
LPYPAPEGI	IPWSIPLEA	QTFSSKTEW
MPTIFNLI	mPTNILGEIVV	LVWKAQNTW
DGFLFLNTL	YVPPPFAAA	SAANIQPIF
IPPPVImV	LPQEVSIAA	HSGPFFTF
LPVEAmVTI	LPYAITIVA	ASLPEAQVW
MPLNVADLI	LVPLLAMS	RAFHPDLEF
DAYPQRIKF	YPASSLVVV	ITTVIQHVF
VPHFPTPSI	TPFMLGALVA	IVRPSIVGASW
YPYVIQEL	LPAEFPDKVFA	RSILAPLAW
LPLRFWVNI	FPVGKGLAA	IAFFDVRTF
DSALLPAV	SAFLPARFYQA	KAYGPKVDIW
LPPEAITI	EAINIIQGIVA	KTLPAmLGTGKLFW
nAAIIMKI	SGGGGGGGLGSGGSIRSS	RVDPNGSRYLL
VPLPAENVTI	FPELMGVFA	SSFYVNGLTLGGQK
DPYGFLTTVI	MPMYVSGSQVVA	VTRQGALW
LPYHIYPFI	YPLTQLVVV	AARTIQTAF
DAYLQRILA	YNNCSPVLTA	ITKGYVIRLY
LPYHVAVLL	LPFLTTEV	KAHPPELKKF
DGYVVKETI	HLTGEFEK	RVLSDLDQKW
ESKDPADETEAD	APNPVVFVA	RSVDVTNTTF
IPYAQPPLGRLR	APRQPGLMA	TTRELQQYW
DAIPGLKI	FPTLSPMVV	TTKPDLLAW
mPVIPMNTI	FPLLLPMAS	KSLPEEDVAEI
VAIPLPGV	qPLLKHWEA	KVWKAPSSW
DAREVMILI	qPYmPTVSA	RTLDFDPLL
DGVLIWKI	SALFQHITA	ITKDVVLQW
DGWTPLHV	HPWVLPVV	RSIPVNEKDTLTY
LPIVTPAL	LPKPPKPVS	KAIPRPDGIEW
NAYFLLPKV	EAKFPILSA	LTKPFEYLF
DALQILHI	FAILQSVKA	ATRPDYISW
mPLLTPRYI	HPLLLNGDATVA	IAAQRTINW
mPTDVLEV	LPNHVVNVV	VTKDGRVFAW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
YPHEVPQI	LPVSNVVSV	LTLEDLEDSW
SAPAVLEI	TVYEGFISA	RSLPEPLmTY
LPLLIADTL	VPFIVPLSV	LSINPNNHSW
LPYIFPNI	YPFELIMA	YTSRQIPQNF
IPFSKPVKV	LPLPLPMA	RVLPYPFTHHW
MPMNVADLI	mPLSVFPYYA	HSHFQNIFW
DASLVFKV	FPKPVTALEY	IAVPRNDEW
DAVQLNVI	GGFGGGSFRGSYGSS	NDEELNKLLGK
IPFGTALV	SSEFQIPTA	LSRELFESW
VPFQVPEI	FPFGGFIGS	KTVAGGAWTY
DPYGFLTTV	HPDEPIIISA	SSGPYGGGGQYFAKPR
LPTSLLTI	VPIMPYPPA	YTVRVIDVF
LPYAITIV	YPFQIHSI	IIRPQNVSW
VPNHLIWLI	MPIYVTGITNH	LTSTLQVFF
FAFRYVTTI	MPSDVLEVT	KSIGDIFLKY
FPHSLLSVI	IPVDFKYIA	KVRSLTLDTW
VPLVVLISI	YPLEKVAEA	RSFDLGRQF
YAYDGKDYI	LPLAVTKEA	HSTLVPHEW
DVFNVPLVI	LPVNESFGFTA	IAHLFNVEW
EALAYFITV	MPHSIMRVDIA	AAFDQRMKTW
VPVFWPILV	YPQLLPGI	ISGVHTVRF
DAmKYTIVV	LPVEFTIDA	RSHDTLVRW
mPLPVLQAI	NAFGPDGVQGFEA	RAFITNIPFDVKW
FPFKPPQRI	FPVSIPAVL	SSSLDAHIRLW
DAFRFENV	SPLDLAKLNQVA	TLEEDEEELFK
LPVPAFNVI	GYFEYIEENKYSR	GIRPAINVGLSVSR
YAFAHILTV	VPITAVIAA	VAGQDGSVVQFK
IPISNILMV	QPHDPLVPLSA	VTFPGIKLI
LPNDVVLQI	FPEHIFPA	HAGPIVSVW
FPNILKEI	LPVSLPTHA	SVTVPANVQRW
EAYLSRLGV	AAIAPIIAA	VSIKAIGW
DAFPEAIIV	WPAGLGGPGGSRAA	SVKITQVTW
LPWASVLRV	HPDYAILAA	KSAVELVQEF
LPAHAVII	IQVWHEEHR	KVLPNDPVF
VPVGKVLKV	LPVDKAFYEA	RTMPIYPTY
IAAVLPKV	LPHDLAVQA	RTVIIEQSW
LFIGGLSFETTDDSLR	YGFVNYVTA	VTPIWKLLI
DAIRLKEI	SPREPGYKA	LSIPDIKTAF
FPAPILRAV	APVPGIPTA	HAGNINFKW
TAYYALVV	FPHESTFGV	IGGIGTVPVGR
LPPPPHPSV	HELTIPNNLI	SAAPLFFSW
TPYALPVI	HPHPFLNSV	SAAYLPRMW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
FPYYPSPGV	IPFIPQNPA	ATVILQRAF
VPLRVSPYV	LPHPYAIAV	IYVDDGLISLQVK
DLYPGIPVI	FPDSLPEV	VQGGALEDSQLVAGVAFK
KADAPVALVV	KPYTLMSMVA	KAFNLRISF
LPLSGVPLMI	AFVDFLSDEIKEER	KVRSLTLDSW
TAFVEPLVI	SPFGSITSA	ATFHQRGIALW
DPAASLPII	mPLLKSEVA	ITVVLEEAKEKW
FPHPLPSL	HVGDFVWVA	KAKTNVKLW
YPRDSWNFV	mPLHVAPLLAA	IAKVNNVVW
DPALDLKVI	LPLDLQELIA	LATTILQHW
EAFYNVITV	LVGKNFEQV	NSSAVLLQW
LPISHPRFV	GPGNIPPPPP	KAFAETHIKGF
VPNLKPLTV	FPHLLQPVLW	TSTIVTLKW
VPPEILNNV	FPHLQDAQV	VSHPNEVSW
DGFISnLTI	FPIAEVFTL	IFVGGLSPDTPEEK
DGYAFQNLI	HPAAFPLPV	IGLPGAGKTTW
DGYLLLKSV	MMIKTQSSLVPA	ETLKLISGW
DPFVAFHI	EAFEAIPRA	ISSGKLNEIW
LPFEASYI	FPKDLIQVV	KTLPAmLGTGKLF
TALPALVV	MPIFLGNHPNSA	EEAENTLQSFR
DAFLEAAKKI	LPRLLVLLA	KGWDGYDVQW
FPYGLFELV	YVISQMLSA	RSLEVLIGSGY
LPIVPQLQV	VPIEIPTI	KSLESLDTSLF
SAYLVAEKV	FPSGHLLDA	RSIQADGLVW
TKKSECSILL	FPLHPmMITNA	RVYVDITTY
HPHDLVILM	LPLENGRFIA	KTFMPIAW
IPHPLImGV	mPNGDHIVSA	LTVDGKVFSW
nAHLPFAVI	qPYMPTVSA	KVLPIIQRW
YPSLPTmTV	YPNYPNPAV	ASMLIKALW
DAKILSNVI	FPVYVGINEA	KASPTQNLF
FAYTVKYV	FVADGIFKA	AARTWLGVW
LPPQAFNHI	LPLGALYTA	KTLPAMLGTGKLFW
DAYLVHLI	SPIEFLENA	RVVDFDETW
LPALVSQI	FALLQKVRA	VELQELNDR
MPHLSMQQV	FPIRDSWNA	IGYVDTTHW
VPNPRIKLI	FPLSAMLEA	VSKPDLITF
YPLEVTKLI	HIYYITGETK	FSKSDLVNW
TPYHVNLLL	YPVHLAVRA	ITKYPVLF
MPPPPPQGV	FPHIMPLA	RASTLLSKVFL
FPANVMDVI	MPQPVPTA	VTHSVRIGF
YPPPEVRNI	NVADLTSLRA	SSDTTVKVW
FPNPEATFV	HPVDNVIAV	FWLVLVVVF

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
VAPIVVVI	MPLFFVSPVSV	LTSTLQQDW
EVFEDAAEIR	FPVYVLPKVEY	QSLPSSVLHII
HATIIPKV	HGYIGEFEIIDDHR	TSASLDISRKW
DAPDVFTV	HSQAVEELAEQLEQTKR	KVGSVVSVGW
FPSEYVPTV	TIAQGGVLPNIQA	QTYYRIFTW
TALKIMKV	YPVRLAVSA	RENLKVWIY
LPGELFHVV	FPHFDLSHGS	SSLPSPLQPSW
qPLPRIVTI	HPNVTLTISA	FSKPDSDRFVF
DAYTHPQFV	FPANPANISV	RARFEEVLTW
FPYNKNGFKV	FPANVMDVI	ASLPFQVANVW
LPSITNVI	FPNQYVDVA	KTIPSQILEVM
mAYPDLNEI	MPFQSGEFKA	ATKVLGTVKW
DAQGQFLTV	TPMPPISSV	ITSPTGETW
VPVGRQPII	LPVPPLSVRPA	RSAVFSVTY
DPFPVPLVI	YPLDFARTRLA	EYFSWEGAFQHVGK
IPYHIVNIV	HATLLFNTA	KAINPINTF
MPHNQFIKM	SSYIPYNPQQFPGQPA	KIISTLPSW
DQYKFYSV	FAHFIQPAA	VSSKVEVVW
TPPVVLRL	LPIVPQLQV	YSLPNVGLIQKY
TAYPQVVVV	RPRPPVLSV	ATRFNLETEW
IPHPLIMGV	YPANSIVVV	KTLGFNLESGW
IPYSPDVQI	LPTLIPSV	RSFGIEDKDKQIITF
DALQYLQKV	mPLQPSILREV	RVKPLHYISW
FPFGYVSNI	MPYFLLTQA	AASAFFTYVSLSQEGR
IAPVLLVV	IPSFAPVLLLA	RVIEFAAKF
LPYVSVTSL	MPHQWLEGNLPVSA	VVMPIAHEF
mPTIFNLI	KPLPPIQVA	KSLTPLQW
LPLSELLV	mPQLNAIIAA	RTYPVQEYF
VPYPTASLV	MPRWFTVQA	AGPGRGSSLPPVYW
TAYPSLRLI	YPRAQLEVSA	ATILGNTERW
TPYNYPVPV	IPYSPDVQIHA	ESLRNYYEQW
DALLQmITI	SPFGTITSA	AALVIQKYW
DALQGFKI	YPFLLPKS	HSLLITTEGKLW
LPYVGmVTII	LVWVPSDKSGFEPA	ILRPPVEKW
MPALAPPEV	VPWLLLGA	KTLTLPFSW
DPFFMPEI	FPYFITY	KTLTLPTVW
MAFLLPLI	VPLIAIMA	TTKAISRW
LPLEDSPVI	PRVLLPAI	KSKESESFVF
mPLNVADLI	YPDSFGHYREA	KVIAINDLNW
IIPPLFTV	FPGGVHWVSV	HTWNGIRHL
VPFLVSVL	FPVPVTVRA	ISLLAQNTSW
DAYLQILI	VPVHFDASV	RTTDLLTDW

HLA-B Alleles

B51:01	B54:01	B57:01
LPNLQTVTV	VLLLIPVTA	VIWPNPVIW
MPmNVADLI	FPYGLFELV	HSMDPPTFTF
FPPPVSPRL	LGVHVDGFIA	ITGPWRSLW
IGYPFLVSV	MPSGAYVYPPPVA	LTVREHLLLF
DAPLSPLL	LPLWVDKEA	RVEPNIKWF
IATIALMI	NPLGmPVPAA	HTITPVIPLLW
DAHEFLNYL	WPLLLVVA	KSRGYVKEQFAW
DGATILKL	HPREPLPPIQ	YLTVAAVFR
LPWKSLTSI	MPFTEKImA	ESARREIALW
SAWRVISSI	IPADPEAGGIGRVV	EVFEDAAEIR
DIKDTEPLI	MPRDILIVVG	TIAPALVSK
IATEIILEI	LFKPPQPPA	AADETLRLW
LPFYFVQKI	FPRLPAGAVV	SALDMTRYW
AVTEQGAELSNEER	LPVQLQRAmA	AVFPSIVGR
DAAEFAISI	MPNDEHWKA	RALRLDVGNFSW
IPMELVNEV	FPVAMFWVS	RSFPIIPRSW
DSFEFKAHV	YAHRVILSA	VAVLLSRTW
FPANVmDVI	FPFMDLKLRAA	LGHGYHTLEDQALYNR
TPESKIRFV	LPWWGAIA	RTKDILIRF
YPWGTVQV	FPYGSFPYV	LAVNMVPFPR
VPPFTIEV	HPFLLLGT	VTRTGELYTW
VPVIVATI	FPFGFFTTV	IQALQQQADEAEDR
YPVELLLV	FVFSFPVSV	SRSGGGGGGGLGSGGSIR
DPYLLPHM	MPVILQDAPSA	SVTEQGAELSNEER
VPFSLDSV	ERQEAEEAKEALLQASR	FAQHGTFEYEYSQR
DPPVLPTV	FPLPTPLSV	YAVVLNATW
IAPVTLKV	FPWINTEGV	ATYmKPEMW
DAmFPVTHI	HPFPGPGLAI	QSLPDFGISY
FPRPEPFV	LPAFPLFSA	PVYmKGVTKsGIPISW
WPGAALLV	APMPYLIGVHA	GTVLKIITF
LPYGFIQEL	YALPPGTTGTLPA	KAFLGLFFI
DPPIARLSV	EAIVRIAEA	VVARTVAQLW
HSFDPFADASKGDDLLPA	LHPFHVIR	LIRELFPTW
DALNRPLNI	TIQEILIPA	QTMEDLISLW
DPYITQPII	MPQSGTGVSV	ITTVVVQTF
FPFSLQHI	LPFLFFST	KVDEVKSTIKF
MPLVKSVTV	YPLLLQSI	ISFDEFIK
LPLALRTV	IPLFHGTLA	KVYFIYEGY
DAWLRAQVI	LPYVADRQGFAA	RVYPESIPRKF
DIYSKFDVI	mPVGLIAGA	TVLPGELQSW
ETDLLLDDSLVSIFGNR	LPLPSVPAP	SAHGIVVAW
LPHILPLL	FPRLPAGAVVGIPA	VVIPDPDILTF

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
IPLSEILTV	HPYPPGPGVALTA	QSLQIFRKW
SAVELPKI	LPSNmPLPSA	RTVYFSEQW
IPPEIIMKV	APYPGFLSV	HTMTDDVTFW
LPHEILEM	IPFFSVPVA	IMNTFSVVPSPK
DAFSFTSKV	QGPASPPSPV	ISVPGLQTNW
DALLQMITI	VPTNIIAA	LTVQVARVY
LPHLPQSEI	LPLLAGLVAA	QTLTDYDIRFY
YPPAPFmHI	FPHFDLSHGSAQVK	GRGTSTYDGFGLAW
FGYRTLTV	MPRGNLEVV	KVIHEQVNHRW
LPPLSPYF	TVFSPTLPAA	GSmGLRSLW
IPQARFLLV	HPIQGLPLAI	KSLPDTELM
YQGKADAPVALVV	MPHTFFIGDHA	LTLNEDLRSW
DMYLVPKL	MPQLNAIIA	GSALPAEINRSF
DAYQVLSTL	NPLQVLVNA	KVFESWmHHW
HPFPGPGLAI	HWPFMVVNDAGRPK	RTLGTPDEVVW
DPRVSINVV	LPALANTSVHA	RTYSLVGQAW
DQVANSAFVER	TPAHVLPSA	GTAAVFNAVNW
ADAPVALVV	FPMSPVTSV	KAWAEYVVEW
DAYLPLRL	HPFLLLGTTA	RTIQELFEVY
VPHVLPFI	QGFLSPLAA	RVWNLNHLW
YPPSPWTI	MPHSIMRIDI	IAFLHALW
LPAEFFEVL	MPPPVGMVA	GFAFVTFDDHDSVDK
DAYIPLQI	YPFKNLPTA	QSLANLIRW
IPNRIPKI	FPYSLLIFV	TTVPNTIVVSW
LPTETFIPVI	MPTLLLWLV	PSPVKmPSPPW
MPYPAPNVPVV	VPAPFFLPA	YAKRAFVHW
mPILISKI	VPNYKLITPA	ISGIKDFSW
DAWLVHSV	FALAKGFTA	ISQSRISHW
FPFPETPTKV	HPNQPLTITA	KSIDAGPVDAW
HPHPFLNSV	NPLGMPVPAA	RTVEKPPKF
LPPSALQSV	YPKNPHLRA	YALYDATYETK
TAPVNIAVI	TEGGFVEGVNKKL	AALPAAALW
DGLNYIPKI	VPHQPFSQA	HIYYITGETK
LPILVNII	LPIEIKAVP	KESYSVYVYK
DAWAQLNSI	MPIYPTYNEV	TVLPGEIQNW
DPFTVPTI	SNRVIELPL	RSLLQENNW
ISNNVTLLSL	YPQAVFLEV	KAVIDLNNRW
LPFFAIQI	LAADIFAIA	ASHKGQKLW
LPFGVPASI	FAFHVGLPA	IEVIEIMTDR
VPLQPVTQN	FPIQMEGVKL	LTMPDTPRLF
YPYPHTLYL	LPTTALPTV	HFNAPSHIR
IPPPVIMV	FPVLLSDTA	RTRNEELAQTW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
TAMDVVYAL	MPALAPPEV	KAFDSGIIPmEF
HYVVSEPLGRNSY	FPFNSFLSG	LTFLGKYREF
LPSHGVPLI	VPVEPVLTV	RSRGFGFITF
YPQDYQFYI	LPHEIVVNLA	VVSPHEDMRTW
FPYSLLIFV	TIPYQPMPA	RSYQLEGVNW
MPQIETRVI	IPALLESA	HALALAWTF
DGLAPPQHLI	IPHLLGDVV	TSLFIARSF
YPYVAVML	SPYAAmLAA	ITHIVNQNF
NPFEKGDLYI	MAFLLPLI	NQGGYGGSSSSSSYGSGR
TPWIIFNVA	IPVQLQRSMA	KVTELLRTF
VPYRVVGL	LPLYGLLQA	YTNRVVTLW
VPYEPPQV	MPGSVIPPP	RTAGHPLTRW
VPYRLLPGI	MPMFIVNTNVPR	KISNIIKQF
mPVIPmNTI	LPHHRVIEV	STLPPRTYW
FAYTARISV	LPVRSLTYFSA	LTPVVVTLW
PSEIVGKRI	LPHAILRLDLA	RVDPNGFFLYW
IPIQINVGTTV	IPISNILmV	AVLPSRVYW
IPTVFVAV	LPVPVPAV	LSKEDIER
DAPLNIRSI	YAFILTSA	QARNVMQSW
VPLGVISRI	ESLLLFEA	ISKPVGFGEEF
DALVLHKV	FPTLGFVV	KSLGVTTKF
LPWQAAFI	SIVEPKDEILPTTPI	ATRDELPYTF
IAYDNIKVV	MPSEDVVSLQV	TTRILSDTTLW
IPAAAFSLV	VPNLQTVSV	RVLPLPSENW
LPSSVISAI	FIFHSSLPT	TVGPKTFSW
YPLQTVQSI	HVPDYLVPPA	VTSPLTVEW
LPMHPLQI	IPFVITVA	SLGTADVHFER
QPYPEILVV	LPDLRPWTS	LTIPDGGVHI
LPYSPTKTLSV	FPMELRQFL	VSRPVQVYF
NAAIIMKI	LPQVYPFAA	YTYRGPKAF
DAPWPVRKI	LPYSHPGVVF	ISKPGQFETF
EPFGGAIII	VPKPLFPVA	KTLEEKLRSLF
FPHVLPLI	FAAEEFKVPA	AIADTGANVVVTGGK
YPFNNGDLTI	mPYFLLTQA	KTILPLINF
LPYVGTSV	SLGGGFGGGSRGFGGA	RAAEPVRVVW
MPWLADLV	MPRTAALGVSF	RVDPDVAQHW
DPPPPmETI	YPQPQLEFA	STNPGKWVTF
mPmNVADLI	LPDDVAISA	KTMTDTYLL
DAYVLPKL	QPILLELEA	ATIRLIFHW
IPFGDITDI	YPHGWVETA	RTYDLYITY
LPFLTTEV	IPQVMAIA	RVYPQAVYF
YPWGVVQV	LPFSSMPTA	ITTTINPRF

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DGRLVINRV	TPWFKIIAA	KVLKEIVERVF
DSLITPHV	VPNKFLVTA	KYHNVGLSK
PASLWEY	EKEGDQGPNIIPA	RSSSYLDNLVW
YALnHTLSV	NPYATLPRA	RVSPALGITW
FPFGFFTTV	KPFSQHVR	VRVELSNGEK
IPRLIPVI	LPAYLLVSA	VTRAKQIVW
YAPPPFLHI	MPIFGGGRYPAV	LELDTELSW
DALKVTVGV	QPFESYITA	RSSGLTAVW
DGYEQAARV	FPAGPGRKVI	AIEENNNFSK
IPLPLEPQV	ITIHLPSPV	ISYPQEVIPTF
MAPALLLI	FPGLLLAA	ELAEDGYSGVEVR
TVYALPTI	FPTHPYFSA	KTATELSTVYL
FAYVQIKTI	FPKPGPLEPT	FSLPSVDGQKRY
QALELPLRI	mALVASVRVPA	STSGIHAITVF
YPFIFPLHKV	YPYNAPTVKF	PGDSDIIRSMPEQTGEK
LPRAKIITV	EAFEAIPRALA	KTKEIEQVY
SPYDmLESI	IPFFSIPVV	NIEDVIAQGIGK
LPTSVVTI	MPSSLPLGPGLGSAA	VTARLVGVLW
LPAGILPmV	VNVEINVAPGKD	ESKDPADETEAD
LPKNPDLRI	SSIASSMSHSTTA	GSKFPVRW
VPFAPIVFI	EALGIPAA	NSVAASLmSW
LPPVVFLLI	FPANVMDVIA	QTVSDIERGW
YIDQEELNK	qPILLELEA	VFDGSSLPADVHRY
DAMSILETI	CGPQLTALLAA	KVLIDIREY
LPFVSRGPLTV	YPFKPPKV	VSLSAGRSW
EPRIEIVVV	KHEAIETDIAAYEER	RAMQDMQLLW
LPAELINQI	FPHVLPLI	RILVDQQVW
MPRDILIVV	mAAVPVAAA	KSINSEVLKF
NAWISLISI	LGPALLLTP	LSHGVPLPNW
FPYSSHLI	KHPDASVNFSEFSK	ITTSLTTKW
HALELLVI	LPFGGVPTV	ISRPAWLW
DAFTIKTV	LPMLQTVA	AHSSMVGVNLPQK
DANLLPLV	IPVYSPLSA	KALGDQILF
FPYVTMDI	SPFSSFISV	KGFTDADNTW
GLGTDEDTLIEILASR	HPWLFIEEA	STLKDTRLLTF
ILGADTSVDLEETGR	YPFLLmVV	VSFYNQNKW
LPGYVPKTSL	LLFHNAVSA	KVQDITMQW
SALPWNITV	mPIYPTYNEV	TEGGFVEGVNKKL
TVQSLEIDLDSMR	TPFYFKEPS	HISSVRAVAVW
MPYVIEFI	EPLSYTRFSLA	LSTLVRPVF
DAFTFRHFL	TPTPVPVV	VSFELFADKVPK
IAPLVKSL	FPHPLPSL	TALSNLITW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
LPYVAPEL	LPPVLLPGAAG	KSFEGNVFMY
SDAPGVPRI	YPIEPSGVLGA	GTWLPSRAEW
VPLDGRPMNI	YPQVPGSYPMQPV	LSSTEILKW
EAFHYIFNV	LPSLPLMSA	LIEVDDER
DATKLLPSV	YPNIELSYEVV	RTLGEIPTY
DAMRLYYV	FPVLGGKAIEF	LSVPSPFTW
DPSSIVPLI	SPYYFLTSA	LTFRDVAIEF
FPAVTVEV	KPYNVYITV	SGSSDGTIRLW
LPEPKVRIV	LPKAGLQSLGSA	LSKRNPRQINW
YPPSQIAQL	RKMMKYWAT	LSSVLGnKF
DPPIIIFV	SKQNEMLVAA	KSLRFIDVEF
DAYKIRIRI	FIFQQPEA	LKGDDLQAIKK
FPSEDILLV	HPWEVIVGT	ASEDRSVRIW
MPRLIAKV	MPDTPRLFA	ITAHPERW
NPDDITNEEYGEFYK	LPQPAFIPA	SSAAQLPWGESW
TSPKALVI	MGKILDQGEDFPA	SSREGAITFTW
DAENAmRYI	FARPAAGFVA	TAADVVKQW
YALEVEKI	FPLQFGREVLA	GTHSLDIKW
ELISNASDALDK	LAFLGNLVSA	QSLNMVKYW
DAmSILETI	LPWQQERDVAA	LAWQNPSGW
LPISHPPQI	FALPGLLHA	GSLQEGHRLW
LPIYAVTV	FPLIVTGQREA	KVIEINPYL
qPPPPPLWI	LENGELEHIRPK	LTSPDSEKW
IPNFDVREIVNNI	MPGYPVLAPA	RSRVFDLQF
TGPLVLNRV	mPPPVGmVA	NVTELNEPLSNEER
VPAPSVPSV	RPYQPLPEA	RSLSDLFRRY
VPYLFKKV	YPYQVVRA	LQSIGTENTEENRR
YPLTQLVVV	FPLIISSV	ADHGEPIGR
LPPDVWMKI	HPNYLGDLIMA	KMFIGGLSW
LPYGEGLRI	MLYEKFSPA	RALDLENIMRKF
FPLQQKILV	MPHLSMQQV	RSVVQAGVQW
LPFDLQRNV	YPNFSLPAA	YTYKMPGDIKNW
DPYPLLVV	EALGIPAAA	AVTEQGAELSNEER
LPFQQFEI	ESFVMPWQA	QAFPNTNRW
LPYQIKKI	KHPDSSVNFAEFSK	ISLSEPRMLW
HPSPVVLKV	MTVPPPPAA	ALRVLNSYW
DPFAGRNVI	PPGVVmGLAWTA	KAMELIREL
IPFFSIPVV	VPFRMTQN	VTLEFAQKW
NALPALLI	HPLYQSWVI	ITRSPYHVVW
QPLPVILHV	SAPVNFISA	LSLDELHRKY
DALIVRPV	EGIPALDNFLDKL	DLSLEEIQK
FADFHRV	LPYLGVHGA	KSYELPDGQVI

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
LPFSQPKV	mAVFVVLLA	LTVKLPDGYEF
DGFTVPQI	NKDQGTYEDYVEGLR	RSRGFGFVTF
LPYRLVFAV	YPIGTNAIVA	SAAADSAVRLW
MTYERILYI	MPNAGLPGVGL	AAKAVLADW
NDLSSDAPGVPRI	HHTFYNELR	HGYIGEFEIIDDHR
LPYAVEEL	WPFQQPVDA	RVLELLKQY
YAHFPINVV	YPLQGPGLLSV	SSGSPYGGGYGSGGGSGGYGSR
YPPNIAVKV	LAPALPLSA	TAIESGQHYW
LPAQPmISV	MPWFKGW	LHPFHVIR
LPPVmLLI	MPSIPVLNA	ISLPNGLQGF
MPTDVLEV	DALLVGVPA	KARLPLRL
QAIERYLVV	FPLNDLLSA	KLADPDEVARRW
IAEFTTNLTEEEEK	YPFPGRLLP	EAGEQGDIEPR
MAFLTQRTI	HPLTGGGMTVA	ITVVSEKQF
NAFATPTI	MPHSYPYVAL	ASARAGIHLW
EPPLSLTI	MPDGQFKDI	GTYSPEISW
SAPEVLLV	TANSKLVIITA	SSRQIISHW
TALLVVLV	IPIEVIPMA	QAAERPQEW
VAWEVANKV	LPLGDGLTLA	GSVSDEEMMELR
SDVWSLGCIL	MPVDLELVA	RTYFVANEW
VPAPVPLM	FPFESGKPFKI	NDLAVVDVR
MAPYVLnV	LPSLYPSFHSA	KVLIDIREYW
FPSYLETV	HPLNIVPPP	LSFKDVAVVF
IPNEKIRNI	MPFQQWEA	SSSSIEVHW
LPHFTSEHI	VHLVGIDIFTGK	KVLELQRKL
LPIGIPYSI	VPFSIPAA	STFVLDEFKR
YPPGAILV	MAAESLLVTV	KVRDPRPW
IAFFILTTI	RGEAHLAVNDFELAR	VTKPNNIKSMF
LPYSFIIGV	IPHSLPGAVAA	MCPSEMGTLW
DAYETTLHV	LPHSGDIIAT	GVQVETISPGDGR
IPRVQVAQI	AAEDDEDDDVDTK	KTFLIPVLF
VEVTEFEDIK	FPYAHRFPP	ASNYFRAMF
VPILAPRI	qPHHIGVAV	KSGSVQEQW
mPPPPPQGV	YPFHYAPFA	RTRIGYSF
YAYPGVLLI	EGFSIPVSA	VTLHDQGTAQW
DFIRILVI	KESYSVYVYK	ITKTVVENI
FPAVSALV	AQYEDIAQKSKAEAE	QAINPKLLQL
TGWLALLV	MPALGWAVA	QKVDSLLENLEK
VAHQQLIQI	LPTTmGVVA	VSWDEKGMTW
IAYKFGKTV	SPTPIPTV	RTYITFQTW
SPYDMLESI	FPYEGPLRLL	SVIPARIIHNW
DGVPVIKV	mPNLLQQAV	SSLQLYRQF

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
qPYGGFLDI	DKHIEEVR	KHLEINPDHSIIETLR
VAADAVASLLI	MPDLPHLLA	LQLPLHPSW
YPASSLVV	KYHNVGLSK	HSVAQAGVQW
DPSLAPYI	FPYKIFKN	VSKKNIFLLF
LPPSVVATV	LPHGFTNMA	TVLIMELINNVAK
VELQELNDR	IMLFGPGAVS	HSWMEGQVTVW
VPYPTASL	FPSEITDTV	LTAKVFRTY
DAFGRIDVV	FVNDIFERI	KALTLSVVF
VPIVMLPKI	APVLLPSAA	RTVEALYKF
DAYVGYmTI	MVMLLPTSA	VSFEEDDKIRW
LPPPPmQYI	FPFDVTKVEV	KDDEENYLDLFSHK
YPFAISLI	FPSNIFYEG	KTHPLWRLW
IAVKALQI	mPYLIGVHA	MSMVANLLY
LPSILPGL	LPGLPLVTA	KTLELPHVF
DGFHIFIV	TLAPGLGLPA	MTKDNLAIVTQW
LSPVVPQI	FPHESTFGVGNF	GSYVAPKAVW
IPNFDVREI	FPQLRATMEA	HTLDDRTQLW
LAAPVLLV	LSLPLAST	VREEEIEVDSR
mALQSILSI	VAIVQAVSA	PSVHNDLWE
FPYFFESRI	FPMKALGYFA	DATNVGDEGGFAPNILENK
SAFEQLVV	LALLPALAA	KSVDRSLLFL
LPYSPRVLV	mAVVIPEAA	KTKRSIQFVDW
FPNLDSPNV	LPVAFKVVA	LTFPVAMFW
LPHPGLQV	MPLSTIREVA	FAYKDQNENRW
VPFIVPLSV	NPVDFLSKA	GSYDGFARIW
VPIKPLPNV	YPQELIVPA	KAKEIYMTF
VPQLQNNTI	ENYNKFISA	ITSPVHVSF
DAHELFHVI	FPAEFGVVAA	KSKVDIPAHW
MAYPDLNEI	NQSVDKSDTIPI	TAQAGIVLTW
FPNEFAKLTV	MPDSILLEA	KSRDPIIF
YPLLIIRE	MPQFLSTEA	HHTFYNELR
MPYEDGIYSVI	FPFHIIFD	AARVLQEAW
LPRLTPPVL	FPIDKPPSFRAL	IGLPSGLESW
EALHAFLLV	VPAGGAVAVSA	SSSRIRAAW
LPYKIAYYI	HKSETDTSLIR	RARELLVSY
TPFGGRLLV	FPYVLLRNA	RTRPAANPIQF
VPFEPSKPPVI	MAAVPVAAA	SVVAGFSELAW
DAYRALQKL	QPYAPPRDFAA	TTHNIPQTF
QPWEVPFV	YPNAELVFLEI	HSVTQAGVQW
DARIFLNEI	FALPFGRTA	LGIHEDSQNR
GYPYNAPTV	MPSLQPVV	NAGVEGSLIVEK
NALGVILQV	VPFEFPPEA	RSVAQAGVQW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
PVIVEPLE	ELYADFIAA	IAAPDSRRW
DAAEIRLV	IPIEVIPmA	RVIEILFSW
FALGILKI	YLHLPPEIVPA	GTLSGHASW
IPAYFVTV	APVILPSA	ISKEEAMRW
TPWQPPTV	DPVANVRFNVA	KTFLFSATM
DAAAKALRI	FPNASLIGLTA	FAAATGATPIAGR
DPYRALDI	MPVGLIAGA	RSIQVGPGAAARW
DADPNFDRLI	FPSHLLVTA	SSSQLVSHLLF
LPIPVPIFV	YPAHAFLAA	YAAIIQLRW
YPLYTIVFI	YPQDPAWRA	RGEAHLAVNDFELAR
YIIEREPLI	FPAQVPSA	ATVPNTIVVNW
IIYPTPKVV	IASGIYLLA	GFGFVLFK
DGPGILRI	FPFLQQEEA	LAWQNPPGW
EPLEIILHL	MAPPTIPSA	TTREPSLATW
YPNVFKKI	MPFNLIPVI	IKDIAWTEDSKR
DPTEHIPEI	SPIENIQRVAA	TANGIALLW
EYVNLPINGNGKQ	TPQEKIFIAA	EGGVKQEYRTW
FGYVDFESAEDLEK	EALTPLHVAA	VFIGNLNTLVVK
LPPDALII	SPVVGEFKG	HTNQDHVHAVW
FPYEGPLRL	YAIYELAVA	VSSSHDKSLRLW
LPYVGNLI	YPTTFVMVV	KTYQDIQNTI
mPIKINLI	IPLDKRLAA	KLYEEGSNKRLF
FPLSSIVEI	FPHFDLS	KTKEVIQEW
TVLPFVSTV	GFGSDKEAILDIITSR	DFLAGGVAAAISK
ADHGEPIGR	MPTSGALDRVA	LSIHLQHKF
YPESVIRLI	qPFESYITA	AHLMEIQVNGGTVAEK
EALPVKLI	SGGGGGGGLGSGGSIR	QSSKALLQLW
LPMFIIVV	VHIEIGPDGR	KSVENLGVSY
SPFSFHHV	NHPYLFPVAA	FSASGELGNGNIK
IPDTMAHLI	SVTLQAIAA	HLREIESRW
DAVRIVHI	HPLGIVQGFFA	TSLQLQHLF
DGFAFQNLV	HPTSIVKA	HAWMDNIREW
HPARPFLLV	IRLENEIQTY	HFIDVGAGVIDEDYR
IPYPRVNL	LPFEFRAIEA	LTVVFENNW
LPFTKPKVI	NPYFPGQAIA	HSAGNMLFRTW
QPITPGPSI	FILKFPHSA	TFIAIKPDGVQR
LPmSVIIV	YPHLVAGALAA	ASASWDKTVRLW
DAALDFKNV	MPSFLSIEA	RVLKIPASW
DALNAPLHI	FPTTKIPNP	GTMDIRHFF
LPANLYPTV	SPVAHLVAI	KVRELELVY
VAPGALLGL	EPVLPCVAA	VNFTVDQIR
DGFIPKNYI	HPLTGGGmTVA	GTIPERPGW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
FPMSPVTSV	TPYTGILYA	ITTDVLYTI
FPAPTPKNI	VPYEIQKGQA	KSLPLPNDKTLLY
TALKImKV	EPFADFHRV	RSGGGGGGGLGSGGSIRSSY
DPGPILRI	LPFHFPGSF	DKHIEEVR
VPATLFEI	YPIALTRA	AELNEFLTR
DSPNVLTV	FPLEKALEA	DYFEQYGK
LPQEIGNLK	LDPHNHVLYSNR	GPSSVEDIK
DLREQILRV	AVFLVMYVAT	KIQALQQQADEAEDR
VPVITPYL	FPFGCPPtV	VIEALLVPDGGKVEGGTP
DAYVGYMTI	IDEPLEGSEDR	GTVGFGSGLHGW
NAPAIIFI	LPFLLSLFPGA	RSLAYIHSF
DALLEQAMI	LPRNIGNAGMVA	ASLDQTVRVW
DGPIAVIV	ASNPPPISNQ	GGGGGGGLGSGGSIR
IPIFLPEV	LPQQILPTA	RARLPVTTW
LPSNTSLVI	YPQLLPGIR	STFPGFVSW
YPAELNNI	FPVQTITTV	AVIAALAICG
FPYGSFPYV	FPYEPFLNA	FADSTVRVW
VPSDLYPLV	mPRFTEQVEA	RSFDKGPFATF
HAFIQPEI	NGTQPPPVP	RPPPEHFR
LGYDTRVTI	FPFNTPKT	VVMALISVPW
YAYRSVPSI	FPQIVSVAA	AAAAAAAAAW
DAYIQEHLL	HPADSVVSV	ISDPYKVYRI
DGWPAmGI	LAHAAFSAA	ATVGRRYLW
LPYELAINI	LPNIPVQTI	RAYPHNLMTF
VPLPPPMAI	MPFTEKIMA	KTFPYQHRY
IDEPLEGSEDR	GGFGGRGGGFGGGS	RSFEHALMLF
LAPPALVV	LPHELGDFA	RTLVPNFTF
VPAGGVLTI	MPMNVADLI	RAASIYSSW
LPYLNKVVV	SAFAYAIAA	ASAGVDTNVRIW
IPLLINHL	YAFLLDKA	KSKEDLVSQGF
VPFITEHII	YPYGLQTFHPA	SVESARREIALW
YPFLLmVV	GGGGGGGLGSGGSIRSS	FAYKVQPRNW
FPVFATVI	LHGFILVTA	NQTAEKEEFEHQQK
VPAGFLLATI	LPQVTWIVQ	GVHTVHVTF
DAYSKRFISV	SPVLPLTSA	MENEICRVW
DGFKANLV	FPILIRQV	TTAPEFRRW
TAFAFHLRV	YPKRPLLGL	HSQAVEELAEQLEQTKR
LPAFVSVV	APLPHLPPA	ASWDHTIRVW
mPLQLLLLL	MPETLGQVA	FIIPNVVK
VPRWSPPSI	FPAVVKNVA	KTLPIPVQI
YPTQLFRTV	LPPEVYAVV	QTFRLYREY
IPYAQPPLGRL	LSMDGTLHTPA	RSRDYQPLLW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
DALHNLFYI	HPYLFPVA	GSASVNSRW
LPPLVDVI	MPGGPGVLQALPA	RSLTTLSEQW
YPFKPPmI	SPYHGFTIV	STFSILQTW
DGYTFVEV	MPEEKLVEA	ISVPPIQKW
YPYEYLGGHI	MPFGNVISA	SSFLPEDEKR
MGVIVHII	MPFGNVVSA	KSLEEAQEW
LPNTTPTI	RPItPVYTV	ATIPVSQISTI
LPVPLLTI	WPLDASFRA	IAANEENRKW
DAPVALVV	FPSNLEVEA	HVFGESDELIGQK
IPmELVNEV	HAFWGGSVV	LVKREDYLY
LPYNGVTV	mPFGNVVSA	VARVEPNIKW
LPSGAVFVI	NPLFIPVAV	AVFSDAQMHIW
TALGILVV	HPNLNLFAA	MAAEALSRGW
FPLIISSV	YPFDFQGA	ISLPDDVRRRL
HPFFYVPEI	EALPPNWEA	ISIPIGFLF
IAYIMPGL	LPQPVPLSV	KIYLPYLHEW
DAAEFRVV	EEQLQQIRAE	KAQSQEEIRRLW
LPSYTPTI	KALMKEIPA	ATGGRIVPRF
LPWSSVLRV	VARGDLGIEIPA	KSTPYTAVRW
QALGITTKI	YAPPLPSLA	TTDGYLLRLF
RYQGKADAPVALVV	WPSHLPIVA	RSKPLFHHF
EPPQVLEI	IPHPLIMGV	KTKDGVREVF
LPPHIIRL	NALLQRLEA	ASGnVSWLW
LPYYIGISI	mAVVIPEA	KTLGDFAAEY
MPLLTPRYI	MPPMPVASV	RTAHVILRY
TLLGDGPVVTDPK	MPWHDIASA	TILPGNLQSW
ALAADIPV	MPYFLLTQAV	SIYYITGESK
VPSYIPLV	YPLALNRIAA	TGATAYRLAWGRSEGGPM
YPmRIDESI	YPFTLRVV	ERQEAEEAKEALLQASR
YPQLLPGI	EQFLDGDGWTSR	HFTILDAPGHK
FPEDVVRVI	HPASVIFTV	ISNTASYLRLW
LPNPTLVTI	QAFSPPPNVTA	SDSFENPVLQQHFR
IAFPTSISV	FPWQPKTGA	HYVVSEPLGRNSY
DAYDNFDNI	TPAWLEQMIA	RTLTFAERW
DIISIAEDEDLR	TPIESLFIEA	VTRLPIKW
ELEEDFIK	FPSEITDTVA	QTLKDYLSW
IPYAQPPL	YPLLIIRE	KIKYPENFF
LPVFQPGV	QPLPVILHV	FHPIQGHR
FHVEEEGK	FPVIPLLPT	TLGKEEGEPLALTC
IGYLIPLM	LPMDTFTVA	ITFPGIKLI
SDAIPGLKI	APLDAYFQV	EKAKLSVGW
LPPAALHLI	YAFGKFPTV	HSLDLQLQNW

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
MPYGWLTEI	MPMERQMSV	VTFEDVAVTF
LPYTQSVQI	LGIAGITGA	ISLIRMLVP
FPEEEWRHV	LPLLIEKV	ISMDPKVGW
mAPYVLnV	IPYQDYFYTA	KTLIEPFTL
VPFPLNSV	MPHDAIILL	ISATEVDSRW
EAMTQIIRV	PVSMAPVAVS	KTIPYSDKLF
LPYFRQSLSC	EAFRLPTA	KTKIDIIRM
SLTNLLCS	LPPEPVLNA	RTFSSISRAW
VPQQALVI	FPSTKISEA	RVAAPKHW
YPTKVRLI	mAmSAGTLLTA	VTTVVNPKY
NPYQFDVLV	APAEVPKSKAL	LGMAKDDILW
TAmDVVYAL	HPNVTLTISAA	NTAVVPQGW
DAFLFNEL	MSVHLPFAV	ATANEIHFW
LAAVTPII	YENEVALRQ	KTDLTYRIL
LPYLASLGI	FPVSWDNEV	RASAIIIQRW
MPYHIQRTI	NPNNEFWEA	KAFVPAILF
nAAIImKV	WAERLFPA	SARREIALW
DPFDLSHNV	EAFEAIKAA	VSFAEKNGW
QPHISPLTI	MAAFVPAA	LTTNEDIKGSW
VPLSKVFSL	MTIPYQPMPA	LSALIDGKNF
DPIVmGVTV	NPFTGFFYA	RVFPDKGYSF
TALKVLEI	NSSYFVEWIPNNVK	SIFRLARKW
YPWVHVVI	FPIKQPITV	FSFAEVHSW
NDEELNKLLGK	QPFAVPHSA	GIHPTIISESFQK
VPPNGLVV	DPHSGHFVA	TTSRVLKVL
EALVMPTL	FPYKIPAV	HSFYPTPALQW
QPYSKLPGV	LPLEMAPWFA	VNISQKQELW
nAIIIWNV	LPMSVIIVGV	ASMPRDIYQDY
DALKAITEV	IPRSFMMEV	KSRGIGTVTF
HAWDALKV	QAFGGLLVA	KLMPGRIQLW
LPYHETRIFV	MPNPSLAQV	HKLDVTSVEDYK
VPNLQTVSV	VAFVMVEDG	IKGEHPGLSIGDVAK
NPPKILTV	LPHVPLGVI	KTAPFDSRF
VALLVGEKV	LGMLQAVAA	KTLAEINQKW
IPADLRIIS	LPYFDQGYEA	RAVGLVSTW
LPVVVISNV	MPFSGDIRA	ATDPNILGRTW
FPVEVNTV	MPRIYELAA	HSKPTTRDW
mPVQFQVV	YPAYISIKA	YTHQVVTRW
QAPVVPYM	LPLPYGFSA	EDMAALEK
TATYLPEV	VVSMLAEP	TARPVLWHW
ADEGISFR	GSGGGSYGSGGGGGGHGSYGSGS	VHLVGIDIFTGK
DPKVQINAI	HNLLLYEA	RISSSPTHSLYVF

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
YPYPVSNSV	LAVNMVPFPR	FDIAVDGEPLGR
ELAEDGYSGVEVR	LPNAVITRI	YYNPDTGVTTW
FPYmTHPSV	MPAEHVAVQV	ETIEQEKR
HTGPNSPDTANDGFVR	LPFWAYSAA	KSLEDVVRAY
LPATIARI	GGGGGLGSGGSIR	LPLRFLSTL
VPYEKGFAL	MPYFQPSAI	ISMASVAHW
VALKIIRNV	APVGPRAAMS	KPFSQHVR
PRAKIITVL	LPFFFGNIT	QLLLTADDR
YPANSIVVV	MPYSNGRPAL	CSHLPRPPALQPCQGQA
YPLLILFV	DAHEFLIAA	ISRPVPVRF
FPLITITV	NPFLFALEA	LVQNPVRLW
LPLTVSAV	WATQGLAVA	ASLTAVVIHW
LPLVVSFI	FPTIKIFGS	KAKDIIRFL
VAVEPRSLI	MAAGGPGAGSAAP	ISHIPASRW
DVLSKLLVV	MLMSPRGCAH	RTLESKLVLF
HAYIGVSLV	YPFLLPTSS	VTGEDRLGWGSGWDVL
KPYNVYITV	YQPRFHVVF	RIRGPTYVWTF
LASPEYVNLPINGNGKQ	LPVKLIFVA	RTTLVDNNTW
YAYLPLHV	NIIVMSLPVA	GSWDHTLRVW
FHHTIGGSR	YPNPVAHLP	RAKAIIVEF
LPDNSILVV	FPSNLVSA	GTFNPVSLW
DAFVFSYL	IALTGIPVA	YLFKGNNRW
mAYAGARFV	YPAPIPPP	EGLELPEDEEEKK
DAFIFKSDV	FPEGFIWSAA	NSNPALNDNLEK
DASPVQAVF	LPLRPFPAA	LSLLRPQSK
LPYWVPLSL	LPIDFPTSA	ELTDEEAER
YPTDLNTI	LPLAQVSA	KAYEALYNF
FTDEEVDELYR	FPIHLVGQLV	HYVVSEPL
LPTTmGVV	NVEIDPEIQ	HSLESQVTF
DAFISVQV	VSENSPNGSLVAT	ACIRIQKTIRGW
DLSSDAPGVPRI	GPAPVLSLPA	QSVHFQTIF
QPYYPQHPmV	DPFDILREA	KTLPADVQNY
VPNEHIMNV	FPAALQLVA	ASASDDGTVRIW
GVVDSDDLPLNVSR	HPFKGFLLEA	VLTKHKEL
LPWESMPSL	VSVSGPSLLAA	RTFGHLLRY
DAmYVKLI	FPHYEVPLAA	GYFEYIEENKYSR
IPQLVSNI	VPQPVPLIA	PATKTITTPTGW
YPILMNQRV	HPIEWAINAA	YDNEAIGLW
MPHLSmQQV	VPLFVQHDA	ELVLDNSR
VAVKILKV	YPAQLWPDA	RSAAPGSLGYQW
LPYNMPLAY	LQMPIVYDLFC	NSRPPLQW
mPYPAPNVPVV	HPTASLIAKVA	AFEQLLRLE

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
TAQVIILNHPGQI	FPTAPTRVV	QSLKELLQNW
LPYLQGQV	FPTTSILPQTA	VSVQNLPQW
NAAIIMKV	LPYDLRASF	GLTSVINQK
NAFQYVNSI	VPRLPATAA	VSAAIGTNLRR
VPYPLPKIDL	LGKFIEIAA	LSKKLVVRW
mPYHIQRTI	YPVQSVIIA	MAHQVQELF
mPQIETRVI	LLLLPLPVPA	LYCPGWSSVAPSRLT
DPFILDVI	LPYNGVVLA	KTPEEIRKTF
LPEPVLRKV	MSFVKGWGAE	STSTFLSQTTY
mAELTEHV	HPASLEFQA	DIDIHEVR
DAIHQLGFI	FNVWDTAGQEK	QSIRIQRML
DAYAQYLWI	MPIEVMMNET	NSIKELNERW
DGIVNPTI	FPVSLPLA	KEKIVRSF
VAAPPSIQI	FPTQALNFA	KHEAIETDIAAYEER
VPLVRRRL	LMPPPPPPP	VVTSRPAAVSAF
GATQQILDEAER	YPFIFDAQA	SGSVAWRVA
HPYmFQHI	LPSDVVTGYLA	ALGRPLPRW
YPFDFQGARI	YPFVFDAQA	RTIADSLINSF
YPGIIVSNI	YPQQAIVFA	RFEKPLEEK
SMPALIII	mPFGNVISA	RARFEEVLAW
YSVVLPTV	IPMELVNEV	IRSHKDFL
IPYGLGHHPPVTI	LAMVISSFGGL	LSNTVMPRF
MALIQHSTI	VPLSHLINA	RSGPVKLEF
SIPMAYLTL	SIINYPKVSA	KSFSFVRVI
FPVQTITTV	FPYYPSPGV	ENMLDLAW
LPLAGPPITV	IPFGTMVAV	NDYKLRW
FPLPTPLSV	EANLLLSA	QLEEAEEEAQR
LPVNAQNYV	DAISNIFQA	AADAEAEVASLNR
MPQNRTIYV	EAFSIPGVLEA	PGSPGSPGPAGPA
LPRLLPAL	MPVERILEA	FSLWKENRT
DAVNLALLM	QPLGTLPQA	VSLVDLAGSER
DPWLLPEI	IAAQGFTVAA	SALLGPPFAGW
HALPIPVI	YPAAITILETA	AFFSEVER
FPFIVLVTV	FPFQPGSVA	TPPAQKGTV
mAWAVVNEI	EIVLADVIDNDSWR	RALLAGGGFSTW
TDTLEDLFPTTK	AMVVIAEP	GSSDSTVRVW
DAmRLYYV	EEEKRTLIAE	KVVDVVRNL
SAYGPGLVSI	SPAAPVITA	WQTTQVTW
FPEHIFPAL	FPAEFGVVA	ISADVHGIW
YPIGTNAIV	LPSASITSTSA	KSVFVKNVGW
LPFAAAQI	EPIVPAAP	SRSGGGGGGGLGSGGSIRSS
FPYEASTPTGI	mAILNGIVA	PGLHDDIAL

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
MAYARQIYI	LAGGLLASA	GPSGPAGEVGKP
NVTELNEPLSNEER	VPVAVTAAV	VSSHVERVF
DAPGVPRI	QPIFAVTSA	RALKEITTF
LPVPLHPQV	NAVLLFEA	AALPDQSFLW
qALEVLKI	mAAFVPAA	
VPVWSGMNV	VKPPPPPPP	
DPSMVILEV	LPTTMGVVA	
LPVTPPRLV	VPVEIVAPA	
LPFSFEHI	IPLsmNV	
mPFRGDTVI	KTQILEW	
YPLALNRI	IAmIITAV	
LPLSGVPLmI	IASVPVVA	
LPLSmIVAI	FALYPINIS	
SLEDALSSDTSGHFR	PFSQYSDEE	
LPPIKVLVV	LVFYGFLAA	
DAIVFVTV	YAVLISEA	
FAMPYFIQV	EIPVFGIVP	
TYPVCISLL		
qPYLFTRHV		
LPPVPVPKI		
MPAFIFEHI		
YPVVSAASI		
DAAFATLV		
DPTQLPKI		
FPFYAGPKPTF		
YPFANKESI		
LPIEANLV		
MPPPVGmV		
DAIKVFVRI		
NPYIVRMI		
EPYPYPIPTV		
VATWMLEV		
VPIVmLPKI		
YPSLPAQQV		
IAYImPGL		
LPMSVIIV		
DVHIQINSI		
MPYEDIRNV		
LAAALAHI		
MPLPVLQAI		
EPFKTQPFI		
IPDGGVHII		

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
YAVLTSTI		
EGNPEEDLTADK		
IQALQQQADEAEDR		
LAPLAKVI		
NEEDAAELVALAQAVNAR		
LPVSLPQI		
EPIPVLPTV		
DGPYALVL		
DAFPPPRV		
DPVHAVVYI		
VPYSTSASLYI		
mAYADLFV		
DAFFSDTQI		
DAFRQPSLFYH		
LPLLEQKQV		
LPPVLTTV		
VAAAVDLII		
mPISSVRFV		
DPYTFAEI		
LPmLVVVI		
QPPPPPLWI		
DSYEFLKAI		
EPFIFHEV		
DAFNIPLI		
YPYNAPTV		
LPHYDTLVK		
DGIVIVKV		
DPPPPMETI		
LPPGFYPHI		
DAPFVINAI		
IPLLLLIL		
LPLmKFLEV		
NDLAVVDVR		
VGYLQPLV		
FPAIAQEI		
IQVLQQQADDAEER		
LALIPSGVTV		
DVPGVPKI		
IPRSFmMEV		
LAPPSPSLV		
YPYGPVENKI		
DGYEVENLI		

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
mAALLEKI		
ASPEYVNLPINGNGKQ		
DAMGHTIVL		
VPLKDIVAI		
YPYIAKIL		
LPPPENIEV		
ELTDEEAER		
VAVAPRLVV		
FPALLVRI		
YPESISTL		
DPYATVTL		
LPIPESQVI		
DAYLQRIL		
DAYPNGLQV		
HPNSAVLMV		
TAFAHLREV		
GDFLPPDEL		
DSLVLNNI		
NPFLGIAYI		
LPAPAVEHI		
YAFAFIQV		
VPMPYTLKV		
YAYDAKIEI		
ALAPPAALL		
FPFDQQFNI		
LAPVVKEI		
MPYLIGIHL		
DMYLAPHV		
LPYNTSLV		
MPISQLLMI		
TAPLISGV		
GDEELDSLIK		
MPIKINLI		
SSFYVNGLTLGGQK		
DMPVVITV		
YPYPmPPL		
LQEKEDLQELNDR		
mAFLTQRTI		
QPYmPTVSATI		
ELISNASDALDKIR		
FPYDANIQI		
LPYNPmMV		

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
VENDEDALL		
LPPPTPSQI		
DGFVFRIRV		
DALAFNSAI		
GLLSPTVV		
LPNVYEVI		
MGYSHSLVI		
LPNDVISSL		
LPPPPHLPP		
MPYTQNFI		
ADAVPLPPP		
FPIDKPPSFRAL		
LPQDVILKF		
CSHLPRPPALQPCQGQA		
FPLATESNI		
LPTTPPTI		
ERSCEADIL		
NQEVNKGVKEE		
EPFHLIVSY		
IASPVIAAV		
LAPLIQVI		
PDYTSPVV		
DGPYVFFV		
DGGVINLSV		
GFGSDKEAILDIITSR		
SEDDESGAGELTR		
LMTNGYVSL		
DAANVmVYV		
HVIDVKFLY		
LPPPIMLI		
FAYTSQITV		
HPFEAQTLI		
LAVILPPL		
ETIEQEKR		
HGLLLPHI		
IPFQPRHL		
DGAFGIRI		
LPPNVQII		
YAFGKFPTV		
DALNIETAI		
LPIDVQLYI		
DAIAVHVV		

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
LPVVVISNI		
FPYVVVPRV		
FPYKIPAV		
DPRIIRLI		
LPYEDVAI		
YPFKFYK		
TAVESFLTI		
GLAITFVSDENDAK		
LPSDVQTAI		
SDVLELTDDNFESR		
TALVIHQRI		
VDDFLANEAK		
DAVRVLREI		
IPPLGLKV		
YPVNTRIYI		
DAPYIFIV		
DPYQGTIVL		
MPYMQPVM		
YPPSMEAVV		
DAIAEIRAI		
LPLPASPVV		
MPSDVLEV		
VPYAGVLAV		
IAFLSPKV		
TPYEVAVI		
SPYATLTV		
DAANVMVYV		
LLDPEDISVDHPDEK		
EGDNVTLVV		
IPFIPMGV		
DGPRVFRV		
FPAAPAPKM		
DANDVVITV		
EAYTSVLTV		
YVQHTYR		
nALDKKSNFEL		
LPFTIPEL		
DPALAPVV		
YPYQAPLV		
DAVASLLIV		
DGIRIYKI		
TALERVVRI		

HLA-B Alleles		
B51:01	**B54:01**	**B57:01**
TPLASFTTV		
FPLLTSLGKV		
QPYGGFLDI		
LRFDIEGSDEADGSK		
NKDQGTYEDYVEGLR		
VPYLMEAI		
qPPSSLVI		
SLADGILL		
YALQALVV		
IPQELFRKI		
LPYSNITV		
VPILFASTV		
AEDGSVIDYELIDQDAR		
SAFTLPVI		
mPFNLIPVI		
ASLEAAIADAEQR		
VPYHIRLSI		
TALPMVPIV		
DAYYKLRHI		
FGPVASVV		
LPSSKLIRI		
LPLAHHLLV		
LPTTGMTI		
LPYFIRNKL		
LGIHEDSQNR		
YPASSLVVV		

[00515] **Table 1B.** A complete list of HLA-associated peptides identified across 12 HLA-C alleles. For clarity, each entry corresponds to a single peptide, which may occupy more than a single line of the table. For example, the entry "FSFRHLEL" (SEQ ID NO: __) under the HLA-C Allele listing for A03:02 is a single peptide.

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FSFRHLEL	FTADPLSL	HLDRPVFL	AADIPINI	KPFSQHVR	FALNHPEL	VLDHFSEL	ASGLIHRV	YVHMVTHF	FYHSVQDL	DSAHGFLK	FSAHRIVL
YAFLHRTL	FSYVSPEL	VYDIAAKF	AADTVVIF	RIPKIQKL	AAAPPLTL	IADRPLYL	MSGKVKVW	YFDEHYEY	VYKVGIAF	AIGKVLKL	VSHLRPLL
LAYIHIVF	YSFDGPSL	YFDEPVEL	AADVLVYL	VRFKVVKV	YWQNHPEL	IFDEAEKL	YGMPRQIL	SYWNHREL	KYLTAEAF	KTVKPLSL	DSAHGFLK
LAFHLAVL	AAAPPLTL	FSDHVALL	ALDDVVIL	YIDRVRSL	LAGPALEL	ISDYAVKI	YAFLHRTL	VYLVHDEL	AYLQRIAL	VSIRPMEL	KALTHLEM
YALPHAIL	FAHSFIEL	IFDEAEKL	ALDTPVMV	VRNLPQYV	FSFVMPSL	FADIIHSL	CSFRVLVV	KYLTAEAF	HFGIHEEM	HTIKPALV	SASLHLPK

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
LAKLMSEL	YSHVGIAW	FYDRAEYL	ASDTYIVF	FVGPSRYL	KAGPILEL	FADENFKL	MFHIRAVI	YFLEHLAF	GYLVRQEF	KSITPLML	YAFLHRTL
LSALLHEL	YAHPGLAL	IYDEVVKL	AVDLPVTL	IRFKIQRL	IAGPVVEI	VADRFSEL	MFHNRHLF	YFLIGKVY	VYVVHDSL	LSGKILHI	SSHVERVF
YAHLFEVF	FASKALEL	YYDVAKQL	FADAVQEL	YGMPRQIL	LTGPVLEL	VADKFTEL	VAFRICAV	IFQVAQEL	YFLIGKVY	YSIRPLIV	LGGHLDAK
YAWVLDKL	FGHIGIAV	AFDVEIHM	FADDVLNL	ARGPIQIL	HAYIISYL	YFDEPVEL	FSKTWIEV	TYTTRIHL	LFNVAHTL	AEFAEVSK	DELRDEGK
FTADPLSL	VAYEAPSL	VYDVTRFL	FADGVILL	FYGIIRNV	RFLGLASF	TSDLHFQV	YIQVEPVL	FYGKAIEL	AFQISKEY	ITTKVLRV	VSNIRQVF
FAFHLRVL	LAKVGIAL	HFDPEVYL	FADVIVLF	YYGPLRTV	ASYLLAAL	LADAVVKI	FANYIDKV	HFGIHEEM	SFQRALEL	LPSHPLEL	LASWGHEY
LAKYLMEL	FSHVGWLL	IYDVYRYL	FGDSPLAL	FSPVGSVL	FFLEHEAL	ILDVAQDL	NAASPLIV	FYQEHPDL	IFFNVHSA	FAGKVLRL	HFGIHEEM
FAFVHISF	FSFDGPEI	SFDWTVKL	FIDEQQIL	HAGPIRVV	FAYHAWCL	VFDSHPVL	FWMTRQEY	FYVEHPEV	FYGKAIEL	KIVKPVKV	LSSIRHMI
FLHILPAH	FSFHGAAL	YFDRAALF	FIDKPVCF	KYGPIRQI	QAAPPIEL	FLDEEVKL	FAGPCKVI	AFQISKEY	VYFVHPTF	ISGKIIFV	FGGQRLTL
IAGHIMEF	FQHVGQTL	HFDPVIQL	FITDPVVL	LRGPVLRL	LAGPVLGL	FWDPSPQL	MSKLISEM	IYMVHIQV	AFTNRIFF	FTADPLSL	AAAVRHVL
FGGEPLSY	LAHVGPRL	TFDVYTKL	FLDGQAVL	RREQERKL	TFLNHPAL	IVDRPVTL	FAHGFHEL	YYHWALSF	IFQVAQEL	ITSKILFV	AEFAEVSK
FIIKKPEM	YIHVGAQL	KPFSQHVR	FLDNPGIL	HRLQHINL	YVSFPLEL	VVDIVQEL	YAKLIAEL	FYGFQIAM	TYLVGNSL	KIGTPVKV	FWKEHPEI
LAYLHTEL	LADQPHLL	LFDAHVEF	FVDAITEL	VMSVGFLL	FSGPAITL	YSDLAEFL	AAFRIVVM	VFMTHLEF	FYFYRLVL	HSGPPIVI	AAATHLEV
FALNHPEL	FAHWGQEL	VFDLVRTL	FVDQFVEL	ASGLIHRV	FADGHVLEL	QADLAYQL	FAFVHISF	VYLTHLDY	YIDRVRSL	VTGHPLLI	VASMRLAY
YAKLIAEL	YWQNHPEL	IFDEIHYM	FVDTVVAL	YAFLHRTL	DAKIRIFDL	FLDKALEL	CAFRVIQV	FYYFVKEF	VFMTHLEF	ASGLPLMV	YALPHAIL
VFFVHEGY	LAHAGVAL	KFDEVVSL	HADLEIRL	AAQEEYVK	VATKIFQEL	DFDLHSEL	ASNYHLEV	VYKVGIAF	YVHMVTHF	HSGPIHVL	VSHTHLAF
FSHLQPTL	FAGPHSTL	INDERVFV	IADLAHLL	GVGPIRKV	LSDDHVLIL	SADFHVDL	FVNVQKEL	LYMVSKEL	YYHWALSF	ISAKPLEM	ASGLIHRV
YAQFLREM	FAFSSQEL	IFDLTSHL	IADLISSF	FGPGVAFR	FAYDGKDYI	TFDVHLDL	YAFLREAL	FYFNTKYF	AYLRALSL	YSNKEIFL	YFNPHLVF
YGVLLHEL	FSHVAMIL	TFDVHLDL	IADQITLL	YRAPEIML	CAHSFFDEL	IADFQDVL	KAFFIESV	IYHAVAAL	TFLTRQAF	RSVFPLSV	YAITRKAL
LATHLQEL	FAAEAIAM	LFDAVIRL	IADSFQVI	HLTGEFEK	FSNVFEHYL	VAEFHTEL	KAKFISSV	IFFNVHSA	LFQSRISL	TNIHELRV	YGMPRQIL
FVFTHSPF	YALPHAIL	QFDVATHL	IGDPNLEF	QVFGEATK	LAYLQRIAL	ILDEAVEL	ASFNRMVM	YYFNQHIF	KYMNNITY	ISVHPLTL	FALYRQAY
FAHSFIEL	FSANPKEL	FYDTFHTV	IIDEQPLI	AGEVFIHK	YAFLLDKAL	IADLAHLL	SAFAGWEV	TYLVGNSL	LYQVGKEF	KTGHVIAV	FAFVHISF
FAHGLGEL	FTMGGPAI	YFDVVEEI	ILDLETQL	KTLPVAFK	KASDLYITL	TSDWPTVL	FAKLVREV	IYIDRHVM	VYLVHDEL	NAASPLIV	FFKDRNWL
FAIILKSM	FAAHALLL	FFDDPMLL	ILDVAQDL	VISSIEQK	FADKTLLEL	FADAVQEL	TIFRTISV	TFTNHMVF	FYLERSNL	PLSSPLKV	FIRDPLTL
FVTELKEL	KAGPILEL	YFDHALTL	ISDGVVLF	VGEVIVTK	FAHHLPVWL	VADFADKL	IIHEIAVL	VFVTVKEL	FFLEHEAL	TTSRVLKV	FFAERLYY
IAHVLPAL	FSFEGPEI	YTDELVEL	ISDYAVKI	FGGLTRAL	VTVPPGPSL	YTDELVEL	FGNVHAYL	VYQAVRQF	VYLTHLDY	FVRVLVSK	VTHIGRVY
FSQIQPKL	SAAPAIQL	HFDTPVQF	ITDGQIFL	SSGPERIL	FAIPLIEKL	YLDPALEL	FAHIQAVF	HYNLQNAF	FYQEHPDL	TTAAPLLL	YFDEHYEY
FAALLHEY	FAHVAIAV	VYDLYKTL	ITDLPIKL	WSLLQQQK	SAIGYIHSL	VADLAESI	FAFRIYDM	FYHSVQDL	FYWIIEAL	RTSGHLLL	FSHLQPTL
RLGHILEY	FNFVGKIL	FFNVSDEL	ITDLYTDL	GVGPIRDV	AAIEIFEKV	TSDQPILL	TFPHPVYY	HYQNALYL	KFFTGDVF	RAGVPMEV	ATKLERVF
FSQLLHQI	LAFVSPSL	VFDLSEKL	ITDTLQEL	ELAQQIQK	FAVLEDHTL	SVDISHTL	YAKLHPEM	YYTVAHAI	FYVEVPEL	FARMLAQE	FSANPKEL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
LTALLM VL	YSKIGPA L	SYDDTV KL	LADALQ EL	EVSTYIK K	FSIDSPD SL	FMDPAS AL	TTKLISEL	VYFVHP TF	KFMDAS AL	VSGKILY I	RAFVH WYV
FAELLRA L	FSHNG MAL	VYDVAM KL	LADAVV KI	MVQIHS IL	NAIREV LEL	VADLAH VL	FNHINV EL	AYMNHI MV	LFRVITE V	LSKGIIH L	LANLRPL L
LIHEFVE Y	YTYIGPV L	NTDEMV EL	LADFAE LI	TAVAPIE R	KADPSH FEL	FLEDPSV L	FAGLVQ EI	FFENHPY F	FYVEHPE V	ASGKLLL L	NSLFEY QK
MTVLLH EV	FAGKGL TF	VWDVG SHF	LVDIPVE F	RQAFIR KV	IAIEDPY SV	VIDSPGI L	FAKCIEV M	FYYDGK VM	KYFNVH EL	KTNVPV KL	YSNIRFQ F
LAQALH EM	YTYIGEV L	LFDSVIH L	LVDTTV EL	NVGLIR KL	YAAGAK LVL	SVDLGP TL	MSGLLK VW	IYHISLEY	KYITAST F	YSNFPL QV	FALNHP EL
FSHQLLE L	FAGKVL RL	YFDVPEL I	NADIVT LL	YRAPEVI L	VADDTP VLL	IIDNHITL	TQMVR MIL	FYVPVSE M	LYVVHA VF	YSGRPV NL	YSTIRPY L
FAWGH DEL	LAGPALE L	FYDKFILL	QIDGLV VL	ESFDGS VR	AADWH NLIL	IIDGGW SL	FAHSFIE L	LYFTGEA I	FFHFVLA L	ASGYPV KV	FAFSRQ AL
VAYHQP TL	FTAPGL HL	SYDFTVR F	SADLVA QL	SEVTDL RR	FAALHG PAL	IGDPNL EF	FKIWDS FL	FYVVAES F	IYDNRIV L	ATGPLL KF	RTALPRI F
YLGKVLE L	FSPVGSV L	VFDPIGH F	SIDTVTV L	FYKDGR IV	VADPYV VIM	MLDVAE EL	VAGFNP AL	RYMFSR PF	FYYFVKE F	SIRSVRL V	FWMTR QEY
FTQKLQ EL	FASGAV EL	CLDEPVE L	SLDEVV LL	FVNVVP TF	YIDDVF HAL	LSDLSTK L	LAGPVQ EV	VFVVGE SY	YYFSAHA L	ATGPSIK I	KSTIKFQ M
ASYVHY VF	LAFLTCL L	RYDPSLT F	SLDGIV RL	ARALAQ YL	FASDVQ FVL	HADVA QLL	KAFLNAI M	YYFAVDT M	LYMVSK EL	ISGKPIL V	HFNTRL SF
FAEHRPI L	ISLEGKP L	ILDEAVE L	SLDLPSL V	QIDNPD YK	AALPVY QEL	LADFAE LI	LANFCRI L	FYVVNSE L	IYITGSSI	HTSVPLL L	FSNIREE L
FAKSLA ML	FAGWG RAL	VFDEVV QI	SLDSPV LL	RPEHVL RL	FAVGSF HTL	LADVHIE V	FGFHKP KM	FYQFVN NL	MYFIVRS L	IGSKPLQ I	SAGEPR VL
ASYLLAA L	AASHPLL L	KYEELQI T	SSDLPQ VL	TRGPVV RL	SAHLFE VEL	FLDYGE NL	YVFIWR TV	HYQLGL AY	MFQVH QVL	ALAPML EV	AISHGR VF
AATILRE L	FSAIGLE L	SFDSTVR L	SSDLPV AL	IPAMTI AK	LLPSHPL EL	LADIAQ KL	FSFCREE M	YWQNH PEL	IYQLQDV F	AGSIVLK V	FTMVGK TF
LGHLLM EL	FNHFSLT L	IFDSPYH L	TIDFPEF L	QFTGIK KY	FASEYPL IL	FSDHVA LL	LTGPIQV I	FYQLQP AM	FYRVVST F	QSGFPL RV	FARIAIE V
FGHEFLE F	FSVTGR VL	LFDNPRT F	TIDGVV FV	LLEGEES R	IAIEDPF SV	NADWP AGL	FSKVTKI L	FFQVGS DL	HYQNAL YL	FGITPLF V	FGNYRP FL
YSWLLN VL	LAADAL EL	TFDSTIH F	TSDQPIL L	GAWSN VLR	AAFEKA LEV	FSDQRS EL	KAGPILE L	YYFSAHA L	IYHVIMS V	SVSNPL EV	TFLTRQ AF
FIHEFISF	FSFSGNT L	FYDIVAE L	TSDWPT VL	FRTQLK TL	FIFSDTH EL	FIDQSQ SL	ESLIACK A	FYVIGSS Y	YFDEHYE Y	TAGRVL EL	YAKLHP EM
RIHIFSSF	FAHTSQ VL	TFDPFCY L	VADPVV TF	FRAPSRI F	QALLDL HAL	TNDISH YL	FAAEAIA M	YYFLGR ML	YYFNQHI F	KEKIPIIV	FASNHI QL
YFLEHLA F	LTGPVLE L	IYDIFQKL	VADTILF L	YNLGLD LR	HADDSF LVL	FTDVSIV M	VANVEH IL	MYFIVRS L	IYHAVAA L	FSGRILG L	HGWLRP EM
TAFLLDA L	LSVNPA AL	FYDFFRY V	VADVVI KF	SLDTYLK K	VADRL MLEL	SADGIV RI	VAGPVG LL	KYMNNI TY	FYLIIDHL	VVGKVL EI	VSSLRLA Y
YWQNH PEL	AAGPGF SL	VFDLAQ TL	VIDSPGI L	GQPNYL LS	FIIYDTH SL	FQDLIRE L	IAGPVV EI	FFRVVSE Y	LYFTGEA I	WSGEPL FL	AAAPPL TL
LITYLME H	FAQTVR VL	VTDEPV YI	VSDLISV L	NFRNPL AK	VAAGVL CEL	LADLPQ QL	FSFQEPI M	YYINSPE L	IYIVHDE V	LSAYPLS V	FALEHLE M
YAHPLE TL	LSFTIVSL	HFDGLIF V	VTDAIV LL	ALGHVR YV	YAIEVD PVL	TADITH AL	AAGPPL VA	TFMNRV EV	IYHTIAYL	YLGKVL EL	AAALRV EL
LSLERPT M	FSFVMP SL	LFIHYLAI	VVDIVQ EL	FKDPNA PK	YSAPVIH VL	VVDQPL KL	FTHRIRI V	VYHAVS VM	IYMVHI QV	HTGYVI EL	IFSQKPE F
YVTELAE L	TAFIGPA L	IYDFIGEF	VVDNPI YL	FDSSLD RK	FIDGHF VEM	TVDLSS HL	LAWINE SL	FYTIHSC F	FYHISLE H	LAGPPL EI	FLENED RR
FTMGGP AI	FAAEAIA L	TFDPFLY L	YADGES FL	FRFPHID LV	LVDDHF VEL	MSDLPV KV	FAFVEYE V	CYLTIKE M	FYVVNSE L	VGSKPL YV	FSINGHF Y
LAGPPLE I	DADALV PL	SWDQTV KL	YADVQ AVL	FRIEYEP LV	FLYPFPL AL	EADVNI KL	FAFVEFE L	YYINHPL Y	VFLLGHS M	HTAPVL DI	FAMIIDK L
FSQSLQ EL	LAADALL E	VFDLIQE L	YFDEPV EL	YRIELLR KV	IADGLCL EV	FADISNL L	FAERSFY L	IYLNHT ML	LFTFRPA L	STSPPLK L	FGGKRL SL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
VAAYLR AL	TSYVGLV L	KFNVSLT V	YLDIAEF L	FRFPKD RAV	RADDTF EAL	MTDPN VAL	NSFVSLS V	FFESFGD L	LFLEGM HY	DTNADK QL	VAQIRM AF
VSHVLA AL	HTGPITC L	MFDEPV LL	YLDLEA TL	ARFPMP RYI	VADRLL VEL	YSDAIV WL	AAFPIAV V	YFKGAIP L	IYTTRISL	KAVRPL EL	FAMVH VAY
YLGPILK F	RFLGLAS F	YYDFLVE V	YSDAIV WL	FRHPHII KL	FADFLV YEF	YADIVQ LL	VTHLHR VV	VYLVTEV Y	YYRFGQ VY	AASHPL LL	FTADPLS L
YAALHG EF	YAEGVR VL	SYDVIIR M	YSDIVTT L	FASGLIH RV	AADPVS PLL	YIDVAV KL	NAFFNN TI	RYFISHV L	HYNLQN AF	HIAKAL AL	YAFLREA L
YALLLTE H	FSKVGRE L	DFDLHSE L	YVDFPQ HL	TRYHFLI LL	SAVSIFH EL	SADKNF YL	NIFRNV EV	IYQLQDV F	SFFLGKE L	DDNPNL PR	KNSIRLT L
FTYLHRA L	FAHSGF QL	FLDEEVK L	AADAGF ALF	FRHENI AEL	RAFLDF HAL	VFDPHG TL	VANIIAE V	TYLVAFA Y	FFRVVSE Y	ISAEPIV V	LSSVKLE Y
IAYEFVE M	VAALSY NL	CFDEITY V	AADEVL AVL	SRPHFLI EL	FAVATP EEL	IFDEGH ML	FAFVEG TL	KFFTGD VF	VFFVAH SY	TYETTLE K	YAALHG EF
FFRLFPE Y	IAGPVVE I	YTDLEVR V	AADFEI GHF	HRYPNQ VYY	AALDIYE TL	LLDLHSY L	MAGPRL EI	YYNTAV KL	VFVVGE SY	AVAHPL IL	ASFNRM VM
HAMELS EL	HAYIISSL	SFDFHF GF	AADIPRI LV	NRVW WQILL	YSFHKF HYL	HIDFGH FL	VAMQV PVV	LYLDGH VF	FYVVAES F	FSGNPIK V	VFMTHL EF
FVIKRPE L	YAFSARP L	VFDEAV RV	AADPIIT RW	YRAITVR KL	SADKFQ VLL	SIDLNW DL	IVGPQLT V	LFLVGSS L	QFRVTE AL	KTSNPL VL	IANYRPT L
IAQVLAE L	YANIGKT L	YYDAIAC L	AADPSV VNL	SYIEHIF EI	CALGLV LGL	VLDPN MDL	SAYEVIK L	NYHFGV TY	IYLNHT ML	IASKPIIV	VSSLRM ML
SSVLLQA L	LPSHPLE L	IYDPFAG M	AADPVS PLL	HRAVFP IYL	FADQAE ILL	FSDVLP VL	LAGPAL EL	AFHTAS VL	LYLDGH VF	YGSKPL NI	FARLPLV V
YAWGL NEL	FSYAGFE M	VFDPHG TL	AAEEPL SLL	YAFPKA VSV	AADEVL AVL	YADVQA VL	MSYVHT TV	VYQAVQ AL	SFNTHFE M	IINTFHQ Y	YSKEGW EY
YVTILPE L	FANLTE GL	LFDQAN KL	AAEFVP SFL	FRFEEP VVL	KALSIFN EL	QFDVAT HL	ITGPLIRI	YFLQRH EL	HYNTG WVL	FVQMM TAK	ITTLRQV L
YSTIRPY L	FSYSSLM L	FYNDTV TF	AGDPVI LYV	FRPTFE NLI	FGHYQ QAEL	NWDIA HMI	AAFYAN YV	FYAFGR VF	FFLLGKT L	AQSKILF V	VSAYPR QL
FSRVALE F	YAGPGL SL	IFDLSNH L	AIDSPVS FL	FRTEKIR KL	AAVNVI CEL	IADFGW SV	IANINNC L	SFLNHRS F	FYIFHVE L	IIAPSLG F	YLGEEYV K
FLQQPR PL	VMSVGF LL	TYDEVIS F	ALDKAT VLL	TRIPKIQ KL	FSHAQT VVL	SADKFQ VL	LNKVISE L	QFRNAP PF	AYQLAF RY	ASAPRL MV	LSSLRFV F
FASDPIL Y	QSLGLA PL	IWDGLIL L	ALDLGG TNF	NRADLI RHF	TASEMI LVL	FSDNPL GL	KAFLNA VM	LYITGAA L	FFQVGS DL	SSGSILK V	FYVEHPE V
FGTVLTE H	AIAQAES L	HFNTSLV F	ALDVPN TML	FRMKYP HMV	FAIDPHL LL	ITDLCLV L	FSFRHLE L	VYLFTEA Y	YYNTAV KL	VSGVIV KI	VATWM LEV
IANYRPT L	FAIRGVV L	FFEEFGK L	AQDEHL ITF	QRAEVI RIL	IAHLEIT AL	ITDLPIKL	KAFPEH FTY	SFNTHFE M	FFQEAVS H	LSGSPLK V	SAACRL QL
YGVVLW EM	FIYVNQS F	SIDEEVY F	AQDLG VVNL	IRPEHVL RL	FSDDSD LQL	YIDSSW EL	FGFHKP KMY	IYHVIMS V	FYQLQP AM	RSSIPIT V	SAALRA VY
FSTNLQ RL	FAVVAS AL	YTDEAV VI	AQDPEI ASL	QRAEIIH HL	TAMDV VYAL	IADSFQ VI	YASSKLL KI	TFVNHP QV	LYQTALH L	VTTVILE V	FAAEHTI F
YTQLLTE M	FAHHGR SL	FQDAYV LL	ASDIPG LHL	KKPEW VILI	NVDGH LYEL	FADYVS TM	FGYPKRL IM	VYLTGY NF	AYLIVKE L	YSAPVIH V	AARQPIE L
YALLLQ HL	FSGPAIT L	VFDTSQ FF	ASDLVT TVF	MRYLHR IYV	FLDGNE LTL	FVDAITE L	LAIEHVR FF	AYFTAA QL	VFVTVKE L	YSSLPVE V	NSSIRPIF
LTHLLFE F	LSYVGIA L	HFDLAV EV	ASEEPW TVL	YRVVFP LEL	VADPVE AVL	FTDLSSR F	VLYDRV LKY	LFHCYIN E	HYVVSE PL	QIGPML RL	HSFFKIS Y
FATVVE EL	LAGPVL GL	FLDEYIFL	AVDAVI AEL	VRWPG VKLL	FSFYFHE AL	VSDINFT L	SAFSRI MKL	FFKDGLE M	DFFNGK EL	STGRPL VI	FWFFRE AF
FIFQQPE A	VAGPSV TL	VFDPVT KL	AVDEAV ILL	LRTPSV QLV	FTEWLH EVL	WMDEA QAL	KSIDLIQ KW	IFIARSQ M	TYLVAFA Y	RTIFPLF M	AFKNRM EV
LAQALQ EL	FYVNGL TL	LFDVHS VL	AVDPLL ALL	FRHPVLI FI	FSITPLS EL	YTDFVM EL	TTVKFV VKM	VYQAVL SL	NYYVRA VL	YSGVEV RV	MFLTRS EY
LAGPAL EL	LAAPLSA L	IYDVLIRL	AVDPN GAFL	VVYPW TQRF	QADQTF ISL	FSDGITS V	FAWPKI LKI	TYSLGSA L	SFQISLH F	VAGTP MFV	IALTRAE M
FIYEFEH F	YAFTGLS L	IFDIPGRL	AVEDSV LLL	FYVPFA KAL	FADGVY LVL	YSDIVTT L	LSSPWY HTY	SYNISEV M	TFTNHM VF	SIFVFTH V	AFNLRIS F

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YSFWLY EL	FSVVGS VL	IYDTHSL M	EIDIPHV WL	VRPGFP VSL	YITDLFQ VL	VLDTNI QL	TAFQRP QLM	YYKPGLL M	FYVIGSS Y	LTERKLT V	FSTVHEK F
FAVALP QL	FSSNPIS L	TYNDTVI F	FADFER HFL	WAYPR QVFI	FIAPTG HSL	LADIPVT I	FSFHVV KVY	IYVNYPT F	SFHVGL QL	ATALPL QV	KSTIGVE F
KAMVFL EY	AFAEALL L	CYDNIHF M	FADGH VLEL	CKPHFQ QLF	FSDPSA YIL	AVDVN NML	MAAER VKAW	IYIVHDE V	MFLTRS EY	HTGPVF TV	RATIGRY F
TAIELAE L	FSAHALK L	VFDPYYF I	FADVAP LQL	IRPDIVN FV	YALYVR DTL	FSDLTS QL	FSKAKPS VL	AFFTSKA L	FYYDGK VM	TSGPPL TM	KYLYEIA R
FIGYPITL	TAAHGL EL	YFNYTVK V	FAEEPG LVL	VYIDKV RSL	FADGVI LLL	FSDHM ALL	KAIDYIK YL	MFLTRS EY	FTMVGK TF	ITGHVL VV	FATVRET L
YAQILRD L	FAARPVL L	EYDLPAL L	FAEMYV AKF	IRTESIR WL	NVEIDP EIQ	YADLVK AL	FASHVS PEV	LFQNIRP L	TYNFSQS L	FTGAPL KV	ISTWKPE M
FGVVLD EI	IADLAHL L	FDDGAV FL	FAIDPH LLL	IRNQIIR EL	IAIPVTQ EL	VADLHL YL	LAYHRL HQL	IYLEGSA F	VYNIHLA V	KSPKLLT V	NFYNRPI L
FAHILTV L	QAAPPIE L	IWDINA ML	FIDGHF VEM	SRSPSL NLL	FAYPAP LEV	VSDMI MEL	YAFVRP VIL	FFLSHPA Y	VFRVGS VL	GSGKILR L	TYETTLE K
YVQLMP AL	FIGYPITL	KSDVEAI F	FIEELFSL M	SRYSFIQ AL	VAAAVD LII	IMDPEI AL	IGVDFAL KV	LFQSRISL	AFNIAEA F	LTAEILE L	AATIRLIF
VIYVLP ML	LTFVDPV L	YTDFHV DF	FLDENV HFF	NYIDKV RFL	MSCLLE VAL	VFDLAQ TL	VGVDFA LKV	AYSVGW EM	MFTNHI VF	YSSKVLL L	SSLVHPE L
FVNVVP TF	LSRTGVE L	TFDSEVE L	FLDGDQ LTL	FRPEHV SRL	FIMDSC DEL	FSDGAV SL	FVVDHV IKI	YYITRAK L	SFVDVM EF	LAGPPIT V	LGNVRP LL
VNFEFP EF	FITDPVV L	VYDNIGI L	FLDGYV SQL	HRLPHV LLL	FAADIIS VL	IFDIATE L	KAYFDV KEY	VFFVAH SY	AFQNVL TH	VVVHPL VL	HGPGLIY R
AAFVLP EF	YTAEPVT L	IYDGPIH L	FLDSTSP LL	HRSLQL SLV	IAIEPGA AL	MFDFSE KL	AAAPHL LLL	LYSTHAA L	YFLEHLA F	SGGKPL EV	NANNRL LL
FSPVGS VL	FAWGH DEL	EESNYEL E	FLDWP QGTF	SRASPV RLL	VADPIIY VL	VMDVN TAL	TAAFWT RLY	NYLVVA AM	SFTNQIIL	HNGEPL YI	YWQNH PEL
HAFIQPE I	FVVTGP AL	IYDEVT WL	FLEDHG LLV	FRSPLA RQL	FVDPAQ ITM	TSDFNT FL	VAINHIV DF	VFLLGHS M	FYSVNV DY	LTGKPV MV	LSAPARL Y
FASLQPS L	HSHVAL AL	IFDLSEVL	FQDFNP SKF	TTFPRP VTV	FALPYVI VL	MVDLN DYL	FTVPHT HVF	SFLVNH DF	FFKDGLE M	RAAVPR FV	ISTLKTEF
IAHLLTS L	LAGPPLE I	QFDVVIR L	FQDPVP LTV	YAFVRP VIL	FAILIHD VL	SVDKVL EL	LASHYIH IV	NYYVRA VL	FYCPGSA L	VSGQVL EL	LSLLGHV Y
AAFLIPL L	LAEVGR VL	FFESFGD L	FQEEVV AVL	SRPDFLS YL	VIVEPLE QL	YLDDWT VL	VAYQHA FLY	VYNIHLA V	VFFVHE GY	YVSFPLE L	VALLQP FL
LAAELAE F	YFFVDP DL	FYCFPD NF	FQEGDII LV	IRFPDIL RV	FSDPIHP QL	VIDVGS EW	ISAPLVK TL	AYQVGA VL	YYFAVDT M	ITAPPM HV	FFQIRDD Y
LALILKA M	YLGKVLE L	FYEGVVE L	FSDAKF VEF	YAFPKSI TV	YSHFLQ FAL	FADAM EVI	FASGLIH RV	IYLNVES V	KYFIRDE F	YGSVPV LL	IAMQLP VL
FSHLLEIL	FSGRILG L	CYDALV HF	FSDTGN FGF	FHHTIG GSR	IADGLP VAV	SWDESL SL	IAYSRPV YF	AFNIAEA F	IFATVRE L	YNSHPL LV	VASIKTG F
LAVILPP L	FALNHP EL	FVDQFV EL	FSDTLKT YF	LRYPMA VGL	QADPTK LEL	PINGNG KQ	YAAPHF FHL	MYTVA MAY	HYQLGL AY	YRDDLK KL	AANLRE TF
FSKIRPQ L	SANIGPF L	IFDEINL M	FSEETP VVL	YRAPELF SV	AAADVL EAL	IADQITL L	IAMDLIL KM	YYFPVRE L	SYNIGRA W	ILSKPIEV	SASFREE Y
KAGPILE L	YGFVNH AL	VFDINAE V	FTDIGK VDF	FREPRLL VV	FADYNL LDL	FLDDITQ L	KLVDFVI HF	FFLVVDA Y	VFHAGT AL	YSGVP MTI	SARKIDA F
LAKLLSQ L	FAVAGQ EL	LFDVHTT L	FTEDHY VEF	FAYPAIR YL	NAILVD TPL	IIDESHF L	FAVYIHA LL	AFTNRIF F	TFMNRV EV	FNTGPL SV	AANIQPI F
FVLLLQV L	LAAIAM QL	AFDRYM AI	FVDDQ QTFF	RRFNYV VKL	VADHPF LFL	FADGVIL L	KAFPFHI IF	VYLNVM EL	HFLEHM VF	VVGYVL TV	FSSERID W
VALVLEE M	YSWLGE TL	VYDLPGI L	FVDDYT VRV	IRPNIILV L	TAISLFY EL	FADAITE L	LAYIHLIE F	CYNTAL RL	IFTYGLH M	RSGVIV RL	FATFKM QY
VAFIVGE M	FQHVGK AF	MFLEWS LF	FVDELRI TL	TRFSLAR QV	FAYDGK DYL	VSDDPQ VL	NAIEKVF KV	YFFAVST L	FFWPGI DL	TTSQPL NL	FAHWG QEL
VSFLLPT L	FFQVGS DL	SFDGIIA M	FVDGSA IQV	SAVDFIR TL	MSVQP TVSL	FADVSV KF	FASKLVL KA	CYNNQQ VF	FYGFQIA M	RTGPPR LL	FVGLRLE L
HILLRPT M	HAAEAL LL	YDPLVVK L	FVDIVK VLL	CRFQIV QVL	VAYLQA HAL	VADAGA FL	HAFPYIK TR	FFLEHEA L	LFVGHM DY	ISGFPV QV	ALPAPIE K

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YSTRLAVL	YVSFPLEL	IYDGFDGF	FVDLEPTVI	FLADIVQKL	YAYPGVLLI	YLDEGFLL	AAKDLISKL	NYLTRIHY	CYNNQQVF	MAGPRLEI	FSQIQPKL
YSWDQPGL	VAVTPFSL	FFDLPDFL	FVDLSGHNL	LSFPTTKTY	FAFDEIVAL	SNDVATLL	LSAPIHTQM	VYMTGKEL	VYLNVMEL	KSYLFQLL	AASVRPVL
LAMLLQET	VADLAHVL	RFDPFNFL	FVDPAQITM	TRPVIIQAL	AAIKAFIAV	NFDNSPVL	YAYEKPHVV	YYEVHKEL	IFIARSQM	TTGPPHLV	YGAATFTR
FSRVIPEY	VIGPPVVL	FNDTFVHV	FVDVQPSSL	SRPDLPLLV	FASLLTVAL	SSDVNLEL	IAFPKAEEL	YYFSVDNL	AYMNHIMV	QAGPVIKV	FSTTKPLF
FAFNIMEI	YVGPSLRM	LYDVSNIL	FVEETVYLL	SRYPDQWIV	YSDDIPHAL	VADYMRYL	CSSPMVVKF	LFTFRPAL	IFTTHATL	FASSPLRV	YFLEHLAF
LALEIRSL	IIAPSLGF	HFDLPWYL	FVEPFVILL	AAASLIRLV	IAAGIFNDL	FVDQFVEL	KQFPEVIKY	TFLNHPAL	FFLEALDF	KTLPVAFK	AAAERMIL
IALLLPQL	AAAWPLLL	LFESPVYL	GADFLVTEV	FRPPITQEI	FVHDLVLYL	VLDVSNSF	IAFHFRVYF	LYLLRLAL	VYQAVLSL	VSGKPLLI	VALVHPDL
IAYIMPGL	TAGRVLEL	AFDEIVAL	GADLPNLLF	TPLKIHPLV	VSDGVPLVL	FLDGQAVL	KAFFAKMVV	TYLTGDQF	FYFNTKYF	FSAVPLNL	GSFPWQAK
FSYILPIL	RAHIGPVL	FYDLCELF	GSDEPPVFL	TVYPMERLV	FMSLLEDTL	IVDPAREL	KAVHVIYTV	FYNITLAF	VFQPVAEL	IAGPVVEI	FAWGHDEL
FSYVSPEL	FTMVGKTF	VFDLPESL	HAMQFPAEL	IRSSYIRVL	AATTVLQEL	SLDFGGHL	KAFARPWSL	IYQVTGSL	FYQFVNNL	LTAEVLEL	SSGLRFVL
YAHYLLVL	IAAIAQEL	VFDALIYI	HTDLPVSVF	YRHDLINQL	HAASVFLTL	VSDPMNAL	KAYPFPLSH	FFLLGKTL	LYQTPLHL	LTGPVLEL	LFTFRPAL
YNFVFTSF	YSIVGQKL	DFDIPAEF	IADGGFTEL	FYVPLPRHL	KAAELEMEL	TADISSHF	FAFEHSEEY	HYNTGWVL	AYFTAAQL	GVGPELEV	FQNALLVR
FGVLLYEM	FAGQPLTI	QIDNARLA	IADGLPVAV	YTFGRIVIY	FSHYMEENL	LSDGVAVL	FIIPQIVKY	FYHPGQEY	QYMERLQL	YTAQPLFL	LDGSVDFK
LTGPVLEL	YINLGNVL	TFDPAALL	IADLAHLLL	LRAVIVRVL	LSIDLFHVL	LADAVTWL	RQFDHPHIV	IYLNGESL	YYFLGRML	ATGLFLYV	HSAERLAL
FAAFLTEL	FIYNDPTL	LFDVVVFL	IADLPSTQL	TFDDIVHSF	RAMYLPDTL	ALDKATVL	FVSPLVKYL	IYFLGNSL	VFNPAIQF	ASGWALAL	VSHLRLLP
LATVLQAV	FVNHALEL	IFDIATEL	IADLVTSVL	YRPLWALLI	SAMEVVPAL	TVDMNIAL	KATPLVLKA	FFLIGPPL	TYLNISQV	STGVLLEV	YFLQRHEL
YAIPQPDL	FTFPSHSL	HFSFCRTL	IADLVVAVF	RRSPFLQVF	SAPVGVTAL	NADIGLRL	LSYWKPFLV	IYEVVRPL	AYQVGAVL	SSFVFSTV	AAAYRVTL
ISIIIQEL	LAVFPSLL	FFEICDEL	IADRLNVEF	RRSSDIISL	YQYLLVTAL	IWDGSEVL	IAIGKVLKL	YFMVGTAF	VYEIGRQF	FAGQPLTI	FSCVKNEL
FAVLLTQL	YLYVGPSL	YFDENPYF	IADVGLVGF	YRFDAIRTF	RAIEIYTDM	ISDVHFSV	FSFDYIVKW	FYLSGTYY	YYINSPEL	VVGPVLDV	VAAVKWVM
YTLNLHEL	YILTSKEL	TYDISQLF	IAEDPKVFL	FRVDYILSV	SAVDLPVTL	RADEHIAL	RAFEYEIRF	IYNTAGFY	NYLFGCEL	GTSGPLLL	VASFPRTV
YAAEIAIG	ASYVSPVL	FFVPHGYL	IAEGVNSLL	MRPDIVALL	VATDFFTVL	FADATVEL	YAHFPINVV	FFVPHGYL	YFIDKLAL	MSGKPLRM	ISLEGKPL
AASVRPVL	LAFPGETL	RFDNFSSL	IEVEIASLA	HRPEFESFF	FAADLAEEL	FADNVSGL	KLASYVKFY	VFLLGVVY	FYNPVQEF	VSGPDIDI	FSWIRNTL
YAQVFREH	FVAPPLVM	KFDPFLDL	IGDPNLEFV	NRLQWVQLV	FAAWFEEAV	FIDGPLAL	KSVDWLLVF	VYLVIRAL	IYFNHMNL	FNEKSKEL	NSSQRVEL
LAFLLAEL	YVGPAKVI	LYTLCYFM	IIDDPNLVV	YRYKMPRLI	FAMPYFIQV	IADKIEFI	KAFFRWLYV	LFNLGSAY	IYQWINEL	TTSLPVVV	LSTIRSFL
SAMLLAQL	FQNALLVR	VFDLAQAL	IIDEFIYQF	FYFGKLREI	YAIGVSHPL	STDENLIL	VAATLLKQL	AFFTGQIF	QFHTGIEI	ITPATALL	LSYSRISL
LTYVHNEL	FVNVQKEL	SFDMAQVF	IIDEQPLIF	HRSPLVLAY	FVFPGELLL	ALDTGFSL	TAADIFKQY	IYFIHGLF	AFFTSKAL	VSTMILEV	VALEHFVL
FVQRLKEL	YIFPGVAL	NFDVEVLL	IIEADEVLL	LRRPAVVYI	FVYEDMEAL	MMDPNHFL	IAFSRPVKY	HYNNIMAL	YYHRGAFF	LSGMILTL	ASHLGLAR
LAHHLVAL	FAWKPQLL	FFDDIGYL	ILDNPVVQL	LRFGNPLLV	TADSYLLQL	FFDSSVEL	FSNGHIKVL	FYFEGTFY	LFQNIRPL	ESKIYLLV	KANMLRTF
LSRLFRVF	LLWPGAAL	FFDIASQI	ILDPHVVLL	NALGHVRYV	SASDWYDAL	IADVSVQM	SAAFAVKLF	IYNIGTNF	LYQTPLEL	QQSKILKV	NFNTRFVM
FSFVMPSL	FAVTGYDL	SFDDIIVF	ILDTGTPVI	SRSPVVITI	ITDPTRIIL	LEQKKEPW	AAMPRPVSY	IYPLVGTM	SYVVGHVL	ATNHRVLLF	VSLVQLTL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YAHSLV EL	FLAPSLV L	VFDNCQ TF	ISDEGIA YL	FASTILH LV	SAAMV FSAL	SLDEVVL L	KAVDIV KQV	LYQTVT GL	SYKVAV AL	YSFHKF HYL	FAVIKEA F
LAFVLQ HL	MIHLGHI L	AFDIAEE L	ISDLVKV TL	RLPDLIK EV	FADHVV PLL	NADLSIT L	SAFDHF ASV	YFNEGT VL	SFQKVLE L	KSVESFL KV	DDNPNL PR
LVYQFK EM	LIYQGRV L	RFDTAFF L	ISDLWK VTF	YRYLNT QFI	YAFSGV EEL	ITDPAA ML	AAFDQ WREW	AFMEGI AL	AFITNIPF	YIHVHFL EV	IQSIRM GM
YASFLEV L	SAYVAL AL	FFDIAHY L	ISDSVLV DI	SRFAKV HIL	IAAGLYL LL	KSDIYLN L	KQFHRI VTY	ATQVGIE W	RYNLQS AL	FSFKKPF KL	FSSLHTV F
YAAELA GL	FAIDPHL L	FFDHSG TL	ITDFSGI VL	IRTGLVR LL	SIWDGS EVL	ESVGYLE I	KAISGV HTV	LYNIGLT Y	FYHPGQ EY	FSFKKSF KL	RAFVSM VY
FSIVMN EL	AAAVGL EL	ITDLPIKL	ITDLPSE VL	YRFGDS QQL	SAIHILD VL	FIDEQQI L	KSIARVL TV	QYYVGQ SF	IYEVVRP L	KAIDYIK YL	SRIEVLK R
LATILAQ L	YALHWL VL	NYDYAV YL	ITDPEV VFV	FKYDGEI RV	FADELS HLL	MVDVG SLL	KSIHIVV TM	FFFYGKS L	LYLIARV M	KNLLHA EFL	ASRVIRE L
FTVLIHE L	ITFVNKH L	VTDDLV CL	ITDPSVI VM	YQFTGI KKY	FAGYSE EVL	FAFTLV HF	TAADVV KQW	FYYFVSA L	NYLVVA AM	KAVDIV KQV	RARFAL GL
FAWLYQ EY	SAAAAIV L	CFDGHL EI	ITDVQL AIF	CRYNLPI IL	IAAMPLI SL	VVDGGL QL	FAYTRL QLL	VFLAGIA L	MYFVIA AM	GSNVKI VKV	VAMVH PLL
FAYTRL QL	TAAPDL KL	YENEVAL R	IVDEAIY YF	FRTPHV LVL	VAVPLY DTL	AVDEPQ ML	FSFHHV LSL	FYFRGY GL	QFRNAP PF	KAIDYYL KA	IAHLRQI L
IAMQLP VL	FFWPGI DL	AYDVLIK M	IVDEVN GLI	NRFPW PKVL	YVVDDA AVL	VNDLTT AL	YAFNMK ATV	YYQFINE L	TFLNHP AL	KTYDYLF KL	LAKVGIA L
FALEHLE M	VSQVGK EL	VVDNPIY L	IVDGAV VKF	QRNEVV VEL	GAVDPL LAL	FADDM QEF	FSMYKPI TY	NFIQARS L	FWYFVS QL	KSFEKL MKI	KAFIHHE L
FGVTLH EL	YSLDM WRL	HYEVAEL L	IVDIPGT SV	FRYEGE WKA	AAAGVF ALL	LSIAYCL M	YAFPKA VSV	LYNIGNV Y	NYHFGV TY	ASMIHP KEV	FASPGRL F
LAFLVHE L	LVGPGV EL	VFDNLIQ L	IVDRPV TLV	FRYHGL SSL	SADPGIL VL	FSDISEK L	CAYDRIV VA	SFNVALS L	SFNVALS L	KNLEVF MHV	SASYKPV F
ISTLPESL	FTYEAVE L	LFDDVG TF	IWDETP LYF	VRPNLP QLL	VAGPAL EAL	DADLAG PL	ISVERVI EY	LFFVGN QL	CFLTALE L	ATYVFL HTV	ATRWAK KI
STYKFFE V	TASEPLT L	YFDLPA GL	KIEDYFP EF	VYDVVE LKF	SAIAVFL VL	LSQVYD LL	IGVEHV VVY	FYLTNSE Y	FFEVRRV V	KTSVVF HQL	VFHPRQ EL
FGILLTEI	AAGPSF RL	QWYND ELL	KQDLVE LYL	SYPDFL RMM	VAADIA VQL	FLDSMA TL	LSFTHPI SF	LYNIAF MY	VFRVGL AL	RSHYFE VEI	VITFPRA Y
LSTLLSSL	AAFPGA SL	FFEAAS MM	LADAIN TEF	FRYTLPV FL	GAVPIFI EL	YAETPL QL	VAFNWI IVH	YYQLSEE L	NFAYRLE L	HSTIHLL KL	YTLLGHE F
TSWIHP VM	LALPGLA L	FDPALLE F	LADEVIT VF	IRPEYA WIV	AAHLLN DAL	IADFFTE L	LSFPHLL QT	SFYNGLS F	NFFEGKE L	KSIFVFT HV	FAHIQA VF
YAAQLP AL	FTTDAIA L	YFDPLIN P	LADGSI AVL	TRHWVI RSL	VSDEM VVEL	SSDPNF ML	FGVDRA ILY	VYEIGRQ F	FYNITLA F	YASSKLL KI	FFFSRLE Y
FASVFEK Y	FAGMPI TL	VFDVGG LL	LADIIAT GF	TRIPKV QKL	TADDFL VFL	FVDTVV AL	AAKEQ WKEL	VYNAVL EL	NYLHAT AF	ASTARH LYL	KALDGF VM
LIYLHAV L	VIIKPSEL	QFDYGV YL	LADIVA TGF	QRFPRIL VL	GGWDV VRAV	VADLTL NL	AAYYHP SYL	LFQNGS VL	VYIFATC L	STLHLVL RL	NSAVLP EM
FGVLLM EV	FAGLVQ EI	IFDESFEF	LADLHP DVF	FRFNHP VEV	SADITFA TL	FVDSVG VM	HAYIHS VQF	IYMESLA L	FFLPKGA Y	FAYKNV KFV	AASLRQ EL
IAELLTEL	MTYVGA VF	VFDILAV L	LADLQL EYL	YRIPLNP YL	VVPEPG QPL	AGDVS MFL	LSVEIVH EL	YFFPRAD L	RYQVSW SL	KSMESF LKV	EQLTPLI K
VALVLFE L	IVVEGHE L	FIDDLAD L	LADPGII TI	VRPVFLI SI	YASDVQ LIL	ISDSNPF L	LAAYHP WVV	YYASFLE V	VFSVTIH M	LDELRD EGK	VVLVAV DK
VALVLKE M	MALLGH SL	FMDVSN PF	LAEAGV AVF	IRADLT HLL	FLYGGE LVL	FTDGSV TL	AAFEKA LEV	AFLTGV GL	WYNTAL EM	KNINKP LDI	QINDYV EK
SVFEFLA F	FSQEYES I	SFDAAV AL	LAEIGA VTL	TSPLRIV AL	YLIEPDV EL	FADFER HFL	CSSPIVV KF	NFSIHM AL	IFYLGEA L	KSLNIST KV	FAAEAIA M
VAVPHI PL	GALLPLQ L	TFDEVLE L	LAEVDV ISL	QAYPEV RIV	NAINITS AL	LIDLHN HDL	TASPVIK AV	IYVTVSS M	FFLVVDA Y	HNVNR VVYI	NATIRN VL
MTILLSE V	AALPVQ SL	FYDPTH AW	LGDPGF VVF	HFDIVIR NL	SASALA VAL	ISDLVKV TL	YTFGRIV IY	FYIESISY	LYLLRLA L	KVVEIVK KL	FTAFKEE Y
YSVVIPS L	NAYTGIV L	VVDIAGL V	LIDLPGT EL	IYDKFIA QL	FALPAY HTL	SADGM RLAL	FSNDIPH VV	FYVNGL TL	SFMTHP EF	KILTKLL EV	FATLQN EL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YVANLTEL	FAAETLVL	VYSFSNDI	LLDVPTAAV	LTFPHPVYY	NAIGPLVAL	SADDLLKTL	IAIPFLIKL	AYQLGSVY	IYHISLEY	RIYKYIHKV	ISVKGRIY
AGGKILTF	FTHASPTL	VRNCSSFL	LQDDIPTTF	AGYPHIRYI	SVDDTIVAL	IADPNIAKL	LAYQKQWEV	FFFAGYYL	VFTTRNLL	SVISHLLRV	YFVTREVM
WAAELSEL	YSAPGRDL	SWDVCSQL	LSDLALHFL	YAFPRVRII	VATGVISTL	VADQIVTKL	YAAVKIHQL	VFSIGPVF	SFLNHRSF	HSTDRVVLI	TFMNRVEV
FALAHAAF	ISLGKSWL	YFGEIALL	LSDLTGSLL	VYIDRVRSL	SASAVQLIL	AADGPQKLL	YGIDTIRLY	VFSLSSEF	YYFSVDNL	VSEIRILLV	LQAQRLVM
YFQLHRAL	IAVNPSIL	FFDSSVEL	LSDPIVNTL	YRYMNPAIV	IADEGTWTL	LSDLALHFL	YARQLEMIV	NFLTEVLL	TYLIVTSL	ASFHRVQAL	TFTNHMVF
IAWPLSTL	FNHINVEL	YYDGMIQL	LTDPAIVKV	NRPNLYYEV	YVDDGLISL	ISDLAQHYL	FATPFLVVR	FFLESIAM	RYMIGVTY	KSWVFGVHF	FALVSQAY
VFRVGISF	FANKQLEL	LFDSLSTL	MADTFLEHM	QRFPNALFV	LSDETLLEI	FVDELRITL	FAVNKKIEF	INPSELTF	RFQVAVNL	YSSNHKLVF	VQSIRPPY
FIIILNHM	MVGPILEM	SLDEVVLL	MLDPLEVHL	YRPLFDYFL	FAVSDGLEL	LSDELRISL	KTFPYQHRY	VYMLAASL	AFLVGPQF	ISNLIVLHL	ELGFRPEY
FAFVLLDT	HAGVISVL	FDGKLVTV	MPDSAAALL	FRTPFPLAF	VASEIMAVL	FSDPNFLAH	FAYLRDLLI	IYMIGVSL	IYAAFKEV	KAMELIREL	MTALREEL
RAQLLHAL	IVFSGSSL	AFNAAFNF	MTDPIRILV	YQYPRPLLI	IADGGFTEL	LSDISKIDL	LAAEFLKQV	FYNAGLAY	RYMFSRPF	KSYPLVHVV	VSMLKQDY
YSAPLPAL	FSYDGNVL	FLFNDFLL	MVDPFHTLF	TYTQLVRLI	LVDLYLMKA	KQDFSPEVL	KTVTHVVVV	AFGTGVEF	KYNLGLDL	ISNVLKLYL	YVTILPEL
IVGKDLEF	SAAPAIYL	LYDKYDFL	NADAIVVKL	FRHNTVIFI	SAIFPDVAL	LADHTVHVL	NTKEPPLSL	VFTNAEVY	VYQAVRQF	RVMEHFIKL	FSASHRLY
LAFVIPAL	FVGYGVTL	VFDDMINL	NADPILISL	SRSLVLNRL	FAQEALTVL	FADGHVLEL	ITFPGLHEL	VFLGGAVL	GYFIGRIY	ATIDKVVKI	FAQPAFML
YAVLLEAL	NSFVSLSV	SFDVGCNL	NADTLALVF	TAYPSLRLI	KAYGIRFDVM	ASDFPHISA	WSYPYEHSY	KEPAALQY	RFQSSAVM	HNLSKIMKL	ISQIQPEV
GLGPALEF	YLNLGPAL	YFVEAGAM	NADVALVNF	SAFPFPVTV	FAYDGKDYIA	FLDDVVHSL	TAYIHQVTV	VYMAGLVF	SYNISEVM	LSIRHLMEL	ASLRKVSM
VAVLLEEL	YAFEGSYL	QFDSVVHL	NGDFLPTRL	RRALLLLL	YVPDQPHPEI	TADEVHYFL	FAYYRDLVF	VYTLTSLY	YFNEGTVL	KVFLHEATV	VAGLQPVL
FAAEAIAM	YSEKPLTL	VYDVTLNF	NIDEGPLAF	YAYLYIRML	FEELNADLFR	FLDENVHFF	SAYLHPQQF	FYIVGLIL	VYFVAMVY	STNIHELRV	ASNTRLQL
FSYAGFEM	LAGIGEVL	SYDYGKSF	NIDFMPTIL	NYRWWPAEV	YAVEGRDLTL	FSEEHPVLL	TAYTRQQVL	AYVHMVTHF	FYTVAHLL	KTYPAHAFL	AANVRELM
FGVTLYEL	LSFTSQEL	TYDLFLNL	NIDVVGVSF	FLYPFPLAL	YADPTKRLEL	AADLSLHSF	SAIDRIFTL	YFHDRFLEL	RYLTVAAV	KTIKLWNTL	TSQLIPEM
IALKISQI	LSVLLSSL	SFDIAGLL	NLDKLWTLV	FRFIEVQTL	YAVELVNDSL	VADHPGIDF	KAFAQLFIL	YFHDRVASF	YFKGAIPL	QSYWNHREL	FSSVGEEF
YAKQYEEF	ESKRVLFL	TFDEFQEL	NSDPYSVAL	FVSPLVKYL	FLPEEAWCDL	VSDLQHVTL	SAADVVVVH	FYGDLRKAL	TYLTGDQF	ASFDKSIKL	YAGTPRFF
FAISTGSL	ISYPGAML	FFHMQREL	NVDGHLYEL	LRSPSVLEV	YASFIEDNEL	YSDFVVHEI	SALDMTRYW	VYIEHRLMM	VFNAVTSF	FSSPHLVQV	YIATPRVW
YGVVLYEL	EAKGLVTL	VFDEADRI	NVDPDNVVL	VRPGILVLI	IAYYVSNEEL	HLDEAIHVL	ITFPGIKLI	KFYYSKIEY	RYFISHVL	KINEWLTLV	FAVTGYDL
FSATLPKL	TGWTGIAL	QFDGGVVL	NVDPDSVVL	YFVPLVKRL	AAINPELLQL	VADRLGLEL	IAYFHPQKL	YYSPHGHIL	VFHPRQEL	KSLFLGQKL	VAGFNPAL
SAAWLREM	ISYASLTL	FFDQIDEL	NVDSLITRL	HRSTIITLY	FAYPNRPDVL	FLDEKTHEL	AAYLRALSL	KFKEVGEAF	NTFVGTPF	LSYWKPFLV	YGLEHLAY
CAWLVSEL	TAIVGMAL	HAPSIVFI	QLDPLVVEL	KTKGFEVYL	LTVSREHERV	AGDTTNFHF	HAASVFLTL	RFPEHVREI	TYFAHDAL	KTSFRIIFL	SAMLQPLL
YVFNLAEL	FAGALLEL	IFDNFSNL	RGDSVIVVL	QSPDFVRTV	LAVHPSGVAL	SADEVQRFF	IAAPFTSKL	KFIDTTSKF	FFESFGDL	MTDPIRILV	DLGEENFK
YGIVLYEL	ETGPAILL	LFEKLESL	RTDPVPVTI	FRSFVVSKF	YGYGGDFVAL	HVDEIKEFL	KAMELIREL	VYMNRVKEI	AYTVTIKY	HQTPLHLAV	FGNLRPVL
LSNVLAAM	YYINSPEL	FYDVVDCL	SADELVTRI	HLPDFVKQL	FAYDGKDYIAL	FGDLHQTEL	YAFPKSITV	YFHEFGHVM	YFNESIVV	KSIARVLTV	FAKVHILY
FSIFLQEM	RSHLGRYL	FVDVLENM	SADEVMRFF	TRYPTILQL	FAYDGKDYLTL	FTEWLHEVL	HAAHIISEL	RFPDFVRDF	FYAFGRVF	RLFEVPHEL	FSPVGSVL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
MASLLPQL	FAAVAIVL	NFDRFSEM	SADEVQRFF	YRNIEPVYL	IAITSGEWEVL	FLDRPQQWL	KASPLTFTV	RYPDSILEH	LYIVHPTM	VSHPRYLEL	MAAYQLEL
LSYIFPTY	LAFTGISL	YADGESFL	SADFPALVV	HYIDRVRAL	TAFTPAPEDSL	ISDTQRISL	YAFAHILTV	HYITPMMEL	GFKVGINY	KMNEKLYTV	AQSFRPAM
MTYVGAVF	LAVVGSVL	NHFSCEIL	SADFSPAFL	FQYPDTRYL	AAENPGKYNIL	VSDVVKVDL	AAFTRALEY	KFIDKQLEL	HYFLHISL	IINEVVLKL	FASLQPSL
TALILSPL	FSVTGTSL	LFDVTGQV	SADKFQVLL	SRSVIIREL	YAYDGKDYIAL	RLDWPVRTL	VALDKVIEI	VFQYRLVEY	SYLISIKY	IINKHYMEV	LAGPALEL
FAASLLAM	VSIVGMAL	AYDNFVEL	SADLIIQEF	NRYIHILMI	NVKFPDEDEIL	KQDLVELYL	FANERCLQL	HFQEKVESL	AFSFQNSL	KNKWFFQKL	YAIIKFPL
LATSLAEL	VSISSPVL	TIDGVVFV	SADPNVVDL	RRPDLLTMV	YAVTPLLEDAL	YAEVGRVLL	SAKTPGFSV	TYGERVVAF	PYQNGFTF	RSLVIVKKL	AAAVRITL
LSFLLEAL	IAPGTELL	FFDLHILV	SAEEMVTLL	FRFDGVTSM	RAIEALHGHEL	YADQLKEYL	MAYLKIQKY	FYQGHVEGY	RYMTVLFY	YSLQHKLLL	ISMEVPVM
MVGPILEM	LSWPGLGL	YFNAPVYL	SAEEVIVKL	NRNETIQWL	FAIDPHLLLSV	ISDLGQHTL	KAVEIYASV	VYWVARKPM	VYMTGKEL	HSRFIFNYV	TAAFPRML
YAVQLVEM	LAWTSSAL	YGNGFGGF	SIDFKPSEI	ARYPNGVVV	FAYDPSNYEYL	IADLVSKEL	LAFLRFVVY	IYQSKVREL	HYTIGKEI	FASHVSPEV	EAVEHLQK
FAGALLEL	MAYNAPSL	GYDAVVLL	SIDFPLTKV	FRNEFQNLL	YAFLSPSPDYL	AADIENRVL	HAVHVALVL	SFHHNVAAL	IYMESLAL	ATHGRFLEI	FFKDRHWL
FSGPAITL	VATTALEL	AFDGHARE	SIDPVPTSI	LRASTIRKV	ADREDDPNFFK	SADERILVI	KSFEKLMKI	KFLAAGTHL	SYFTGLEC	HSLDHLLKL	FTATQPEV
YIAHLRQI	LAVIDWEA	VFDESLNF	SIDRNPPQL	NLYPFVKTV	YAVDAYFREAL	AADFEIGHF	LLKNPFLSV	WYQRVYQSL	SYWNHREL	ISDYAVKIV	FCSLPRKY
FAVTLETV	SAIISISL	FFEDYGLF	SLDIPATYL	RRFPEQVRV	HAISPSAADVL	LSDLRVIDL	TIKHWITII	AFQERLNSY	FYVPVSEM	KTVSFHLYI	LAAVRLWL
YAGQLAEL	FADFERHFL	SYDVFSLL	SMDPLPVFL	FAPYNKPSL	FALIPTALDAL	LVDDHFVEL	TTFPRPVTV	LFMPRSTEF	FYVNGLTL	SSAVRALEL	FAYLGRLA
FSVSLGEL	FAALHGPAL	VMSVGFLL	SSDGAISLL	NAPLVHATL	FAEDITTGQVL	YAEEFRTYL	ALLNFVVKY	RYQEFVRAL	FYIESISY	KSQVPHIVV	IAQVLAEL
FALLLPVY	HASDRIIAL	VNDDFVLL	SSDLPVALL	NRFPAVNSL	EADRTLIYITL	VSDFETKSL	RAYAKDVKF	YFLTTRQTL	NYMMGIEF	HGNWIRLYL	TFLNHPAL
LAMFLGEL	FGWSHLEAL	FFDGAAVL	SSDPKVLTL	RRYNFPVEV	YTFEPRTPDEL	IIDDVMKEL	SAVPKVMKV	FYNLIHPEY	TYTTRIHL	RISDVHFSV	IALEHPML
FTIIVAEL	YAFVRPVIL	LYDVVSVL	SVDGSPLLL	TYINHVVSV	FADEGSIFYTL	SADKFQVLL	TAFSRLILI	HFIEKAHTL	FYQVGILY	VTNSKVKFV	YSYVTEEL
IAGPVVEI	YLLDHFLSM	LFNVTSTL	SVDLPACFF	ARAWALFWL	VSVNPYQELPL	KADVEEEFL	EAVDWLHEL	NFLLHVTAL	VYFIVREV	KSFAHILEL	CCTLKIEY
MALVLEAL	FASHVSPEV	RFLGLASF	SVDPLPAGL	FRSAEPNAL	AALPDASPGNL	IADRLGLEL	SAVGHVFSL	HYPDFHQEL	TFQTALFL	KSSQLVTHL	VATEQPEL
AAFTLPAL	LAYLQRIAL	FYDVVLDF	SVDPSIVNI	NRIDISQLV	FILDPNQENVL	LADLIEKEL	IAYDNIKVV	VYIDKVRSL	IFQPVAEL	AAYYHPSYL	FQVDNNNR
LGILALVL	YAKRPGIGL	IFNKDYIF	SVDWPESSL	ARAERVLEL	YSDPGLAGVSL	KQWLMTEAL	LAIDAIHQL	RFYAFGRVF	KYLTSLNY	LTNPRTLKI	YAGLQPYL
VATELGIL	VTVRPGLAM	VWLTHEEM	TADAFIVRF	NVEIDPEIQ	YIWDPHNGDIL	AMDLVKNHL	AAAALVLKA	YYTVRQLEL	AFLNNQEY	KVVEHGLFV	LASFIPAV
AAAQLPSL	SAVSHFFSL	SFDVSQKF	TADDFLVFL	LRPEIAVYV	KRYIQLPVTHL	HVDLQVSAL	YQFTGIKKY	YYITTRVQF	RFAFRASL	LANPHELSL	FAMVKGYF
QHRMKEFL	YAVHEGLGL	YQAELSQM	TADEVHYFL	RTTDIVIRI	PASSPLLPVSL	LSDYGPPSL	RSFPSVREL	SLHTLFGDK	NFANFAHF	LSHAGILKV	NFAYRLEL
GAYLLMEL	FAVYIHALL	IYDMSTVM	TADIPALFL	YRATMILTV	TYDLMANLAFI	FTDVNKIYL	KATAYILSV	YFISYGIEH	FFVPHGYL	RTDVNIRVI	KHTMIRLF
ISELQPSL	LANLHITAL	LELVKPCS	TADISDVWL	SRADLIKQY	QVDGFCLPWEI	FADQVEEIL	LSFPTTKTY	RWPDYVREL	YYKPGLLM	YSLKHIQEL	AANVIPVL
AFAEALLL	FVMETFVHL	EADFPVYF	TADPLDYRL	YRPLFENFV	GARESAVWNVL	HIDTVINAL	VAFPSPAEL	KYIEGVSDF	YYTVAHAI	KTFDAPPAL	QLEQVIAK
LSTIALAL	LADVKVHIL	LELVRVCG	TADWRLYLF	LRSGVIVRL	FALLWSLGSAL	SADELVTRI	IAYPHLRIR	SFVWHALDY	AFMEGIAL	KTLPVAFKV	YAFSKLTY
FAGSFLEY	FAATHSLEF	VFDTSLQV	TIDPTEFKF	SRRFFPYYV		SSDPKVLTL	LQGPLRDVF	AFKEVGIEF	VFGKGVAY	FSNDIPHVV	AAAWPLLL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
VMSVGFLL	LAAVAHSPL	SFTFRNHV	TIEDAIAVL	QRSRFIVVV		FQDKRNLYL	AMYPHIFYF	YYYDKNIIH	SFYNGLSF	KLYEKFLEF	FAASGLEF
FGFDLPAV	YAFPLAHSL	HFDVTVKM	TIEDGIFEV	GRYPEAQSV		SADTFTRNL	TAQTLVRIL	NYIDKVRFL	IYVNYPTF	AAEFHARFV	FATILVEY
VAFLGNML	AAYLRALSL	IYDNPNLI	TQDLPGVKL	QRSYLVQYM		TADGAHFEL	VAANRVIIF	YFLNRKLVY	VFSIGPVF	HSVPLQLEL	SAQEIPVV
WAITADIL	YAFPKAVSV	VYDISYLL	TSDALAVTF	SRFQGTLYL		FLDEPTNHL	KAAVMVHQL	VFLPRVTEL	VYLTGYNF	RVVEKFLKI	FAFVEFEL
FGIVLYEL	FAILRQAEL	DFSRYDFF	TSDNPVVQL	GRPEFVIKV		VSDPNLIHV	KVIELVKKY	MYIARQLSF	SYGLNIEM	KIDDTIRYL	FAVALPQL
MAFTFAAF	YAQIRTIAI	FDHDRDYE	TSDPALLSF	IASTILRLI		MADTFLEHM	AAFIWPMLI	FYRPLAPEL	RYLVVLYY	HSTVHLIEF	YSSIRGFL
FAQIALQL	SAFDHFASV	YYMCLNLL	TSDPLELFL	SRFSRVVLV		YIDDVFHAL	AGYQHIRMY	FYILTSKEL	AFFEGHFL	YAMRYFATV	FAALQLEY
FGYVLPII	LSKGPGLEV	TFHQDNNF	VADEIRFSL	ARFERE QLL		KVDPSGVSL	KAFAEQIFY	VFYELAHQL	AYQIAEQF	ITQERIVFL	FFFSHVGW
FAGQMAAL	FSFVRITAL	AYDAAQFL	VADFGSATF	FRSNGVQLL		KGDEVTITL	VSGDFVKVY	RFIPYTEEF	IFHNHLDY	HSLQHLLYV	KANITFEY
ATGYTLEF	IAYIRDLAL	TYDVSSIL	VADFQRYIL	FRMPVLREY		GADERIFSL	MTYERILYI	SFFPKVLEM	LFLVGLEF	SSFQKVLEL	QEAFDISK
LALAGPQL	LANPHELSL	DYFAFRNF	VADFSATYL	FRYFSKQEL		TQDELKEVF	SSYDKPITF	RFPQHYKSL	YFSPFRPY	LSDLALHFL	SAIVGFIY
FGTTLWEI	FADGHVLEL	NYGPQITV	VADGLFSKF	IRSSHIKYI		KADLGKIVL	SIPEFFHIM	IFYDRAEYL	AYVSGLSF	HSQQHVLVM	SFFTRSFF
FSQSSLAL	YGIEHALAL	VFDVMNLL	VADHPFLFL	RRFPLEQRL		HSDWVNITF	FVYLRQPYY	IYQYMEEIY	RFWNSIVM	QSIEWPLKF	VSQVGKEL
FSLAHPLL	YAFPKSITV	AYEGSNFL	VADIAVELL	NRIDEPILL		FTDYDVIHL	FSQDHLVIY	KYNIMLVRL	YYQFINEL	KTEETLRFL	VVTFPRAY
KAIYHLEAF	ISEENFRVM	VDTYDTIF	VADLIGLNL	FRSLFVHKV		IGDLVKSTL	FSSPHLQML	FYVPFAKAL	LYNIAFMY	KSYSKAFTL	RVTERFVM
FALHKTLEF	FGFSHLEAL	NFDDKVML	VADLQLIDF	SYIAHLRQI		VADDQKLMI	SAFTNRIFF	SYNDYVREF	NFKAFASL	QSINKKLEL	VFKERIGY
FTVPHTHVF	FSYAFPKAV	YYDVAKIL	VADLVVNIL	YRPHTITLL		TWDERFSAL	KSYSKAFTL	TFGERVVAF	SYTIQSEL	RSHYFEGVL	TASLPREL
HLRDYFEEY	TAISRYMEL	VFDVEVCL	VADPIIYVL	YRAQQIIQL		FSDTKIISL	RAIELFHSY	VYLERLLTY	IFVNGHFL	ISNFHVLLL	FSSTKEEF
FAYLGRLAH	FAHLRLEVL	YYVGFAYL	VADPILYCF	FAYPAPLEV		KSDLLKAAL	AAAHFYFEL	LFHTIGVEF	VYMIRVYL	KQIDQFLVV	YAQFLREM
LAYLQRIAL	VGDPSVHLL	SFTFSKFL	VADPVEAVL	HRASVFYRV		FGDLTIKSL	FICDHPQIM	TFINNVISH	IFFNSHNV	VGNRHGLLV	FFENHPYF
YLLDHFLSM	LAFSRALEL	EVDMPVFF	VADPYVVIM	QRYPMPQNL		FSDDSDLQL	LSVDLIKTY	IYIINVHSM	AYLNVVGM	HQIFHVLVV	NVVFVIDK
IAVYHLQEL	WAYPRQVFI	LFVYEQKL	VADQIVTKL	FRGPTVSNI		HLDEVFLEL	SQYPFPVTL	WFHYTLVAF	YYINHPLY	KSIGSPVKV	FSATPRYM
HSRLFDQAF	IAFPKAEEL	NFDNPVYL	VADRLMLEL	KATNVVRLL		LTDGHPLTL	YGYYRTVIF	FFYPGWKVL	LFHIGVAF	GSTEKVLRV	FTTLKPEL
FAFEHSEEY	FSNGHIKVL	TDDYFIFS	VADTFQDYF	VFDWIEANL		VADEISFRL	AAFHEEFVV	AYTPFHAVL	SFFMARVF	KNTIYPLTV	LAAEPRLL
YLRPPNTSL	FAMDVYKNL	FFDSTAIL	VAELTVTDL	HRAQLQIRI		SSDIQVKEL	KAAGFISVL	AFQVLVKSL	NFSIHMAL	KSYYHVYKL	SASVLPEL
FSEPHARFY	HAASVFLTL	GTTDFFLL	VAETPDIKL	ILDPHVVLL		KADPSHFEL	FASEYPLIL	FYLFHPLAY	IFNYGRIY	RVGDHMMFV	QLANGVDR
FASHVSPEV	LANDTFRTL	KQSFPGIL	VGDTQVVVF	IRAEVFNAL		LVEPPPMSL	HSINITRVY	FYQDKLKSL	LFQNGSVL	VSAAFAVKL	AASALPAL
LAIEHVRFF	FVNPVQVVL	AFDKHMNL	VIDPVPAAV	NRYDGIYKV		KADVVPVTL	KNFDMVIVY	IFPECPHVY	VFMRNSVL	KNVDKVLEV	FASNLPTL
FAYRGFKYL	MAYDRYVAV	YFDEHYEY	VIDTPVFEL	LRHPAIRVL		ILDEPTNHL	SAYAQIVQF	YYNLQGISH	IYSFSESL	KSIPVTQEL	IMMNTPVI
LALDHLHSL	ATVHPGLEL	KVDQEVKL	VIDVAPELL	CSRYLYTLV		LADGLKVVL	AAFCKLIVY	VFPEFAAAH	LFNVTSTL	AALMRPLVV	LSMEILEV

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
LAYIHLIE F	FAHTNV ESL	HFDLHE EM	VLDEVV TVL	FRSVFPL SV		SADMS HVAL	FAYPSEL KA	YFLSRAQ SL	RYQEAL HL	RQHEIV LKV	VFFVHE GY
FAATHS LEF	FGIDRPA EL	IFDVHTK I	VLDVVE RSL	CRFSAP LFL		VADPYV VIM	YALNRIT VW	FLYPFPL AL	AFLLAIA Y	ASILKQL AV	AASLLPV L
FAHLRLE VL	FSNPRAL YL	LFDHVG CL	VQDFLR VLF	KLPAFV RVV		LADMH STEI	LAFSRAL EL	YFHTMV ESL	AYSVGW EM	KSIHIVV TM	FAAVIQ AL
VTVRPG LAM	AAVPRA AFL	FFSEYEK L	VQDLIE GHL	KTPDFIL QV		VIDFTG HAL	LAVNLT RVL	SYYAYVV EL	QYYVGQ SF	KVSERYL TM	TAGLRPI L
YAAPHF FHL	FAYSSRI AI	SLDSPVL L	VSDGVP LVL	VKPNFP FLL		VADTGL QIL	YTTDRV MTV	YYLTHGL YL	HYWVGL DI	KSFWGP LEL	CAQVLP YL
YAFKFFD TY	LSDPQV HTV	NYDRFH YL	VSDHFP VEF	YRPGSV AYV		YADHPFI FL	FVRDMI REV	YFPKKIS EL	YYYYHR QY	KVLDFE HFL	AASLRLT L
FADPHG KVF	LAMLRS LDL	LSDHHIY L	VSDLQH VTL	HRHWH VVQI		LSDDHV LIL	GAYEQV IKY	VFHVSN LEF	TYNGSFY F	AAIWFR TYL	FTSEPRLI
FVKGQF HEF	SAIDRIFT L	IYDVSHN I	VSDPVT VHF	KRCDIIL VM		AADAEP LEI	MAFPKP FES	YFQHRE FSF	VFGTHQ AF	RSIHVIQ DL	YAGAILE V
VAIAGL MEV	FAVISRH SL	FIDKPVC F	VSDVPS LSV	FRPEKV LQI		FAIPLIEK L	RAFDHV LHL	SYYKDAL RF	FFLIGPPL	KNIERTL YF	SFMTHP EF
WARPLS VSF	FGIDPIW SL	IFDEGH ML	VSDYTP LSL	FTVPFLR DV		IFDRVLT EL	RAFPLP MSF	KYIHSAN VL	VYQIVKP L	KTVTHV VVV	ISLLQPQ V
YVIQHVL EH	FAIRSLA EL	LFDYEVR L	VTDPRV VDL	VGHPFV IQL		AIDIHNK TL	YGMERV WCV	AYKPPG FSL	AYGLSRE V	RTTEILH HL	FAGWG RAL
YAFPKA VSV	FISPTGH SL	VYDEFLL L	VTDTGA LYL	NRYPAV ILF		VQDLIE GHL	FASYME QHL	FYHLRIA YY	AYTFSEP F	KMSEKI LLL	YAAQLP AL
FALNLFK HL	FITPTGH SL	FYQEHP DL	VTDVG QILL	IAFSRPV KY		HSETPN MEL	MAAPS WKCL	NFIEKVE AL	AYQYQN IF	RSFEKA VHV	SAFVFP QL
FSYAFPK EF	FAVPES DHL	CFDGHL EV	VVDGAF SYL	LRANLL VLL		FSDLTM HEL	FAGWLC KTL	FYHAYD SYL	CYVTVVS L	KVSDYE MKL	VAYHQP TL
FATPVFI TK	VAFPSP AEL	IYDHAVL F	WADD WLVHL	VRFSNI MEI		FVDRGF YSV	FSYAFPK AV	AFHLRVL AH	FYNFASS F	KSSVKA VIL	KTLPVAF K
AANPHS FVF	FAAGHT LTL	TFDPVTK M	YADVLG LLL	VRYPERI TI		IIDQEVQ TL	KQFHLT PVM	FYPDLGP EL	LYQTVT GL	YLNALV HLI	VGSFRQ EY
LANPHE LSL	FIAPTGH SL	KVDMPI TV	YAEVGR VLL	FRNPDT IFI		VFDARE LEL	VASDLV MKV	VFMHVS TAY	VYLFTEA Y	YTFNKV LML	MFHNR HLF
FAVISRH SL	FARPASP SL	FLDKPTL L	YGDEIAI EL	TRFDM VQLI		FADKHI QVL	YAFLRRE YY	LYHFSSS EL	AFFEAAS M	RNLLHD NEL	VATFRL ML
KAFPFHI IF	YALNHTL SV	FSDVEA HF	YGDSLV VLV	YRRSVP TWL		VADKDL LDL	KAVSFH LVH	HFNVTN TTF	AYHEQL SV	RNLPFM REL	RAFVGF EY
LSKGPGL EV	FADSTV RVW	FTDVEAS L	YGDTLV TGF	FRQGLI RVL		FSDTLKT YF	VLVDHV VEF	KYPDYEV TW	CYLTIKE M	ISLLHLSL L	YATYPRE L
IAIFKLPA F	FALNLFK HL	YFDLPG AL	YIDLPPP RL	FVVDHV IKI		FSDPVY KEI	KQAEIV KRL	FYLPHGL SI	TFAFQA EI	TSAAIYH VL	SGFVNP VL
FAALHG PAL	AANPHS FVF	VFFCHG EL	YIDQGI AEL	YSAPVIH VL		ILEEPSK AL	FAIPLIEK L	YYHARV YEF	TFLVISH Y	VTTDIQ VKV	MTAVRP AL
FADGHV LEL	FVAEGG PEL	HWDSEV FI	YLEINPL VV	KVPAFV RMI		NADPLE VML	QAADFA LKV	AFIHISTA Y	TYSLGSA L	LSNDLKL NL	SGSGLV GR
YAALHG EFY	LAYHLA VVL	VFDRHV VL	YQDLLN VKM	KRPEIIS TV		QADFAI EAL	WAYPR QVFI	FYNNRL QAY	YYFSVEN L	HPNSAV LMV	TFITREQ L
FAMDVY KNL	RALDHY LTL	SWDKTV RL	YSDDIP HAL	QALPW VRYI		SADEV MRFF	YLADLY HFV	VYLPTHT SL	IYLEGSA F	KNMEKL VKL	FFLLRIH F
YAFVRP VIL	YSAPVIH VL	LFDRVVT L	YTDIVG LLL	SYVTFP REL		IQDEIRS VI	KAYEKIL FT	YFQAKIR AL	YFFAVST L	RQAPPH IEL	FAWVYR EI
FAVAM HLVY	LAMRPL ASL	VWDYVE KI	YTDNLV RVW	RRFPSP HYL		SADISLE RL	NSFGQR VYF	TYPSNIL SH	IFLHKSEL	RSIHIFD TL	WAARII QH
LARFNA HEF	VADTVA RVL	RYDLYHT F	YVDDGL ISL	CRAFLIR EL		VADEM DVML	VAIQSV RCY	YYFALAH TV	NYTLKIE Y	SIIQRLL EV	AAAVGL EL
SAFDHF ASV	FADELSH LL	YFDSYA HF	YVDVVK VLL	TRIDLIQ KL		KIDLETH SL	KASHILIS V	LFIEHSV EV	PYTWRIE L	KSLLFVN TL	FAIYKMS F
YLLPHIL VY	LATRAIP EL	FMDPAS AL	AADFEI GHFL	TYFGLP RWV		FTDEESR VF	AAQEAV KLY	YYEFREE AY	FFNSAN VL	KALSIIL HL	VITNQPE I

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YIMAPG LLH	LALTRSS SL	LFNVAH TL	AQDEHL ITFF	IRAQFA VYI		FTDTDE LQL	KAFNHP ATL	RYPTSIA SL	VYLVTEV Y	KTSDFLK VL	AAAAQI RY
FVFGFR THF	VTVPPG PSL	SFDPSRT F	FADGH VLELL	FFPDFI WTV		MADLE GLHL	SSYLFIV KY	NYNPAQ QAF	HFNFAIV F	KSVYWE NTL	VAFIRAE Y
KAIELLQ EF	IAIPFLIK L	VLDVAN HF	FADKET LIQF	TRADLIF TV		VADFLQ NIL	YSFTHIV PY	KFLASDV VF	IYMIGVS L	KTIDYIQ FL	GSALPRL Y
IAFHFRV YF	FSIRPSP VM	VMDDE VFM	FIDGGG SVLV	VRYPGT TRV		LWDEVL SHL	AAFDKI QQL	YYFDSYA HF	LFFLGVS L	KSIIKAT NL	FSFVMP SL
FSWLFH TVY	LASHLNL AM	VYDIAKH L	FQDEVG ALLL	ARFYLPI LV		YMDAP KAAL	LSSNVIL HV	NYQVQF VTL	IYNIGTN F	RIHVNF ELM	MASLLP QL
YSVDRLY EL	FAIDPHL LL	VVDEEV FF	FTDEES RVFL	RRIAFIL YL		LSDIKGS VL	VSVPFP VTH	IYHNGVL EF	HFYQGL VY	RVSPPH LTL	HAFIQPE I
LAWVH ATVY	YAANPG QLF	LFHCYIN E	FTDTDC VVRF	GRFSHR IYV		SADVKE VLL	YSAPVIH VL	SYISEVK EV	MYTVA MAY	ALNAVR LLV	YAEGVR VL
FVNPVQ VVL	AAFAHF PEL	VIDEPVR L	FVDCPG HDIL	LTVPFA RYL		VADRL MLEL	HSFLKAL YY	YWPDVI HSF	SFLEVSE M	HSISIPT KL	SAALPRI L
LTHLFKN YF	YAIHGVL EV	FVDTEIR L	FVDEGS LYGL	IRAEPLN SV		FSDEIRH NL	HAAPFQ NIL	AYQQRV TAL	FFQGSQ EF	SVHKGF AFV	YAAIRD NY
KAFDFP SSF	YASQWF LTL	VYDHQG IF	GADLPN LLFY	SRNWN VREM		LSDPIVN TL	MAFYVV KMY	SYLFSHV PL	AFVVGN CL	RVYDVT RFL	VVALSRT Y
LSFTHPI SF	HAVHVA LVL	GFDDVV RL	HADSNI VIML	RRFFHLI QL		YADFPE LDL	MAVEFL HEL	FFPKKLL EL	IYIDRHV M	HIVQKF LIL	LAAHRE LL
FINPKPI TY	IAISRTPV L	FLEEDHY L	HIDGDH LTLL	VRPRLTI YV		AVDWD PTAL	MAYAR QIYI	YYFVFD HAL	NYLDVA TF	IQYDRTL LV	FVGFQP VL
FSYAFPK AV	FHHTIG GSR	HFDSVM QL	HIDPNV DYQF	YRNAYT MVL		HLDFSG NAL	GAYGQA VRY	FYYIRISE L	RFSFKKS F	KAVHVI YTV	FALVMQ QL
YSKLPG VSL	FLDEKTH EL	FSDGAV SL	HLDDS WVTVF	YRVFTT QEL		RFDVHD VTL	QTYPEV VRM	FYITPSTS L	FFIFGAQ F	RSLWYQ QTL	FNSVRS VF
GIYPHKL VF	HADDSF LVL	IYDALIY M	HLDLPS NNNL	YAPGAR LAL		SADPEV MLL	SALEHV VEF	KYQAQD NFM	NYFMSK GI	KSFHFPL FM	IRPFFPQ Q
YALNHT LSV	FQNPFR SEL	AYDIYSR L	IADLAH LLLF	QRAEVV VQV		FIDGHF VEM	VAIVRPS IV	LFLEKA MQL	VYQARP QL	YASRFV QLV	LSAIQSE V
FAIYKM SFF	IADSGLK IL	FYDDVT TL	IADPNIA KLV	TLPYFP HVL		LADEAE VHL	FAYPAPL EV	LFQHICT AY	LYLLGFE L	KATAYIL SV	FAAKQR EL
LSFPTTK TY	LGAPPG PQL	SYDIAAC L	IIDTPGH VDF	YRSLTLN VV		FADQAE ILL	HAAELIK TV	TFLEAGV EM	SFFIGQE L	KVFKDF SEL	KFHLRPE L
YAQLHS LTL	FADVLV HRL	FWDGKI VL	ILDDVSL THL	NRAVQL LIL		FADAVQ ELL	VAKPPV MSF	MYSIMV HAL	YYASFLE V	RAIAKIK ML	CASINRI Y
FATGV WHQM	SAVSIFH EL	QFDGLV EL	IMDTPG HVNF	KYVGLV RVL		HTDSIGL VL	HAIKSVK IY	VYQYMH ETI	AYQNHLI L	SSMPRP VKV	YAAVTP EL
FVIHNLP VL	FAINNSK SF	YMDTSH LF	KSDAPD TLLL	QRSLVL FSV		KADIIVS EL	RMYPGL QVY	YYLGKIL EM	TYFSGNY F	STYLRPL LV	NPANPV QR
HAIPPTL AM	FAVIAHV GM	YFMQVA HL	KSDVSS LIFL	ERAYILN LV		YIDEGRL VL	FFYQRL VEF	FYIHEVQ EL	FYLTPES F	ASLDRTI KV	DVSSAL DK
HAYIHSV QF	FAHPYQ YEL	VYQKYV EM	LIDSPG HVDF	FRFPAA VVV		SADFSP AFL	YATIILSK M	FYQHNV EKL	LFQEAEE F	RSYEHW EYL	WFNVR NGY
SIIKKLAA L	LAVEKA AEL	HWDVV TCL	NADGP APLEL	FLFPHS VLV		LTDIHG NVL	FSSPHLL EA	IFQGNV HNF	FYTNRIS F	FTVKLRL LV	LFVQRP EF
VAFGSH MSF	FIISRTQ AL	FLDLEQH L	NADGP NPWML	NRFKGV KYF		ASDKET YEL	YAYDAKI EI	TYVTPRR PF	LFLVGSS L	SSQELFR LL	ISLEQPE V
YAVSELA GH	FVDEGIK TL	VLDVSN SF	RTDGKV FQFL	HYSSLV RVL		FSDFPQ HDI	MAAAW PLLL	RYIGKT MDY	IYNTAGF Y	ITNELIL RL	DFVQPP TK
YSFTHIV PY	YVDPVN KVL	FFEIYNE L	TADFPSI LTF	NCPERII TL		HFDLSVI EL	YTYLRIN FY	TFQDKTL NF	YYITRAK L	GSTDHII RV	TGGFVLL Y
HLRDYF EQY	KAIEVLL TL	LYDIANV L	TLDFGR PILL	YRDTW VRYL		FADELS HLL	AASSIQR VL	VYVKHSI SF	AFFTGQI F	NSFKGIK YL	YALLGRT L
FGHYFE TTY	FAHSLSP TL	NMDGPI SL	TVDDPY ATFV	FRYNGT VGL		YTDHQF TEL	AAYKEA FEI	FYPELKL AY	FYIVGLIL	RAFDHV LHL	WERPFE VK
YTYLRIN FY	FLVEHNL VL	LFDAHQ DL	VADPD NPLVL	HAPIRV SPL		AIDFGE QAL	MTFPGE RIY	YFVDDR LVM	YFHLAV AF	KTNEKL YTV	FAFVEYE V

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FAFRNFL YL	SAIGRA MEL	IYDITNV L	VADPVY RTFL	NYIEFTR IL		FFDEKL NSL	FAYYRV GEY	FFQETNI PY	TYLWTD VY	KISEWQ VKL	SATWPK EV
FLYPFPL AL	YAITTLH NL	VFMTHL EF	VQDFLH EIYF	FRNPLA PAV		TLDFEN EKL	KLSDLLK YY	NYIHVG AQL	LYITGAA L	SANRHS LMV	TTWTRP IM
VTYSFR QSF	VAIKAGT TL	RFDGYV FL	VSDPNL IHVL	SRFDMI FIV		FQDLQV EAL	AAFWG QMQM	VYQNQI AEL	YFIPNKE F	LSVEIVH EL	AAAVLF RM
RALDHY LTL	LAQDIFK EL	SLDEAVI M	VTDEPV YIDL	IRRQFP VYV		VADMV KQFF	AAIKIIR QL	FFKERV MEI	AFIATLLY	FQNIRP LFI	AAAMA PIK
IIYHLFD AF	YSLDHIS SL	VVDEAV LV	VTDPRV VDLL	FRSLLIN AV		KADLGPI SL	AAKPFF CEL	AYYERAL QL	YFGSFSS L	KTMNM IQKL	IALLLPQ L
LAHLHLI EY	TSPLRIV AL	IFDVGAL L	YVDDTQ FLRF	YRTDMI QAL		LADKNV PNL	MALEHL VVW	TYSEFAR EL	HFQGTL EL	ASYEFV QRL	YNAVGF TY
HAASVF LTL	FAFHVG LPA	GFDDTV KF	YVDDTQ FVQF	FRINEA NQL		SADLIIQ EF	AQVPFE QIL	VYQIAM VHY	NAQLGF LV	KIYEGQ VEV	LFQTRQ EM
FGNNKL TTF	FAYTSQI TV	FFDHAA HL	FLDNPG ILSEL	KKYPGVI YV		FADFLQ AHL	KAASQIL IL	AYLALRI SY	SFQITDA L	KSIKNVT EL	SALEEYT K
FIISRTQ AL	FAKPENI DL	ISDFAVF L	IADLSNI INKL	RRPPYR WFV		FAEDPP TSL	KQYGNE VFL	FFFTART SF	VYMLAA SL	KTLEQA LQL	MSTCRLI L
FSFYFHE AL	FNDPNA KEM	IFTCHEIF	IIDLEQT ATHL	FYATLV RYV		KADVEG ELL	TATMHI LVV	FYNEYVR EL	YYQPGLL Y	ASYKKAI IL	SAHLAG LL
SIFDDFS HY	SAVWNS PPL	AYDLEA NL		KRAEEIL RL		YSDDIP HAL	FSIEPWL KV	LFPGKV HSL	IYQSASV F	KSVDWL LVF	SSGFRDF L
FVADVR LIF	FAVGSF HTL	NFDNPL GM		FLPITPH YV		RQDFSP EEL	KTIDYIQ FL	SFNKMSI EY	LYQTTFE L	ATNHKV LLF	CSAIRES Y
LSSTVTL EH	FAYPAIR YL	LVDYLM GE		FRNEIQ SLV		FYDEIKI EL	SASVYIK KV	KFLPDA QAL	RFLAATF L	ATILREL EV	YSAPGR DL
VANPAF LKY	MADPNI RFL	IFEPFGKI		FQIGKM RYV		NADSQF WSL	STILHLV VM	NYHAMT EFL	IYLNGES L	ASFYQR ALL	IAHVLPA L
VAVHVF SEF	FASFPH MVL	ESLIACK A		SRAELV QLV		FLDSPA KAL	NIIDLVK KY	SFIAFAR VF	AFFVASL F	ASVPKE LYL	LAQLQQ EF
FAEDSLR VI	SAMKAV TEL	KLDDTV YL		SRYPNG HFV		MSDTTF KAL	RLPAW QPIL	TYQAMV HEL	KFQIGDY L	VTMAHI IQI	VAAALS PL
FAQDVG RMF	YAETIAH IL	VFDQIIE L		QRAHQI LVL		ALDVPH AEL	YSKEGW EYV	SFPHMV LSL	IFTMGIA L	TIRLFW NEV	KSAVGF DY
FAAKFV TSF	FLFDHLL TL	FWDNV VYI		YTIEFLR HL		AADAAL RVL	CLADIFR IY	IYQEKVL DL	NFLLSHE Y	KSDYIKL YV	AAAVGA VF
YAYKDFL WF	VALLRVT PF	NFMCHS ML		HAPLTN IPL		KADSVV VLL	ISFPDPK ML	HFNPTG SAF	VFLLGL MF	KSYAGE KIL	VEYGFQ VK
FSKWWI NEF	FAYPAPL EV	AYDNFG VL		SAFPHL RVL		VADHPF LFL	KAFNLRI SF	IYSFHTLS F	LTQVGSI L	KVFERQ LQL	VTSILPV L
SIYATLAI H	FITDHVN SL	VLDAEVL L		FAADIP RIL		NADAIV VKL	KTADIC QML	VYINTAQ EF	AFLTGV GL	YSLDHIS SL	FSSNPIS L
FLKLFITE F	SAIGYIH SL	YYDGVA KI		NRIAYIH LV		AADWH NLIL	YAPECLK EY	SFMYAH LAF	NFGYNIP L	FTAWRI LEV	SAMVM FEL
YAAQNL LSH	TASPFFR AL	FLDVAGL L		YYIDCIR QV		SVDWPE SSL	RTTDIVI RI	AYHELA QVY	YYEVHKE L	HNSNIIK KL	AALVGF LY
FSNAH MIMY	AAIWQY ESL	VIDECVE M		FLPNFV KML		FDDEAN HLL	KAAHFF STL	IYWDGP LAL	VFLLGVV Y	ASIFHQ QEL	FTAHPR VL
FSNPRA LYL	FASDVQ FVL	YTDFHID F		HRYEVV TEL		MLDEPT NHL	SASPIFT HV	RFHTITT SY	LYASIAV F	KQTPKV LVV	TSLVHP VM
ASHLHIH VF	ISVQPSS SL	VIDAAVL L		QTFQHP RYL		FVDEGIK TL	VTFPGIK LI	SYLPHAP PF	IYQLGLG Y	FADGHV LEL	VTTVILE V
FVNPHV SSF	FAHLNS PQL	IVDEGAL L		SRPELIF RL		IVDRPVT LV	YSSPEIL RV	KFYNAG LAY	IYLEGTLL	HNINRP LTM	KAFCQH VY
GAAGV HFIY	AAAYPH TSL	VYDIICN L		TRNDIV NML		LAEIAKV EL	YVYMFL VKW	SYMPTV SHL	VYILDP WF	KIFQEM LYI	RANLRL TL
IAYIRDL AL	RAIDFSP YL	IFDLSSEF		LRIYHEQ QV		LADDLN EKI	AAADIF KHY	NFMLHL VSM	FYYFVSA L	YSNKYL TML	KLVTDLT K
FLIDRSP EY	LAIDAIH QL	FVDNHV EL		YAPLHL VPL		LSDHIQE EL	YIFEEPF TI	AFNTQV TAL	VYLPTRE Y	ISNSHPL SL	VALTHLT L

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YAIFRILL Y	FSQPKV TEL	HMDETV SF		YRYYQQ LKL		VADTVY RAL	HSAPFS WET	VFQPSV RSL	LGQSNF LI	SSLSRFL MV	NIPVVS GK
FAYKDYL SF	LAVDKS ASL	TFYSWM SY		HRVYLV RKL		TADFPP SKL	KAFEHL QQL	VFSVRG TSF	GMKGQI LV	AVNDH VLKV	HWLVG MVY
FLNDSYL KY	TAIRSGL EL	FFDIFGR L		LRPLLVK KI		ALDKAT VLL	SAADLV HFL	FYIENQK EY	QYLIERG F	RSLPHIT DV	PINGNG KQ
FSQSSLA LH	SAHSHFI SL	TFDPIAK M		SRFPMP RYI		FADDGV KYL	MARET WEVL	CYQEGL RSL	LFFVGN QL	KAIDYIR FL	FANYIDK V
VAYWR QAGL	CSSPHAL VL	VLDMH GFL		YRFETV QKL		VSDDTV MHL	KAIDFA ASL	YFMDHT VAF	FMPGFA PL	KIYEHHI KV	AAMILN EL
FSQDHL VIY	LASHILT AL	AFDALV TF		YRIQIQ NQI		LADLHP DVF	MAFDPT STL	FYMDTS HLF	FFPNGN AF	RTFHIFY YL	CAALRM LL
AAFTRA LEY	YSDDIPH AL	LFDTAISL		ARAPIS NYI		LQDFSQ VTL	NIKAPKI SM	IYLIGHV AA	LYVMVR AM	VINPKD LRI	VAAIPRL L
CSSPHAL VL	FLYPFPL AL	NFDVAT HV		LLPSHPL EL		KADGVP VYL	YAFPRV RII	LYHWSV ESY	KYLREFQ L	YSYKEAL KL	FSDVLPV L
LAMRPL ASL	YATLFA QAL	SFEWAE DF		QLPPFP REL		VADWV YNEL	CSSPHA LVL	TYINHVV SV	AFYDSEL F	KINEAFI EM	KAREPM EL
HAYDNF LEH	FLFDHQ MVL	LFDAVSS L		TRSAIIL HL		VLDVVE RSL	ITGPLIRI L	KYIDFTS DY	YFMVGT AF	YSVDRL YEL	KARLPLR L
FIYHLPQ EF	LATRSFP QL	IFEPFGRI		RRPLFAL LL		LMDPP GTAL	KATNVV RLL	AFIFRSL NL	AFMVVN NL	LTNDW EDHL	VAAEILEI
LLHVFST EF	FSHLHEL SL	ANDGFV RL		YRALTV PEL		FTETPSP VL	TAVALL RLL	SFMDPA SAL	FYTIHSC F	VVNVW THLL	FSIVMN EL
TAFGGF LKY	FSVAVSP SL	LYLHRVL L		FTADFV RQL		MLDFEN QTL	FAYTVK YVL	IYMDTL NIF	YLTVAAV F	RMLAH PLHV	FAAVKLF L
FSEPFHL IV	IAIPVTQ EL	FGDACV YL		HRANW IKAV		AADPVS PLL	VIGDVIR VY	RYFDHA LTL	VFNKLLS L	VINKKQ LQL	SSYVGLV Y
FSAPLFL SH	YIDEGRL VL	LFDRQG FL		TRNLKL RFY		VADELV SEF	YAYLKAI VL	IYFEYSH AF	FYIPRRD L	HSSIRSL EV	AAMLGL MY
FLYDKAL TF	YAIEVDP VL	NFDATC LL		FRPDLIE MV		ITDLPSE VL	KAFMYP YTL	FFSEREA SF	IFNNVM TL	KTLGHN LLV	FASFSDY Y
FVKPAFE EF	FATIKSA SL	FYDKPM RI		TRAEMI LKV		VADPVE AVL	VTYSHE VYF	VYYFSKG TL	VYSIAISL	KSQIHDI VL	FSHWTY EY
IAQDFKT DL	FVTSSHL QL	SYDCIGR L		KRIDIIH NL		MADLE QKVL	FAAHLR CTY	YFHIGSN AL	FFIAVTFI	RNLPVN FEV	LALAPRL L
AALPVY QEL	KAPDFLP LL	LYTINTN L		LRFNQA ILV		VADPIIY VL	LANGDV WKV	IYLPAAQ TM	VYTLTSL Y	KSIKIVK KL	FNFVGKI L
FAYPAIR YL	YAFGGG CEL	AYDFYYL F		NRADLLI WL		YYDEIIN AL	LTFPHP VYY	YYLPKLL SY	HYLYVR AH	LQNQR VLYV	VAMQV PVV
YLLPDTK AY	MANGA VIHL	NFDPTA NL		LRSLILL DL		EIDVPSH EL	RAILRIIY F	FYAHSLV EL	FYGRHA EL	SSLQKLL EV	FSMEAL EL
FAYTARI SV	LATDFIQ SL	VMDSPV HL		ARYFYIQ AV		SSDWVT TDI	HTVGFIL QL	SFPHPLP SL	NYLTRIH Y	YSNFHP LLV	FATTAV VM
MADPNI RFL	FSIDSPD SL	FFDLPQ QL		VLVHKS HDL		EADFPK NPL	SATSLLH TV	YYFSKLIE F	YFLQRH EL	FAFRNF LYL	FSPTGEI L
FSVNLFR TL	FSYAFPK EF	VYDIVN NL		YKPVFV TEI		KADGKI MAL	FIYHLPQ EF	FFEFLTK EL	IFSEHSC L	KAISGV HTV	FAAEAIA L
LATDFIQ SL	FADGFV KAL	RFDEAT QL		YRINLQ MRL		FADVAP LQL	YAIDNPL HY	NYNFQYI SL	AYNLHS AY	IVNRISL FL	YAIPQP DL
FALLPRL EY	IASPVIA AV	IFNDGYK L		LRAALLK VL		IADFPGL HL	YVSPRIL TA	YFKPMM KEF	LYSTHAA L	RSVPVR LHV	ELPEHTV K
FVKGW GAEY	FQAPTA KEM	AYDVTYS L		FYFGKL RNI		SLDRPFT NL	FAFTPSR IY	QYLELAH SL	LYLNRTS L	KTFLFSA TM	AAAQLP SL
VALLRVT PF	FGDVTA HLL	LMDKVV RL		TRILVIR EI		FAEEQT LVL	ASVDKV LEL	AVNIMH SSL	AYQDRL AY	IVQNGR LIV	MSMTG VSF
VTVPPG PSL	YAQEHG LNF	EFSIPVIL		FRKDFIS RI		SQDLAF LSM	VATFILQ KI	FYFASKL VL	IYLTADN L	KNIYVL QEL	MAALEN LL
YAIDNPL HY	FSIPFAP HI	YFDVIEEI		YAFDFA RQS		LADIAQ SQL	FSEPFHL IV	IFQTAKE TL	IYPLVGT M	KSLTKLLI M	YALETLT M

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
RAIQFYL EF	SAVGHV FSL	VYGYNSL L		CRTQLV WLV		FSEETPV VL	KSYLRCI TF	VFQVKT LSL	VFFCHG EL	KTNVKF LAI	IAVLIDEL
FAIRSLA EL	VAVFPW HSL	IFDEVHY I		MRFLAA TFL		VADFQR YIL	LMYPYIF HV	AYQLMT DVF	RYHIAKV Y	RIVELFR NL	GQPNYL LS
VAKWA TVTF	FIEDAVH VL	VFDQYL NF		ILPGFQR TV		ASDIPGL HL	SGSDIVK LY	LLPHYPN WF	VFFVGQ SA	FALRVQ QLV	ITLVPGT L
SIKDYFL EF	ASSPEHP EL	AYDVAD MV		QRAQQ LLQL		FVDKYSI SL	AAANLT KIV	RFLYSNI AF	YWQNH PEL	VSSPNIL RL	KHEVIH AL
FAADVR LMF	YAFPKA VTV	IYDIILD M		YAFPYIIL V		LADLQL EYL	FSFQRPL LV	AYLEAHE TF	IYFLGNS L	KLSETFL HI	FSTVRKE M
FAIKSLR KL	YGYSNP KIL	NFDNSP VL		NRYHVP VVV		ATDYDN IEI	FTYHHI QEI	HYINEVL FL	SFQEVRE Y	LSDDHV LIL	TARLFRP L
KLNGQV LVF	AALPVY QEL	ITDGQIF L		AAYMF VRKI		HQDFPS VVL	HAVEW PVVM	HYIDRVR AL	AFIERLE M	SSVTKVL LL	VANVQL VL
FIRVVGS EF	SAAFPG ASL	TFEVVFI V		HRFWK PSEV		IVDLTCE SL	LAVSRVI TW	TFLAQH ASL	YYENRM YL	ASSPISH FL	YTGKRIA L
AAFDFP TSF	LASPVFA RL	VFDNQL TI		RRNVAV YYV		FQDPVP LTV	SAAPVA HLL	FFNSVRS VF	HFQVVK CL	ASDPYQ VHV	AAFVGL YY
LAKDFY VAF	MAPERV ASL	GYDGPIY M		FHYPGV QNL		YLEDSPL EL	SAHSKV VIF	FYIIEREP L	AYFDVK EY	LSAPIHT QM	YSNTILA V
NAPLVH ATL	VAVHVF SEF	KLDVVV RF		SRARYIV LV		IADVNK PII	VAYPGIP KL	RFHEMH VAL	FYHPAQ EY	TVNFRK LLL	GVLSDLT K
FASDVQ FVL	YILGKFF AL	FYDPPRR L		SVFPGA RLL		KQDVIIT AL	VAIAKV KLY	VMINKA TPY	IYKIGQG Y	YSHKKIL QL	YSSEQLL I
IARLPSS TL	FAEPGR VPF	FLTDMII Y		ALRRLLL LL		YLDWD VSEL	AAINFQ PKM	FYITSRT QF	FFHNGR YL	KINELEL RL	FSYAGFE M
STFFPFH EY	IVMEHV VFL	FFENHPY F		FYHSKR RLI		VADELV AEF	VALLRV TPF	YYFDYKE QL	FYINKLC F	KTSPKAL VI	VLQLRV HTF
YAVNSQ FTM	FAAQRG LAV	IFNVSQ QM		FRYGRH PLM		FVDGDH VIL	HAIDHR LSI	VFMPHV TEA	FYQTAEE L	RIIPRHL QL	AAVWK GHVM
FVVDRLI AL	LAFPTGC SL	NVPVGK VL		IRNDYIN WV		QADLSN LHL	STYPAPF YV	NYPAFM MEM	FFENHPY F	TTFPRP VTV	VSSHVE RVF
LSFTHPT SF	FAMQLV KIL	SFDGTIK V		KRNELVI RV		AAEEPLS LL	KAWFLP IMY	SYPDNFL HI	ATAEGA LK	HIIFHITL V	ISIHRPL AY
IYRWFNI SF	FAYTARI SV	VFDRHK ML		SSVPGV RLL		SADFPA LVV	VTKPNP SFM	FFHEYLV SV	LFLTGES Y	FSNPRA LYL	AQTLRH YGY
YTMPNF RQY	AAYYHP SYL	LYQTPDS L		TRPDMI RIL		LQDFAQ VTL	ATYPYQ VVR	FFPMHF QAF	VFQLGK KY	KTLFLAV QV	FAHLRLE VL
IARFFTE YF	AAVPKSL QL	LFDVHSI L		IRSKIITY I		TSDPIGE VL	IAFEFPV LV	LYIHHAI DL	YYVNRD TL	RNYVQ QVTI	SAAELR HVM
FAKPENI DL	FSDPFLK YL	NFDLHQ QL		KFDDGA VFL		RADTFP QVL	FALPYPR FR	VYQEIWI GM	YYSVAKA L	AAAPHL LLL	FAVNKKI EF
FAHLPKS TF	TAYDNF VEL	LYCHNM QL		IRPDINV DV		ILDPHV VLL	NSYPHQ LYT	VYVVGT AHF	HYPSQP VF	ASWPHI QLV	FFKERV MEI
FAHPYQ YEL	LATSHM LEL	VWRSDV QF		MQFSKP RKL		LLDSPG KVL	VVYPWT QRF	YYVRKVL EL	YYFPVRE L	ISLQHAL YL	YFHDRFL EL
YAAQQL PSL	FSHAQT VVL	VYDGFSF I		VRYPDR ITL		FIDEYVE TV	FLLPIVV RY	FFPVHF QEF	AFGVGS EL	KSMNH MNYL	YFQHRE FSF
IVNGHT LLV	LADPVF RTL	SFGDVYL F		FRMRHL QSL		FTDISPE EL	IAILIPVV F	RFPNFT NQL	HYQDVS CL	SILQHLL LV	FSAPRH GSL
LAAARL AAA	AAMKAL QAL	VFSLSSE F		TAFAHL REV		IQDLGP KEL	NAAKVH LMV	AFMDQ VRAF	AYLEALS H	YSNNIR QLL	SVTGVH RLY
LAKNFF NEL	FSITPLSE L	IFSENDIF		TRVKAV RIL		LADVDP MQL	HATIIPK VL	NFICPAL EF	HYNNIM AL	RAIQFYL EF	ASFHRV WSF
YVYSHFL QF	AALVPR QAL	TFDEIVN I		YVPDIV RCV		QTDIPFT RL	RALNFA YTV	FYFALRD TL	VYFEGS DF	KNIPMT LEL	KSFVKVY NY
YAITTLH NL	YTIPPGH QV	IFDNTTS L		ARPPFVI CV		HADILLI NL	SNFLHP VIY	VYFVQK NSL	FYSHLPE L	ASVDKV LEL	FASEKK WAF
FSFVRIT AL	FAEGKPL EL	FYDERIV VV		LRADIK HFV		YIDQGIA EL	IAYPKAV TM	VFLERGE VM	FTADPLS L	IQYIRPV FV	VASFSKR FF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FANEPFADF	FAMEIDPSL	IYDLVDRHL		FLPEAPAEL		AQDEHLITF	KGFPHVIYA	VFQERINCL	NECFLQHK	KGFLFLHTL	AASLRKVSM
FTSEKFLVM	NAPLVHATL	VFDEWVSKL		AAIGLVIYY		ISDVLQRDL	LIYGRPVYV	SFVIRALGF	MHKAELVK	KSFYDARLL	HALERLFTM
VSYEFKFPF	FQYDHEAFL	IFDVHVHEV		QTPNFVRGL		FSDFEARQL	NAARWPWVL	HYIIAARAL	VYHAVSVM	QAADFALKV	AVTHIGRVY
SAAFPGASL	FIMDRAQAL	HFDIVIRNL		YRARYLMLL		IADQRNFIF	FLYPFPLAL	VYFPALTSL	YFGARAIL	ASSPLRLWL	HASDRIIAL
VSFHFSNYF	YADVIVHRL	HFDLNLRQF		TRSPKLFVV		NVDGHLYEL	KANITFEYM	RYVPRASYF	YYLWVKSV	HSDDYIKFL	FATIRFHDL
LALSPRLEY	LSNHVFNAL	YWEVQPATF		HRPEFSSCL		IVDDPEGFF	FAMEFVKYY	YFLEWRSVL	VYITGKEV	ITNKYQLVF	AAISHGRVF
AAMSHLLEM	HSWPWQVSL	KFDDIRIYF		LPINGNGKQ		VIDTPVFEL	GAYGKVFLV	FFPEYTHQL	LFVPRPVL	KQYPISLVL	IASTLVHKF
FTIFRTISV	FQVNHTVAL	KYFLWVVKF		SLVNLGGSK		YTDLPNRQL	IIYPTPKVV	QYFTARTSL	FYMIGSEV	RSVPHLQKV	SASAIRKLM
YILGKFFAL	LLAQPGEAL	HYDPMIAKL		FLVGGRRYL		KSDPSIVRL	MASKILKSY	YYHYSYSVV	FFLSHPAY	IVMEHVVFL	YATEKLRMI
KAFSFPSSF	FAEGFVRAL	YFDVSHEHL		SRFPEALRL		NADFAKLFL	VLFEHAVGY	IYLEGKIDY	FYSFQDKL	KAVEIYASV	ILHLRQVTF
VANVFLEAY	YAAPWFLTM	LYDEAIRHF		HRFQWIRNL		YVDEVMTRL	KIFPSVIKY	FFMEKRAKY	NYVNGKTF	KTMTDTYLL	SAMVRVISV
FAANVYEAF	YITDLFQVL	VYDVVELKF		NYLPFIMEL		HIDVITAEM	VAINLIVQH	KYQAVTATL	FSPVGSVL	RTADWRLYL	LDELRDEGK
YAVPALEAH	FAPYNKPSL	KFDPMGKYF		FRAQRNLYI		MTDPEMVEV	YGYEHILTL	FFGTHETAF	YWVPRNAL	SSSSRFLEV	VFSHRLSVY
YSMPSTHAM	LAVEPGSNL	LYDPVISKL		GRAPITRFL		FVDDQQTFF	RSYPYAFSV	IYIDRGVVF	LFQEVRCM	KSFGDTKFV	SAFYRKYEL
FAYYRDLVF	FAIGILCSL	LYDVRTILL		YFPAFEKVL		VADDTPVLL	HGLIRKYGL	AFMSQVHSV	VFRNAASF	TSEIKSLFV	FATKVVHLL
IAHGFFSVY	MSVQPTVSL	YYDEKVVKL		EFNAEVHRK		GADLPNLLF	ILPPFIWTL	IFQNIKQEY	AYGKGTYF	KVADLVLML	LATAYIHRF
IVIDPKNPL	FANNVQLSL	YFDVGLHNF		RRNTQLLEL		FTDLGNKDL	SAVNIIRTF	YYQLMKTAL	ATQVGIEW	FSNVMIHVV	FASGLIHRV
LAHSFVTSF	FLFSKFIEL	IFDEFRTVL		WRNPHLSML		YVDNRFFTL	NAAFALKQY	FFNGLRTEL	AFHTASVL	KAEEHILKL	AANLRMHIF
YVIQKFFEF	FAVDPDQPL	FYDQRQVLL		SRSKIVLLV		SIDFGKTVV	VAFNQPVKL	IYFTRIIAF	YFSSRPAL	YSAPVIHVL	NFHWRDWTY
FLMDPFAIH	FTVNPKGEL	AFDVHLNAF		VRFKVPQQI		AADFAQMEL	FGYPDPTYL	VYAFSARPL	SFLTAAHM	ATVQRLPEL	AAIKAIKLY
IAISRTPVL	YAISPGLDI	SFDLLVKNL		FRHDRSLEL		AADPSWNSL	NSFPQKISY	AYIFNSNVM	VYQAVQAL	GTNFRVLWV	YTIENPRHF
KAFTDFLAF	LTDPDIHVL	HWDPQEVTL		ITVALPRLV		NTDEPPMVF	KAYEKLQIL	KYAVQLVEM	FYQLSHFL	HSNSVPLAL	YSISRKYDY
TAYDNFVEL	HAPFTATSL	LFDHAVSKF		GRAPQVLVL		SLDLPHSEL	LTIDHVPIW	AYIMKRMDM	KFNYGFEY	KVIEINPYL	HAIKSVKIY
YSYFHFVFF	FSDPIHPQL	LFDLVCHEF		HAPFTATSL		ASDIAMTEL	YAYRDAVFL	NYMMRNAVL	LFHCYINE	RSTPFRYLL	HASTLHRLY
FTNPWTKEL	TAAPPAQPL	TFDDIVHSF		QRALLVHDL		FVDLEPTVI	AAYQSVRIL	RFFTSSTSL	VYLVIRAL	ATYLRFIIV	KAAVMVHQL
FSITPLSEL	YAQLHSLTL	HYDLFIERF		TRADYLIKL		SADLKELSL	KATFIIKII	KYYFILSPY	LYLTGGVW	RALDTPVMV	LSSPWYHTY
FSYVTPRAF	FAVEYFTRL	ILDPHVVLL		IRSVNLLVV		LLDFPNIVI	CAYPRLEIY	VYVERAEVL	LYYPGSNL	YLTEVFLHV	TATVRSVHF
VILPPLSPY	NGIFPGTPL	SYDLAIKAI		YRKAFESRL		YSDSFPMEL	FAYTARISV	AYQYTIRAH	VAPVASAL	AIVKVFLAL	SATLRVEDF
FAYPAPLEV	YTSPVIPAL	SFDLAKVLL		SAKSWPIFL		YVDGRVLVV	IAVEFCHVT	RYMVHLLEL	IYVVGGAM	HLTDITLKV	VSYLRPLDF
FVYITDNAY	FVYENPISL	SYDHVELTF		IKVKEITYI		AAAGSPVFL	QASPFVLRA	KYQIINEEF	AFKNRMEV	HSIPVTVEV	IATLRKYTY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FAMPPPHGM	VVVQPYNSL	AFDLKAAVL		RRAPVVVRL		NVDTPVSTL	VTIVKPIVY	SYQEHVKQL	VFTNAEVY	YSDSAVLKL	KAYFDVKEY
FLFSKFIEL	YAVRDTIAL	RFDPLGHYL		YRKEWPLLV		IQDFQASVL	AAQFIPKFF	YFYKGGLVW	HYYNAISV	HAVQYFLHV	YSSKLYRFF
FAIDPHLLL	FIIYDTHSL	SFDKSIRIF		IRVGKIITV		LVDENFTEL	FIIPNVVKY	NYMAHLVEV	RVDPVNFK	LSNMKILTL	KAADFVKAF
FGEMGGKFM	YAAPWFLTL	IYDKFIAQL		FRSEALFLL		HADDSFLVL	TVYPVAIKY	VFPDFYLHL	FFLVSREL	MTYERILYI	LLHERIVQY
MAHSFGESY	FTEAGLKEL	HYDVQSILF		VRPGFCFHL		LIDKPNLQF	AAAPVIKAY	FFIAGRYEF	LYNIGLTY	RVESLFRVI	AAYLRALSL
FANNVQLSL	AAAHFYFEL	HFHPSVALF		SRAEWLLAV		VADLQLIDF	KAQNKPFYV	AYALMAHAM	VFITKPPM	YAFAHILTV	KATEYIQYM
YAFGGGCEL	YAAQAHLKL	NFEDEPPLL		GRIDRIIYV		YVDAVGQFL	MSYEQLMQL	FVYITDNAY	VYLVSAML	SATYRILEV	KATPIKLIW
YIMDWMDEM	CAIAQAESL	TFDAQIVII		VVPEWASCL		FADVNGWHL	NIRLRLEEY	FYPHHPQML	VFLNGNKL	VGDPVRLEV	YSTKLYRFF
FFYKFFQEF	FSYGRALQA	IYDEDEVLL		RRHWGGNVL		KADIPSVAF	FGYDKPHVL	VYIDQTMVL	YYFNRKTF	WQNVRALYI	SLHTLFGDK
VVVDPIQSV	IVIDPKNPL	YFDEPVELR		YRAPFLLTL		VTEPDHPVL	RAFPGLRYV	YYPQQAIVF	AFNISSNL	YSSSRTLLF	FTTAQKRVY
YAIEVDPVL	YAAYPLTEV	FFDEVVKQM		YRNPSLKLM		ALDTGWNEL	VAASLIQKM	YFWPRTVPM	FFYGHSAF	KANDWLQFI	YSALREIAF
CASDKILEF	LASPVSPEL	HYDHVLIEL		FKFPGRQKI		FTDRPDLSL	KSFEGLFYF	AYLPVNESF	RYQVGVHY	KLNPQQFEV	FGLARIYSF
QARWFWEAY	YAYTGRLEL	YYDGKVMKL		FRRDGTNVL		IIDDPNLVV	LAYPNGHYF	SYLPLAHMF	FYFPAAYY	KSQDNVIKV	YAQIRTIAI
FAIPLIEKL	YSVYVYKVL	MYDSFWRQF		SRAALQRYL		YNDFINKEL	QSTDIIRYL	SYQDLVKCF	SYLVGSHM	RISSKSLKV	HAISRYWYY
FLRDKIASY	LAFLGSQSL	YYDLVRTEI		IRSFLLKVL		QQDYFPKAL	TWINHFVIW	VYPTAVHVL	SYQVASTL	FSIEPWLKV	MAKMRLLTF
YAKDDPLEF	YAVGIQQVL	SYDWFPAEL		MRALLARLL		SSDLHLVTL	AAVLRIPIL	HYQPVDVSL	QFTTRSEL	VSTTRELYL	VAIWGRVVF
FALGSPIAM	FSNAHINEL	AFDLIEHYF		VRPPRPHVV		KLDLNGNTL	FAYTSRIVV	KYLTSNVAY	IYLNVESV	KANIVHLML	YSLNKIHAY
FASFPHMVL	FSNLGTTHL	TFDPVTKVL		KRASYILRL		KSDIYLNLL	FILHFEPVL	IFIDEVDSL	NFFTGCPK	RTNFFIQLV	AAFDQWREW
YIRDLALEY	FASTMVHAL	AFDVAEREF		YAYPGVLLI		VSDEVGFGL	KAYELALYL	VYIDRVRSL	LFNLGSAY	TSMTRVIEV	HQRTFVLEV
KAFVFSVAL	FSVPFHQAL	VYDLLKTNL		FRSEDIKRL		KADFPTPSI	TMFVQRQVF	LYHAGAVAF	RYTNGHLF	FTYHHIQEI	SAKDYFFKA
FASEYPLIL	FAYDGKDYI	VFDLIQELF		FRFGNPLHI		SSDDINKFL	SAFPHLRVL	YFEDVANAM	LYQTINSL	YTIPLAIKL	FSQIRKDAL
YFWPRTVPM	FSNPAHPEF	FFDAQEVLL		NAYTGIVLL		AAEFVPSFL	MGFSGIVVH	AYLSKAMEI	LFYFRVPF	YVDGRVLVV	NATKLERVF
FAIPMIHAV	FSVNLFRTL	SFEEKPVYI		NRYPRKKFW		LLDYPNNVL	NAIEHVIIP	FFKLPGGEL	LFNVGNKL	FNWGRVVAL	SATALKHVF
FAMEFVKYY	LAVERSLDL	AFDLDVVKL		QRAVAINRL		FIDTAQHML	SAIQKIITI	LYQIQQVTM	YYHCAVTL	TVNEIVLKV	TFHQRGIAL
NAHEFITSF	SILSHFQSL	TYDPWIGKL		QRHNHLLWL		GADVVSKFL	FAYHMIETY	SYHPSGLSL	IFLVATSF	YAIHGVLEV	AALLRTFSF
ISEENFRVM	FASEVSNVL	VYDVFWLRF		FRYGYPVRL		VSDFGGRSL	AAASLIRLV	IYELMQTEF	VYQLRFQF	KNIDHMLWL	KTIDPKVAF
FFYQRLVEF	IAIAPNGAL	MFDELRTWL		YRFPSSLCV		AIDSPVSFL	FAVSRLIYW	TYNTQVNFM	VYQETSEM	KAVFPLLYV	LAAVKAIAW
YFFTWDTEY	LAIVPVNTL	FHYDYIDLL		SRAPFIRNI		IAEDPKVFL	TASPLVKSV	VFMISSHEL	QFLMFRLF	KISDWALKL	AATVRPVTL
IANHQVLII	YSLPNAPTL	VFDKTLAEL		NRIDLVKYY		KLDETGVAL	FAYPAIRYL	AYVPGFAHI	SYAVGHFL	ISLEHEILL	AATGFLKLL
LANIRSPVF	IAYPKAVTM	VFPKEPVEL		SYPTKVRLI		FADYRPTEV	KAYNRVIYV	KFQAMDISL	VFRVSSSL	MLFGHPLLV	YAFVRPVIL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YAHIYH QHF	FAAISG MIL	IYELAVA SF		FRHDKR VYL		VLDVQR YPL	YSSGLVR LY	FWPPYV ELL	IFASGSE L	SVYPNG HFV	VATNLL KLF
SAIHVLA SL	AANPIQ FTL	YFDPAN GKF		RRAAIA QAL		LTDDGN KWL	AAFLKAI GY	FYPPKVE LF	VYNNSR ML	VVDGH KLEV	IANAVV KEL
VVNGRV LEL	FCMDRA LEF	YFDLQLL VF		SRKQGV IKL		VADDPI VMV	KVANLV KAY	SYYEEAL EL	IYTVGKR F	RSVNIAS KL	SGLVRLY SF
YAAPPH VIH	YSMPST HAM	KFDADP VEL		FRQAHL IEL		YSDAPV SEL	MQISFIH QL	NYVPEV SAL	SYSVGV AY	AINPKLL QL	KAMELI REL
FIMGKTI EF	FAILIHD VL	LFDCYVV VM		HRAPVA IKV		FGDTGG FHF	RAIQFYL EF	SFPHTTP SM	AYQLGS VY	KAAHFF STL	TAADIFK QY
YAAPWF LTL	FAQHGG IYV	YENEVAL RQ		HRYENV SIL		SSDVVV QVL	LSIPYRLI F	FYQRFPL SF	RFNVAK SL	VSTPWL QHL	IASEVLK LF
LIRPWFP EF	YAIGVSH PL	LYDFIHT SF		RRNPDT QWI		SADFET VRM	QAYPEV RIV	RYTVQF TTM	LFHFGN CF	WSQSRF LYV	HFQIRN VTF
SANDIYL IF	LAVHIAH SL	LFDDIDH NM		FHFPHP KYV		YQDLLN VKM	FAIWHII AF	TFQSRTL AL	RFINGSA L	RALDHY LTL	MGYIRN VAY
SIFDDFA HY	FSMLESP AL	AFDLSQ VLF		LRYDHQ QRL		AADLLV VHL	GAAEIIS RI	AYMKSL LSL	VFRVGIS F	RTFEAF MYL	TAAFWT RLY
WAMEQ VLEF	LAYIAHP KL	MLDPLE VHL		YTVPLV RHM		YVDPVN KVL	VAVGRA LYY	FFPFDTR QM	AYFTHS NL	RTTDIVI RI	IANTLYR IF
FSHAQT VVL	FASEYPLI L	LYDLVTE KM		KRPVIVK VL		FFDEESY SL	FASFPH MVL	FFYQRLV EF	YFFPRAD L	SLHTLFG DK	ASYLRL WAL
FIRVSGS EL	SIVAPGG AL	YFDLQT HVI		YRFLRNI FV		YFDDSN VSL	RVFPYIS VM	RYMAFA HDL	FFFYGKS L	VIYDKD QFV	ASFHRV QAL
TAAVFK ETF	FAVHVE SVL	HFDTIYSI L		RRFNYV VRL		AADVILK TL	QAIQWI LHY	FYHPETT QL	FYFAAEH L	NNNIPP VEF	AAAFGRI AF
YTLINHR VL	FADHPR APF	SFDEFIKI F		YYYTEIR RV		FIAPTGH SL	VTYNYP VHY	FYVRLID SM	KYMPHA VL	RIFKDF MHV	SAIDFYR KF
FAFVTD NTY	LAIGPCK SL	VYDVVE EKL		KRAAVP RFV		KADLTA LFL	YTYEKLL WT	LFQDKA SEL	VFQSVK SL	VSTAKH LLL	VAIAKVK LY
IAIPVTQ EL	FAIDSSH PW	LYDELRN LL		VRYRLPL RV		SSDVVY NAF	CSSDFIRI L	MTQIMF ETF	TYQVLS NL	ASLDLVL HL	VLQQRLI AL
AAAPLL PMI	FATMVR PVA	TWDYVA PFL		FRPSRV VVV		LSDLQVI KI	AAIYHVL HF	SFQFAHL EF	FFFNGQ HM	SIQAHP LLL	AAVLRNI KF
YGSPGIL EF	FSTVVIH FL	AYDLAK ALL		FRADNL NKL		FVDRSLL TL	LSKDGV LYV	IYPPEVA EF	FFNSVRS V	HSETHL LYV	FFVNRP DSY
LASPVSP EL	IAQDFKT DL	VFDIVIH RF		FRSRLIQ ML		AADEVL AVL	VAFSPV TEL	TYQVQK LSL	AYQSVRI L	RSFFHQ HYL	HSTVHLI EF
YSLEHTV QF	NVEIDPE IQ	FFDPSLL HL		SAPVGV TAL		FVDIVKV LL	VTYGHE LIW	HFYGKAI EL	FYFPHYE V	VQYAYF KKV	AALFKA WAL
FAQEAL TVL	FAIPHSA ML	TFDLQRI GF		FRPELK VLV		SADFAE LEV	YAFDRV FQS	IFSIREVS F	NFNWG RVV	FSEPFHL IV	FAFLRFV VY
KALEVFP EF	SAAQPG VAF	YFDEILN KL		FRYFRM PEL		QADQTF ISL	NAVHW QPVF	AFIQEAA AF	HFLLGSI Y	IITKAYLE V	LAFLRFV VY
SNYHFG VTY	SAMEVV PAL	AFDLTKT NM		HYIDIER KL		EADGAA WVL	YSFHKF HYL	YYIDCIR QV	FFLPAAA F	KTGIPLN VL	HNALRIL TF
VALPVFL VI	AAEEGL REL	IFTPIVEH L		QRGDLI RIL		LADFSPL TL	FSGPPE PVL	TYQKLA RAL	AFNVSS HL	RNFHVF LEY	LSTPYIH SL
LVFPFRT FY	SAIPHPLI M	DYDPLV VKL		KRMQH VICV		QADEVI AIL	AAIDHQI EV	VYLYYKL AY	AYYAGH VL	LSDLHA HKL	VFQYRL VEY
FQRPNA LAV	TAMDV VYAL	HFDTIFE VF		TRGPVV RLP		SIDRNPP QL	KIPNFCV LL	FYVDTV RAF	FFQTHP YF	TSMSKIL KC	LSAMKE FAY
VANPNS AIF	FSFVRVI SL	HFDVLPT EF		RRYLRV QQV		HVDESG LSL	VASPQV HFI	KYPNFD VEY	YYQLSEE L	KINQLPL FL	TATHFP RVY
FALVFPL MY	IAAPNM KAM	HFDLSVI EL		RRTETV QKL		FADHVS SSL	FTAWRI LEV	AFLGEA NVM	LFINTSSY	KSQDIYL RL	AAFVKK LVY
YAIVRFN QY	LSVRPQT AL	VFDEVV QIF		YRFTKLL QI		IADHYM QVL	SAIPHPL IM	FFPALHE SL	YYYVGF AY	AQNRFL LEL	FVYLRQ PYY
FAEGFV RAL	FQYSKSP SL	HYDEQQ NFF		MRSRLL LSV		IVDQVM VTL	ISREHP WEV	VFVDRTL DL	FYQNHR RY	ASNIME VKI	IFGLRPV DY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FSSWVQ LEV	LAFPGE MLL	SFDVFH RAF		SYTHIRR IV		STDFPST SI	LAYLRTE CY	AFIDQS QSL	AYLSGH WL	KSIYPTL EI	LFSERID VF
SAYVKKI QF	ISTNSHP IL	FFDALD HVI		ARYHLV QQL		YLDGVH TVF	SAFGQIY KV	AYEFMS QAF	YYGLSNF Y	KSNYKM MFV	MSSPLS KEL
AALPFTK SL	LTVEPG ASL	FFDVLIK SM		KRKDGV VLV		YGDKIIE EL	HQIDLIV QL	IFNVAGY SH	FFFAGYY L	KNYDFA QVL	FATVRW IDY
YAFPKSI TV	LIHFSGV AL	SWDEHV FEL		VHVGH VVRF		ITDKGII AL	FAYHYP YTY	TLPHEIL EM	FYEDVSA V	SIYRVPL LL	FFAERYE SW
LTHPFFE PF	LAIPVFL TL	VFDEAD RMF		RRFKW AIEL		AAEKSIT IL	AAVSFIS KF	SYPHHA TQL	LFYLDYR L	RNFHPF AEL	TYGERV VAF
LLHAFQ ATF	MASGHF AFL	LFDVQR NNI		VRFDIIR RI		SADFVV ESI	TLVHFV VTW	AYQEAV RTL	YYNANR AF	VSVAHA LSL	SPELQAE AK
VVKMPS GEF	VAYLQA HAL	IMDVSL RSF		ARFYAV QKL		SIDFDQ GEL	KAVTHQ VKF	SFPQPA AVY	FYLSGTY Y	KSFNIPL LV	FAFEHSE EY
YSFDYPS DM	FSYSCPK FL	KFWDYL QEF		FRRPKTL RL		ALDKITA SL	SAISSVR LY	VYFTQG LGL	SFGKSIN F	KTNAIPL TL	FNSVRL WDF
IAHLFNV EW	FTYNIPT CL	YYDLQE VLL		FRQEKA VWI		FIDEQN YIL	FTGPLRP FF	TYVTEVR EL	YFQLHR AL	RSLDQQ MYL	AAADPK VAF
LADPVF RTL	AACSAF ATL	YYDLVKA FM		FGFHKP KMY		LIDAGV DAL	HAFSFPL LI	RLPPYSS QL	SFMINN VY	RSTLVL HDL	FATPVFI TK
EVYDDF LHY	FAIPMIH AV	VYDALN VLM		VRIGHL YIL		FSDVHT MDL	LAAAMV RVL	AFIDTAQ HM	YYYHAD FL	RSLHML LML	KAFARP WSL
AALPKA TIL	FATFPSS AF	TFDDVA VTF		FRSFIER DL		IADLPST QL	YAYEW QRCL	HYFFAVS TL	VYFVVT VY	RSVYHQ LFM	VAQITQ RFY
LAIPQLP SL	LSDPVHL TV	LFEVISH SF		IRIRVVQ ML		LFDEIDQ AL	FQAEIA QLM	SFPEVFT TY	YYLISRSL	RTYEKFF GL	FFNNRII AI
YAYFNF PEL	FAADLA EEL	SYDEAIL HL		ARAELE MRL		KVDELT TEI	YAFPKEF PY	SFIHAA MGM	VFLCARP R	TSHPVLL TV	YAALHG EFY
VVKPPG SSL	FASELSR SL	YFENLLS HF		FRIEGVK SV		VSDYTP LSL	QSFPEPL II	YYFFTPY VY	LFGTFSC L	KSLSVVT EV	LAALRL QSL
CTYGKP VTF	LIYGTPR AA	AFDLVNI HL		SRPVKLF RV		SVDISGL QL	HQSGIV QLL	FYTVAVT SL	IFNVSQ QM	FSFYFHE AL	LSIQRL WYF
ATYIFLQ TF	YSYFSPR TM	VFDTAIA HL		KPTRLEL KL		LIDESVH AL	KAFSVVI QA	GFPEAA SSF	VFLLGKV M	FTNRTV LEL	HSIVRLV AF
TAISLFY EL	FSVPHTK SL	SYDSKLV WF		LRNPDI RVL		YAEYMP IKL	MSYAEV MRL	AFMEKV RVL	AFLHPEE F	KTQYRA MFV	VAQYRP EEY
TIIPKVLA M	LATPVDL KL	HFDYQS LLM		FRNPVIE RI		LQDLTF VHL	QLLPFLV RY	CYQEFA AQL	NVPVGK VL	RMLPH APGV	FSYAFPK AV
LIRPVSA SF	YGVTVF KAL	TYDIGHV LL		SVYGKL RKV		MIDRDN SVF	IAVGTVI RY	YFQALV NNM	HYINGSL F	SAVPKV MKV	AANPHS FVF
FAYYRV GEY	FSIDPAR TL	TFDNIYL HV		YAYEW QRCL		ASDLTRI HF	KAYHEQ LSV	IYMQKVI YY	YFYNYPA V	KIYISKIV V	LATWAT KEL
NVYDFK TTY	FSYLNPQ EL	VFDEAIR AV		SLPSMI RKI		KSDIDEV AL	NAFMK AVEL	VYFSAA HAL	GVTIFVA L	AIYYFKI AV	SAAQRL TAL
VARPVF TEY	KAIDFAA SL	IYDKTSV LF		SRSEYL NRL		RADDGF HLL	YLKEFIHI L	AFADYV STM	VYLASF WL	ATAVVQ LYL	IAYSRPV YF
YARDET EFY	LAEAGV RLL	IFDGNV AHI		ARLDFV VRY		KIDDFP NEL	RVYERLL YV	LFMSSF QSY	IFLSASEL	VVNTHK LRL	FAKYWH IIL
LAHEFL QNF	SAIFNFQ SL	KFDAELL EI		IRSNRVI EL		NADLIQ VAF	FSYGTKI LY	SFPQLRA TM	GYAGFI MP	HAVHV ALVL	YASLRIE EL
LANGEV RIY	FASIPGL EF	IWDETPL YF		FRRWEV ADL		YADIEA AWL	LSFFYPV LF	VFPWHK NLL	FFKDRH WL	LGTDSH LVV	VAAVRE FYL
LGYYHK HAF	FAEDPPT SL	MFDIVG THL		LRFLHE NQL		YVDISEN HL	YTIPLAIK L	VYNVTQ HAV	YYYHAR VY	RSHGVL LEV	VLFLRTF QF
MIIEPTS PC	FATEVR AVI	RWDEAF RKF		SRAKAV RAL		KSDHPG ISI	SANHNI LQI	FFIDQAN YF	AFQAAL AL	RSLHLA VQL	TFNLRP NEF
NCPERII TL	IAINISRN L	RFDGRV VLV		FYHQLL REL		KADIPLV VL	MAHTG VIFF	YYISPRIT F	SYYSVAE L	ASTVRIL EV	LAIDAIH QL
FASIPGL EF	TAVMPK VSL	DWDLH QSLF		LRSEILH RV		LADAIN TEF	YAYLYIR ML	HYYGPA LEF	NFHPGT LF	KADMN VHLL	IFSPEGR LY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FSPFHASVL	FTLSHITQL	VYDFVGLLV		YRGPAIRAL		RIDQVNQLL	FAQHGGIYV	KYMNNITYY	LYLAERWL	RTLAEQLEV	VAYWRQAGL
HADDSFLVL	FVFETPFTL	KFWQFLETV		FRASSTLKV		RTDMENLVL	SAFPFPVTV	SFLETNVPL	LYNIGNVY	ASIGNAQKL	NATKTFREF
SAWSFITTF	VAVQHFSLL	KFDFPVSYL		VRPKVVRSV		SFDAVLEAL	FASPKIDSV	KFYSVNVDY	FYFEGTFY	KAIEVLLTL	SATGLARYY
TVQPHFLEF	GAVDPLLAL	VSDPVTVHF		RRYQDAIRV		FFDNISSEL	HIISFTVKY	KYLAVRLAL	NFIQARSL	KITEPFLVV	FVQQRYLSY
FAVARLEIL	RALEHFTDL	AHDVDPIEL		KRPNAILKL		VADLAFAHL	SVYSRVIQV	NFFPSGIDF	YFQVAKTV	ASFTRAYLL	FADGHVLEL
SAIRRLKEL	LAFLRALEL	KFDLAARTL		RRAENVLRL		YSDQPEIAL	KAIEKNVLF	VYFQMQTTY	IFYKWTAY	KLFEEFLEL	FTNPKVREW
VTYVPVTTF	LATTVRPVF	LYDVVDVKY		SRVNHLILV		ASDQPWSGL	AAANAIRVY	VFVEDVDSF	FYNAGLAY	FADKHIQVL	SANIRLTAM
YAANPGQLF	YAMDIVKGL	IFDLMDAKA		FRALRSLVL		LADLSELQL	KAIDYIRFL	IYYFKANVF	FFQQGTYL	FAYRGFKYL	VTSFRFVYF
FVYENPISL	VVNGRVLEL	SYDPLRIYL		LRALGIRLV		ALDEPTTNL	VAKMYISEL	SYPLFSQEF	VFQFKVDY	FTAKFPLYM	YAFPKAVSV
YSMDENLEF	FISGHTSEL	KFDPVGEIL		KRFSGTVRL		FQEADSPTL	YSLEHTVQF	AYNFPVTAM	YYFKANVF	KLNPNFLQL	YGIDTIRLY
SIFDGFRDF	SAAENFLVL	SFDAHLTEL		NRAELLLHV		LADLADFAL	STCEFVRTL	LYLTSCVNY	LYAISAVY	RSLAQFSYL	LASYIHYVF
YIQEHLLQI	LTTEVHPEL	AFDEAIAEL		VTVPLVRRV		SAAFPGASL	AAFQEAFYV	FYLPIAAAM	MFHTRNSL	ASNPKILSL	LSKGPGLEV
FLLDRLLQY	WATDHYQPL	FFDSVQVVF		LRPVFQQRF		SADPGILVL	AQISWVTVF	LFIPRETTY	AFGTGVEF	KTQIRDVKL	VTQLRLIFY
LAHAYFAQY	FADDGVKYL	IYDAAIDLF		SRPAIVFRI		VADLIGLNL	CMVEIVQKY	NFFTKATPL	FFQRVRAL	RSMAHILKA	FLTELTRLF
FAFDPSVNY	FAQEALTVL	ITDVQLAIF		RRFPRMLLV		VVDLAPLHL	FVFSTVVIH	RFLENALAV	VFLGGAVL	QSIGLIQHL	KQFHRIVTY
YAMDELRSL	SSIEHLTTL	IYDFIGEFM		YVRDLRSIV		LSDLGISSL	KIIPLVVKF	VYALQQTAL	SNFAVSTL	SSYAKFNFV	VANPEHMEM
LIHGDFNEF	VADPYVVIM	IYDLFQKSF		SRIGHIAHL		VADRLLVEL	SLAPYVKVF	VYQTYVNAM	AAPEGVPL	ATAKNVLKL	TASNWLHLI
FAATLEQVY	FAIDIGGSL	NFDPPIEEF		KLPDLERLL		LADLGLDSL	MAVYLVKQL	IFPEGFVEL	GSNLVYFL	VSNDLLLKI	AFQERLNSY
FAVGSFHTL	LSVPRSVPL	FFDGLQVIF		TRIPRIRQV		LSDYDILSL	NAFSGVMML	AFISKVSTH	YSQMWRMI	AVFPHLTVV	KAYLREDFF
VAAPQLPVL	FSQPGLRSL	VFDVIIRCF		RSYPHLRRV		KVDEAVAVL	NSSPVINHL	IYQQIIQTY	AFMAAESL	RSWDQQIKL	FSEPHARFY
SAAQPGVAF	FAHQTISAL	FFDVTYRHF		SRYGDIRRL		FLDDLSQKL	SAVTFVLTY	WFIPFVQSL	VYFEGSIY	GSNLFKLEV	KTTKFIKSF
TARPPGYEF	LVTDIQPVL	SFDEIHQLF		YRIELLRRL		GVDLPSVNL	FSFFDLIRY	LFHNAVSAY	INPSELTF	KSYGERLQL	RTTFFHHEY
YAIGVSHPL	FIAPSGHGL	YYDVAKQLL		FSFQLPRRL		IADLAHLLL	FAFEGILIK	IYYQSPLSL	LYQTPDSL	KQQQWLLYL	NAIWRAWYM
YSFHKFHYL	YAFSPRNSL	VFDAREL EL		GKRRSIFRT		LADIQIEQL	QAFPLIIKL	VFYPYPQYF	AYVHMVTHF	RSHYSPIYL	VLALRPWSF
FSYDTFVDY	AAIKPGTPL	YFDDLKGEM		NRSNICRFL		RTDRPNFEL	VAAPFRCEF	CFYGFQIAM	YFHDRFLEL	RSQSWILSV	SASEVLKEW
YARLHPRAV	FATIRTASL	LYDTHITVL		SRSRITLLL		ASEEPWTVL	AAAALHPAL	FYISPRITF	YFHDRVASF	ASYSGLMRI	VASIRLFGF
FATFPSSAF	FVIPVVQAL	NHDVQVILF		LRSDIVRIL		IVDDFGTHL	FFIAGRYEF	SYENMVTEI	KFKEVGEAF	ATLTRPLAL	RATKLLKAL
LAFSRALEL	YAAGAKLVL	SFDAVLEAL		MRAAINQKL		IADPDQPVL	FINSRIITV	VYPQYVIEY	RFPDFVRDF	FAIDPHLLL	FSMYKPITY
LAMKLLKEL	FLIPKFFEL	HFEELETIM		AASPIITLV		ILDEVDAAL	SAYGSVKAY	LYAIRTQEY	TYGERVVAF	FAYPAIRYL	IATKDVRIF
CAMPVAMEF	FGYDKPHVL	SYDTFVVRV		YRQKQVVIL		VLDNPTPEM	YSKLPGVSL	RYWNSYTEF	HYPDFHQEL	KSMSQLAVL	YISFRHHVY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
RAAPFSLEY	FAIQYGEDL	VFDPVQKTL		FRNPLKVLL		TSDPALLSF	MTPEIIQKL	LFHPSNVEM	VFQYRLVEY	KSWADVVKL	FGLARIYSY
FSVDQLMEL	LAPAGAAL	VFDVSHNAV		YAFTRIRSI		FVDVQPSSL	RAFPYGNVA	FYNLSIQSF	KFIDKQLEL	KSFNSVHLL	KASGIIHSY
VIFEGFFAH	YANAVLQAL	HFDGFVVEV		NRTDLLLKL		VSDVPSLSV	MSFENQVKY	VYPEYVIQY	MYIARQLSF	RIYPFLLMV	LLSLRILSF
YILDQTNVY	TAIDRYLCL	LFDDKAVEI		WRYPEPRVL		IQDEIVDFL	HAFWGGSVV	IYQYVLNSM	KFIDTTSKF	HSIHWPCRL	KASLRELAL
FAVIAHVGM	FVAPPTAAV	FHHTIGGSR		YAIEKVREI		FVDLSGHNL	SAAPLPLYT	NFHGEWLEV	IYQELVTKY	GTNFRVLLV	YATLREESL
SIIQRLLEV	CAFDHGLEM	LFDANAEL		QRSVILHLL		MADAGILRL	TAYNLVHEL	SFLAAAETL	LMVHTVATF	KCLELFSEL	FGFHKPKMY
FLYSGHLAL	VALPVFLVI	VYDTNPAKF		SAPIFTTSL		VSDSALQEL	YASRFVQLV	HFPGLASEL	HYITPMMEL	RISDIRLFI	VANPAFLKY
FSVDSPRIY	VVIEPISEL	KFDVQWIFV		TRIPRVRVL		YADFAPSLL	ASYSGLMRI	FFYTHLINF	NFIEKVEAL	SVTQIYHAV	IAMDLILKM
NAFDVFAAY	FLPEAPAEL	TFDIEAVTL		RRSGLILTI		AVDKANLEI	TLVDFIIIH	FYLSKMISM	AFQERLNSY	AINPKLMQL	KATFIIKII
IAMPLHMIF	HAIATVASL	VFDGKPPQL		KRTPLLTRL		FTDDQLLVL	SAANIQPIF	LFPDVVNCM	RYQDAIRVF	FSSWVQLEV	SAIDRIFTL
LASPESLEL	YSTGHSPAL	VFDIHLAFL		FRAARLIKL		FTDGITNKL	SAFEKPQII	NYIEFTRIL	LYIHHAIDL	KLVGEFLEV	FGQLRDFYF
FARPASPSL	SAPYGRITL	SFDKLEAVV		LRAPQNLFL		KMDLPGVSI	YNFEKPVVM	AFPKAVSVF	SYQRAFNEF	KSMDAIRSL	SAGLRLFAL
SALEKFFYF	AAASHFFNL	IWDQDIQFL		PRHLRLLRL		RTDPVPVTI	FAIPMIHAV	AYQFFREAL	MYSIMVHAL	RTTSHLLRY	YAAFKRWHF
YSYFSPRTM	CAIPQVMAI	VFDLQWLEL		VMPNWVRKV		HLDLSFNSL	VAWDIPITY	SFFTNANSY	VYIDKVRSL	ATAPPHVTV	ASLLRVEPF
QIAEFKEAF	YANSKAVTL	YYEEQHPEL		CRYQGPVLL		TSDIYFVSL	TSYPDPILL	SYLIARIAL	SYLPHAPPF	ITNVQILIL	LSFVRAFEF
FVHEFFYSF	AAVAVFFIM	RFDEGPVRL		LRKRGITPL		GVDLVLNSL	ATYHRAIKV	HYYSITINY	FYNLIHPEY	ASLSHQSLV	FGTIRTIDY
FAASGGFLH	FAQAPQLSV	HFDPEVVQI		IRKENPVVV		KNDDFMNAL	FQIGKMRYV	IFIKDSNSL	FFKERVMEI	ASVVTVLRV	FATLRWIDY
FAVNMFRTL	VAMGYSHSL	VYDVTPPEL		VRFTRIQNL		ALDPPGPTL	FSHAQTVVL	IFPDRATLY	FYLFHVQEV	KSFSHWSKL	FTGPLRPFF
SAADFFSHY	HSIGSYFTL	IWEEWPLLI		HRFYMIQSF		VAEEVNAIL	VAYWDVLKA	RFLDKALEL	SFVWHALDY	KSTGNFLTL	KVTELLRTF
FAISILQQI	IIINPSSSL	LWDPVIELI		LRFFREVLL		LIDELNQAL	RTYPVEILY	FFTDNVPAL	SYLEERKPY	KTYDKTVAL	MAFNRAASF
FTYDQRTEF	YTTDFIYQL	VFYPFVDLI		TRARLVFRV		QADLAVLVI	AASDFIFLV	RYLYMVMEY	FYQRFPLSF	YNWERALEL	YARQLEMIV
NIREIEIDY	AAINPNHPL	AFDLTEQRY		ALPPKPRFL		VADGYPVRL	LTYPRAVVF	VYQNIFTAM	LLPHYPNWF	RSIIFANYI	YGQWKNETY
LALEPGVAY	LATDAVQIL	DFDVAVVTF		YYKERLLYL		FADFLVYEF	YTPDWIFLL	FYPIYFRPL	VYSPHVLNL	KGIGHVIKV	FASHVSPEV
LAMEPTPEL	VANPNSAIF	TFDAHLTEL		RRIEIANAL		MSDLPVKVI	YVFPGVTRL	KFLVAVESM	RWPDYVREL	KSSDQPLTV	VSNFKPGVY
YVYPKYLKY	FAVGVQQVL	IYDEAISSF		VVPEPGQPL		LADLPQQLL	AAFQHLLLL	YFPELIANF	VYLERLLTY	LRLSYPLEL	NIRLRLEEY
FVYKGGKIY	FSDLTMHEL	VADPYVVIM		IRAAWTRAL		QWDLVENYL	AAMWALQTV	LYNIMKEGL	TFGERVVAF	YNQGFEIVL	YVVEPYRKY
FQNPFRSEL	YSLDFGGHL	IFDPLEIIL		IYVDKLDIV		SADRFVTLL	VAFHTQLFF	RFPDLTVEL	IYFTRIIAF	ASFDGTIKV	ISRDPFYEM
LIYEHLQQY	FASDIAPFL	SFDPKDIFL		KYCQVIRVI		VWDIVGTEL	HSYELLVEY	SFPENLRHL	KFLAAGTHL	KIEVSFREL	SQQYRPYSF
YAYTGRLEL	FLVEHVLTL	FFDACEVLL		FASVLIRRI		SQDARFYAL	AAIEWIIEH	FFPLHPMMI	AYYAHLVAF	RSIEHLKQI	VQMQREWSF
FALGVYRTL	FSSANSPFL	FYDSELFRM		YRLHHVVVY		HIDVMYTTL	EAVKWMVVF	FFTSKALNM	HFIRPGNAL	SNIDKSLYV	KAYVRVLDL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YAAGAK LVL	AVFGHP FSL	LFDGAE VVL		LRSQLIL KL		NGDTPN LSF	FVFPGEL LL	AFIITGQ TY	NYNPAQ QAF	TAYLFSR FV	KTFARYL SF
SAIPHPL IM	FAEDSLR VI	IFDLMEY SL		IRYQHL MTI		FAEGFV RAL	NAMPHI KTY	YYINRTF FF	WFHYTL VAF	TQNYLK LLL	TSFIRTIE L
VAMIYP LEY	VATAAD LEL	YFDESFF HF		IRFYYEQ RL		SADSLE HVL	SQANIA QVL	YYMDYL AAL	LFIEHSV EV	VSTSHLL IL	YSAAKS WVF
FQYESK VFY	FSVKAG EAL	FHDVAG DIF		LRFNKT VRV		VSDEEM MEL	IVATKPL YV	FYEETKV KF	TFAPQV HSL	VTNAVL HEV	ELYQRIY AF
FALPYIR DV	TTIKPGL AL	FDPSLLH LL		SIPGGY NAL		YADDNS LLF	RFFEAIV WY	IFIPKTEE M	VFGGQR LTL	ATNVVR LLL	IATPFIKL F
LVREIAQ DF	KIVKWD RDM	TFDDYLE LF		SRFARL QKL		VLDEPG QDL	AAFYHP VRY	IYPYAAIS Y	FYNNRL QAY	AVMKQ FAFV	FSFVRVI SL
FALDSGL EI	FLVHNV KEL	FYDEIKIE L		YRAQLE VKV		FAEGKP LAL	AAYGYG IRY	AYMPHT FFI	IFSIREVS F	HSFNVP MQL	TASPVIK AV
IASPVQP VL	FAYMPN NSL	IFDPVKQ QF		SVIDHIH LI		KIDDTIR YL	HVFDHP WET	KYMLTH QEL	HYINEVL FL	RIPAYFV TV	IFSIREVS F
FVNPSL RVL	HFTIPMI II	IFDWVE ANL		KQAEIV KRL		AQDLIT RLL	IATPFIKL F	RYIPTAA AF	KYPDYEV TW	RSFPSV REL	SSAVRAL EL
CINGKVL IM	ISTEVNP KL	YFIKPPV YV		TSIGWL RLL		VADAIR TSL	KQFGNI LIL	FYEDNVL YM	VFYELAH QL	SIYVKFP LL	YFINRS WEW
SILEKTS AY	LAIFVIC QL	VTDPRV VDL		KQFPEVI KY		YVDVQK FPL	RASWIA QVF	RFIGATA NF	SYIEHIFE I	TSSQKA LML	AASYVR KVI
FSVEGQ LEF	LAVPIFV AL	FFEGPPF KF		YRPFEP QAL		STDFPQ MQL	FAVGIC NKI	LFHEVV QAF	SFLDLAR NI	AQYEHD LEV	LATLRNY DY
ILGPPGS VY	VVKPPG SSL	FTEDHY VEF		ISFPDPK ML		VMDEIH TVL	IAASYVK YL	QYIRTFV DY	VYIEHRL MM	IIFDRDL VV	KAIDYIR FL
RSFPGF QAF	FTFPDPP PL	YYDPKH VIF		NYIDKIK VV		ASDVVF ATM	NAVNLA IKY	AYPEYLI TF	AFIFRSL NL	TVNLHL LML	SFFNRL WEV
LLYIFKQ PF	AIVKPGV PM	LWDEVL SHL		KLASYV KFY		IVDIPGT SV	SAVEVC VVY	IFQDPRS WF	KYIHSAN VL	AIMDLL LRL	HFNPKIE SY
TAMDV VYAL	FSHGQV VSL	FFNYKV VLL		RSFPSV REL		TADISD VWL	TAYPSLR LI	FYAKGAL QY	IYIINVHS M	ATMKR MLSL	VATTRD YYF
RAIEGLA TL	YAIGLV MRL	IWDFVS GSF		ITFPGIK LI		ALDVPN TML	AAIEFIS KM	VFLEAAK AL	LYFIAPT GH	FNNGW MIKI	YMADRL LSF
FADGVY LVL	YAYFNFP EL	TFEDVA VLL		IHPDIFP LL		FTDVIG HYI	NTINLIH TF	QFQEKV AEL	LYHFSSS EL	LALLHLL YL	SSSYREA VF
FAYMPN NSL	AAIAAV NAL	FFDEYFV LL		FVKDSIR LV		LIDLPGT EL	YIIDTTG KL	IYMGHV KGY	FYIHEVQ EL	QSAQH ALRL	QSSSWT RVF
FTMPLH MTF	YASSPG MSL	SFDETVT HF		YRNQLL NIF		LNDLQA NSL	GAVDRV LQV	HYYQKA LEL	KYQIINE EF	VSLGHIS ML	LSFPTTK TY
FAIGILCS L	LASPESL EL	NTDEPP MVF		SMKAFI SKV		YVDVVK VLL	IAFGFH QLY	IFQEPTE PK	YYYDKNI IH	VTSSHL PQL	TLNERFT SY
FARPGD VEF	LALAIAQ EL	VFDLQW MEV		YRPLYPF SL		FGDDIPS AL	KTPDFIL QV	KYPASSS VF	FYIPKIQ DL	KTLSAIL RI	FTVPHT HVF
FCMDRA LEF	LLPSHPL EL	TFEDVA VTF		IRDDHIR FI		LSDPTYR EL	YQYPRP LLI	AYYVSN EEL	FFMLRSL SL	RSEEVV RLL	KLSEIVR EF
FAYHYP YTY	NVLDHF SEL	VFDQPQ EYF		YLFERIK EL		SVDKPG IVV	TAFVEPF VI	IFFPGVS EF	YFVDDR LVM	RVVDRF VEF	YASLHG RIY
YIPHGY MEL	YANKYNI ML	NYFLWT EKF		HRGDIV SLV		LADLAK EEL	WAAPIR KLY	YFIRDVK SL	IYMDTL NIF	VTFKSIL FV	ALTEWL RFY
FVNPGV VEF	FFMLRSL SL	SFNDTFV HV		VSLDFIR AI		FSDIPSP YL	QSFPGIL KA	LFFDSKQ SL	IYAPKLQ EF	FTLSHIT QL	FFKDRH WLF
IIAEPGR YY	YSSPLFR SL	FFSPKVV SL		GAFGEV RLV		ISDLSEH VF	SAAPLQ PVL	SYMWTI NNF	RYMVHL LEL	RSNPKI WNV	FGLARA FSL
SAMPTV RSF	FAMIPA KEA	TYDYGG FTM		IAIPFLIK L		IVDSARS IL	SVIDHIH LI	AFLEQA VSY	FYSNHG LAI	LATSHM LEL	FATPFLV VR
SSVPGV RLL	KADMN VHLL	AFDIAEK EL		IRKAEIIK L		TADIPAL FL	RAYSFK VVL	AFLKTAL EM	VYQEIWI GM	ASVGRL LEL	FAKEHQ EFL
AALLFVE AF	LTNFHG MDL	LFEEAFA IF		NRFNYP FEL		FVDPVL NQL	TASDKIL IV	QYPENIL SF	FYVRLID SM	RSMEE QLLV	TFALRYL NF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FLLPVIN EM	MRYLHR IYV	IFWFFRE AF		VRPAEP AFL		LSDTVR TVL	HAMQF PAEL	VFQPSV KSL	VYIDRVR SL	QSLRLF REV	FAYLRDL LI
KIHLFSM AF	YSFHKFH YL	TFDEVLE LM		DAEAW FTSR		HANLTT LTF	FSSDLISI H	FFFAPAS SY	KYQAVT ATL	FTHSQFI VV	FSFVRIT AL
LAIPVFL TL	FVIQPFS PL	VFEHDS VEL		HRPELV TKL		QSDIPSS LL	ISKSPW TCL	FFQDKA RFY	HYSFYIE TF	IVNGHT LLV	IANQRIT AF
LAQQYY LVY	GAFQPG RPL	HYEGAV VIL		HAFLYIR QL		MQDM VKDAL	LAYHLA VVL	RYQFIEE AF	AYQKQP TIF	YQNHLI LKV	KSNPKPL VL
AAIKPGT PL	AAAIPRT PL	IYDVQH ANL		YAFPLA HSL		VVDDIV SKL	RAFCGIL YM	SYIYGAQ HL	AFADIIH SL	YTTDRV MTV	LSQNRV AEF
AAIDPR VQY	FVEEEEH FL	AFDISKK EM		ISAELIRS L		LIDLPTC EL	YFYDRR RIY	LFPGPSK PF	IFYDRAE YL	RINAQY LEV	FARQYY EML
LATWAT KEL	YAYETKD AL	IFDSKVT EI		FRFPSG AEL		VADEGI CYL	LAKAWP TVL	RFQDLIR EL	AYQWM VPFL	SLIKYFLF V	VWNMR LVFF
FQYPDT RYL	FAHPPLL VL	VFDNVK DFF		LAVNLT RVL		LGDVG MAEL	FTANQV KIY	IFPEFLKE L	FFSEREA SF	FSNKHS LVL	YSFTHIV PY
MSVQPT VSL	FIDGHFV EM	SFDDLIA CV		IRGSKIR FL		QADVA VLVV	VAMER VSVL	TFIDPRIP L	FYVNRIL WL	KTSSFIR HV	AAFTRA LEY
SAVSIFH EL	SANIRLT AM	TFDPMT RQI		YLADLY HFV		GIDVQQ VSL	YMVTIV HIY	SFHTHV KEL	LFMPRS TEF	RSHLNF SML	FQRPNA LAV
HSHLLKT PL	YGSPNA LVL	VYDTVVI TL		KKYPFIL EV		LIDEPSA YL	QGFPNR VVF	SFPVNYK SL	YYEIRYQ FY	ISLLMRL VV	SAAFAV KLF
FTADPLS LL	FAVGVG EAL	FWEQKP LLI		VRPDLR QDL		NIDEIYK AL	IASWLV VTV	RYVAIAR AL	AFLKTLV EY	RTLPWA SVL	LASYVHY VF
AVFGDF EQF	FAMYPP SMI	RTDPVP VTI		KKPNFIL LL		AVDAVI AEL	QALPQV RLY	AFYDPT HAW	TYQVLA VTF	IANTVEL RV	LSIPYRLI F
AAFDNF KEV	FGYDYPS VL	TWDDAF ATF		AASSIQ RVL		TADTILN TL	SATELM NIL	FFYPLDF TF	YFLSRAQ SL	RTFPWII EV	FAYYRDL VF
VNNPHF LIM	TAVPYFS NL	LFDIFLET V		IQYIRPV FV		FADQEV RSL	VAFSQV LTI	RYLTVAA VF	YYLTHGL YL	TIYDRFV HL	ISVERVIE Y
FALPFG RTA	YAEMGT RTF	TYDEIGV MF		ERPLFP QIL		NIDIQN GFL	YGYSNP KIL	FYNTSIE EM	SFAAVIQ AL	IIFEQIRF V	LSQERII QF
SAPYGRI TL	IASPVQP VL	VFSTVVI HF		HHIPDVI TY		FVDFEGI SL	AAYPQV RCY	TFIDDIS AY	VFPDFYL HL	KTIEWA EEI	MSLPYR LVF
VAYPCAI LY	FGHYQQ AEL	VFNETK NLL		MQIELA RYI		VSDGVP LVL	FIHNFVE VL	VFVDRA ACF	YYTVRQL EL	RSSPQEI KV	VAATR WWQL
AAFAHF PEL	HAIPPTL AM	CYDLAEL LL		LRHPGI VNL		FADREV QLL	SAVDKVI FV	FYLVPAC SY	FYGDLRK AL	ATYHRA IKV	VASQLP RIF
YAYPGV LLI	FAADIPR IL	TWDKIA VSL		QRPSAI QLL		MNDDIT TSL	KIADFG WSV	VFIDEID AI	AYIFRPE VY	RVYERLL YV	TASNTF RVV
FAIQRTT NF	YAIALIN AL	KADGVP VYL		FHPTMP LIV		VADAW GVEL	QAFSRV QIY	IYPVNAI SF	LFYFSNE KY	KSSPSIL AV	GMLLRL EEF
FAYDGK DYI	YIIIPKSSL	SFDVAD RMF		EGYPFP REV		AAETPA LEL	HQSTVD WIV	YYQNHI MNL	FFKLPGG EL	KTTLAL HHL	IAKNVFL HL
FAIPVGS GL	FAFSCLL TL	YFPEEIA KL		HLPSHIR IL		FLDQHG HNL	YVIELQH VV	SFLATGS NL	KYNIML VRL	GSYHRI RAL	MQIAW SREF
IASPVIA AV	IAAMPLI SL	NYDLALK YF		RVSDILR YL		VADFGLI TM	KTFPEII DY	NFQAIR VTL	YFISHILA F	KTLARA LGL	FSKPPN PAL
FAVPHT YNY	SVIIPGM TL	RFDVHD VTL		VTFPGIK LI		FGDFSP TDV	VAAHLV IIM	AFNVM GEQF	WYQRVY QSL	LLNDHIY VV	TFQLRG LEF
FAHDST RVI	VVPEWA SCL	TFPQNP VEL		AAYQSV RIL		LLDEPT NML	YASDFH NVL	YYLVKRE DY	AFQVLV KSL	RNYEYLI RL	YFLNRKL VY
FSSDVT HEM	KAIGLFIS F	IWDPVL SVM		IIVDLAR YV		LSDDEIV SL	SAVDFIR TL	AYINKVE EL	NFQWP VLAF	TATMHI LVV	AAMPRI YEL
AAFWAF TVF	YAFPVS NNL	VLDDKL VFV		SGAGIL RMV		NVEEAF FTL	YAIHKIA KM	SYLPEAG QY	SFPNVY HEL	HILTKILY L	SAVQGP PER
FANLPN QVY	ATIPPISS L	FWPPYV ELL		YKAPITN EF		QADTPA LSL	FAQEAL TVL	FFMLRSL SL	SYLIARIA L	KIRPHIA TL	YYHARV YEF
SIMDEF QEY	FAYTGQI LL	HFDYSP AGL		FKPTRIIF Y		SWDEA VQAL	FTIFRTIS V	FYPEEISS M	YFISHVL AF	YALNHT LSV	AMYSRK AMY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
CVSPWI VTM	YASNITS VL	KYEDGIA LL		LRIEFEQ TL		FLDDVN LIL	LAQAHI QQL	FYNGPV SKF	RFPEHV REI	MTISVE KKV	KAAMLF RQY
FATDAIL AT	YQIAVTK VL	FLPEAPA EL		IHVDFP VIL		IADLSHE AI	IASAIVN EL	SFISEAES L	IYPEVVH MF	QQTPLH LAV	FFYQRLV EF
FGIDRPA EL	HAPIRVS PL	MFNDTL ELF		GRFPQV QAF		LADEVIT VF	SAMVRV ISV	VYPPPH QVF	FYEERLT WH	QSQRVL LFV	HAASVF LTL
YARAKFL DY	FAIPVGS GL	FFEEVFT EM		SKIDFVL SV		LTDDHV QFL	VAYWR QAGL	YYYNGK AVY	YWPDVI HSF	FTIFRTIS V	SAQDRQ LTL
FAPYNK PSL	HAPTYTI PL	RFDPVR VDI		QYSNNI RQL		QIDQIN TDL	LLPSHPL EL	IFPLIYSE M	KYLATLE TL	VTSNR WLMV	FLYPFPL AL
SAFSGFP SF	TSVPPGS AL	HFDDFV TNL		SAFGNV KLV		VVDFVA ATL	LAVSLVK VF	VYVAAV REF	RFQDLIR EL	KVIVRFL TV	LSSWVL LMK
YGIEHAL AL	LAAFPTT CL	HFDLAST TI		TAVALL RLL		SADFVV EAI	MSLHFLI LY	YYQTPRL WL	SFPFVSK TL	FSIDRAL NV	MFLIRD WSY
KAFSFLS SF	KSTSVILF L	AFDPAA AAF		YRPAYL VTL		ASDVVL EVL	ASIYFCI HF	FFHYAV DNL	SYFPKILT F	MSVDR YLAI	VAYLRFL EL
VSSFVFL RF	VSPYTEI HL	VADPVE AVL		HRNPLP EYL		DVTEYPI EI	CTYGKP VTF	FYPEEVS SM	SFFPKSP AL	HNLISLL EV	AAMDY HWVF
FLRIAFN SY	FATEGLR TL	LYDLSKV VL		SRALTIQ LL		HSDELT SLL	RVYPQA VYF	KFPEIVA PL	VFHVSN LEF	HTVGFIL QL	FSSWVQ LEV
FAADIIS VL	TIYHMFI AL	YWEPAE VFL		FKPDDP NLL		LLDYPN NLL	VAADIL NRL	FFHLVNS EM	AYTLGVK QL	YNNFKS MVV	SASSFFK EL
VVYPWT QRF	LSVAPQ QSL	YFDAIPV TM		FRYPQD YQF		YGDEIAI EL	VAFPKSL VA	YYVWTV KEV	KFLEVIK PF	FNIDRL QEL	AAANAI RVY
HAPFTA TSL	NAVPLFL RL	FFNYTVR TL		FSYSCPK FL		YSDTQF PSL	MAQRL VRVL	FFQQTT TSF	RYQFIEE AF	FASGLIH RV	FAKVHIL YV
WQNPH MLFL	YSIYVYK VL	AFSLAEA KF		HLVDIV RSL		YSDVILE VL	RAWFPP AIM	FFVENVS EL	LFALHAS QF	KSLPLPS SV	LSLHND HPY
FADGFV LVY	FANGHV NSV	SYDVFQL EF		ARWQQ VWLL		ISDEECF VL	FQNIRPL FI	SFMSGA DSF	IYVNMK TDF	RTPVQ MMYL	RLFVGA RIY
YSSSRTL LF	HATQAIF EI	TFDDVA VHF		VSPYTEI HL		NSDDIG VFL	VSPYTEI HL	TYFIVGT AM	NFMLHL VSM	SSSHLNL KV	VATSRII KY
MANGA VIHL	LASPPW RVL	FFEVFTP VF		LRPQMS QFL		VSDLGP VVL	FPYPFQ VVY	AYMELV NNM	SYLELVK SL	SSSPRP VAL	YGSEGR FTF
YNMPYP PVY	FAFDEIV AL	IFSEKPV FV		YKPNLI QAL		YADFGP LNL	ASYPHC LQF	RYLGGS MDL	FYMVRA QAW	VSFSRPL LV	FANLKY VSL
IIAPPER KY	FLQDTRL AL	NAPLVH ATL		QRFLEV QYL		RADYDN LVL	ASFPHL RIL	VYNYAE QTL	AYLEAYK EF	YLNDLIH SV	HFYMRK VKF
GALDLL KEL	LAMEPT PEL	SWDSRD VVL		QSTDIIR YL		FLDDNQ IVT	FTYDQR TEF	YYQHIVT TL	FLRDPAE AL	KALETLR QV	FSYAFPK EF
YAFNMK ATV	FSMDIID SL	VFDLTKE IF		IITDLLRS V		ILDISEH TL	MAAPK VRFM	CFNPMK SVL	FYILTSKE L	KAVQPL LKV	ILTERGY SF
FAILRQA EL	LAAPSPA AL	YWENKI VRI		FQKERA IFL		QADNP HVAL	AAADSI KIW	SFAAEAI AM	TFAEIVT PF	KCLELFT EL	NSTVRLY EW
FIMDRA QAL	TAIPVTQ EL	IFDGIIVS L		EYIKFLR SI		SSDKPG LDL	NSFGFP QYV	AYQVSV CAF	FYPDLGP EL	KGYGKIL EV	AASFYQ RAL
TAMPKL LSY	VAVSPSL DL	NFDEILR VV		FVADLQ RVI		NLDLQH NEL	RAIDKC WKI	RFQDQV LDL	NFLLHVT AL	KSFEGLF YF	LAIEHVR FF
LAREFLA AM	YTIAVIN AL	HFDFDLE DF		VGEFSG ANK		ATDIQV LAL	TAFPKPL LT	NYHWQ ETAY	IYWDGP LAL	KSNPIIR TV	FAMDVY KNL
LAVENL PSL	FLYSGHL AL	TSPLRIV AL		IRHPNII TL		VADLVV NIL	HAYPYP QMY	TFNEDV QAL	FYVGEII GK	KVMELL VHL	SAGLRVL AL
IAIPVTV AF	FSSLTNL PL	VFDDMI NLL		SRAFLA QAL		NADGKII SL	FASTILH LV	FMHVQL EVM	AFPSPFG HL	KALELW MQL	VGYVSG WGR
LAILFGA TF	YAISKPE VL	YFDDALE DF		TKPNFIS TL		LADEAF FSV	SAFYFV MKF	SYHSYVI GF	FYVPFAK AL	KSLNFN MSV	VWKLRI VSY
YLNDAF LEF	FTIDGPL CL	FYDECLR KY		SYNYLIR YL		YADVGG KQF	YAKIVEI PF	FYPPDPA QL	AYAGAR FVF	SVNRYIL QL	YAIHGVL EV
AIVKPG VPM	YAYLYIR ML	MFDEKL VTV		VTYNYP VHY		YLDKATL IW	FGIPFLL RI	HFIFFVQ EF	IFPDRAT LY	VTNPNE VKV	SSSLRVL VY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FVFPGEL LL	LANEHN VAL	VYDPLFS QL		KEEVVT VET		FGDDW GSIL	YVYEYLL HV	IFPAKTIT Y	LFNEHIE AL	ANQAFF LLV	TLQERLL AF
KAMGI MNSF	AALLHFF FL	FFDGELT KV		KRNDYV HAL		FLDSEVS EL	GVISKIII F	FYLNQST AY	FFQDKA RFY	RSFAQV LEL	FTSEKFL VM
KAFPFYS SY	VAVNPH LHL	IYDSVKV YF		YRVPN MRFL		LIDFGSG AL	LVSQYF QTV	FTIFRTIS V	FFQETNI PY	RVSELH LEV	KATAYIL SV
FSHEVG SEL	FSHSSNL TL	LFDLALR GL		MRPTLL WSL		SSDLGL QAL	RAYPTV KFY	SYIIGTSS V	RYFDHA LTL	SSDPKV LTL	FAVISRH SL
FSNPYSI EY	FAISILQ QI	VFDPKV FTF		RMPELV RQL		VGDGIG MDL	VAFPTEI KV	VVNIQTI AM	RYQFTP AFL	AAFEKA LEV	TFGERV VAF
FTSLPGS TM	VALDFE QEM	AYDDKIY YF		ARLDLE RKV		VTDLNS LEL	AQGPTP RYF	YYQYME TYM	KFQVAT DAL	LTNPELL KV	FFSEREA SF
IAIDVID AY	YAPGAR LAL	YFDLLGE LM		YKFDFP VSY		YGDLGG PII	SAMPTV RSF	RFYEGV VEL	LFHTIGV EF	TVTDRYI FV	NSYLRD QWF
LAWVSS QFY	FALPYVI VL	FLYPFPL AL		ARSELYL RF		RADLTY AEF	TTIDIGV KY	FFLARPT TF	LYASKIIS Y	ATVKIIQ ML	IAVLRGL AY
QATPVP LEF	FAVNMF RTL	FYEERAL YL		KRAITV QEI		YADIVQ LLL	AAVQLI WVV	AFLEAA DNL	AYINRAS LL	IGVSHPL SI	LAQIRQ QQY
FLCGVM KTY	FATDAIL AT	KYDPSYI EF		FIKSFLV FI		SQDLTH LNL	AAAPQL LIV	SFIQGTT TM	VFPKEPV EL	RTFDEF QEL	SAFLKTI AL
FAQPSG LSL	FSMNDS PSL	NFFEWE ALI		THFLQPI YL		FSDDNK ITI	KIYEEPII L	SYFPKILT F	VYQIAM VHY	FNLSRIV TL	VSSVRW ISY
FVNDYIL YY	IAIEPGA AL	FFEVSPV SF		FAKVHIL YV		NADLFR GTL	FAASFA HLL	AFISLAK TL	HFYYFVK EF	KAFFAK MVV	LTLLRFL EY
SAYAGF LAL	IAAPTSS AL	SFPEHPA FL		HRNEVT VEL		AADSAV RLW	TAYYRLL IT	LFEGRRI EF	SYQILTR QL	QSNPLLI HV	SAYVKKI QF
LIREYIVE Y	YIVEAGA SL	FFDHQD QVW		TAQTLV RIL		EIDLQK MPL	SVVSFLL RV	FLPKGYL AL	PYQEFT DHL	ISSHIPLII	TVSEWL RLL
FALPILN AL	FVYSGKL SL	FFDSIEK GF		VYFWLE RTM		YSDHSW VVM	AAFHNF IKV	FYLDNVI GH	SYQFAA VQF	FSFQRP LLV	VAQTW FRFL
FLHEFS MAY	TASPVA VSL	SWDKIL ALV		YRPISAS VL		FSDTGN FGF	LAIPNLV IF	FYISWAE EY	TFINNVI SH	TIYERFV LV	FGSLPKV AL
SAPVGV TAL	LSFWWP LAL	LFDARTS LV		KVVDVV RNL		NADLPI ATA	AAVPAV IQF	SFPFVSK TL	FYTAIAQ AF	VIFTKFD EV	KASDAF HFF
FAASVA HLY	LSDPTYR EL	CFSLQET VF		RYPDRIT LI		VSDEM VVEL	FAYDGK DYI	SFMIMK TNF	KFYYSKIE Y	AITDHYI QV	KATNVV RLL
LTVEPG ASL	MVIVPT REL	FFDAAKL MF		NHPEIV QLV		SADVAA VVM	MTKDFE PIL	VFPEKGY SF	NFIRVLV SY	HSDEYIK FL	YSNTRA YYF
AAIASLL YL	VVILPKT PL	SFDLAIK GV		YQYPVII HL		FIESAHT EL	SITRLIKK Y	VYSNPV SSL	RYQEALS EL	KAYEIM REL	ALGVRD LSY
FAQPGS FEY	FAQPSG LSL	VSPYTEI HL		KRVTWI VEF		VMDLSI VRL	QALPW VRYI	FYQPTCI VL	SFFPKVL EM	YTLKLQ VVL	ISAARLY YY
VARPDV VEM	HAIMRS PQM	KFDDGA VFL		SRYEHV MKL		YYDLVR TEI	RVFPSP MRI	LYYVGG EVY	KFYSVN VDY	FNQERI VDV	AVAERL WEY
FIMINPL EY	FAVSVLD SL	SYDVRIE NF		VYSQILR KL		FQDFSHI FL	RVFPYS VFY	LYQDFV RDY	TYPENW RAF	STHSKV LYV	CTTPHL HSI
YVNLPTI AL	SSIDPGL SI	LFDLPPA LL		ISAPLVK TL		HTDLPV SVF	AAAGW LLRL	NFLAQT EAL	VYPWTQ RFF	LSDIAHR IV	IAISLGKI F
FALPYVI VL	FGVIPST PL	SFDPLLIT L		FYNEYV REL		VADILA HEI	VTFSGIH LL	YYHSYW HSM	SYLPLAH MF	SSDGHE FIV	VNALRP FYF
TARYIYIS Y	FGIEPNA EL	FYPPDPA QL		IRYPDSH QL		FAYDGK DYI	AALTFP VLF	YFYVIGS SY	NYQVQF VTL	YTVKAIL IL	SMIFRKE PF
FATEGL RTL	YAYPGV LLI	IFDRVLT EL		IRYQTPL LI		FSDENV RAI	SQYQGV VVY	IFPNQTE EL	SYPDNFL HI	KSIVPVT KL	YLRPPNT SL
ILYEFPR VF	LAGPPG PEL	NHDMTL TEF		TYSEFA REL		LADELIN AA	CSSGLV KLW	SFLATITS F	TFIQRVQ SL	HQNHLI VKV	YSTPHAF TF
KINEAFI EM	YCYVTV VSL	NFDVLD LHF		KVPTFV RML		SLDAVN LAL	FAVAM HLVY	TWPDG WTAV	AFYDPT HAW	KAYELAL YL	KSTDVA KTF
LALFPGV AL	FTVMPG QTL	YFDPQYF EF		GRPMNI QLV		KIDDILQ TL	HACGVI ATI	YYKPDSP EY	AYTSQF VSL	KVLNWF SEL	AAAVPR AAF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FGVIPSTPL	YAVNSQFTM	KADSVVVLL		LRAGKPHLV		LSDDIKESL	VTFPECVRW	IYYFAAVAH	TFQNDIHVY	VVNKTDLKV	NVRPVPLEL
HAAGFFIAF	VSMPVFQSL	SFDGIIAMM		SYAEVMRLV		FSDSSGLTV	YAIGLVMRL	YYRDYPTLV	RYLGGSMDL	YSISFLKQL	LAFLRGLSY
VSHFFSLPF	YTIPLSPVL	FLDLSIIRF		TISPIIKLL		RGDWPGVVL	YATDLVVCV	AYLAALTQL	SFVIRALGF	GIMDRFLQV	LSAEVYRIL
SIIEYLPTL	AAMPRIYEL	YYELAQVLL		TRPPHVFAI		FVDEFLTYL	FLFDHLLTL	IYQIHKEYL	TFIGRVAGL	HASPGVLVV	AASNYFRAM
GAVDPLLAL	LSQVPMSAL	FVDWCPTGF		YTPDWIFLL		IADTVPKYL	FTVTFNPKY	VFIDGPLAL	FYLPHGLSI	KTISVVLQL	FGFVRFTEY
FASTILHLV	SAFPFPVTV	LFDVLHEPF		MTPEIIQKL		NIDVVGVSF	FAIHKKIVL	FYPSGGLEV	SFQDFVSHF	RSVPFQMLL	FNITRIVTF
FNRWFAEKF	YAAPHFFHL	YFPTKPMFV		TRYQGVNLY		LTDVGFTTL	NAFAGLLKL	IYPEVVHMF	AFIPHSIVL	YGYHFPELV	KFDLRIYVY
FVFKGFDAL	SAIAVFLVL	FYPPKVELF		SRPGFELVI		QSDDPPIIL	YAFNGTQRF	RYIPDAMNL	IFIKDSNSL	FTMKTVLML	VSTLWLHLL
FSKEQLPIF	SAAMPGASL	TFEDVAVYF		TRPPHVQLL		LIDEMVNTI	SAFINLVEF	VYPMPRVIF	FFWTARLAF	ISIPAVQKV	VQAIRITSY
HAFVTEVAY	FATSTEPVL	YFDALYNIM		LRHPNIVSL		NADPILISL	AATPAVRTV	YFPGQAIAM	NYATRIVTL	SSYSRALEM	KVFERAVQY
LAVDGLMEM	RTIGFFYTL	YFEYFGPDF		SFYEHIITV		VADFGSATF	IAFFDVRTF	VYIGVHVPF	SFLQRITEY	AATLYSLKV	IAQDFKTDL
FAYSSRIAI	MAMAYGSSL	LFDDSEVKV		VGLQVVAVK		YVDDFGVSV	STIDKVSVL	FFPFNPLDF	SFLEKTAVL	FQIGKMRYV	SATLRNVEL
LAYIAHPKL	AAYSPRNPL	RFDEAYIYM		VRPFGVSLL		IQDFQSVTL	VAVPVAVTF	KYFPSRVSI	IYQEKVLDL	KILEIIRVI	TQAVRAVAF
FVEVGRVAY	FQIQTSTSL	SMDPLPVFL		YKKQFSQYI		AADPSVVNL	FAHPYQYEL	YYQSSVQYL	KFLASDVVF	SSAPPHTIL	NALVHLIEV
IAYTFARAF	YTIDPSNPM	FFSEKIYKL		FRNIPGITL		MVDDRLVTM	FQNPQTHVI	IFMENRNEF	AFQTTISKY	IIDPVALEI	RAAQFLRKM
FAIRRLPAF	LANEPSVAL	YFDDCMQLL		LRPFFLLSV		IIDLQANPL	FAFFDPVMY	YYFKANVFF	RFYAFGRVF	KSGVPVLAV	SISDVFRQY
CAIPQVMAI	YALPKSLSV	TYYLWVKSV		FRPLYTHEY		AAEFLTSKL	FALVFPLMY	NYIMQSHSL	YYKNIGLGF	STIVQVLEV	SVSPLQRIY
FAHLINVEF	TAIPISMVL	IFDEAALEV		LRHVGLNEV		IADGLPVAV	FFPDFIWTV	SYYSPSIGF	GFVNHALEL	KSLPYILIL	KTSDFLKVL
YSLPNAPTL	YSSPFDPVL	AFDDAIAEL		FALPYIRDV		HLDDQMTLL	FTHSQFIVV	NFPKVATSF	HFPGLASEL	RTFGFLSRL	SIKDYFLEF
AALPIFSSF	FVYGESVEL	TFDDVAVYF		GPSSVEDIK		TADIVINLL	KAFNWPSTL	NFQAIVISL	HFPPLYKEL	TSIAQLKVV	VSLLRLYQY
TALPTRIAY	FVIETARQL	MWDTRIAKL		QRYNFVLQV		RADDTFEAL	SAAFPGASL	VFLPRALAL	MYGFVNHAL	KSLHQLLEV	NGTYRLLEF
FLNFHYLTY	FVYPFGATL	SFDATTCIW		SALSHVRKI		SADDWSEHI	FATLRWIDY	EWPPFVVTL	FYFDRNPYF	RSHSVFTLV	FTSYWIHWV
FSIPILMQL	FSFPEPEAL	YYDVEPFLF		TSSWVIRDL		FLDGYVSQL	ATVPFLLQL	LYYNANRAF	KFQAMDISL	SSQTQPLKV	NIYIRRYVF
GVFQFKVDY	GASPIGPTL	LFDITGQDF		FRPPGTSDL		HSDIVVISL	LTFAGVKMY	FYSNKEIFL	RYQEFVRAL	HMSTVFLTL	VANTMRTSL
VAAAYQELF	FAIGLTPML	IYELMQTEF		EKPDIFQLV		SADDIGTLI	FSSPHLVQV	NYFLRLCSF	AYYERALQL	HSVPVVTVV	YATASLRKL
FLFDGSPTY	FADGVILLL	NFDRFSEMM		AAYTEIRAL		SIDFPLTKV	KAITFVTQY	RFFAQSQSL	FFMERSWSV	KTQDLFRRV	AAVWPYRRL
FVSPSLAVH	FADPHSKRV	SYMEVPTYL		ERFPYPFQV		TADDFLVFL	YGYDNVKEY	HFLQQPRPL	IYSSKTLEL	LSSNVILHV	IAYIRDLAL
YAISKPEVL	IAISRMKFL	TFDFQNDFL		LRIEFEQNL		AIDIPHIWL	AAIEHTIQW	YFPKALAPL	FFHEYLVSV	SSTSHVPEV	VASFRSKAY
QAFEFSEAF	LAVDGRLSL	TFPNNPVEL		AQYDELARK		SADIIHRDL	LAFPGEMLL	LYHGMALAL	YYFVFDHAL	KSISRLIVV	RAKELFHEL
YTTDFIYQL	YSAPCTYEL	LFDEVAIYF		HRFQTQQLL		SADDKTVRL	LASAIINTL	AFISHTSVL	YYISPRITF	RSYEFFNEL	YSAPVIHVL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
VAPVAQ VAL	FIAEHY MFL	DFDPALL EF		KAAVM VHQL		LIDVART SL	YIKDFFE QM	LFYFSNE KY	KYPNFD VEY	HNNIIVL IV	YSFHKF HYL
CAIPDLG PA	AAIVPGS QL	FFDHSG TLV		AVSWVL RSV		QFPILLD FK	QTFIRAI FY	AFQVSA CAF	SFKLSGF SF	RGDPHI LVV	FSAYNY RTY
FADGVIL LL	FGNGWI PTL	LWDSAV SHF		AAFREP RLL		YADIGG MDI	NAFPEIF YT	HFYRSLV AH	AYMKSL LSL	GTIKKFL SL	SAYARLI DY
SIFDSFP TY	FTVPHT HVF	LYQIYIDE L		LKPDLV NVI		YVDRVT EFL	SMFHN RHLF	RYQEALS EL	NYIHVG AQL	NSNPFE VKV	FVRDMI REV
LATAAA LTY	AAVNVI CEL	VFDCME LVM		NRPKFE QIV		IVDPVD STL	TAHPSP LSV	YYPELAF QF	SFLPRTL SL	RSSSWN MVL	VGAALR PAF
YFYVIGS SY	FANDAT FEI	FFDPHQ STF		ARNFYE NLI		YFDLQT HVI	VAMKFA QVF	NFIRVLV SY	SYIVKNI AL	RSYSQQ LFL	FIYHLPQ EF
FILEHIM VI	FAYGET DPL	IFDNTFS RF		YRNEFT AWY		YTDDFT DRL	TASEMIL VL	SFLPRTL SL	AFISLAK TL	IVIGIIKT V	HAKPPT PSL
YAQIRTI AI	SAVGQF VSL	SYDPLVI YL		YVFPGV TRL		AADEPV TVL	IAIDWE PEM	AYHGLT VPL	RFIPYTE EF	RIFQTLL EV	LSPLGEE MR
LAPTDV KEL	YAYLKAI VL	FFYTHLI NF		YLAPFLR NV		ILDDVA MVL	MTSNIV QCL	FYPAKVT AV	RLPPYSS QL	VSQFIHL YL	NAAERR GPL
YAAYPLT EV	ISIHVGQ AG	TFDASRT TF		YYGPLR SVW		SQDIVN QVL	RLGPPE PMM	AYMAAF NSI	MFQHIE ESF	AANKVV LQL	VAVLRA YNY
YAQLHS FTL	YGYEHIL TL	TFEDVA VHL		YYLTFV QEL		VADTVA RVL	YIVDHTII M	RFIGAVN NM	FYIENQK EY	ASYVNL PTI	AANLKSI DF
FATDSG LEF	YAIDSVL EV	IIDEQPLI F		NRPEFIT EF		NVDPD NVVL	LGYEEV VLY	HYPNWF KAL	IFVKTLV TF	ATLEKVI EI	YAIFRILL Y
LQFPVG RVH	YALDLST FL	SYDNVLI KW		TYVPWP LML		VADMA AYQL	PSIVHRK CF	SYQILTR QL	SYNDYV REF	HEGLPE PLT	LASPPW RVL
RAINIAL QL	YQYDFS RTL	VFDNYA VTV		VRPPQI KSL		MADSD FLAL	FQYPDT RYL	YFILNSS CL	SYLFRNI GL	IVGSKPL YV	RFYGRD YEY
IAHMYQ VEF	FAYGLL MEL	YFDVEPF VF		NSTYIM RVL		VADLTG ELM	IAAKKVL RL	AFIAQAL CL	AYTPFH AVL	NNQIKE LFI	ILGGHLD AK
MATVVY KVF	LSIPSFQ AL	SFDNIKN WI		TRAKLV SKI		KADMS VLEI	KAFQKLI TV	FFPGFPL AL	RYWNSY TEF	RIIAHAQ LL	SAITRPF PF
ISSPVIL QF	VAAKKN VSI	TFEDFVA II		KRANEF LEV		LSDETLL EI	AAVPLY RLY	NFLALAR EL	IFQNIKQ EY	STNKYQ LSI	KARNIFK EL
GVYLFTE AY	IAQGSYI AL	TFVSPEV FL		ARNTVT QVL		VADNLA IQL	IVINHVI SV	CYNLET NSL	AHPMYG NIL	HSMSQ PIMV	SASDYFK AM
LIIANTM AF	FAFARD KEL	ITDPDVV HI		FYVDTV RAF		SADEPM TTF	SALHIIV QY	NYETMG RAL	LYDWNV KLL	KSFLFEP VV	VAIVKAL YY
FIVEETL PL	NTIDPSH PM	VYDELFY TL		YGSFVT RAL		FTDERIF ML	VAADIA VQL	AYFPDA RDM	AVNIMH SSL	SIFGKQL VV	YAFPLA HSL
FTQNH MLIY	YAIDNPL HY	VYDLSIR GF		HYSEKL REL		SVDEVEI SV	FAVNMF RTL	IFQTGLV AY	YFHIGSN AL	VTDAVA LRV	FASVFEK YF
FASGAFL HI	FSTGVA PAL	SFDPLAS FI		TRNLDV QLL		MADEA GLDL	TAFGGF LKY	NYNTIFQ YY	FLYPFPL AL	KGFDW PLLV	ISNLRDV FY
FSIEPWL KV	AAQNSR LSL	TLDELPA ML		AYSDIVK MI		TVDAPN FIV	TSAAIYH VL	YYLTFVQ EL	VFQVKT LSL	KVFSAFI TV	RSILREF AF
YQQELE REL	FALGVY RTL	VFDPAL NLF		LKPPHVI LV		FAMEID PSL	VQIDITR VF	SFLPSGS EM	TFHFSW STF	QSTDIIR YL	ALFFRFV DF
LAASALP AL	FAEEVG AAL	VYDTVF KHF		LRGDIIN EV		SADLYYT SF	AAVGHV LVV	SFVDSV GVM	VYVVGT AHF	RALPHFI LV	FAMEID PSL
YAKIVEI PF	SAPVGV TAL	TFDFVH NVM		VRNPRI TSL		SADKEI MSL	KAFQKIV VL	FFQFGG QSL	AYQFFRE AL	YTIPPG HQV	MSADRV VAF
LAVPDM SSL	TAISLFYE L	TFDLVVS SL		SRPDLLK VV		SSDSQIL DL	AAFVKA VGF	VANTMR TSL	IFQDPRS WF	YTNWK AFLV	NATAVV RHM
VALDFE QEM	FALDSGL EI	YYNFTVL KV		SYTEVIR DV		AQDLGV VNL	AGYEAP VLF	YYPSDVS SL	FFHYAV DNL	KAFKGSI FV	SALDMT RYW
WSLPAT ATM	FSSPVC MAF	HFDQMF QRF		QRPPLIA AV		FSDLTEE ML	SAFPEV RSL	GYPEVAL HF	LFEARIIS L	KTNILLR YL	FAQAPQ LSV
YARASFL TF	LAIPFAIT I	TFDAGL QAF		RFPEHV REI		FSEEIGN HL	QTYGYE HIL	RYQDAIR VF	NYIEKVV AI	RSLDDA LKL	FATGVW HQM

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FGFVRF TEY	FAQEAIS VL	AFDDIAT YF		IHSPVV NEL		QSDVYT HVL	SIFEHKI VF	TYPPYVP EY	TFTFSHA TF	KIFPAAL QL	FTIFRTIS V
YAFIEFA SF	FVALPG VAV	HYDPAT EEF		YLAPHV RTL		VADAVT YQL	FTMEM VRQY	FFYMHK EIF	AYKPPG FSL	KIYPGW LKV	ISAPQER LY
FARVPV ATY	TTMVPT AAL	IFDLSCM GF		SRNENL RLL		AGDDAP RAV	YAKPYFL RL	NFYNFA SSF	HYFSKM KAL	KQSDV MRFL	FNFLRN VSL
ISTPVIRT F	AASPQA PTL	KFDIYTIA F		NKYPQA VFL		FLDASG AKL	AASGHF ICV	FYLPHVC SY	MTQIMF ETF	ATLQLSL KL	VATEKA VEL
YALELLT VY	KAFPAS AAL	FYETLPA EM		FKMTIP LLV		LADDDF LTV	FAFRYV TTI	GFPEQA TAF	RFHEMH VAL	FSSDFTL KI	VFSVRG TSF
AANLFA QTY	YQQELE REL	SLPDIPA HL		VRAKW FPEV		NADIAV VEM	NAYTGI VLL	FFLVQTK EV	FFSEYEK LL	SSNLRN LEI	KISSFIRK Y
SILGNLK DM	SAPVPA SPL	AWDKEP VLV		VRSPVV HSV		IAEIYETE L	VVKPPG SSL	VYHVVG VDV	IFQEVVG GF	VTYPGE LLL	YAIVRFN QY
KSLLWA FPL	VALPMV LVL	LFDLGG QYL		YRYVTK LLV		ILDEPTN NL	LAYPDKL VM	FYMVRA QAW	FYPELKL AY	GSLVHIS YL	YAYEKP HVV
GAMGI MLVY	YAIESQL QL	FFDAVE AAL		KYIDKTI RV		FAEEPG LVL	NAFKEIT TM	FYQPKIQ QF	IYLLIHN NF	KSAIPHP LI	IIYDRDF SY
FAFPGEI LM	YIPHGY MEL	LFDPMT GTF		FRIAFEQ QL		QADFEA HNI	YAAPWF LTL	AYPEIVA VY	SFNKMSI EY	RGTKVIL HL	RAAPHR ISL
VAINRLL SM	FADLGY KQM	SYDLFVN SF		SSADLIR HV		YAEQLV VEL	AAAPIIS SV	AYPEYLI TY	FFEFLTK EL	RIVPRFS EL	RATWKS NYF
MAPERV ASL	FAEASGL EL	EFDPELV LV		FRAPSM KEL		FQDLNQ EVM	FVHPDP LWI	KYYIPEV VY	TFQSRTL AL	TSTPNV HMV	LAVLRLD SL
SAFGYFI TA	LATEHYS PL	HLDPGPI YM		ITFPGLH EL		GADELG EVI	TAYPQV VVV	YFPDKV ALL	VYPPPH QVF	YTSPVN PAV	AAGIKLI FF
SAPIFTT SL	HAVGPS TSL	IWEPLA VKL		FKSHLIR LI		GSDEPP VFL	YAFPKA VTV	YFHDAT RVY	IYSFHTLS F	AATSRIA EL	FLYGRLY EF
FASEVS NVL	TAASPTI AL	LWEPTP VKL		FVIETAR QL		LAEEPE AVL	KATEYIQ YM	KFPAYER VL	NYLDRFL SL	AVHNVP LSV	TITQVIK VL
FSFVFKP VF	FAADIIS VL	SFDTMQ QEL		LLPDLIQ KV		FADRSLL EM	FSAFLEK EY	RFSLNTV EL	AYLEALS HL	KNYDRF HYL	VAVNKP AEF
ILMDDL SPK	FAFPGEI LM	IYDLATQ TL		NRIPLLK EV		VTDAAF NFL	KAIDVV VMV	YYQDTP KQI	MYNFQL VTL	KTFKRIL VL	CGTISLR VY
SGIERM GPL	IAIGSQP VL	SFDVTQ SPF		RRFPDL NRL		LADFEA GLL	LGRGKF AVV	SFSPGA GAF	TLPHEIL EM	LQNADP LKV	AISENYR IM
FAIWHII AF	FAWPQP ASL	CYDLGA AYF		ARPHF MSQF		KADPSQ FEL	SSVPGV RLL	NYIEKVV AI	IYLIGHV AA	SSNVVQ LIM	FAIPLIEK L
STFSGFL VF	YSVPSSQ EL	NVEIDPE IQ		AAAEIT RKL		HADPTE LAL	FQAFLR TEF	NYFPGG VAL	IYQSKVR EL	LVNTHR LLL	VSTPFHE IM
GAVPIFI EL	FATQQF VAL	RFDYTNS EF		HRPESV VLV		IADLME EKF	MATPLL MQA	AYPYYAS AF	RFLPEAL FL	SVANNR LFV	LAVNLT RVL
FVRDMI REV	NAMDIFI EL	FFWEER DIM		RRPEFQ TLL		TSDNPV VQL	SAFATPF LV	AFNFGS RPL	TYNYPV HYF	FTNDKII NL	PASLRD VAY
FAFTPSR IY	NAVWA LSNL	LYDVLGI EL		KKINWI VQY		VQDELH SVL	TTSWIH PVM	VYYEVA GHL	YYPEYKL LF	RTLPWS SVL	VAFLRLE DF
SALFFG NAF	LALFPGV AL	RFDESM QVF		KRSELV NWY		FIDDAN YSV	FARSFYP ML	VFLLDLG KV	KYIEGVS DF	TLMGH MLYL	VAKDYP FYL
FVYLRQ PYY	VATDFFT VL	TFDLMQ ILL		KYPDIIS RI		SLDSSGF SL	FTNPKV REW	AFALVS QAY	SFPHMV LSL	KSLPSVL VI	YTYLRIN FY
TSFKHFI FF	FSPFHAS VL	IWDMGL ELF		LVIDAV REI		YIDQDM QVL	HVFWGI VFF	TFPMQC SAL	AYVPGF AHI	KTTHQL LFV	YAAIRD NYF
FSFDGP EIM	LAVGIAL VM	QYDEAV AQF		NIFVRPS LV		HVDGHL YEL	IAVALPV VY	NFIPTGS AF	VFVDRTL DL	KIYAIPQ EV	FSGIRNI SF
VAYMN PIAM	YAIRGVP SL	TFESLVA KL		HFPELV KII		TADLDIT EI	MTTEILR SM	NYYTPIT PH	YYEEQH PEL	SSFSRFI MV	GSFLRIY SL
VALPMV LVL	FGYSDAL EL	YYDVAKI LI		NYIDIVK YV		SIELPSM AV	AAVHIIL VI	FYPPPRI TL	KYYFAV DTM	FSTSLVH SI	IAFVRLP SL
YSMPISI EF	YAYTGVL QL	SFDLVLL GM		LRHPNIL RL		YVDDGL ISL	IAHVKPS IM	VLPVYM NCL	HYFFAVS TL	RAYSFK VVL	LATAVV QLY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FLREWV ESM	YADDNS LLF	HYDAVE AEL		KAMELI REL		RLDIAG RDI	FGVPLIV HV	NFPGIVT SF	HYFSPFR PY	SVYEFFK YL	MFLVRD WSF
FSTPVFN LV	HSVPVFI PL	EFDEVSR IV		LLPDNV HYV		VADEEI AAL	FSFVRVI SL	QYPDFN NYL	SFLPLAH MF	YTIKGIR NL	AAYLRIH AV
FTIKELR EM	SAAMVF SAL	LYQYYLD HL		SRPEIIFL L		VADEYIE RL	ESINHV VVF	TYLGVA ASL	HYSPIYL SF	KTVNKIT VV	KLSTYIRL Y
MAVEFL HEL	LAQHTM LTL	FFDYSGR DL		IRVPFLR QV		FAEAVG VQL	FTSEKFL VM	KYMYFT VVM	VYHVVG VDV	LSAGRV VVV	SLLERLL TY
NAIIFRE SF	FATDSGL EF	VFDWIE ANL		LAAAM VRVL		ITDDEIIS L	YLKDFFS NV	AYQDRL AYL	LYQDFV RDY	STNSVK LEM	YAMDIV KGL
FIPFLPLE Y	IAMATV TAL	VMDVQ YNKF		FHIDFG HFL		SADLEVL DL	FSYAFPK EF	FFLIVKTL Y	SYKNPGL VL	TSVPKPL KF	SAWERN LVY
LAKGW APTF	VAAPAS LSL	AFDIAEE LV		NYTDNE LEK		FAGYSE EVL	YAMDIV KGL	KFNVTT VDM	NYHAMT EFL	HSAFIILL L	TVFLRSD SY
FVAPPT AAV	YACILGA VL	IYDALDV SL		YAYEKP HVV		HLDDAL RAL	YQADIE RMY	VYNFSLV AL	NYIDKVR FL	KSIWNN RWL	YVKDIYQ YL
FAQEAIS VL	FALDGQ WIL	MFNPM YALF		YIDQEEL NK		LADPGII TI	SAVSIFH EL	AFQHVG KAF	SYHPSGL SL	KSNFKP SLL	FITYVEH VL
KANPAL YVL	VAEPNR RVL	TWDELG EAL		FQKIQV RLV		LLDVAPL SL	TMYPFI VTL	IYTWGT EEF	NFRLLG NVL	QSIVPAL EI	KILNHPR VY
LARIIDS EY	YATRQAI SL	LFDTTN QLF		TRYLFAL QL		VIDAVT HAL	YALNHT LSV	TFNNPT TEF	FYMDTS HLF	SVNPYIV KL	LSKFYEL EL
VARPSSI NY	YAIGNA PEL	LYDPCTV MF		FFSANP KEL		FADVEG KNL	YTYYYPH YL	VYLFTEA YY	FFFDKTE EL	QSYGNV VEL	FFMERS WSV
YSGSPTS YF	FTHAFSS DL	NYDEAL RLL		ILTEIYRI V		TADVKA SVL	VTSPVL VIH	FFLSKIRS H	FYRPLAP EL	ENGIKP VYV	STMLRL YEF
YWRQA GLSY	LPTATSL PI	AFDNM VTSM		SQYPFP VTL		FTDFQG GTL	IIYGDPV TF	AYIGGIC SL	LFHEVV QAF	HAIHKV LQL	FLGIRFA EY
YASSPG MSL	YTIPISNP L	FFDEKLN SL		KRPSSV KVF		GVDGP HFPL	FQIMNE IVY	LYGPKYT FF	FFPMHF QAF	KVADGF KVV	LAFVKN DSY
FSNDIPH VV	LPINGN GKQ	IFDLGGG TF		SRSDIFN DV		AMDLIIS TL	RTYPSIQ IM	VYFPWV SQY	VYYEVA GHL	RTSPINL GL	MATGD ERFY
LASYVH YVF	FSIPVV WTL	VYDETE VSL		TYVENL RLL		FADLNL AEF	SLFPHAI CL	VYFASLL TV	VFNRYLE VM	AIIALFH LL	MTSSRL WFS
YAYATV LTF	VATHSTL VL	ALDVMV STF		SRNEDL LEV		YSDPRFL NL	VFYPYP QYF	FYYGGQ VNY	VYVERA EVL	ATYIFLQ TF	RSTDSIR LL
TAFFFA GYY	GAVPIFI EL	AWEERE TIL		AALGPI REL		MADIPG HVF	YAIEVDP VL	SYNLTVR EL	FFIRETTS L	KSNPKP LVL	SAHSHFI SL
TILGGLN EF	HAPLTNI PL	EFDHLP ALL		ARPGLG QYL		FADPIA ANL	FLADIVQ KL	FYPYGLQ TF	GYLPLAH VL	RVQSHI LHL	SSAPPRT AF
IAPGVT HEL	FAENNF TEL	VFDTYM LFF		IRPVSAS FL		YIDLPPP RL	RTIDFVH QV	IYLDSVM CL	IYLIKGSA L	ASAPRL MVL	YAFLRRE YY
YAISPGL DI	VAVISGE AL	YFDNILN SF		FTHDW MVFV		TIDDGIF EV	FVKDSIR LV	IYPEAVT MF	SHREPPL EL	ASLVFPL LV	YSSLRVV GV
YANEVG EAF	VVPEPG QPL	IFDEVM GCF		FRNFFS NMF		NADISQ SLL	IGYPMP TGY	YMPAKI GAF	VYITGKE VF	SLLGHL MIV	IFFTRAV QF
AARTIQT AF	RAVAPT MSL	SFDLLPR EF		LLPVITK EL		SVDVTN TTF	AAADIV NFL	YLHPLRS LF	AYPTAYP SF	ASQQKI LSL	NATIRVT NL
FVYGES VEL	TQTVKP LTL	VFDLMG SEL		LRSPIPL LL		VADEIRF SL	FAYMPN NSL	IFPSSISA M	FFPKKLL EL	KTVDVL LKL	FVKEHF DEL
FLIEPFV PH	FTDESYL EL	FFDEESY SL		IRSNNIN TL		IADMGF ARL	SQYPDIV IV	FFIDCM AAL	FYVRTEV NY	GSFGKV FLV	AARVFY LLL
IAIPFGT AL	VTIPSGS TL	IFDPNILT I		FGVDRA ILY		FADGKV YAL	LQKEFIT TY	VFQPETS TL	GFPFYG KPM	KAFEHL QQL	RGFFRS VFY
FAYNFR EEL	AAIPSAP VL	WFDPAI FTI		QAPNFS RLL		TADIAIV AL	FAMYPP SMI	FYNQVS TPL	LYLFHLIT M	KNTEVN LML	VASVRP AVL
MTKKPG MFF	ASLHVM MTL	KYDLAIK DL		RAFPLA RDV		SLDQPG GTL	AAFSKLI Y	SYFSSTK TL	SFLETNV PL	HSLPLLL FI	MIRAAP PPL
FVMETF VHL	FADGVY LVL	AWDIAI ATM		GRTEILK WY		FADGVY LVL	NAFLLPI KT	YYNSQT FDY	FFYPGW KVL	ASEFGN HYL	STAIREIS L

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
AAYVFE DPF	KAMEAA SSL	YFPDKV ALL		VRNLFE QLV		LAEIGAV TL	QSSELTK WY	AYLGSAI QL	LFLEKA MQL	RNTEYF NQL	YALNHT LSV
MAPLK MLAL	CAFGYG LPM	KYDTAL NLL		SLPEILK EV		NIDLVV KEL	YSYPELV KM	NFLNMS RSM	RYSVFV NEL	ASIQQT LKL	YAIDNPL HY
FLADPV SNM	EALTEAE LL	LLPSHPL EL		QRPGFV IDI		SADPNV VDL	AAQVRI KIL	HYMSIN DSF	VFMPHV TEA	ASSPHG LVM	FATIKTV NY
FVSSFM SEL	LVNPEG PTL	FNDESPL GL		YKYPFEL IM		AVDTNP LSL	FAFRNFL YL	SFFGAAS QY	IFQEQVE KL	KTNHVF FLL	QALPQV RLY
YAIHGVL EV	YSQSPAL EL	KFDQVT VFL		AAIKIIR QL		FADYNL LDL	YASPVV AFY	IWPLYLR FL	YYQLMK TAL	LSNLHQ LQM	RAILRIIY F
VAVSML NVY	LSTPFGQ AL	FFDHAS AAL		ARVERV IVV		FVEEEE HFL	YSFGGC HRY	VFQQVG VSM	FYLSKMI SM	RTMEAF HFV	YAQLHS FTL
YAIGNA PEL	FVNEAV MCL	FFDPAIR VL		FLLEHIRI L		FAEEFA HSI	FASPMK SVV	NYPVTG LAF	FYPPKVE LF	KSGPIFI VV	AASSIQR VL
AATPV WLLF	SASSFFK EL	GFDTRV TVL		SATELM NIL		FQDENH LYL	AAYKWL VCY	NYVDLV SSL	IYVTGIT NH	RTYIIPR SV	FSLAPYR DY
VIRDFA GPY	FSYPAGT EL	KWDALV IKL		FVYPWY RDV		YGDPYY SYL	FSFHFPV CV	VFQVTA PRL	KYPHYFP LL	TANSKI VVV	LNSPYAK LY
YAFDFA RQS	YAFSGV EEL	LYDHTTI LF		SLANIIR QL		ISDLGEL SF	FVVDHC PYM	NYQAYR SYL	SYIALPLT L	YSLLQA ALL	SIVENIRI Y
FAGSFLE YY	YATDVV EAF	YFEELIT ML		TIAPALV SK		SVDDAA IVI	MAYSNL LRA	GFMPGA HVF	NYNFQYI SL	FSTVVIH FL	AVLLRF WAF
FVIPVV QAL	IASTAYL EL	RWDAIV AEV		VRPLLPS EL		VADLIES ML	SALEHSI QY	AYYYRKF FY	FYEERAL YL	KLNGQV LVF	FAIDPHL LL
YAIESQL QL	FAYEGP MYL	VLDVVE RSL		LRPTFDL TV		AIDDVDI DL	YAIEKVR EI	AYHAVV LSY	KFLPDA QAL	KTAEFLS KL	FAMVKG YFF
LVHLFED AY	MANPTA LLL	VYDIAQ VNL		TRSEFYK HI		LLDVPT AAV	AAAAVI PTV	YFFAVDT AY	VFPKPVT AL	MSYYRF GEM	SAFDRK VQF
FIYLHLS YY	AATDIFS YL	FFDDLLV VL		KTYPLG RIL		SAPVGV TAL	AAVPLV RLF	SYMDP MNEY	VFQDM VIVF	RAAERA LQL	VALLRVT PF
HSFYNG LSF	FASGAFL HI	SFDIQLT SV		FLPAFV KKM		RADMLE MEL	VQINVPI TF	YFPHYEV PL	FYFASKL VL	RSVEETL RL	CATPEW RHF
YIISGLT GF	RAHSEPL AL	TFDNEIV MM		QHIDFAI QY		SVDGSP LLL	YAYTGR LEL	IWVDYI NFL	LYQHAV EYF	HNIAYQ LQL	NSLLREN SF
KAINPIN TF	VTIHPSS SL	NFDEEN AYF		NRYLVV LYY		HIDFGG TSV	AAVVFP MMV	VFPKPVT AL	SFIAFAR VF	RSYWS WVLL	FSLVNQI YY
FVYPFG ATL	SAYAGFL AL	QWDLVE NYL		AYVQLI RSL		FNDKHI TTL	KAFSWP SIL	MFCEKA MEL	VYADQP HIF	YNIDSHL LL	FSNDAL KTY
FSSPVC MAF	AAAPAA PTL	TYDLPG NFL		TTAAFIR VV		IVDAVG TML	SAVDVH INM	FFLSHQT AL	FFREVLL EV	FSINVG HMV	VARDLR AEF
FQYSKSP SL	FAYENSP EL	VMDVAF VQF		AAKDLIS KL		MPDSA AALL	AAFAHF PEL	SYIAMD TEF	FWPPYV ELL	HSGPIH VLL	FAYPAIR YL
FAIDSSH PW	VAYVSS VAL	NFDFTRS YL		FTVDQI RAI		QLDLEN TEL	AAFVKK LVY	SYYTVAH AI	RYVDQV LQL	RTIGVIT KL	NTLFRF WSF
VAPVTH VSV	LCTDVA PPL	HYDPDY EFL		SRPDLIL FL		FVDEILT SL	LACGVA KVL	RFATHA AAL	AYLPTGK QF	SILEHQI QV	YAKLFA DAV
FQVNHT VAL	VATKIFQ EL	MYPGLP SRL		YRYPIVL GY		SADTVVI FD	FAVALP QLL	NYYPGSL FL	IYYFAAV AH	SILGKFA VV	ALRPPLP PL
FVIETAR QL	YSWVGR PLL	NLDQPP AFF		MRPLDI VEL		AADLSEI EI	AAAPLR LIA	QYHYGT LSL	SYNLHVL DF	VTIARAI EL	LAFERGY EF
ASWQN TDLF	FSSPAG GVL	TWDGQ EVVV		DLPEHA VLK		LSGENE LVF	KAVVFF VFY	AYLIMIS AL	FFPALHE SL	VVYPW TQRF	VAAALA RLL
FIVDARP AM	FAQYLIS EL	IFDVLPN FF		SRYPDL SLV		FPDDAT SPL	YSYNIRH SF	FFLQKRL QL	VYFSAA HAL	KSDPSIV RL	YTRQQV LEL
FAYGLL MEL	LALETTN SL	SFDEFVY IF		LRSGKF NVL		KSEKEAL LI	FLREWV ESM	FFHWVN NVL	NYHATT EFL	KTYSFLT AV	VAISPW KTY
SIQVPG MQM	FADQEV RSL	YFDEKEL EL		NRMPIA RKI		LTPYAD EFK	KQIFETI YY	FYIYGVS DL	TFPQNP VEL	KVSTQG LFV	ESQLRSY SF
YSIVGLS SL	AASPSEL HL	LFDYDKV EL		SRLDHP FFV		KMDDIV VVA	LAVSRIIT W	RYFGPA AAL	VYLPTHT SL	MVNEF KLEL	FIQTRG GTF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
SVAGKL SVF	LADHTV HVL	VFEVIVT SV		FAKDFM TYL		RVDDVY SVL	SAFPYA HRF	SFIENSS AL	RFLYSNI AF	RSMEA HNIL	KARNYLL SL
VVPEPG QPL	VDHSWF GPL	AYDTLPV LI		LRNPFV QVF		FLDGRP LTL	VAKIVAE TM	SFISVIKE M	YYFSKLIE F	SSGRVQ LVV	FFMLRSL SL
YAKRPGI GL	FSVASKL AL	VLDGKIV AL		NRLPKP VLL		FADLLG TAF	AGVGW RVDY	TYLQTM VFY	AMYPHI FYF	TSDFHQ LIL	FFQETNI PY
YGIPFYL QY	VTDHNL HEL	HYDDVE VFI		NYRWW PAEI		FTDVPSI QI	CAIPQV MAI	NFYSTEV SV	FYLDNVI GH	KASPLTF TV	KVMERL IEF
LANGSIL VY	FALPGN SQL	IWDLLK NAI		SRSHAV LLV		GVDEPG WVL	IAINHTII T	RYLGKVL EL	IWVDYI NFL	RVSDILR YL	VASFPRT VL
YAFNGT QRF	KAVNPG RSL	KFDEVLV NH		IAVSIVR AL		IIEEEFVS L	NSFPQVI LL	YYITTRA QF	AFLDWA LAL	SAVQGP PER	FLVLRQ QQF
FVVPYG TPL	YTADPY HAL	DFDMTL SRF		YRHPDP REL		IWDVSV NSV	SAAPFF VLF	FFPIAGL EF	VYFVQK NSL	AGSIVRL YV	LSSLRSV SL
FSHPRE PAL	FTVEHSV SV	FFIPDIEY L		VFYPYP QYF		LSDLLEQ TL	VLFPTQI LY	NFPIKAR SL	AFLKTAL EM	FNIEKG RLV	TSSTRFL VF
FTYKGLR AL	IVMPNIL VL	KFDVSP VKI		ARQSIIR KV		LLDGSN VVF	AAMSHL LEM	SFVDQV REI	IYEIHKEF Y	INTENIR LV	YAFPKEF PY
MALLFLL PL	YAVNSR PPL	MVDGK PVNL		DRYFRI QEV		KQDLGP VPM	IASPVQP VL	SYPDFLR MM	SFQEFV QIF	KSNQIP TEV	AAADIFK HY
IAYDVTY SL	FSYEVSR SL	SFDVVK RWV		MQGPY RAMV		IADEAFY GL	SAADIPI NI	QYPGRS LVF	AFLEQA VSY	LAAHIPL FL	AAQLRE LQL
AAGPTG MFF	LAITCSF PL	AFDEAF AEF		VRANLP QSF		NIDHDP QEI	LQIGVIR VY	GYLPLAH VL	IYIDRGV VF	RNMPV SFEV	LAAEFLK QV
AINPKLL QL	MALFGA LFL	MFDKDV VML		SRYPTIS MV		FSDEQIL TV	IASPVIA AV	IWPEKVL DI	SFMDPA SAL	TSGINPL LV	SVTISFRI Y
MAFLYH VAY	VALGN MYEL	NYDFGPI HM		VRAELIR AF		ILDVSG NAI	YAANLK NVM	IFQPHVR HL	YFHTMV ESL	VIRQITA TV	VATSPG RLF
IAIAPNG AL	YCIPVVQ SL	LFDLTPA KV		YQKPFQ TLM		KLDDML SEL	KACDYI QEL	GYMVM GDSF	AYADFY RNY	VSFKRS MVL	VATTFT HSY
FALSVT NPL	RAVEVS AEL	TWDPAL AQI		ARYPDTI AL		LLDLGE VAL	NAPLVH ATL	SFMGM VISH	IFPECPH VY	VSLARA LFM	VSSGVQ RVL
FLPEAPA EL	FAMPPP HGM	TYDPET QEF		NVVNIA RYL		NSDPYS VAL	TVVNFLI RV	SYEFMR RSL	FYHKGIA SL	KTDYFFL EV	AAAFHP EEY
FQNPST VTL	FVVPYG TPL	LFDETFE FL		FYIPQRP YM		FYDVQF KEL	VAFHIPF EV	SYLTSAS SL	KIPEYQQ LL	RTMPRI PTL	IAQDQP KIL
YGSPNA LVL	FSCGVIS TL	VFEAEIV LL		ILPWYP KVL		KSDVPI QLL	WAYART INV	NFITGVG IL	AYPHNL MTF	KSMLEF QEL	LSFQEVR EY
AARFVS TPF	SCYGYPI QL	FFDVDTS QV		TRTNML LEL		IVDEVN GLI	FAHLPKS TF	WYYSTK VQL	KYMSVI AEL	RIPSFVT EL	SLAPTAA AK
YSHHFV SAF	FANLKY VSL	GFDFSG AEI		GRPVFV IRI		FVEDSK VVL	FAISILQ QI	YYINIRK AL	HYQLQG LEW	VTNSQK LQL	VFQLRD SVY
MALAVR VVY	YASDVQ LIL	TFDVSIL TI		NRPKFL NAL		YTDIINIF L	YAAGFIF TT	RYLEMLL EY	SFMYAH LAF	KQNGHI KFL	FFAPSR DMY
QAVAIFT VY	AALPPVS PL	AFEDVA VYF		IRSELIPY L		AVDIPH MDI	QAIAIPV TV	FFIACVT SF	IYHIQYD EY	RNVPVN LEL	LAKDGV LTL
FAMPYF IQV	YAYDVP TSV	FFGTHET AF		SGTDIV RQI		FFDTNT SVL	RLFGAV VRW	YFPTQAL NF	FFGTHET AF	KSIQEIQ EL	SAAERPL EI
SANNVY LVM	FSIPILM QL	HWDWK IALL		SRHGLE QYL		VADGLV TTL	LFAPFIV YY	LYPAVSA VY	FFNGLRT EL	VMRWF QAML	KASGTL REY
AAFQGF PSM	FSVPVA WTL	LYDVTW EEM		SVYPMP RVI		ISDLSVN SL	MVVDIV QEL	QYQPPA PAL	VAPEEH PVL	HSFNIP MQL	RTTNLIR HF
GIARSLL VF	YTLLHNP TL	LLDPVPP VL		VVFIGV RYV		SADAP MFVM	QSYGNV VEL	FFPSNVE QF	HYIIAAR AL	RSFPTLP TL	TLLERLF SY
LSMER MVPA	FTVPHSL AL	TYDYAKT IL		AAGPIR VVL		FTDVAG PEL	SAAEHF SII	LYFENA MRF	LFQLMT HSY	RNQPM ALSL	VNIMRT YTY
SIVENIRI Y	FAYVEG ESL	DFDGQV VQV		LFVDRII YI		LADILSE SL	FAFDPS VNY	TFMPVA SGL	AFNTQV TAL	SIIPPLFT V	AMMAN RLSF
YSAPVIH VL	FGIPVL MAL	CYDQLS ALL		RYYSDP RFL		VWDVIG RSL	FVNPHV SSF	AYYYSLQ IY	FFPEYTH QL	SSYGKLL LI	FANTRIE NF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
SASFLLQ EL	FNDPVA MVL	VFDDTIT EM		SYKYFPS SL		IADPIVL AL	HAAPFS KVL	NFPEHIF PA	VYQNQI AEL	STNQHII RL	FAVAM HLVY
YLRELLT TM	FSVEGQ LEF	VFDNSIK TF		FRFMAT NDL		TIDTSRV SL	NSFIHVI MY	SFQGMV TSF	HFQPSA ASL	ASNPRG LFV	IIREPLTE L
FAYAHT LAL	AASGHFI CV	HTDLPVS VF		QFINFPI YV		TVDTPH GIF	FVYENPI SL	IYADYAR SL	SYETNVL GF	KTVNKIL QI	LAQDIFK EL
LARPLPV EY	AAAPPP TPL	IWPLHPS LL		TRVDLV TMV		VADLQS INI	KIPNFW VTT	QYQRML STL	YFPKKIS EL	QALDYF LKM	RAIDALR EF
SAYNAF NRF	KALSIFN EL	YYDEIIN AL		YMPQN PHII		KADTEE EFL	VTVAFV QEY	SFFGGS NPF	AFIDQS QSL	WTTSRV LKV	AAQEAV KLY
IAFDPRS AY	AALGRA LAM	AYDDLSP LL		NHIGW VQEF		VSDLSQ VTV	IALQYPV YW	FYLDTVS AL	VFPEFAA AH	YIMDW MDEM	AASPYFR AM
FAFLFNS EL	FANDAN KVL	SAPKYID YL		ARFGSV NEL		FLDMNF QSL	NAFWK CVQA	SYLDFTN PK	RFHTITT SY	YSNLIKL LM	LQSEVIR HY
LAIPITN TY	IAAGIFN DL	YYDVPIA TL		FRRLTPT EV		FQDDRY LYM	VASQLP RIF	AYGRM GLAL	AFQETLE TL	ATNLLKL FL	LSFFMA RVF
LALPVFF IL	QAIPVTS EL	AFDVVE RSF		HRPGIV VDY		IADLVTS VL	VSVPLIV RY	AYPYNFS NL	SYMPTV SHL	IILSKM MLM	YLYLRGL VY
SSFGDF VAL	LATHPGI SF	IFDVVD GTY		ARADFQ KVL		IIDDVDS FL	QASEEIL KV	TYLPAG QSV	TFLEAGV EM	KGQWS PLKV	ANVVRN ISY
YAFSPR NSL	SLVNLG GSK	VFDQTC VDF		NLPYFLR YI		LADQMI SRI	RAALPL QLL	SAPVGV TAL	VYAFSAR PL	LIYGRPV YV	RAIQFYL EF
YAGYIP QAF	FSSPSFQ TL	HFDLSH GSA		FYAELY HII		FAIPLIER L	FIADHCP TL	AYIRKTL AL	VFLPRVT EL	SSLQRIL EI	AVSAVV HEY
YSLDHIS SL	LATGAA MVL	IFDSKTV SI		EYQELM NVK		SSDPSLI GL	FVKPAV VTV	FFDEKLN SL	VFSTVVI HF	KSFSFVR VI	IGSPFLR AY
MAYVSG LSF	LAVPDM SSL	FFDNISS EL		QRALLA NAL		FGDLGS AKL	FTFGFIQ VM	GYYSHAL YL	IYLPAAQ TM	LDTNAD KQL	YARLHP RAV
FAIPGSS FL	YSPFGDS PL	FYDQAF AIY		YKFDFL QEV		MLDFYS DKN	SAKPYA HIL	HFNTVLE AY	SYYKDAL RF	RIIPWIQ QL	YSAEPLP EL
LALAIAQ EL	FAYAHTL AL	QLDPLV VEL		IRAERDI LV		TMDDLT TAL	FAYGLL MEL	YYPEHTS VL	TFNEDV QAL	KTFNYP LDL	NLSIRIA AY
KARPFF NEF	KAADVG ISL	QFPTPE AVL		TRLPTP VLL		FTDVVT TNL	YAFPLA HSL	SYPFDFL EF	AYAIQV GSL	YSAEPLP EL	FAQDVG RMF
MDDNR LLTL	NSLPRLE TL	DWDLM ERFM		FAKPFL ASL		LADVMS EQL	FSEEQA RLY	TFPSDIT EF	GYYSHAL YL	KSSPLLV YL	TASPLVK SV
FSNGHIK VL	YAAEALI SL	TYDVQK LSL		LSKGWP LYL		LIDDLQ HCL	LAIPFAIT I	KFMDKK LSL	LLPSHPL EL	LSHDQL LEV	TASQRFI EL
FTTHVM NLL	FAMEAF NWL	EFWLAC EEF		YYFEGIK QT		RADVSL TTL	SQSGLV HIW	TFPLQVL GF	NFHGE WLEV	SIADRPL YL	AAWLQ VLPV
LATGAA MVL	VANGKL MIL	VADPIIY VL		FYVGQP RFL		VADLGA MVV	TAIELIPS V	AYYKKAL EL	NFQAIVI SL	VTVQPS PYL	FASDVQ FVL
FSTGVA PAL	FALSVTN PL	ITDPEVV FV		SAKPFM SLV		QLDIIIHS L	FAYYKL NDL	SFPAHR AVL	SLPRFIST Y	HNEGYI LEL	FAMEFV KYY
FALGPTI SF	IAVDCS WTL	MFDHIP VGV		MRSVLT QVL		SAELAS MEL	KAPDFV FYA	SWPDG MLSM	AYQSLRL EY	KMMEL FIRL	FIKEIPPE L
TSPEAFL AL	MSKSLG NVL	TFDVSPK AV		TRIPKIQ QL		YTDKIM TYL	TGFPWA FKV	TWPKEV RQL	RFQDQV LDL	KGNLLIII V	FSNGHIK VL
FAVAIYA VY	FAFIQHP SL	TLPTLPA KV		VRNNVII VM		VQDLM ETDL	FAFPLH VDY	HFIRPGN AL	SFMIMK TNF	KQYGFF SYL	MAADG RLVF
LAIVPVN TL	AILPGKL EL	HFNVTN TTF		MRMAT PLLM		FLDGNE MTL	YATFIVT NY	QYPGSA LAL	TYQRSVL AL	KTPNFS TLL	IITAFIRA L
NGFGGF GSY	LAPNIIS QL	SYIELPAY L		QRTSIL QTL		LTDEGV VAL	LAKEFAE IL	TYPSLPK SL	KFYNAG LAY	SAGPVH PLV	LAVSLVK VF
FAVSDG LEL	SASTVFI AL	TFDVAPS RL		VRNLHI REL		GADLPV SAL	RSLHFFV EW	YYPAKIE AI	YYITTRV QF	TAAIKDL QV	NATKARI PF
FALGAG TAL	FVTKPNS AL	AFDPELR IM		YRMVG GVLV		ISDEGIA YL	YAYTSQI EI	VYISSRP PL	YYQDTP KQI	ASLLFKT LL	LATDFIQ SL
FVADRL RAV	LAAPVIS VL	AFDNVL NYI		FRYPFA PMY		AAEAAE VIL	FAADLA EEL	SFHAAG LQM	FYHPETT QL	ITLRKSL LV	LLSDYIRL I

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
YIIGVFR KF	QAIRAG LEL	MWDQR LVKL		IAFEFPV LV		TADGIV SHL	LSIPRVF YV	SYFMAT NSL	LYIGHLT TL	RSFQRA LEL	YALYNN WEH
YIYPKHL KY	YSFDYPS DM	SFDCIQQ TF		TKADLI NNL		FGDWST EAL	RSLEFSV SY	FFMPGF APL	SYQDYEI EI	RSIPVWI KI	FASFPH MVL
FALPVGL IV	FSNGYL ASL	EFDLLDV RF		VKPEFSF NI		IIDETMA QL	YQKPFQ TLM	SFMDVS NPF	KYLQSTI SF	YQYPRP LLI	RATFYLN VL
VAKHHG IPF	AGVPLFL LE	HFDMNI ISM		FVYDEV RKL		YLDGVG DTL	YSYPSPI TA	VYVMG GVAM	LFPGPSK PF	RSIEEVL RI	FAVDFE KIY
YTVTDL VEY	YTSPYFY AL	IFDAVGF TF		GRAYLF NSV		TADLFLT TL	MLFGHP LLV	FFPYQVT ER	AFFRDA MGF	STAYYAL VV	AASPFYR GY
LAVEPG SNL	MAPLK MLAL	FFEPWV YSF		AAVPDA VGK		KIDEKTA EL	TAAVHII LV	SYGAAG LAF	FFLRMK CTL	VSQQRA LAL	FSEPFHL IV
SIPEKNR PL	WASEVG PVL	NFDEAL VDY		FRFPETT FI		VSDSGV IAL	VSSHIAS ML	VFYPSSL AF	IYQYME EIY	YSDDIP HAL	KGSSAV RVY
TAAPTIG VL	YAYFDFP EL	YFILDEFL M		IRNNVII QV		SLDIPAT YL	ILFSGVH FY	SPGAAV VML	AFLADPS AF	ATVPGL LKV	MAQLKC YYF
FAMIVS SAL	YAMISSP FM	FLDEPTN HL		QRAPVF LVV		FTDSGLS TL	MAIPLV FQI	AFATPTI SL	VFNDVR LLL	KAQTKL LIL	FIFLRLN VL
YAFQFV GAY	ISSPVVT SL	SYEYPEY FL		VKYNDP IYV		QADIEV RAL	VAYGKG TYF	KYQIQQ VDM	YFMTMI VSL	KIYSGDL VV	HAAPFQ NIL
VAYVSS VAL	MTICPG TVL	YYTEFPT VL		NRIPKEI TV		VADTFQ DYF	MAVAF VLSL	VFVEAT HVL	IYHNGVL EF	KNADHL LHL	SLNEEA VKK
GGLFGT SSF	YSFTHSE PL	YFFTWD TEY		KVPELIR TI		LASKSM ESF	VAKWA TVTF	QYYQND IPY	TYNTQV NFM	LGSQAH LTV	VALLRLL LL
VAAPLLS AY	AAVDAG MAM	SFDITGR FL		FRQIIAV VL		YTDLVP KEV	SVLPFQI YY	SYYAVA HAV	RYLSKVL EL	RALKGV LRV	YSSDFR QIF
VAVPVA VTF	VSVPPAS AI	LYDVPA NSM		FGYPDP TYL		ALDVPN TAF	VLFHNTI YY	AYQAKV LQL	TFASRVS SL	SIKRIFH TV	ATFVKEI TY
TALLGPL PL	SAVEPKT AL	VFDPVP VGV		YRFPN MVVA		FADGVIL LL	EAYNAV VRY	VYPPGF MGL	AYEFMS QAF	YGNPNT LRL	VATPVLI PK
IAIPGLA GA	FANERCL QL	IFDSSDL SF		YVTPVN RNV		LANLSA EEL	STKPPG TFL	FYFDRN PYF	FFDEKLN SL	LSSLVILE V	VSSTWD RQF
IAAGIFN DL	FIITPGG CL	NYDPLP MWI		KRSDGL LQL		STDGIGF AI	AAFQYG IKM	IYVTGGY SY	FYPPDPA QL	SSVDQP LKI	AAQFIPK FF
MAIVGG MAL	FSVEQIT AM	YFDLTCQ LL		LVVPFA KVV		NADVAL VNF	KAFLTIII L	FAPYNK PSL	VFAEKIT SL	YSVPEIL RV	LSVIQL WHY
YAYPYSY YY	FQIAQYK CL	YLDLILN DF		YRYPRP ASV		ISDPYNV NL	SSSAVFL II	LYPEYGA AF	VFIDKQT NL	ATIAREL LM	LALARLE TY
AAIGLVI YY	TAIESTP TL	IYDPNLA FL		FAGLVP RLL		TADFVN YYF	FASEVS NVL	NFPVGQ RVL	YFISYGIE H	QNTEVV LYL	YLKPYFL EA
SALFLGV AY	FIAPPGR VL	SYDFFSG EF		SAMVR VISV		VTDTGA LYL	NAFRIIK EV	LFMPSTS SM	HFIFFVQ EF	RIISLFSL L	KAVIRV NVF
AAFADA LEF	FSSEVTA AL	YFEVPSV LL		AQYEDI ANR		QIDIGG VTL	YNYIRIM VM	FWPEAF SEV	YYTDFLI TL	RSNLQEI FL	EASWRF TFY
SVPLAA TSM	FAGGHP AQL	YYNISEV KV		ERSPLLF TL		VADLRE AIL	RAYPHV FTK	SYLRDVL AL	VFSVRG TSF	MQNPQ ILAA	SAVNIIR TF
SAIAVFL VL	IAYDVTY SL	CFDQFV YKL		FQYESK VFY		LADDSV RSL	VASGMI LVM	SIPGGYN AL	GYRNSLE FF	HSYAD MREL	AAFLKAI GY
YALLGH RQL	LATHVSP PL	CYDAIAV FL		VQNPAL RLV		LSDLAH FSL	VAVEFI QEW	YYYDPTT GL	YFLTTRQ TL	KSYYDIL GV	NANEM FRIF
FLYGGEL VL	AAILPD MAL	LFDKSIN EF		FAGDLV RNL		TADDPS LSL	YAMRYF ATV	VFLSTGS EL	TYNILTH DY	NAPLVH ATL	AALPVY QEL
YVFGGF NSL	AVVLPH QPL	LFDPINL VF		YSSMVI RDL		GADLPN LTP	TAVWLP RYY	RFVNVV PTF	GFPWKT SDF	ANAASP LIV	FAADVR LMF
FAAASF MSY	SFPHMV LSL	RYDGQV AVF		LDELRD EGK		SQDFVE SVL	AGYSDPI LV	AWIDGV LDM	FYQGHV EGY	ILSNKFLI V	FTAERSS YY
LTTDISLI F	AAIFHYLI I	YVQDYE DFM		VRSDKP KLF		TADRIPI AV	VAVHLIL YV	YYTDFV MEL	LYQPSAE SL	KALEVF PEF	VQALRT VSL
IAAVPAT AM	YIDDVFH AL	FFDAIFT QL		TRPLILK TL		YAPGAR LAL	FGTFLV QEL	LYPACLR EM	TYSEFAR EL	KAYHEQ LSV	YAAAQL RQY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
NAIEGLTEY	SAVTPDIPL	FYDWDNTEL		MLPSILNQL		YSDELQSVI	FINNINSVL	YYAVCQNLL	SYNLTVREL	LTDPSQRLV	DAKIRIFDL
VAIQAVLSL	MIIEPTSPC	VFDNLIISL		SGAGILRLV		IADGGFTEL	AAFPYPMMH	YYLPKDDEY	IYLWSNISL	LTNPQKLMV	IATQVVVEK
EAEDGLLLY	WAAVPGKTF	NFYVFPKPF		TAYLFSRFV		LLDSSHSEL	ATFPKEIQM	FFFDKTEEL	KYLTSNVAY	SSNKALLEM	QATPLLHAL
LAAGAFILT	FSALPSPPW	CFDTNAIIL		VRAWVVFKL		FLDEDDMSL	FTKWVNSHL	TYIGSVEPL	FFSPKVVSL	ALNSKILSV	VARPPNIVL
FAYEGPMYL	FSSDVTHEM	AFDFQDVTL		AGSSVLREL		SADPGVFVL	IGYSSPLTL	AYNYYTKAI	VFLERGEVM	ASAASALHL	LAYLRLNTL
IAPTGIESL	VATGVISTL	KWDSNICEL		TRTQILLSL		GQDTPGVSL	KAFSPVRSV	IFMDEIDSI	AFPIGSSGF	FSAPSALRV	LFMPRSTEF
AAANPTLAF	VSPEHVVLL	TFDIASDAF		TRPVRAVFV		IADIVTSVF	MVFPKPVTA	IFEGGATEL	IFMDVLFVY	KIYERTMAV	SAQDRFLIM
YVNGKTFLEK	TSHLIVVTL	FYEAAIPEM		NHPNVIKYY		SADDFAMEM	ISTPVIRTF	VYLPMSYCY	TYFPWPQPL	IIYPRQQLL	SQAPQRLSF
YAAPHPLQSY	SAQGKPLAL	LYDIVFKHF		QRFYNLVLL		ISDPEKWEI	ATYNEIVTF	IYIDGVQEV	YYPQQAIVF	KVNAQFLEL	AATSRIAEL
YVIPHPVHAF	QATPYIAVL	MWDQRLVRL		YYKDALRFL		TQDSSILPL	KAKDPFAHL	VVPEPGQPL	SYIEFPAVM	PSVPVFLEV	ATTDWIAIY
YLRPGQAAAF	YASDYFDQL	VFDAVVEAV		AAFLLVRKL		FADEHSDWV	IAIIRPSIV	MFASRLTAY	KYLAVRLAL	RALQQFLYV	AAQLRAQAL
YAFNGTQRFL	LANLVTLEL	TFDLTVVSY		ARIGGVRML		LTDVMLHAL	NAYPSPQLL	RFPELSLAL	NFQAIRVTL	SNFDRFSEM	NSTPWVKEV
FAVDLEHHSY	FIQDTSLIL	VFDVESREL		YYITRAKLV		VTFRSDTVL	TWINHLVTW	VFSDGAVSL	VFPDKGYSF	SVVSFLLRV	AAMPRPVSY
VVYPWTQRFF	LAITGGVTL	VFENIVAVL		HGFAGVILI		KIDDMMFVL	YWIHWVRQM	AVLASGATF	SYYAYVVEL	TSIANLPKL	NSALRQMSY
FALDGLKQVM	NAMMPGAPL	TFEDVAIDF		IRNGQLIQL		FADGFVLVY	AAFGAPGII	AFFGGSNPF	LYQDGVFKF	RTQAFQVLL	YAAVKIHQL
FAYGQNKTAF	FAHEVGHNF	IFDGFIVSL		VVAPLLRKV		FSEDAGISL	AASPIITLV	SFAAVIQAL	LYSDRISEL	RTVQAIVEL	YFAFRNFLY
FAFESDLHSL	FSYITAVTL	FFDSAYQGF		YRPGTVALR		HVDGVAVTL	FAFSGVLRA	HFITPVSTL	AFIQEAAAF	VSGPRLFLL	FSSERLFSW
FLYPFPLALF	FTAPATVSL	NFDWLENCL		LRSTIINLL		AADRPGVSL	IAAGLYLLL	RYMNHMQSL	ALNENVSSF	SSHPIILYL	GAFLREYLY
RIPEFNMAAF	IAGSAIATL	TFDDLPARF		ETMQSLNDR		VGDEAFREL	SASPWALTI	LYDQISLPF	AYQLMTDVF	VSMIPPLLL	SATRYIKAL
LAVHPSGVAL	YAAGVHSVL	NCPERIITL		GRPLFPHVL		VTDADRSIL	AAATSVHVV	VYISNGQVL	FYFALRDTL	YIYMHFGEV	SITERYRIY
FLVNHDFSPL	NAITAFSTL	IYDNAVQGL		KKPELVISY		FAEEVGAAL	FAFPGEILM	RYLEKCIAY	IYATEAHVF	IQRIFLITL	IAVEPVKTY
VLPHQPLATY	LAQKPGAPL	MFDELTATY		FQIVNPHLL		FVTSEYPVI	YQYPVIIHL	YYPFHYAPF	AYLSEAMKL	KSLEVHLQV	AALWRFAEL
ALIEFIRSEY	EVHDLEIQL	TFDNVTSYL		HNGPEHWHK		LADERNELL	FAKYWHIIL	RYLLQNTAL	AYNFPVTAM	ASLFSGRLV	FAVPHTYNY
YVIEPHSMEF	SIPGGYNAL	VFDCVVNSL		ARKDNVIRL		TAMDVVYAL	NQIPFIIQY	TYTIMYREM	LFQDKASEL	ASNVMQLLL	KATQNFKVM
FSKDWDVTEY	VGAPVGIAL	VFDEAILAA		YRPEFLKSY		FLDVSGISL	VTYPGELLL	KYNACILEY	VFRFYRESL	TANRHVLRI	NAKKILLEM
YADPTKRLEL	YLHPLRSLF	YFDDSNVSL		ARSPALQVL		HWDPQEVTL	RAATFPLQV	VFQEVGINY	VYINTAQEF	YNFEKPVVM	YSSGLVRLY
YAPPRDFAAY	FSTSASPLL	YFDESLVLL		FKFIIPQIV		LVDPDTAVL	AAFPLPVVV	CFFPNGNAF	YYFDYKEQL	ASSPEHPEL	AFFSRVETF
ISIEGNKMPL	FAVSDGLEL	FYDSQPTLI		NQIPFIIQY		SADSIGAVL	AASGLPLMV	HYQAIVTAY	AYFTETEKF	IQHVFQNLI	SFFVRGQEF
FALTIHTQVF	IAAVTDIPL	IFDANESGF		AAALIIHHV		FIDVGAGVI	ESYGNPLRV	RFIPSAYPY	LFPRPVVAF	KVFNRYLEV	FIAPNKYEY
FQLPGGHLEF	FAMIVSSAL	TFDEIASGF		VVPQLVKLL		HADVGVALL	LAYAEYVIY	SYADNILSF	VYQSMVLFF	RTVPVFESV	ISTEFIHKL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FSFGGKL VTF	YQMEH RASL	VFPDKE VML		SYPGYL RIV		ISDYTVT EI	YLAPHV RTL	FFPPFVS CI	FFGFDTE TF	VINDWF KVL	MNVVR NLTY
FLPTRAL AAL	CAIDPTC VL	IVDGAV VKF		SMAEIL RSL		FTDSLIS NL	YSVPFYP TF	KYFGRSL EL	LYVEKVL EF	YVTSVIL HI	HSFLKAL YY
VAYHQL FQEY	FQNPST VTL	RFSDHV ALL		WSLPAR VSV		RADLIEV VM	QMFQGI ILF	NYIEGTK ML	RYTVQF TTM	LANRFQ LQL	LGAPAK PPL
YALCGF GGVL	YSMPVH AAV	FFPEDPV KI		KRASVF VKL		FVDDSG RYL	RAFGIPI RV	WYQSN VNTL	VYQDT WMKY	LVNQRL LEV	FSVVQP SSF
MAYGAS FLSF	FAYEYTL EI	FADLNL AEF		QRTSLIV HV		LLDTVN NVF	FASVLIR RI	IYQSMP RML	AFVAIVQ SV	MSYYFL HVV	FAKPENI DL
SLPALPL AEL	ISNPNSII L	FYNLSIQ SF		AAYGYG IRY		SQDLLPL SL	FLAPLVT EY	MDDNR LLTL	FYHAYD SYL	YIQEHLL QI	KLTELLR YY
YMIDPS GVSY	FSQGGA LSL	SFDSALQ SV		IFPEFLK EL		FAQEAL TVL	QAADTV VIF	YYLWML HSV	IFPLIYSE M	AATARV LVI	TAAQVA RVL
YALNEN VSSF	FAIPGSS FL	YFDTVP VAA		FAFFDP VMY		FVDPAQ ITM	SAVELV QEF	FFLRMK CTL	LYHGMA LAL	FSMGKT LLV	FAHPYQ YEL
FAYGGH PYPF	FAATQF EPL	HIDVITA EM		AKIKWV ISV		FVTTPT AEL	FASFIVQ YY	AYFELVS AL	VFNFTIH EI	RVYEILR LL	KAASVR PVL
YINPAKL TPY	FAIISGL NL	IFDWIYS GF		SGSQLIR LI		IIDEFEQ KL	VVPQFV VFY	RYSEAVF YY	FMHVQL EVM	RTIQRP VTM	KMFLRG TFY
LTMPDT PRLF	VIVTPLT EL	EFNAEV HRK		FVRDMI REV		NSDINE WSL	FAAGIIA HL	YFYAAIV AV	SFYPRNI TL	RVIPVLL QL	AAGTR MYEY
LAADLSL HSF	DSNPMV SSL	VFDAFL NMM		FTPNNI KQV		SVAMN CQGL	FLCPFHL SV	GFPWKT SDF	AYHTLRL AL	FTQKNIL LV	FLQQPR PLM
FADPHS KRVF	FFMPGF APL	AFNHNG NLL		MLPEFY KTV		HTDVAD VLL	TVPTFVL SI	YFLTLQP EM	HFLDRH LVF	KSIYTPL EL	SAKWPL PSC
FAVDPQ ITSL	TAAPVP TTL	IFDGLLE YL		LGNDFH TNK		IAEAVRT TL	LAVPFC VNF	YYLARLL GL	SYHLVGI SF	RSIMEP MSL	MTTAFI HAL
YAFPKA VSVF	FADPIAA NL	HFDDTV VCL		VRPALQ HVV		WTDFPP SKI	RASFIFIS V	VYEGEV TEL	SYLEKVS EV	RSVPTW LKL	MATVVY KVF
FVAPVD LQAY	YAITRVL RL	LFDGSPT YV		FLPDHPI VL		VADEEL VHL	YTTDFIY QL	AYLEALS HL	AYYEHRL QL	RTLDNQ LFF	MAVEFL HEL
LSPAIPL EAL	KEHQNY FGI	EFDPVM VIL		IASAIVN EL		FAEQPS VKL	AGIDHL VSY	KYLALRI AL	RYIGKT MDY	INTPEVL RV	SMLLRLI QY
GAYVH MVTHF	LAHVRTL EM	FAPYNK PSL		SLIDFLR VV		NADHTT LLL	FAYPIPH TT	YYIEGIN QL	KYIDFTS DY	RTFEPRL LV	FQRQFV LTL
AIVHGA AAYL	SASTVFL SL	YYDEIAV PF		SQYQGV VVY		TQDLQA KEL	IAIEKIRL L	VFPLFSS EL	SFQLAVE TF	KSNELW TEI	IFVARLY YF
VARNPP GFAF	DSPFLILP L	IFDENEL EL		LLPDIISR L		KSDFML EKL	QSYPTP VTV	YYQPLV HLL	VYQYMH ETI	RAHNVP LKL	AATRW AKKI
PEVKFN WYVD	ATIPIFFD M	VFDFCE HDL		ITMQNL NDR		NADTLA LVF	RAYELT QYY	LYYIGGE VF	FYVDTV RAF	RSIDDV VRL	LAKNFF NEL
FADPHG KRVF	YVLSKSR AL	KFDALIT TF		SRTQLV YVV		FLDGHD LQL	FVVEHD FIM	LYQPSAE SL	VYHEILI GY	LQNNTI LRL	YMGIRN ESF
FLPARFY QAL	HANEKV EML	SYDLAN RDF		QRAAM MNLL		LADETLL KV	FNFWRA PIA	VYPLYTI VF	AFKAIGT AY	RSMHAI IYL	DWFERP DSF
FLPEEA WCDL	FAYRGF KYL	YVDVAV GAF		LRTDFA QKL		ITDPSVI VM	SVFGGL VNY	YYFVTRE VM	AYLPVN ESF	AANRLT LEL	NAQLRN INF
LVKNW VPTAY	FSDPVYK EI	SFDLGR QFL		VHFIKPL LL		VIDLETT SL	AATQLV NQL	HFSNMN KAL	LFVDKIR EY	HTVTIW LTV	YQTPFN KEV
TQKSLSL SPG	AAAPAG PRL	VVDAIPV FL		FRNPKT SFY		VVDSIM TAL	IAVGLVP QY	NFPNGV TDF	AYMAAF NSI	TASDKIL IV	SAFPFPV TV
VAMNP TNTVF	IADGVFR FL	FFEGKCV EL		HGVAQ VRFV		LVDDLV DSL	TIYPGL MIT	SFADFGS AL	FTIFRTIS V	VAIKAG TTL	VATIKSV SF
FAYDPS NYEY	LTDANIH EL	VYDPSLK TL		FVFFLPR LI		VIDDLVY SI	YSYFSPR TM	IFIDEIDS L	HFPFAIR VF	SSFPRFY FV	SATAVA QLY
LQPPKPL SSL	FATEVFK AM	YYDDYR VQL		LRSISSN AL		YVDSAL KPL	LAVEAV LRL	IFPPSVG EF	RFLENAL AV	AGNGIR VFV	SISDFFR LF
FVSAGI QTSF	SAIEIYLK L	SWDGRY ALV		LRSPVYL TV		HIDGDH LTL	IARLPSS TL	VFVVDS AAF	RYPTSIA SL	ASLMHS FIL	TFTERM MAY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FAVDPR FLAY	GAVEKG VPL	LFHPSNV EM		LYNGAT RKL		IADDFIE SV	NASPVIS SV	NFLSTLT SF	SFHHNV AAL	KMDDK ALLV	FANLPN QVY
FVNDTL RSEF	LAIESAN EL	GFDERV TVM		RRPLLL NSV		ATDLLSV AL	RWYNHI KSY	AFLAEAS VM	VFHVM GFSV	KTNEML LNF	MATPY MNHY
FTMGGP AISM	QACGIT AVL	VMDSKI VQV		FFSEYEK LL		SADQVT RAL	FFYTHLI NF	YFADGV LSL	AFIHISTA Y	RSTDSIR LL	NSANRL FQY
FAVNPL LRVI	VAPLPRS AL	NFMLHL VSM		ALPDLT KVI		VFDYSIN SV	KAVSLIN AI	AYLRSMI PH	AFQNVL THV	RTFQAF HSV	FAATHSL EF
VAFLAM LLVL	AAALPP RPL	AYDFLYN YL		KRAEKL TEL		YSDGPG EAL	SAFPSNI FY	FFPWNS HVV	AFQAEIA QL	SSLELPL AV	QSTDIIR YL
IAYIHLV ADY	SAPLGK MSL	VWEETII LL		LRMPG VQEY		VSDSVT PVL	YATKHL RVL	IFPTLTSP L	SYYSPSI GF	ASNLIEV FV	FALDMK YAL
YLPIGGL AEF	FAIHVST VF	AYDVSSF SF		VVPQFV VFY		FTDTVG NIL	YTYNDT VIF	LYFIAPT GH	AFPNLA RVL	HNGIIF QFV	FAYHYP YTY
FAMMH GGTGF	YANDVT RVL	CFDGVLL EL		TRSGLIQ WV		SLDSPSY VL	SIPAITRY W	LLPSHPL EL	AYLEAIH NF	HNYLQN VSM	HATQAI FEI
FAKTFV GTPY	FMAPPV TDL	IFDLSEVL C		ARAFIIL SV		FLDNLTE EL	CSIGFAV RY	VYPDGIR HI	TFMDHV LRY	KQSTSFL VL	KVYERA VEF
FTPFVD PRVY	FVNPSLR VL	MYDKDII ML		IRNILLH QL		FAEWKV DML	FAADIIS VL	VFLISGV SL	FYNGPV SKF	RSVDRS LLL	VFSFKM VSY
YMNPY QLNAY	FAQAM MSVL	TWDELV EHL		KRTNIIP VL		FLENHG KNI	LIYGTPR AA	SFYNVE MSF	IYEGYAL PH	VTYLFPI QV	YIMDW MDEM
YADPNF VRTF	VSIDTVT VL	VGDGYV VHL		TRAAIM QAL		YADPVT DLL	VASEGIK RY	SWIDDT SAF	NFQALA AEF	GTIGLIH AV	YFYDRR RIY
FSYPFTF EAF	NAFSGV MML	YYEVHKE LF		VRALSIQ RL		TIEDAIA VL	VAYPLYI LY	YFEGGV SSV	QYFTAR TSL	ISILQHL LL	YSMPST HAM
YTNGSF GSNF	YGMDSR PPM	LFDLNEA IM		IGKPAP DFK		IGDPEVL EI	AAYYPP SQI	LFPDTPL AL	SFEDAKE AL	MSYAEV MRL	AADWH NLIL
AAINPEL LQL	FNYPGG VAM	FYDPDT VEL		ALYPNV VQV		SADDFL PTL	ATFAAV VLY	YYLNEIQ SF	AFHDNL RSL	ESYGNP LRV	FFNGLR TEL
FLLPTGL SSL	YTTDFIF NL	IHDGLTV HL		DYFEFP REL		LQDQLR VAL	VALPMV LVL	AFNKLAS SM	KYYFILSP Y	RSVDIIN ML	LFYERFR AY
FLPEVPL GQL	FAMPYFI QV	IWEQYT VTL		IVIGIIKT V		VVDLLQ QEL	AAFGDK IFY	AFPPSVR AL	QYMERL QLL	RTYVYV LTV	TGTHGL LVK
FAYGTY RSNF	FTSLPGS TM	VFDFAG EEV		QRFPPP QEL		MVDEN FSTL	LTLDQA YSY	IYMDSG MSL	SFLDQVT GF	SSGSHL VFV	VAAKKN VSI
KLPNFG FVVF	YSFGPSA VL	IFNGTFV KL		TYPEVV RMV		TIDADA PEL	SAITKP WEV	NFNMSV SSM	VFLEAAK AL	ALNILKL VV	YAFSRRF AW
GAIGGT PPAF	CSIDISSV L	NYDIAIA EL		AGYNRV RIV		YVDLIEE QL	YITGHVL VV	TFFMGK VAL	FFYQRLV EF	QNAIQP LFV	AAAPVIK AY
FAVGDI ALAL	VVPEPG TSL	QWDVD TIYL		KLPEFSR KL		IADSNP MVV	FATEGL RTL	SWPTYP QLY	LYTEKFE EF	RNNSVV QVL	NATDLL RKM
HIPDHLR PEY	LAASVFT CL	LFDLIQS EL		FRYPTTE EL		NADSAT RLL	SAAGFPI RV	LYIQRTK SM	NYQVTN SMF	RSQFRQ IFL	SATYRIL EV
KLPEFTK SEY	LAVVVT KEM	CWQNYL DFH		RRSSIPI TV		RADKP WTRL	YSHPHV RLL	VYIPSRV AL	SFISFAN SR	RVFPFF RVL	LSMTRP VSI
FAIGGIA RTY	TRSAIILH L	LFDLAM LAL		EYLNFIR GV		TADLPN ELI	KISNLLK FY	LFQLGN CTF	FYPTFKE GM	YSHSLLP VL	FASLPQ VER
FAESGW RSAL	VAAEAF SEL	SYDEAIL RL		NRAEIIS QV		SADWSL EAL	NAMGK QWHV	IYPDSFT VL	SFPHTTP SM	ASSRMF LLV	LSAVGE RVF
RALPFV PMSY	FAAMEA AAL	WYDPN ASLL		QSPAFT RQL		SAEEMV TLL	RTFPWII EV	GFVNHA LEL	FYEPYSR EL	KITTVIQ HV	VGSFRS NSF
IARNPP GFAF	VSIPVWI IL	MWPLV AALL		SRLDSVL LL		VADGLI TTL	AAIGLVI YY	MYPAFA EEY	FYYIRISE L	KTFNLPL LM	AAFVKA VGF
TSGAML ANVF	VAPVTH VSV	YLDNLLV RF		LRALNV QVL		VLDLTY NNL	FASPTQ VFF	MFFFSRL EY	SFPQLRA TM	RNIFPS NLV	AAMSHL LEM
YAAELA GLSY	FCSPISSE L	IFDDPLN AF		VAYPCA ILY		ISDNAA RVL	HTFWG VVFF	YYHPARL GA	SFVPFITE H	RSAEVN LYV	FAHPPLL VL
LASPVPT TPF	FQYPDT RYL	FWDGKI VLV		ISTPVIR TF		LAMEPT PEL	VAVGFP MMI	LFIPRRA PF	TFLAQH ASL	RSLWFP SDL	VIGDVIR VY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
KSREDE TKPF	MALTPP LLL	HFDVLF AEF		LLPKHP HLV		FADDYKI AI	YAAAQL RQY	TYQVYG LAL	QYPGRS LVF	VTIGHIA LL	LSAGAT RVY
FSSSATE FSF	YQEKGV RVL	VFDEAII AI		NRFWPI IQI		LLDTAD VAL	NAFEAP LTF	FGPREQ STY	RFMDG HITF	ASYEKK VRL	SATHYV AEL
AASDHA HGVF	FAPGLSA RL	AYDPYLI AM		TKVPFPL TL		VGDLLE VSL	YAFDFA RQS	SLPAYLN SL	YFVHSA GQF	FSFHHV LSL	SSAPTAR VF
FALTNGI YPH	IITTVGP EL	KYDYVG RLL		HQSGIV QLL		MAEIFG TEL	LAVNHV FEI	SYPDAIL QA	HFITPVS TL	HILPHP VVV	TFFSRGL SF
ALPEDD FLSL	WAMDL RPEL	KIVKWD RDM		IRNKTV VNL		FASEVS NVL	AAISEVL YV	SFLEDAR AY	SLIREAA NF	RSIPTM LSV	FAHTVV TSR
RLPDTAL PTL	RVIDVGS EW	LFDVSIM AV		SQYPGA KYI		IADEGT WTL	FFMEKR AKY	NYAEYQ VCL	VYWDY MKAI	RSLSYPF LL	RISGVDR YY
YALDVR VNSL	SAINQVE AL	NYDTSD VVL		FRFENV NGY		FLDLTE QEF	LASQIIK TL	SYPSVVS TL	YYLARLL GL	SILQHFL LI	FANERC LQL
YAAPPH VIHH	LAASALP AL	TYDDFR NVL		FIVLMII SL		MVNISL RVL	MAYLYP LQW	KYFSSM AEF	SFAAEAI AM	CSSPHA LVL	IIAPPER KY
SPFSYLE GNP	TAFSIYC GI	MFDVTE GAL		YYRTW NVVV		FAEGFV KAL	FGYDYP SVL	NFIEDVL GY	SYYTVAH AI	ATMGH WILL	TVALRG YAF
FASKEIA ENAL	DALVFIIS L	KIEDYFP EF		ERIPKAL EV		FQDLSSS IL	MSVTKV VVH	RFPDTV KQM	SYIELPAY L	KSALVV RFL	ELALRLT EY
VAYWR QAGLSY	FVHPKP VSL	LFDVQIL NY		SRSHSIF TV		LADPVF RTL	FSFKKPF KL	FYIESISY L	FYPIYFR PL	ATTVRP VFL	ASTVRIL EV
FASQEIA EKAL	FIYEGSS DF	FADFER HFL		ASSPVL RQM		FAIDPHL LL	IASFILLR L	SYFGSFS SL	LFFDSKQ SL	KSIEEDL LL	LAAARL AAA
AVRDISE ASVF	YAYLNV VGM	KAPDFLP LL		FLFQEP RSI		VVDSED IPL	FAKVHIL YV	YFYLFPN RL	TYPSNIL SH	KTFSYPL DL	SDVVYT DWK
YGAEAL ERMFL	HAYLSK NSL	NFDNILN SF		YRYDEQ LNL		AADFVK AFI	FQYESK VFY	AFPGASL YL	AYFPYFI TY	KTTTIAV EV	SSSIKTV YF
FAIDPHL LLSV	FSLAFIL WS	VWEEM KTTL		YYWIGI RKI		TQDLPG VKL	FVNEIIS RI	FYEGHIT SL	LYNIMKE GL	KVARAIL YV	YAAGAK LVL
YSLDGRL LSTY	FSAPPGS EL	AFDITYV RL		VAPVTH VSV		YADPVA DLL	YLIPIVV RY	KYYSADI NL	VLPNIHP EL	MVNSKI LLL	KWLLRL EEY
FAYDGK DYLTL	YAAEIIS AL	LFDTLVN FF		LRPIGNI VL		QADILK NKL	FAYSSRI AI	HFGWY MCSL	RYVPRA SYF	FSLDLV HTL	RANIQA VSL
FAKPVY PGQTL	AAADVL EAL	LFNHTLT CF		VLPGLIH KV		TLDQTL NEL	RSVDIIN ML	TYQVLA VTF	VFHWTD LSL	KLTEIRH EV	VATSFIR TI
YAYDGK DYIAL	AYLTYTT SV	RFDVSLV YL		FLPHQT VTI		VADFGL SRL	YTFNKV LML	QFLRGA RAM	IYLEGKID Y	KSYVKL RHL	TLTALVR YY
SAYDGK DYIAL	VAYMNP IAM	SFDNIRN WI		KAVDIV KQV		ISDHAIQ EL	AANPHS FVF	SYLSTMS SL	YFEDVA NAM	RTLETLI RL	ILSPPRP PT
YAISPGL DITF	QIPEIKQ TL	SFDTGFT SF		LRPNFTI AM		FAEASG LEL	FAGFLP RII	FFNDTTT AF	LFHNAV SAY	RVYFFFT EV	ISNPVTK EM
FAFEGIG DEDL	FTVPQII EM	FYDAND VGF		LRIPAVR TV		SVDDFS SAL	VSAAIVK EL	FYPPLTS SL	RFPNFT NQL	KINGFPI FL	YAFNMK ATV
YAVDPA QLQAL	TGIQPG TSL	YFDLAA DVL		QRNQAI QAL		ASDLVT TVF	AAFAYT VKY	IFQIHTS RM	SFSFHAA GL	RAHSEP LAL	AARPFT QTL
FAYDPS NYEYL	VAVTKA FPL	LFDHVT VRI		GRALEL LYL		NIDFMP TIL	AMASII NRL	AFPNLA RVL	SYIVSQI AV	RSMGLP LQF	FALHKTL EF
YSLPTSF SGSF	LTTDISLI F	LLDLCEE VF		LKPGM VVTF		SLDKDIV AL	GAYKYI QEL	YFPNWA MAL	HYQPVD VSL	SINQFAL EL	YAKPYFL RL
HACGVI ATIAF	FTFIQHL PL	TYDIVITT Y		IIFEQIRF V		SMDSSH VSL	LASPPW RVL	AFEDYV QSM	VYTTNIQ EL	KTAQAL AQL	ALALRFL AL
MAPSET QFSHL	CAMPVA MEF	RYDLSPI TV		NSFGFP QYV		GSDPSII SL	MQFSKP RKL	FYSPNIM AL	KYAVQL VEM	KTFFHQ ENV	FATESSH FY
FLNPAA HLEPF	FSPQQN MSL	TFDTTFS HF		THSNILR LL		NCPERII TL	LSYTEILK I	IFQIGVL GF	AFIETPS SL	TSMDW LPQL	LLPSHPL EL
YSYPAA VPQAL	SAANHS AAL	YYDPDYS FL		LTMEVI RQV		TIDQGM AAL	FSFDGP EIM	LFAPYGT VM	ILPKYVQ QV	RTIGFFY TL	KAIDYIK YL
TTIDPR WLVEF	AACNIYS TL	YYDPMIS KL		MSVYLV RQL		SSDGHE FIV	RAFNRIY VA	YYFPDSG FF	SYENMV TEI	RSHFQH VFI	VFFSRGS SF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
FAAAVL DGMIY	KAIRPYH AL	FFDNRP GKL		DHENIVI AK		SSDPEVL TL	YAFSGV EEL	AYHTLRL AL	FYSNKEI FL	RTLLAIL RL	QSRPFF NEL
PALYGG VQAAF	LAVASGL SL	TWDEYN IQM		SYVNLK RTI		TVLLNPI SI	YAYPGV LLI	IYVISAET F	FIISRTQ AL	SAFPFP VTV	AASPKSF TL
FAEYPG SSAQL	FVMDGS QPL	FADPIAA NL		YRFLQT AEM		LVDGQI FCL	KTVNKIL QI	AFAVVA SAL	SYLFSHV PL	KIIDGLL VM	FGIYRFL PF
FAKSVSF SDVF	FASDAS AVI	AVDPLLA LL		FLFDHLL TL		FTDIGKV DF	MSADV PLVV	LYHEHIIK Y	VFYPYP QYF	RTFAAQ SLV	IGSSFPR MF
YAWESS AGGSF	STEAAIT LL	YFYNDT VTF		YAFPKA VTV		VFDPVQ KTL	SIPDFP MHL	FFLAHLS FL	YFEPKDI TA	SVNPHD ITV	MSAGPR YEY
AAYYPS DVSSL	NCPERII TL	IWDVSV NSV		IRFPMQ RNL		VLDSDS GLL	IAFHSAV SL	AYALAG VSF	FLPITPH YV	RVVDYL TKL	FAIFKVT AY
YALVIFE MVHL	SAPIFTT SL	SFDETCT RF		VVYPW MRKV		YENEVA LRQ	SVISHLL RV	SFSEFTS SL	CYQEGL RSL	SSYGNIR AV	LLVMVN ESF
GIHETTF NSIM	FATTSPL VL	FTDNVP ALV		FGSAVP RNV		YADYIGF IL	VVYPILV EF	KDEETYE TF	HYQILN QAF	SVIPQIQ KV	NALLRP RTF
QSNLAP SQLEY	IATNGTP EL	LFLDFLE EF		FLPLFDR VL		GNDLPS VEL	KAFKGSI FV	FYVMEY REL	KYMYFT VVM	ANSPW VVQL	FGTGFP HML
VASYKK GTLEY	YVVEST GVF	NFDMFV SHY		TRHTFV VFF		MQDIVL NEV	HVINHIL KA	YFMTMI VSL	RFPLNIL PM	AVGPVH NSV	TAMDV VYAL
AAGVTA APLPL	FAFITSSS L	YSDTQFP SL		FRYPFYY EM		ISDIAND AL	MANGEI HIY	IYFDSSA TY	AYQAKV LQL	KIAPNT PQL	VAAVRA AAW
AEDMGL WASHL	NAINITS AL	VFDDTL GSF		RVIDLLR VI		FIGDSGI PL	RAYIFA MKV	SYLITSVE L	IYVISAET F	KTYGNV LVL	FLGERVF PF
FKDSLHS LMAT	FAVHFY RSL	ILPEYADI F		VRFLEQ QNK		NSDLVL QTL	AAFGRD LFL	SYSSIASE F	NFQTAK EAL	RVMEYI NRL	SAVVHE YAL
AVAEAL TNLVF	FAATVA VPL	NLDPLVY LL		MVYGG VRIV		NVDPDS VVL	ISFPAPL YI	GYLAAS QSF	SFDGRIS VY	ASTFRLL TV	VAREWF FLI
	MAIVGG MAL	YYDFPA VET		FAQHG GIYV		YCDERIT EL	QAAGILL RL	AFQAEIA QL	YFRDNP SEL	GTYTGFI KV	FAGFQR KAV
	ISIEPGVE L	EWDQV TVYL		VQPQFT RFL		FADAGL VCI	SQYSNV VIF	FYYSSGT VL	FFTNVIQ AL	TAFAHL REV	FASTILH LV
	FGMIVS SAL	LVDLEPG TM		KRFGNA VIL		VADLAE SIM	YIFTTPK SV	KLPDYN NRL	KYYVTIID A	YGNRQ NLEL	YTTDRV MTV
	LANPTTS AL	DFDLLN NSL		SAFALV RTI		NVDIPD VPL	AAFPIAV VA	AFPDSV NSL	SYQEAW STL	AAASHP LLL	IATLRAY VL
	YANAKIY KL	NFDERPI SV		TRPWLS QHL		GVDLSKI PL	VASEIM AVL	VFAPPA EAY	VYLKTAL GL	AIMDIVI KV	VASNVP KVV
	SALGKSP WL	NFDMLY NHV		FRMPII NNL		NVENAF FTL	KIVDWA IQV	TYPAGF MDV	VYALPTI AF	ASLHVM MTL	YGYDNV KEY
	AAYDRY LKL	SWDIVV QRV		LYSTMV RFL		LSDEENL KL	LASPVSP EL	IFNTVNT SL	VYQNIFT AM	ATVVTQ LLV	IAREWF FLL
	AALWRF AEL	YFPEFLD ML		VAPVAQ VAL		QANGTK FAI	AAFPYG GVL	AFPIGSS GF	MYFTYK VRY	KALSIFN EL	SAFLPAR FY
	YALERLK VM	RYDLGG LVM		SRYPSLL AV		AASFEYT IL	AMYPIR SAY	LYLPATT PY	RYPDSIL EH	RSVDET LRL	YTMVY WHAL
	VSHPRYL EL	WFEAQV VRV		FRNGLG NQL		VVPEPG QPL	FAYEGP MYL	LFLPTAA AY	TFQFTVE RF	MADPNI RFL	FYNNRL QAY
	VAFQHF QEL	FFDMAY QGF		FRSILSW EL		NAETFGI PL	SAFGNV KLV	FAPVTP ALP	SFAARSF YY	ATASVN LKV	ISIVRPFS I
	YLFERIKE L	NYDYAV YLL		SLADIA QKL		TQDLTV SQL	IAFPSAN EV	NFISGAG IL	SFNAYE NHL	ATLKLQ SEL	VGPEAD KYR
	YLLEKSR VI	IFDFFEE DL		SRVLKVL SV		LIDNPNL VI	SAASICA KV	NFLGAE NAF	FFYTHLI NF	IIYPTPK VV	FAAQRG LAV
	TIYDRFV HL	AFDPTST LL		GRTSLT NLL		AADGP MPFL	RIYPFLL MV	NYPGLSI SL	RFLVGT QSL	YSFSELL RL	FASVLIR RI
	AAIWFR TYL	NYDNLLS QF		TKPAIIF RI		FADAM EVIP	AAIASLL YL	FTFPSDI TE	AYQGVL VEL	IVATKPL YV	ITAPTVR QY
	FAYLRDL LI	QFDMTR NLF		ARFPGN LLL		SQDYPT LAF	ITFPIIVH F	IFVVASS SY	SYQVMF FTL	KQSNV QILV	FALLPRL EY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	HAMQF PAEL	CTDDNIY MF		FQAEIA QLM		AADSYF SLL	RAFHG WNEF	VAYVSSV AL	YYQTPRL WL	TINDIVH VV	FATIRTA SL
	FSHPREP AL	AFDYAY VVL		QSYGNV VEL		AADYSQ LEL	VSFPYVI AL	KMLAVV VFA	AYLSKA MEI	KVGHVI LEV	FIRKVFL VL
	VAILRHP TL	EHAPSIV FI		TGISDVF AK		SSHDDTI LI	LTPSHIK AY	FYPGLGL AL	SFAEIIM GY	RTDPIPI VV	SAIYRLF DY
	FSLPHPE AL	IFDEILV NA		YDGIILP GK		VADGFK SKI	AAFHLA LYT	GFPSSVA AL	SFQGIVD AY	HAIQKY LEI	TAVMPK VSL
	LSAPIHT QM	TFDVCV NQM		VRPDTV RNL		WIDKCQ NNL	FSFRGV KVY	IFIPSSIAF	KYQAQD NFM	KIFDNFS NL	AANPFF KLL
	LLVDHF MEL	NYDEFIC TF		FRQGLA NVV		YTDLAM STV	FSYGRAL QA	SFNSSFT SL	AYFPQIV SV	RAFQSV LEV	MVSAIV RTM
	MSSPLS KEL	QFDDVLI YL		TLPSMV HLI		IADMDF SAL	FTPNNIK QV	IYPETAAI L	LYAIRTQ EY	RTFEEF QEL	NATQFIK QL
	FSLLPLS HL	YFDQVL VNI		VSVSFIR TI		VSDPND LFL	NSSSIIQ VM	LYFGGA AAV	AFMSQV HSV	SALPIIQ KL	TAIELIPS V
	KAMELIR EL	KYDQLK VYL		FRAGKI WVL		YLENEPL ML	SSTILVV RY	AYAIQV GSL	HYMSIN DSF	DTNADK QLS	FSNPRAL YL
	YLQIHPQ EL	VYDMNL REM		LKPNLV LDI		YADGPQ LYI	LASAFFL VV	VYFGIAA SL	RFPDLTV EL	FSALRFL VV	SATWLA LSR
	VAYWR QAGL	YMFVDE NTF		AAANV VRNI		VIDNFTS QL	MSVYLV RQL	YYFNRKT FSF	RYLPQCS YF	HMHIHI STV	SVAVRV LSY
	LALDHL HSL	FTDTSIIL F		GRAFIFP SY		VVDGAF SYL	NAYQRA ILL	VFMPHV TEAY	YFLEWR SVL	KSFFGPL EL	VAKMYI SEL
	FSFHHVL SL	FFDTNTS VL		PYLDIVR EV		LMDNPS LAF	RAYAKA LHY	RFPNFT NQLL	AFKEVGI EF	FSHAQT VVL	SAIPHPLI M
	IAAPFTS KL	FYDSIPQ EL		VRKDDP TLL		FLEEAN RVL	EAFYNVI TV	YFIAPTG HSL	SYKQVG VSL	KTSVVG LFL	VSYLRVK SF
	KAAHFF STL	FWESSIV YL		LRAEMV AQL		LADGVP VAL	YASQQI RQI	YFADRLY DSM	YYQLGD HEL	RSLLLLQ LL	FAASFA HLL
	AAVPKT FQL	IFDQSGT YL		VRTSFLL NL		YFDAIPV TM	YAVNSQ FTM	FYFDRD DVAL	GFNVET VEY	SSSPSPL SI	FTREHY MEL
	FAIPLIEK L	FYEDNVL YM		IVINHVI SV		FSETINT EL	ETLALLEI L	FYYDGK VMKL	KYYSADI NL	FSREEFP TL	FTAQPK PAT
	FGDIFLH LL	AFDCMK NYL		MQPTH PIRL		FTDFDP HHF	LSADIFQ QV	YFIAPSG HGL	FYRSPEV IL	RAATFP LQV	VASVGH GVF
	FLEEANR VL	EFDVAV DEL		TRPPLIK NL		HADLAG VPL	AAYHLII EL	YYFDRD DVAL	FYTVAVT SL	RVNYHL VNV	YSSPLFR SL
	LAQAHI QQL	RLDVTV QSF		FQFQNL RQL		YVDEIAS VL	RVYFGH WVV	YYLQHP PISF	KFPAYER VL	SNAKHL EIL	VALPYF WEH
	AALFKA WAL	EWDPLD VRF		EFTEAV EAK		FTDGGP RTL	FITGLIRI M	YFITPTG HSL	NFLAQT EAL	VVNGR VLEL	YVSDLG KVF
	FIYHLPQ EF	QYDMTL TSF		YKPTYV VYY		AADLSM LVL	YSADGH SIL	NYIDRFL SSM	NVEIDPE IQ	AINPELL QL	AATLLHL EL
	YAIARFK FL	FFDTELE NL		TVYPME RLL		IADFMT TNV	SVYSWD IVV	YYRYPTG ESY	NYPAFM MEM	ATVPFLL QL	VSVTHR PPL
	IAMDLIL KM	NFEVSTV IF		LRSQLIV LL		NIDEGP LAF	TAFPFQ VEV	RYPGYM NNDL	HYIDRVR AL	FSYKDF DTL	FAALEKT YY
	SAILRSP AF	SWDEAV QAL		SKPDIIS QL		QAESKV FYL	YASNITS VL	YYYDKNI MTK	SFISVIKE M	KVNIIPII A	FSTSVVR PF
	YAEVGR VLL	TFDPIHQ WL		LRSDIQK RL		SADITFA TL	STVHFIIF V	YFISPTG HSL	YFPAFEK VL	LSMKTL LEL	VAKPIPE EL
	YAIFKSQ DF	VWDTKE VQM		SQAPLL RWV		FQDIAIE VL	NAMDV VVQF	RYMELY THVY	AYYDGV AKI	QTALVE LVK	KAFVFSV AL
	VALVVG HEL	CFDVPT ASV		VYHPNV KVV		YSDGRS LHL	RAIELAT TL	FYFWPR TVPM	HYTVNL NTY	RSLQLSL VM	TNTLRIL AL
	RATPHFS GL	AFEDVA VNF		IGYGHV RAV		NADYVA AFL	VGFDAV MRV	SFYNLLT RTF	NYIEFTRI L	KSIPGLL RL	VASPAL RAV
	VINDWF KVL	EFDAGII EL		NSYVSP RIL		YAEIPDE TL	QAFPGL LQL	IYFDHDL QSY	SYQEHV KQL	RNSQW VPTL	GFQVR MFEF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	ISIDRFLAV	KFDVTQCMF		SRPGFLTFW		GADVFLEAL	QMSNITVTY	KYYDEIINAL	LYLSSKTEL	VGQTRVLML	LTRGYFLEH
	LSDPFYRTL	TFQPYLDTL		YRNSKLTYL		TSDFFPRPL	EAADIIQKL	SYFEKETLTF	RYFIPVSCF	YNVWLRAQL	LVTGTVRTF
	VASFPRTVL	YFSNTFDLM		LRFDGALNV		FASFPHMVL	YAYAAQNLL	SYFEKGPLTF	DYIAGVSPF	HVITKTMEL	RLFSRLYTY
	MSVEVRQTL	AFESEPLFL		AAFAYTVKY		SSNLELHSL	HTIDTILTV	YYFEGIKQTF	FYETTLEAL	IVNGQIHSV	YITFVKPAF
	YSKLPGVSL	FWDPSVNLF		TRSELLPFL		FADGLSLGL	ITYGLPIMV	VYFAERVTSL	LYFISPTGH	KSNPYFEFV	AAKFYSFLV
	AAAIKALEL	QFHMQLNEM		IRASLISAV		VLDEIGIEI	MSIPFRSAY	IFQELVEGVF	FFPVHFQEF	HTIDTILTV	ASSLAIREW
	AALDKATVL	SYFKNNAYL		YAFNMKATV		FMQAVTGWK	QAVGIILHY	YYYDKNIIHK	KFNSSVLSF	KAIDFAASL	IVTELIRDY
	FLYAGHIFL	VFDYAYIVL		LTPNIVRAL		RADTLAFEM	VAYPCAILY	AYMDAPKAAL	RFIGATANF	RGNPLVVRF	TVWAYFRVM
	FIADHCPTL	FYDASLGTF		SRIPFNQAL		MSDGFISNL	YGYGIRYEY	NFYEGHITSL	TYGFRGEAL	ASSPKFSEL	FITGLIRIM
	IADLVSKEL	IFDLQNKVL		HRNGGLITL		AADDFLEDL	FSSENVKVF	FFYEGSRVLF	KYFPSRVSI	KTRNLVLKL	RMSGMIRLY
	FAIYKMSFF	NYDFPVVIV		FRNNRFPNL		FAMFDQSQI	NAATILVFF	SYIDRLISVF	VFVEATHVL	LMNNHQLEL	VWWYRPFQY
	VANPEHMEM	CFDPKELRI		VYADWQRWL		ASDVGSITL	FMKPGTLYV	HFFEFLTKEL	GFVEQAEAL	ISSSIQLLV	CLADIFRIY
	FSIEPWLKV	DFDSVSSIM		VRFFTGQLL		DDSLPVLLE	NAIEDTIFY	RFPEELTQTF	KYYIPEVVY	ITVPVFHLF	VASYGVKPR
	FGLPRWVTL	LYDICFRTL		VRPSVIQKL		EVDNPNVAL	NAYEFIMKL	YFYDRRRIYL	YYHYSYSVV	RMLIKLLEV	AAAFEKQVL
	TAIDWFHEW	TFDDVALYF		EIAEAYLGK		LTEDPHTVL	NAYPSPLGY	SYFEIPTKEF	AFPDNQRPF	RSAEVTLEV	AATLTSKLY
	ITDFQFKEL	VWDHQGVEL		IRGSTIKYL		AVDPQITSL	YVYEYLLHI	FFFPTQGHDY	IFRSSDVVY	VSMFRWLEV	FARFLNYQL
	FAFRNFLYL	FLDLTEQEF		KVGPVPVLV		FAYVEGESL	FAFGSPIGM	FFYNLIHPEY	RFQNYMVAL	KNFKAFASL	ITLLREISL
	TALPRIFSL	YFYLFPNRL		AAAELLKKE		NMDSPGPML	QAVAIFTVY	FFPDKPITQY	SYPDFLRMM	SIQPKPLLL	TAVWLPRYY
	YTIPLAIKL	FYNVTEMSL		QRNPEISHL		LADGYDLEI	RSTDSIRLL	RYPDIQASYL	FFPLHPMMI	GSVNRVTIL	YIYIRGEFY
	FSLDLVHTL	VFDVVVTDP		YSSPLFRSL		FVDADNLIL	FSIPFAPHI	AYYEFREEAY	VYITPMEAL	KTNGFILFL	VQHIQLLQK
	KAISRWSSL	VWDIVGTEL		NVFFYPRLL		SSDGAFLAI	AAMPVAQHL	IFIDRDPTVF	YYASFLEVL	LIYSGKLLL	YAAPWFLTL
	LANERLMTL	LFDDCTQQF		YRSDGALLL		NGDISSLEL	EAFEHPNVV	YFHDRVASFY	AYQLMVDVF	RSLKQVHLV	LQQTRDLAF
	FALRPTFDL	FFDIPVDNL		KAYPKRPLL		IAEIGSLSL	YFVPLVKRL	HFSVEGQLEF	FFPDFIWTV	SSSAVFLII	MTQQPRPVL
	AAEDAIRNL	FFKELIQEF		LYPEIPRKL		SADTTILFV	FAFSCLLTL	YLPNQLFRTF	VFKIPGFSL	STIDHFLEI	FLAKSRPEL
	YTTDRVMTV	QWEETVTYM		VRPDNTYEV		FSSEVTAAL	FSFSGVNRL	FYIGEHLLPY	AFADYVSTM	LSRLFRVFV	VACPPPPAY
	FILEHIMVI	TWDLTGLLL		QTHGFIIRV		ALDDMISTL	MAYPSLVAM	FFYNEHTNDF	FAPYNKPSL	RILVQQFEV	YSGLRVQAM
	KAFNWFSTL	CYDFDVHTM		SAMESHSLL		SVDIGSLAI	NTIPFIIRY	RYIMGSGESF	FYAKGALQY	SVNIQELLL	FIVDARPAM
	FSEPFHLIV	LWDKIAAQL		IRKGETIFV		SADISGLNL	HVYEIPVEY	KYYDKLFKEY	FYPSGGLEV	FSSKSYLIV	SAAPPLPSL
	KAFPFHIIF	NFDIDEVQL		LVYDGIRDI		YGDSLVVLV	KSKAPWLNL	KYYDKNAIAI	IYYFKANVF	KTKWGTIEV	FAIPMIHAV
	LTDGHPLTL	QYDLEVTTF		ASGPIRPIV		TVDDLVAEI	RAAPFSLEY	IYYTGKYQSL	QFLPRTITL	VTIKKALTL	FSKDWSFYL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	AATLLHL EL	NYDEFPT MV		FRFEMQ RDL		IGDPNL EFV	YTSGDV RVW	SFYPEEV SSM	RYAFSG VAF	ASYTKA LKL	KAMDD TFYL
	WAVSPE TEL	AFNTAFT TL		MLPTFV RSI		TGDVM SLSL	FAFRHV LKL	YFPEEKF ESL	AFQIMQ EEL	KSFLGV KEL	LSRPNIFI L
	AATSRIA EL	LYNFTGE QM		LRSTVIL VL		EESILDL VL	MAWDL PSVL	YFFDND SKSF	YYLPKLL SY	KSIKNIQ KI	NATGPR PAL
	FGLNIFH QL	YYDLQG HLF		ERPTFKI LL		FAIPGSS FL	QAERIFS EV	FFFTART SFF	YYVNRD TLF	PSSDIYL VV	YFGLRTE EM
	FWIPYIH NL	VWPLPP AVL		HFPGLA SEL		FLDSVT AEV	FSATLPK LL	NYYNKV STVF	IFQGNV HNF	RSQSRIF YL	YVHELSL EM
	YAENAM RYI	VYDQVV EDL		QRIDLA VLL		LTDEYD TVL	VALNFII SY	AYMELV NNML	LYQFNP AFF	RSVILIST V	AGSALP RLY
	FLINFIHT L	FYDDTY NTL		IRFTSPV SL		AVDGVII SL	GTVQILI KV	SYYGNR AATL	CYQEFA AQL	VAFHIPF EV	KSSWKR VSF
	LVIGRVL EL	AWDLGT NFF		FSTPEQ AAK		MNDMT AVAL	QAIERYL VV	RLMVHT VATF	RYLTVAA VF	ASVLRTL LL	NLSQRV VSY
	LATIHLP YL	YYDIHRS YL		IRMEHV KIV		IVDAALS AL	YIATIHS RL	FFPEYTH QLF	LYPEGLA QL	HSALNIL LL	AAKSYIQ SL
	ASVDKV LEL	SFGYQIT SF		RRIDITA KL		LADLEN LAF	YSMYRE FWA	SYFDRYR DSF	RFAVILE AY	IQNPQIL KV	YAFAHIL TV
	AALPKA TIL	RYDLQIR YL		IRSPAIS WV		SVDDTI VAL	LAPGFVI KV	YMIDPS GVSY	SYPLFSQ EF	KIYEEPII L	FAIEREF FF
	VAFSPVT EL	QFDVVV SAF		SGFSGVI RL		FASETNL DF	LSFLKPG IL	YYPPSQI AQL	EFMPFV KEL	LSNKHE LQL	FANFAN FSK
	FIQAVR QTL	YFPELIA NF		TKPDIIF KL		IVDQEG SLL	YGAEIVR RY	IYQEGW RTVF	IFIDEVD SL	QSIAFIS RL	FARPAS PSL
	KAFFTSK AL	FFDDPM LLE		VYPDGI RHI		LSPGSTT AL	GAFGLPI TV	VYFHTLT SEY	FYRDYDI PF	RNEDV QLRL	IGYARQ YVY
	SAVDFIR TL	FHICSAIL M		LADALQ ELR		SAETPTI PL	FGYEPTI YY	SFPEHRV LSF	IFIAGSK QY	RTFHLL HTV	KCWLRY IEF
	FLIIPLHS L	FYIESISY L		SEDKYP LIM		SSDLPG GEF	KTYPCKI SY	SFYTAIA QAF	IFQIGVL GF	SSVPRT AEL	SALEVPR LY
	FGLARA FSL	NFDGKF ANL		ARVEKFI YV		FADEGSI FY	LTFPRIV FM	PEVKFN WYVD	SFQLIKV AF	TNQDW MLRV	SAVDFIR TL
	KTIPSW ATL	NFEPHES FF		FTSQVIR NL		VTDTDIL AL	FAAFLAS RL	MYKYPS DISY	FFQIVTD SL	ATNPEH LEI	AAADLE RFF
	YAEIVHL TL	YLPDFLD YF		LRAALE VHV		YSDLAD LML	FAMFSG THV	YFLDKAA EQL	GYADIV QLL	KLYDGF QYL	FANTRL QSV
	IAEMVR HAL	AVDAVI AEL		TYSELLR RI		LSDLNL ASL	MAINSIS KL	YYYDPQ TGLY	SFPQPA AVY	RAYSNL RRL	FAPYNK PSL
	GAAAW ARPL	VFDTSIA QL		MRYLLP SVV		FLDTEEA EL	YVVPFV AKV	YYIDDVF HAL	LYHWSV ESY	RTVELFY DV	FAQMY QKTL
	FAVPKN YKL	FFDDLSD SF		SLPPLPR KV		SSDPML SEF	AAYPEIV AV	AYYLGKI LEM	SFGYQIT SF	ATLNSFI HV	RAKNW VKEL
	VIAPNPA QL	VFSQNM VGF		LRASGIY YV		AIDIQN AYL	EAVPHV LQI	SFYEKGP LTF	VYYPELF VW	KITWYIL VL	SATVKII QM
	YGNPNT LRL	KWPDRI TLL		QYPVIIH LI		IVDAAN AVI	LAGPAE PEL	AYPDFA PQKF	AFSMEA LEL	KTLDMI KKI	AATFRGI GM
	FAGLVFL HL	SFDHVP ALV		YGYEHIL TL		AAEYGL VVL	YTIENPR HF	RFVEVG RVAY	KFVEKM TSF	KTNPEV MVV	SARFRPF TF
	YLADIFT KL	SFDVGC NLF		YKNGWI VMI		SAAGPG FSL	FSSHILV VV	YFPEMQ ILAV	SYPDAIL QA	RTFIKPK EL	VATTRIE TM
	YYVDFFK TL	AWDEA DVRF		MVSAIV RTM		KSDDLP HWVL	LSAGAT KVY	YFFDRSS QAF	YFNEKM SIL	FTSDIAL RL	FASVHS VSA
	AALPFTK SL	LYDLLVN EI		FKPPVL VFV		LSDEENL KLF	AATEVV NIL	FFPEAA QVAY	AFQLRLA EL	KTITQVK KI	SAKTPG FSV
	FLIRESET L	LFNLSEI NL		LLNPHL RQL		YVDDPP RIVL	IQYIRPV FV	RSNFGY NIPL	SYNLFSR EF	LSSFSNL KV	SVSPVV RVA
	VVVDPI QSV	CLDDFRT EF		SRPDLYL NL		FTDSGIH IIL	MAYPDL NEI	VYPNFR PTPK	AFILHRL SL	ASSSQII HI	FSSLKLN VY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YGSFVTR AL	FLDLSSN QL		NDLAVV DVR		ISDGPSK VTL	FAGASIK IA	YFIPFLPL EY	AYLALRI SY	FSIKMFL TV	IIAEPGR YY
	CTYGKP VTF	IFDLQKT SL		ERFNVP VSL		HADSVT GLSL	FTVDQI RAI	LYPENIV PSF	IYEHITLA Y	KIMDYS LLM	VASALW RHF
	STLNRFS AL	LFDASPT FF		LRPPQP RFL		AADGEF LHEL	IAFPTSIS V	SFFDNIS SEL	LYFQSKE NL	LVNDHL LNF	FATIKSA SL
	SALEKFV EL	HFDFQG CNF		NGVPFV RTI		FADDNR FDFL	CSFSWT VTY	LYPEVPP EEF	NYVESI MHY	RSLEQNI QL	KQINDY VEK
	FTIFRTIS V	CFENVA VHL		ARVPHS LDL		LGDGLG HVEL	SSYYNV TYW	RFFDTN TSVL	QYIRTFV DY	ATHGAA LTV	YSISERLE M
	IAQPVRS FL	SFDETLT AL		FQPDLV KRI		LSDPQV HTVL	FINPKPI TY	AFFPGFP LAL	RYLTVAA IF	RTIDFV HQV	AAARPK SAF
	IAWPPP TEL	VYNVSA EIM		SRFEEA MKL		YADPGA EVKI	FAIEREF FF	EYYDKHF TEF	SFIERLVE M	YVYSHFL QF	VAREWF FLL
	LATLIHQ VL	MFSDFL QSF		NYVSLT RIL		IIDPNHE IEF	QAVDYI KKL	LFPEPEH SSF	IYELMQT EF	ALNYLQ LLV	NALVHLI EI
	AAIVAK QVL	FSDTGN FGF		NRYLYI MDL		ILDDVSL THL	SAFAYAI AA	YYYDPLA GTY	IYQQIIQ TY	HSLIKVL RL	NAKDFF RVL
	YATIILSK M	YFDPTIV SV		SSFPTV VIY		AADFEI GHFL	VALDFE QEM	AWIDAE VTEF	IFNTVNT SL	KTIGDLL QV	YSQERV NCF
	FIFSDTH EL	FWNDSF ARL		YLASLIR SV		AADPGL HETL	YAKDML TSL	IYLPGRP TSM	LFMSSF QSY	RSFEHA LML	AVSPIAK YY
	HAAHIIS EL	SFDPNLS EL		LLPDIVT CV		FADGHV LELL	AAFNAL VTF	AFYEHA QTYY	LYHLLRQ EL	RVMAP RTLI	ILYIRNLP Y
	YAHLTYV TL	IYSSLPVE V		YLSDNV HLV		KSDQSY VISF	FAFESVV AI	AFLDFH ALPY	SYYEEAL EL	STHKW MVYV	AASQIN RAY
	FYILTSKE L	RFYEGV VEL		IRGGIVS QV		VIDFSH GLAL	FAQYLIS EL	NFYGDL RKAL	VYQHGL TGF	HSVDQY LNI	FQAPTA KEM
	FSHPQA AQL	SWEDAA ILL		LRYTPVL LL		FTDEESR VFL	VAFDAV LRF	SYQIPTE NSM	FFFTART SF	KLNVAP LAV	MQTVYL REI
	ITLLREIS L	HYNVTT TRL		MRNILG LVL		FADENN EKLF	YLSMVF SIV	YFYPYGL QTF	SFSHSFS AL	KTAEGF LFV	AASLSYR VL
	VIMPHN MYL	NFDDYT VNL		RLPELA RVL		FGDFDI KTVL	SAAEIM AVL	NFPEHIF PAL	RFYEGV VEL	RTLAHL EEL	FATRRW IEY
	YLLDLHS YL	TWYLDE STL		SIPILAS AL		IYHSHID APK	MALAVR VVY	YYIQNGI QSF	RYQEKIS AL	VSARNI MLL	IASQRLT PL
	YVHPFIF AL	LLIENVA SL		SYKDYIT FI		AADWIR ISEM	FASQVE QLI	FLPARFY QAL	TYPSLPK SL	ASLEKV QKL	HAATIRL IF
	AAVGEP AFL	WWDAF TTEF		VRFGEY QFL		LIDLPGH ESL	AQKNHI PVF	VFQKPS GVSA	AFSENFL EV	RNIDLH YIV	LSSFKVA QY
	FTSEKFL VM	EWDVLI AHF		MAYAG ARFV		VVDNP QKFAL	MALGH VIVL	NYYDLV RTEI	KFLERFT SM	AANKTII YL	VAIPLKY EV
	FLNQPH MVL	VWTELL DVL		TAFPAL RFV		KADVQS IIGL	ATIEKIIR F	QYYIFIPS KF	NYHWQ ETAY	GSYDKS VAL	YAYLYIR ML
	FADKHI QVL	CWQPVI DYI		NRYPAS SLV		VADGIF KAEL	FSFPHKF EI	RFPDQP FIAL	KLPDIFS VY	RIQAQF AQL	YTMPNF RQY
	FADPHG KVF	IYDLLDT AM		FVPDYT REL		YLDEEF HQSL	SAIFCVV IF	FYPEELD QLL	LFISIAQA L	TATRWP LAV	FANNVQ LSL
	LAQEIVK AL	EYDNAII TM		RRYEIAV NL		VTDEPV YIDL	VGIPHIR WY	AFFEEER SAL	LYNWEV AIF	KSIRTVV KI	LASLKSL TY
	FSLAPIT KL	GWDEAL LTM		SSYGNIR AV		HLDLPS NNNL	KAIEVLL TL	FLPEEA WCDL	NYFHLA VAF	KTSGKIR LL	LQSQWL RAY
	FTVRPG ELL	MMDVA FVQF		STPDHIR EI		FVDPNG KISL	LAQQIH PVV	AFVTFST RAM	VYPDGIR HI	VMNKL RLLV	VCTFVYK EF
	LAHPYFE SL	MFDNAL STL		FLFQGF RLV		VADWG QKVSF	MAPLK MLAL	IYTDYRP TPL	IFQTGLV AY	LSNGQK VLV	CGALKNI SF
	FASLPDP VL	NFDVTY NWI		HRPVNV VNV		VIEDFPA KEL	YGYNQR PPY	AFYDWD NTEL	AFNIVYV AL	YSISQER FL	GSEMVV AGK
	AQAEVY KEL	FLDSQTA TF		MAPER VASL		AADTPP LETL	YTFPAG VSV	AYYPSD VSSL	IYMQKVI YY	KTSMFV LYL	YNFEKP VVM

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	ASVGKTSIL	IFDSTAVLL		VRPLFCALL		DPPWDIHMEL	KAWPLLLVV	TYIGYLPLAH	IYQLKEETL	LVSQYFQTV	MASKILKSY
	AAAALHPAL	YIDDLVVIL		FSYAFPKAV		HSDDYVHISL	ETISLIIHY	AYIDPIAMEY	PYNTSLVEM	RSIAFHSAV	RAWTRLYAM
	AAIHPSLEI	VWDVIGRSL		KRFSAATYL		TLDKPSVVSL	FLPDHPIVL	SYPAAVPQAL	AFISKVSTH	YSSDPVIEV	SARDHAISL
	AASMRALVL	AFDPEEYQF		SSVHLVRNV		FVDNFVHADL	FAFCYPFSY	YWPHQPIENL	FFAKQATEL	ASMVLPRAV	SITSVFITK
	SALNVRLFL	FYDGVVQTV		IRMTEPVYL		FADKETLIQF	AAFDHICTF	FYPGWKVLVF	VYFPWVSQY	KSLNLPLQI	YAHLTPREL
	RADDGFHLL	IFYVDTLKF		DYSPLIRVI		AADPGLPARL	LATPVVSVA	MFPEHAVKAY	FFIDQANYF	LSIPRVFYV	AARDVFLML
	AAMYKSLEL	RFDPFGPIG		GRAFLFNKV		HIDGDHLTLL	VAYMNPIAM	SFMQHDVQEL	VYIDQTMVL	RNQLLNIFV	FAAASREVL
	HAMVILLTL	RFDGMLLAM		RQPDLVLRL		FVDDETKLTL	FTLWWSPTI	YLPENQVLPH	GYISKAEML	RSISSLLRF	MTQLRIIFY
	VALPASGWL	FFEVFDNSM		IRQGKITEL		FADDQIAQSL	SIYTGVIIV	YWPTYTPMEV	LYLPMAQSV	VNNPHFLIM	QTALVELVK
	YALTAIMKL	NYDLCSIFL		KKPNLILNV		YADQHSVQVF	FSSGAIQVV	MMPPMGGPPM	YYTEFPTVL	FNIDKAREI	VSSTWLRDF
	TAINHFFIW	YVDDGLISL		TSATFLRVV		YLDGHLITTV	SAAAAPHLL	SFFGETSHNY	HYYSITINY	FSYAFPKAV	FSNPNIQKI
	FAQKSGYFL	EFDGTKVFL		TRIPVINKV		PEVKFNWYVD	AAFTLRTQY	YWPTYVPMEV	IFQTAKETL	ITFPGLHEL	YATQLQKTY
	MAFDPTSTL	FWDYGRIAL		FAMEFVKYY		FIDKNGETEL	FARDEIIWL	FFYDGIKAIF	LFAPFIVYY	TSNTVKLLL	YFHDRVASF
	FVVDRLIAL	TFEDVAVYL		VRSVHPYEV		FVDGSAIQVL	AAIWFRTYL	TYPEFLANAL	AFNVMGEQF	ASKAWTLEV	LATTVRPVF
	VAQTWFRFL	NYDAALRKI		LRLMAPISL		RSDVPSLVTF	AAREVILVL	IYMEPEKQVM	LFIPRETTY	IIFETPLRV	TAISLFYEL
	ASYLRLWAL	EFDPIPVLI		CGKGFSVTV		IIDTKGVTAL	KTFPDLVIY	YFISHVLAFF	LYGPKYTFF	RSQLVELLV	IAFFDVRTF
	AAIAPPTSL	FYESLPPEM		SRNELLQKL		VADSPAEVAL	LAVDKIIFV	YFINGDISSL	SFADHVVPL	KTSATWLAL	SAIASTKVM
	YTFSEPFHL	SYDEAIANL		IGHPAPNFK		KLDFGETTVL	YAAELIERV	IYPGYHQSSY	SYISKVDVL	SSSQWALVV	YAVQRNYGF
	ITISPLQEL	TLDVGGLVF		QRFSYQQRL		KADLPEGVAV	AAFPGASLY	VYYVGVASCL	IYENRIYSL	ISNDKFEYL	QTAPLRAEL
	YSIGPNSKL	NYDVLANEI		RRAMELLKV		GGLPERSVSL	AARPVPWNA	YFYDPDVGNF	LFQHICTAY	RSNLVQVKV	STGSWSTLK
	YTIHFIEEM	VFDYSINSV		IRHDVIVSI		CADLLDRQIL	ASFLGLPRV	FYFDNILNSF	GFPEAASSF	SIIPYILKM	YFVMTRQEY
	SIVEQQLPL	FVMFYDSEY		SRFYYEQRL		FADSHELSEL	IQFKKPIIV	YFYPFPVPPL	NFFTKATPL	RSFVFFSQL	TASPFFRAL
	AAFWGQMQM	AWDEVGDEF		YVAPLKREV		LADDLKIESL	LAYMNHIMV	VYMTEPIDEY	RYNLAILAF	RTIEYLEEV	VSTVLTSKY
	SGIERMGPL	FYSNKEIFL		GRPERQFFV		IADNRPSVEF	FLPPYTFQI	SYVNLPTIAL	LYSPQYISY	ASTSRLLSV	FARPDLLLL
	FVHDLVLYL	KYDSTAIYL		FRNNRYPNL		FLEEVGSQAL	LAADIFAIA	YYYYSANEEF	RYIPTAAAF	VVGPHPLVV	IDQNVEELK
	AALYHGMAL	VFEPSWEEF		LSTTVKREL		FADGVPREGL	QTIDNIVFY	YYINYTTIEL	VYWVAPVEM	YNMQYALAV	YSAVRPFGC
	FLYPFFGVL	RFDPTWESL		FRPPKEVHL		ESDPGVFTEL	SALPFITYL	VFPPLTQRTY	AYIFNSNVM	IANHQVLII	AASAIYRLF
	LAAHLGSAL	IYDFTDTVI		ARHSLLQTL		AVDPNRAVPL	VAIEMLLKL	AFVDKPVSPY	SFQENIAQL	RNLYLIMEF	ASSPVLRQM
	FAAASREVL	FTEKEWPLL		TRIEAVKSL		FADLNLVQAL	SVEDIFSEV	AFPGGPLGAL	FFHNVDVPF	RTIQAPTQV	FCYVNDIVI
	FVNPHVSSF	EYDPVIILI		EKYEITEQR		KSDDPIVTSL	AAFPLAPLL	QYYNGKIHAY	FFTDNVPAL	VTNSVFHEI	FSTVVIHFL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FGEMG GKFM	VFDPIAN CW		AMAPIK VRL		RMDGE GQLTL	FSNPNI QKI	VYYGHT NYIY	FLPEAPA EL	ASFQEI MEV	LFYQRQ DTF
	SAIHVLA SL	LFDAVSS LI		AAFPGA SLY		SADPFP QVKL	YAIHGVL EV	FYHLGV RESF	SFISEAES L	FTHDW MVFV	YVIVRAY QY
	YADVGG KQF	QWDPM ITTL		VALAHI RHV		TADFSG DVTL	AATTVL QEL	YYYDGDI GNY	SYHSYVI GF	KSIYAAL YF	FAALHG PAL
	GALAVF PSL	TFNHSGI SV		FRNTVE RMY		WLDPN ETNEI	GAISKIF VL	LFPEGPA RAF	YFYLFPN RL	RMNSKI MSL	RAKDFSL IL
	FIIQGLR SV	FYDDKV SAL		TVFPKA KQV		FADPN MLDTL	KAFEYN MQI	YYYDPTT GLY	AFAKGLL AL	RSVVKV LSL	FQAFLRT EF
	FISHLFM QL	CFNLFET GF		FTYKGL RAL		RADPGV LAAL	LAAAVP KIM	VLPHQP LATY	AFIDTAQ HM	IAIGKVL KL	FASSPLR VL
	YTMVY WHAL	VFDASSI QY		ARATHL VEL		YQDPSF HLSL	LSFQEV REY	FYADFG PLNL	LVQSPN SYF	HQMW HVRKL	FGSEVIK VY
	KAFNYFS SL	IFEVAEG GF		FRKEFYE VV		SADKGG FLYL	YLFEWR TQY	YFPDYSI GNL	YYFKAN VFF	KSLAAP PAL	FLGPLHP SF
	LATASSP KF	LYENLGE YF		FRAFLKS EF		VADPDN PLVL	EAIGAVI HY	FYNQVS TPLL	YYMDYL AAL	KSTPVT VVL	FSATFPK EI
	VVAPAG ITL	YFETVTI KI		GRYTGV RII		FVDPSQ DHAL	FTSPFCL QV	YYISANV TGF	FYITPSTS L	RAYLFA HAV	IATFWN KAF
	MATESIL HF	IVDEAIY YF		ILPKWL RFI		YCEPPT GVSL	KGFDW PLLV	YLPDFRF TPF	GYQVHV LTF	VTIDGIR FV	LATIRLL DV
	LSEPMV HEL	HYDVVV GVL		LRGDFV RRL		VIDFDE NTAL	YAKRPGI GL	AFVTFTT RAM	IYPYVIQ EL	FNTWK PMWV	AARDFV NYL
	FADVAP LQL	IFDAVLK GV		FRSEHEL DV		TIDFTPG SEL	SSFPTVV IY	YYLQIHP QEL	KYMNNI TYY	VVLPYQ MLL	YSFYLPI AA
	FSSPHLQ ML	LFDSTLT AF		AKVDHV QMI		NVDAFK LESL	TAFPEAS FL	YFHDGV RVAA	VYFTQG LGL	ATIDGV RFL	FAKPFLA SL
	YVVPYM IHL	SFDEYSS EL		TQVHVI REV		KADTVS KTEL	YNFEYS VVF	YYYHAR VYEF	FFPKWL QVL	ITNIVILS L	AARTQQ LLL
	YVIDPIK GL	SWDEPG VDF		TSPEAFL AL		ICDLGG VNEL	FSAYNY RTY	SYFDAIP VTM	AFEDYV QSM	MANGA VIHL	FTADFV RQL
	FTVPFYK QL	VFDIHVV YV		FKPAMP RSV		VSDDPQ VLAV	RTYDMI QYY	FFFDSA MESY	LYQIQQ VTM	STSPWI PQL	KINEAFI EM
	YIVKWPL SL	MQDPM EVFV		AIPAFIS LL		LLDDRG MTAL	RQIGVE HVV	IFIDRDP AAF	VFPEKGY SF	YANKYN IML	LAAPSRF VL
	FTMKTV LML	DFNATS ALF		SRAQFF LHL		SIDLPGI KGL	TAVKIAP RY	NYYPYTI TEY	RYPEETL SL	ASHGFY EFL	SANDIYL IF
	FVVPNQ KRL	ISDHYPV EV		QRALAL HVL		YVDAGT PMYL	KSISRVIE Y	FFPSTFQ PSY	VYPTAV HVL	KVIYVLP ML	YSALSHP YF
	YSYDLSH SL	VFEPSW AEF		NRAEYY HLL		LVDWSS GNVL	LTFPVA MFW	YWPEGK RVAM	AYHELA QVY	RAQGV VLKV	KATFHY RTL
	IVVAPSQ TL	ISPEFFTV L		ARFNDL RFV		FADPVD VNPF	LAAQFV KLL	VFINVPT VSF	HYTFYFV DY	RIHSTY MYL	VALPVFL VI
	HLDEAIH VL	VFDDIET NM		FVADRL RAV		FLDNSL DTVL	TSSPINI VV	HFGGGG FLAF	SFPEVFT TY	SSSIKDL VL	YGYNQR PPY
	VIYPARIS L	FYDPGV TLV		FRVEYA SKV		HIDSEAI SAL	TASPVA VSL	LFPELPK SAL	FYIFDRD VF	ATMKD FTSL	KITPWF KII
	FTIPHTQ EA	EFLNYDI ML		KQMHL PRSV		LADFGV AGQL	VLFTQLI YY	RFPQLDS TSF	FYISPVN KL	RATHRL LLL	YAANLK NVM
	AAMKN VTEL	SFDYAAS IL		AAFPRL RTI		HADSNI VIML	FLFDGSP TY	QFYDNK GITY	VYVQPP LEL	GSYVFE NTV	YALLNLY EH
	GAHFSV SSL	QFDEIIV DI		QASGKI RLL		FVDSGA PPAL	RVTALLK VY	FYPIYFR PLM	FFPFNPL DF	RQIDQF LVV	FCGLRG NEF
	VGVPVG SAL	FFDAGA AEF		SRPLLEN KL		WADGLI HTSL	VTYGFPI ML	LFPEYKN NKL	IFPLETP AF	AAAPQL LIV	IATSHNI VY
	SIIAMG NTL	FFDQKP EEL		FRKPGE KTF		FADISSQ ILF	MSYPAK VTL	RFIDISPA EM	SFAFNI MEI	KSTSNIT KL	KLSELLR YY
	LANIRSP VF	FFSEVER RF		LRFKKP QSL		VSNISH DTVL	RGVEFV HVY	VYIGYLP LAH	AYIGFIQ SL	KVTKYFL FL	ASTLRVV VF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LAYIHLIEF	TFDSEVELM		QRAMMANRL		YVDEAGTVKL	IAAMPLISL	FYYFPDSGFF	IYMFNMTGL	LSDPQVHTV	FALDSGLEI
	LLLAHIIAL	IFPEPVAFL		VRPPIVKQL		LTDMSRPVEL	AAAKNIRVW	YYPAQGVQQF	SFPIYKVLF	SINEGLLKV	FASEYPLIL
	IAIIPSKKL	YLDEYIARM		LKDELASTK		KSDVSSLIFL	MTKTYIPIL	MFQTAVGHSF	VYTDWIMAL	SSQVHPLAV	SALEVVRKY
	KAMPITLHL	NMDGPISLI		VRVPHTQAV		SADEPGVMYL	VAMGRVVKV	YFYDDVTTLY	AIMEMPSFY	ASISHFMQF	FTHLYTLIV
	VTVQPSPYL	NYEDVATFL		YRAGPMRQI		NADGPAPLEL	VAAPQVQQV	YYYDGDVGNY	YFPIRTLYL	SAIPHPLIM	SATSLLHTV
	FAESLRTSL	YFDSGDYNM		RRIQFPIEM		KSGLDLNTSL	VTIDRVMSY	KYFSGPAITL	AYYQFINEL	HAASVFLTL	TLTDVAHEY
	FSVENKWSL	ATDEFASYF		FVFPGELLL		VADDIMDSSL	YSINWTQKL	SWFKDFLPVD	SFIPAVNDL	KIIEYSVYL	AATPAVRTV
	VASEYPVIL	MVDSKPVNL		GRSLIINHL		VADPVYRTFL	AAVALLLQV	SWPTYPQLYV	RFLDKALEL	KTYSEPLAL	SALTRLASF
	YVNLPTIAL	QFDNYGEEF		YSHPHVRLL		FADEKPLQDM	VAVGVIKAV	IWPNARISVM	FFIQDQIAL	RVYNGRLKV	FAQEALTVL
	LSVEIVHEL	FFDHSTRIV		LRPESLHQV		NADGPNPWML	HTFYNELRV	VFITDKISF	IYQIHKEYL	QQNPQPLIF	FGKGYFLEI
	YASLRIEEL	VTDGKEVLL		AAYYLPRHL		TADPLSNMVL	LIFSVPIVY	TYLETKGAAL	IFQEPTEPK	RSLDHPNVL	FSTSLVHSI
	FLAEAARSL	RFDNADRMF		KRAAILTKL		FADGILPLDL	FAVGVEKNW	YYFSTISSSF	KFMQDVNTL	TSNVLPLLL	SAKPYAHIL
	AVNPKFVAL	AFNKTIVKL		QAAPNLRKL		SADVPLVVEY	GTPPWVKRY	GGYDGYRPSF	SFVDQVREI	FSVNLFRTL	TSSWVIRDL
	GIIDPGSTV	ILDRHLAIL		KNIILEEGK		KSSIPNNKEI	VSPEHVVLL	FFQETKTGEL	IFIDEIDSF	KINEAIVAV	YTRPGLPTL
	TASPVIKAV	NFDKIGKEF		LRYAAVRTL		IADVSTGLEL	YAFPYIILV	YYYNGKAVYA	AFIITGQTY	KSTAISLFY	FQNPFRSEL
	YLAPHVRTL	NWFVWVTQM		PRPTHFVAL		YVDGPASTAF	ASFPGANII	NYIDLPVLAI	FFQFGGQSL	RSFFGSLML	NATPLTIER
	FALPYIRDV	VFDTPEEAF		FAADIISVL		VIDIPGADTL	TAIGHINRY	FFFTGPLSHF	IWPLYLRFL	FANNVQLSL	SAAPVAHLL
	AADPVSPLL	LYDLTLEYL		QRYPEIRFF		MADTGKLNTL	YAFGGGCEL	YYVDTAVRHV	IYELAVASF	KTVSVALVL	FAMPPPHGM
	FGVFSGHTL	FFDLNDTKL		ERAGVVREL		ASWFGSVFTL	QAITLVTQY	FYPGASPTEF	FYNQVSTPL	VGTIIYHEV	FAYDGKDYI
	FSYTGRVAV	SVTDTNVIL		GRMVQVHEL		FVDTAGNFSF	SAFDRKVQF	AFFTSKALNM	NWPTYPQLY	VINPEPITL	LARIYSFQM
	KSIPSFSSL	FYDPDVGNF		FLFGYPKRL		IVDGHSVEEL	FAQQQPPVV	YYIPEITSVL	TYLDPALEL	AISSVRLYI	LIKSYFLIV
	FGNPRKPVL	VVPEPGQPL		ERKIPLKQL		FLDPPPYETL	RTIAKRLVL	LYHITDQVHL	NCPERIITL	KSGILPILV	CAKQDWLIL
	YAYEKPHVV	VWPLLPALL		YAISMARKI		FSDPAVSQSL	FSSFVFSTV	HFIGNCVSSF	AFTEKVSTF	KTASIELRV	CSSPHALVL
	YAYRDAVFL	SFDKTASVF		FRPEWTQRY		LVDDSFSQAL	LAAPVISVL	SFYNKRTLTF	AYHAVVLSY	MSLKWMSVF	FVSERKPAL
	LSIDLFHVL	VWDRFLSTM		VRALPLLRV		LLDSLPSDTR	NFFPGVFEY	SYQSYQSPTM	AYMELVNNM	QSQALILKI	SPNAEIHIL
	FVADVRLIF	VWDVPVEEF		IAVHVVRVL		SADIESILAL	FTADFVRQL	FFFGKSTLPF	NFIEDVLGY	RTSKFVLRI	CASDKILEF
	VIMGLSPIL	FFPFDPCVL		NKPPTVRFV		AQNVGTTHDL	LGYPWVEYW	FYQDTFGQQW	FYPEEVSSM	RVLHQFREL	AAREVILVL
	AAAGSPLSL	LYDEYMYYL		SVPLAATSM		FLDDEVTVPL	VATSRIIKY	RFPGQLNADL	TYQVYGLAL	SNINQPLEI	FATPQYRGV
	FVFPGELLL	HFPGLASEL		IRASALRVL		VTDGLPATAL	LAFPAPLYY	FYFDLNSEQM	FFMEELNTY	YNTDVPLVL	LSSSVIREL
	FTIDIKSFL	NFDVRFETF		RMTVVRQIF		YAFNGTQRFL	FSSHLINLL	YFGTGFPHML	FLPKGYLAL	ASLWQELEV	VAIAAARVW

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YAHLTPR EL	AFNTTV AAL		LYPPRA KLV		TADGLP VGVL	AAVSFP YVI	FFPYYVY NII	IFMRVA TML	HIYTKPL VL	VATFFA KML
	FALDMK YAL	NADAIV VKL		SVPAFA SSL		SADEPM TTFV	HAAKVIL QV	KEEEYEE EPY	IYLTFPV AM	RSIVLLL KV	ANMFRF YAL
	KANPAL YVL	VFQPSLA VF		HFGWY MCSL		TVDFSEF LNI	SAAENF LVL	YYLNNF DNIL	RFTFYLIA F	RTNNLF KQV	FFMEKR AKY
	FTVKLPV AL	YYDPHQ ATF		KYAELVL ER		NADELL ESFL	RASLLLK TY	EFTNAYK LPL	VYSNPV SSL	SIIDEFL HI	YAIGVSH PL
	IITPAFAE L	NFDALIS KI		NHPNIV KLY		VADIDG QYAM	VAAEAF SEL	KEFGHEF DLY	AYPHTSL QL	SVFKLLP QL	DYSVVLL LR
	RIPSFVT EL	LYAFSHN ML		RAFPGL RYV		SWFKDF LPVD	LAYSGY KYV	LYINHTP PPL	FFIINKE NY	VVNPYY LRV	NAMPHI KTY
	AAVHIIL VI	CFDPLLY FF		CRMEII HEI		VSDGAA AILL	KAVSLFL CY	MFYIIGG VAT	FFQIQD DYL	IGSKPLQ IW	AATSRTY LY
	FSYEHFY VI	KSDPSIV RL		VRAEVE QKL		SADESG QIFI	MANPR ELRI	SFPDDA TSPL	FYNLSIQ SF	KNIEKII HV	RAALRLL TY
	IADPNIA KL	NYYANS YSF		WRFKPI EQL		LVNEVT EFAK	NVKEM WTEV	KYFDKRR DYL	IYPVNAI SF	LLNPHA LVI	SVSTITRI Y
	MIIEDPA AL	NYMEVV SLL		IVIDHLR SL		RIDGGIT GAL	VAFYIP MSV	NFISLGP SIS	LFLEHDL SL	MSVDR YIAV	VFALRP VGF
	LTIEKISA L	AYDTLPI VV		ARPAFR VHV		FADSFD RGTL	IAVHVV RVL	FFQDKEL RSM	AYQEAV RTL	RGFEFTL MV	AQHPLR PEF
	YTIENPR HF	FFEALEA LL		ERIPKTI EI		FADAHN MLLF	YATTVIP RV	AYSLYEH FYL	NYQAYR SYL	VVLFFKT LL	TTSERIIA Y
	YLLEKSRI V	YFEDVA NAM		FAFPGEI LM		ITDPYQ QAFL	KGIPHLV TH	FTMGGP AISM	RYLEMLL EY	QTDYRI FEL	VARPDV VEM
	YSAEPLP EL	YFHEALR AF		TSYPDPI LL		FANGRS TGLI	QAAAFN VTF	HFIQAGL LSAL	HFYSSIP SM	RTMQPL AVL	FSIEPWL KV
	VGIKPSL EL	RFDDGL VHL		PTSLFAV TV		FMDDTS RSII	SVFPGA RLL	HYMNPY QLNAY	LYPSIIQE F	ITSPVHV SF	HANYQP VEI
	FADHVS SSL	NFEVAES DF		VFDEAI RAVL		YVDPYE LASL	FQKPFQ TLM	AYMELQ QKAEF	AFLVQIS AH	YNFPVE VEV	FLREWV ESM
	ISNSHPL SL	VFDPVT KLW		FRYDLS PITV		SAEQASI LSL	SATRLIQ RL	IYMERAE DLPL	AYLDAL QTL	KVADTIL FL	QCTQVR VEF
	LSQQPFL SL	SWDLW SVHF		YYVDTA VRHV		TASIWN VTAI	RAAEFIK NY	YYIPGQG RSTY	TFPLQVL GF	RSIDKPF RL	RALDHY LTL
	YVFPGV TRL	QFETALS TF		AKSDVP IQLL		FNDSDS GISL	FAKGPT LTV	FYIDPYK LLPL	FFPGFPL AL	RSLEQD LKV	YAFGGG CEL
	GIIRPGT AF	FYDNGK VVI		SAQGSE SHSL		TIDAEV MNSL	SAFDRC ATL	YYIDADL LREI	IYNVPVA AV	SSVGKV SVL	YQQELE REL
	HVITKT MEL	NYDELD VEM		FRPTFE NLIP		IADGNP KLTL	QAGPIN REM	VFQEPSL LSSL	IYSPEGH VL	LLNRHLL AV	FAYYRV GEY
	YVIQKFF EF	FFDNLVY YI		FFDPSLL HLL		VADGSLI NQL	IAIPVTV AF	YYIGDIH PSDL	NYIMQS HSL	MSVDR YLSI	FSSDVT HEM
	AAYQSV RIL	SAPIFTT SL		KDVDG AYMTK		YADDNS LLFM	SAKDFIR NL	IFFFGTH ETAF	SYLPEAG QY	MTVQIL LKL	SAVADV RLY
	FGNNKL TTF	SYNLFSR EF		PYSPPTF RFL		IADISSP PVL	KAYGKD FHL	YYPGFN PFRAY	SYMWTI NNF	ASGPPV SEL	YAFPKSI TV
	IAIDGGK VL	CFDNTFS TI		FMGNTI IIVM		IADGNP SLVL	QAYPTT VVF	YYYDPQ EEVYL	YYRPLYD AY	ISHTQT RLL	AAIFHYL II
	IANAVV KEL	LFDQIDE NL		YYFEGG LRKV		TADDPS LSLI	AAMPRI YEL	SFFDATD RVSF	FFYPLDF TF	ISSVPH GEL	VTKEFFL LL
	LAIDSIH QL	SVDLTEV EV		HRYENV SILF		EVAFGS QVTL	LAWQN PHML	FYVDSD MVNEF	IWQHVV QEL	KSIDTFF GV	SNMIKTI AF
	VSDFGG RSL	FFEEHISS V		FRSPLA RQLF		ASDGSF SLPL	NAVGVP IKV	YYFDAA EAEAW	KFPEIVA PL	YQTPLH LAV	FTSAAF HEL
	MSDTTF KAL	AFGNSC TAI		YVFDGK PPQL		IIDTPGH ESF	QAYQEA FEI	VYQSLCP TSWV	VFAHGA ATL	KLFDRP QEL	KSSDIAK TF
	SAIASTK VM	IFSPSVE DF		FLPARFY QAL		LATREA ALPI	YANYYT REV	SYYGPLN LLTF	FFPYQVT ER	SSVPGV RLL	ATTLRLS AY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YTIPAHQ NL	LYWYSN QMA		ALPPGS YASL		SADPGV FVLL	FVFETPF TL	SFPTTKT YFPH	LYQLQV NTL	WAHELL LSF	NSILRKQ AF
	YAYAAQ NLL	IFYPEIEE V		IRSNNIN TLF		FAGQDL SAYL	NALDKV LSV	VYFKGK WKTPF	NYIPEVR IM	FSNPNI QKI	TAVVKFI DY
	YIMDW MDEM	TFSQTIA LL		YRPDMI ILQI		FADNVS GLRM	SAAYLP RMW	KYMNSL LIGEL	GYLALVT SL	KSIELFY KF	VAMIYP LEY
	YVAQAG LEL	FFDTSVP LM		FRYGGA PQAL		FSDNAP PPEL	SAYARLI DY	IYALNEN VSSF	SFFTNA NSY	KSIPGFS SL	YAKDDP LEF
	FIIISSQH L	QFDFTF VEV		YRMDG HIQLI		FFDPNT HENL	YTSPDFL YV	IYIDRHV MQPY	TYLPRIK EY	RISPWLL RV	RNFSRYI AY
	FTADVR SVL	RYDGQI AVF		QSTDIIR YLF		SSDRAM MNAF	FAYTSR HEI	YYITNDT VQTY	VFMHVS TAY	RSAQL WSQL	NCPERII TL
	YLIARV MLL	MWDPA AQAF		KRYDNV TILF		ALVQQ MEQLR	MAYAG ARFV	YYYDPQ TGLYY	AYMPHT FFI	RSLGIM QTV	TATMHI LVV
	YLQDEF RIL	TFDQKIV EW		VVDADI PALL		VSDMG VIHPL	MSFGN VVEL	FYNQVS TPLLR	AFRVVD TEF	RVGDRI LAV	VLAIRYD AF
	AQVPFE QIL	VFFLFDH QM		YYPPWK RLLF		VADDRF TKSI	NMYIFP VHW	YYYDTHT NTYY	NYFPGG VAL	ATYHHII RL	VSTPRSS FY
	FAEGKPL AL	IWDRAIT TL		FRHPHII KLY		MAATLA NGGF	TAADLG SVV	RYINPAK LTPY	RYNSQLL SF	HATLVF HNL	VTSPIRA SY
	TAIAESP VI	IFDSVSV QV		KLPEYN PRTL		EYTDAS FTNR	AAFPGE NAL	YYFAQQ NSGHF	SYQDLV KCF	KSFSEFG KL	LSTEALR LW
	FGYPDP TYL	LFDYTDT LV		SRAALQ RYLF		SADLPP PSAL	FTSPAV KRL	SYIFPSSI SAM	SYQDLV QRL	TSISHYV IV	VAATLLK QL
	GATKLFL IL	FYEEKEV DL		GRFHEV LQSL		SADPLP NSYL	TAVFLT GVL	KYPKGA GRVAF	VFVEDV DSF	KSDSHV RML	VSSTKLV SF
	FIHQHFV EV	NFDTID QQF		PAARRG AILF		TADGNV LSVL	TSIGWL RLL	YYFDNV SSTEL	AYMER MNYI	LGYSVY RTV	ITTTFRP EL
	FSDDSDL QL	VFDVTG SMY		LRGYEEL LLL		GGVMD VNTAL	RAYQRQ LVM	YYYDPTT GLYY	YFMPKS TIY	SAQGKP LAL	VANAIIH LF
	MAINSIS KL	RTDPIPI VV		HPGRVL LQNL		LSDIPET VPL	NAIETM PCV	KYMPSV KVSVF	FFITLPLS L	SSYYFDL QL	FALPYIR DV
	AADPQI RQF	MWEDFI TCL		MAGPL RAPLL		FVDEGS LYGL	QATELV HQL	YYLNEQ GDRVY	VYPQYVI EY	TSQEYA VKI	FSTLYGR VL
	YLVPQA RAL	NFDGHV VLP		HRPEDV VQFL		VADGA NAIVL	FGYGLP MLV	YYYDPLA GTYY	WFIPFV QSL	VTMPAI LKL	FVVTFPR AY
	YVYSHFL QF	TFEDVA VLF		LSELEAA LQR		FSDDPN VTKTL	IASHLHI HV	GTAHTE AQQSF	FYQGHIT AF	GSIWKQ LYV	VATAM ARVL
	FLADPVS NM	FFVENVS EL		RLPQGI VREL		AADDPL VHESL	NIICGITS V	FYQDTF GQQWK	RYMNH MQSL	KIIEILQF I	YATLYYR EH
	FVAETHI VL	RFEDGA VFL		YQFTGI KKYF		IADDAD PRVAL	SSFTKVI TL	YYPDGH NDYGY	VFQPSV KSL	KLYGKPI RV	FAASVA HLY
	FQLEHI MDL	IWTDLLL AL		QEMQE VQSSR		FIDLDSH AEAL	KAYNYIR IM	YYALCGF GGVL	VYISNG QVL	KVSDILL RL	RVTALLK VY
	IITAFIRA L	TFDDLLN RL		LRPEELT NQM		FADDGV KYLEL	RQFPVT VHF	YYMEGR DSMQL	HYMFEA ICL	QSLQHY LEL	DFSIRTY TY
	YLTAEILE L	SEVFEIT DF		YEELQSL AGK		FGDESN KPILL	SASFLPK YF	YYGYEDY YDYY	YFTDLFD YL	ILYPKTL FL	TITSYIKE M
	FAVALP QLL	YLDNGV VFV		YLPSQV SRVV		FADPAH GGSWL	YSFDYPS DM	FYYPLEG SKSM	HWPEYF IVA	RTLAEIA KV	ETFQRP YQY
	SATRVYI VL	ILDLEETE M		LLLQVQ HASK		LADWVS GKISF	SAWSFI TTF	TYMPSV SLQSL	SFVDYQ TTM	RTPTHLL LV	KLPGNIS SL
	LSAPSLH AL	IYDEIQQ EM		IRNDEEL NKL		YSDELQ SVISH	FAYEQC LLV	LDFCAS NIIDH	SYFDPRE AY	VVNKIR LKI	KSLWKH HEY
	FVLGRLL TL	QFDVQR KYF		VQVEYK GETK		IVDLARY VQEL	FFAGLV PRL	YYDGDV GNYYY	VFQVTA PRL	MSTSKV TVL	SAFPHLR VL
	FSFLPTR AL	FFMPGF APL		FAYPAIR YLL		FAYDGK DYIAL	MAILHY FEI	YYDGDI GNYYY	YFPELIA NF	SSYFRA MFM	AATAV WHAY
	AANRLT LEL	VVPDHP VLL		KSDVEAI FSK		IADLSNII NKL	ASLLHP VVY	FYYLGSG RETF	YYIDCIR QV	VVQPQ PLVV	CSSDFIRI L

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LAEFKVR AL	IFDPTRE CM		VKPNFP FLLF		VADIQD RIQAL	YTKNYLP LL	IECLPTS GHLS	AFHPTA QLL	ATNPISR VL	FARSFYP ML
	AAALPA AAL	NYDNLL EAF		TKTEISE MNR		KVDVAS VIVTK	KVFVMP NGM	DIFTGLI GPMK	AFMEKV RVL	FTLKKLL LL	SATRTLH EW
	VTIARAI EL	TFDSDPP LL		AAQDR DQIYR		YIDIADR SQVL	AAGTTV KVW	YFYDVEA LRDY	HYQNLR VFY	HSFYNE LRV	AASTLV HKF
	AAIPYW LLL	RFDSDV GEF		SIPEFQR AYV		AAENPG KYNIL	FIQSIIST V	FYYNTSE QNVM	SFLSQG QVL	KSYSFIA RM	LALLREL SL
	NADPN MKLF	TACVDIP QL		FLFDGS PTYV		FAYDGK DYLTL	GSIALIVL Y	NYPDYM PSNIF	YMPAKI GAF	KVLMKF LEL	RGTPWL RVH
	LADIGYK TF	IFDVLPT FF		ARFGPG GQLI		AADIEN RVLEL	IAGPVLL IL	IYHISGA STFL	AYLDKIS EL	SIQSLFL EL	SANVRT VNL
	VNNPHF LIM	TFDISILEI		FRMPVL REYL		IIDDPNL VVKI	AALTIIR YY	AYYPAQ GVQQF	AYPEYLI TF	VTHIVPL FL	AAASLIR LV
	SALERLT TL	LWEYDP VKL		VYEGER PLTK		YVDLLKL EDVL	FLVEHVL TL	SYYPAEN LIEY	FYEDNVL YM	ISLEKQL QV	NFGLRT DMY
	YALPAGL SA	ILDCQFS EF		GGEIQP VSVK		LADLNS VERSL	KSKDFV QVM	FYNTAQ SPSAL	LFMIEIM EM	ISLPHP MEI	FAYLGRL AH
	LSQPTPA TL	AYDASL AML		FRNPDT IFIL		FADFVE GSSHL	SAAAIFK IY	EISAHRT EFHM	SYFYMV SAW	ITVHRH LML	LAMEPT PEL
	FGINHGI EL	NFDEVIS CF		IDTIEIIT DR		FADLSQ KSPEL	RAYPSM MGL	VYEAGP CWVLY	FYQPTCI VL	MVATW MLEV	LSTMFR VEY
	AAMSHL LEM	FFDDVT VYL		LFDQAF GLPR		GAEDPE TQVVL	SAAFIFS YI	RFSEKPT PSDF	FYLPIAA AM	QSISVA KEV	NQTEFE RVF
	IAFHSAV SL	LLPRETL CT		YLPDGF LRKM		FTDLSRL PLAL	YQITSVI QY		GFYPAEI TL	RQMTVI RKV	YAAQRII SL
	YISAKPL EM	CFQEVP ASL		IQEAGT EVVK		VQDILE QNEAL	KIVKWD RDM		SFPIFISA L	RSSPKAL NF	FFGIRDS SF
	FMSDLM KAL	VFHVQQ TEM		GGVVGI KVDK		AADAEP LEIIL	NAAKILP IM		VFTGIVT SL	KAFNW FSTL	MASIRL QGL
	FILGHLR TL	YFDLNSE QM		FYYDGK VMKL		FAEDITT GQVL	HTWNGI RHL		VYPPGF MGL	RNFYDF YLV	RAVEPL RTF
	YSDPRFL NL	HFYYFVK EF		DAVTYT EHAK		KSDQTN ILSAL	LAVDNIL YI		CFYGFQI AM	ESNHLLL MV	TAASLFK EM
	HLTPVTL EL	CFDFTEK HV		QLSSGV SEIR		TVDLGE PLHSL	TTVPFG VTY		FFTSKAL NM	ISNPPILL V	FAASGG FLH
	VAVGVI KAV	TFDSSGA FL		EVFEDA AEIR		LSDYSDI VTTL	QAFLEA VQF		IYTWGT EEF	KTAFYSF YL	FSAEFLK VF
	YSDFVV HEI	NFDDIK NGL		SKTGIPL NVL		ISDDTTH PISY	SALEVV RKY		NYPVTG LAF	KTYFSG NYF	KAMPYR LLL
	LIVEPSR EL	GFDPVS TVL		NIIHGSD SVK		KVDSPT VTTTL	YAALHH RIL		QYEAYV QAL	LLIPIHLE V	KAVSLFL CY
	FIVDARP AM	TTDNAN ILL		AQLGGP EAAK		FADLGD LSSGL	FALPYVI VL		SYISEVK EV	AAIASLL YL	QATELV HQL
	QVEDAF RYM	FSPFHAS VL		LVQAFQ FTDK		IVDPVEP HGEM	IVYPGIA VF		VYETVVL PL	ITRARFE EL	AAAPAL PFY
	YIVDHTII M	FYDYPA GPF		GEGQLG PAER		TSDVQD RLSAL	TAVRW VVTL		AYLEAHE TF	MILNKA LLL	FSHFYIIS V
	FTYGLH MIL	GWDVA ELQL		SAVDFIR TLL		FADKET LIQFL	FAFVTD NTY		FFTEQNL SY	RTMEIF QLL	HDNEET FLK
	LSSSVIRE L	YLDSPLV RF		EGVHG GLINK		IVDLGD HREVL	FANLGR TTL		SYPDLLP TF	IQGNRV LVV	LASLKTD TF
	WAQPG GAAF	CFDNCV TYF		LRDLED SLAR		IMDDPA GNSYL	KAFPKA YLL		SYLSSLS HL	KVMGF GLYL	VELEDW NGR
	ASIPYFH AM	SAPVGV TAL		YYPTED VPRK		LSDEHA GVISV	SAVFNP SVL		LFPDVV NCM	LSIEIGH EV	VSPYTEI HL
	FSVPGG HNL	QIPEIKQ TL		YGYDNV KEYL		YADPNF VRTFL	YTIGGVK IY		IFFEESSS L	LSYNLPL EL	WQEEM ELYR
	RAINIAL QL	TWDPSR FPQ		IDIIPNP QER		SQDLLD LMHTL	QSFNAV VNY		LFADAV QEL	LSLMLH GLV	YALTSPL QL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	RAYAKFY TL	CFSVQKT NL		HIYYITG ETK		TADLPN ELIEL	TAADTVI IY		LFPPEPL VL	RSLGVH LSF	AAAALH PAL
	YVVPYTI HL	FWDPEL GHR		FLPEEA WCDL		SADVNG KIIVW	ATIPLLV FY		NYAEYQ VCL	RSYSYFI EV	RSHPFIK EY
	FGIDKSK SI	TWNTSN PDF		FYVPFA KALY		YADGEA KVEQL	FAHDST RVI		VFIWKIS DF	KNIPEIL KI	YQADIE RMY
	FSVPLPA RL	VWDESA SFL		SISLYYT GEK		TIDQSEL SSQL	FTIPHTQ EA		SFILKAN EL	KSNNIM ILV	KAQDFY VEM
	YQYPRPL LI	AYDEAL AEL		YRNPKG FSTL		AADGSV KLWSL	KAWQR VIQI		TYQDIQ NTI	SSVHVI MYL	AANIYPL SL
	FAADVR LMF	LFDAISIA V		KYIKRPG AVL		SAEDLE KALEL	YAQLHS FTL		MMNVS KISF	ATKIVFL TV	FAKDFM TYL
	IADPFFR SA	FFSSYLV TL		YAFNGT QRFL		YIDFRD GAGLL	FAFMVV NNL		VFLPNS NHV	RNIGRIL GL	FINQNL RTY
	IAVYHLQ EL	MFDPLT NKW		LRPLVK PKIV		FADDTY TESYI	SIAWFT VFY		LYHYYIM EL	RSIDLTV KL	IAFSRPV KY
	AVLPFSP AL	VQEYLF MPF		LHSKFL DQSL		AVDKAN LEIMT	FQSMLH PVM		SFQGMV TSF	RSQWS TMEL	KAADPV PSF
	RIVPRFS EL	VYDGKIY TL		TPASPV VHIR		SADGTIK LWAL	KAAPCIY WL		YYLGKIL EM	RAIPFGT MV	FALPFGR TA
	SAFPHLR VL	HMPTSP TFL		NGVMP SHFSR		YLDCGD LSNAL	NVYPEE MIV		FFPIAGL EF	RTVDLF PVL	FAYPAPL EV
	TIIDKSKS V	HFITPVS TL		IRSVVAL HNL		FLDVGE YNSAL	QATDTIL TV		FYPGQA PSL	ANLEHA FYV	RASWIA QVF
	FALGSPI AM	TSPEAFL AL		TTVPPN LRKL		ADPPW DIHMEL	AGYPNV NIH		VFQTKIQ EF	TSTSDIL KV	TTSWIH PVM
	KASDLYI TL	TYDEVK ARL		TRFLPH GQLL		FADNPG PMVVF	SLFSVPV IY		VYPLYTI VF	KNIFLN QVL	VSAPLRL QA
	RSIFPQQ SL	ISDEGIA YL		CRAEILH EIA		YSDPGL AGVSL	YAFGKF PTV		AFPKAV TVF	MSQYLE LKL	VSYVRS VYL
	FVVPNQ KEL	CWDTAI LRV		KGESGQ SWPR		FAYDPS NYEYL	HAAPC MLFM		KYMDRS LDI	RVTAH WLLV	GNYYKP WFF
	VADVRL YSL	LFDTLLL NF		FLSRHSL DMK		FQDPSA VYSEL	YPKASRL IV		QYQPPA PAL	GSWDG TLRL	IARPFIE AL
	YVSPRIL TA	YYPAFLD MV		HSESKV LILF		FLDNPGI LSEL	LSVPIIIK Y		FFHWVN NVL	KTYLQG VEL	MASLRS LSL
	RAIQFYL EF	FFDSNG NFL		DRPHEG TRPVR		TADQVD LTSAL	KAIELLQ EF		IYYQSPL SL	RSADFL GKV	TAMDW FIAV
	VAIFPSP MM	PKEMVP AEI		TEWLD GKHVVF		FVEEPSK KGAL	NAKDFF RVL		NFLGAE NAF	RSQEYKI VL	TSSFQPV SM
	VCNPIIT KL	EFDSLPA LL		ITQIEHE VSSS		IQDLIDD KDAL	AAMDS AWMV		NYQIVVS NL	ASSPIPV VI	YGLEKF WAF
	RAAEPLL TL	MFDAVL ILL		LRFPGQ LNADL		AADALG KLISI	SAYESL MEI		VYMNRV KEI	FNSKQL LYL	AAASHF FNL
	KAFNWF SYL	PFDLQS VIF		AWEISD QLLQI		NLDVPH SYSVL	SSFTTIV TY		FYITSRT QF	KTTPDVI FV	HAAPFS KVL
	LSKDSILS L	NWNEIV DNF		PATVGV TQPYL		AADDIM DPTSL	MAVEFP LVL		QYPDFN NYL	ASIVRVK KL	AAVPLV RLF
	AASPAG LDL	PVQEGR DEF		PRNEGA LLHEL		LVDAGV PMRAL	SAFGYFI TA		SYPLNSY EL	KSQEIFL NL	QATIYV HKV
	FVIGNG KNL	VLDEQL NEF		ARFENA CPALV		FGDEGA VIEVL	SMFGG VMVF		AYILDTL VF	KTVQFV LQF	SSQGTV RFF
	LFMPRS TEF	RFDCAIV LL		NLYYEG QNLQL		ISDLDR QIEQL	VAASNI VQM		SYLHSLL EM	RSLPLFL TL	YANYFIR LL
	LIVDRPV TL	FFNLSLK EV		LVYPND FRLTD		NADDM DRIMTL	ATADTVI IY		TYQAMV HEL	RSSTYEV RL	YAPYPSP VL
	FVIDLQT RL	VYTLFNK TF		HVVAAS ALLYF		LAEMPD SAAAL	FSFHKKK IV		IFPAKTIT Y	RVIEPFS RV	YMDYRG YSY
	CSLWPG QAL	VWDFSE AVC		RLPAVA SKRYL		DIFTGLI GPMK	VAIPSYI CY		LFYPYCQ AL	SAFDHF ASV	KSTAISL FY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YVTSVIL HI	CYPDTD VFL		IGGIGTV PVGR		FADVLP EAAAL	YAKDDP LEF		QFQESV GSF	SSIEHLT TL	LANERL MTL
	FAVLED HTL	EVDPEP VYI		LVSESSD VLPK		SIDSPKA ITSL	FAIPLIER L		AYGNVF SAF	VSVPYP SSL	MAPLK MLAL
	ITIKPVLS L	KWPETP LLL		ADREDD PNFFK		HADTVG IDAVL	LIPYWT VYF		FFYEGSR VL	VVIGKM LIL	YSSFSRFI M
	IASPPSLI L	AFEKGS VLF		YGEPGE VFINK		TANGGL ALASI	VWKLRI VSY		SFGLVG QSF	ISTVEVL KV	YVTPVN RNV
	LTYMPS VSL	LLGALDY SF		LTSQLPP LREI		IADLSHE AILL	YSYIDAV CY		SFMGM VISH	YNIEQE QKL	NSTNKL FQY
	NTMGH MMEM	FWDDA VKEV		LKGDDL QAIKK		FADGER KVEHL	AAFEGT VFF		SYHPAL NAI	FQYPDT RYL	TVTTVIL EV
	FIEPNVR FW	YVDFEGI NF		PAPPKP EPKPK		FVDDSG RYLAI	AAMELA QMV		SYVVAM ETF	FSITPLS EL	VSLLRVL EM
	KINEAFI EM	LFDYDPL TM		SAYVIRL EPLL		YADIDA AWQAL	VAFDVEI HM		VFQPSLA VF	KAFPFHI IF	AVSYRQ VAF
	VAVPGG VDL	FFGEGQ ASL		EAAENS LVAYK		KTDLDD DITAL	MAANVI PVL		AFLAIIH AL	KLNQDV LLV	LAAYHP WVV
	FTNPWT KEL	FFDEGTI NF		IFGVTTL DIVR		FANNSA FVAEL	NVPVF WPIL		AYINKVE EL	RTFLRPP KV	ALSPNH RIY
	VAFDKF WNM	FYNTSIE EM		FAIDPHL LLSV		SIDVSLP LNTL	RTISVILF L		SFIKEAN TL	ASSSLPK KL	ISTPVIRT F
	TIDPNTR TL	VAPWNS LSL		YALYDA TYETK		TLDGGD IINAL	SAASLYP VL		AFQNAY LEL	KTIETSP SL	LAAIWF RTY
	AAIDHQI EV	ILDNSPA FL		HLSPDG QYVPR		YSDFDLL NNSL	ALYPNV VQV		FYIPQRP YM	KTNIAM LTV	LAKPPV VSV
	LSQDPV LEL	SIDSEPA LV		IRYESLT DPSK		FAIDPHL LLSV	SAAMVF SAL		HIITGVA VF	RSVDNV QFL	VAAMQ PRML
	TIIPKVLA M	VWELLP TTL		YYIDADL LREI		FADQNS VPRAL	YVTSLLK MY		IYIGSQD AL	SVYDGK LLI	AAMEFL QEL
	LMMDP LTGL	IFDDVIE HC		NSLESY AFNMK		LLDEPT NHLDL	KTISVVL QL		AFALVS QAY	AMNSQI LEV	LAVLKLY QF
	HTIFPSE YL	EFDNAG AMM		FYAPELL FFAK		FSDDAF NTTFI	RAFDVP KRY		FYHFSVL QI	KTRLIN QVL	MTAVRA WEF
	LAYEPFS TL	VFNLSN AIM		VVHED QGKKP Q		IQDQLSL SEAL	AAVAAV LYV		NYPSGP QAF	YNIPVIH AF	YAVNSQ FTM
	LSQVRFL VL	LFDYTDT FL		DQVAN SAFVER		YAYDGK DYIAL	FAYTAKL IL		AYLGSAI QL	FMNPH LISV	FTSDPKP TI
	MAEPFT KAL	IFSEVPV QL		MAPSET QFSHL		VVDPVT SEHEL	AAQAIF PSM		TYLQTM VFY	PSMGH PLEV	HSGPLR VAM
	FIIDGKG VL	MFASTY MLL		FATHAA ALSVR		MAPSET QFSHL	VAFGSQ VTL		NFPTNL HPM	RSMEEA RLV	FGKPYFI KL
	FVNSQE WTL	RYDFFVS RF		FGSDQS ENVDR		IVDGGI NPDSL	AARLRA VDF		SYIIDVR AL	ASAPVP FTV	SANHNIL QI
	LADQKV HML	TLDDTV AEF		GSGTAE VELKK		VIDESTT ASIL	SSFPGVT VI		AFMDQ VRAF	VNNPKS LSL	KASALLR LY
	AAIKAFI AV	IFDVASII L		YRDGLN GLLQL		RVDVAI STSAL	FLYPWK KEF		LYIRDILD M	EALHYM LLV	TASRVIR EL
	FSTLYGR VL	NYDETIS TL		LVLVGD GGTGK		KSDVTN QLVDF	VGYDGP IYM		SYNAIRT GL	KTIRDIIA L	LAGPLRP AA
	LVNGKSL EL	SIPGGYN AL		YSTDVS VDEVK		AADLDA VPMSL	VIPPFVF MV		TYVTEVR EL	RNIEGK QYL	MAKRFA YPL
	HACGVI ATI	YFIPEFN LF		GESPVD YDGGR		IIDLEQT ATHL	VSFQEV VTF		IFPEGFV EL	RSSDKV VLV	FEVQVT VPK
	IAVPDPS VL	QFDCSP ELF		SNFAEA LAAHK		AADFSG FGSTL	RTFGHL LRY		AFIQQNI SF	VINKVKL EV	HTRSIF WEL
	FTADPLS LL	FLDGYVS QL		HADIVT TTTHK		YGDLGG PIITT	RVFPHE VNW		AYGFKIS SL	HNIWVI LVV	AVSNVF KIL
	LIVDSVK EL	LYNHDL VSM		RQFVKD SIRLV		GSVENG TFLEL	CSYPHII RL		IYESKMI EY	KADVVE LLL	IASPVQP VL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LTLKHVK AL	VFEDLSV TL		TPVEPE VAIHR		VIDFTG HALAL	AMMAN RLSF		YYFVTRE VM	RSYDEQ LRL	SSSAVFL II
	YANFNRI IL	YSPFGDS PL		FIPGGK ASRGL		FVEDAE LRQTL	YAAGVH SVL		YFMDHT VAF	QTSATF LRV	CSLWHL YPL
	SALGHLS FL	CADPRV PWV		DRVTDA LNATR		FVDTAD RLASL	YASQYIA RY		YYQHIVT TL	SGVGIFL RV	FVTFYTR KA
	AAMEFL QEL	VFDAVT DVI		VTVPSG ELRHV		SADTILI GHSL	FTFPGN LVT		FFNYTVR TL	ATEPHV RMV	NATLWY KIF
	HVLEPLS SL	FFIDVSS NL				IVDPTG EEEHL	FAKDFM TYL		AYKNFT NLF	HNADQ PLRV	AAAPER VVL
	IIVGNPK AL	EFDKNIA LL				LLPHAN EVSQK	AIIDTVI NY		GWPRG VTQF	KVFDAF LNM	AGYYRK YFY
	FSDFEAR QL	SFEPTTV EL				FVDLEQ FNQQL	QAFGGL LVA		IYQTQGI FL	YSINWT QKL	IASIHSFE L
	TIIRQNQ AL	VFDSSED YF				FSNTLD TLSEI	SAAIVPV RT		MFFFSRL EY	YSYWTK NGV	MANIPL PEY
	KAINVFV SA	LYFIFLIN L				VIWTSS DHQVL	FLKDLVA SV		RFQTYIT YF	KILAAIL HL	MTFPGE RIY
	YAVGGY TRL	FYDSISIV L				RQILKN PDDPD	AAVALA VLV		VYQAVQ ALY	KTVEQH LRL	YAAIRYD TV
	YVENQF REF	IADLVVA VF				KVDSPT VNTTL	AAAKAL RIL		SYQLWA DNL	RSTELIP RL	ASYERLD VF
	WAVTG VSSL	WFDGKL VTV				VADVSN NKGGL	YAKIHIPI I		AFLEAA DNL	RVIDYA VKI	MTMEY KQEL
	YVIAYIR DL	TWEAQP VKV				QADNP MESSIL	LSTHLLIL Y		FFLSKIRS H	TVYPME RLV	FAVNMF RTL
	SITAVTP LL	SFPTVVI YV				FAEISSN TSQL	QAIENA HVL		FVRDMI REV	LTMEVI RQV	FSSENVK VF
	YCTEIFD YL	LLVYSME DS				DGWSD LDGLLS	SGFSGVI RL		IFMDEID SI	ITYGQF AQL	NATFRIL EV
	LAHPNII AL	LFDFAA DFI				KLDGNE LDLSL	FAFEEAI GY		SFGGKLV TF	RALEHF TDL	IAVGLVR AY
	RAIPNN QVL	QFDQLIS SM				NSDGYP DSLAL	MAAPQI RKM		SFSPGA GAF	ASRTRIT FV	SAAAAP HLL
	SAAPRT VAL	VFPNNV VFV					RAFKKP VFY		KYPHYFP VM	KTYNILR NV	ISLLKAV FY
	RAFQPS VSL	FWDMLS KTE					SIITYVVT Y		NFVARV ESL	MATAH VTEI	LASFKIL AL
	QATPAA LVL	IFNRVSE HF					FSAEFLK VF		VLPVYM NCL	QSNAVP LFL	LATETVR SI
	YAGYIPQ AF	IFEEEEV EF					AAFLGE RVF		FYISPRIT F	RTQHAI LYM	LDGSVD FKK
	PSRTGL HVL	FSTRKID MV					AAYHVE VTF		AYITQKV EF	KTLLLLS SV	TSYVRPV KF
	IVNGHTL LV	SFDGIYA NM					LAFEGPI LL		LFPEGIK GM	MSYEQL MQL	FSFYFHE AL
	YILDPKQ AL	VFMCGT NAF					FASVFEK YF		VALLRVT PF	RSMVLK LTL	HTTILRP SY
	FSAGEP RVL	HFDSPP HLL					TSFPSPV SV		AYYPSSF PK	RSVPV WLLL	FVKFFIIG V
	FVMEGV KNL	KFWDYL HEI					AGIAFA PVY		SYQRFTA FY	RTFSLFQ QL	LSQVRFL VL
	YLNETFS EL	HFDLHE EML					TGYSEVI VV		NYLSSIL NH	TAAVHII LV	RAAPFSL EY
	WQNPH MLFL	HFDTPP HLF					YSFYLPI AA		RFFAQS QSL	YTSKSYL TV	SSVEVR MEF
	ISVASFQ EL	NFDKIRV WL					YSSPLFR SL		AYFGTG FPH	HNVDIV LQV	AAKPFF CEL
	LAIIPHV TI	KYFLWE EKF					VATGVIS TL		YFHEFG HVM	KLNQAH LEV	KAALAH PFF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LAYDTQ LVL	IADPNIA KL					TAMKKV FRV		FYQPKIQ QF	LSTGKYL NV	KYFLRGY RY
	FLHPHLL VL	VWDHG GRIF					AALMRP LVV		TFIDDIS AY	SIFVFTH VL	YASQYIA RY
	YALGAL NHL	AFDHMK VCF					LSVFPLL DL		FYEETKV KF	FNHPNI LRL	FASTMV HAL
	FAWEPF RGL	ICDELIAK L					FAMPYF IQV		VYFQM QTTY	LSISKQT RL	LSTIREV AV
	FAIKSLR KL	KLDVALK EM					YMISIVH IY		AYGRM GLAL	FAYPAP LEV	RAYPTV KFY
	FLQTPLT EL	HYDRFVI FL					YTFPFQ QLM		FFVENVS EL	RNQYQ MLVL	LIAPPRY VM
	SLHTLFG DK	HFDLFLR FL					FAQEAIS VL		FYMEDY LTV	HSFGHL KEV	NFTPNL RVW
	YALLGRT LL	HYWTWI NHF					LCHLEQL LL		FYPFPVP PL	HSVSQP IMV	RAKGYD LEL
	FSSPHLV QV	MYEEFLS KV					VAFEMC SQL		TYNMAP SAL	KSIILPKS L	VALDFE QEM
	SVVDVF AQL	KLDEHIA YL					QSVHFQ TIF		NFQEYV TFL	RSFLQA LVL	AATAVT NLY
	LAAHIPL FL	YCDERIT EL					AAYGW PLYI		VYIGVH VPF	KTAENF RAL	FQTIAR NAL
	AAIASLL YL	HFDNLFS KM					SAFDRV MRL		YYQTNYL VV	LSDETLL EI	KAIGLFIS F
	YSVRVSP QM	CGDFPH LLV					TAYPSLR LL		AYLAALT QL	RNTDE MVEL	LTIFTAR LY
	FAGVER LAL	HYDIPKI SM					YIIKDKHI L		RYMAFA HDL	RVVGR WLLV	MANW QLIHM
	AADAAL RVL	FYDVQF KEL					YVGPAK VIV		AFNPEPL VL	AIQDHL LEV	RAINIAL QL
	VAVPVA VTF	HWDVTE AVF					MATNKE RLF		RFQDAL ESL	QSNHFE LSL	RASPFLL QY
	FVSDPLS DL	LYDEIKK YV					VNDNAP YFL		TYQVQK LSL	RTSPLDL KL	RSALPRP SL
	LVVDKA MEL	IYDKCITE L					FAATVIT TI		VYVLTNL AY	TAHPSP LSV	NSSEKL QFY
	FIDTAQ HML	VFDNKV LTI					AAASIA NIV		SYLITSVE L	ALFQQK LQL	YATKHL RVL
	FSVVSPS SF	HYDMN TASL					KGYGKIL EV		TFQENLS AF	ASQYF MLLL	FASIPGL EF
	AAVRIGS VL	LFEEVISK M					LSAEVYR IL		IYLNHIEP L	RVLFKYF EV	YITSVSR LY
	YTIMSPA VL	VWDLH NQTL					NMYGK VVTV		SYLAETL GL	SSSPNI MLL	FAPIQPL AM
	IAIEDPFS V	LFPLWP AEM					FLAPWA TIA		YYRDYPT LV	RTFQTA LFL	LALRPPP PL
	KAMEY MFGW	TMDIHL NEM					AAAGVF ALL		LFHPSNV EM	ASQLYLL FL	ITTVIQH VF
	QSYGNV VEL	VWDLRN MGY					AAFYGC LYA		IYLPIREA L	RLNPEM LQI	AAREFS HML
	SVIPPRT EL	IFDNCHE LY					FVPVFV AVL		FFSEIISSI	SSNAVP LKV	CAHSFF DEL
	KAIDLM NAL	LYDIILKN F					NNPQFV WVV		NYVPEV SAL	VSITFIK QI	SAIGYIH SL
	NAISIHH AL	TFDPVTK ML					KLYGKPI RV		SFEQILA SI	YANAKI YKL	YANAKIY KL
	SAITTLM HL	HFDSRS VIF					LATLITQ FL		IFQDASI TF	RSYYYG KFM	GRTGPR APL
	VAVDGI NAL	FSEEHPV LL					QAFPRIT QL		LYIDRPL PY	ASFGSF HLI	YGPPVR TEY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YMLEHV ITL	GFDLSEE KF					TAAPTIG VL		LYYQYM ETY	FSNAGIL KM	YQILRGL AY
	MIIENFE AL	VFDPIGH FT					FLNQPH MVL		VYLPMS YCY	KSIDNGI FV	IISEFALE Y
	SFVDLRL LL	SFDVVTK CV					MAVPA TVIY		KFNVTT VDM	MSADV PLVV	LAMINR FQF
	SQYPFP VTL	IFDEMK KKF					YSYPETP LY		NYSDSIS PF	RSYWS QTIL	QAIETAR AW
	IARLPSS TL	AFDASR TSF					IAFQQA QYI		TYNMVL NLL	ATIGELA QV	QNMERI FSF
	AATGVV LDL	VYNLSDT HL					SASEVLK EW		FYSVRNI FH	ITFSNPK EV	RAIIREN EF
	NALFHA STL	MFDDIG RNF					YAYPYSY YY		AYHGLT VPL	RNIPETL EL	VTIVKPI VY
	YAASDM LQL	KFEEWCI EM					FAVAIYA VY		FFVGYG VTL	RTYSFLN LL	LAAEVH RVL
	SAYQNH LIL	IWQAYL DYL					ITTIVVHI Y		HFYNVK SSL	ASISLAQ YL	MISEPRI SY
	KAFGWS IAL	LFDLFRG FF					QLPNFA FSV		VYNFSLV AL	KTLSLVK EL	LASAFFL VV
	SAAGPG FSL	HMDTFI ETF					TAFETIIL L		YYQEYP MSI	KVLELQ TEL	RLHLRP VAF
	KAFQKIV VL	AFTSDPA LL					TAYPGQ TQY		QFLAAIE SL	FSIDPDL LV	YASQWF LTL
	AANKTII YL	VYDELR QCI					YQFKRL KYY		YYPEYLI NL	KTDRQF QEL	LVTGFA RIF
	FAEGFV KAL	IYDLHES TY					AAAFQP LII		FYQSLGI PY	RMFGIP VVV	SAAENFL VL
	FQTIARN AL	RVYEFLD KL					AMYGG LVLF		MFPMP RVIY	SSLEKSY EL	VSSFRP NEF
	FSQALQ HAL	LFDIFVNI L					SAFPFLQ EY		SFFFGKS TL	YSMPST HAM	YATFIVT NY
	TIMPRG PTL	AMDLVK NHL					SAFGLPI VF		NFPHGV VSF	YSSPEIL RV	FSAMFE HEM
	QLLDIKI RL	AYDHSY VEL					ATIQLIRI L		HFPDLF HVM	RNIILMS LL	LAALPRP QL
	FTIVSPL DI	VFDEAD RLF					EAAEVIL RV		SYMESV VTF	YNMEM ARKI	FLSPLFR FY
	GAYKYIQ EL	QFDPQP LAM					GAYTVTI KY		TFVPVA NEL	GVNVT QVFV	NSTYIM RVL
	MAKRFA YPL	HFDVVK CIL					QAFLIAI VV		FLPLFDR VL	WQNPH MLFL	VVSVPQ RIM
	YAFNHS ADF	AWDYV QAQV					KAFTYRS NF		AYELYTE AL	YTYKRFE GL	YLPYRDY NY
	FVVERQ PCM	RYPDRIT LI					QAADSIL VL		LYRGIFP VL	GSFGRV MLV	RLTPIDR VF
	YTSEVQ AIL	EFDIFTR LF					SAAHFV MFF		NYPHFFL DF	ITVEKAL AI	YTRYQTL EL
	FLLPVIN EM	LTDPAIV KV					FSFPLLI ML		AYIGSM RPL	KIMDYS LLV	TSQFRP VEL
	FYVPFAK AL	VSDHFP VEF					QATPLL HAL		YYFDSYA HF	SILESFIH V	YSMYRE FWA
	LAHVVIT QL	FFDDCIE KL					FASDVQ FVL		NYETMG RAL	MATRA GLQV	VGAIRN AAF
	LTAEHFA AL	YFPKKIS EL					MALIW GIYF		TFPRFG GSL	RSQGKP IEL	AAVDLK PTL
	FTMDPK LSA	KYDPNV YSI					RAWGH PCEM		YYFFTPY VY	RVNNN VLTI	LSKDYTL IV
	ISAIPTRS L	YFNYTVK VL					SAIGYIH SL		SFLDISR PK	VVNSG WLVV	SQSLRIL CY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	SAVDVHI NM	IYDVNK NEW					RTVDLF PVL		TYPTGA ATF	FTYNPF MRV	TVIGPD GHK
	ASITPGTI L	IWDYHV VLL					LAFESIQ KI		YYLNEIQ SF	KSDLRLI EV	WFYIAS AFR
	SAANIQ PIF	SMDEAL EKF					FLFDRP MHV		AYQPDIL CL	KSNNEI VLV	FAREALR AL
	IAAVPAT AM	ITDPRTV FV					FASGLA ATV		AYYGNIS HF	LSQPILL EL	FLTVTRL YF
	ASSPPVL SL	KYDNM AELF					YSHGPIA VL		HYYDLAL AF	RQFLFH WTV	VASGMI LVM
	FQTEVG KQL	LYDCLEE HL					FAFDEIV AL		MYQEHI NEI	SIIDTELK V	LATQMV RMI
	LSMERM VPA	MLDLAKI IF					LAYSGV HLY		KYQIQQ VDM	SVNTLP VVV	TFMEKL YPY
	SAAEAY QVL	HFNLYSS IL					LASGLV VFF		LFQEMN IEL	ATASNL VKV	AAMYKS LEL
	FSHHRV TVL	SYWEWL PLL					AAASFP WSA		VFTATD VAL	RNIPGP HMV	RASLKTA IY
	SSVHVI MYL	IFEVADT HL					AAFDAA WMV		LLIENVA SL	STFGEV LMV	YANYYT REV
	YALPAGL EV	AFELHG VFL					ATVNFIT SY		LYNFMG DAF	YTWKKI MRL	YTSDYFI SY
	CSTVPSL AL	VYDLLHC LV					TVTTVIL EV		LYYNAN RAF	HANPILL LV	AAVPLY RLY
	FVTEEIIP L	YYDKHFT EF					YVYPKYL KY		SFADFGS AL	KSYVNP TEL	FAQNKP TGF
	LIDVART SL	CWDHR PVQI					MAAPLV LVL		YFLEMQ EKL	TNSSWL LRL	FSTNLQ RLM
	FLLEHIRI L	YFELVQ HEY					AAYGLV VVT		QYYPNGI RL	KTDWH RYNL	FSTPPR QVL
	YFNPHT VTL	YGDCHP VFF					LTVPWL VEF		EFNHYLT SM	SSAPGP LEL	FTKGIPN VL
	TATPRDL VL	KWDPTG NLL					YGSPNA LVL		TFISAAS KF	RNQDM KLKL	YTAVVPL VY
	VAVMTV REL	YFEDKLT EI					SAAEHF SMI		NWIEEV TGM	TTNPQE LML	EATDYLR NL
	FAMKEFI AT	RFDLLKR IL					FSFPFQT YY		SFFSTPS EL	ASYFEPL IL	IFMENR NEF
	LAVEAVL RL	HFNPTG SAF					NAFQW AIKA		SFMSGA DSF	FGQRHR LLL	LTTLRV WCY
	SLINPSS SL	LWDLQD RVL					NASPIN RIV		SFTIMQE VY	SSMTRP QEL	FANSRD TSF
	AADWH NLIL	MVDPFH TLF					VGIENIH VM		VYALQQ TAL	ANTLVY HVV	FASSFKI VL
	AAINRQI NL	SLDDGW IRF					WAYTIF ENI		VYFYTFN SL	KVTEVFI LV	YARVSV RTV
	QAIERYL VV	GYDTRV TVL					HAYPLIQ EA		FFINEA MEL	RTISVILF L	LVRPEV DVM
	GALPYFS EM	LLMDRV DEM					KAFSVR SSL		FYPPPRI TL	TADIPAL FL	QTSEFIR AL
	YAPYPSP VL	VLDQVE ARL					YATEKLR MI		LYFPQSL DF	VTKEFFL LL	YISGLPR TM
	VALNAH TFL	AFDEYG RPF					CLYPDG VFY		TFIDPRIP L	SSAQFA LRL	FAVGSF HTL
	FSEEDYR TL	KFDHAM VAF					CQWDQ PVRY		FYEYHAL MM	TSKIPAL AV	FLSIGAR YY
	FTVPAN QAF	TFDLLRN SY					VAIPVSI FY		SFPENLR HL	AIMAIF RYV	VARSNIL TL
	VVIGKM LIL	LLDEVLN VM					RATHRL LLL		TFPRAM EAL	FSHTVN LIV	SAQGKP LAL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	AAVPSPL EL	VYDSPLC RL					KASEKIL QV		VYPGIAV FF	ISLPVSL YL	SATYIAE EY
	FLVDPNL DL	NFDEFSK HL					AAKNFIT KM		SFIHAA MGM	KTVLVFL NL	FQSQFE RLV
	FTLDVM KEL	FYDPRSL DI					CSFPRPR SW		VYPEYVI QY	AQNGIP LRI	YANLML LTL
	AASFHSL SL	TFDSTIH FY					RGFDKA YVV		FYNTSIE EM	ASGRLP LAV	FGSNIA HMY
	IAIPFGT AL	HWFVW VTQM					RAIAKIK ML		LYLTSCV NY	KVLGAL LFV	FSAGEP RVL
	LAYMNH IMV	VFDKVK VKI					RQYPEVI KY		LYPIKNL EM	VGNFKF IYV	LAALAK APF
	LAQQAIL SL	FFHLVNS EM					AAAGLH RYL		MYYGLS NFY	KINNKV VQL	MAFYVV KMY
	FAIHKKI VL	MWDCA TELL					SAFPVK RLW		SFMKGL TEL	KNQDHL LKL	STSDVV RQY
	IIITPGYG L	VFEPTIV KV					TAFSRLI LIL		FYIVDRD AF	KTIDKIL KC	MAAMP QTVY
	NAIREVL EL	AFDSTLT HL					VSQDPR HMVL		KYPASSS VF	RIHAHF TGL	VWFDRR TNY
	SAIGPFS GL	LFSSPPVI L					RAPDNII KFY		TYIDTRT VF	RTIGVM TMV	VASEVY KAV
	SSMYPP HPL	HFDDIG PSV					VAVTNT LPVL		FVYITDN AY	GTFLFLA EV	FAEPGR VPF
	AAAAPS PVL	NFDEKP VII					FASKLVL KAL		FYISWAE EY	KTIDAM KRV	WAMDL RPEL
	SATELM NIL	FWDKKV THF					VSWTGK PVSY		TFPQFIK AY	RGSNVA LML	AAFLILP EL
	MVADKF TEL	KWSWYL DYL					SAFEKP QIIA		VYRTVIE YY	TNVDKP LRI	EIGELYL PK
	YQIPTEN SM	RFWTWI NHF					FVVDHV IKIT		YFQHRE FSF	FQNLKV LLV	FAIKSLR KL
	GAISKIF VL	FTDEESR VF					CAYDRIV VAG		AFALLFS EL	LSYSEIL RL	FAYTARI SV
	QAIENA HVL	KYDATM IEI					KAVGW RLIAL		RFSINGH FY	RTLYHL RLL	YAALHH RIL
	FMVEKG PTL	SYDGRA YVI					ALIEFIRS EY		RFIGAVN NM	KVSHHQ LIL	YFFKRTQ YF
	KCLELFS EL	YYEERTC IL					YIFEEPF TIR		YFYDDV TTL	LVYKNF PQL	VAALLTR TF
	WASPPG RWL	AFDKPK VEL					YQFTGIK KYF		YYKERLL YL	RIKDEF QLL	LSTPLIRT F
	FAQTLH PSL	HFDFIQS HI					YAFDLK CDSV		SYADNIL SF	RTLPTL QEL	FVAEQK VEY
	LLIENVA SL	FFNLTVK EM					ASFDGRI SVY		VFQQVG VSM	RGQLHV LRV	FSVNLFR TL
	YAKDDP LEF	YWEEEP AEV					FAWEPN GSKF		FYHDAK EIF	YSQKDP LIL	HARLAP PSL
	YGINNIR EL	MMDFF NAQM					YAFPKA VSVF		FYRVTTE QY	ASNGVL LLM	YAIEKVR EI
	FQSSAV MAL	VYDLGG GTF					AAAPQL LIVL		KFLVAVE SM	ESWDKI LAL	QDGSVD FGR
	LSMVPIT SL	HFDADG NYF					ASYSGL MRIE		NFPLPSQ VF	KSTEMA LRV	YSTAPRP SL
	LAFPSPE KL	YYDMM DLKV					FAYPNR PDVL		AFPKAVS VF	KAYKAY RLL	FTNPWT KEL
	LAHLRA AVL	HFSELLD EF					YTFDQKI VEW		TFFPACV SL	YNIQKE STL	LAAAMV RVL
	AALDIYE TL	IFDSIIVT L					FVYPGN PLRH		IYPETAAI L	RNYFSEL TM	LARIYSY QM

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FTSPFCL QV	AFGLHLI DF					FAYPAIR YLL		IYPGHG MMF	TSDPLEL FL	LQIGVIR VY
	ITLHVF WEL	CHDLTLA VL					YAFNGT QRFL		KYIQEAE ML	ITSDQPI LL	VATEVL MWF
	FAANVY EAF	RYDCVV LFL					NAIDKLF VLF		AYALAG VSF	KNSGVL MVV	YTVDGF RYF
	FTNDKII NL	IYDNQGI EL					SAVNIIR TFL		CFFPNG NAF	RSYPEIL TL	LLAARLV TF
	FAVTLET VL	CFDTVTK EL					FAIGGIA RTY		AFIYDAA VL	SNSDVII YV	VSRAHQ LVM
	FSADGH TML	RYDNVTI LF					FVHPDP LWIP		HYQAIVT AY	TAISLFY EL	AMALRN KSF
	TAVAPN VAL	NYDACL QHL					KAFPFHI IFD		NFFPSGI DF	HSFFKIS YL	VAAVGN RLY
	SADFPR VGM	IVDGRVY YI					VTFPGIK LIY		QFQPKL TDF	RIRAKFY SV	ITSPVHV SF
	FATGVW HQM	NFDYLRK EM					FAGLVQ EISF		SYPFDFL EF	RSLKVG SFL	LSLFRDE VF
	FTLVGKV LL	HFYEHL NQM					FAADIPR ILV		TFIVQGV TL	RTLTKVL AL	LSMERM VPA
	YAMDEL RSL	YFLPDTA HF					YAYLKAI VLF		FYAHSLV EL	FNYKSILI V	NIFSEVR VY
	SADSLEH VL	YYEHEFV EL					LLYPFAP LIL		FYYDGEL FL	KSIRQDL TV	SSTPVVL VR
	FAAVEGI FF	TYEGKPI FL					HAAPFQ NILP		IFVPARN NM	RLNPLV LLL	IIKNIWIP M
	FGSQPG LYL	LAPTDV KEL					TAFHGC MELL		SYPFLVL QM	SGTPHA LIV	ITTPGVR FY
	FSIADSIE L	HWDGN MSLV					RAFGIPI RVY		FFIDCM AAL	SIHIFDT LL	FSQINLR EY
	TAAPTIG VL	NYDEMK DFI					LSFPTTK TYF		AYQYTIR AH	FSKTEEL NR	LALAIAQ EL
	VSIRTGL EL	HYDPAE LKL					YAFPKSI TVF		IYHPNV DKL	FTRKGV LRV	LAYLRTE CY
	AAAGSP VFL	VFHCQS AVM					CSFSGYK IYP		QFIGYPI TL	KTLEGEF SV	SASSLAR AY
	TIIEATH VL	YFEAMF RSF					YTFGRIV IYI		WYQSN VNTL	LINANM MVL	MTTEILR SM
	TVIPHL MAL	IWDVTIL EY					AAFGGN PKSV		AFSINVG HM	LTTLELL EV	ASSLRLY LY
	FTTGAIK DL	RFQSMP VRL					AAFTAD PLSL		HFYGKAI EL	TLNRYLL LM	FVITKPD VY
	QAFPRIT QL	TYDLQES NV					FARYPN GVVV		VFIDGPL AL	ASLPKPF FL	MSIPFRS AY
	YGSPGIL EF	SYDSVLA LV					YVFDGK PPQL		YYEFREE AY	ITNVAEL LV	RIAEFAF EY
	FALPILN AL	FFSEREA SF					KAVDIV KQVW		LFNMAG VTF	KTALKLL LV	DHAVDL IQK
	FLENHV RHL	ALDKAT VLL					VAHEFG AITF		LYHENIV KY	QSVDLV FPV	LMAKPR PPL
	SAACPG LQL	FYETLPV AI					SDESLIA CKA		RFIGLTN SF	KVYELFT DF	AASFINL LY
	SVVFHST VI	VYDLLKN HL					AAVHIIL VIN		AYLIMIS AL	LIGPPLLI P	FAQPGS FEY
	TAFHSS MAL	HFDTPV QFL					MATPLL MQAL		QYQRML STL	RIYPKG QRL	KANPDL PIL
	AAFPYG GVL	LFDLVCR TL					VTYNYP VHYF		SFVDSV GVM	KINEKP QVI	YARFKP VAV
	VSFPYVI AL	NYDEHIS NF					MSVDP DRMVI		YFKPMM KEF	KSLQMI RQL	YTSSEIR VF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YSIAQFK YL	YFWEAL NNF					YAFPKA VTVF		FYVPGV API	RNQNL MLEL	YYTYLIM NK
	SAAPLFF SW	VYQEMP AQL					MAVEFP LVLY		LYQAVA TIL	SNYFKM LFV	FASFIVQ YY
	AAAPEY KTL	NYDEMC FHI					YMIDPS GVSY		FFMPGF APL	KSCEKIH FI	IATIKNIS M
	AANPFF KLL	CFDVKD VQM					CSYDRK VIIW		IFQIHTS RM	SSAKRPL WL	RITAVRR VY
	QAHLTL MAL	FMDFQ MQRM					FAFNRK RNVL		IYLTRLLS V	VNINRI MSV	RLDGSV DFK
	IALGEFS TL	VLDNPT PEM					FSFEGPE KVH		SYIQGGR PF	YTSDLH FQV	TSSPPRL AM
	RTMEIF QLL	GYDTRV TIL					QAFTHA PATL		KYKASIT AL	KTLVLIL VV	NMTVRF FSF
	RAIEIYT DM	HFDASLS TY					FAFESDL HSL		CFVDAG NAF	LGNIARL EL	SAMEVV PAL
	YGITSPIS L	TWDRTP VSM					FSNDIPH VVR		EWPPFV VTL	MSYPAK VTL	FAFTPSR IY
	FGMQA RYSL	HFDASH VAL					FFLDHV RTSF		SFLPVVS TF	QSLTHIL AL	AAARRF YQY
	YTNPSGI VL	SFDVTN KCL					MSYEQL MQLY		YFPGQAI AM	SILRHVA EV	FAQEAIS VL
	AAGSHV IIL	TFDLQM KFV					KTPDFIL QVP		YYLVKRE DY	VSIGYP QEL	FSVDSPR IY
	IGIDHIKE L	VADLVG FLL					YGYDNV KEYL		AFADNV SGL	ASISHV AHV	SATDTIR KM
	FSQKSFL VL	ITDHLIA ML					FAFSPD GRHL		AFLPTLQ TL	FNTPQA LRF	HSSMPR PDY
	LASSEW PEL	KTDVTV VRF					TSKIDEV LKY		NFPKVA TSF	FSHGQV VSL	AAFLRH WKL
	QSLPPGL AV	IFCESLR NF					TAYPNR PMVL		VFYPSSL AF	LSNEKLP NL	ICADPRV PW
	SAASITP LL	ILDLVISC F					FLYPFPL ALF		QFTANA LAL	HIPEVYL IV	LSAPLHP EF
	SAVDLP VTL	IYEQKIA EL					FASYME QHLM		VFPDDM PTL	KSTSVIL FL	AARAFY EAL
	VAIQAVL SL	FYNERV VIM					YAFAHIL TVL		VYNEAG VTF	RAFGIPI RV	FAHDST RVI
	KQYGNE VFL	SFDEMN AEL					FSFGGKL VTF		IYQKAIE VL	ISEEGFH YL	FAKFHP NLV
	LAAAMV RVL	AFDFAA REM					YAFPYIIL VL		QYYQND IPY	KSFIHIK EV	FVITFPR AY
	SAAEIM AVL	FLDALIV SM					YAYDGK DYIA		SFHAAG LQM	HTFYNE LRV	FVKPAV VTV
	VAYGKG TYF	IYEEFLA AF					LAFDPS GQRL		SYLDKVR AL	KSLDW QIDV	GARNFV LVL
	LAVDTQ LLL	AFDPVL NRW					AKDIGFI KLD		VYQEMP AQL	TGFPH MLFM	RATHRLL LL
	LSIEQLT TL	NMDLM RADM					FTPFVD PRVY		SVFWAS SPY	VSSKVP YEI	VAIESTP MI
	FISNVKT AL	GFDLQE TLV					NIKAPG EQTV		TFMEQK ITY	ASTILHL VV	IAPTGIE SL
	YVLEHNL HL	QFDTDA VRL					YATTVIP RVY		VYFPALT SL	KTYQFL NDI	SAYQRY YSL
	AANKVV LQL	YFDLPG ALL					SAFDRK VQFL		IFQDPTA MM	RGSSLH LHV	RAAEPLL TL
	VATQVG IEW	TFDETVS TY					QSFPEPL IIP		NFYVSSE SI	RSLLQTT FL	SQTPVL REL
	YAIEKVR EI	VLDLMK VDM					FAKCTG MIIL		SFQFAHL EF	VTNEYQ HML	SAGPLLR PY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FAVGPG HGI	RFDYVPS FL					YFIPFLPL EY		TFLEEVT EY	ASFDRAI EM	TARDYY TFL
	FLNPAQ RAL	TWPDKV VCV					RTVDW ALAEY		FYLGKRC AY	QTYFFPI HL	IAIDWEP EM
	FVLDKVP FL	VYDPAT ETW					MIAEPA HFYL		SFSEFTS SL	HNQFIP LQV	KAFDQR LTF
	YLNEWL QIL	TFDPSLA YY					AAFGGH PQCL		AYPYYAS AF	KSFEGN VFM	NAKAAL LEL
	AIVKVFL AL	AMPGVP AFL					AAYIYIR GEF		GYLALVS AL	LTNATI MVV	SAAYLPR MW
	RAVPVG SGL	LFDHVA ECL					RALPFV PMSY		AFQTILT EI	RSFQIFR AL	SFLQRIT EY
	ASTARH LYL	FLPPFPA HL					IAGPVLL ILV		NYVDLV SSL	ASYPIPII L	YASPVV AFY
	FALKGLR TL	HGLIRKY GL					KSFEGN VFMY		RFPELSL AL	FGTIVNI QV	YSHPHV RLL
	SAVGKT SLL	IYDIAWC QL					FTFDQD PSVL		SYPGGQ LVF	FINSRIIT V	AAQLRPI SL
	YALTSPL QL	AFIEPPE RM					KAFQKIV VLF		NAPLVH ATL	QSHAYQ QFL	SAPYGRI TL
	YAYGQY NMP	KFPSPPA FI					YAYEKP HVVC		LYITLPLA L	YSISGPH VL	SMQVKT VAY
	YTSPVN PAV	AFDLYE QRY					KAKWP DRITL		RYLYMV MEY	KTILDPL TL	FAAFFSH IL
	AAMKL MTAL	TFDPQR QTV					YAFEYLI ETL		SFPQVV GSL	VIFDRFR GV	VANPRL DTF
	FQTHTT PVL	NYDYLK GFL					GPPPPP GKPQ		SYSSIASE F	ATDGRV YVV	VTSDGR YVF
	HVFIGGT PL	WFDNQI HEA					AAGVKQ HPVF		YYALQH SFF	ITDPRTV FV	YAAPHF FHL
	TANKIF MVL	DYDPQT VRL					FAKTFV GTPY		AYFPDA RDM	KSASGIV AV	ATMFPR REF
	YSIVGLS SL	HFPDME IFL					FLFDGSP TYV		FFYSEIM EL	TSQIQR LIV	YAATYP RQL
	HSIIPRG SL	SIPERPA QL					AAIGLVI YYL		IFPNQTE EL	VSLAEA LEV	YISAKPL EM
	TIDPIPH QL	IFDRAVA AY					FASGLIH RVC		IYATRLIQ M	KTLLFVR LL	FAMQLV KIL
	YAEEFRT YL	NYTDNE LEK					SAVDFIR TLL		RFGESTT GF	KSYPET HII	FSVVSPS SF
	YVQDPF AAL	AYDYMC MGF					MAFLLP LIIV		FYLLISKT F	ASHFFN LMF	TGLQEV EVK
	YAVTGD VKM	MVDPAI NLF					FLFDKV VIVC		AFLDILS EF	FSQKSFL VL	FAFFDP VMY
	LASFKIL AL	FFNQHII TF					IIPSWPL KVL		TFMTVG IAL	RVTVVF STV	IAQLYGR LY
	FVVDHC PYM	NFYPFLQ RF					SSFDGII AMM		MFLPITK WL	YNIASLV RL	VFGIRYD DY
	MSSDVF PLL	LFDVPVL NL					FANDLK PKVY		QYPENIL SF	YTSRIVV RL	HATTYIP LM
	FASTILH LV	QFDNFK RVF					EAGHQK VVFY		RFNSITS AY	KVVALV HAV	VANDYA RQL
	FQMQTT YVL	YFDWGP GEM					VAMNP TNTVF		FMKDVV TPL	RIRESFF RV	AKPALE DLR
	FSSHLIN LL	FYEVVD ARL					VAYEGL PLHL		QYHYGT LSL	RNYFSK LWL	LQGYLR SVF
	LAYTGFV KL	HFDSYIT CV					AAYPYN FSNL		FFESRW EEF	RTPEHF ALV	RARDLFF AL
	RIIPRHL QL	TYDLIAN IV					YTARVY NMFW		FFPPFVS CI	YNNIMA LYL	FAAHLR CTY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YTVLTRI GL	KFDYVM QFL					AQVDSS FLSL		TFPMQC SAL	YTSPDFL YI	LTVQVA RVY
	AVVGDP IAL	VFDCVV TSL					ITSFLTLS WY		FFQQTT TSF	ANGIKV LLI	SAFPEVR SL
	YVINVTT HL	SWPTKII YL					SAYPLSV EWL		TFNNPT TEF	FSSHLIN LL	FAQTLH PSL
	MALLFLL PL	CMDPFI YFF					NAGPAI VISF		NYQFVY QNL	FTIFKA MMV	LAIPVFL TL
	YLIPFSSK L	AWWE WDTKF					VAFDGD AVLF		FMVDNE AIY	RNFGQ WLQV	VAKEIIY TL
	FSYHQFI HL	IFDNWIP LL					IAGPVV EISH		NYFQQA NEL	RTSRTLL LL	YCSNLV RTL
	HILDFSP SL	LLDGGVI NL					VAKLIQC IVF		LFADSFA AL	KTPDFIL QV	AARSFYY KL
	FLLQHV QEL	LWNISD YFF					VVKMPS GEFA		NYAENIL TL	SSFFKSL VI	LMSPVK PFY
	IIIPNPAA L	VFDIGVR VV					AAFGLA LPLA		VFFDMF NAL	VSIGKG VTV	YAYTGR LEL
	NAFMKA VEL	SYMPVI DVF					HTFRVG SLIF		VFYYFVS AL	KQIDVY RSV	FVTFTTR AM
	FLQEHN TTL	TFDLLFV TL					LAFSND GTTL		HFPIEVR HY	SSNDML LFI	TCTLKLL EY
	ISILQQIE L	VFDHPW ETV					VAVGFP MMIL		VFSDGA VSL	SSYYGV VRL	FALGSPI AM
	LAVRDV SEL	VFDPRYL LL					MATTFG QKGG		FFNNQIE EL	FQNDFL RLL	FAQVFH LIL
	TAFPQR TEL	AYDKAV ASF					NATVKG VNFY		VYFGIAA SL	KSMLRL LLV	LASGKY RTF
	HSALPN QSL	GFDRNA VIV					YAVGW GPITW		FFNDAIE TY	QAIERYL VV	NATSRIL DM
	YTLINHR VL	NFDCFG DKL					AAFPGA SLYL		FFIAGRY EF	RIVAHA VEV	SAAQPG VAF
	GAIPAFI SL	MTDPE MVEV					RATSNV FAMF		RFYSAEI SL	RSYSYYV EV	YAITTLH NL
	VALPVV YSL	LFDHIAE CL					PAPIPDL KVF		SPGAAV VML	ESIPIRLF L	AATDIA RQV
	NAYTGIV LL	QWDELL CQL					QAKGEP WTFL		VFPAIAQ EI	KTLNND IML	LFDERKY PY
	VAVPTL NAL	IYEYVES RM					FQNPQT HVIE		KFLARYV SL	MSSDVF PLL	TSTGVIR DF
	YAIPKFK HL	IYDIMNE LM					MATLLL LLGV		VLGPVRL PL	NSGINV MQV	LVPPWT RVY
	FSLPPGH AV	IMDATNI LV					MAGVV WFVVL		FFHIQA QKL	SSNPVP LYA	VSALFSR IF
	YIIPVVLF L	RFDCSD RQF					ETMHK MIPLL		FWPEAF SEV	VQYALP LQL	FAISILQ QI
	SAVDPV AVL	IYNFTYK VF					YAVDRA ITHL		SYILDTL VF	ASNIVSL KV	AAAAPR VPF
	YAYDGK DYI	FVDDYT VRV					RQIGVE HVVV		TVYVSMI AL	RTIPVAT TL	AAKEYPF IL
	AAMPV AQHL	LYDLAAV VV					KAVGHP FVIQL		FFNVHS AVL	YTDATP LRV	VTSGKII EY
	TAAPVV PEL	YMDTLN IFM					FAVDPE KIQLY		FYPPLTS SL	HNLGRF ITV	CALDFFR QI
	KSLLWA FPL	AWDLYY HVF					DPFNPF ELTNH		IYPPEVA EF	QSLGKP LVL	FAILRQA EL
	YLIEPDV EL	HFWTWI NHL					YAKDIGF IKLD		KYYDAIA CL	RSFTKLP HL	FGTSHP RYY
	FLLEKPF SV	IFDCVSQ EY					LSSDLIKI IYV		YYGNSL VEF	YTSPDFL YV	MWLPV VRTW

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LSSLPLN SL	RYDEMV ESM					VASPFYL IIDH		KYQDVY VEL	HSLSLLP LL	YIIDTTG KL
	QALDYFL KM	KLPNDP AII					FSFPHKF EISF		MYQSFV QFL	KVHVH DLTV	FAFVTD NTY
	RTFEAF MYL	RFDKEV ALF					SAVNPE HLSYF		TFASPTQ VF	VTLLVAL KV	LLLLRGY AF
	GALQAV YEL	IADGLPV AV					RQIGVE HVVVY		TFYDIVA EL	YSQHSV LLV	VATQVG IEW
	VILEPM QEL	MLPSEP VLL					VATSFIR TIEL		VYQPVR YYY	YTTDFIY QL	AARLRA VDF
	FSYQVA STL	FFDPDT NIV					SAYDGK DYIAL		FYPLMG VEL	QSSSLT VHV	AARSVFL HL
	ISFPSPD AL	FYDTKVT VM					HAYDGK DYISL		NFPAEV KDL	SILRRFL VL	FALPSPQ HI
	NIDEAYK IL	IYDDCIV TV					FAYDGK DYLTL		TYQFSGE VL	SSMAEF LKV	FAMAG HENL
	FITESYQ TL	ILDNPVV QL					HACGVI ATIAF		VYVAAV REF	KASEWV QQV	FSAFLEK EY
	FTNRTVL EL	WFDYNC IHV					FAKPVY PGQTL		NFIKAM VSY	LSIRSVR LV	QALPW VRYI
	IIYTAKIS L	SVPLAAT SM					ISSPLTKS ISL		RLIKDTL AL	RITELM QVL	RATDYV FRI
	MANPQ MQQL	SYDPVT NTW					YAYDGK DYIAL		CFSVQK TNL	RNIMF MQEL	YAVNSK RML
	FADRSLL EM	SFDAMF REA					FAIDPHL LLSV		FYIIEREP L	TASRQH LYV	MATLLR TSF
	AAAPSLL IL	ILDVIVRS F					FSNDIPH VVRF		LYQEVF GRL	TSSGVV WEV	AAIKAIK FY
	FGGPEV LKL	NLDLTER QV					YQYPRP LLIAF		NFQDTV NTL	YQYLRQ LEV	VMGMR SYYY
	IAIKFGS AL	IYDEVVK LL					YAFPKSI TVFF		TIIPKVLA M	VSAENIL TV	LATNFLL EM
	IGYSSPL TL	MFDQQ EIQV					HAFDSL SGISL		VFHLPTT TF	YQTALH LAV	LTAKVFR TY
	VSVPYPS SL	IHDLLTIF V					YAFPKA VSVFF		AYPEYLI TY	HSGPVV AMV	FADPFA FIH
	EAYTGG LEL	FWADKV ASL					AAINPEL LQLL		MYPAFA EEY	LSAQQIL HV	GYTQQL AFR
	HVMKA MQSL	VFEVSLA DL					TAFVEPF VILL		NFFPGV FEY	RLQSKTI KV	QVTEAF REF
	IAVPEAR FL	HYDAIC QYM					LSFPTTK TYFP		TFPDWA DMY	RSNFKL VAV	VSSFVLR AM
	AIMDLLL RL	LFPEWP SYL					VATPHA RIIEL		VLPVVR AEL	ATVPNA LEF	IGALREN TF
	YSDSFP MEL	FTDVIGH YI					MAFLLP LIIVL		VYNVQY SFI	KLSEIPL TL	YIKDFFE QM
	SAIFHG WVL	RFMDLA TYI					ISSHIPLII QF		FYNLVLL PR	KTVLIILE V	YARQGQ IEV
	FSFEAQ GGL	FLPELPA DL					SSINPDH LTYF		VYVSDIQ EL	RTLDGR LQV	AAAHFY FEL
	IASAIVN EL	VADDTP VLL					VAVDPSI LARL		GYLAAS QSF	YTYYYP HYL	FARWLFI GL
	LINANM MVL	FYDGIKA IL					YTTDRV MTVSF		NYMEVV SLL	ASHLHL NSV	LVEPEGI EK
	GTAPPTL AL	KLPGNIS SL					FAHNSN WYITF		AYPYNFS NL	FTISDPK LV	RAAEGV RAW
	VAGNRL QSL	LYDLTKL CF					YAYETK DALCL		LFPHHIG EL	RNIPGIT LL	TSSLPKY PL
	YIITGGG FL	VTEEFGV HL					AAFGAP GIISA		RTYDLYI TY	FSSSYIT AI	FATRFD QVM

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	IAMGM AQAL	ATDPFAS VF					FASTILH LVVM		VFIDEID AI	RLNPHD IRL	FGTEHV LRI
	KSVDPTL AL	KMDFTA ARL					HAFSFPL LIML		AFTEM MEAY	RSLDYV AQL	YSYFSPR TM
	SAVVQH MSL	TFDSSCH FF					YAVDPA QLQAL		SFLATITS F	RSYIDFL ML	DISEVVT PR
	VAVDVN NML	SLDAFM SEM					RIMDPD VITGY		SYAVMQ ISM	RTFNQF SNL	IAVIKGL TY
	FIMDES NVL	YWDCSV CTF					YQFDKV GILTL		NFFETTI KF	VTITGIV KV	VAVMTV REL
	QAISAIQ AL	MFNSTD IKL					FAYDPS NYEYL		QYLELAH SL	YTNEYR LTI	VAWNP SPAV
	LAAVPV QDL	VYDVRQ AYV					YAMAH TGVIFF		RFIDTTL AI	FAIKSLR KL	FSNPYSI EY
	FIVEETL PL	EFDKLVA LL					IAGPVLL ILVH		TFITNTD VF	ANTQV VREV	IALGFYR FW
	QAMPTL IEL	SFDSVPV SL					AAFSHT QVIEL		FYLNQST AY	KSRAEEL KL	FFIAGRY EF
	SVIEISRA L	YFDGDLS KV					FAYPAIR YLLY		IYTPIFNE Y	QTIGYQI RL	HAKGFG MTL
	FAVPEN SSV	LFDHVV NRV					KAFENLL GQAL		SSQFGSL EF	SSHYMT LVV	LATAAA LTY
	IAFGPAL AL	ITDPSVI VM					GHQQLY WSHPR		MYYFSEL AL	RTVFLP AEV	YAKIVEI PF
	HIIENIVA V	RYDEIKE EF					AAFFVR KKSSL		AFNQDI TAL	KILDHLT MI	YTRPGLP TF
	NILDRFL AL	FFDFTG MTL					CAFPYSL LIFV		FFIPDIEY L	ASIYKIL HL	ITVGPRG PL
	RAIELAT TL	LFDTKPLI V					TAQNHP MLVEL		AYYVSN EEL	ASWDH TIRV	LQAMPR TEF
	VALPTSL SL	AFEQLV VEL					RAFGGIL VVVY		FYPDAV EEW	FTVDQI RAI	FARMKP RKI
	ASAAAA LVL	RYDDMA TCM					TIIDSDKI MVL		LLPSARP EL	RSIFSAL VV	FASEVS NVL
	FSFDGPE IM	KAPEPLS SL					AAAPQL LIVLL		QFNRMT VEY	RTFSLVL VL	ITSSPHP EY
	GAGPVL EAF	YFLMHE EVI					FASSHT PRITF		HFPEHL DHF	ATNAAV TVL	YALPAG LEV
	LAITTEH TL	TWDCM KTQL					AAYYPS DVSSL		KFSPNTS QF	FSSDVT HEM	AATLAT HEL
	SAIPWGI SA	FYDRRRI YL					KAFQKIV VLFY		AYIGGIC SL	ITPENLP QI	FSSDLQK TF
	TAIIPNS QL	ITDFHPD TW					SAFGDL TIKSL		AFAVVA SAL	RMFFHF SEI	HAKMIF MEL
	AAISHGR VF	VWPSEP SRV					ATIDPDT ISAL		FFQNAFI FF	ISNSSVV KV	LLIENVA SL
	YQVGVH YEL	SYDTHW ITM					SAFPFPV TVSL		IYLDML NVY	KAFYFL NSV	FAGFLPR II
	FLYDTH QNL	SFPSEPV KL					AAFTAD PLSLL		SFVPFTI PH	AVINRV QKV	VAKAVT QAL
	LATAAAL TY	KFPVKPA DL					NAVDAA RLHYM		VFPLFSS EL	STNTRV LYF	VAKDYV RLM
	SAAPLQ PVL	HYDLAFT DV					RAFEVS ENGNL		CFHIETA HF	SVYGKL RKV	AASWTS RQV
	HVPEHA VVL	LWDNAF SEM					FQNPQT HVIEN		SFFGAAS QY	YLLDHFL SM	CTAIREV SL
	FTEQGV RLL	RQDPFT VHM					SSINPDH LSYF		AFPYGN VAF	FSSGAI QVV	FSFHHVL SL
	FVVPDT VDM	LFDLAGI TC					TSYNVR VVVVY		IFEVGGV PY	KASHILI SV	FTTNKK VSF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	NASPVISSV	IWDLTTATL					QVDGFCLPWEI		PPSTFHSFL	RSSSLLRAV	QANIRLTSL
	LAQVSGLEM	AFDRKVQFL					YVVDHAMKIVF		RYLGKVLEL	TSIQRIQRL	RASLLLKTY
	SALEKSLAV	SIPILASAL					HAANIVTAIYI		FYQLKILTL	YNSFISLTV	VDFTLSSER
	FASSPLRVL	WYDPKVTRV					YAYDGNRVRKW		AYFESLVEL	VIMSQYLEL	AARSSIRVV
	FLVTVIHTL	FWDGRHLSE					QAIDPKNLSRL		AYQDRLAYL	ASLISVRNL	TTRDYYFAL
	TGIPVHLEL	FWPLIPQFV					AAYGELRAMVL		HFFCEVQAL	ATNPKPVKL	VAWPNPREI
	AAVDTNLTL	WMNGPLFLL					ATFPVGLISVV		RFPVEIKSF	RVNPVTLET	AAAPLLPMI
	IVAEPGAVL	SLDPLPPYI					FADICFISTTI		SAPVGVTAL	HSLSFETQL	SVRPVPLEV
	QANIRLTSL	FYEETKVKF					STINPDHLSYF		AFLAEASVM	ASSVSPLIV	FTSPFCLQV
	YGDLGGPII	VFDVGGLLE					YAFPRVRIITT		FFIDSVLGL	RTYDMDVRL	YSYFEKETL
	YGFQYPLAM	FYDGIKAIF					QAQVNTLTPRV		FYIESISYL	QSTSIKLAL	AAAKNIRVW
	YMDAPKAAL	GFNTVGRLV					HGLIRKYGLNM		LYFPFSSHS	RSNIWLAAV	MLAPPRELF
	IAIPDASKL	SFDYSNTVM					FESKHSCTLVM		AYMHQLLGL	YAYPGVLLI	FGKDYLLEM
	SALAWQQSL	HFDLLHEDV					FAEDPKKHNLL		AYQELLQHY	ILNPYNLFL	FVIRPSRFY
	SALNRLLVL	SWDLPGSHV							IFIGTIQVM	KTYLQQIGV	QLMLRVNEY
	VAMTGEITL	EFDPLLREI							LMNIQRNPF	LSDIHTRFL	AATTVLQEL
	YTSGTFRTV	VWDEVSGQW							AYLESINCV	SIRGNNIRY	AAVLRHISV
	AAVVSSPSL	VLDLAETMV							FYEVAYTVF	ASITLQQQL	ATAARAVAF
	SATIVIAYL	LFELNTPEF							SFAVPFREM	KSFALLPRL	FALPYVIVL
	MVVGTGTSL	NYNVTVERM							VYCARFVEL	RNGITPLHV	RAREVIEAL
	IAIVAPEAL	LFDAFVSVL							AFEFMQRAL	RTIPGKQQL	LASLSNRLY
	LSFTHPTSF	RFPDLTVEL							AYGASFLSF	KITDHFMRL	IAVLQAEVY
	VAFVGGIDL	SADFPALVV							GYMVMGDSF	KSNTLPISL	SAAYYLNDL
	FVSSFMSEL	FFPRQPCIF							NYMPGQLTI	QNTEEFLRV	VASPQVHFI
	STIDKVSVL	KIDDKPVKI							SYNAGALTW	SANIPPLKF	YVQDFHPRL
	VSIAPLLEL	IYDDGITSL							GFPEGSVEL	STTELPLTV	SAYGSVKAY
	FLYMYSRYL	SADPNVVDL							IYFNYLSEL	YSYFSPRTM	VARGFFNYI
	YINPRAVQL	VFDLGGGTF							KYMDINFDF	HTQIVRLLV	FVHDLVLYL
	VAVGSGLSW	SVDVTNTTF							LFLPGRMAY	KSLTGTLYL	KAPDFLPLL
	LATFDRQEL	VADLQLIDF							SMILNVLEY	VINGNIKTV	LSTTKPFEY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LVLVPTR EL	YFPPGIV EV							IYPEAVT MF	AGYPHI RYI	FSNFWY HSY
	VASEIM AVL	MFDLAV DAL							NFIATVR EV	QSFPEP LII	VAVVKG LTY
	IAVANA QEL	TFDLAAP TV							SFLPSGS EM	RSINKLI RI	FARSFTL ML
	MVNPVI YAL	MMDVS GVGF							VYFASLL TV	VALAHI RHV	FIFMIDV SY
	AIAAVFH TL	YIDLPPP RL							FFIACVT SF	VGSEVH LEI	IAKTSLS FY
	FAMAG HENL	HLPPFFD CL							YFYVIGS SY	ATTDLLT KL	ILMDPS PEY
	FSTPLNP LL	TFWLLLR QF							AFVLSSN SL	KTWDK VAVL	ISASAEE LR
	FTDSGIH II	VFDGCP LKI							KFPEVII NF	ASTALV WVV	YVTSLLK MY
	LVFPGFF EL	SFDLVA QMI							NFLESKF SL	RQVGKT LRI	VGFNRL LEY
	YAVELFE GL	AYSFKVV LL							SYLAGTL GL	KSFEAPI KL	IITDLLRS V
	FASSFKI VL	FLDWPQ GTF							VYAHFPI NV	KVFGGF QVV	SANNVY LVM
	IAVEPG NQW	VFDNTP AAL							YFPTQAL NF	LSNPKLL QM	TATGFS HVL
	KITEDFR AL	YFEGSIY EI							IFFPGVS EF	LTTRIAH FL	SSAPVPK VM
	YASGINV NL	AFDDVV KYF							IFVVASS SY	SINAEEV VV	YAHFPIN VV
	LVISDGS SL	REDVLW FKP							HFHITNT TF	FTSPFCL QV	FVNPTSF VY
	AAAPHL LLL	VADGYP VRL							NFLPEAL DF	RALVML LEV	QAQTDR VSL
	SAIIFETP L	QYNTTIA HV							IYADYAR SL	RITPRHL QL	EAGGRF VAF
	SSMLPV MAL	WYENH NISI							RFLEGVR NV	RTGEGF LLV	SAANIQ PIF
	YVYSGV ETL	VFDMVV AHI							VYIPSKT DL	YNMQIF NEL	TAQTLV RIL
	FTIEVER AL	RFWYFV SQL							VYIPSRV AL	KAFQKI VVL	FTVVRVI NF
	FGVPVV VAL	IFEDKTV KL							AYAPSG NFV	KTLDNV AIV	VSHVRK LVF
	LAVEYV DSL	LLDPLM PEL							FFIPGVS VV	NSNTQV VLL	HAAGFA YTY
	LNAAPRI AL	LWPEKT SFL							FYPYGLQ TF	QASHQ PLYL	QFALRLL AF
	RALNVF YYL	HFDVQS MLF							RYAEFSS AL	QSTEILK KL	TSPEAFL AL
	FGVDPY NVL	LLPSHAS YL							SYLAILSA L	KTFYHK SLL	FTHSQFI VV
	FILEPRSF L	TFDEIVC KI							VFHVQQ TEM	HAQTVV LCV	FLCPFHL SV
	LALELHQ EL	TWDPLG QYV							VVNIQTI AM	IVYPKPT WL	TTSLRVL AL
	YQMEM MRSL	SFDSGIA GL							AFDNM VTSM	KIIDIFTT L	VAAPKH WML
	ASGPPV SEL	HFKELPT LL							NYYGKYI AL	FNSNV MVKV	YAAQAH LKL
	IISPLFAE L	HFDPEA PFL							TFPDIIR NY	HSTNVL LSL	FAAAKLL AL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LAFGSG MGL	VFETLEA RM							FFEAVG VTY	ISIDSPQ KL	SVPLAAT SM
	YITAAYV EM	ALPEIFTE L							NYPGLSI SL	KTSPYP VIL	AAIEWII EH
	FAYTRLQ LL	IPILCSYF F							TFPKEIQ ML	RTVDAR LKL	SSQKRH WTF
	MGYSHS LVI	SFDFHG RRM							TFQDFTE QF	SSDPIAL GV	RSFLRGL PA
	YILPWES EL	IFDWLG RSL							AFIAQAL CL	STNSVR LML	SAASAL HLL
	YSNNSW RYL	YFISHVL AF							CYNLET NSL	HGLHRI LVV	AAVNRI HSF
	YVQIPG MEI	YFESVRT FV							TLLRDRD EL	QAQYHS LKL	FATEGLR TL
	SAFLKTI AL	QWDLRL TAV							FYYIHNL VV	AITSYLL QL	HSLLQTK NY
	VAFGSQ VTL	FLPDHPI VL							VFNIVFT SL	RSSTQF HVF	FAAFFTR AF
	YVIPDW KVV	FTDFDP HHF							VFNSML VSI	TSAVPN LFV	FASGSPL LI
	TALSFFH ML	NFDMTS KFL							VYISSRP PL	FQNVK QLYA	FTYLEIN PL
	ALSHILT AL	HLPNKA CFL							FRVTLVS AI	YSIEKPL KF	SLLFNMI SY
	SAVYVLS SM	MYEQQ VVKL							SFLFTVIT F	YGNVVE LRI	VATWFN QPA
	FGSDISP EI	IFDLFLEC M							AFARRVL SL	YSGISGL EL	AAAKAA LIY
	FILEHIM VV	YFDKELI QL							IFIFGVLN V	YTFPAG VSV	SVTELDR VY
	LTLRPGV SL	AFEDDAI QL							YFYNDT VTF	RNFGTV LRL	YAAYPLT EV
	FAVEEG DHL	FHNELN AHI							TFQDKTL NF	RTYREL RLL	YTSGTFR TV
	FCIWTES AF	AWDLGS AFF							GQPFDY SPI	VSMLRI LFL	ASTPVA REL
	IAFPTSIS V	LLDLALE GM							LYLPTRV TA	RVLGKIT LV	FFLARPT TF
	LCHPHII RL	MAPLK MLAL							RFPDGT NGL	KSTSQL VNL	YSQEQR QAF
	STPDHSF SL	AYMVTT VLL							KFNLDA TEL	QNSSVIL FL	TASPVA VSL
	YSADGH SIL	VMDVV VKSV							QFFPEAI SF	RSNAAL LFV	VGGVQP VSI
	FSQPVFP YL	IFDNSDN RL							VTYVPVT TF	WSLPAT ATM	AAKAAL AAF
	IANDRFI NM	VFSEME ANF							DYVRYRL PL	YNYLQR AYI	FSVEQIT AM
	LGYTSGL SL	HYIYPPA IV							FYLLNDA SL	FNQKFF QEL	AAAARIE AM
	NAILVDT PL	SIPEKNR PL							LFPDTPL AL	KNLDLLS QL	SAAAIFK IY
	NSNPVIA EL	LFDEIDQ AL							MYPDQ VQLL	RIQVRF AEL	FVRPYS DYL
	GIIEPLM NL	HKEFYD GLF							AFPTVTL PH	SVVSQFI TV	TTTTEHR FF
	AAHMP AAAL	RMPEKV TWM							AFYTLVR EI	TSQSRV MNV	FQTSRYK LH
	AAIETYN LL	TFEDVA VHF							RYQAVL ANL	RAIPNN QVL	LANGEV RIY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	AATTVL QEL	LWLNITK DL							AFLTQTV CL	STINTVL KM	QASEHF FEY
	AAYHLII EL	HFDETV NRY							AFPFSFG SF	STWEKP QEL	RSGPVK LEF
	LAGPVA SAL	LFDAFH AGF							LFEGRRI EF	TSIGHV VQL	YAIESQL QL
	FSTSVVR PF	QYDLAT KRV							LFNDTR VSF	ATISSPL EL	TFFQRA VYL
	YQYLLVT AL	IYDLLSIT L							LYAISAV YF	LVNSYH LLL	SAAPLQ PVL
	LIMDAY NSL	PWYFW GETF							QSIDVSL PL	AVNPLL RVI	FARSSYL VM
	HAIHGLL VL	TIPITPAF L							SYMPPS TVL	FSVVPS PKV	VVSPPKF VF
	RIFEKMF AM	LYPSSRS MF							NFPEHIF PA	KMGFA VLLV	GARWYS MEM
	FQEPDIH FL	NFPNTP VKM							VYMGLL AVF	RAVPVG SGL	AAAPHL LLL
	QAVKIG QSL	YFWEYS EQL							YMPQN PHII	RTGPAL LSV	VAKPNF VVM
	KATPQV PVL	NFDVLM VKL							ILPEMV GSM	VVTSPM LLV	YTLINHR VL
	SAIFPDV AL	VFEDVA VYF							SYVWRT YHL	FSTLFLE TV	FVNPSLR VL
	YANYYT REV	YYEEFPI NL							VYSPKSP SL	RSLSVP VDL	CATKLFK KY
	ISAGYAP VL	YYSPSCR EF							QYQEEI QEL	ITNLQLL KI	FAQKISR TV
	QAFPGL LQL	AFDPSG QRL							RFQSLG VAF	VINGHT LCL	FSRSDHL AL
	SAVLPA VSL	YMDYAQ ARF							AYQVSV CAF	VTYSKP RLA	IAIEPGA AL
	KASIIFVT L	LLPDIISR L							EFIEGVS QF	YSLELIQ MV	YFHDAT RVY
	VAYPGIP KL	SVDGIPA RL							FYNFSRE YL	ASSSYN MVI	YIIDFGL AK
	IAVAITE AL	IYDKAFIT V							TFIDDVF AF	LISESFLT V	KAVFVA RVL
	MSFGNV VEL	HIIAGAG EL							TYIQTEL PF	RSFEPIL RL	KSKDFV QVM
	SASPASL LL	VFMDKP EEF							AFSQFV RPL	VVNPQI FTA	LAQQYY LVY
	AIIESGKT L	LFPGQV VIM							LFPGSPA IY	YGMAL VRFV	GLEVTIT AR
	AAVSRIV AL	HFDVVQ LLV							RYNGGL LEF	ATISYILT L	LVAASQ AAL
	LAQPQ MMVV	EFDSM MNTV							AFSNVFE HY	SSYENEL ML	QATTLV HQI
	FADHVV PLL	FYPEEVS SM							SYLDLIV TY	KTLDHV FLV	TAVENM PSL
	QSISPGS RL	LFLESVT EF							FFEEVFT EM	SSLARLP SL	RVTNW NRKL
	FLFPPAE SL	VADLAE SIM							FLREWV ESM	VSMPVF QSL	ISLFQIES L
	FMEETE RSL	FLDLARN IF							YYPELAF QF	ASNYFR AMF	VLAIRQ QSF
	FSSDNIA VL	RFDMAV MFM							HWMYN ATSY	AQMDY QLRL	AAAMN WRLF
	IVYPGIA VF	LFLTVNK SV							QFLFSLV EH	HSYRGH LWL	LTTEVHP EL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LSYIKSLPL	VFPTTEVLL							TYYVSTVLF	KIMAQILTV	SIPEKNRPL
	FSVISSSEV	KFDENVSMV							GFPSFGSGF	KSSDLLKHL	FSALITRIF
	FSQPSLTTL	LLPEEQVYL							IFINLPRSM	HTTAAFIRV	IAPGVTHEL
	FQYSSHVSL	HYNGTDVSF							FYFNTVLSL	IGSKFRLVV	FNYQKRVSF
	ASSEQPPPL	YFCSKMAEI							SYIIGTSSV	RNTGQVVHL	LAFDQQPAM
	KAASVRPVL	TYDLMSSAY							TLPQGYGQF	RTDVHIRVF	YAAQLERQL
	AAVTGVLSL	IFDPSPEDI							AFLFSLTGY	ANVEHILKI	AFAEFLRTY
	FTHSHVVSL	FLDFAPHYF							FYVLSTLAF	FNFFNPLKA	AWMDNIREW
	HAFAQPFAV	RYDDMAAAM							KFNVLLTTY	SSNTWSPKL	FAVGSSRFW
	TALNLFFKL	VAPVTHVSV							AYPEIVAVY	ATQTQFFHV	LTAKLEPAF
	FSESRRLAL	MFNQDIEKL							LYQIYIDEL	HNSGVPVYL	VAVGRALYY
	IAFQYSTVL	NYDDIRTEL							LFPPGPAGF	RALDHAMSV	YLKQDPLEM
	YLLHIFMEA	EGEYIKMFM							RFVNVVPTF	YNIEQIMYL	AQRFYNLVL
	GAIPVFFSF	MYDLTSKPP							TFVVGNSSL	ESNVQILKL	FSNWGHPEY
	QAMGSFLSV	VFEDVAIHF							VFRDIVNAL	KSYSVALYL	IASLIPTPR
	TVYVSMIAL	DFFRPCRLL							YYQQLNTEL	RDMGYPLAV	TASEWERFI
	AAGETFLVL	SYDHVIYSL							HFILNTASL	ATILKLLEV	TVTDVVRFI
	FCIEVGKNL	AYEPLASFL							NYHLSPRAF	ISGGKPLEV	AAQDRVLSL
	AAVNHISQL	FFPAFITLL							QYQILKENY	KAGVAPLQV	VASMTVREL
	LAQPTLLYL	YAELDFEKI							RYMSINTHL	KSAWALLQL	YVTSVILHI
	YAASAIGYL	CFYGFQILI							KYVTDVGVL	TSMVTALQL	FADGFVLVY
	FVMLRVFQL	ILDVASLEV							LFEDATSAL	SSLSHAMVI	HAVLRVVDF
	FSVGLQPTL	IWDYMHPFP							FFVDLVSTI	KIMDRFEEV	IAAMPLISL
	SSVPGVRLL	YVPDSPALL							IITPHALPM	VSIGQSLKV	CAQDAFFQV
	FAIQKGLQA	RWENIATIL							IYFEYSHAF	VSNVKPLSL	ISYYKPEFY
	FALPAYHTL	FMDESTQCF							SYLGREVAL	ETLALLEIL	VFHDRRLQY
	KAIPGFRNL	LFDSLSQML							GFQRDLGSL	ITLDLKLEV	GQWLRRVSY
	LAIHGMETL	LWPTHEVVL							MFPAVTVEV	KIIGIMEEV	VAYMNPIAM
	LSQPILLEL	IWDWKTTKL							NYQDTIGRL	LSLMLVSTV	CAIAQAESL
	AAASAFTSL	SVPVSLQTL							VYYFSKGTL	SALNVRLFL	FSNDIPHVV

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LTFPPAT AL	VFDYSYR DY							KYQEVT NNL	TIRDKFA RL	LLPPPM KEL
	VAADAV ASL	FYDPVEP VD							MFILEQE EY	KAVLAG QFV	VAHPGF YAV
	VASGMI LVM	VFDESTR KI							NFYNFA SSF	KSTTIS MYL	VGTKST RFF
	LAGGTG LSL	LFDATLT QY							FLIDKVN AF	QQASHY LYV	RAALRV YAV
	SSAPPLS EL	YFNDTLV FL							VFTIQSI VM	RNIGRPI EM	FASTYLL LL
	YSLQPPS AL	VFDESLS MF							AFLKVSS VF	ATIRKAL RL	FSIEKRF AY
	ATTHLSP EL	RLPNRP ACL							LSQFGAS LY	KSLDIYS FI	SAMPSR LMM
	IYPGPLG AL	SFDDTN EKF							RYSEAVF YY	NSTDLP LNI	STIPPEL VK
	FQEADS PTL	MFDHLS YLL							IYQSMP RML	RSITVEQ HI	FSESHLV II
	GTIPWF MEI	AFDGDA VLF							SYQTVFL AL	YTVWH FRRV	HCTGHI HVY
	IASIHSFE L	AFDSSSA VF							YYFPDSG FF	HSVPAP QHL	MAVKQ GRFY
	LALDDV AAL	GMDVA ASEF							FFLVQTK EV	KTNDQ MVVV	SIPDFQR KY
	NTIETFN EL	LFDAETV AL							LFQALFA VF	RSYFGA FMV	VSTPQR PPL
	SGIGFGE SL	CYYVTTL SI							TYIGPST VF	FNSPRN LAM	FAALQLE YF
	FQMESQ KFL	AYDPTA PTL							YYTDFV MEL	SADFPA LVV	MSSLRP LAI
	EAQEFA LHL	IFNVTTV DL							EFNPMG DTL	CSLSHAI TL	VAVHYY RLY
	FTVPKN RSL	FWDQQ EPVIV							FYSSTVV SL	KTVDNF VAL	YTSGDV RVW
	GALFISP AL	TWDYVA PFLE							AFFLEAL DF	SAPVGV TAL	FWAPVP RVL
	IAVGVG AQL	VFDEAIR AVL							AFLTQSS QL	ASMSVV LKL	MAPERV ASL
	SSSPAVL AL	FYDFFRY VEM							AFRVPT ANV	ISLNHV RQV	RWPDYV REL
	ASAPQA PTL	FFDATD RVSF							VFMLIVS VL	TANGYIL FF	VANPNS AIF
	VANPVP ASL	TYDDRA YSSF							IFIGPVEK L	HSHPRV VEL	IAIPVTV AF
	FAAGIIA HL	VFDTAIA HLF							YYQPLV HLL	IIVDIFH GL	VSGPGR PEL
	FADVNG WHL	FYDEIRT PLL							AFLAAA REL	VSQHLI RPL	LALEPGV AY
	IATWGIV VM	VFDEAD RLFE							SYISRTN QL	IASNYHL EV	NASPIN RIV
	QAMPPL FSL	FYDLYG GEKF							TYVTPRR PF	KAGNN MLLV	YAKMIF MEL
	AALFPG EEL	LYDLLRN TNF							AYSSILSS L	RSKDIFD QL	EFDHNS NIR
	YAGDVS MFL	LTDMSR PVEL							LQHYVT MEL	VSLNRIF TV	MAAYYE HRL
	FTEKSGR LL	AFDVVE RSFL							SYQEMI ANL	FSLDNA RQV	YTTDFIY QL
	GSAPWA PVL	HWDPV NGYFF							AFNTTV AAL	QQNGT PLKV	FAADIIS VL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	NAATSF QVL	FYDDREF IYL							AMIDQV LEL	RSLFRRL KL	FARELA NQL
	VIIGSTH VL	FFDEMA DPDL							FFLQKRL QL	VSFYHW AMV	NATSLQ HLL
	FQFGVP QAL	FFDPSLL HLL							HRDGQE HAL	KMNGH LRLL	NFNLRR FMY
	MIDPRT KAL	IYNETVR DLL							VYPFGIV GM	ASTTQH LRL	SNTIRSL SF
	RAIGIGA YL	FTDEESR VFL							AFFEAAS MM	FSIPILM QL	FQNDFL RLL
	LIYDGKV EM	VYNLSDT HLF							NYLFSTS AI	TSISLLP AL	ITTTVTR VL
	GAVPTSL EL	NFDEKL VEHF							FFPDLV WTL	ATMPVT MLI	SVVFHST VI
	KAYEIM REL	SYDPVL NPVL							IYNNMK QFI	FNGAPV LYL	VAPVTH VSV
	SNVYPSK PL	FFDSQG QVLL							GYYELA QVL	FSIRYQY LL	AFVYLR QPY
	SAFGYFI TA	KFDLAA RTLL							NFQYPN QAF	ISFPAPL YI	IAMPLH MIF
	FLIDNGV SL	VFDLND ESKW							TYFIVGT AM	NSTGVL LEV	VAMPY QWEY
	KAAGFIS VL	VWDLA QQVVL							TYPPYVP EY	RSHEVIR AL	YAIGNA PEL
	YVVPGE TAL	AFDLVNI HLF							IYLFSPEA L	RTFPVLL RL	AAVAEL PVL
	AAAVM AARL	VTDEPV YIDL							RYQEVIQ EL	RTRPPS VQV	LAVGLSR IF
	GAAPVL LDL	QWEDLT PLTF							GYPSLQ NSF	TVLHAL VEV	LGVYELL LK
	IIVDPAR EL	KYDPEEP IYF							NFITGVG IL	AGYNRV KIV	YGNERFI QY
	SSVGKVS VL	FMEAIA PPLL							NYNTIFQ YY	KSAVVQ LTV	AASLQV LEM
	FTDASFL TL	VFDLVEL EVL							TTQELV QAF	VTYGFPI ML	AATDVR RVW
	HSKSTW LIL	TFDILQD LEF							VYPYLCR AL	ILGGHL DAK	ESTVRTI AM
	VIIEKTYS L	MFDLTT RLIL							FFQGYPL SL	SINSRFA KV	LAPLAED VR
	KATFHY RTL	YYDDLKY RYF							HFYLKAL SL	AKPALE DLR	AAANPT LAF
	SAYGKF RKL	FFDPNT HENL							IFQAVET AI	FTYKGL RAL	FALPVGL IV
	MAYFPA ISL	DFDPALL EFL							IWPEKVL DI	KIYEPPR YM	FATSVLR WI
	TAAFPFA AL	RFDEISF VNF							NLPAFV NRL	QTVAAV LMV	VVIDPYL VY
	SAASLYP VL	FWPPYV ELLL							SFQVIES LY	TTNPYV LMV	FTVNPK GEL
	SAQPWI AAL	IFDLQSN TVL							VANTMR TSL	KAYHEQ LTV	FVQLMP ILI
	FINGDIS SL	VFDMG AEVGF							YFITQDS AF	KSNRAA LHL	IASNYHL EV
	IATLAITT L	FLSEHPN VTL							EFMTKV SAL	ASTAFN LQV	AVSYDS KEY
	FAHDST RVI	LYDPCTV MFF							RFSLNTV EL	ISYLRVR KL	YSTIRKQ EY
	VATLYGL SL	YYDPQE EVYL							TWPKEV RQL	ASDPRII RL	FNHILPY FY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	LSTVVSP VI	FYDNKGI TYL							IFAKLWS LF	YGSPGIL EF	FVQVPG RVV
	QAADSIL VL	GWPDEP PEEF							FYIIGAIT L	RTLRGV MRV	QAAARL LVF
	SATQVY TIL	SFDIGD QPVF							LFAPYGT VM	SSNAIDL VV	SNTLRPL TY
	FLMPTSS EL	CFDEITY VEL							RYFGPA AAL	KSYEAKL RL	VALYNP VSF
	LAAEGQ LTL	VYDITNV NSF							SYFGSFS SL	RIPAHRL VL	VAMKFA QVF
	AAWGG QLEL	AYDDKIY YFF							FYVESRS MF	KTIDGHI NL	VAVILM RVL
	FANEPF ADF	FFEDEKP ALL							RYRPGT VAL	VAIAGL MEV	AANLFA QTY
	FQYPAES VL	VYDPSLK TLL							SWPTYP QLY	RSYPHL RRV	FADGKV YAL
	SADPGIL VL	FPFDVTK VEV							VFESNAI AY	YSVKRSL KL	MAALRT QTL
	SALGVG LAL	FLPARFY QAL							FYFVNG KVF	RTAHVIL RY	TFIDPRI PL
	ASIYTGIT L	RFDDPG LMLM							CFPFETS SY	KSFFEAK KL	VAVWE GRIY
	FIGDSGI PL	QYDEAIS DYF							NFLITQT EL	KVRAHL AEL	AAAPQL LIV
	TASEMIL VL	MFDQS QIQEF							SFDAHLT EL	TLNSKLL KV	FQGFRL VPF
	FCEKSFR QL	FFDDVG AVTL							TFMDRG FVF	ATSSVF QEV	LAASALP AL
	GIIHVISR P	LFDLTPA KVL							LFPGKV HSL	YSSPFD PVL	IASPVIA AV
	ASAPDP PVL	VFDVLD GEEM							AFQVSA CAF	GSTRIIT RL	SIVEPKP TL
	SVLDRPR AL	VFDTSIA QLF							VYLGSSL HM	RSLEGR WEV	ITQGIPR SY
	FTYKGLR AL	GSFDVA DRMF							SWIDDT SAF	YSNVIFL EV	MALVRF VNL
	SSTTVIP TL	YWPHQ PIENL							VYPGYYL TF	QSTSDY LVV	QAAAVR HVL
	LSSPPTE SL	NYDLHD TVSF							AFSVTGT SL	RHNSV QLQV	SAALPLP VL
	LSSPVA QML	VFDPVQ KTLL							FFPFDTR QM	RLLPAFL KV	AATEKLL EY
	AAIEGNL QL	VFDVTE RTAL							ITFAGMI PY	SGQPVP LVV	QAITRVI PL
	LAQAME TAL	FFDEESY SLL							NFLALAR EL	ATDPNI LSL	YARLYPV LL
	TIVDTGI GM	AYDPAA LCGL							NYLPFIM EL	RGLQVH VVV	FATDSG LEF
	AAGPTG MFF	FFDHSG TLVM							SYIYGAQ HL	IRNIHN DEL	SATTSLR VL
	AAVRHV LAL	QLPDWP EVYF							YYITTRA QF	GSNPLK REI	FTTTAER EI
	FAVDRE ARL	YYDLYG GEKF							FYVYDK NVL	KAEGKV RLL	QQTLRT VAF
	FSNPETL DL	QFDEGL PPIL							KFYGAS VAY	KIHSSFR SL	RATSFLL AL
	AAAGVF ALL	VYDIAD HPDF							NFPGIVT SF	LLNDRK VFV	FSTSTGR VY
	YAEDRE RFF	NFDEAL VDYF							NYHAGY SMF	RAFHHG RFI	MAWKT LPIY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	TALLGPL PL	FYDSIPQ ELF							NYLETG RGL	RIAPPD RRF	VSASLPR SY
	SAAPEG VPL	YFDWGP GEML							SYIGLGH IY	RAMSIA QRV	TATDIRV AF
	FSSAIGL VL	VFDLTDL DVL							RFPDVA NGF	RIYPTFL HL	YAYPGV LLI
	LSMAPP LSL	IYDEAISS FF							GFPEQA TAF	ATYNFS QSL	FASIAPSI Y
	NAGTVIL EL	HFDSAV GEFL							SFIENSS AL	RSIDGPI RL	MTIEPFI SL
	AALSQA VSL	PETEQV NGLF							YVSLDN AVL	FLTAAK KAR	FGMDD REIM
	AAAPQS LEF	VFDASSI QYF							AYIKGG WIL	KVLDKP SRL	FAQYLIS EL
	AAQIPTA AL	AFDVAD EDIL							GFPVKA EEF	RSLLHTL EI	ALSVRP NDY
	FSIPVVS DV	EWDQV TVYLF							AYQSIQ NYL	RNHPLD LRV	FVIETAR QL
	VVAPPG VVV	FGDPGN PPEF							YFSPYPQ EL	FSHHRV TVL	SAMMYI QEL
	LAAVAA VLY	LFDISGR APL							FYVASSR QL	RSVDGP IRL	AAMDEI PVL
	VAIFAVD SL	TFDAGA GIAL							KFPVFN MSY	KSGEQIL RL	FAVDSL RQL
	YVVDDA AVL	GGFDLS EEKF							SFIKRNT PL	RTHSLLL LL	YIIGVFR KF
	LGSPWA VEL	SYDPTIE NTF							SYHFSPE EL	ASAAAA LVL	FALGVY RTL
	MAVGG GLAV	AYDGKD YIAL							KYNACIL EY	KSTRMI LNL	FADPHG KVF
	LAMPGE TVL	VFDMA GEIGF							AFPIVGE PL	TSYPDPI LL	FIVEETL PL
	AAMDA EIVL	AFDLSQ VLFI							SFFGGS NPF	TVNEVE LLV	QAVQVR PSL
	LAFPDV VSL	FFDAGA AEFL							TYLTSDL SL	SGNTYA LYV	AAAVPT RSY
	TAISFAP YL	FFDTLPS SEF							IYLDSVM CL	RIYPHGL VL	IFLIRHS QY
	FSMEEG DVL	YFDPAN GKFS							LFIDRQK CM	LSIDHP QKV	VLRQPR PAL
	MAAAM PLAL	TYDTSFL DFL							NYYTQK LHL	RVIPLVR EV	SAISSVR LY
	SSSAVFLI I	YFDDSII QQL							YFFAVDT AY	MANPR ELRI	VARSNI MTL
	VVLGQF LVL	FFNLSLK EVL							IFEGGAT EL	SSHGRV LSL	NYTDNE LEK
	ASSPYFA AL	RFDPFG PIGT							IFFNSGL SL	RVTDEIL HL	YSSLSRF LM
	LTIPASL DL	FLPEAPA ELL							IFQPHVR HL	STNRFV RTV	FANDAT FEI
	SAIYGAL TL	IFDVVD GTYV							RYYDDP REY	RTLTSW LRV	TALERRI EY
	SALDTGF SL	FFDVDTS QVL							RFTEYSS LY	KAVQQ VQRL	AISELLE RL
	LSAPLIG AL	VFDVTA PNTF							CYGGTA AVF	RADASI RLL	HARFYFL FH
	YIIDPQN GL	FFDTAEE SPF							KYYFYD NYF	ISDKVLK KI	VAQPVP LLM
	TALGTFL FL	HFDLASS IFV							NYPLWS QSY	RNSSKIL RF	NASFPK VFI

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	MAAMV LTSL	TFSEEHP VLL							VYMFQY DST	FSNGHI KVL	FAKMVV DAV
	FALVGSY TL	YWPTYT PMEV							HYQLQV QEL	YNTGAV LFV	IQMGRF ISF
	GATPVSL AL	RFDPLG HYLL							NYYPGSL FL	RSALPT KTV	RATVHV RLV
	ASIAAIV AL	FFDDPM LLEL							TYLPAG QSV	RTLLRHI LV	VANVFL EAY
	IAYGLPV SL	FYDPTA GVVM							VFPETVP SL	KSNGTII HV	HLPSGV KSL
	FTLPMM STL	VFDVGG LLED							YYEDNK QFF	RNISRI MRV	IAVPEAR FL
	FIMSATP TM	FYDPDT VELM							MRQGSY HLA	RNADVF LKY	KANPAL YVL
	KEGFPIT SL	MFNDTL ELFL							IFPYAFK EV	ASNPA MLLY	LLCASPV EY
	NVIESFT EL	VFDQPQ EYFM							IFQPIEES F	RSYPQL RRV	MANPT ALLL
	ISSPVILQ F	MFDVTN ATTF							TFPSDIT EF	RSYWKE VLL	NAVEGL RTL
	GAYVPSL AL	SFDNSDL VML							LYMPAV GFL	KATEKIL KM	NSVIKPT QY
	LAVDGL MEM	YYDEKV VKLL							QYPWG VAEV	VSNPLE VYL	FASFSDY YY
	MAISGV PVL	QWDEQ LDPRL							SFMDT MLQM	KSQEQV HLL	IMNTRH IAF
	MASLGA LAL	YYDPKH VIFS							SYPLTIAT L	TINPILLY F	ISQVFEI AL
	LAFEGPI LL	PQRGAG APEL							KYPDIVQ QF	YSVTGE LTV	LGALREL GF
	LAGPVA EYL	YWDGEK ETYV							LFNITSS AL	IGYGHV RAV	PSVNYS KVY
	AAYAGG LVL	DINDNA PEFV							QYFPKA PEF	GSVSNP LFL	FASLVSQ DY
	MAYPSL VAM	TYDYGG FTMM							YFADGV LSL	FTEKSG RLL	AAGLRV LAV
	FSFIPSA AL	AFDSSSA VFL							VFPLAA GIF	RVRNLF NVV	AASTAR HLY
	SVNGFIS TL	SFDKGPF ATF							AYALGA TVL	RQKWH SLFL	FGEVRP YFY
	AAIYLVT SL	ISDFGLA TVF							AYPVGG LCY	KLYTGL REV	YTTFVKP AF
	FSDPSAY IL	FFDVLPV HKF							RFTTDAI AL	KLYQRD LEV	HAPFTA TSL
	ISIGVTQI L	HWDIAD ATVL							NFPQYV MDV	RSFREFS GL	FATPYG YAM
	FAGFPS AAA	CFDDAT LGFL							RFRDFV DAL	TSNTYV MVV	FGNNKL TTF
	VSSLPPL SL	ILDVIEPS EF							AYSIVAG VF	LSSAPV VLV	QWSLRE VVF
	YAFTALD AL	FFDTNTS VLM							IFIEDAIK Y	TSDPAE VLV	VAAVLV KKY
	MAISKP RNL	TFDPVD NIVF							LFQEDPE AF	KALQHE RLV	AAAAVA RLW
	FLYGGEL VL	CLDEPAT EFF							LYTVTG QSW	RAFGF MTRV	LASPGHI SV
	FSQPRHI SV	SYDENT GLYF							VYQTYV NAM	FSQPRH ISV	LSQYRD QHF
	AAVGSV ATL	LSDFGLC TGL							CFPFYVD SL	RSNLRQ LTL	MQAPG RGPL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	TATFAISIL	LAFDVAEREF							YFSELALTL	RVVEHWIEV	AAAEVRISF
	FAGDIANQL	VFDETGHFVL							AFILTTTVF	SSFPGVTVI	AEFQDALEK
	ITYGQFAQL	AFYDWDNTEL							VMQYVTVPL	SSYAYILMV	FLYPFFGVL
	LMGLLPGLA	CWDPSPQAYF							FMPHVTEAY	RSSIRVVRV	FAADIPRIL
	ISIGPGASF	FYNHMHITKL							NFLNMSRSM	RVMSGKLTV	FAYHMIETY
	SASALAVAL	SWDFGTGAGF							IYQYVLNSM	RSFPAEPRL	LARNPSFVL
	ASTPAILFL	VFDVTKGSKF							RFHTMSIML	TSSPINIVV	VAPGLHLEL
	LAAIASLTL	VSAAGLVQGL							NFFPGNADF	VSALYALQV	AAALWRTFF
	LALSPDLSL	IWDDPDAGFF							TYQEIWTSL	YTVPAGMTV	IAINISRNL
	MAANVIPVL	VFDLMGSELF							VAYVSSVAL	RSQPVPRSV	YAKRPGIGL
	SGYSGGLAL	VYDDMAFRYL							TFGTMGVGL	YSTPPHRTV	FSSGAIQVV
	NAIGPLVAL	LYCSNGGHFL							AFQQQIQTL	ASLPYAQQL	VVIDPTRTI
	GVIDAYMTL	IYDAAVLNYM							SLPAYLNSL	ESNTIHLKV	HAKEYIQQL
	VSSFPSPSL	LWAGDDHGSV							AFIEESRQL	KNLRRLLYV	SASESILEL
	GATGATLYL	HFCPNVPIIL							IWPEIQQEL	RSAFKLIQL	AASLIQAMW
	MAYVSGLSF	IWPEKVLDIL							VYPMPRVIF	KIRPHITTL	QLSLRTVSL
	VANVPNTSL	HWPDVNEALV							YFQALVNNM	RTLKIMLKV	TASEMILVL
	SVISVVSYL	LYDILSQNTF							TYKDPITEF	KNLDHPHIV	LAITCSFPL
	FSIGAPNLL	HLGNNGLQEI							MFAASLLAM	VAMGRVVKV	FARMCSLML
	YTVPAGMTV	QTQISETNVI							SFTPVGDVF	ETLKYLFLL	ASSPGHPAF
	MGMVAGTTM	TFDLTVVSYL							SYIPYARDA	RQLGHALLV	VALPMVLVL
	EATDIALLL	TACVDIPQLL							AFKADTPSL	RSQFYMLRM	PANQNLPEY
	VAQELPTTL	FYDLGLMGYV							AFSSDTSFF	VGTSIHYKV	RSSEYLRAL
	VGVPWGLPL	HFNNSKASTV							SYIAMDTEF	ASVDKVTRL	SAKDFEVAM
	SAYPLSVEW	SFDVGCNLFA							CYTLINVPM	KAHLMEIQV	AASFHSLSL
	SIFSGAASL	IWDLTTATLM							FFPDFVWTL	RSRLEVAEV	YAISKPEVL
	TVTTVILEV	TFDETVSTYV							FFRNRSISL	ASTEVKLRL	FATSALRSL
	FSVGADTAL	ALPPGSYASL							AYYNDPAFY	KSTELMRRV	FAYVEGESL
	TALPSFTSL	YFSIECVLYL							HFVPGTTAV	QSIHLEQKL	AAAMTLRTV
	LAAPSNLSM	AYDPTAPTLF							IYMDSGMSL	RTGPPRLLV	ATVVYQGER

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FVIFGATSL	SFGGSYGGSF							AYGFRLQSL	RIFSRFNAL	HPASFVKLF
	FIVAEGDSL	SWPEFYIDQL							LYAAAAGVL	FTKTEELNR	FVMETFVHL
	AAAAATMAL	TFDVAPSRLD							YFPDKVALL	KTSTQKFFL	VAVWNGRQV
	TAVPSLSVL	TWDLTGLLLF							GYPNFVATY	RTLDCIHVL	SASPWALTI
	VIIDGGWSL	VYDDGTNTFF							ILQDYTHEF	RNFDEILRV	FSSDNRQIV
	QAVAVILSL	GGDKTYSFLT							VYLPGVIAA	QSEPRVRLV	TATALAIIY
	LAAGGVMVL	FLYDKYEEYD							VYTVAIQSY	RIHPFHILI	VAVDVAVPK
	LGIDGLIVT	VFDMSLTYIL							AYYYSLQIY	YAAQAHLKL	ALPEIFTEL
	YITDFLARL	IYDDQGHIHL							IYSEVMEAL	FSIKKTKQL	MAVLLGKVY
	VALPLLSLL	FLDDGHTFNY							SYAFLREAL	HSHHFLELV	NAKGYTIPL
	SAVSSFVFL	VFNSMLVSIV							FYTAGTLSL	RSHGFAAEF	QGSFQGGFR
	IAAYAYSAL	VFDVFLVEGY							SFPAVVAPF	ASIRIPRTV	SAIQNRFKY
	STLPALTAL	VFDQSFLAPL							LFVPRRAPF	SSAHVYLRL	FAYEGPMYL
	SISGITMVL	SYGVPASLPV							QYVIQLTSM	RSSAQHLEV	HAIPPTLAM
	VAEAGLTIS	FFNFKPPKNL							VFPLKVFGY	RSGHQLIVV	AATFARRLL
	LIYEDSIVL	LPDFDISAYF							AFIITINSF	RSLDGRLQV	EASWRFLFY
	FTEGNFAIL	DANMDELLDL							VFLISGVSL	RQNTIVVKV	FTTSILRHW
	QATDSILVF	YLDLAPSTFL							YFYEAFEGY	LRQNLGKKL	WAPIMKWGL
	VAYFGLTTL	DYFLMEEKYF							ILPALPHAI	RAGSIVLKV	SASNFYRQF
	SAVTTFEAL	MADGKIFVGS							LFSPEVESL	KWPLGAPML	RAGGKILTF
	LASAVISVL	FFEGATVVIL							LYGPSSVSF	FSIKKIRFL	SAVTNIPHV
	FASETNLDF	TYGNGDPQNF							VYFPQISSV	RSVRTVMRV	TFDLLRNSY
	FAIPGSIFL	PDFLSYRHAS							SYPYFVIQY	RIQDFVRRV	MAYLKIQKY
	TAVENMPSL	KFDEVLVNHF							TYIGSVEPL	VAVPKSMRV	SHALQLNNR
	IAPGLALLL	IFDRYGEEGL							EELGDPFII	HVYPDHRLV	TMPDTPRLF
	FANMLGVSL	VYDVTKMTSF							VYPSGTVCL	SANKCLLKV	SAIAVFLVL
	FSTPGMQSL	HYMPPPYASL							AFFPNGYAF	RSSVEILRV	AAHAWRTLF
	YADPTKRLEL	AWDIFQPLLF							QFPAWISQF	RSRDGLLTV	FVTFSTRAM
	FGYSNRVVDL	SFDETVTHFI							RYQDLQLDY	FSIKHPHTL	IATSQNRIY
	YFIAPTGHSL	KWEWPNPVLL							SFVGQTRVL	YTLINHRVL	SAIPSTPSI

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YFISPTGHSL	HYDPATEEFI							LFIEATEKF	YSFQDKRNL	VAPEEHPVL
	FAATADPAAL	VFDDGRYVYL							RFIPSAYPY	RTVFPNHTV	YFVDDRLVM
	LAVHPSGVAL	HFDMNIISML							YFLQQRDTL	HNIGQTCCL	YASQQIRQI
	VFDEAIRAVL	HWDVTEAVFH							AFPPSVRAL	KTLAGDVHIV	RATFLVISH
	LAAPGHPPVL	AYDVPNPVFL							FYAEALRAV	KLNPQQFEVL	KAKDNFNFL
	YFITPTGHSL	LYDLVTEKMF							FFEEERSAL	RSFEHALMLF	SAPVGVTAL
	FSHSQTDLVL	HFDASLSTYF							IAPENLPPL	QSYWNHRELM	ASAVTVRFY
	VAAPPPKNSF	SWDDSSDSYW							WYMDNPQNL	KSYESQIEVM	FSREEFPTL
	AAYAFAPATL	VYDSQGLLIF							AFFASEYPL	DTNADKQLSF	ISSPVILQF
	FAYPNRPDVL	IYNFTYKVFF							AFQAVTEFY	KSAIPHPLIM	LAYTLARVY
	FAYGGHPYPF	VFDTTFQSHL							ALPEIFTEL	RTLPFQLSSV	LSQIRIDAL
	FSVPPTEETL	VFDEAILAAL							FYMPQQVAY	KTPDFESTGL	RILRITGYY
	LAYSGKLEEL	LWDSAVSHFF							IYNTTELVM	RVYEWFGLVL	ATTLLHKVF
	YAVEGRDLTL	AFDGRPSVAM							AFIFGGRHL	KSVDRSLLFL	HFYRFYLEF
	FSYHPSGLSL	VYDVTDQESF							AYLEQLESL	KVYERAVEFF	KAYERGISL
	YAFNGTQRFL	MFDDIGRNFL							SYIAFRTAL	YGVDGKLLQL	FARNAFTVL
	YALCGFGGVL	LWDDKGPAKI							AFSDLTSQL	KQTALVELVK	AAAPSLLIL
	FAYGQNKTAF	FFGTHETAFL							DFPTISLEF	KTLDHVFLVL	YVMDTRPKL
	YSLEPVAVEL	AYNMANSFTF							VLPSHLITY	KNIPMTLELL	AARSGPLAM
	FAFESDLHSL	YFDAIPVTMT							YYQYMETYM	RIYPFLLMVV	CFSPNRYWL
	FALPYVDHFL	LFDVLHEPFL							IYPDSFTVL	RQYPWGVAEV	IASSYMYEM
	FAVEPQGPAL	FYNWTDNAEL							LYYASFLEV	YAANPHSFVF	AASFVGYSY
	LALPGKPPFL	LFDPCNSVEF							NFYSTEVSV	KSIDFPLTKV	YNYYKKFSY
	AIVHGAAAYL	NFDPHYPIIL							FFIAQSYVL	RSTLVLHDLL	FSHAQTVVL
	FAAPTTGNQI	LFDANKAELF							NFIDFGLDL	VVNGRVLELF	FQRDYYDRM
	FAIDSSHPWL	AYDVSSFSFF							QYYALEVSY	KTLDVFNIIL	MSVEVRQTL
	FAVDPQITSL	YFYDRRRIYL							SYIWIGEEY	RVLDFDPMAV	WIKEKIYVL
	FASPTSPPVL	YVDGPASTAF							SFTVRPGEL	RAFAFTNLLL	FAKGPTLTV
	YSMPSRNLSL	VFDAMFNGGM							VYNNIMRHY	KVFNRYLEVM	NATAFFRQH
	YAYPTRDIFM	VFDFPDLNRF							NYYTKAIDM	KTYGVSFFLV	FATDAILAT

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YVFDGK PPQL	SYDVLHL VEF							AFSDGIT SV	RSLHDAI MIV	MTAPLK LTY
	ISIEGNK MPL	LYDQLAT ICP							AYLQSYL SY	RSVPFQ MLLL	AATLAG RLY
	FSAPTPI QAL	MWDPV TPYRL							GFIDFVC TF	KTNHVF FLLL	AAVAAH RFF
	SSFYVN GLTL	VYDGEH LGSF							TFLEGNT VV	HNVDIV LQVL	FASGAN FEY
	YATDVV EAFL	LYPEVPP EEF							LYHEHIIK Y	KSVTPT KEFL	IIVDPAR EL
	KLPEYNP RTL	IYDIYGK RGL							ALPPYR QMF	KNIERTL YFL	AAFAHN YDL
	FSLEYPTI SL	YWPTYV PMEV							EQFHLK HQF	RTLDNQ LFFF	FAIQKGL QA
	KAVDPS SVAL	VFDEAD RMFD							TFPLSVQ KF	ANSPW VVQLF	LAHYFT AIL
	YAIENVE TNL	FFDYNY GQYF							SFPELGA AL	YSYLHG MEIL	AASGHFI CV
	FVDPNG KISL	HFDVAL GRMV							AFQHVG KAF	RSYLFLG GIL	YANDVT RVL
	SAQGSE SHSL	YWDPLL GTCM							RYTVSNL SM	RNYFSDI DFF	NASVFG RVM
	GPPGTG KTLI	AYDLASR EWL							AYYKKAL EL	RSMGFI GHYL	RAAAFFL SL
	FVLPATP PQL	FYDQCN DVGL							SYPHHA TQL	RNIDDH SRFV	FASELSR SL
	FADPHS KRVF	WFSVLA GIII							YYQSSV QYL	KTIGWK LLSV	ESDEET QIK
	FSYGFD GRGL	FWGLIS GLLL							LYPAVSA VY	RSVEG WILFV	IVSLRLLS L
	MAYGAS FLSF	GPPPPP GKPQ							NYIEGTK ML	KTYDYLF KLL	MASGLV RLL
	IALNPTG TFL	VWDYA GDNYV							SYYSTPI AV	LDTNAD KQLS	MATTMI QSK
	FLPARFY QAL	FYNNLE NFNV							AYSDLFR SL	TVNEVE LLVM	SFAARSF YY
	VAMPG VPAFL	SYNKLSD SVF							IFLPRMN PF	KSLPASL SFL	TAAPGR FSF
	FGFGGT NATL	TYDLMS SAYL							NFMYQV DTL	RNNEVD LLFL	FTSKLHR MY
	YVIGPKG NSL	TFDDLPA RFG							VFPTRTA RF	KSINPLG GFV	KANAFL KEF
	FGISPST NAL	KFDNIG MNAM							YYLESLL CL	RTVELFY DVL	LTTDISLI F
	SAPGPG YAPL	WCMAV GISYI							YYPAKIE AI	RSLAAFL QQL	MVIVPT REL
	FADVKG FTNL	GSFDETC TRF							VFQPETS TL	YSLDHIS SLF	VTAGVR LAM
	YASFIED NEL	IWDKAV VTGK							IFPTLTSP L	YSFKFGF NEF	FLIEPFV PH
	LALPSYP KPV	LFDLGVA YGI							LFTEPSE PL	KTMDLP FLEA	FMMMR AENF
	FAAPTT GNQL	HFDDTV VCLD							LIPEYLNF I	RNHNF DGLDV	HAAHFA RAF
	FADPHG KRVF	VYNVGI HGPF							QYMNT VVNF	IQHVFQ NLIL	FAGLVP RLL
	AANNLL AAAI	LYDDIDK AVF							FFAVDLE AF	HSYFGS FSSL	RAKEPIL AL
	YSVWIG GSIL	VYDDGK YVYV							LYPTPSN PF	KTYDLLF KLL	TAVALLR LL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YCEPPTG VSL	VFDVSN ADRL							FYQGIV QQF	RSLDW QMVFL	VAEVTSI QL
	FAMLDD VKIL	NFITNPR TLL							RFYLAEI VM	KSLVSK GTLV	YSMPISI EF
	IADNHT PKEL	HASGCM MDLF							YYQSGR MLL	IGYPHL QEVL	ATTVIPR VY
	VLPDAR YSAL	SWNAGI MTVM							QYQSLL NSY	KVNDFL AEIF	IIINPYRE T
	FAINIDN KDL	ILEPGDP PLL							AFPDSV NSL	LVNEVT EFAK	TVALRA AAY
	FTMGGP AISM	QGGVV QPALE							FYMEKR EAL	AAAAPH LLLL	AAASHP LLL
	LSFETTD ESL	YIDFMG TDAA							IYYLDPS VL	QSTDIIR YLF	HAAAYR NAL
	VSAAGL VQGL	EAIFDAG TLG							LFLPTAA AY	LSNNQR YLFL	IAFLMIN AV
	FAAAQI GNSF	SLGLTGY DFF							LYQAAA PVL	KTYEGS FNAL	SAMYSR KAM
	FADSHEL SEL	NFDVGH VPIRL							NFGPRIN DI	ASTLKTL LFF	VVPEPG QPL
	MAAPLR IADV	AFDVVE RSFLE							AYLTLTS RM	FTILWS VARL	FSIPDSLL I
	ATMSGV TTCL	VFDLAW VPGEL							FYIYGVS DL	KTIEGIT VTV	QATTAY FLY
	MAYHGL TVPL	VFDLNT PVHTF							GYFAGK LSY	RNTIPLA VVL	AASVSL HLL
	FTITPGS EQI	YFDPLIN PISH							YYIEGIN QL	KSNEGK ELLV	FAVIAHV GM
	HPSDIEV DLL	AYDDLG NSGHF							TFVPSAE DF	KTAAFLI PLL	VAASLV REF
	LALATH DNPL	FYEPQK GSIYL							TYQDRL TKL	KIYERT MAVL	LGPLVE QGR
	FVAPPG NISL	HFDLSH GSAQV							VYIEFTE YY	KSREFIG SFL	RALLRLL AL
	FALWIP DLFM	FFDEMA DPDLL							LYYIGGE VF	FKDLGE ENFK	CAADFP WEL
	FAESGW RSAL	AYDIGN HFNEF							QYNNM RVEF	RTPDTP FSLF	KAKPSVL AL
	TATSSPH SEL	DRPHEG TRPVR							SLVNLG GSK	QQYEIW RELF	AAAAAA LLY
	FADPEVL RRL	YWIDEP DVLVM							SYMPTIL WL	RTYEKFF GLL	FATFLSH VL
	FAMTGE RVDL	VWDLFP EADKV							FFFIPAA VF	KSIDWG ILAV	LAQEIVK AL
	ISIIDTPG IL	KFDLGQ DVIDF							GFYPGSI EV	KVSPVS YLRV	AAREFIL KM
	FSFGGKL VTF	TFDVAPS RLDF							YFILNSS CL	RSLDFLI ELL	NATVKG VNF
	YAEDYH QQYL	VYDIDN KTIEL							LYPACLR EM	KTVEIVH IDI	SCYGYPI QL
	ALPPGSY ASL	FFDDLG DELLF							YYYLKNE AL	RSMDTI VGML	MAGPLR APL
	LAVDPN GAFL	FFDPSLL HLLY							NFIPTGS AF	LAAPGH PPVL	NAPLVH ATL
	FTVETAS REY	VFDTAP TGHTL							RYFTQIV GF	RSFNPF FPLL	RAAAFQ HLL
	FIMEGG AMVL	VWNAQ EAQADF							SFQTAA RIL	KANGVT DLLV	VATPLN RKM
	PSLNPLV YTL	GGSFDV ADRMF							TYRIIAN AL	RSYDFE FMQV	FAFCYPF SY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	IAYYVSN EEL	YAYDGK DYIAL							HFSNMN KAL	RSSEAVI WEV	FARVGG RLF
	LAAAVP PSSL	FYDPTA GVVML							HPEDTFT VT	QSIERA KELF	KWPLGA PML
	LSYPQTD VFL	SFDVTQ SPFFP							MFIGHA TAL	RQAEIT RLLL	NSLINPF IY
	YAMANT GIAL	IYDRDFS YNYF							VYVDAV GQF	KSFEGLF YFL	AAIKIIR QL
	AAAERLL GPP	SYDAPS DFINF							AFYKGV APL	LSSLVILE VL	ASSSAFR LM
	FVAPWN SLSL	TIIDTKG VTAL							VYPNWA IGL	VVYPW TQRFF	IASEVAR KL
	VSGAISH LSL	FFDHSG TLVMD							DVGELFI PI	KSFNIPL LVL	IAYIRITQ Y
	FSNKGA DVFL	ITQIEHE VSSS							PYFMVQ KEM	KTFNLPL LML	FSADPR HIL
	YALPHAI LRL	YDAEISQ IHQS							YYLYNH VAM	TTTNVF HFTF	TATQLLK LA
	IAVDPR HLSL	FYDPDTS IIYL							FFNDTTT AF	RIYPHGL VLL	CSNIRDS SF
	FALGLSG GSL	HFDDIG PSVVM							FLPDSTG SF	RVAPEE HPVL	FAPEKL QEL
	YAVDRAI THL	QTQISET NVIL							TFQDVA TEI	KSLSGSP LKV	SALFLGV AY
	FAFSPD GRHL	FYDETYD YGGF							VFQGKKI TF	YALAAR DVFL	SAQFAL RLL
	YVIPHPV HAF	FYNWTD NAELM							MFSDFL QSF	KTKDW WTYEF	VNTEKLT AF
	YSWVGR PLLD	VFDEAIR AVLC							RYGDGG STF	GPPPPP GKPQ	AASPPR PLL
	AAIDPRV QYL	VFDFGR RPVLL							KLPGNIS SL	KITPLEIE VL	FQTVTD YGK
	FLSEHPN VTL	NGSYDL ANRDF							VYIKHPV SL	ALNGFV KLGL	QTLQRS WAY
	LAHIYTE LQL	LYDPAS GTISL							AYTNHT VLP	KTLSDIF LLF	FLMATP RLM
	YTYESK MAFL	IFDLQSN TVLA							AFQEPH LQM	RIPSFGF SVV	FTTSNIR KV
	FATLTRP LAL	VYDNIGI LGNF							AWLIYSI AF	RVYDFV GLLV	ISTPNVN AL
	LAFDPS GQRL	SPEGRLF QVEY							QYPGDI GCF	KSNNEI VLVL	QAMERY VSM
	CAVPPP NFEM	LGIHEDS QNRK							SFSTVTN TF	KTIEDFQ QKI	YAVDRAI TH
	FINVPPQ IAL	TFDAGP NAVIF							HYGPG WVSM	KTAGPQ SQLL	EGPIPAH LL
	FALGGN KQAL	EGNTGT TPIYF							KFWERFI AL	DLAGRD LTDY	SAVAAIR TL
	MAIDIP HIWL	LEGGQE DFESS							YFPHYEV PL	RTINVS NLYV	VSTWRP VEL
	YSLFLPL HEL	TMAAGP NSILF							LYFENA MRF	RTIGFFY TLF	VANVSL LAL
	YAFPKA VSVF	SYDEIEG GGLL							QYLSAIL SL	ISGLGRL LTL	YVSPRIL TA
	FSDIQTG RVL	TFNTSTG GLLL							SFQMSE QSL	RSSTVT VLLL	AVSSWF RQL
	FTQPSRL LSL	MFDPHH FLDEG							SIYWTA VTY	KNHTYN ELFV	NALGVIL QV
	VAYPRT GGTL	NYEGPG MARKF							VFLKAAI LS	KSYEAKL RLL	RKDGKH LTL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FAIRGLA EAL	FFDASLP GTLP							AWIDGV LDM	RALDGA WLMV	FTVDQIR AI
	FAQQNS GHFL	AAGVTA APLPL							SFGIGAF PF	RQYPW GTVQV	FTSPAVK RL
	YAMRAF ADAL	FFVISLA VSDL							TYVLAAT EL	RSIEHLK QIF	ILRAILLS L
	YVIEPHS MEF	NYFLHG PSNKS							GYNPDT VAF	KSFYGST LFL	FMTPPR LHY
	YALDVR VNSL	KYVHELI PAVM							NFPNGV TDF	FSFEVEK ELF	LVVALSR TY
	FSINAQR NAL	VYDGFG PADLR							EYNFSIS SF	AIIEARG VSV	VAIAGL MEV
	FALDGLK QVM	PPPPPA HKAAP							FFGKSTL PF	RTLDKI MILF	SMAGPR LEI
	FLIENPK TSL	IYDFIGEF MKA							FVNVYY TTM	RSDPSV PKIV	YAIAFPLI C
	YALGKD FVTL	HFDTQN NISTM							KYYHRG AFF	RSNPSV FVIF	FARKTFL KL
	IAVPAVL PSF	IYDPQEG AVVV							VYNYAE QTL	RIYAAFK EVL	VSNVKP LSL
	AAIKPGT PLY	SFDEML PGTHF							LYLPKET CL	RSLLHR NLVL	TIAMRLL AY
	FTLDPLY REL	DPFNPF ELTNH							QFIDGRL DL	TTEGIPV LIV	CASLFLR LL
	LSSPFPS SSF	GPPPPP PGKPQ							SYINYVIT M	RNSQW VPTLP	FAMYPP SMI
	FSYQGR ASSL	HFDLASS IFVA							VFQPSV RSL	RTGKPL SVEL	NAFTMP LHM
	HYMPPP YASL	HWDPEY SDVKL							VYEGEV TEL	RSVDVT NTTF	IAAVHN VPL
	AAAPVP TTTL	YFDAIPV TMTM							LYYVGG EVY	KTGIPLN VLP	NATEW VREH
	YAIMPPL EQF	FAYDGK DYIAL							KFMQDP MEV	KTMEAI SEVL	FAMPYFI QV
	YIDEQFE RYL	VYNVTG EEVSF							VFQHGK VEI	RSNELI WLEL	FSTVKG VEL
	YAFGRV FSGL	VWDEG CAVVHL							SFPHPGF NM	YTERGV FFSV	CAIPDLG PA
	FAFSPD GKFL	IWDPHN GDILM							LFFTSTIY F	SSLSRFL MVM	LAAGKP RVL
	CAVNPK FVAL	VFDDSG VFDQT							SFNGYVI DF	DSGFQ MNQLR	FVTYVV REH
	VADGIFK AEL	KFDLLVD ANDV							YVFQSE NTF	RTIDKLL AIP	YIETDPA NR
	YLDPRIT VAW	VFGSNV DNVLL							AFGGLT RAL	RSMGYF VEVL	QAAPVK WIF
	KAYTSQF VSL	FFDPDT NIVYL							VFGTAIS AF	RIVATKP LYV	GYAILRV SL
	LLYPFAP LIL	MAPSET QFSHL							SLIGGAA SL	KSQDKT LKIY	VAAPQL PVL
	PEVKFN WYVD	LYNISDG RGKV							IYNGETL VF	VQPYLD DFQK	YAASFIN LL
	ISNGELF QVL	ISFGYSG MGKG							VYVMG GVAM	YSSPFD PVLF	FARYDR LLL
	FVMEGE PPKL	YSTDVSV DEVK							SIPGGYN AL	RTADW RLYLF	SIPILASA L
	LAVEHD NISL								LFNFTTQ EL	KTVLPF VSTV	TLVLASI TY
	FAIRWG FIPL								LYDQISL PF	FTNDTIL DVF	IAIKYSRT L

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FAIVASDTRL								YYQNHIMNL	YANKYNIMLV	LARAALQEL
	YAYDGKDYIA								FFQGTKAAL	HSGPVVAMVW	NMAEFRPEM
	VAYSHDGAFL								QYLHSYLTY	RVMAPRTLIL	AAFAYTVKY
	FQYPVRPASM								SFSFHGAAL	NFPEHIFPAL	CAFDRGLEM
	LLDPNIYRTM								AYPTYPVGF	RSYFAFLQTV	DGYLFQLLR
	YADPNFVRTF								FFPWNSHVV	SSMAYSLYLF	FTSQVIRNL
	TAYPNRPMVL								SYHVSAQNL	ASRIFFEKVL	MMSEVIRIL
	VSIEPNFHSL								TYYSLITSF	LSNAHIQNEL	NAMGYVRMI
	RAMEGELGEL								SYKDSTLIM	RIVGSKPLYV	FSTDSPRLL
	FAHVGQLTGM								AFFSYAEVL	KANEHQLITL	FVNDYILYY
	FAVSSKVTSM								FYEPNALMM	RSRSPLLVTV	FALLTTPEM
	FAIPMIHAVL								LFPLLATAY	KTIEDTLMTV	YAQQWNQYY
	AAINPELLQL								FLPPNMQGL	RSRSPLGFYV	AAAVDIRTW
	HIYDNQGIEL								MFHWQATIM	SSAIKGAIQL	FLPEAPAEL
	YAIFDEGHML								AYIRKTLAL	IIAPPERKYS	YAVDFQRRY
	FSVPDVPKSM								NYPFPGETF	KTMEDTLMTV	AASALIRTL
	IAMENIHSEM								YLHPLRSLF	RTAGPHTQFV	QALDYFLKM
	FAPKMSEIIL								TWPVGFRCL	HANPILLLVM	SNYAKLIEM
	YIVMPNILVL								FYPEEISSM	QSIPAEIENL	NFQVRDHPL
	YAMASRDVFL								FYPPDPSQL	ASYHGFLPVL	SGAPNLPVY
	AEISMALGHL								LFPSDVQTL	SMDNNRNLDL	ITTLRKYTY
	IAWKGDTLVL								NFKTPRGPV	SSFDFRTSEI	KAAGVRDVF
	YAVWFGGSML								NFNMSVSSM	QSGPVHAPVF	LTADFLREY
	SAAFPYGGVL								FYYYQRHFV	KSFNLPMLML	MAVERCLAL
	YQDPSFHLSL								VFIITTLEL	YSIGSKPLQI	ETLALLEIL
	IAWSPDDNYL								FYYGGQVNY	KTAQPHPKLL	FTITKTVEY
	WAVEGTAVAL								IFPSSISAM	KSIYAALYFF	MLRLYVLVM
	KAIGNAFAVL								VFIHQPRAL	FSICGKHVTL	FALVRTIRY
	FLPTSLPPEL								AFQFSYTAV	ASMAPGALLL	AANLLIPAV
	YALAARDVFL								AYLSIWTEL	RSASVLLLLL	FAISILQQL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	VAFLAM LLVL								TYLVKRL EY	ASTILHL VVM	IAMGM AQAL
	FAITEPL VTF								VVPEPG QPL	RTVGNA VLFV	YAYPYSY YY
	LAINGSN LPR								YMNAAL QAL	KSNNEII LVL	FASESSV FL
	VAVVGD PIAL								AYPLPG VTY	VSGVLR LLAL	SCSPFHR NL
	HALPPSL IPL								AYALVP VFF	RIMEFT TTLL	YLHPLRS LF
	ISVDSRS VSL								HFLNES GVL	GGSLIPL LQL	YTLMHK AHT
	AAYGFR LQSL								IYTAMN TVL	KSNGIYII NL	ASNIMIV TL
	GAIGGT PPAF								LFQNMT CEL	DIIHNA NDTF	FSYVTPR AF
	LAYPARP AQL								VYTEKVL EA	KVFDFA GEEV	LCSVRVY HY
	YAVPFIQ PDL								YYPEHTS VL	RNLDLS WSEL	SAAAFYY VF
	FASTILH LVV								LYQMQ HLQY	RSLEAK GVTV	AAMMA VRVL
	AAGGVL PVDL								NFQEPV QPL	RSLHYQ FYVW	YAMDEL RSL
	FSELSNP ESL								QFPELM GVF	RAFHHG RFIM	FAFDPS VNY
	FTIPHTQ EAF								SFIQGTT TM	RQKDVK IVTV	VTTTWE RLY
	YAAPHP LQSY								GYMISLI AL	KTKDGV REVF	YSSPYPQ EY
	KTPDFES TGL								ALAGGA LLA	LTPALH KLQL	AAADSIK IW
	FAVVNH QGTL								YFQQKIL EY	RSHYFE VEIV	ELFERFL LY
	YAHPLET LIL								YYHARV YEF	STSAVP NLFV	TAIESTP TL
	QAIEPYI TNF								RFFTSST SL	RSSQAIL RVL	LATPLH HTW
	FIVPTGK TGL								SYMEVP TYL	PSLTLLL EKL	IATELLKL N
	FICPVVG LEM								ALPTFSQ PF	HLHSWE APGL	AAQDLP FVL
	FIYPSN MQTM								KYAMM FAEL	RSYPHL RRVF	IAIEVLHL L
	YALPHAI MRL								VFLLDLG KV	DINTDG AVNF	AALGFA QML
	MAFLQK IEAL								FYNTTVE EM	RSIEEVL RIL	AAAFAR RVL
	VAFSPT GKYL								SFLVSGD NY	KTFSKST YLL	EATSFIK QI
	FAEALAT HIL								SFPHDV QFF	RSFDLG RQFL	IWFEKRL AY
	AALWPI MTAL								VFSFKM VSY	KSVDPR LIHV	YASVVV KRY
	FQLPYN GVVL								AYFTTPI FY	VAAPS WLHRF	AAYPQV RCY
	VFDTAIA HLF								KEITFLEY Y	RIAEALS KMKL	QAIENA HVL
	LATDFIQ SLL								SYEFMR RSL	YGAEAL ERMFL	FFQDKA RFY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	QALLMII GAL								RFFDGA KDV	KAVDSQ ILPKI	RALSPAF EL
	VALPGV AVSM								SFSDYQ NYL	FYAPELL FFAK	WGAAQ SKEI
	VCAPPS RLTL								SYGAAG LAF	RAIEALH GHEL	LSALEEY TK
	YTWEDH GYSL								YGGVIQ TEF	KTIDIAQ EEVL	TAVRKM KPL
	VAVPAS LLGM								AFGFGIN SV	TSFYDR VWAAI	NAMDV VVQF
	VAMNPT NTVF								FFSDSAL CF	LDTNAD KQLSF	NYNLVE SLK
	LSDVNV ERVL								FYQETYL PY	KAMLA QLLAEL	AAALPP PAY
	LVHPNP PSVL								TYMAM YLTY	HTYDFK KLAEV	YSSSRYD DY
	FAARPQ VVAV								AFIDLTE DF	KTYDTS FLDFL	QVVAGL NFR
	AAFEAL GTAL								ILPVHITS L	RSYLFLG GILM	VASKILK TF
	FVPPQG SPTM								YYQDVY SLY	HAVYRD DLKKL	VNNPHF LIM
	YAVELV NDSL								SYLTSAS SL	KLNPQQ FEVLF	FFGTHE TAF
	FADDTY PRWV								AFIGVAS NF	DLATVY VDVLK	LASSYER KL
	MAALPF TKSL								QYFYSFV AM	QSIPYQ DLPHL	RAYAKA LHY
	FAASPSE LHL								LYIDDTL TM	KSFEQV SGVTV	FGAVQV TPL
	IAISRTPV LM								TFPASVL QF	DTNADK QLSFE	KAVNPG RSL
	YSIRPLIV AL								YFPKALA PL	VTALLG RLAEL	LLAHLPK EM
	MAIAPN VTVM								FFLARPT TF	AAIDARI FHEL	FTKEQIR EL
	SAMDLP DVTL								IYVTGGY SY	RTNASIS VLEV	YSTELKK LY
	VAFSPSA KYI								NFISGAG IL	VSYFPD KVALL	VAAWLK KIF
	FATFPSS AFL								FYNLTTV AL	KVLEPSE TLVV	FTRSSHL TM
	YLIQSVP AEL								QFTIIVA EL	RTSVKIS YIGL	MAQRL VRVL
	FAEMLT GKTL								NVNVIIS TY	RTSDDV AKEFV	SALKRQ NLY
	MAIVKA MGNL								FKDNLN KPY	KSLPASL SFLV	LAIPITN TY
	AAFPGA SLYL								KYKERFL VY	RVLHEV EPRYV	QNVARR IEF
	AALGLA EGPL								SFVIKRL PL	KSYEPLE DPGV	AAATYIL EA
	VGGALFI VLV								GFIVLTT SA	HNMPP SALSQL	FARSFH PML
	LAFSVTG TSL								QFFLSSV TY	KTNDQ MVVVYL	KAYLKKI SM
	LAMGV NLTSM								LFASRYP IM	HANPILL LVMY	NALGHV RYV
	HEQLSV AEITN								LYPLVAK SL	FSIDRAL NVAL	VAYVSS VAL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FAYDGK DYLTL								MFLTSDI YL	RSNDGA YSLVL	IAAERWI KF
	YAVDPA QLQAL								YFICSIQ DF	GVSVDS QFTHL	AALPNV YEV
	GIHETTF NSIM								NYFVSIS EL	DLAGRD LTDYL	AASTAIY VY
	LALDAS QHSSL								VYGSLAS VL	KMDQG SIERIL	FLANVR KAF
	FAYTGR TAQEL								YLMIQQ TPF	RSVDVT NTTFL	IATTALA IY
	YAYDGK DYIAL								TFQMTIL ML	DLDTNA DKQLS	SIPGGYN AL
	HFDLSH GSAQV								FFPSNVE QF	FLTAAK KARAG	AALEKE QHL
	FAIDPHL LLSV								AFMKGV FTF	LTAPPE ALLMV	AMATVT ALR
	FAVESEH DQAM								NYLGLT NEL	RSNPKL KDLYI	VIIDDRH VY
	FSINSRL ASSL								RYQLGT SPY	ISSHIPLII QF	FTSNAF RKL
	FAHFPG LASEL								AYLVNTY AL	YTTDRV MTVSF	FSNITGI DY
	VAAPPT AVGSL								SFAAKQ REL	VSFPFG KIGTV	KARNPL VTV
	YIMEPSI FNTL								SFFGNV MSM	KSFFDNI SSEL	TASDVH PTL
	FAYDPS NYEYL								EFPAAA REL	QSIYPLH DVFV	MAISGV PVL
	YAFGQE TNVPL								IFVELVN AL	KSKSPAI FGVL	SLFFRKV PF
	LALKTGP TSGL								LYFVYSK VY	ISSVLISI QSL	LLPTGLS SL
	AAAPPS PPFSF								VYGPLP QSF	FSRATA LDNVV	LMGLLP GLA
	FAKPVYP GQTL								FYKISTLY Y	LVAASQ AALGL	SASALA VAL
	YAISPGL DITF								LFPFEAE AY	HISDEISI MTL	YAAEALI SL
	IALDPDT MQAL								ASNIMIV TL	YSSLPAS KQML	FAVDLE HHSY
	YALSPKT TITM								RYQDIIH SI	DPAAAS HPLLL	VAAMP RPVSY
	FAVPPAL GSNL								KLPDYN NRL	RTQFEE TWATL	VASDFYL RYY
	FAFEGIG DEDL								RYHTGSL AF	RASEAL SFNEV	HGGLYH ENMR
	LAVDPN RAVPL								VFQERIN CL	RVMAP RTLILL	FANDLK PKVY
	HTIFASN TSSL								VYHLHIH VL	LTAAKK ARAGL	IYHSHID APK
	FALSGS WDGTL								AFPGASL YL	KSWDV ETATEL	HDNEET FLKK
	YAMEQS IKSVL								YFLNRKL VY	LSPSMG HPLEV	SKEQLTP LIK
	FSAQPS REGAL								YYLKALR SL	ANSPW VVQLFY	KQTALV ELVK
	FAMNV GKARGF								VYVKHSI SF	KTIVPAT LPQL	YGAEAL ERMF
	YAKMGE MMLAL								VFVDRA ACF	KTNTKL GKLYL	HTLNQI DEVK

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FAFSSQE LASL								VYGSLPA FL	RNSAEL TVIKV	VATWFN QPAR
	FAIMQT PAGEL								QYPGSA LAL	KTLEGH DGIVL	IATSQN RIYL
	IIHDPGR GAPL								SFLMLCY NS	KSIPASD LPQV	HIPDHLR PEY
	YSYPAA VPQAL								FFILRKQ YL	RVFEQG GARVV	FKDLGEE NFK
	YSLPTSF SGSF								SYREKPI VF	RNFFSN MFSSV	SDDKVT LEER
	AAYYPS DVSSL								SFGSGFS SF	RSLPAEL GNMV	LETPDF QLFK
	ATIDPDT ISAL								AFFGGS NPF	LSRYEDT WAAL	YAANPR PDAL
	VAFPSG DASSL								FFEGKCV EL	RSSRFLS GLEL	EDGGG WWYNR
	HAYDGK DYISL								MFCEKA MEL	RTNPQV LDTGL	AAIDPR VQYL
	YAYGSA GSLPK								KFMDKK LSL	DAGAGI ALNDH	KWQEE MELYR
	FADLVG NWLDL								YYSPHG HIL	AAFHPT MPLIV	VATNLL KLFL
	FAYDGK DYIAL								LYQARIV SH	KNFISEP ARTV	DEPPQS PWDR
	FALLTGP GSEL								HFIEKAH TL	AEVNAD RITWL	LVNEVT EFAK
	FAYLKD GDVML								KYMLTH QEL	RVYQPV RYYYV	KATAYIL SVQ
	TIFVGGV PRPL								SFHNIH NTF	KAMLAK LMSEL	FAVDPR FLAY
	ISYSNPV RQPL								AFHLRVL AH	GSSFHS HLSEL	YVTDVL YRVM
	FTEPGA GLRAL								VYWVAR KPM	RSNLEIS KMEV	FYHPEKE DGK
	ISMFKAP AYTL								KYISGPH EL	KSGSSG KSKEL	YAFNGT QRFL
	FAHHFG TSWTL								SLHTLFG DK	RSRNTD EMVEL	HYEGST VPEK
	GALQAV DQLSL								LYQKEVS HL	ASAANA PEPAL	FAGDRD QYIL
	FANSFSR NLTL								FYDDKK YTY	QEFLTA AKKAR	FVNDIFE RIA
	TYDLMA NLAFI								HFLQQP RPL	RSFDKG PFATF	KAKWP DRITL
	FAFDSE GNYML								VFQDRT LHV	KTYDYLF KLLL	RFVEVG RVAY
	MAIAM ALTGGI								VSPYTEI HL	RSYNRF QIATV	DSGFQ MNQLR
	DEIDSIG SSRL								HFQEKV ESL	ASRTAG ITASL	SATDAAI RVW
	RCPAEPL GVEL								AFYEHA QTY	PKFEVIE KPQA	HAKDPN NLFM
	AAGVTA APLPL								YYIFRVA NH	QLVEKII SCKQ	WLQGS QELPR
	MSIYPSP TGVL								HFNTVLE AY		LSAFLPA RFY
	FGYTVSE ENYM								FYPHHP QML		IATPGRL IDF
	SADPSG AFRML								LYHAGA VAF		KISPWT GRFY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	FYAPELL FFAK								HYPNWF KAL		FTLDPLY REL
	MSMEISI HRSL								AFTSHP QEL		FAVSAV VHEY
	FAIYESLK KYL								VFSHRLS VY		SVMHEA LHNR
	FSDDPN VTKTL								HFQTMY EHL		YVTAIED RQY
	YAFRSAE PNAL								AYQLAG HSF		VTSYDPL RIY
	YGAEAL ERMFL								RFPQHY KSL		YITPFIRP VM
	FLLDPYK YMTL								YYSPSCR EF		GGYDGY RPSF
	AALPAEL QREL								AYYFHL QTF		YAVDAY FREA
	FSIDVGY ERFL								FYQDKL KSL		FFYNLIH PEY
	YAFQTE GKLYL								YYNLQGI SH		FAVEAE NREM
	FGISSVP TKGL								YYQIRSS QL		WIASHT TEER
	TAIPVHD GYVL								VYNVTQ HAV		LAEFAFS LYR
	RAAPLD SIHSL								HFYRSLV SH		YVADPV YRTF
	FANTPK YSQVL								KYQHTG AVL		IVSPYTS RIL
	YAVDAY FREAL								HFVEKA AAV		QSVQSIR PPY
	VAYRPIS ASVL								KFISSVTS H		VQPYLD DFQK
	FAIADAA YKAM								NYMMR NAVL		KAIEYVH GYF
	HAFDSLS GISL								SYYKKAL AL		FAVTVE GKVY
	YAIGVSH PLSI								KYMQKS LEL		SAMSRY ILIM
	YAFQTG GKLYL								RWPKKS AEF		FALTNGI YPH
	FILDPNQ ENVL								HFNVTN TTF		SAKDFID LTL
	FYLPLDA IKQL								YYTPDR MVL		GKWERP FEVK
	FAAVKD TILQL								RYPPAA NEL		FAYGGH PYPF
	LAYLGAK PRSL								RYYHCA VTL		AAAISH GRVF
	AAIDARI FHEL								SYFSSTK TL		RAVEPG RPPL
	YTLSPEN LQSL								NYIRDRL AL		FTVETAS REY
	SALRPST SRSL								SFPNYGL SH		FAFESDL HSL
	YLHDQN PDAAL								AYQQRV TAL		LSITGTY DLK
	FAVADT VYRAL								IFPEFLKE L		SGNTFR PEVH
	LAGAKR DALLL								YFISILQH L		SVLGQL GITK

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	YGLLPSH ASYL								YYKPDSP EY		VSAAPR TVAL
	FAFQESP PRFL								SFLSEAR SL		FAIGGIA RTY
	LARDPL AWENL								AYIMKR MDM		SAAYIPA HTY
	FTFSKDK LVAL								KYQPRIA VF		DGAGD VAFVK
	FAFGEN KMGQL								GYPEVAL HF		EFNAETF TFH
	YAYGFEK PSAI								YFPDRN VAL		FAQETF GKQY
	AAFLAK DFNFL								YYFALAH TV		TSTADY AMFK
	FLWDVP SNWTL								SFPVNYK SL		VAIKGAF KVY
	RAFEVSE NGNL								KFMEHII TY		FTSEPRLI VI
	FLFDGSP TYVL								YFPVQV VTH		FSAPSAL RVY
	FAWEPF RGLEL								NYTDRI QVL		LWLESV RLEY
	FSLPENI QLSL								NYPSAF HSV		QTVSW AVTPK
	IAFDPRS AYYL								IFIPKTEE M		YVPAEP KLAF
	FAVPIES DKTL								RYCFQIT SF		VTSIQD WVQK
	AAFQPN QYQML								RYPCFFN TL		YVGGQE HFAH
	AALPDA SPGNL								TYINHVV SV		KLSSWV LLMK
	YADERL RINSL								VFVDRA GEW		LNNGEIT QHR
	FAVVAR GTTIL								SYPDFLH KM		GHMLE NHVER
	YTIDPSN PMVL								SYQRFT DCY		DEYGRP FLII
	FSYESEL FPTF								TYFQRA QSL		VAVGHR VYSF
	FAHGTA GLVFL								SFPHPLP SL		YSSAFTN RIF
	TAISISD HTAL								YFHDAT RVY		FATLVSD RFL
	YSHPVV SSVPL								AYGPPT RAV		YAKNFQ PFAL
	QAFSPSS LSSL								HGLIRKY GL		AAINPEL LQL
	YAMPTK TIEVL								KWPETP LLL		FFLDHV RTSF
	VAVHPS TVNPL								SFHTHV KEL		FAMDVY KNLY
	FALIPTA LDAL								SFPQYSP KM		NLAVSQ VVHK
	FIVPPPP EKSL								VYFLIGK VY		YIAPWS GRFY
	GVVDPR AISVL								HYYGPA LEF		VALHQP LISF
	FALESGG GSIL								TYSPALN KM		TIFSPEG RLY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
	GFYPAEI TLTW								VYQPKR SVL		TLNNDI MLIK
	FALAVRK GGAL								AYNAVV RYF		FAFSPD GRHL
	YISVPKE NSTL								YFSEKAY AY		LVAASQ AALG
	SIFFPSE GSNL								YYINRTF FF		YVPDQP HPEI
	YLIFTNE GRAL								LYQDTH QEY		FAIDLNG KKY
	YSYGSG VVWAL								RYYPSG DAF		EYTDASF TNR
	FAVVAT GETAL								TYGFNDI AL		DFDFVP PVVR
	LSIEVNP NRPL								YFIVTRQ DY		YAAVPL YRLY
	VAVFPK DHSSL								FYLFHPL AY		FASYME QHLM
	VAYPHD GKIFF								YFIIILNH M		YSQEAD DRVF
	IAGPVLLI LVH								YYSPTKN EI		KASSPG HPAF
	FAINQE QKEAL								SYMISV NMH		ELLESYI DGR
	LSYAAA GVKAL								IFQEPVS KY		LGQYAS PTAK
	YAIEPGT PPLL								RYVAIAR AL		FTPFVDP RVY
	YAIRQSI SKAL								YYVRAVL HL		MAYGAS FLSF
	FAFESDL HSLL								AYLNYK VCL		QAINPKL LQL
	FAEYPGS SAQL								VFAPTPS AM		ALFVSEE EKK
	AAMASL GALAL								YFQAKIR AL		CAFYDP THAW
	FAVDNV GNRTL								SYYAVA HAV		SSFDLLP REF
	VAVDPSI LARL								SYLPHSS EY		YATTVIP RVY
	FSDPTSK MRHL								FYNEYVR EL		YTLIGAS GQR
	SIISPKVK MAL								VFADYE AYM		FAAQGE PKVY
									YFPEYAE KI		LLFYETS ASF
									FYQHNV EKL		VFLMIE QNTK
									IYPVLPK LL		FASLAEG RLY
									RYYSSEY HY		KAITPPQ QPY
									AYNYYTK AI		QFTSSTS YNR
									YFVTGN HEY		VLLDGV QNPR
									YFYKGGL VW		LSQDSFY RVL
									AYALMA HAM		RTTTWT RPIM

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									RYSEYAEEF		FAVNPLLRVI
									YYHVYKLTL		AAVAVGHRVY
									IFMERIKNM		LFSLSQLDKY
									LFLTSLHSM		VAFSPDGRYL
									FFYNAIKSY		RSNFGYNIPL
									FWPPQPKLY		MSSGGEKVVL
									YYIRFFITY		MIKEGDYNPL
									YYLWMLHSV		YASPAKLESI
									RYMEVSGNL		YMIDPSGVSY
									FFNSVRSVF		LAAESNFRIY
									IFNVAGYSH		SAMPRDILIV
									KYFSSMAEF		QARPDINLIL
									SFYDHALHL		LAVEPKTETY
									TYQKLARAL		VAFDRHLYVF
									NYFFDAAKL		KVMARDELIL
									LFIHFANVY		VAVDPSGRLL
									FYDNKGITY		GIPTHHPRVY
									YIPHGYMEL		LAIDKRFRVF
									HYRYYVREM		IAVDTAGRVL
									LHVDPENFR		FMSAIWISAF
									LFPLWPAEM		KAVPPSKRFL
									SFLAAAETL		LSSPAVITDK
									SYFMATNSL		AASQHVFRFY
									YFRVMVDSL		KATNVVRLLL
									VYLYYKLAY		TAGEEDSQAL
									YFMDVKCPG		ALVQQMEQLR
									KYQEYTNEL		FAYDPSNYEY
									YYNKVSTVF		HTGSMLRLTF
									VFHCQSAVM		QAINPKLMQL
									YYTRLGNDF		LAVSVGSQPL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									RYQATG LHF		NAADIE NRVL
									AFADHV ECL		RASMDP KRFY
									NYMAHL VEV		EALPLAF TQK
									AYIHCVS AF		YAVEGR DLTL
									HAPFTA TSL		THLPEVF LSK
									NFICPAL EF		SAVSSVL LSL
									TFMPVA SGL		SAADPQ IRQF
									LAPTDV KEL		YAAEFH ARFV
									YFTDKA ASY		FAQDVG RMFK
									FFMEKR AKY		LAAPGH PPVL
									LYALQV HCY		STFSPDG RVF
									VGHVM GSAL		AAMAK AFSTL
									YYVWTV KEV		GMLLKG ERGF
									AFQFFA EEY		FARYPN GVVV
									GFLGGA KAM		YLYRHN YCSK
									VFPWHK NLL		FSPSPGF SPY
									IYTSSVN RL		SLSTMF RVEY
									HYYQKA LEL		AAGFLR SNKI
									YFHCTLI GY		RAFGIPI RVY
									YYQDQV DDF		AAMGGI LLAL
									SFLATGS NL		KGIAKVE DTF
									AYPPGV KEI		YAFDKY RDQY
									FFNLTVK EM		FLTDAKR PAL
									IFMENR NEF		YISPFHD IPI
									SFFLGKV CF		AAVDFF RPSA
									FFNNRII AI		SWFKDF LPVD
									YFIDRDG EI		AAMQH FLPVL
									FYWARK TSH		FQPTLLT LPR
									KFNPCG KVF		GHFSISI PVK
									YYLHDVL DL		FSLGSKG FYY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FFTARTSFF		ISIIDDLSKY
									IYPYAAISY		FFAQVLLVDG
									AYNNVKACL		GAQSHVKISF
									KFPDSVEEL		QGIPFFGQVR
									MYLHRPEEY		AAAPLTATPV
									NYYTPITPH		FAKLPNLLQL
									SIPEKNRPL		YITFIEGRSY
									YFLTKSQSL		RARAGRPHAF
									FFPTQGHDY		LAAIPVTHSL
									SFMKNTKSV		VTRDGFKLVM
									VFYGFAVHM		NFPEHIFPAL
									AFLGEANVM		ALPEDDFLSL
									LYIQRTKSM		FMFKEIKGLQ
									AWAEYVVEW		VAVVKKGGSF
									YFHTLTSEY		FASIVIANGR
									FFEDEKPAL		VASEALARVV
									AFSFSKTPK		NAADWHNLIL
									AFYTTDRVM		SAMQGWRVSM
									YYPLVAQHY		FAILNVFQGL
									AYIENAKQV		WSSTSPHRPR
									LYPDHFHLL		NNATKTFREF
									YYIYSKVQL		GEKVVEIVKK
									VYNASNNEL		SITHVFSLNK
									HYFCALNTL		LLAIRRILVI
									IYPLGSKSL		AAERGALLVF
									KFIEKAQNM		FAFDRKKRHY
									HAPLTNIPL		HSTIFENLANK
									KYIGYARQY		VATPHARIIEL
									NYQTLKTSL		VAAAISHGRVF
									HFPEFSQIL		LSVAPSKAREY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									NYFLRLCSF		FYAPELLFFAK
									IYQKDATFY		LLSAARLLTSF
									SYHDGALVV		VAYWRQAGLSY
									IYYWHVIAA		ATEHLSTLSEK
									KFPDYKSTW		DTVQIHDITGK
									VYTTTVHWL		VAVGQLGVRVF
									IYQNAATSF		VATSFIRTIEL
									YYQRMLVVL		FASKEIAENAL
									VYPERSTSY		AAIDWFDGKEF
									HFNPTGSAF		DLATVYVDVLK
									LYYRDARSY		SLSQARLLTSF
									VFYNPVQEF		LGEFVSETESR
									TFVEPVSAF		SAINEVVTREY
									HYNNIMALY		AAVIGDVIRVY
									IFHIVENDL		VASEAKIQQLM
									MYQDKLASL		KATNVVRLLLG
									RYTLQASTF		YIMEPSIFNTL
									AFATPTISL		VTIKPAPETEK
									FIAPTGHSL		KLVNEVTEFAK
									RYPDIQASY		SAYDGKDYIAL
									YYYNGKAVY		PLVEEPQNLIK
									KYTEGVQSL		YAYDIEDGKFY
									VMINKATPY		FALPSELERSY
									IYMGHVKGY		ITSSAKVDMTF
									AYLWTKQVL		SASDVHGNFAF
									TFQSTKAVY		FAIDPHLLLSV
									SYMKDVCYV		FAYDGKDYLTL
									YYPDHIKGL		VSSDVIDQKVY
									HFFDGKTAL		VGFYESDVMGR
									FYFPRCQGF		AASPNAEIHIL

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SFLEDARAY		SASDLTWDNLK
									SWIQGVLSH		SAAEVGFVRFF
									GYQLTGHAY		RVEPYGENFNK
									KYMPNVKVA		FAKPVYPGQTL
									HYLYIQMEY		DNDGWLTSDPR
									YFQYVGTDF		EFQLFSSPHGK
									FYEECKMEY		LPPNVVEESAR
									RFIAVVHPL		FNWYVDGVEVH
									AYHTQTTPL		TVLHQDWLNGK
									RMPPFTQAF		QELSEAEQATR
									VYQYWNTKA		QGLLPVLESFK
									FFFAPASSY		GSESGIFTNTK
									RYPDNLKHL		QSGLYFIKPLK
									RYVDRVTEF		LVAASQAALGL
									FYSEVHPHY		FAQEALTVLSL
									RYIPDAMNL		YAISPGLDITF
									VAPVTHVSV		AIGYLNTGYQR
									LYQPRASEM		THLAPYSDELR
									SFQEVREYM		SAFVPSSGRIY
									VFPEDMAKY		YAYDGKDYIAL
									SFLDSCNSL		HSIFTPETNPR
									HYFSQGLSV		LSNENHGIAQR
									SYLDFTNPK		FFSDARELESF
									VFIEDAIQY		FAVDNVGNRTL
									AFPGGAKEL		NTSEPQHLLVM
									HFYRSLVAH		YAVPSAGLRLF
									KYSCQFIEM		FYNQVSTPLLR
									NFYCPGSAL		EGYYGYTGAFR
									VFLTTRQTL		VASVAKESIPL
									YFYAAIVAV		FVAEPDNKNVY

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SYFSAPNSY		IATPGRLIDFL
									TYYGSFVTR		AFALAGNQDKR
									SYIGSHREL		FVAESHIILVL
									LFYEAAQEL		VQPYLDDFQKK
									LFTENVLAH		FTSSMRGMDAV
									FYHEAVVLF		YAVDAYFREAL
									LFLEHAHNL		TTTEVNMARVY
									LFPKHFVEY		AAVPEIMDRIY
									QYFARMCSL		FSSDKHAQLIL
									FYHPETQQY		VARDYESLIDL
									YFQYLSKTY		LALDPSLVPTF
									GYLAANSRF		YSFDSRHKPAF
									AYVSPRAPF		HPDYSVVLLLR
									GFPFYDKPM		LSILVGSSVDY
									AYHNSVECL		ETEGLRQEMSK
									KFLNAESYY		NFPSPVDAAFR
									KYQSPVRVY		ELDESLQVAER
									AFALKALQF		SASNMAIVDVK
									RYLESARCY		YTTDRVMTVSF
									SYGLQHNCL		YASTEMSLHAL
									FFLIVKTLY		LLPHANEVSQK
									IFIDEIDSL		ISDPYKVYRIV
									YYYDPTTGL		AAMASLGALAL
									YNMPYPPVY		HYEGSTVPEKK
									YYVDFFKTL		AASNAKLALFY
									SFPTSIKCL		TVGSDTFYSFK
									LYATVHQSY		VKSPELQAEAK
									RFPDTVSTV		LEALKENGGAR
									SYQNNITHL		LLDSEWIPVSF
									AYFKKVLEK		QAIEPDVLRQF

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									QYYSYFTSH		DIFTGLIGPMK
									HFQPSVLDF		KASVMRLTISY
									KFPTYPVPH		TEVIPPLIENR
									TYLGVAASL		LATGPDTRHSF
									IYILTNVAY		MAVEDEGLRVF
									NFMKPTQEM		ALEVDETYVPK
									VFMISSHEL		ADREDDPNFFK
									VYSCMRDFL		VSTPTLVEVSR
									VYYASPRSY		NILTSNNIDVK
									AYVDKYRHM		KIREEYPDRIM
									HHPDYNNEL		LSVEIYDRREY
									TWPDGWTAV		EALQGVGDMGR
									VFLPRALAL		YAFDEAFVREV
									TYPPFVNFF		QLNEINYEDHK
									RYADRVKEL		FAFEGIGDEDL
									HYPDYSWSA		DYEIMFHVSTL
									FAPYERRAM		FAQEAISVLAL
									AYFELVSAL		GWVTDGFSSLK
									SMIENVLAF		QVDGFCLPWEI
									YYHSYWHSM		MAPSETQFSHL
									YFQDERHPY		VAIRPSSKKTY
									RYTFYVLEF		KLVAASQAALG
									NYIKKTYPL		SKEQLTPLIKK
									YYPSDVSSL		SITTDFIPSFR
									VFQLRDSVY		TVVLPLDERAF
									AYSHIYSSY		YTVEPNNARQL
									NTMPRVTEM		GATNVGSIRIY
									FFIRQGRSY		ASDGFKANLVF
									YFLHRLLHH		ETLFSVMPGLK
									TYLFTYSSV		AFHDNEETFLK

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									KYFSSLTTH		VAAPPTAVGSL
									YFPDARDMV		FSIDVGYERFL
									SDPFTHLAP		HAMVDQPPVTY
									SYQESTKQL		GDSGGPLIVHK
									TYIKRVIAH		EPQVYTLPPSR
									SFLNKASAV		LVPFATELHER
									YFSDNILCH		EDVYVVGTVLR
									GFMPGAHVF		YGLVTYATYPK
									RYFSTAVSR		SSGSLLNNAIK
									YFEEIKQFY		AALPDASPGNL
									NYQEVSRTL		SAAAAHGPHAL
									FYFTVRECY		YANMYSSILTM
									AFACMGQTY		IASDGLKGRVF
									FYPAKVTAV		VPPPSKFSLHY
									RFPDTVKQM		AARQPIELLSM
									FYSGSPTSY		ISGNIFSSLQP
									GYAPYVNRI		GGYTLVSGYPK
									NFQTAKESL		NNYTALMSAKY
									TYQFSGVYV		FSTGSVSSPII
									MYPGIADRM		KVLLDGVQNPR
									YYIDDVFHA		SKLPGIVAEGR
									VYNITKWSI		RVDTVDPPYPR
									YYHPARLGA		
									TYLEKAVEV		
									MFPPPGQSY		
									YYMRDVTAI		
									FYEGHITSL		
									FYICHEVHL		
									LYLDESNAL		
									RFMEETANF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									RYLEKCIAY		
									IFHITLVSL		
									KIVKWDRDM		
									IYPVGWCEL		
									VFQQIALSY		
									YFPENVKAM		
									FYLDTVSAL		
									FYSPNIMAL		
									SFPVRGTPM		
									AYMPPTSEA		
									LFKEREKPL		
									KYMAEVKKY		
									YYLAWIREH		
									SFMDVSNPF		
									LYPKSTHAL		
									RFATHAAAL		
									IFPPSVGEF		
									SFKNQIATH		
									TYIDKSTQL		
									HYITIVKSH		
									IFLCMETHY		
									YAPGARLAL		
									YYALEVSYF		
									QFQEKVAEL		
									KAPEPLSSL		
									FLPDHPIVL		
									TYPAGFMDV		
									HYVFEAKEF		
									YYQSGTRSL		
									YYLPKDDEY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FYPDKIDYA		
									NYITPVNSL		
									RYMKPGKEL		
									VYNLVKETM		
									LFHEMETCL		
									RFFESFGDL		
									SYYKNGWIV		
									IYFADGKVY		
									YYYNKRILH		
									AVLASGATF		
									YYINKISST		
									YYLTFVQEL		
									FYALVSQEL		
									KFPDGFEKF		
									AYIHLVADY		
									RWMDEAQAL		
									FFYMHKEIF		
									AFFAAPNSI		
									LYPEYGAAF		
									FFHLVNSEM		
									FYVETVVTY		
									AFPDGRSSF		
									FYPFAGHDL		
									SYPNPVAHL		
									RMPEKVTWM		
									PYYASAFSM		
									SYAVGLAAL		
									YMLDCRTSL		
									KYFGGVLEY		
									RFPDPRMHY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YFPSWLSQL		
									VFIPHGLIM		
									VFPKVRITA		
									VFQEVGINY		
									VYTYIQEFY		
									SFLPPGWEM		
									SFIAAGICF		
									SFMEGAIIY		
									NFIKAIQAY		
									FYNCLQHAL		
									SYAPRRGEF		
									TFATMVSSL		
									VFCGRILSM		
									KWISITEAL		
									HYIQMVKEL		
									QFLRGARAM		
									RFPEAFSSI		
									SYLLQSTEL		
									SYYWNAQRH		
									NYPIGTNAI		
									SYIHTSASL		
									LFPDQATQL		
									VFQSTDTCY		
									RYAEAVQLL		
									RFIAGTGCL		
									TYTIMYREM		
									FFVVMEHCL		
									RFIEATKQY		
									YFQTTSTNL		
									AYSALSHPY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									VFNPMSQDL		
									SYYNSHDSL		
									AYQKYSEFF		
									IYVAYCTVY		
									RYVWDYTEL		
									SFPELNAAF		
									NFPVGQRVL		
									FWPNPCSTF		
									SFPAHRAVL		
									AYNPMARDL		
									YYYPKQQGL		
									GYMEKIKPM		
									YYNSQTFDY		
									HFPLFESHM		
									VYALVVVSY		
									VYADGSICL		
									YFLPLANTL		
									KYFTQGNCV		
									NMNTMGHMM		
									NFPIKARSL		
									RYYAFDEAF		
									YFLDKIDVI		
									NFCGKSISY		
									QFLEQALQM		
									CFNPMKSVL		
									LYPYWISAL		
									VFQGAVESI		
									YYTPITPHL		
									HFHTQTQSL		
									KFLAASLSL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									GDFGGP TPR		
									KYHVSEK PY		
									YYANKYS FW		
									VFLSTGS EL		
									FFYVTET TF		
									LYQRAK HVY		
									YFIRDVK SL		
									LYFTHDA SL		
									WYYSTK VQL		
									FFYEKIS AW		
									YYALRAA GF		
									AYYEKG VAF		
									SFHQPT QPV		
									RYSDGSI AL		
									QYQDNI KEL		
									NFNTSV QAL		
									FLPEMM VDH		
									YFMTYH TVL		
									IYGPHAV SL		
									LFLDTVS TF		
									YYNGKIH AY		
									AFLTSGT QF		
									IFHNNW REM		
									VYIEAAI RF		
									AFPFNM QEL		
									AFAHHG RSL		
									FFQPMA ECL		
									SMITGV AAL		
									SFSNAA RVL		
									VFHPKR AVF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									GYSFSLTTF		
									QFQKVITEY		
									IYLAIQSSL		
									GYHTRLNRL		
									YFQPSFESL		
									LYDRGNIVL		
									SYMAYMTQY		
									EYHIMSSCY		
									SWPDGMLSM		
									FFIEDFKTY		
									SYEAQITAL		
									YFEGGVSSV		
									MFNIHRGFY		
									YFLLSDGKF		
									CFRYYSSEY		
									YFIEPLQSM		
									IFQALNVYY		
									HYNTITDCY		
									RYNVMHVAA		
									FYQPMPLKA		
									SIPILASAL		
									VFFPKRREL		
									SFNSSFTSL		
									VYKETCISF		
									YFLPDTAHF		
									AFIFLIHCL		
									VFNEATSSF		
									YFHEALRAF		
									MFASRLTAY		
									AYVPVSRAV		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									IFNAVKASL		
									NYFGAAGRL		
									SFPDNPRKL		
									YFSERSNPF		
									FWPAVVKSV		
									SFIFGVTNF		
									TSPEAFLAL		
									LFMPSTSSM		
									TYASFTRAY		
									QDGSVDFGR		
									SFLSSNSTF		
									LYQENKREY		
									LFPVPGSGL		
									LHYPIDSLT		
									EYIPGTTSL		
									YYFLTNLSF		
									NYSPYVNYF		
									QFPDFNNYL		
									TFPNNPVEL		
									VYQPMEKLY		
									AYPHFMSIL		
									RYIQGILNV		
									AFFHQELPL		
									TFLYTGNCF		
									VYIAYSTFY		
									LFPGSNATF		
									YYPIMVTQL		
									SFTTGASRF		
									SYMVKGMAF		
									TFLVQLENY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FYVVVTEGY		
									LFMDNKNEL		
									IFLETNMSM		
									QYPEGYLEA		
									LYFIAPSGH		
									AFQKHIQAL		
									HYLVSVMAV		
									IYFDSSATY		
									YFRPIDTTM		
									SFYPPAHQL		
									YYAVCQNLL		
									QYKGMGLSM		
									FMLPKALAL		
									VFAPPAEAY		
									AFSDKANEF		
									TYQEKITHL		
									YILHPQTSF		
									SYMTTVIEY		
									KFYATLVRY		
									AYATYPREL		
									KFFDSACTM		
									AYPLVGHAL		
									SYLPGSTAF		
									AFVAKFMAL		
									AFHVCITSY		
									FYHFVQIVH		
									AYAPAAATV		
									GYLISGSSY		
									VYLFTEAYY		
									YYIPEITSV		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									VFYFSCREL		
									IAYDVTYSL		
									IFIAAASEI		
									RFYESGSSL		
									IYNEVNQTY		
									LFGPGAGGL		
									VYYLAGRDL		
									SFRSQMLAM		
									GFQTGTSSL		
									AYVDYKTVL		
									NFQPFALNH		
									HFIAVAVCL		
									SFSILMSPF		
									SYYQSSVQY		
									QFPDMILSA		
									MFLNSVFHF		
									QFPLYNNDI		
									SMPLYAVMY		
									VFVVDSAAF		
									NYEKSQETF		
									LSHLQYFYP		
									SFYNVEMSF		
									YVLMPFKLA		
									IYAVNGIAF		
									VFMDKPEEF		
									AFPKSITVF		
									NFLSTLTSF		
									QYVCQQTGL		
									TYFAVNANY		
									SYPSVVSTL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									HFPMQS REF		
									LFSAVKN FT		
									TFIRNSR PL		
									IFEAKKS FY		
									SVPLAAT SM		
									EVNVYG AIM		
									TFIGRAN HF		
									FAPVTP ALP		
									TYVSWA IAY		
									VFPSSAA TY		
									GYLPGT AEM		
									YYIAGSL ST		
									LLPTGLS SL		
									VFMPHV TEAY		
									RYPDTIA LTF		
									YFADRLY DSM		
									FYFDRD DVAL		
									YYFDRD DVAL		
									RFPNFT NQLL		
									FYIKVRP AEL		
									YFHDRV ASFY		
									RFPGQL NADL		
									YFISPTG HSL		
									SFYEKGP LTF		
									YYLQHP PISF		
									RFTDEES RVF		
									YFIPATG HSL		
									YFIAPSG HGL		
									YFIAPTG HSL		
									HYPQFS GQSF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FYINVEREEW		
									RFPEELTQTF		
									FFFDVLIKSM		
									KFPLTTESAM		
									HFFEFLTKEL		
									AYRDWFSSQL		
									IFLDYEAGHL		
									AFAEPGRVPF		
									SYFEKGPLTF		
									IYFDHDLQSY		
									FFYEGSRVLF		
									FFFPTQGHDY		
									RWPDLHKNEL		
									YFITPTGHSL		
									RYMELYTHVY		
									FYIIVPPLTL		
									RYFPTQALNF		
									YYIDDVFHAL		
									SYFEKETLTF		
									IYHNPTANSF		
									SYFEGKQVSV		
									NYIDRFLSSM		
									HYVVSEPLGR		
									CFYTHPTEVL		
									RYPGYMNNDL		
									LYPHEPTAVF		
									SYYTVRQLEL		
									FLPSELRDEH		
									FYNSVKPIQI		
									IYMDTLNIFM		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SYMPARVVVF		
									SYIDRLISVF		
									FYYDGKVMKL		
									SFYNLLTRTF		
									RLMVHTVATF		
									VYFKPAAGFF		
									KYYDEINAL		
									VYFAERVTSL		
									SYYGNRAATL		
									FYSPQENVVF		
									IYYTGKYQSL		
									IFQELVEGVF		
									LFPELPKSAL		
									EYPDRIMNTF		
									FFPDKPITQY		
									YYYDKNIIHK		
									LFPEPEHSSF		
									GYPNVNIHNF		
									FFMKDVVTPL		
									SYFEIPTKEF		
									AFHPFIAGPY		
									VLPHQPLATY		
									AFVTFTTRAM		
									IFIDRDPTVF		
									FRPEYSASQL		
									FFFTARTSFF		
									HFPATPLLDY		
									LYVPHEPHSF		
									YYHDEGWVAI		
									KFYNQVSTPL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									LFIEHSV EVA		
									AFHQGLI SAW		
									LFVITKP DVY		
									SFMQHD VQEL		
									RYPDIQA SYL		
									MWFDK TPLSY		
									KFISGILA AL		
									AFYMDT SHLF		
									RYPEEDY ESF		
									LLPQHQ VPAY		
									LYYDEIA VPF		
									YYFEGIK QTF		
									SFPEHRV LSF		
									FYFVDD RLVM		
									AYPDFA PQKF		
									FYHLGV RESF		
									FFYDGIK AIL		
									YYFDLQL LVF		
									RFPDQP FIAL		
									FSQFGT VTRF		
									YYLQIHP QEL		
									AYYEFRE EAY		
									RFQSSA VMAL		
									TPGNRIV YLY		
									IYQEIRN TDM		
									TYPVPHY SFF		
									VFIAQN VASL		
									RFQSAAI GAL		
									FFYNEHT NDF		
									RFVEVG RVAY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYRYPTG ESY		
									FFPEAA QVAY		
									FFPYGD ASKF		
									FYIGEHL LPY		
									FFLQVKE GIL		
									YYVDTA VRHV		
									LYYEVEIL SH		
									FYFWPR TVPM		
									FYTPQN PSSL		
									GGLPERS VSL		
									SYVNLPT IAL		
									YYLAQIPI AM		
									YFHDDG FLAF		
									HYYRGN YMTF		
									AYISQVP TQM		
									GFFNGL RTEL		
									DYRLGAI HSL		
									VFFEVSP VSF		
									YYFSKLIE FM		
									FYPGWK VLVF		
									IYQEGW RTVF		
									NFYGDL RKAL		
									SYFDRYR DSF		
									YFPEEKF ESL		
									HFYPSG GLEV		
									LFPEYKN NKL		
									YFPEMQ ILAV		
									AFYDWD NTEL		
									IYLPGRP TSM		
									AYYEEQ HPEL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYFDVS HEHL		
									LFQLLQ GLAF		
									AFPHLV HAEL		
									AYFDLQ THVI		
									RSNFGY NIPL		
									YYINKISS TL		
									AYMDAP KAAL		
									VFRTDLI TAM		
									YYPPSQI AQL		
									YWPHQ PIENL		
									NFPEYEL PEL		
									TYIGYLP LAH		
									VLPTCP MAEF		
									IYQELLG LAF		
									SFYLPIA AAM		
									NFPNKP PLTF		
									YYYHAR VYEF		
									RFFDTN TSVL		
									NYYNKV STVF		
									AYMELV NNML		
									AYIPLQI NSH		
									YFYDPD VGNF		
									HFVPGT TAVL		
									RTPDAFI SSF		
									SLMDHT IPEV		
									FFPEYTH QLF		
									VYFHTLT SEY		
									FSPFGQI MEI		
									VFIGANP LAV		
									FWPPYV ELLL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									AWIDAE VTEF		
									SYQIPTE NSM		
									RFPQLDS TSF		
									FFYDGIK AIF		
									SYHDINV YSL		
									FLPARFY QAL		
									NYIDLPV LAI		
									YMIDPS GVSY		
									RFPWPS LRTY		
									SFPKYKP SSL		
									SFFSEIIS SI		
									VFPPLTQ RTY		
									IYMEPEK QVM		
									NYISLFV HTM		
									SYMVG MIASF		
									KYWDVP PPGF		
									KFYDGV VQTV		
									QFVDW CPTGF		
									SYFPKDV TVF		
									VYYVGV ASCL		
									TYMGHT GAVW		
									AFPGGP LGAL		
									NFYTVA VTSL		
									TYPYNPP ICF		
									QYMRTG EGFL		
									SYYLNEI QSF		
									AYLPKNT HPF		
									HFPQYA PPVM		
									SFYPEEV SSM		
									YLPDFRF TPF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FFNPIQT QVF		
									FFYNLIH PEY		
									FYPIYFR PLM		
									LYPEVPP EEF		
									YYQPYEI PAV		
									IFIDRDP AAF		
									NYYDLV RTEI		
									AFYEHA QTYY		
									VYYGHT NYIY		
									FTTKRPN TFF		
									AYVPESV GSF		
									SFYLFHP LAY		
									LFGHSST SAL		
									YLPNQLF RTF		
									RLPEEEF GHF		
									FYIPYRP KDF		
									SFFGETS HNY		
									YVIPHPV HAF		
									MFQTAV GHSF		
									RYQGLA FSVF		
									AFLPYEA QVF		
									MLPHYE PIPF		
									VYPNFR PTPK		
									YLPNGR FKEF		
									FYNQVS TPLL		
									YYYDPLA GTY		
									FYLPIAA AMY		
									RYIMGS GESF		
									AFVDKP VSPY		
									YFYDRRR IYL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YFLPEAP AEL		
									FYFDNIL NSF		
									YFIDTDL NQL		
									YFRDGD LVTF		
									FFILPCT DSF		
									FFPHVP HPSM		
									HFFMPG FAPL		
									NFPEHIF PAL		
									SFVDKTV LPF		
									YFIPFLPL EY		
									FYPEDV AEEL		
									SFPALAP LTY		
									NFYEGHI TSL		
									FYLAGKL HCF		
									SYVTTST RTY		
									AYFPELI ANF		
									YWPTYT PMEV		
									FFPYYVY NII		
									YFINGDI SSL		
									AFFPGFP LAL		
									SFGVIPS TPL		
									AFFTSKA LNM		
									SYSDQIQ QPL		
									QYYIFIPS KF		
									VFPLLVA ETF		
									AYIDPIA MEY		
									KLPEYNP RTL		
									SYLDEKI SPL		
									FVNVVP TFGK		
									TYMIAHI TGL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYYDPQ TGLY		
									HFGGGG FLAF		
									SMPTIPA LAL		
									QYFDSR GMFI		
									GWPDEP PEEF		
									YFIPTPP SSY		
									AFPEIHV AQY		
									YYIQNGI QSF		
									RFFGDS AASM		
									FYPPAH QLSL		
									IFYHPET TQL		
									VLPPIPA NSF		
									SALFGIP MAL		
									LYPENIV PSF		
									RLPETEL GEY		
									VYMTEPI DEY		
									IFMEKST RDF		
									LYYDPNS QYY		
									SLPEFEK SSL		
									SFAEPSS VSF		
									SYPAAV PQAL		
									WYPLLK NISM		
									YFYPFPV PPL		
									RYYKNIG LGF		
									FFHQEN VRAL		
									FLPEEA WCDL		
									LYYPQQ AIVF		
									LYLNTLS ADF		
									RFVDVQ PSSL		
									HFVDIRI AAL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYPTSSS TSF		
									YYYDKNI MTK		
									VFMPQ HIMAI		
									ALPTLPR GLF		
									TYPDWI GQSY		
									TYPEFLA NAL		
									KFMTHV ASQF		
									FYPGASP TEF		
									MFFSAN PKEL		
									IYMIEPI DEY		
									SFPSFLT NSL		
									VFINVPT VSF		
									FYFVHSA GQF		
									VFVDFE GISL		
									IMPLED MNEF		
									SLPTSFS GSF		
									FYPAEITL TW		
									FFYDQA FAIY		
									YFYPYGL QTF		
									NLPVPS GVAF		
									VFYDAN DVGF		
									AFVTFST RAM		
									FFPQYP DKEL		
									IYRSQSP HYF		
									QFFGFD TETF		
									VLVEPPP MSL		
									YFHDGV RVAA		
									LFPIHVQ TSL		
									FFQELFD SEL		
									SFYGLTA LAL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SLADAIN TEF		
									FYLDVK QNAK		
									IFNDSVK AVY		
									NYVVIGT CTF		
									YFILSIINS M		
									YYYGNSL VEF		
									SFISGLF NFY		
									TFIPGFIG SL		
									FYPEELD QLL		
									YYARPQ TLPL		
									SFLFPPA ESL		
									YFYDDV TTLY		
									YWPTYV PMEV		
									KYVDISII AL		
									AFFGSYR NAL		
									KYYDKLF KEY		
									FLPPGSIL CM		
									KYIDQGI AEL		
									YYINYTTI EL		
									IYTDYRP TPL		
									MGPAIE RMGL		
									AYMNHI MVSV		
									CYINATL QAL		
									LYCPVAF LSF		
									SFTDFDP HHF		
									LYPDLLP TDY		
									VYSEVA AYEF		
									AFMVD NEAIY		
									SFMAPP VTDL		
									GFPTYG GITF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FFPGISV KSV		
									SYGLGYT SPF		
									AYMGF MNSFL		
									NFPEPSR PPL		
									SFYNKRT LTF		
									GVEAGP DLLQ		
									VFSITEH ESF		
									YYVQVA AQDL		
									AYFSSCI PFL		
									ILPDEDL ASF		
									SYMFVD ENTF		
									AYATFIV TNY		
									MYMDR RCVYY		
									GFIVEET LPL		
									NFFQQT TTSF		
									TVPELTQ QVF		
									FYYFPDS GFF		
									VFIGNLN TAI		
									VYQMEK DIAM		
									RFIDDVV SAV		
									AYYPSD VSSL		
									SVSLVGP APW		
									LFPTSTP REL		
									SFFDNIS SEL		
									GFPEHLL VDF		
									AYIAVGS ISF		
									AYYLGKI LEM		
									LYSDSFP MEL		
									YYPAQG VQQF		
									YLRELAV GSL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									HFGGGK TTGF		
									SYVDRH MESL		
									YYAPSIG FPY		
									FFFPFDT RQM		
									AYYESEI NSL		
									YMPSVK VSVF		
									GYVDVA VGAF		
									AYLGAK PRSL		
									VFMDGI QISL		
									HYQDVS CLQF		
									VFLVPTG EVF		
									SMIDPP RAAV		
									TFYTSDG VPF		
									AFPELFL SCL		
									FFFGDA PASL		
									AFITIQV AQM		
									GFQYLT NGIM		
									TFPLEAIT AF		
									FLPVPEL MPF		
									RFPEEPH VPL		
									AFMDES TQCF		
									YFIDRDG KAF		
									VFMFPV GLYY		
									SFYTAIA QAF		
									AFSSQEL ASL		
									YYPPSIG FPY		
									RYLPTGS FPF		
									SFMESG GTVL		
									LYQILQG IVF		
									AYYGYPY NAL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YFYDGSTERV		
									YYYYSANEEF		
									SFYVPSGNYY		
									YFPDRENQQF		
									LAGLSSAIEL		
									YFPVGTVVEY		
									AFIDGGGSVL		
									FFFGKSTLPF		
									YYYDGDIGNY		
									MYIISGLTGF		
									LYFEGGVSSV		
									FLPDLPTTPY		
									QYYSGELVSY		
									AFYVPFAKAL		
									SYFGATLNSF		
									VYLPDGTASL		
									SFPDDATSPL		
									NFIGNYASTF		
									SFYEAAIPEM		
									AFPLPSRTSF		
									FYPEDVSEEL		
									SLPAGDALYL		
									SYVDPQFLTY		
									SYCPGMGVAL		
									VYIDARDEEL		
									FFQGGIPRAL		
									FYPECEIRTM		
									FFVALPGVAV		
									TYVGGHVEAL		
									YYLAQIGIAM		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									VFIDMG HSAY		
									IFYNLSIQ SF		
									QYYALE VSYF		
									VTIILGVF ML		
									VYVSRPS HFY		
									MFPSNFI KEL		
									ILPEQGV SAL		
									YLPEAM PASF		
									YYYDGD VGNY		
									IYIDVPV PEV		
									NYILDQT NVY		
									VTLLIYRE SL		
									LYYEGQ NLQL		
									VFITDKIS SF		
									LFGWVA RHSL		
									IFPTPDP AAL		
									HYISLPA GVL		
									YYFSTISS SF		
									VFYPGET VVH		
									LFPESER PEM		
									LYHITDQ VHL		
									FFLVTY MAPL		
									RFQSLG VAFY		
									YYLDMH SLPH		
									VLPDAR YSAL		
									NYLSQP RLTY		
									IYVVQGI YGY		
									RFYEQV VQAI		
									NCERCL AGYY		
									SYLPVGS VSF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									MYKLAG AVLF		
									LYPRLKV LAF		
									QYIFQP QQSV		
									PLHVFVL LLM		
									NMPGLS AATL		
									TYPSLLQ GEY		
									KYYEKRL LEF		
									NGMIGL VTSL		
									FGGGYG GGGF		
									FCPSLSK PDF		
									GFFDIPV DNL		
									YAAVHT GNMF		
									KYYDKN AIAI		
									SFITISTI GF		
									SYIPLVE NPY		
									FYMVGP IEEA		
									GYGGGF GGGF		
									YFPDYSI GNL		
									SFYDGYR HEM		
									FFQDSLI NQM		
									FFYPGG NVTY		
									SFSPGNS SLF		
									SFFDKVR RVL		
									SYFDAIP VTM		
									YYPDPTF PAM		
									IYMFFNT SEL		
									HYPGCIN LSF		
									TYMEYE TLTL		
									AFDAGQ KKTF		
									NYYPYTI TEY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									AWYDN HREAL		
									NFYDRY RGDY		
									SFPSSNF YAL		
									GFAPYE RRAM		
									SFPDCH VGSF		
									LFPQYKF REL		
									FFQDKEL RSM		
									VYHNVK PAAL		
									YYFNRKT FSF		
									AYYCHP PTSW		
									AFIDRKD SYY		
									RFPEHR AAEI		
									AYFAWK ATAM		
									YYQTAP KAGY		
									MFPEHA VKAY		
									YFFDND SKSF		
									VFQKPS GVSA		
									MYKYPS DISY		
									YFISHVL AFF		
									YYYDTHT NTY		
									YYFDGK GKAF		
									HFYDFER DAY		
									HFPSNLV TEM		
									YFFDRSS QAF		
									YLPENQ VLPH		
									GYMSPH PSPL		
									IYPGYHQ SSY		
									SFQDQKI ASM		
									TYYDLVK AFM		
									SFPHYGF PTY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									VYIGYLP LAH		
									IFLDSKG LEY		
									NFYDKK TAIH		
									LLVVYP WTQR		
									FFPEIDL EKY		
									TYLETKG AAL		
									TYFFKRT QYF		
									RYYDVPI ATL		
									FFYHPET QQY		
									YFLSHIPI TL		
									EYYDKHF TEF		
									FFQETKT GEL		
									GGYDGY RPSF		
									QFYGLTP LVR		
									FFFTGPL SHF		
									AYYDPKT RAM		
									NYYNLQ GISH		
									YFYDSTR NVY		
									AFYDVD FLCK		
									YFPDCIV RPF		
									VYYIFER LCA		
									SFPGFH GSEM		
									VFLDYEA GVL		
									KYIESPV LFL		
									YWPEGK RVAM		
									RFQEAD SPTL		
									SYFDKM SNEM		
									AFFEEER SAL		
									TYITYFV RAM		
									KYFSGPA ITL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SYSFDYP SDM		
									MYYYNG KAVY		
									SFPYCGA HEI		
									VYYTNR ALCY		
									YYYNGK AVYA		
									AYYEFKK QFF		
									SYIPYNP QQF		
									YYYDGD MICK		
									QYLTFKP QTF		
									YYIDGKI QTN		
									AAPGYA PPPF		
									VFPMEK LSSF		
									MMPPM GGPPM		
									SYYGRD RSPL		
									LFPEGPA RAF		
									LYHKNV SSPF		
									VYQFCFS NEF		
									SFFNLTV KEM		
									SFIAAPV TCF		
									YFHDNV RVAA		
									IYLNWSP EAY		
									IYPTAPP RSY		
									VYYKDD THYF		
									VLPSERY KEL		
									VYKNPSE YHY		
									KYFDKRR DYL		
									TYFQDE RHPY		
									HLEDQM VLVH		
									FFPSSCV REL		
									IFYEHLT RSL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FLPTYPP SAY		
									AYCTFPA SVL		
									YWPEAK RAAL		
									FFFDSA MESY		
									GPPPPP GKPQ		
									SFYDSQ GIHF		
									AFLDFH ALPY		
									AFLDSQT ATF		
									QYYNGK IHAY		
									MYFDW GPGEM		
									AFADYR PTEV		
									TMPGLP TRPC		
									FYVPEIV DEL		
									TFLMDL SITY		
									AFIRVVG SEF		
									LFPPDQF ECL		
									FYADFG PLNL		
									VFQAM WLSFL		
									FYFDLNS EQM		
									YYISANV TGF		
									LFYTGKQ SYY		
									FFAQVLL VDG		
									QFYDNK GITY		
									SYPDWG SNYY		
									FYSGSPT SYF		
									YFFPDDP PTF		
									SYSPEQA DEL		
									YFNDIAV GAV		
									SAQGSE SHSL		
									SYADGY SPPL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									LYINHTP PPL		
									YYYDPTT GLY		
									FFPDGH VMML		
									VFAEGK PLAL		
									SYPSAPG TPF		
									YFYDGV SRDA		
									PSACSHK QLY		
									FYFMKN GSDL		
									ALPEDD FLSL		
									AFYTFPF QQL		
									SYQSYQ SPTM		
									KFINIHQ NSF		
									VFIDTEG SFM		
									NFISLGP SIS		
									SYIFPSSI SA		
									YYVDTFV SVY		
									GLFQHIC TAY		
									PEIFVYE GYV		
									YFPGYFP NEL		
									YYIPEITS VL		
									RFIDISPA EM		
									RYYSGLI YTY		
									VFAGVR EQAL		
									KASLYGA ILF		
									FTMGGP AISM		
									MQTLAQ NPDF		
									SYSLEKIS SL		
									RYIEKLT NEM		
									VYLHYLP SYY		
									VYIVLDK AEY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYGNYD YGSY		
									LWPDSV PSAL		
									WAPESA PLKS		
									LGHSPL GGLR		
									KYFEGVS PKSL		
									IYVALLR VTPF		
									YFWDPD YQEAL		
									FYVPAEP KLAF		
									HFIQAGL LSAL		
									HYMNPY QLNAY		
									YFYDVEA LRDY		
									KYQEVT NNLEF		
									RFPPYH VGQTF		
									FFNEDG VIRPY		
									AYFHEE DESSF		
									AYSPGG AHGML		
									VFLDRE QSISL		
									FYYPLEG SKSM		
									HFQEN MQIQSF		
									IYMERAE DLPL		
									NFQRLL DTSTY		
									FYLDNVI GHSY		
									GYFEYIE ENKY		
									YYIDADL LREI		
									LYILTGH QSTY		
									VYTDFD GTRVY		
									VYVDLG GSHVF		
									YYYDPQ EEVYL		
									AYMELQ QKAEF		
									IYALNEN VSSF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									SFFDATD RVSF		
									AFYTTDR VMTV		
									YYFDAA EAEAW		
									HGRYLT VAAVF		
									SFKKSFK LSGF		
									FYPVVKE GRTL		
									YYIPGQG RSTY		
									IYIDRHV MQPY		
									RYIGIVK QAGL		
									KYMPSV KVSVF		
									LSMKPG EYSYF		
									HFPEFPA TRAY		
									YFYPFPV PPLL		
									FYYLGSG RETF		
									YYLERIEE TAL		
									FYYEILN NPEL		
									YYIGDIH PSDL		
									KYMNSL LIGEL		
									VYQSLCP TSWV		
									TANLQT KEFNF		
									FYFISPF GHGL		
									FYYENE NVKGL		
									VFQEPSL LSSL		
									HASPILPI TEF		
									HSQFIGY PITL		
									TFIGERT VGAL		
									AFIDIFTS NTY		
									IFQELVE GVFY		
									IYADPTK RLEL		
									AFIEYEH ERDM		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									FYIDPYK LLPL		
									VYFKGK WKTPF		
									SYYSPSI GFSY		
									FVNVVP TFGKK		
									AFPFSDK LGEL		
									FYVPGV APINF		
									SIQGQH TISPL		
									TADPLSL LRNV		
									SWHDV QVSSAY		
									AYIDPIA MEYY		
									SFIDTQK FSVM		
									AYFQSIK AIAL		
									FYVDSD MVNEF		
									HFPEFPD PHTY		
									FYPEIEE VQAL		
									SFPTTKT YFPH		
									AAFKEL QSTFK		
									TIIDTKG VTAL		
									SYYGPLN LLTF		
									SYYGLSS VPSM		
									VRMNVL ADALK		
									KYPKGA GRVAF		
									TYYGSFV TRAL		
									IYIPDGH TKEM		
									SYGRAL QASAL		
									YYHGPT PIQSL		
									FYGPEG PYGVF		
									AFADAL EVIPM		
									TGAAPII DVVR		
									YYIEGIE NSVF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									IYFDTRII TPM		
									YYQTIGN HASY		
									YYYDPQ TGLYY		
									FYNQVS TPLLR		
									FYHHEA GVTAL		
									LFQENS VLSSL		
									SYYPAEN LIEY		
									FYQDPSF HLSL		
									FYFEGNI HQSL		
									YYPGFN PFRAY		
									LYYDTDP FLFY		
									KVPQVS TPTLV		
									YYPTSSS TSFM		
									SYYPTSS STSF		
									VGLKAP GIIPR		
									MVVPAA LKVVR		
									VYSPGSS GVPY		
									AYFDGLS ETIL		
									YYITNDT VQTY		
									RYVASYL LAAL		
									AFPGEYI PTVF		
									SYVDPQ FLTYM		
									AFRADD TFEAL		
									GYIPTEQ VNEL		
									TYMPSV SLQSL		
									AFYYFPD SGFF		
									TYQYPSE SSVL		
									MFHDDS MKSFF		
									YYFDNV SSTEL		
									GYNQRP PYGYY		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									ATIDPDT ISAL		
									AYYPAQ GVQQF		
									VYPSRA VITTM		
									SFSDYPP LGRF		
									SYYNSH DSLSL		
									AGLQFP VGRVH		
									SYLAGLT PTEF		
									FFPSSLA YSPY		
									SYIFPSSI SAM		
									YYLNEQ GDRVY		
									SYRGPQ DFNSF		
									YYYDPTT GLYY		
									YYYDPLA GTYY		
									FYGPAG PYGIF		
									YYQGLYE ILEL		
									IYYVGIYS SSL		
									KYRDFDI PAEF		
									LYFAEDP PTSL		
									KAPIRPD IVNF		
									FFPNMV NMIVL		
									VYGSPQ DGIPY		
									YYDGDI GNYYY		
									LYFGSAF ATPF		
									SFGVGA FPFGF		
									YYDGDV GNYYY		
									RYINPAK LTPY		
									FYGSKED PQTF		
									SYINTSLI QDY		
									FMRDQE KLSLM		
									FYPNFAE GIAL		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									MYSDAF LNDSY		
									VYSPVQ PGAPY		
									NYYVGG EIVTI		
									GFGILGH SQNL		
									KYIPTED VSGL		
									YYYDTHT NTYY		
									IVKPVKV SAPR		
									YYPDGH NDYGY		
									HYPDGR KEITF		
									FEPYKAV ALAS		
									AAGVTA APLPL		
									QWLIPD SADTT		
									YLPEAG QYSSF		
									AGRGFS LEELR		
									IECLPTS GHLS		
									QYPDYD TRQEL		
									AFPGASL YLPM		
									YTNLHIS DLAF		
									SFYSGLT PTEF		
									SYYAPSI GFPY		
									FFRSGKY DLDF		
									FMFQGS SNTEF		
									SYFINGD ISSL		
									NFGIGQ DIQPK		
									SYYDRG YDRGY		
									SVCTLSK MLEI		
									FFPEGED QVNF		
									TYINLKP ARKY		
									MKFNPF VTSDR		
									PKMMTL HQQCI		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									YYYDGD VGNYY		
									KFMDQ HPEMDF		
									HYMSPY QLNAY		
									FYPDEIQ RPPV		
									HYPSQP VFAPM		
									YYSPTKN EIVF		
									YYFAQQ NSGHF		
									CTFIRVS GSEL		
									FYQDTF GQQWK		
									VYFGTS HPRYY		
									FYQDTY GQQWK		
									YFLERGL ESAT		
									IYMDPH YCQSF		
									FYMDTS HLFNT		
									YFYDPD VGNFH		
									HFPDPN KLHCF		
									SYQDPA QLSCL		
									MAPSET QFSHL		
									VYHEPSS IGSM		
									YYMEGR DSMQL		
									IFFFGTH ETAF		
									FYPGSIE VRWF		
									QYWDPL LGTCM		
									YYALCGF GGVL		
									FYLNPD QSGEF		
									FFHELSP GSCF		
									LFPEADK VRTM		
									VYNTVS EGTHF		
									NYPDYM PSNIF		
									RYMLTA GLTAF		

HLA-C Alleles											
C0302	C0304	C0401	C0501	C0602	C0801	C0802	C1202	C1402	C1403	C1502	C1601
									WYFEGL YPTYY		
									VYFENSS SNPY		
									RFYDPTA GVVM		
									VYQETR ERLAM		
									KYEIASV PVSL		
									TFPAYPG SSSM		
									FYYDEFG FRVY		
									RYPEYD GRGVL		
									VFMDSN GIRQF		
									RYHGLSS LCNL		
									YYGYEDY YDYY		
									ADREDD PNFFK		
									FYNTAQ SPSAL		
									AFPGEA RISNV		
									LHQSVH TGEKP		
									FYYNTSE QNVM		
									HGLIRKY GLNM		
									LDFCAS NIIDH		
									YYQALSS SSIM		
									GSPVAQ ASQPV		
									DNPPVF SSDHY		
									FYYGGV SSASY		

[00516] **Table 1C.** A complete list of HLA-associated peptides identified across 3 HLA-B alleles.

HLA-B Alleles		
B0702	B0801	B5001
APAPVPVL	APLLRWVL	AEFLFNQC
APGPGLLL	AQRLKFRL	EFFPPSPR
APLLRWVL	DALVHFAL	FEFRAIEA
APWLGTVL	DAQFHFVL	HEREFGSV
LPIVTPAL	DAYIRIVL	IEWRFTEA
RPFLLRRI	DFKDKIVL	KDFIFVSA
SPAILPPL	DIWKKFEL	LEWPSLTA

HLA-B Alleles		
B0702	B0801	B5001
APAAPGLSL	DLFFHYVF	SEAIFLEA
APALLGLAL	DLIEKVVI	SEFEGFSF
APAPTAVVL	DLPEHAVL	TEFESFSF
APASGYLTF	DLWTKIIL	TEFLFHTA
APATVGLAF	DLYRKVML	TEFPGVVA
APELLRALL	DMKTKYFF	TEFPNFKY
APFLRNVEL	DMLIRQLL	TNLDTLLA
APFRSEVCF	DVITKFEL	YEFDKWAP
APGYLPTSL	EAFVRAFL	ADFAKVLEL
APHEILIQI	EAFVREVL	ADIRQTVPA
APHLVGPHL	EALIRTVF	ADTIFVTAP
APLALVTSL	EALKKLIL	AEAFRLPTA
APLAVFQML	EALLRYVL	AEAIRILAA
APLGVGLGL	EALYKWLL	AEALPSLAA
APQVHIFSL	EAYLKAML	AEANAFSVL
APQWPIIAF	EIIRKYVL	AEAPPPKIP
APRKPDWDL	ELQKRFIL	AEAQLWWAA
APRVPVQAL	ELWQRVSL	AEAVFASEV
APSLVAPAL	EMLIRVNM	AEDLNLLIA
APSPLQPAL	EPLVRQVL	AEFDSFVLV
APSPPLSGL	ESTLHLVL	AEFEWENKV
APTFTGSFL	FAMIIDKL	AEFFLSQQA
APVAVWAAL	FAYLRDLL	AEFIKFTVI
APVYLAAVI	FFYEKAIL	AEFLQKLLP
APWLNLREL	FGLLKAIL	AEFLTFHYA
APWQVVPEL	FIKIKMAF	AEFPGLPEA
APYGGPIAL	FLKVSSVF	AEFQVKITA
APYQFLTAF	FLPLKTML	AEFSFHVPS
ARGTYRLVI	FLRLITTL	AEFWKFSGI
FPFWPAKAL	FLVVRHQL	AEGPVAVVV
FPHEPWLRL	FLWERPTL	AEHDLWHII
FPMELRQFL	FLWQHQLL	AEHFSMIRA
FPNIPGKSL	FLWQHVEL	AEHGIFLPP
FPNKPPLTF	FMLKKIVL	AEIAHLYIA
FPQVGRTAL	FNWIKTQL	AEIDAHLVA
FPSPIRLEF	FPFLKMVL	AEIDLFRAA
GPAGPILSL	FPFSRPEL	AEIEDPPIP
GPGWRPLLL	FPHIKLTL	AEIEHFIHI
GPLDKWRAL	FPIFKACF	AEIIFNPSA
GPLFRNSQL	FPIYKVLF	AEIIQLVNA
GPNASIISL	FPKAVSVF	AEINNIIKI
GPRLPWTRL	FPKEIQML	AEIQGVIDA
GPSPNPLIL	FPLIKEII	AEKDFWELA
GVRPPAPSL	FPLPHRVL	AEKYEWDVA
HPRDFFSRL	FPLVKSAL	AELATRAIP
IPAGGVLTL	FPNLARVL	AELDKLTSV
IPALGGISL	FPPLHYEL	AELDVPALP
IPAPAFLLL	FPSIKTEF	AELEFAIQP
IPEELKPWL	FQIEHHLF	AELFWPSMA
IPFAAPTAL	FVIKKHEL	AELLPLVSA
IPHMDIEAL	HLLIKRSL	AELLVLLAA

HLA-B Alleles		
B0702	B0801	B5001
IPYPRPIHL	HNFIKVTL	AELPWAVKP
KPINFSVIL	HPHWKVRL	AELSFFGHA
KPMEKLLGL	HPTLKLIL	AELWKNPTA
KPRPIIPML	HPYFRVLL	AENYFQLSV
KPRPPLHLL	IAKLMVEL	AEQPYFIEA
KPSKWWTCF	IPMIIHQL	AERFHFEAL
KPSLPFTSL	LAIYKQVL	AETEFFSKA
LFQMPLESF	LAKLKYQF	AEVDRQVIP
LPAEFFEVL	LAVLKHVL	AEVEKWLGP
LPAGIVAVL	LGHVRYVL	AEVFPPPVA
LPASGQIAL	LLKSKLYL	AEVGRVLQV
LPAWIRIVL	LLLKKWSL	AEVKPILQA
LPAWPHRGL	LPFKKSLL	AEVLTFLDA
LPFGPFKEL	LPHVVPTL	AEVRVIAPP
LPHAPGVQM	LPKIKAIP	AEVWWNLVP
LPISVAASI	LPKLLVEF	AEVYRILSV
LPQGIVREL	LPKLYVKL	AEWKFLNPA
LPRLTPPVL	LPLTHFEL	AEWLGVLKA
LPSPPAVAV	LPLVKPYL	AEYAGLKVA
LVMAPRTVL	LPNIHPEL	AEYEFLSFV
LVRPVFGEL	LPNIQAVL	AEYGHFVDI
MPALRSINL	LPYIKQEV	AEYLHWLLT
MPSQFRDIL	MAFLKTAL	AEYLYFFRV
MPTMRLLSF	MAFLRELL	ALPEIFTEL
NPAENFRVL	MPKVHIEF	DAKIRIFDL
NPASPPLSL	MPTVHYEF	DEYQFFTQA
NPISTVTEL	NIKPHWMF	DQFTCPDGF
NPLLRVINL	NLKVKVLF	EEFGDFRLV
NPRIPYTEL	NLLGKFEL	EEFGRFASF
QPASFAVSL	NLLLKHLF	EEFPAFPRA
QPGLPGLVL	QALLRISL	EEFSFIPSA
QPNPLPLRL	QFIIKHEL	EEFVFIPAA
RPALPVSYL	QGYLRSVF	EEHEWFIPA
RPDGFLLVL	QPLLREVL	EEHNFFLAP
RPLYKNIVL	QPYLRELL	EEIEGLISA
RPQLKGVVL	QPYSRFLL	EEYYPFSEV
RPRIDLIVF	QSFLRAIL	ELNISEIPP
RPSLPLPHF	SLMLKEVL	EMLKRNIGV
SPAFRILSV	SNKLHFAF	EMLQRADPP
SPAGPILSI	TLKLIFSL	ESLAGILGT
SPALKRLDL	TPFIRPVM	FDKTFEISA
SPALPGLKL	TPFPKNFL	FEALPFAMA
SPASPKISL	TPLKKFLL	FEARFFHLA
SPDLRLTWL	VHFKLSPT	FEARIALLP
SPFHRNLFL	VPKTHLEL	FEFDIFTRL
SPGWVRLAL	VPRLKTWL	FEFDTKTSA
SPHGHILVL	VPSIKFCL	FEFEYQTKV
SPHIPYKLL	VPSPKVVL	FEFGVFPAI
SPILPITEF	VPYLPRLP	FEFLLKLTP
SPISHFLDL	WIKEKIYV	FEFLTKELA
SPLLSVTSF	WPLPKALL	FEFPDYCTP

HLA-B Alleles		
B0702	B0801	B5001
SPNAIFKAL	YAFLHRTL	FEFPRPFLP
SPNLRLLDL	YALPHAIL	FEFTDFTLP
SPQPRLIYL	YFIVKEIL	FEILPGLSV
SPRLPVGGF	YGMPRQIL	FEIPTGREA
SPSAYVLEI	YGVLRFIM	FEIRGTLLP
SPSLPNITL	YIKNKLVF	FEKEWIECA
SPSSILSTL	YILPKNVL	FEKPFLWLA
SPTTAFTVL	YIMVRLFG	FEKVFSIGP
SPVFRLETL	YLFPKFTL	FELLDRILP
SPVLSLSSL	YLNYKVCL	FELPYVSVT
SPWLLRVEL	YLRSVFAL	FENLFSKPP
SPWSGLMAL	YLWTKQVL	FEQKGFRLV
SPYLRPLTL	YPCSKFII	FETEFNTQP
SPYQGGVFF	YPFHVPLL	FETQFILSP
SPYQNIKIL	YPLWKVTF	FEVKKWNAV
SVRPLVTEL	YPMPRVIF	FEVPHELVA
TPLSSTVTL	YPWVHVVI	FEWTFPTRP
TPWQPPTVL	AALARLLAA	FEYILSHVA
VAPGALLGL	AAMPRIYEL	FEYPNFIRV
VPAAVFGSL	AARFKLWSV	FEYSIRTTP
VPAEPKLAF	AAYLRALSL	FEYVKVPLA
VPAEPSSLL	AILLKKISL	GDRIFFVSA
VPQSGVPAL	ALALRFLAL	GEAIPALAA
VPSPYLSSL	ALLDKLYAL	GEAWPFESV
VVAPAGITL	AMLERLLSL	GEEFLFRTA
WVRPDLGEL	ASYLRLWAL	GEFEGFVAV
YLRPPNTSL	AVILRALSL	GEFGGFGSV
YPAAKRVKL	CPLLKIEDV	GEFGGFSEV
YPAAVPQAL	CPLLKPWAL	GEFHLWYQV
YPKRPLLGL	DAAIRVWSL	GEFLAFQTV
YPRPLLIAF	DAFVRLIAL	GEFLPIQPA
YPRSLFPSL	DAHIRLWDL	GEFTFLLPA
AANPNRFITL	DAKIRIFDL	GEHCDFTIL
AARPVPWNAL	DAKQKWLLL	GEIFDHLVA
APALSWRLPL	DATIRIWSV	GEIFNVQLP
APGPIHLLEL	DFKIKTVEL	GEIFSLCLP
APIIRVGGAL	DFKIRTIEL	GEILGLLGP
APKRPPSAFF	DFKIRTVEI	GEINVIGEP
APPFVARETL	DGLLRVLTV	GEIPKVLVA
APRDAYWIAM	DIHHKVLSL	GEIVRLTTP
APRIALHTAL	DIIKKPIAL	GEKPGFLAP
APRLPLPYGF	DIITHILAL	GEKSFFLQP
APSGSLAVPL	DIIYKKIAL	GELLFVHSA
APTPIQALTL	DIKEKLCYV	GELMAFLLP
APVPTTTLVL	DIKKILDSV	GELPFLTHV
AVDPNRAVPL	DILHRVLCL	GELPLSLAA
KPHSGFHVAF	DILKRLYEL	GELSDWSLP
KPIFSKIVSL	DILRRVLVL	GENFDKLLA
LPAGWILSHL	DILSRIHTI	GENLGFWEA
LPPEIVPATL	DINVRWLAV	GEREIWNQI
LPPLPKRPAL	DIWVKSYSL	GETIFVERP

HLA-B Alleles		
B0702	B0801	B5001
LPRGSIPRSL	DLFRKALEL	GEVFDYLVA
LPRPHASIMF	DLHEKDFSL	GEVPPGPLP
LPRRPNDIYV	DLIGKLTSL	GEVVLRFAA
LPSDLRTISL	DLILKWLTL	GEYEWVHKP
LPSFTRSRPL	DLIMKVENL	GEYGGWYKA
NPRQINWTVL	DLISRDYSL	GEYGKFFVT
QPDQTRIVAL	DLKAQILEL	GEYKFFWTA
RPAEVGGMQL	DLKLRKFVF	HELPFYGCA
RPDERRFAVF	DLKPRNIFL	HEYPWILSA
RPGRFFGVYL	DLKTKVLVL	IEAFTPLLA
RVREIIINAV	DLKVKLTEV	IEAKFYEEV
SPAGEWRALL	DLLARIETL	IEAPHFPLP
SPANTRYLFL	DLLEKSFSL	IEFPYKNLP
SPHPGLLLDL	DLLKRILKM	IEFSRIREA
SPTSAHLLQL	DLLKRLEAA	IEHLKENVP
TPAAVRELVL	DLLLRIREL	IEIDFPRAA
TPFGGRLLVL	DLLQRLDAL	IEIERILSV
VPNATIRNVL	DLLRKVGAL	IEIYPLAEA
VPNQKRLTLL	DLMIRLLEL	IELDMRTIA
WPKDVGIVAL	DLNYRWVSL	IELPSMAVA
YPFKPPKVAF	DLQARITSL	IERPIRIVA
APFEPLASGIL	DLQKRLLAL	IESPPAFTA
APRQPGLMAQM	DLRTKGFSL	IEVSLPEAA
APSHLMALLTL	DLYTRFDTL	IEWDKPPVP
APSPVIPRLTL	DMFYRNWAL	KDLLFILTA
APTQEKIFAVL	DMIKRALDF	KDYPFYLTV
FPMGDRLYIGL	DMKIKVTDL	KEFEFSQLP
HPRDPNLLLSV	DMKIRLFTS	KEFNFPEEA
IPDAKHVFTTF	DMKTKYFFF	KEFPFDVQP
IPRTPLSPSPM	DMLLKEYLL	KEFPYGIEA
IPYHSEVPVSL	DMLLKIKAV	KEFQLFQGV
LPRTIFPTSTI	DMLVKVNAL	KEFSPFGTI
LPVSLSRGALI	DNMPRILSL	KEHLYFETV
MPAFSKIGGIL	DPPLKFMSV	KEIDVISIP
NPRQPLPASGL	DQFQKVLSL	KEIFQTTVP
RPFGSISRIYL	DSIIRIWSV	KEKSIFLVA
RPYAPINANAI	DVKLKFEEI	KEVEQFTQV
SPANPAHILSL	DVQLRLNSI	KEYFGIVSV
SPAVERLISSL	EAHLKFLAF	KEYLFYAEA
SPDEQKVFALW	EALPRIVEL	KEYLFYLNV
SPRPALPALLV	EALQRLVNL	KEYPDFNFV
SPYLPRGDPVL	EALVRTVAL	KEYPFILDA
TICLAHALTVL	EAQLRQFTL	KEYWFVLTA
TPDPSKFFSQL	EARPRPLSL	LAEFKRDLE
TPDTGRILSKL	EGFLKAQAL	LEAELHFPA
TPRRPAGLLML	EGKLRLVEI	LEAHFVPLV
TPSLVKSTSQL	EGLPKPLTL	LEAILAAVP
VPDSSGPERIL	EIIHRYVEL	LEALPQIAA
VPDTSRIYVAL	EIKEKLLQL	LEAPDLLLA
VPRASVPDGFL	EIKLRLLDL	LEAVLKLLP
VPRPVLRALSF	EIKTKIKEL	LEAWLQREA

HLA-B Alleles		
B0702	B0801	B5001
YPMDLGGRNFL	EIKVKLIEA	LECEIKLAP
	EILLRKLPF	LEDRPRLLP
	EILLRVLTL	LEFERWLNA
	EIRLKIVGT	LEFPQFETL
	ELDVRITAL	LEHALFTAL
	ELFLRALCL	LEHPFVSSI
	ELFLRFISL	LEHQVFTVL
	ELFLRGPAL	LEIDFPARA
	ELFLRRISL	LEIENLNLA
	ELFPRYTSL	LEIPDILNA
	ELITKAVAA	LEIPRLPPP
	ELKQRFSVF	LEKIFQNAP
	ELLFRPTAL	LELDTNLPA
	ELLQKVITL	LELFCKILE
	ELLTKALHL	LELIGHAVA
	ELLTKTYVL	LELPGQPVA
	ELLVKGYEI	LELPHLTSA
	ELNPKILAL	LEREEFLVP
	ELQEKFLSL	LERFPWPSL
	ELQLRLLAL	LERPHFTLP
	ELQSRLAAL	LEVKLGELP
	ELRLKPQLL	LEVLKLLVA
	ELRLKYYGL	LEVPGLRSV
	ELRPLPVSV	LEVVKFTQA
	ELYQRIYAF	LEWDGFFST
	EMKSRILVI	LEYGLPIQV
	EMLKKFLSF	LEYHVPVTA
	ERPIRIVAL	LEYLAFSDS
	EVILRAEAV	LEYWNHLAA
	EVISKLYAV	LEYYDFYEV
	EVKTKLFSL	LTQALKDNK
	EVLQRIESL	MEALPLLAA
	EVYLKPYFL	MEDIKILIA
	FAHLRLEVL	MEFQRFVTP
	FAKIYADTF	MEHPYFYTV
	FAKLRELLL	MEIERILGV
	FAKVHILYV	MELAEQITL
	FANLKYVSL	MELWPCLAA
	FFKERVMEI	MEYDQPLYV
	FFMERSWSV	MEYPNFEET
	FFMLRSLSL	NEFPFGCPP
	FGFERLEVL	NEIIFPHCA
	FGKLRNIEL	NEYAGFLMA
	FGLARAFGV	PEFKFWHAA
	FGLARAFSL	QEFDHFLAT
	FGLARIYSF	QEFLTEALP
	FGLPRWVTL	QEFNRLLEA
	FIFLRLNVL	QEFPFPETP
	FIFQKVGKL	QEFQNFKTL
	FIHQHFVEV	QEFSFFDKV
	FIISRTQAL	QEFVRALAA

HLA-B Alleles		
B0702	B0801	B5001
	FILKKLDSI	QEFWNFCEV
	FILPKEIAV	QEHPVVLLP
	FINARNWTL	QEIATVVVP
	FLAPRLLSL	QEILGVLVP
	FLAQRAVEL	QEKALFAVP
	FLEEREIAL	QEKYFLLQA
	FLFSKFIEL	QELPGLPAP
	FLHIKETVL	QELPRLLSA
	FLKEIVETF	QELSRFIAA
	FLKIKPVSL	QEVERFLAP
	FLKINVSEL	QEYFGSLAA
	FLLDKKIGV	QEYNQFCVI
	FLLEKGYEV	QEYPTLKVP
	FLLEKPFSV	READFFWSL
	FLLPKVQSI	REFALRLVA
	FLLQRVHSL	REFDFFNKI
	FLLRRLVTL	REFPVISVV
	FLREWVESM	REFSDFIRV
	FLREYFERL	REFVLLPAA
	FLYIRQLAI	REHAPFLVA
	FLYPFPLAL	REIFFPETA
	FMKPGKVVL	REMIPFAVV
	FNFLRNVSL	RENFFPVTV
	FNRPRIETL	RENVFKLLP
	FNWGRVVAL	RESVFKLLP
	FPFERLYDL	REYDRFYVI
	FPHLREEIL	REYFSWEGA
	FPHLRVLEA	REYMGFIQA
	FPKWKPGSL	SEFCFILKV
	FPLTKVYVV	SEFEGFSFV
	FPMAKLLYL	SEFISFITS
	FPPKKLFSL	SEFMFEKAP
	FPWEKPTTL	SEFRNPLAP
	FQKVKEWSL	SEHCFDLIF
	FQMKKVLCL	SEHVWVEVV
	FSFVRVISL	SEIPKLPAV
	FSKMKALAV	SEIYGLMKA
	FTIFRTISV	SEKPYILEA
	FVKILIVEI	SELAFPITA
	FVKTKVWSL	SELDRLLSA
	FVLQRLVFL	SELERLIVP
	FVMLRVFQL	SELFVLNAA
	FVQPRLESL	SELPFTIAS
	GLCERLVSL	SELPIVTPA
	GLKVREYEL	SELQQLGLP
	HAIQKLYSL	SELTPMLAA
	HALERLFTM	SEVELMKVA
	HFLQKLYSL	SEVGKLLSA
	HLEIKVLCL	SEVILPVPA
	HLFQRLAAL	SEVNLFLVP
	HLILRAEGL	SEWKFTITP

HLA-B Alleles		
B0702	B0801	B5001
	HLKPISREL	SEYNAFWKC
	HLVQKPFSL	SEYQWITSP
	HLYARQLTL	SVHETCIIF
	HPYNKLWSL	TDFAFRITP
	HVITKTMEL	TEALHFVAA
	HVNIRLVEL	TEAPPIIFA
	IGKMRYVSV	TEAPRWPLP
	ILIRKVSSL	TEFPLFLQT
	ILRAILLSL	TEFQEFLSV
	IPLAKRVAL	TEFRNFIVW
	IPNEIIHAL	TEIGKLLSS
	IPNVRIQAV	TEIPEFPIA
	IPQVKYICL	TEIRDMLLA
	ISPKVKMAL	TEIWFLDRA
	KPMEKLLGL	TELELFKAA
	KVVFMVLAL	TELRFEVEA
	LAAARLAAA	TEYSFLKEV
	LLFKKVKAL	VEAFFLVHA
	LLILRPEEL	VEAQLKKTP
	LLKEHYVDL	VEFARPQIA
	LLKSKLLVL	VEFEDFSQP
	LLNQKPLSL	VEFGNFNNL
	LLQIRAEAL	VEFHRLWSA
	LLQLKVKCL	VEFMHYIIA
	LLRIKINEL	VEFNFGQRA
	LLRLLYEAL	VEFNGKLLA
	LLTLKLVSL	VEFPDFSST
	LLYEKGISL	VEHDAFIFA
	LPDERTISL	VEHEDFLTV
	LPDIKVLTL	VEIFKFEEA
	LPFLRITSL	VELFFQEVA
	LPHHRVIEV	VELQRMKIS
	LPKLHIVQV	VELSQLRVA
	LPLHKVKSL	VERVIEFAA
	LPLLRVLSI	VEVIKPLVA
	LPLMKFLEV	VEVPETPKA
	LPQIKIISA	VEWSAFLEA
	LPQYRLISI	VEYDFHLLP
	LPSLKVSCL	WEALVSPVV
	LPWKRIVAV	WEIDNNPKV
	MALVRFVNL	WEIENNPTV
	MAPLKMLAL	WEIKTITSA
	MFHIRAVIL	WEIRDRLLA
	MIKEKLCYV	WELLPSAAA
	MLAARLVCL	WERGFFLSA
	MLATRVFSL	WEVVPEPVA
	MLLYIRDAL	WEVYLRETA
	MLYPKLISL	YEAFLVGKP
	MMKLIINSL	YEAPIFTIP
	MNILRFLAL	YEFGQIINA
	MPALRSINL	YEFHLPLSP

HLA-B Alleles		
B0702	B0801	B5001
	MPAVKAIIY	YEFLVGKPP
	MPFLKETVF	YEFNVWTRP
	MPGTRFIAF	YEIDKTLGI
	MPNVKVAVF	YEILNNPEL
	MPSSRLWSL	YEILRLLVT
	MPTMRLLSF	YEIPPITPP
	NFIEKVEAL	YEIPSNLTP
	NIKDKVLEL	YEKFFGLLA
	NIWIRVASL	YEKILFTEA
	NLFTRPEVL	YELALILKA
	NLHLKFLAL	YELAQVLLA
	NLKEKIKEL	YELEHLSTP
	NLKLKLHSF	YELLFKEGV
	NLKLKLHTF	YELQFRLGP
	NLKLKLTAV	YENELMLMS
	NLKLRIYFL	YERIYNEIP
	NLKSKYFAV	YERLFGTTV
	NLLKRFLVL	YEVRLTQTV
	NLLPRLAAF	YEYAYLKAI
	NPIWRVISL	YEYKFGFEL
	NPLLRVINL	YEYLLHVGA
	NPYSRLMAL	YEYRFLEFT
	PIATRIFDI	YEYRHVMLP
	QAITRVIPL	ADFNATVQFI
	QANIRLTSL	AEAFGFKVNA
	QAWLRLTSL	AEALNVFQQA
	QILPKIKAI	AEAQLRFIQA
	QIVERLFSL	AEFDSFVLVT
	QLELRVEAL	AEFLKVFIPS
	QLFQRPNAL	AEFNSTPAVF
	QLFVRAQEL	AEFPHSFLVS
	QLFVRLLAL	AEHPTIKIFW
	QLGSRYFAL	AEIDAHLVAL
	QLHIKVTSL	AEIDFRLVSF
	QLIQKFISV	AEIEHFIHII
	QLLEKVIEL	AEIEVRSLLP
	QLLLKKMYL	AEIKVKLIEA
	QLRLKPFYL	AEILRSLNSA
	QLSLRTVSL	AEINNIIKIV
	QLWLRIQEL	AEITELIHIA
	QLYLKLWNL	AELADVLTEA
	QMKLHIVAL	AELDSVFSSA
	QNLVKIMSL	AELGVPLSQV
	QNMERIFSF	AELLGFLTHA
	QNMIKGVTL	AELYGPFTSA
	QPILRFLQL	AEMLYGLIHA
	QSMIRILGL	AEMRPFIEII
	QVIIRVLEL	AEPDFIFRAP
	QYHIKPLSL	AEPSFPFQVA
	RPWLRPAAL	AEPYMIFKEA
	SAFLKTIAL	AEYDNFFQHL

HLA-B Alleles		
B0702	B0801	B5001
	SALERLTTL	AEYDRPNLLP
	SAMVRVISV	AEYEFISSGL
	SIIQRLLEV	AEYIPLTPAA
	SIKKLITSM	AEYLLGPLYA
	SILQRPLSL	AEYSRFVNQI
	SLFKRLYSL	AIHYMTEQAP
	SLITRLLEV	ASIALEDLLP
	SLKKFIYAL	EAFLEPLGTL
	SMKENKVAI	EEIKDFLLTA
	SMLNRILAV	EGFGVHPKNI
	SMLQRVLHL	FEANFGKIQA
	SNKVRILEL	FEAPATINSA
	SPLTKSISL	FEEGNVKLLA
	SPYLRPLTL	FEFGVFPAIL
	SQMLRAVSL	FERPEGFLQA
	SVFQRYLAL	GEADVPFYYA
	TAKFHFVDL	GEAEAFAIGA
	TAKIRPFAV	GEFADPFKLA
	TALMKLKSL	GEFEGFVAVV
	TALPRIFSL	GEFGGFGSVT
	TALRKVLSL	GEFNEVFNDV
	TFIQRVQSL	GEFPFAKCFV
	TFLQRLISL	GEFQSFPKVF
	TGYLKGYTL	GEFRQGLISA
	TIIPKVLAM	GEHLPFLTSV
	TIKFKWWGL	GEHVPGFCLP
	TIMPKDIQL	GEIDTRFSFC
	TLFKKIQAL	GEIEGFRLSA
	TLIHKPVSL	GELGNGNIKL
	TLKEYLESL	GELLERLSSA
	TLKRTIEAL	GEPKRLETEA
	TLLERAFSL	GEWVGFTLLC
	TLNEKLTAL	GEYDFRYIFV
	TLNIKPVSL	GEYGKFFVTI
	TLRLKVEEL	GEYSKVLAIA
	TLTSKLYSL	HEFLHEVPAA
	TNMLKVVAL	HENILGFIAA
	TNTLRILAL	IDITPETPTV
	TPHLRNLAV	IEFDNFIQRT
	TPILKPVSL	IEIELENSRP
	TPISRLVAL	IEVEKPFAIA
	TPLARIVAF	IEYDDFVECL
	TPMFREYSL	KEFCAFSQTL
	TVKVHVVAL	KEIDAYIVQA
	VAAKKNVSI	KEIQGFFNIP
	VALLRVTPF	KEIQGFLDCA
	VGLIRNLAL	KEMEAFLVSV
	VGLLRLHSL	KEYAAFVLGA
	VIIEKTYSL	KEYDFGLGAP
	VLHVKTESL	KEYDGFTITI
	VLMIKALEL	KEYLSAFLAA

HLA-B Alleles		
B0702	B0801	B5001
	VLQQRLIAL	KITPLEIEVL
	VMAPRSLIL	KNLNFRHKMA
	VPFERPAVI	LEFAFRYVTT
	VPLVREITF	LEFKEFVGLP
	VPMFRNVSL	LEFLNRFEEA
	VPYEKGFAL	LEFPYGILAA
	VPYLKIFTV	LEHYFHAVVA
	WIHVKPERL	LEIEFKETQA
	WIKEKIYVL	LEIEGERELP
	WLHLIPQTL	LEIQQELKTA
	WLKICRLTA	LELPGPLMAA
	WVKEKVVAL	LENPSPFHSP
	YAFPKAVSV	LEVFPEFAAA
	YAFVRPVIL	LEYPDFYRKL
	YAKIHIPII	MEHPYFYPVV
	YAKIVEIPF	MEHPYFYTVV
	YALNHTLSV	NEYRFAWVEA
	YAQIRTIAI	QDFPPDCWVS
	YFKIYIDSL	QEFAEGFVKA
	YFRVMVDSL	QEFDYQPIAA
	YGFEKPSAI	QEFQDAWKLP
	YGMERVWCV	QEFSFGNLRA
	YGYVRAEVL	QEIECRLVEA
	YIHVHFLEV	QERIDAWAQL
	YIIKDKHIL	QEYDALAKVI
	YIKRLLETL	QEYGSIFTGA
	YIKTELISV	QNNHTLFTDL
	YILGKFFAL	REFDAFVETL
	YLFERIKEL	REFSDFIQAV
	YLFERTFNL	REGDLLFTVA
	YLGAKPRSL	REGPPFISEA
	YLHPLRSLF	REHQFYETLP
	YLKPYFLEA	REIEELLAEA
	YLKTKFICV	RETDFYLQSV
	YLKVKGNVF	REYEIEFIYA
	YLKVLPQEL	REYGVPFLET
	YLKVLVDSL	REYMGFIQAM
	YLKVRPDEI	SEFQPSFHQA
	YLLEKFVAV	SEFSFSKLAA
	YLLEKSRIV	SEHCFDLIFA
	YLLEKSRVI	SELEKTFNLP
	YLLLKTHQL	SEVTFALHSA
	YLLQRAVEV	SEYARRFGVP
	YLRELLTTM	SEYNFEDLSA
	YLRNLTWTL	TEFRNFIVWL
	YLRQYPFQL	TEPKKLGTVP
	YLSPKLWAL	TEYENFKVQV
	YMYQLFRSL	TLPPPDFPPP
	YPFQKPVTL	VAAFSCSVAP
	YPKLKTDVL	VEFMHYIIAA
	YPLLKDPSL	VEFNGKLLAS

HLA-B Alleles		
B0702	B0801	B5001
	YPLLKNISM	VEFRNFKIIY
	YPNERFELL	VEFVKSFNLP
	YPRLKVLAF	VEHYFFGVEA
	YVKLTPVSL	VEIRSGFLAA
	YVLLKALAL	VVPPFLQPEV
	DIKESHLIEL	WEAYLGLLQA
	DLRTKATIEL	WNCSSIELAP
	EAFLKHILSV	YEFDFSKVYW
	EAYLKYIEGL	YEFPRVFSSV
	FMKEKLLAEL	YEIKQFLECA
	FPLIKEIISI	YELDLGLNHV
	FPTVHAVILL	YELLFKEGVM
	ILKYHTEIVF	YEQDFAVLTA
	IPIVHRVIKV	YEVRLTQTVA
	LLALVGLLSL	YHEMSPLLAS
	LLKIKGVISF	AEADKIGLLLA
	LMQAGILELL	AEAERLLAPFL
	LPHLRNKLVI	AEANAFSVLQH
	LPHLRSLVEI	AEDVLSGKVSA
	MPFIKSQHEL	AEFHQIEGVVA
	MPSLKHIVEL	AEFPLGPVTTA
	TIPPMEKAVV	AEFWKFSGIVF
	VLLKARLVPA	AEGLPTPIIYW
	WPLIKATVGL	AEHDLWHIIKF
	YAYLKAIVLF	AEHRFWAGVVF
	YLFDRNGVCL	AEIDAHLVALA
	DIKLKDIEHAL	AEIDPKQLVDI
	FIFEKKLAQAL	AEILELAGNAA
	FPSVRELGAAL	AEILNGKEISA
	LPHLRNKLVIK	AEIQFADYIFP
	SIISPKVKMAL	AETPGFGAVTF
	SLFTKELEHAL	AEVDPDTILKA
	VPLLKTLDHVL	AEYAGRLGVGA
	VPNLHKVIVVW	AEYGHFVDIRI
	VVLLKARLVPA	AEYIPLTPAAA
		DPFNPFELTNH
		EATKPAGEQIA
		FEIKDKMLIEF
		FEVGPPAFRIA
		FVTLCEKEVAA
		GEDSSFLVVRL
		GEFGGFGSVTG
		GEIDTRFSFCA
		GEITLRGLVLP
		GEWVGFTLLCA
		GEYVSLGKVEA
		KESPVFAPVYF
		KNEVYLMKNTM
		LEAAQGLLVEA
		LEFDPAQRITL
		LEHVFFQVVEF

HLA-B Alleles		
B0702	B0801	B5001
		LEIAPHALLQA
		LEINFGDLGRP
		LESLPEPVICY
		LEYDPAKRITL
		LEYDPLSNYSA
		LEYGFLRLSQA
		LEYIARAILSA
		MEHDGSLFQAV
		MERNFQPVIIF
		PSGNGYKFLSP
		QEIFTEQVVTA
		QEYLSGRSILA
		QGLEKEELEDL
		READAALFSEL
		REFLFNAIETM
		REIEIPLGELF
		REIFLSQPILL
		RELENLIGISC
		RELLIIGGVAA
		REPPADVWTPP
		RESGQLFHIDF
		REYDRFYVINY
		REYEIPSNLTP
		REYNARLFGLA
		SEEDRVVVIRF
		SEIDESVKLIP
		SEYSGFVNPVL
		TEDPHTVLVEF
		TEFFFGASGSP
		TEYENFKVQVL
		VEFQHIIPISA
		VEYIFGIVGIP
		WEYDESHVITA
		YEIPGLEPITF
		YELDLGLNHVV

[00517] **Table 1D**: Comparison of the number of overlapping and unique peptides between our LC-MS/MS dataset and IEDB (all lengths)

Allele	Count MS	Count IEDB	Overlap	New	% of MS	% of IEDB
A*01:01	1328	6931	808	520	39.16%	5.82%
A*02:01	2668	22631	1799	869	32.57%	3.84%
A*02:03	1883	4234	3	1880	99.84%	44.40%
A*02:04	1796	17	0	1796	100.00%	10564.71%
A*02:07	3420	170	46	3374	98.65%	1984.71%
A*03:01	1698	8397	383	1315	77.44%	15.66%
A*24:02	2237	7733	951	1286	57.49%	16.63%
A*29:02	923	7569	628	295	31.96%	3.90%
A*31:01	1314	4978	1	1313	99.92%	26.42%
A*68:02	2234	4385	1	2233	99.96%	50.92%
B*35:01	1001	2752	18	983	98.20%	35.72%
B*44:02	1085	2235	163	922	84.98%	41.25%
B*44:03	923	2741	241	682	73.89%	24.88%
B*51:01	1510	2298	7	1503	99.54%	65.40%
B*54:01	1276	660	0	1276	100.00%	193.33%
B*57:01	1365	3356	283	1082	79.27%	32.24%
Total	26661	83079	5332	21329	80.00%	25.67%

Table 1E: Negative control peptides

ControlPeptides	ControlPeptides	ControlPeptides
QEYDESGPSIVHR	VSHVSTGGGASLELLEGK	AGLQFPVGR
GPGTSFEFALAIVEALNGK	IREEYPDR	HGESAWNLENR
GHYTEGAELVDSVLDVVR	SGKYDLDFK	EIIDLVLDR
ILSISADIETIGEILKK	ARFEELNADLFR	EITALAPSTMK
VTIAQGGVLPNIQAVLLPK	DRVYIHPFHL	DMGFTEEEFKR
LISQIVSSITASLR	STAGDTHLGGEDFDNR	GNPTVEVDLFTSK
AMGIMNSFVNDIFER	GGGGNFGPGPGSNFR	PPYTVVYFPVRGR
VDNDENEHQLSLR	FEDENFILK	TEWLDGK
LGDVYVNDAFGTAHR	LGIHEDSTNR	ISEQFTAMFR
VAPEEHPVLLTEAPLNPK	YYVTIIDAPGHR	VEIIANDQGNR
AQLGVQAFADALLIIPK	LFIGGLSFETTEESLR	GEWTMCTPPTGINKTNIE
AAEDDEDDDVDTKK	GLGTDEDTIIDIITHR	QIFHPEQLITGK
THINIVVIGHVDSGK	LGLVFDDVVGIVEIINSK	TLVLLMGK
DSLLQDGEFSMDLR	QVHPDTGISSK	MAVTFIGNSTAIQELFK
LHFFmPGFAPLTSR	LFIGGLSFETTDESLR	GFAFVQYVNER
DSYVGDEAQSKR	ILLANFLAQTEALMR	IILDLISESPIK
DLADELALVDVIEDKLK	ILTEAEIDAHLVALAERD	VLGSGmQYHLQ
IWHHTFYNELR	RFDEILEASDGIMVAR	LDIDSPPITAR
RVYIHPFHL	HLEINPDHSIIETLR	LQQELDDLLVDLDHQR
LIIVSNPVDILTYVAWK	DRVYIHPF	FAEAFEAIPR
HFSVEGQLEFR	ADDGRPFPQVIK	GFGFVDFNSEEDAK

ControlPeptides	ControlPeptides	ControlPeptides
LISWYDNEFGYSNR	DLTDYLMK	SQIHDIVLVGGSTR
SLTNDWEDHLAVK	GVVDSEDIPLNLSR	QVLLSAAEAAEVILR
YISPDQLADLYK	TFVNITPAEVGVLVGK	GALQNIIPASTGAAK
IGAEVYHNLK	AVFVDLEPTVIDEVR	KLFIGGLSFETTDESLR
VVIGMDVAASEFFR	SNYNFEKPFLWLAR	VGVNGFGR
GYSFTTTAER	NLDIERPTYTNLNR	SLADELALVDVLEDKLK
AVFPSIVGRPR	AGFAGDDAPR	DSYVGDEAQSK
HLQLAIR	AEFEVHEVYAVDVLVSSGEGK	NPLPSKETIEQEK
LLLPGELAK	VNPTVFFDIAVDGEPLGR	LVINGNPITIFQER
HQGVmVGMGQK	LLQDFFNGK	GDLGIEIPAEK
FGVEQDVDMVFASFIR	RPPGFSPFR	IIAPPER
YPIEHGIITNWDDMEK	DLADELALVDVIEDK	YPPLPKDKLNPPTPSI
HLmLPDFDLLEDIESK	GGNFGFGDSR	ELSDIAHR
	YPLSFMAAVPHRtHAVDYLGLE	ALEEQLQQIR
LGGSAVISLEGKPL	PVDLSKWSGPLSL	SRSGGGGGGGLGSGGSIRSSY
VGAHAGEYGAEALER	DNNRSLDLDSIIAEVK	STGDVNVEmNAAPGVDLT
LTSFIGAIAIGDLVK	SLDLDSIIAEVK	LSDnIIA
EVVEEAENGR	DLDSIIAEVK	HFDPTISL
PPYTVVYFPVR	mDNNRSLDLDSIIAEVK	HSLPDLPY
EDQTEYLEER	PPYTVVYFPVRG	YIHPFHL
EGLELPEDEEEKKK	TNAENEFVTIK	HLPETKFSEL
QGVnDNEEGFFSAR	VIILNHPGQISAG	PPAGKWKQVRTNPA
LEQTGLR	DNNRNLDLDSIIAEVK	TLPKISPSSL
ASGQAFELILSPR	IIHEIAVLEL	VSPVVRVAV
DVNAAIATIK	HVTVIGGGLMGAGIAQ	DLEmQIESL
SSGGREDLESSGLQR	NVKVDPEIQ	mNCRELPLTL
EAEAAIYHLQLFEELR	VmAPRTLIL	TAWLDGKHVVF
EDTEEHHLR	YFAERVTSL	TNGKEPELLEPIPY
ESYSVYVYK	FTPAVHASL	KQGSLPDIQGPAAAPPL
STTTGHLIYK	VNLPINGNGKQ	NSGDVNVEIN
IVADKDYSVTANSK	SVPNVHGALAPL	TIPVSPLHL
YKPLDLRPK	TLGVKQLIVGVNK	PVDLGAPI
FADLSEAANR	TAQVIILNHPGQISAGYAP	IVPEGVHAL
IPYSLRRLTGLEVQNm	NAENEFVTIK	YLNENPLRAL

ControlPeptides	ControlPeptides	ControlPeptides
LIHFSGVALGEACTIVLRG	GnCPERIITL	YLPDGTASL
KLFIGGLSFETTEESLR	AAPLRLIAA	NLQIDPTIQ
VPGSIRTAEHFLGF	NVEIDPEIQK	LmPTVNQTQVFK
VAGMDVELTVEER	HSLPDLPYDY	AAPGVDL
IIAPPERK	NAPLVNVTL	VLPEHVSVL
GIMNSFVNDIFER	ALEEQLQQIRAE	LNDmRQEYEQL
AFVHWYVGEGMEEGEFSEAR	QSLIQPI	STGDVNVEmNAAPGVDLTQ
ITGEAFVQFASQELAEK	HLPEGALNSL	YIPEITSVL
TTPSYVAFTDTER	YEEIAQRSKEEAEAL	IAPTGHSL
PmFIVNTNVPR	TAAENDFVTLK	PPYTKNIIFVET
FLVVQETQLsSKVVQK	HAVGDIPGVRF	NLPIGFLEL
MFVLDEADEMLSR	NAPWAVTSL	RQSMDLVELVSLFPTL
TLTIVDTGIGMTK	MFPLVKSAL	AGVLEHLNAIVQIDLNE
NQEVNKGVKEEIY	YLPEELSAL	
WEEVRSVDSEEGTIEAR	TAQVIILNHPGQISAG	
IAHGTPHLHPF	YPKSELLEKAAKCIGK	
LSGPALPKDLHSTFNSVV	GSSAVRVYRmLPPLt	
VAVLPEVQVTQNP	mNCPEIVTIGL	
ARAPPAARTGSRVAPATTP	EESNYELEGKIK	
VHVGLVQnRIPLPAnAPV		

[00518] Table 2: Sample Summary Summary of the samples used for HLA-peptide identification. A description of the global allele frequency, the amount of cell equivalents from each immunopurification used for MS analysis, the number of MS raw files, and the total validation yield form each HLA allele are reported.

#	Allele	Global Frequency	On Column Cell Equivalents (10^7)	# raw files	Validation Yield
1	B54:01	0%	9	9	4.8
2	A02:04	1%	5	6	9.1
3	A02:07	1%	3	4	14
4	A02:03	2%	7.5	4	14.1
5	A68:02	3%	5	8	4.9
6	A31:01	5%	5	4	8.3
7	A29:02	6%	5	2	6.5
8	B57:01	6%	5	4	8.1
9	B44:03	9%	5	7	13.8

10	B51:01	11%	5	5	9.5
11	B35:01	12%	5	1	9.8
12	B44:02	14%	5	4	15.1
13	A24:02	18%	2.5	4	21.1
14	A03:01	25%	5	4	15
15	A01:01	28%	0.5-5	10	8.5
16	A02:01	47%	5	4	14.9

[00519] **Table 3:** Positive predictive value (PPV) calculations from SLECA Model used to quantify the relative contribution of variables to HLA-peptide presentation for individual HLA alleles.

	PPV Calculation															
	HLA.A 01_01	HLA.A 02_01	HLA.A 02_03	HLA.A 02_04	HLA.A 02_07	HLA.A 03_01	HLA.A 24_02	HLA.A 29_02	HLA.A 31_01	HLA.A 68_02	HLA.B 35_01	HLA.B 44_02	HLA.B 44_03	HLA.B 51_01	HLA.B 54_01	HLA.B 57_01
SLECA	0.723	0.470				0.399	0.547				0.538					
LECA	0.695	0.457	0.431	0.411	0.329	0.403	0.510	0.549	0.492	0.463	0.524	0.547	0.546	0.522	0.530	0.567
LEC	0.051	0.061	0.053	0.075	0.062	0.054	0.037	0.064	0.053	0.053	0.101	0.041	0.049	0.037	0.040	0.070
LEA	0.688	0.392	0.394	0.335	0.283	0.369	0.470	0.526	0.448	0.426	0.472	0.547	0.522	0.522	0.528	0.548
LCA	0.612	0.317	0.298	0.276	0.227	0.303	0.391	0.432	0.280	0.349	0.352	0.363	0.347	0.397	0.417	0.386
ECA	0.697	0.449	0.427	0.419	0.330	0.399	0.502	0.542	0.470	0.459	0.514	0.540	0.544	0.520	0.527	0.561
LE	0.016	0.018	0.030	0.018	0.016	0.013	0.013	0.009	0.065	0.048	0.030	0.005	0.005	0.012	0.019	0.040
LC	0.014	0.022	0.014	0.034	0.024	0.012	0.016	0.036	0.002	0.013	0.047	0.005	0.016	0.018	0.008	0.015
LA	0.598	0.287	0.265	0.232	0.185	0.271	0.359	0.428	0.243	0.315	0.306	0.350	0.325	0.389	0.425	0.412
EC	0.046	0.058	0.054	0.070	0.059	0.056	0.036	0.062	0.060	0.054	0.113	0.041	0.049	0.036	0.034	0.066
EA	0.681	0.392	0.388	0.338	0.278	0.361	0.475	0.519	0.453	0.419	0.474	0.526	0.530	0.519	0.528	0.531
CA	0.589	0.270	0.247	0.233	0.199	0.292	0.353	0.364	0.219	0.310	0.302	0.299	0.314	0.374	0.402	0.367
L	0.002	0.004	0.005	0.004	0.003	0.004	0.006	0.002	0.005	0.003	0.008	0.000	0.000	0.008	0.003	0.006
E	0.014	0.016	0.027	0.016	0.013	0.013	0.013	0.007	0.065	0.045	0.026	0.007	0.003	0.014	0.015	0.030
C	0.016	0.024	0.011	0.028	0.023	0.007	0.019	0.037	0.000	0.008	0.057	0.002	0.000	0.017	0.010	0.000
A	0.603	0.258	0.203	0.163	0.154	0.282	0.353	0.391	0.241	0.288	0.271	0.299	0.317	0.373	0.422	0.403
SLECA	0.732	0.452				0.407	0.532				0.530					
LECA	0.700	0.424	0.422	0.367	0.310	0.411	0.485	0.549	0.487	0.457	0.514	0.557	0.568	0.526	0.536	0.561
LEC	0.002	0.015	0.028	0.014	0.013	0.017	0.010	0.004	0.065	0.035	0.026	0.007	0.011	0.016	0.018	0.032
LEA	0.688	0.392	0.394	0.335	0.283	0.369	0.470	0.526	0.448	0.426	0.472	0.547	0.522	0.522	0.528	0.548
LCA	0.628	0.298	0.297	0.244	0.203	0.313	0.366	0.423	0.265	0.336	0.350	0.350	0.350	0.390	0.431	0.399
ECA	0.697	0.424	0.412	0.368	0.295	0.409	0.478	0.552	0.470	0.452	0.506	0.547	0.563	0.526	0.530	0.541
LE	0.016	0.018	0.030	0.018	0.016	0.013	0.013	0.009	0.065	0.048	0.030	0.005	0.005	0.012	0.019	0.040
LC	0.000	0.007	0.006	0.004	0.006	0.016	0.005	0.002	0.005	0.013	0.002	0.002	0.008	0.008	0.006	0.004

	PPV Calculation															
	HLA.A 01_01	HLA.A 02_01	HLA.A 02_03	HLA.A 02_04	HLA.A 02_07	HLA.A 03_01	HLA.A 24_02	HLA.A 29_02	HLA.A 31_01	HLA.A 68_02	HLA.B 35_01	HLA.B 44_02	HLA.B 44_03	HLA.B 51_01	HLA.B 54_01	HLA.B 57_01
LA	0.598	0.287	0.265	0.232	0.185	0.271	0.359	0.428	0.243	0.315	0.306	0.350	0.325	0.389	0.425	0.412
EC	0.005	0.015	0.027	0.014	0.013	0.019	0.012	0.005	0.065	0.034	0.022	0.010	0.011	0.016	0.018	0.034
EA	0.681	0.392	0.388	0.338	0.278	0.361	0.475	0.519	0.453	0.419	0.474	0.526	0.530	0.519	0.528	0.531
CA	0.617	0.258	0.247	0.193	0.160	0.291	0.336	0.375	0.258	0.296	0.296	0.302	0.322	0.370	0.409	0.372
L	0.002	0.004	0.005	0.004	0.003	0.004	0.006	0.002	0.005	0.003	0.008	0.000	0.000	0.008	0.003	0.006
E	0.014	0.016	0.027	0.016	0.013	0.013	0.013	0.007	0.065	0.045	0.026	0.007	0.003	0.014	0.015	0.030
C	0.000	0.006	0.006	0.004	0.005	0.016	0.004	0.002	0.005	0.013	0.002	0.000	0.005	0.008	0.006	0.004
A	0.603	0.258	0.203	0.163	0.154	0.282	0.353	0.391	0.241	0.288	0.271	0.299	0.317	0.373	0.422	0.403

S = Stability (NetMHCStab)

L = Localization (Uniprot)

E = Expression (RNA-Seq)

C = Cleavabilty (MS-based prediction)

A = Affinity (NetMHCpan-2.8)

[00520] **Table 4:** Machine Learning model performance for individual HLA alleles with available stability predictions. **A.** Internal Evalaution. AUC and PPV machine learning model performance for individual HLA alleles as evaluated on the LC-MS/MS data set. **B.** PPV and AUC evaluation results on DFRMLI competition data set along with the number of binders and non-binders per allele. **C.** Due to the small size of the data set, the rank of each evaluated HIV epitope are shown for 'MSIntrinsic', NetMHC-4.0 and NetMHCpan-2.8 predictors, instead of PPV and AUC evaluations.

[00521] Table 4 A

	NetMHC-4.0		NetMHCPan-2.8		MS Ensemble 1		MS Ensemble 2	
	PPV 0.1%	AUC	PPV 0.1%	AUC	PPV 0.1%	AUC	PPV 0.1%	AUC
A0101	0.547	0.997	0.582	0.998	0.702	0.999	0.746	0.999
A0201	0.180	0.990	0.188	0.991	0.410	0.994	0.550	0.995
A0203	0.167	0.980	0.188	0.979	0.408	0.992	0.499	0.994
A0204	NA	NA	0.140	0.989	0.434	0.996	0.572	0.996
A0207	0.135	0.969	0.141	0.981	0.453	0.995	0.556	0.996
A0301	0.222	0.981	0.249	0.982	0.439	0.987	0.533	0.989
A2402	0.291	0.994	0.297	0.994	0.469	0.996	0.579	0.997
A2902	0.313	0.995	0.351	0.996	0.498	0.997	0.607	0.998
A3101	0.174	0.987	0.198	0.987	0.422	0.990	0.549	0.994
A6802	0.253	0.942	0.265	0.948	0.472	0.964	0.560	0.971
B3501	0.229	0.976	0.231	0.979	0.429	0.990	0.591	0.994
B4402	0.292	0.993	0.290	0.993	0.596	0.996	0.684	0.997
B4403	0.361	0.991	0.251	0.991	0.590	0.994	0.664	0.994
B5101	0.365	0.980	0.374	0.981	0.527	0.987	0.623	0.993
B5401	0.386	0.979	0.420	0.977	0.506	0.987	0.578	0.988
B5701	0.306	0.962	0.321	0.968	0.418	0.977	0.537	0.983
AVG	0.281	0.981	0.280	0.983	0.486	0.990	0.589	0.992

[00522] Table 4 B

Competition Data

	Counts		PPV			AUC		
	#Binders	#Total	netMHC-4.0 (#missed)	netMHCPan-2.8 (#missed)	MS intrinsic (#missed)	netMHC-4.0	netMHCPan-2.8	MS intrinsic
A*02:01	971	5811	0.818 (177)	0.825 (170)	0.841 (154)	0.955	0.957	0.964
B*35:01	152	717	0.862 (21)	0.862 (21)	0.855 (22)	0.970	0.969	0.964
B*44:03	85	256	0.941 (5)	0.894 (9)	0.894 (9)	0.994	0.980	0.971
B*57:01	133	1715	0.902 (13)	0.887 (15)	0.962 (5)	0.989	0.989	0.993

[00523] Table 4C

	HIV epitope ranks		
	MS	NetMHC 4.0	NetMHC Pan-2.8
A0101	121	283	272
A0201	1	2	3
	2	12	14
	16	18	16
	19	20	33
	40	37	62
	106	110	70
	147	135	147
	156	222	201
A0207	1	3	1
A0301	4	2	1
	14	3	4
	15	5	20
	24	12	24
	29	17	30
	31	27	36
	66	73	92
	73	84	100
A2402	1	5	6
	5	16	45
A2902	1	4	7
A6802	5	78	63
	29	173	145
	167	252	150

	HIV epitope ranks		
	MS	NetMHC 4.0	NetMHC Pan-2.8
B3501	1	1	1
	8	3	2
	10	12	13
	11	21	21
	21	27	25
	37	33	26
	39	67	31
	242	70	38
	401	84	82
	613	909	1653
B4403	583	224	216
B5101	7	4	1
	31	19	2
	34	20	3
B5401	1	3	1
	4	9	13
	56	100	17
B5701	1	6	6
	2	8	7
	11	14	8
	12	21	20
	31	25	24
	33	31	30
	43	32	40
	48	42	41
	176	180	107
	305	346	288

[00524] **Table 5**: List of cysteinylated peptides identified from all mono-ellelic cell lines

Allele	Sequence	Cys-Cys Position	Allele	Sequence	Cys-Cys Position	Allele	Sequence	Cys-Cys Position
A0101	KTDIQIALPSGcY	*12*	A0201	KLFADAGLVcI	*10*	A0301	RLFQcLLHR	*5*
A0101	FTDGITNKLIGcY	*12*	A0201	YLSDPcPGLYL	*6*	A0301	ILYcIPLRY	*4*
A0101	VTDDLVcLVY	*7*	A0201	cLYPHIDKQYL	*1*	A0301	VLYSLQIcK	*8*
A0101	FSEAcWEVY	*5*	A0201	YMLPDGTYcL	*9*	A0301	RVFQEcLTY	*6*
A0101	cLEPQITPSYY	*1*	A0201	LLDGcRIYL	*5*	A0301	RLPSATLcY	*8*
A0101	TTDcSFIFLY	*4*	A0201	YLYcGQEGL	*4*	A0301	GLYHGQVLcK	*9*
A0101	TTDcLQILAY	*4*	A0201	KLVDcIIEV	*5*	A0301	RITEWVSVcK	*9*
A0101	YSDLASLGcISRY	*9*	A0201	SLSTcIPAI	*5*	A0301	AIFPATFcQK	*8*
A0101	HTDIQEYIGcY	*10*	A0201	ALTDVILcV	*8*	A0301	ILNSHcFAR	*6*
A0101	ESENVVcHFY	*7*	A0201	SLLDcTFRL	*5*	A0301	cLYPRFVQR	*1*
A0101	YSAEPLPELcY	*10*	A0203	ILAPcKLETV	*5*	A0301	IVRTGGHFIcK	*10*
A0101	NSELScQLY	*6*	A0203	VLFDHVGcL	*8*	A0301	TVLcQPTGGK	*4*
A0101	ATDSGFEILPcNRY	*11*	A0203	YLFDRNGVcL	*9*	A0301	RIYSGENPFAcK	*11*
A0101	ALDDFTIcYF	*8*	A0203	TVYGGYLcSV	*8*	A2402	HWAEIcETF	*6*
A0101	YSDFFTDcY	*8*	A0203	YMFcELVTGV	*4*	A2402	SYVcPDLVKEF	*4*
A0101	LSELAALcY	*8*	A0203	MLYGTGPLcSV	*9*	A2402	DYLPSFcKW	*7*
A0101	YLDLLLGNcY	*9*	A0203	VLKDcIVHL	*5*	A2402	IYLAPGDYHcF	*10*

A0101	WSEPQSLcY	*8*	A0203	FLSYcPGmGV	*5*	A2402	EYQLIDcAQYF	*7*
A0101	KLDTLcDLY	*6*	A0203	GLFAGPcKV	*7*	A2402	RYFIPVScF	*8*
A0101	KSDIWSLGcILY	*9*	A0203	SLFTcEPITV	*5*	A2402	NYVVIGTcTF	*8*
A0101	FSELSAcLY	*7*	A0203	YLFKcPQSV	*5*	A2402	IYIDAScLTW	*7*
A0101	cSDKmSLLLVY	*1*	A0203	AVYEGHVScV	*9*	A2402	LYGELcALLF	*6*
A0101	cLDHVISYY	*1*	A0203	ALYcEFINRV	*4*	A2402	VYIPcIYVL	*5*
A0101	LLDDmNHcY	*8*	A0203	RLFTDVIIcV	*9*	A2402	HYQDVScLQF	*7*
A0101	SSDQcAVQLFY	*5*	A0203	TVYGGYLcSV	*8*	A2402	SYLcNVTLF	*4*
A0201	ALLGAGcDPEL	*7*	A0203	SLKTLLEcV	*8*	A2402	LYLEcSAKF	*5*
A0201	ALLEDScHYL	*7*	A0203	RMIKEKLcYV	*8*	A2402	AYITGLcFI	*7*
A0201	SLFPHAIcL	*8*	A0203	VLFScHVRKV	*5*	A2402	RYLPQcSYF	*6*
A0201	YLLDIGcGTGL	*7*	A0203	SLASFcFSHI	*6*	A2402	IYQWIcDNF	*6*
A0201	ILFDcPGQIEL	*5*	A0203	SLHDALcVV	*7*	A2402	cYIKILHQL	*1*
A0201	cLIKEVDIYTV	*1*	A0203	SLKYQTRcI	*8*	A2402	VYADTcFSTI	*6*
A0201	GLLPGcVYHV	*6*	A0203	cLMGKGMKRV	*1*	A2402	TYDPFHNcW	*8*
A0201	TLVTWLQcV	*8*	A0204	TLLEALDcI	*8*	A2402	cYLLQVDEF	*1*
A0201	TLVTWLQcV	*8*	A0204	GVTAIIFcV	*8*	A2402	VYQPVTTEcF	*9*
A0201	YLSDPcPGLYL	*6*	A0204	RLLDVLcEm	*7*	A2402	IYSTLVTcVTF	*8*
A0201	SLMEESGIcKV	*9*	A0204	ALAcWEWLL	*4*	A2402	RYPcFFNTL	*4*
A0201	KLVDcIIEV	*5*	A0204	AILPSIFcL	*8*	A2402	QFIDKPVcF	*8*
A0201	AIIDGKIFcV	*9*	A0204	ILLGNYcVAV	*7*	A2402	LYDPcTVMF	*5*
A0201	GLYDGPVcEV	*8*	A0204	FLFTTPcRL	*7*	A2402	SYIISGcLF	*7*
A0201	ALSEAMGLFcL	*10*	A0204	VAGAKVAKGQPLc VLSAMK	*13*	A2402	cYVLFSYSF	*1*
A0201	ALIDEQILcV	*9*	A0207	FIDDLADLScL	*10*	A2402	cYVQPQWVF	*1*
A0201	FLFDcPGQVEL	*5*	A0207	LIDDLQHcL	*8*	A2402	AYLEcIERITF	*5*
A0201	AIIDGKIFcV	*9*	A0207	YLDcGDLSNAL	*4*	A2402	VYLPcLQNI	*5*
A0201	SLLAcEFLL	*5*	A0207	LLVPVIcQI	*7*	A2402	IWPEKSFcL	*8*
A0201	SLVYLcYTV	*6*	A0207	YIPTFIcSV	*7*	A2402	SYIHYFHcL	*8*
A0201	SLMEESGIcKV	*9*	A0207	LVDGQIFcL	*8*	A2402	AYTDcIPQL	*5*
A0201	LIDEQILcV	*8*	A0207	SVDEDFcHYL	*7*	A2402	TYGcTWEF	*4*
A0201	ALIDEQILcV	*9*	A0207	VLPETcEEL	*6*	A2402	RYRPDMPcF	*8*
A0201	GLFGVPLcL	*8*	A0207	ALEEYVIcV	*8*	A2402	IYLDSVMcL	*8*
A0201	ILDcIYNEV	*4*	A0207	ALDYIVPcM	*8*	A2402	YYAVcQNLL	*5*
A0201	ILDcIYNEV	*4*	A0207	TLDNIFLcV	*8*	A2402	RYRPDMPcFLL	*8*
A0201	cLYELPENIRV	*1*	A0207	MLDQINScL	*8*	A2402	IYLGQLEcF	*8*
A0201	cLYEIYPEL	*1*	A0207	ALPDWcEQL	*6*	A2402	cYAELGTTI	*1*
A0201	QLQPTDALLcV	*10*	A0207	FLDDFIAcV	*8*	A2402	QYGTFcEKF	*6*
A0201	RLMQGDEIcL	*9*	A0207	SVDSHFcHL	*7*	A2902	ALLQcALLY	*5*
A0201	SLAPVLcGI	*7*	A0207	AVLDVLLcL	*8*	A2902	FLPELIWcY	*8*
A0201	ALVDcSVAL	*5*	A0207	YVDPSPDYcL	*9*	A2902	QLQcVVIFVF	*4*
A0201	SLIEYcIEL	*6*	A0207	TLPEVVGcEL	*8*	A3101	cVNQFIISR	*1*
A0201	LLPDIVTcV	*8*	A0207	FLnHcLEHL	*5*	A6802	MTSNIVQcL	*8*
A0201	SLLPADcQIHL	*7*	A0207	HLPDVcVNL	*6*	A6802	EAAcLIVSV	*4*
A0201	ALTDVILcV	*8*	A0207	mIDDTYQcL	*8*	A6802	NTSAIVIcI	*8*
A0201	YLLDIGcGTGL	*7*	A0207	ALDYIVPcM	*8*	A6802	ETIYIVGGcL	*9*
A0201	ALSEAMGLFcL	*10*	A0207	FVDcPGHDIL	*4*	A6802	AVYFHQHSILAcKI	*12*
A0201	SLLDcTFRL	*5*	A0207	TLDSIcDSL	*6*	B3501	SPTcLTLIY	*4*
A0201	SLIEYcIEL	*6*	A0207	VLPDEIcNL	*7*	B3501	VPVSVVEcF	*8*
A0201	QIMDYLLcL	*8*	A0207	AVFGLTTcI	*8*	B3501	FANPEDcVAF	*7*
A0201	SLEENLPcI	*8*	A0207	AInNcRSI	*5*	B3501	LPFDcTQAL	*5*
A0201	ALSQLVPcV	*8*	A0301	ILNSHcFAR	*6*	B3501	HAcGVIATI	*3*
A0201	ALIDEQILcV	*9*	A0301	RIKEIFcPK	*7*	B3501	FPYKNcKTDF	*6*
A0201	HILEcEFYL	*5*	A0301	KLYDLVAGSNcLK	*11*	B3501	FPQEFIIcF	*8*
A0201	ALSEAMGLFcL	*10*	A0301	VVcEYIVKK	*3*	B3501	LPVDFVEcL	*8*

A0201	LIDEQILcV	*8*	A0301	RLFcVGFTKK	*4*	B5101	LPYcPGKTLVV	*4*
A0201	ALSEAMGLFcL	*10*	A0301	RLADKSVLVcK	*10*	B5101	FPFGcPPTV	*5*
A0201	LLPDIVTcV	*8*	A0301	QVLcIPSWMAK	*4*	B5101	cPFTGNVSI	*1*
A0201	AIIDGKIFcV	*9*	A0301	TMcPHILRY	*3*	B5101	FPFGcPPTV	*5*
A0201	SLAPVLcGI	*7*	A0301	AVWDTcLEY	*6*	B5101	DPLQQIcKI	*7*
A0201	TLVTWLQcV	*8*	A0301	RVFFPLcGK	*7*	B5401	FALNPDILcSA	*9*
A0201	GLLDcPIFL	*5*	A0301	TMcPHILRY	*3*	B5401	cPFSSKFFSA	*1*
A0201	SLLEWcQEV	*6*	A0301	RLFFHcSQY	*6*	B5401	mPLQTGTAQIcA	*11*
A0201	RLLEQGcTDFTV	*7*	A0301	KLFTEVEGTcTGK	*10*	B5701	HSQVcSILW	*5*
A0201	TLWVDPcEV	*7*	A0301	TLYISEcLK	*7*	B5701	HTIGcNAVSW	*5*
A0201	GLYDGPVcEV	*8*	A0301	RVNKLIcVK	*7*	B5701	STLPVScAW	*7*
A0201	cLYEIYPEL	*1*	A0301	RLFcVGFTK	*4*	B5701	ATLIISPSSIcHQW	*11*
A0201	SLMEESGIcKV	*9*	A0301	RVKcNTDDTIGDLK	*4*	B5701	ISDHEATLRcW	*10*
A0201	TLcDLYETL	*3*	A0301	TLcKPLVPR	*3*	B5701	GSIDSSIRcW	*9*
A0201	FLGcIGAVNEV	*4*	A0301	TLYISEcLKK	*7*	B5701	RAFTcDDLFRF	*5*
A0101	KTDIQIALPSGcY	*12*	A0301	KVcNPIITKLY	*3*	B5701	RSVNIKEIcW	*9*

[00525] References

1. M. Bassani-Sternberg, S. Pletscher-Frankild, L. J. Jensen, M. Mann, Mass Spectrometry of Human Leukocyte Antigen Class I Peptidomes Reveals Strong Effects of Protein Abundance and Turnover on Antigen Presentation, *Mol. Cell. Proteomics* **14**, 658–673 (2015).

2. D. Hunt, R. Henderson, J. Shabanowitz, K. Sakaguchi, H. Michel, N. Sevilir, A. Cox, E. Appella, V. Engelhard, Characterization of peptides bound to the class I MHC molecule HLA-A2.1 by mass spectrometry, *Science* **255**, 1261–1263 (1992).

3. H.-G. Rammensee, T. Friede, S. Stevanović, MHC ligands and peptide motifs: first listing, *Immunogenetics* **41**, 178–228 (1995).

4. H.-G. Rammensee, J. Bachmann, N. P. N. Emmerich, O. A. Bachor, S. Stevanović, SYFPEITHI: database for MHC ligands and peptide motifs, *Immunogenetics* **50**, 213–219 (1999).

5. R. Vita, J. A. Overton, J. A. Greenbaum, J. Ponomarenko, J. D. Clark, J. R. Cantrell, D. K. Wheeler, J. L. Gabbard, D. Hix, A. Sette, B. Peters, The immune epitope database (IEDB) 3.0, *Nucleic Acids Res.* **43**, D405–D412 (2015).

6. J. Robinson, J. A. Halliwell, J. D. Hayhurst, P. Flicek, P. Parham, S. G. E. Marsh, The IPD and IMGT/HLA database: allele variant databases, *Nucleic Acids Res.* **43**, D423–D431 (2015).

7. I. Hoof, B. Peters, J. Sidney, L. E. Pedersen, A. Sette, O. Lund, S. Buus, M. Nielsen, NetMHCpan, a method for MHC class I binding prediction beyond humans, *Immunogenetics* **61**, 1–13 (2009).

8. C. Lundegaard, K. Lamberth, M. Harndahl, S. Buus, O. Lund, M. Nielsen, NetMHC-3.0: accurate web accessible predictions of human, mouse and monkey MHC class I affinities for peptides of length 8–11, *Nucleic Acids Res.* **36**, W509–W512 (2008).

9. E. Boen, A. R. Crownover, M. McIlhaney, A. J. Korman, J. Bill, Identification of T Cell Ligands in a Library of Peptides Covalently Attached to HLA-DR4, *J. Immunol.* **165**, 2040–2047 (2000).

10. M. V. Larsen, C. Lundegaard, K. Lamberth, S. Buus, O. Lund, M. Nielsen, Large-scale validation of methods for cytotoxic T-lymphocyte epitope prediction, *BMC Bioinformatics* **8**, 424–424 (2007).

11. E. Caron, D. J. Kowalewski, C. C. Koh, T. Sturm, H. Schuster, R. Aebersold, Analysis of MHC immunopeptidomes using mass spectrometry, *Mol. Cell. Proteomics* (2015), doi:10.1074/mcp.O115.052431.

12. Y. Shimizu, R. DeMars, Production of human cells expressing individual transferred HLA-A,-B,-C genes using an HLA-A,-B,-C null human cell line., *J. Immunol.* **142**, 3320–3328 (1989).

13. Y. Shimizu, B. Koller, D. Geraghty, H. Orr, S. Shaw, P. Kavathas, R. DeMars, Transfer of cloned human class I major histocompatibility complex genes into HLA mutant human lymphoblastoid cells., *Mol. Cell. Biol.* **6**, 1074–1087 (1986).

14. K. V. Ruggles, Z. Tang, X. Wang, H. Grover, M. Askenazi, J. Teubl, S. Cao, M. D. McLellan, K. R. Clauser, D. L. Tabb, P. Mertins, R. Slebos, P. Erdmann-Gilmore, S. Li, H. P. Gunawardena, L. Xie, T. Liu, J.-Y. Zhou, S. Sun, K. A. Hoadley, C. M. Perou, X. Chen, S. R. Davies, C. A. Maher, C. R. Kinsinger, K. D. Rodland, H. Zhang, Z. Zhang, L. Ding, R. R. Townsend, H. Rodriguez, D. Chan, R. D. Smith, D. C. Liebler, S. A. Carr, S. Payne, M. J. Ellis, D. Fenyo, An analysis of the sensitivity of proteogenomic mapping of somatic mutations and novel splicing events in cancer, *Mol. Cell. Proteomics* (2015), doi:10.1074/mcp.M115.056226.

15. F. Boisgerault, I. Khalil, V. Tieng, F. Connan, T. Tabary, J. H. Cohen, J. Choppin, D. Charron, A. Toubert, Definition of the HLA-A29 peptide ligand motif allows prediction of potential T-cell epitopes from the retinal soluble antigen, a candidate autoantigen in birdshot retinopathy., *Proc. Natl. Acad. Sci. U. S. A.* **93**, 3466–3470 (1996).

16. P. Guasp, C. Alvarez-Navarro, P. Gomez-Molina, A. Martín-Esteban, M. Marcilla, E. Barnea, A. Admon, J. A. López de Castro, The Peptidome of Behçet's Disease–Associated HLA–B*51:01 Includes Two Subpeptidomes Differentially Shaped by Endoplasmic Reticulum Aminopeptidase 1, *Arthritis Rheumatol.* **68**, 505–515 (2016).

17. K. J. M. Jeffery, A. A. Siddiqui, M. Bunce, A. L. Lloyd, A. M. Vine, A. D. Witkover, S. Izumo, K. Usuku, K. I. Welsh, M. Osame, C. R. M. Bangham, The Influence of HLA Class I Alleles and Heterozygosity on the Outcome of Human T Cell Lymphotropic Virus Type I Infection, *J. Immunol.* **165**, 7278–7284 (2000).

18. M. Berg, A. Parbel, H. Pettersen, D. Fenyö, L. Björkesten, Detection of artifacts and peptide modifications in liquid chromatography/mass spectrometry data using two-dimensional signal intensity map data visualization, *Rapid Commun. Mass Spectrom.* **20**, 1558–1562 (2006).

19. Y. Kim, J. Sidney, C. Pinilla, A. Sette, B. Peters, Derivation of an amino acid similarity matrix for peptide:MHC binding and its application as a Bayesian prior, *BMC Bioinformatics* **10**, 1–11 (2009).

20. E. Milner, L. Gutter-Kapon, M. Bassani-Strenberg, E. Barnea, I. Beer, A. Admon, The Effect of Proteasome Inhibition on the Generation of the Human Leukocyte Antigen (HLA) Peptidome, *Mol. Cell. Proteomics* **12**, 1853–1864 (2013).

21. D. Fruci, P. Giacomini, M. R. Nicotra, M. Forloni, R. Fraioli, L. Saveanu, P. van Endert, P. G. Natali, Altered expression of endoplasmic reticulum aminopeptidases ERAP1 and ERAP2 in transformed non-lymphoid human tissues, *J. Cell. Physiol.* **216**, 742–749 (2008).

22. L. Saveanu, O. Carroll, V. Lindo, M. Del Val, D. Lopez, Y. Lepelletier, F. Greer, L. Schomburg, D. Fruci, G. Niedermann, P. M. van Endert, Concerted peptide trimming by human ERAP1 and ERAP2 aminopeptidase complexes in the endoplasmic reticulum, *Nat Immunol* **6**, 689–697 (2005).

23. C. Keşmir, A. K. Nussbaum, H. Schild, V. Detours, S. Brunak, Prediction of proteasome cleavage motifs by neural networks, *Protein Eng.* **15**, 287–296 (2002).

24. M. Nielsen, C. Lundegaard, O. Lund, C. Keşmir, The role of the proteasome in generating cytotoxic T-cell epitopes: insights obtained from improved predictions of proteasomal cleavage, *Immunogenetics* **57**, 33–41 (2005).

25. P. Saxová, S. Buus, S. Brunak, C. Keşmir, Predicting proteasomal cleavage sites: a comparison of available methods, *Int. Immunol.* **15**, 781–787 (2003).

26. K. L. Rock, D. J. Farfán-Arribas, J. D. Colbert, A. L. Goldberg, Re-examining class-I presentation and the DRiP hypothesis, *Trends Immunol.* **35**, 144–152 (2014).

27. J. W. Yewdell, DRiPs solidify: progress in understanding endogenous MHC class I antigen processing, *Trends Immunol.* **32**, 548–558 (2011).

28. D. Bourdetsky, C. E. H. Schmelzer, A. Admon, The nature and extent of contributions by defective ribosome products to the HLA peptidome, *Proc. Natl. Acad. Sci.* **111**, E1591–E1599 (2014).

29. C. McMurtrey, T. Trolle, T. Sansom, S. G. Remesh, T. Kaever, W. Bardet, K. Jackson, R. McLeod, A. Sette, M. Nielsen, D. M. Zajonc, I. J. Blader, B. Peters, W. Hildebrand, M. S. Gilmore, Ed. Toxoplasma gondii peptide ligands open the gate of the HLA class I binding groove, *eLife* **5**, e12556 (2016).

30. T. Trolle, C. P. McMurtrey, J. Sidney, W. Bardet, S. C. Osborn, T. Kaever, A. Sette, W. H. Hildebrand, M. Nielsen, B. Peters, The Length Distribution of Class I–Restricted T Cell Epitopes Is Determined by Both Peptide Supply and MHC Allele–Specific Binding Preference, *J. Immunol.* (2016), doi:10.4049/jimmunol.1501721.

31. M. Andreatta, M. Nielsen, Gapped sequence alignment using artificial neural networks: application to the MHC class I system, *Bioinformatics* **32** (2016), doi:10.1093/bioinformatics/btv639.

32. M. Harndahl, M. Rasmussen, G. Roder, I. Dalgaard Pedersen, M. Sørensen, M. Nielsen, S. Buus, Peptide-MHC class I stability is a better predictor than peptide affinity of CTL immunogenicity, *Eur. J. Immunol.* **42**, 1405–1416 (2012).

33. K. W. Jørgensen, M. Rasmussen, S. Buus, M. Nielsen, NetMHCstab – predicting stability of peptide–MHC-I complexes; impacts for cytotoxic T lymphocyte epitope discovery, *Immunology* **141**, 18–26 (2014).

34. M. Harndahl, M. Rasmussen, G. Roder, S. Buus, Real-time, High-Throughput Measurements of Peptide-MHC-I Dissociation Using a Scintillation Proximity Assay, *J. Immunol. Methods* **374**, 5–12 (2011).

35. R. D. Bremel, E. J. Homan, An integrated approach to epitope analysis I: Dimensional reduction, visualization and prediction of MHC binding using amino acid principal components and regression approaches, *Immunome Res.* **6**, 7–7 (2010).

36. D. O. R. Torres P.Rondón-Villarreal, *Peptides: Calculate indices and theoretical physicochemical properties of peptides and protein sequences.* (2014; CRAN.R-project.org/package=Peptides).

37. G. L. Zhang, H. H. Lin, D. B. Keskin, E. L. Reinherz, V. Brusic, Dana-Farber repository for machine learning in immunology, *High-Throughput Methods Immunol. Mach. Learn. Autom.* **374**, 18–25 (2011).

38. Llano A, Williams, A, Overa, A, Silva-Arrieta, S, Brander, Best-Characterized HIV-1 CTL Epitopes: The 2013 Update, *HIV Molecular Immunology* , 3–25 (2013).

39. E. Lorente, S. Infantes, E. Barnea, I. Beer, A. Barriga, N. Garcia-Medel, F. Lasala, M. Jimenez, A. Admon, D. Lopez, Diversity of Natural Self-Derived Ligands Presented by Different HLA Class I Molecules in Transporter Antigen Processing-Deficient Cells, *PLoS ONE* **8**, e59118 (2013).

40. G. P. M. Mommen, C. K. Frese, H. D. Meiring, J. van Gaans-van den Brink, A. P. J. M. de Jong, C. A. C. M. van Els, A. J. R. Heck, Expanding the detectable HLA peptide repertoire using electron-transfer/higher-energy collision dissociation (EThcD), *Proc. Natl. Acad. Sci.* **111**, 4507–4512 (2014).

41. H.-C. Guo, T. S. Jardetzky, T. P. J. Garrettt, W. S. Lane, J. L. Strominger, D. C. Wiley, Different length peptides bind to HLA-Aw68 similarly at their ends but bulge out in the middle, *Nature* **360**, 364–366 (1992).

42. F. E. Tynan, S. R. Burrows, A. M. Buckle, C. S. Clements, N. A. Borg, J. J. Miles, T. Beddoe, J. C. Whisstock, M. C. Wilce, S. L. Silins, J. M. Burrows, L. Kjer-Nielsen, L. Kostenko, A. W. Purcell, J. McCluskey, J. Rossjohn, T cell receptor recognition of a "super-bulged" major histocompatibility complex class I-bound peptide, *Nat Immunol* **6**, 1114–1122 (2005).

43. H. D. Hickman, A. D. Luis, R. Buchli, S. R. Few, M. Sathiamurthy, R. S. VanGundy, C. F. Giberson, W. H. Hildebrand, Toward a Definition of Self: Proteomic Evaluation of the Class I Peptide Repertoire, *J. Immunol.* **172**, 2944–2952 (2004).

44. E. Milner, E. Barnea, I. Beer, A. Admon, The Turnover Kinetics of Major Histocompatibility Complex Peptides of Human Cancer Cells*, *Mol. Cell. Proteomics* **5**, 357–365 (2006).

45. M. M. Gubin, X. Zhang, H. Schuster, E. Caron, J. P. Ward, T. Noguchi, Y. Ivanova, J. Hundal, C. D. Arthur, W.-J. Krebber, G. E. Mulder, M. Toebes, M. D. Vesely, S. S. K. Lam, A. J. Korman, J. P. Allison, G. J. Freeman, A. H. Sharpe, E. L. Pearce, T. N. Schumacher, R. Aebersold, H.-G. Rammensee, C. J. M. Melief, E. R. Mardis, W. E. Gillanders, M. N. Artyomov, R. D. Schreiber, Checkpoint blockade cancer immunotherapy targets tumour-specific mutant antigens, *Nature* **515**, 577–581 (2014).

46. C. Linnemann, M. M. van Buuren, L. Bies, E. M. E. Verdegaal, R. Schotte, J. J. A. Calis, S. Behjati, A. Velds, H. Hilkmann, D. el Atmioui, M. Visser, M. R. Stratton, J. B. A. G. Haanen, H. Spits, S. H. van der Burg, T. N. M. Schumacher, High-throughput epitope discovery reveals frequent recognition of neo-antigens by CD4+ T cells in human melanoma, *Nat Med* **21**, 81–85 (2015).

47. A. L. Pritchard, J. G. Burel, M. A. Neller, N. K. Hayward, J. A. Lopez, M. Fatho, V. Lennerz, T. Wölfel, C. W. Schmidt, Exome Sequencing to Predict Neoantigens in Melanoma, *Cancer Immunol. Res.* **3**, 992–998 (2015).

48. M. Rajasagi, S. A. Shukla, E. F. Fritsch, D. B. Keskin, D. DeLuca, E. Carmona, W. Zhang, C. Sougnez, K. Cibulskis, J. Sidney, K. Stevenson, J. Ritz, D. Neuberg, V. Brusic, S. Gabriel, E. S. Lander, G. Getz, N. Hacohen, C. J. Wu, Systematic identification of personal tumor-specific neoantigens in chronic lymphocytic leukemia, *Blood* **124**, 453–462 (2014).

49. T. N. Schumacher, R. D. Schreiber, Neoantigens in cancer immunotherapy, *Science* **348**, 69–74 (2015).

50. C. Hughes, B. Ma, G. A. Lajoie, in *Proteome Bioinformatics*, J. S. Hubbard, R. A. Jones, Eds. (Humana Press, Totowa, NJ, 2010), pp. 105–121.

51. B. Ma, Novor: Real-Time Peptide de Novo Sequencing Software, *J. Am. Soc. Mass Spectrom.* **26**, 1885–1894 (2015).

52. J. Ng, N. Bandeira, W.-T. Liu, M. Ghassemian, T. L. Simmons, W. H. Gerwick, R. Linington, P. C. Dorrestein, P. A. Pevzner, Dereplication and de novo sequencing of nonribosomal peptides, *Nat Meth* **6**, 596–599 (2009).

53. P. A. Reche, D. B. Keskin, R. E. Hussey, P. Ancuta, D. Gabuzda, E. L. Reinherz, Elicitation from virus-naive individuals of cytotoxic T lymphocytes directed against conserved HIV-1 epitopes, *Med. Immunol.* **5**, 1–1 (2006).

54. D. B. Keskin, B. Reinhold, S. Y. Lee, G. Zhang, S. Lank, D. O'Connor, R. S. Berkowitz, V. Brusic, S. J. Kim, E. L. Reinherz, Direct identification of an HPV-16 tumor antigen from cervical cancer biopsy specimens, *Front. Immunol.* **2** (2011), doi:10.3389/fimmu.2011.00075.

55. D. B. Keskin, B. B. Reinhold, G. L. Zhang, A. R. Ivanov, B. L. Karger, E. L. Reinherz, Physical detection of influenza A epitopes identifies a stealth subset on human lung epithelium evading natural CD8 immunity, *Proc. Natl. Acad. Sci. U. S. A.* **112**, 2151–2156 (2015).

56. J. Rappsilber, M. Mann, Y. Ishihama, Protocol for micro-purification, enrichment, pre-fractionation and storage of peptides for proteomics using StageTips, *Nat Protoc.* **2**, 1896–1906 (2007).

57. J. Sidney, S. Southwood, C. Oseroff, M.-F. del Guercio, A. Sette, H. M. Grey, in *Current Protocols in Immunology*, (John Wiley & Sons, Inc., 2001).

58. J. E. Elias, S. P. Gygi, Target-decoy search strategy for increased confidence in large-scale protein identifications by mass spectrometry. Nat Meth. 4, 207–214 (2007).

59. B. Langmead, S. L. Salzberg, Fast gapped-read alignment with Bowtie 2. Nat Meth. 9, 357–359 (2012).

60. B. Li, C. N. Dewey, RSEM: accurate transcript quantification from RNA-Seq data with or without a reference genome. BMC Bioinformatics. 12, 1–16 (2011).

61. R. C. Team, R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 2013 (2014).

62. Kronke et al. "Lenalidomide induces ubiquitination and degradation of CK1α in del(5q) MDS" *Nature* (2015) 523(7559): 183-8. doi: 10.1038/nature14610. Epub 2015 Jul 1.

63. Krönke et al. "Lenalidomide causes selective degradation of IKZF1 and IKZF3 in multiple myeloma cells" *Science* (2014) 343(6168): 301-5. doi: 10.1126/science.1244851. Epub 2013 Nov 29.

64. Udeshi N.D.; Mani D.R.; Eisenhaure T.; Mertins P.; Jaffe J.D.; Clauser K.R.; Hacohen N.; Carr S.A. "Methods for quantification of in vivo changes in protein ubiquitination following proteasome and deubiquitinase inhibition" *Molecular & Cellular Proteomics* (2012) 11: 148-59.

65. Fusaro et al. "Prediction of high-responding peptides for targeted protein assays by mass spectrometry" *Nature Biotechnology* (2009) **27**, 190 - 198.

66. Eyers et al. "CONSeQuence: prediction of reference peptides for absolute quantitative proteomics using consensus machine learning approaches" *Mol Cell Proteomics* (2011); 10(11):M110.003384. doi: 10.1074/mcp.M110.003384. Epub 2011 Aug 3.

70. Muntel, J., Boswell, S.A., Tang, S., Ahmed, S., Wapinski, I., Foley, G., Steen, H., and Springer, M. (2015) "Abundance-based Classifier for the Prediction of Mass Spectrometric Peptide Detectability Upon Enrichment (PPA)" *Mol. Cell. Proteomics* 14, 430–440

71. Searle, B.C., Egertson, J.D., Bollinger, J.G., Stergachis, A.B., and MacCoss, M.J. (2015) "Using Data Independent Acquisition (DIA) to Model High-responding Peptides for Targeted Proteomics Experiments" *Mol. Cell. Proteomics* 14, 2331–2340.

72. Mommen, G.P.M., Marino, F., Meiring, H.D., Poelen, M.C.M., van Gaans-van den Brink, J.A.M., Mohammed, S., Heck, A.J.R., and van Els, C.A.C.M. (2016) "Sampling From the

Proteome to the Human Leukocyte Antigen-DR (HLA-DR) Ligandome Proceeds Via High Specificity" *Mol. Cell. Proteomics MCP* 15, 1412–1423.

73. Rock, K.L., Farfán-Arribas, D.J., Colbert, J.D., and Goldberg, A.L. (2014) "Re-examining class-I presentation and the DRiP hypothesis" *Trends Immunol.* 35, 144–152.

74. Bourdetsky, D., Schmelzer, C.E.H., and Admon, A. (2014). "The nature and extent of contributions by defective ribosome products to the HLA peptidome" *Proc. Natl. Acad. Sci.* 111, E1591–E1599

75. Yewdell, J.W. (2011) " DRiPs solidify: progress in understanding endogenous MHC class I antigen processing" *Trends Immunol.* 32, 548–558.

76. Kim, Y., Yewdell, J.W., Sette, A., and Peters, B. (2013) "Positional Bias of MHC Class I Restricted T-Cell Epitopes in Viral Antigens Is Likely due to a Bias in Conservation" PLoS Comput Biol 9, e1002884.

77. Guruprasad, K., Reddy, B.V.B., and Pandit, M.W. (1990) "Correlation between stability of a protein and its dipeptide composition: a novel approach for predicting in vivo stability of a protein from its primary sequence" *Protein Eng.* 4, 155–161.

78. Behrends, C., Sowa, M.E., Gygi, S.P., and Harper, J.W. (2010) "Network organization of the human autophagy system" *Nature* 466, 68–76.

79. Christianson, J.C., Olzmann, J.A., Shaler, T.A., Sowa, M.E., Bennett, E.J., Richter, C.M., Tyler, R.E., Greenblatt, E.J., Harper, J.W., and Kopito, R.R. (2012) "Defining human ERAD networks through an integrative mapping strategy" *Nat. Cell Biol.* 14, 93–105

80. Sowa, M.E., Bennett, E.J., Gygi, S.P., and Harper, J.W. (2009) "Defining the Human Deubiquitinating Enzyme Interaction Landscape" *Cell* 138, 389–403.

81. Sidney, J., Southwood, S., Oseroff, C., del Guercio, M.-F., Sette, A., and Grey, H.M. (2001). "Measurement of MHC/Peptide Interactions by Gel Filtration" *In Current Protocols in Immunology* 31:18.3:18.3.1–18.3.19.

82. Nielsen, M., Lundegaard, C., Lund, O., and Keşmir, C. (2005) "The role of the proteasome in generating cytotoxic T-cell epitopes: insights obtained from improved predictions of proteasomal cleavage" *Immunogenetics* 57, 33–41.

83. Li, B., and Dewey, C.N. (2011) "RSEM: accurate transcript quantification from RNA-Seq data with or without a reference genome" *BMC Bioinformatics* 12, 1–16.

84. Oates, M.E., Romero, P., Ishida, T., Ghalwash, M., Mizianty, M.J., Xue, B., Dosztányi, Z., Uversky, V.N., Obradovic, Z., Kurgan, L., et al. (2013). D(2)P(2): database of disordered protein predictions. Nucleic Acids Res. 41, D508–D516.

85. Eichmann, M., Ru, A., Veelen, P.A., Peakman, M., and Kronenberg-Versteeg, D. (2014) "Identification and characterisation of peptide binding motifs of six autoimmune disease-associated human leukocyte antigen-class I molecules including HLA-B*39:06" *Tissue Antigens* 84.

86. Theano Development Team (2016) "Theano: A Python framework for fast computation of mathematical expressions" ArXiv E-Prints *abs/1605.02688*.

87. Bremel, R.D., and Homan, E.J. (2010) "An integrated approach to epitope analysis I: Dimensional reduction, visualization and prediction of MHC binding using amino acid principal components and regression approaches" *Immunome Res.* 6, 7–7.

88. Osorio, D.; Rondon-Villarreal, P.; Torres, R. "Stability Analysis of Antimicrobial Peptides in Solvation Conditions by Molecular Dynamics" *Adv Comp Bio* (2014) 232, 127-131.

89. Ishihama, Y., Oda, Y., Tabata, T., Sato, T., Nagasu, T., Rappsilber, J., and Mann, M. (2005) "Exponentially Modified Protein Abundance Index (emPAI) for Estimation of Absolute Protein Amount in Proteomics by the Number of Sequenced Peptides per Protein" *Mol. Cell. Proteomics* 4, 1265–1272.

90. Chowell, D., Krishna, S., Becker, P.D., Cocita, C., Shu, J., Tan, X., Greenberg, P.D., Klavinskis, L.S., Blattman, J.N., and Anderson, K.S. (2015) " TCR contact residue hydrophobicity is a hallmark of immunogenic CD8(+) T cell epitopes" *Proc. Natl. Acad. Sci.* U. S. A. 112, E1754–E1762.

91. Walz, S., Stickel, J.S., Kowalewski, D.J., Schuster, H., Weisel, K., Backert, L., Kahn, S., Nelde, A., Stroh, T., Handel, M., et al. (2015). "The antigenic landscape of multiple myeloma: mass spectrometry (re)defines targets for T-cell–based immunotherapy" *Blood* 126, 1203–1213.

* * *

[00526] Having thus described in detail preferred embodiments of the present invention, it is to be understood that the invention defined by the above paragraphs is not to be limited to particular details set forth in the above description as many apparent variations thereof are possible without departing from the spirit or scope of the present invention.

WHAT IS CLAIMED IS:

1. A method of generating an HLA- allele specific binding peptide sequence database comprising:

(e) providing a population of cells expressing a single HLA allele;

(f) isolating HLA-peptide complexes from said cells;

(g) isolating peptides from said HLA-peptide complexes; and

(h) sequencing said peptides.

2. The method of claim 1, which is a method of generating an HLA class I - allele specific binding peptide sequence database comprising:

(a) providing a population of cells expressing a single HLA class I allele;

(b) isolating class I HLA-peptide complexes from said cells;

(c) isolating peptides from said HLA-peptide complexes; and

(d) sequencing said peptides.

3. The method of claim 1, which is a method of generating an HLA class II- allele specific binding peptide sequence database comprising:

(a) providing a population of cells expressing a pair of HLA Class II genes, consisting of one α and one β subunit;

(b) isolating class II HLA -peptide complexes from said cells;

(c) isolating peptides from said HLA-peptide complexes; and

(d) sequencing said peptides.

4. The method of any one of the preceding claims, wherein said sequencing is performed by LC-MS/MS.

5. The method of any one of the preceding claims, wherein the population of cells comprises at least 10^7 cells.

6. The method of any one of the preceding claims, wherein the cells are dendritic cells, macrophages or B-cells.

7. The method of any one of the preceding claims, wherein the cells are tumor cells.

8. The method of any one of the preceding claims, wherein the cells are contacted with an agent or condition prior to isolating said HLA-peptide complexes from said cells.

9. The method of claim 8, wherein said agent or condition is an inflammatory cytokine, a chemical agent, a therapeutic agent or radiation.

10. The method of any one of the preceding claims, wherein the HLA allele is a mutated HLA allele.

11. The method of any one of the preceding claims, wherein the HLA allele is selected from A*01:01, A*02:01, A*02:03, A*02:04, A*02:07, A*03:01, A*24:02, A*29:02, A*31:01, A*68:02, B*35:01, B*44:02, B*44:03, B*51:01, B*54:01, B57:01, C*03:02, C*03:04, C*04:01, C*05:01, C*06:02, C*08:01, C*08:02, C*12:02, C*14:02, C*14:03, C*15:02, and C*16:01.

12. The method of any one of the preceding claims, wherein step (b) comprises lysing the cells and isolating the HLA-peptide complexes by immunoprecipitation.

13. The method of any one of the preceding claims, which comprises carrying out steps (a) to (d) for different HLA alleles.

14. An HLA- allele specific binding peptide sequence database obtained by carrying out the method of any one of the preceding claims.

15. A combination of two or more HLA-allele specific binding peptide sequence databases obtained by carrying out the method of any one of the preceding claims repeatedly, each time using a different HLA- allele.

16. A method for generating a prediction algorithm for identifying HLA- allele specific binding peptides, which method comprises:

- training a machine with the peptide sequence database of claim 14 or the combination of claim 15.

17. The method of claim 15, wherein the machine combines one or more linear models, support vector machines, decision trees and neural networks.

18. The method according to claim 14, wherein the variables used to train the machine comprise one or more variables selected from the group consisting of peptide sequence, amino acid physical properties, peptide physical properties, expression level of the source protein of a peptide within a cell, protein stability, protein translation rate, protein degradation rate, translational efficiencies from ribosomal profiling, protein cleavability, protein localization, motifs of host protein that facilitate TAP transport, whether host protein is subject to autophagy, motifs that favor ribosomal stalling (polyproline stretches), protein features that favor NMD (long 3' UTR, stop codon >50nt upstream of last exon:exon junction and peptide cleavability.

19. A method for identifying HLA- allele specific binding peptides, which method comprises analyzing the sequence of a peptide with a machine which has been trained with a peptide sequence database obtained by carrying out the method of any one of the claims 1-11 for said HLA- allele.

20. The method of claim 16, which method comprises:

- determining the expression level of the source protein of the peptide within a cell; and

wherein the source protein expression is one of the predictive variables used by the machine.

21. The method according to claim 17, wherein the expression level is determined by measuring the amount of source protein or the amount of RNA encoding said source protein.

22. A method of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from a given set of peptides a plurality of peptides capable of binding an HLA protein of the subject, wherein said ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with peptide sequence databases corresponding to the specific HLA-binding peptides for each of the HLA-alleles of said subject.

23. A method of identifying from a given set of neo-antigen comprising peptides the most suitable peptides for preparing an immunogenic composition for a subject, said method comprising selecting from a given set of peptides a plurality of peptides determined as capable of binding an HLA protein of the subject, ability to bind an HLA protein is determined by analyzing the sequence of peptides with a machine which has been trained with a peptide sequence database obtained by carrying out the method of claim 1.

24. A method of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, wherein the subject has a tumor and the subject-specific peptides are specific to the subject and the subject's tumor, said method comprising:

(a) whole genome or whole exome nucleic acid sequencing of a sample of the subject's tumor and a non-tumor sample of the subject;

(b) determining based on the whole genome or whole exome nucleic acid sequencing:

(i) non-silent mutations present in the genome of cancer cells of the subject but not in normal tissue from the subject, and

(ii) the HLA genotype of the subject,

wherein the non-silent mutations comprise a point, splice-site, frameshift, read- through, neoORF or gene-fusion mutation; and

(c) selecting from the identified non-silent mutations the plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each having a predictive score indicative of binding an HLA protein of the subject,

wherein said predictive score is determined by analyzing the sequence of peptides derived from the non-silent mutations by carrying out the method of any one of claims 16-19.

25. A method of identifying a plurality of subject-specific peptides for preparing a subject-specific immunogenic composition, said method comprising selecting a plurality of subject-specific peptides, each having a different tumor neo-epitope that is an epitope specific to the tumor of the subject and each having a predictive score indicative of binding an HLA protein of the subject, wherein said predictive score is determined by analyzing the sequence of peptides derived from the non-silent mutations by carrying out the method of any one of claims 16-19.

26. An immunogenic composition for use in a method of inducing a tumor specific immune response, said immunogenic composition comprising two or more peptides identified with the method according to claim 20 or 21 and a pharmaceutically acceptable carrier.

27. The immunogenic composition for use in a method of inducing a tumor specific immune response, comprising autologous dendritic cells or antigen presenting cells that have been pulsed with the two or more peptides identified with the method according to claim 20 or 21.

28. The immunogenic composition for use in a method of inducing a tumor specific immune response, comprising at least one vector capable of expressing the two or more peptides identified with the method according to claim 20 or 21.

29. The immunogenic composition according to claim 24, wherein the vector is a viral vector.

30. The immunogenic composition for use in a method of inducing a tumor specific immune response, comprising at least one vector capable of expressing the two or more peptides listed for an HLA allele listed in Tables 1A, 1B and/or 1C.

31. A peptide sequence database consisting of a set of peptides listed for an HLA allele listed in Tables 1A, 1B and/or 1C.

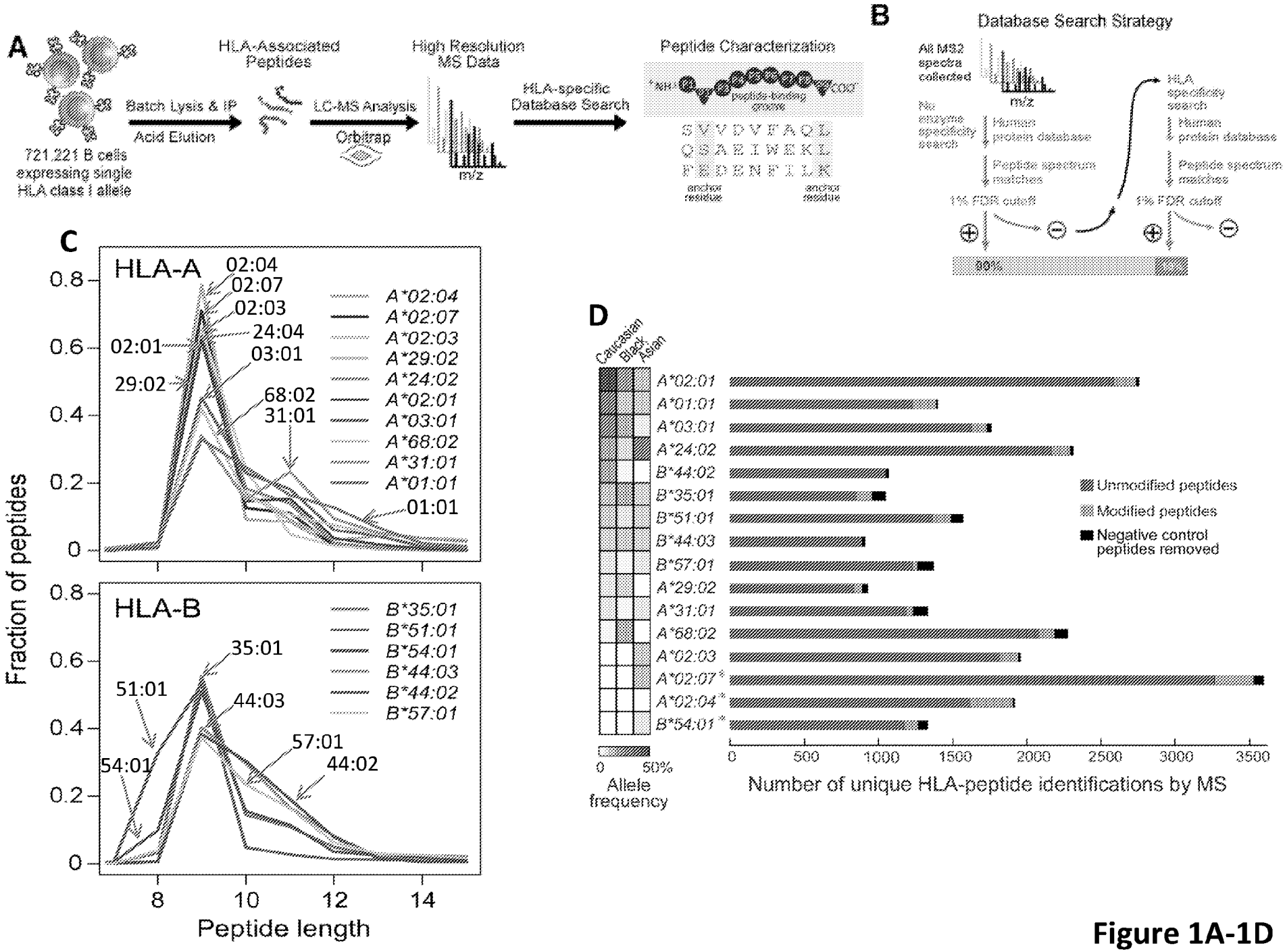

A
721.221 B cells expressing single HLA class I allele
Batch Lysis & IP
Acid Elution
HLA-Associated Peptides
LC-MS Analysis
Orbitrap
High Resolution MS Data
m/z
HLA-specific Database Search
Peptide Characterization
S V V D V F A Q L
Q S A E I W E K L
F E D E N F I L K
anchor residue
anchor residue
B
Database Search Strategy
All MS2 spectra collected
m/z
No enzyme specificity search
Human protein database
Peptide spectrum matches
1% FDR cutoff
HLA specificity search
Human protein database
Peptide spectrum matches
1% FDR cutoff
80%
C
HLA-A
02:04
02:07
02:03
24:04
03:01
02:01
29:02
68:02
31:01
01:01
A*02:04
A*02:07
A*02:03
A*29:02
A*24:02
A*02:01
A*03:01
A*68:02
A*31:01
A*01:01
HLA-B
35:01
51:01
44:03
54:01
57:01
44:02
B*35:01
B*51:01
B*54:01
B*44:03
B*44:02
B*57:01
Fraction of peptides
0
0.2
0.4
0.6
0.8
8
10
12
14
Peptide length
D
Caucasian
Black
Asian
A*02:01
A*01:01
A*03:01
A*24:02
B*44:02
B*35:01
B*51:01
B*44:03
B*57:01
A*29:02
A*31:01
A*68:02
A*02:03
A*02:07*
A*02:04*
B*54:01*
Unmodified peptides
Modified peptides
Negative control peptides removed
0
50%
Allele frequency
0
500
1000
1500
2000
2500
3000
3500
Number of unique HLA-peptide identifications by MS

Figure 1A-1D

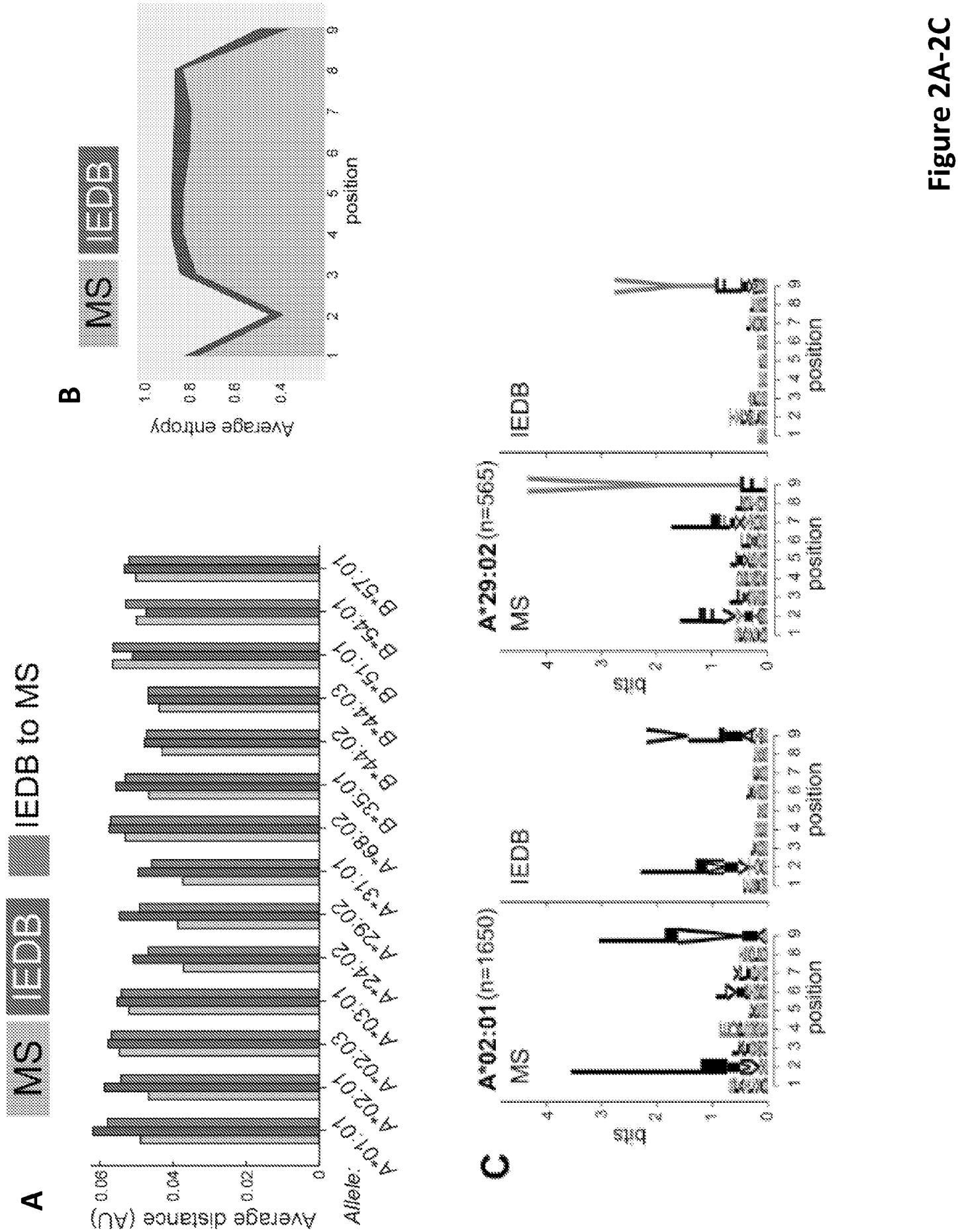

A
MS
IEDB
IEDB to MS
Average distance (AU)
0.06
0.04
0.02
0
Allele:
A*01:01
A*02:01
A*02:03
A*03:01
A*24:02
A*29:02
A*31:01
A*68:02
B*35:01
B*44:02
B*44:03
B*51:01
B*54:01
B*57:01
B
MS
IEDB
Average entropy
1.0
0.8
0.6
0.4
position
C
A*02:01 (n=1650)
A*29:02 (n=565)
MS
IEDB
bits
position

Figure 2A-2C

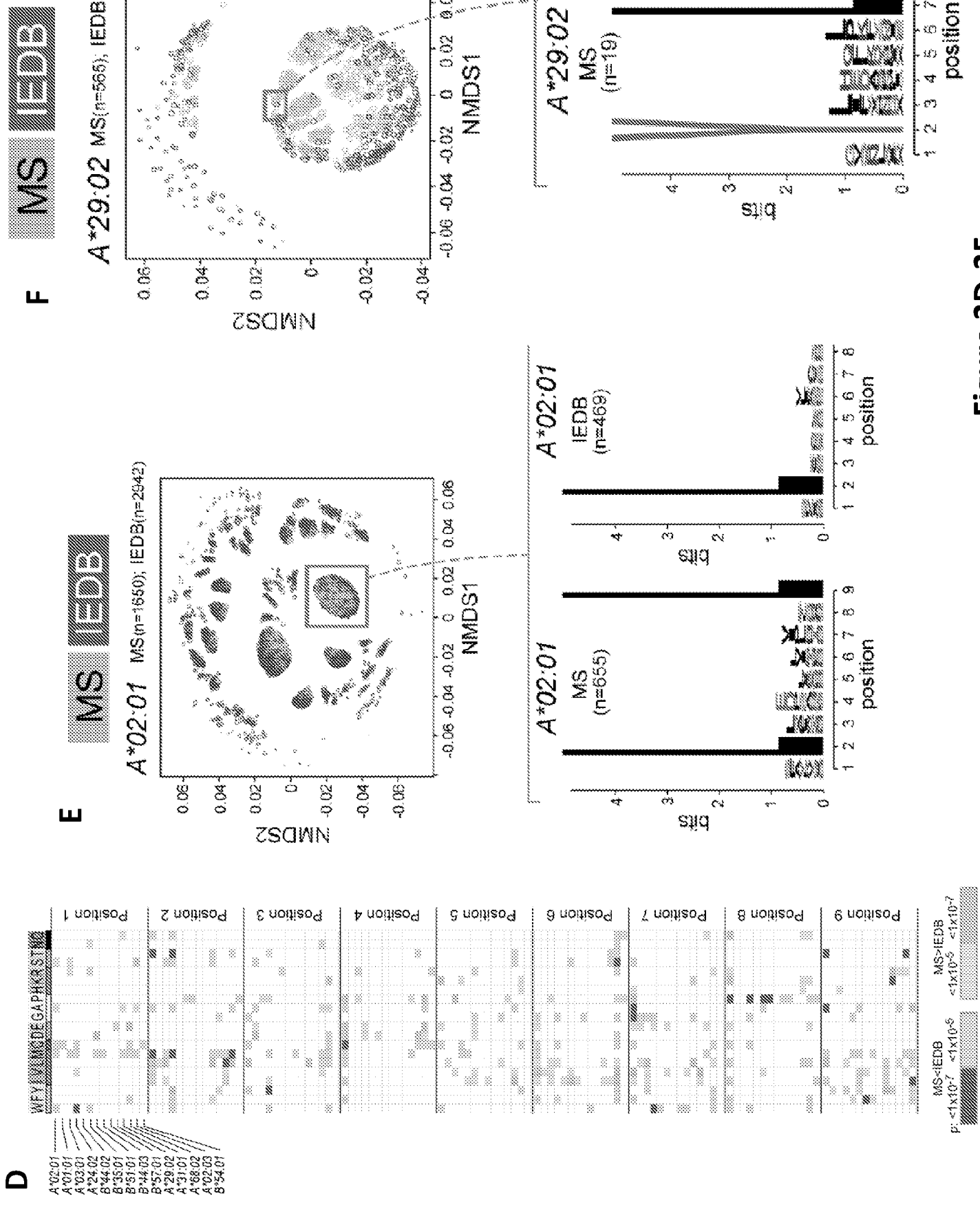

D
E
MS
IEDB
A*02:01 MS(n=1650); IEDB(n=2942)
NMDS1
NMDS2
A*02:01
MS (n=655)
IEDB (n=469)
bits
position
F
A*29:02 MS(n=565); IEDB(n=408)
A*29:02
MS (n=19)

Figure 2D-2F

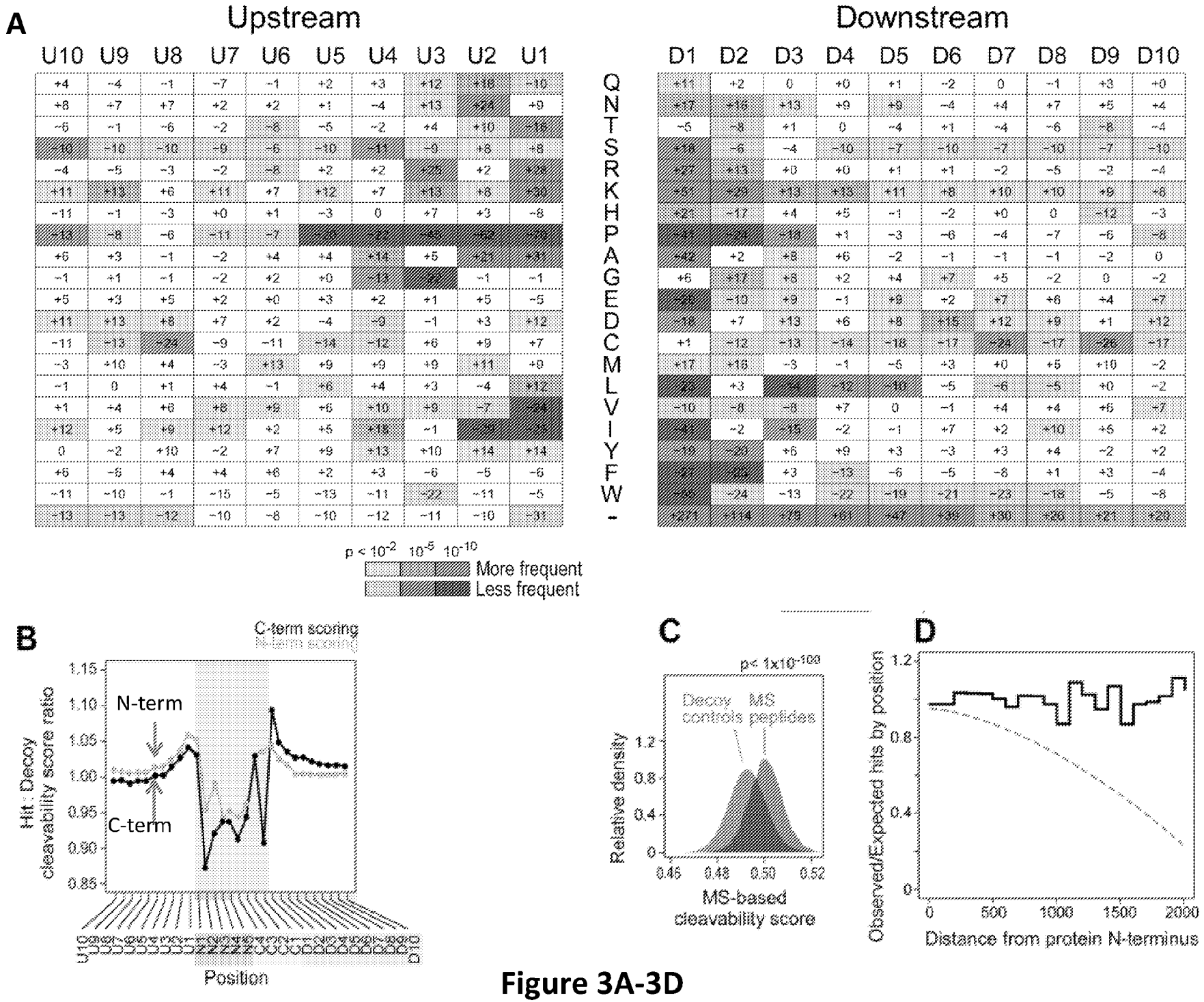

A
Upstream
U10 U9 U8 U7 U6 U5 U4 U3 U2 U1
Downstream
D1 D2 D3 D4 D5 D6 D7 D8 D9 D10
Q N T S R K H P A G E D C M L V I Y F W -
p < 10^-2 10^-5 10^-10
More frequent
Less frequent
B
C-term scoring
N-term scoring
N-term
C-term
Hit : Decoy cleavability score ratio
Position
C
p< 1x10^-100
Decoy MS controls peptides
Relative density
MS-based cleavability score
D
Observed/Expected hits by position
Distance from protein N-terminus

Figure 3A-3D

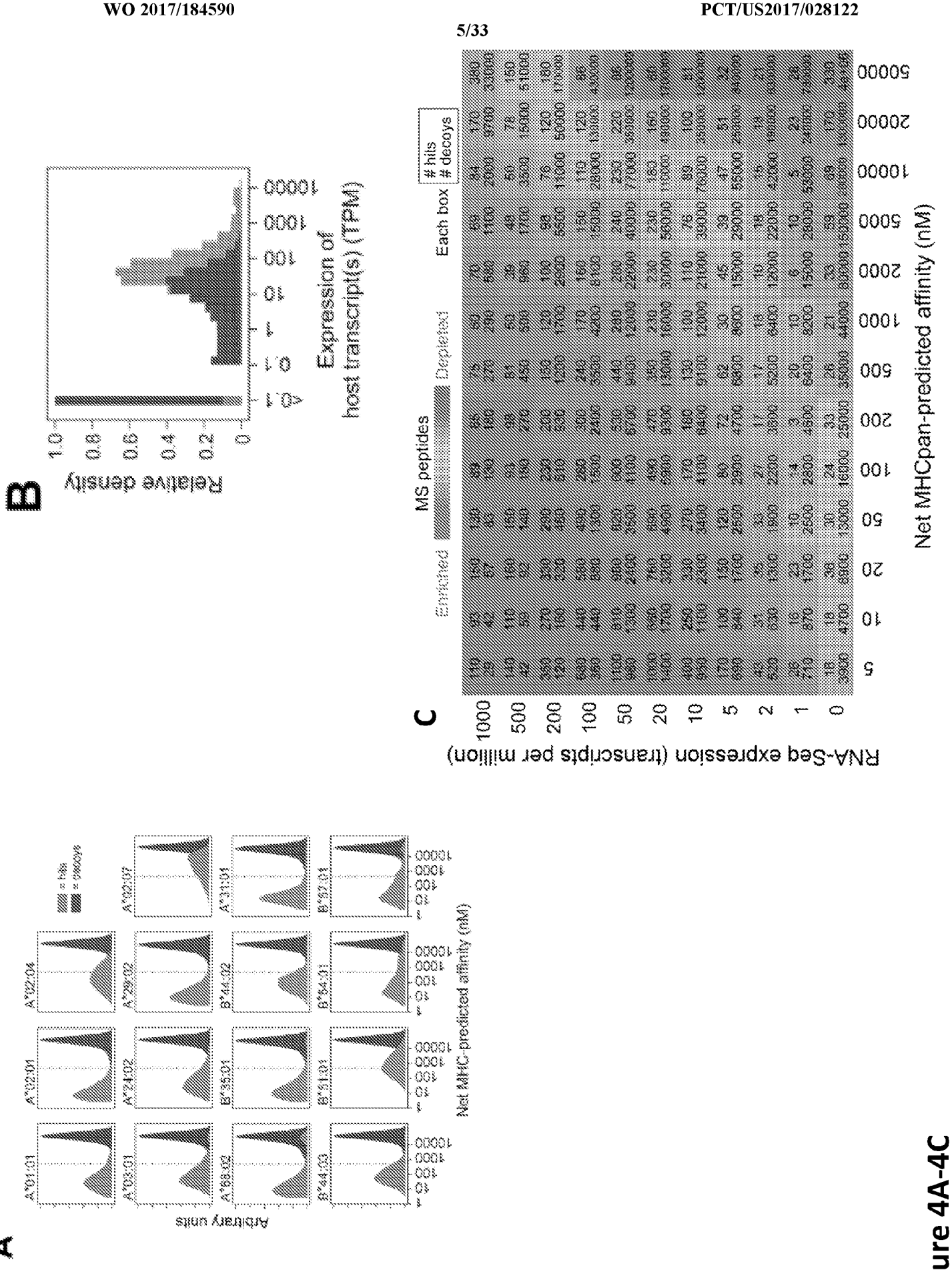

A
A*01:01
A*02:01
A*02:04
A*03:01
A*24:02
A*29:02
A*02:07
A*68:02
B*35:01
B*44:02
A*31:01
B*44:03
B*51:01
B*54:01
B*52:01
hits
decoys
Arbitrary units
Net MHC-predicted affinity (nM)
B
Relative density
Expression of host transcript(s) (TPM)
C
MS peptides
Enriched
Depleted
Each box
hits
decoys
RNA-Seq expression (transcripts per million)
Net MHCpan-predicted affinity (nM)

Figure 4A-4C

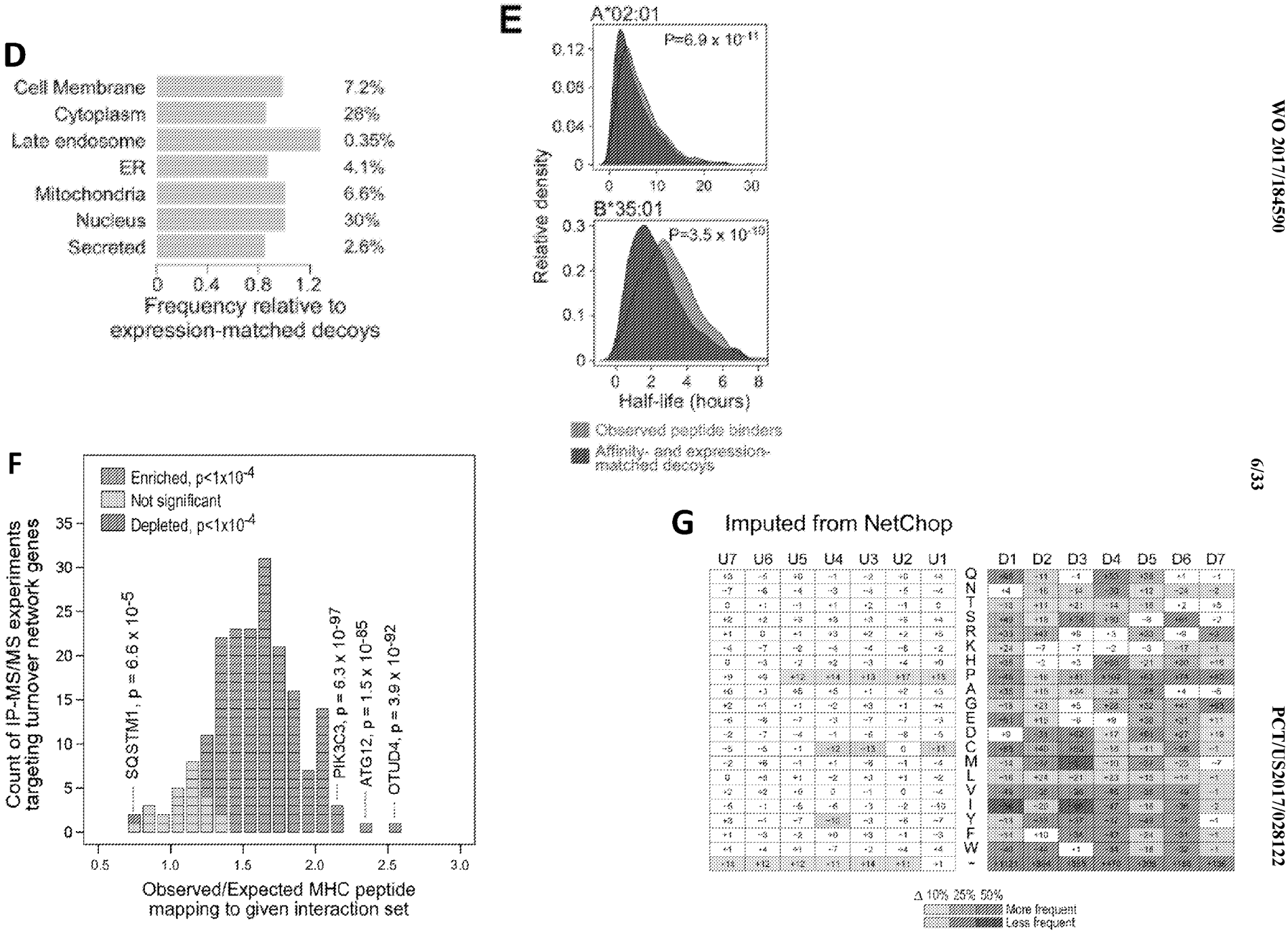
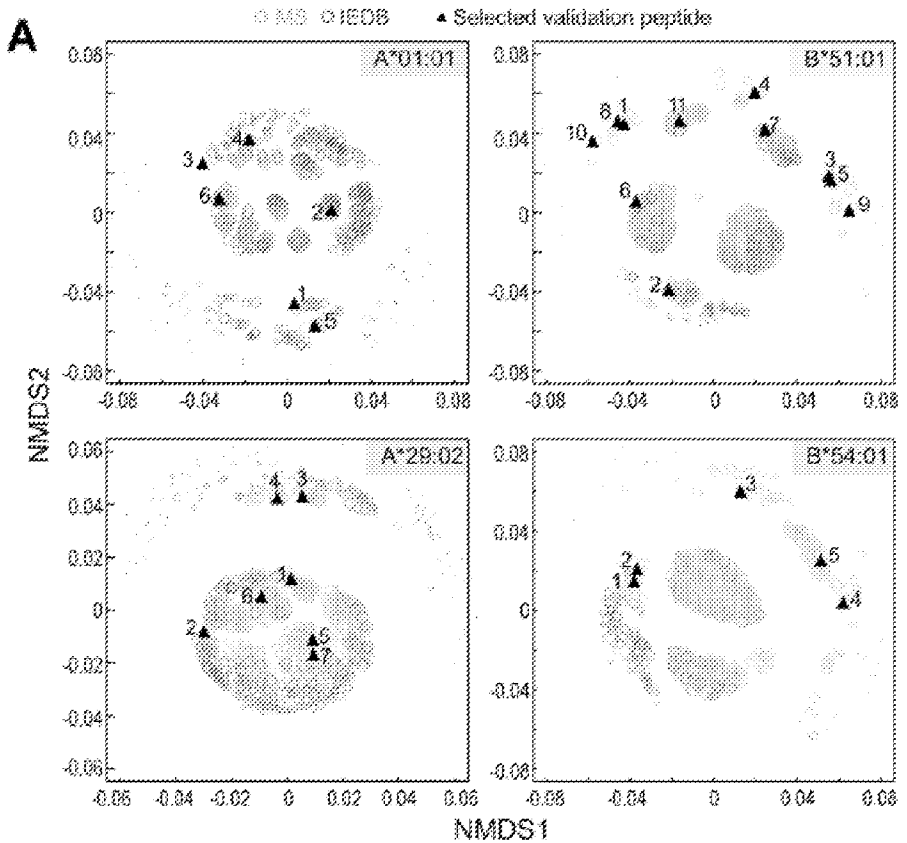
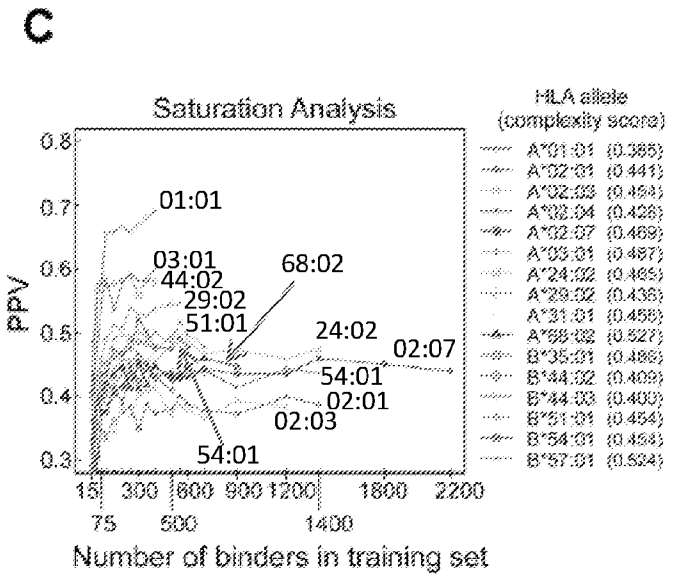

D
Cell Membrane 7.2%
Cytoplasm 26%
Late endosome 0.35%
ER 4.1%
Mitochondria 6.6%
Nucleus 30%
Secreted 2.6%
0 0.4 0.8 1.2
Frequency relative to expression-matched decoys
E
A*02:01
P=6.9 x 10-11
B*35:01
P=3.5 x 10-10
Relative density
Half-life (hours)
Observed peptide binders
Affinity- and expression-matched decoys
F
Enriched, p<1x10-4
Not significant
Depleted, p<1x10-4
SQSTM1, p = 6.6 x 10-5
PIK3C3, p = 6.3 x 10-97
ATG12, p = 1.5 x 10-85
OTUD4, p = 3.9 x 10-92
Count of IP-MS/MS experiments targeting turnover network genes
Observed/Expected MHC peptide mapping to given interaction set
G
Imputed from NetChop
U7 U6 U5 U4 U3 U2 U1
D1 D2 D3 D4 D5 D6 D7
Q N T S R K H P A G E C M L V I Y F W ~
Δ 10% 25% 50%
More frequent
Less frequent

Figure 4D-4G



B

		Peptide	MS (score)	netMHCPan 2.8 (nM)	netMHC 4.0 (nM)	nM (measured)
A*01:01	1	FLWPEAFLY	0.98	409.9	1235.4	1.3
	2	YVPEHWEYY	0.96	551.9	225.3	11.1
	3	KLDLLEQEY	0.91	466.7	105.6	70.6
	4	TTDGYLLRL	0.80	792.1	283.0	78.9
	5	DTEFPNFKY	0.66	344.0	123.8	60.6
	6	ATDGKVLLW	0.97	532.5	945.4	191.4
B*51:01	1	DGLLRVLTV	0.87	11221.3	15547.6	0.2
	2	DAPLNIRSI	0.96	17149.1	13149.4	6.5
	3	DGLRDLPSI	0.96	12708.1	18809.8	12.6
	4	DGYVVKETI	0.98	13414.5	13070.7	13.4
	5	DGRLVINRV	0.60	18358.8	26689.8	13.5
	6	DAYPQRIKF	0.63	12680.6	9533.1	31.0
	7	IIYPTPKVV	0.92	11854.4	4611.5	38.0
	8	VPPLVPKVL	0.79	11306.6	3759.2	56.3
	9	TPESKIRFV	0.86	9336.0	10184.8	84.8
	10	VALLVGEKV	0.93	9509.3	3785.9	143.6
	11	YIIERPLI	0.84	16193.4	10011.8	1791.8
A*29:02	1	FYPELKLAY	0.89	396.3	68.1	0.2
	2	HFLDRHLVF	0.89	825.4	235.6	1.6
	3	YLPALKVEY	0.82	113.3	80.9	2.6
	4	LPLDIQIFY	0.96	359.2	116.7	4.6
	5	ALSDLALHF	0.97	217.6	418.3	6.0
	6	GLDDKLLHY	0.90	187.5	211.0	21.3
	7	GLPDLVAKY	0.98	123.9	668.7	29.7
B*54:01	1	YPVIQPVGP	0.67	8015.0	1237.9	1.7
	2	YGFVNIVTA	0.60	5011.5	391.5	6.0
	3	FVEILIPVA	0.80	6043.1	612.6	12.2
	4	FPKETFEGP	0.82	8478.9	682.8	16.4
	5	SAPVNFISA	0.63	5762.2	7614.0	16.6



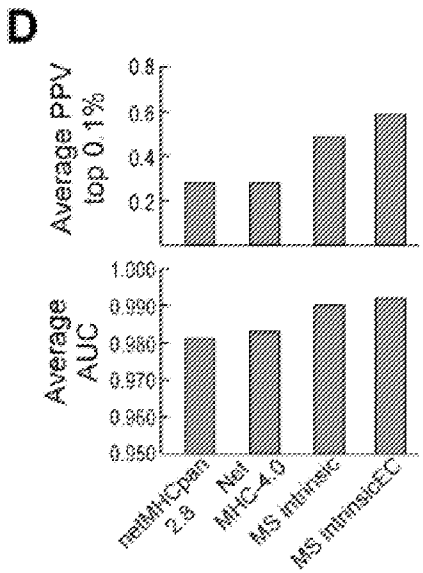


Figure 5A-5D

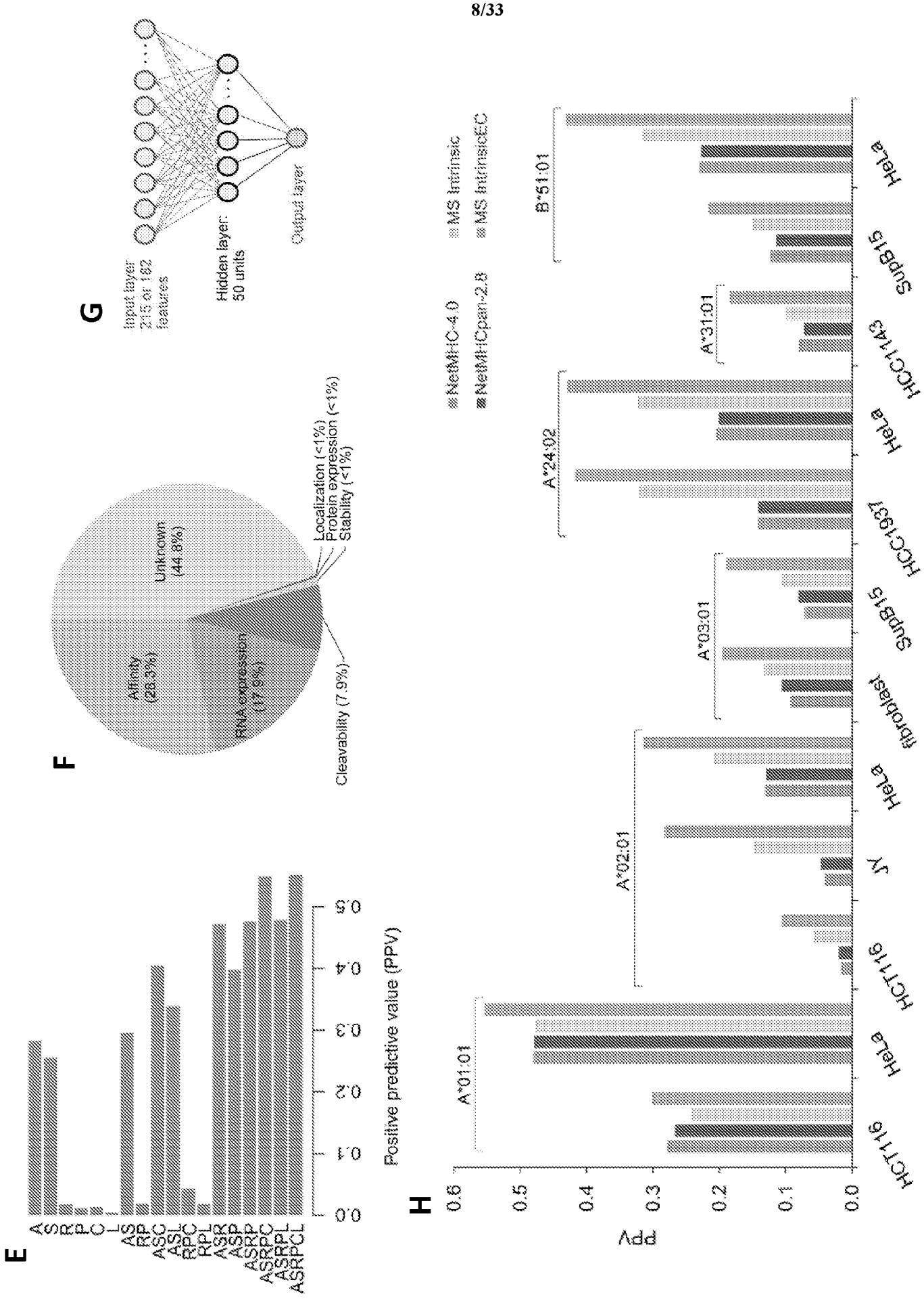

E
A
AS
ASR
ASRP
ASRPC
AS
RP
ASC
ASL
RPC
RPL
ASR
ASP
ASRP
ASRPC
ASRPL
ASRPCL
0.0
0.1
0.2
0.3
0.4
0.5
Positive predictive value (PPV)
F
Affinity (28.3%)
Unknown (44.8%)
RNA expression (17.5%)
Cleavability (7.9%)
Localization (<1%)
Protein expression (<1%)
Stability (<1%)
G
Input layer 215 or 162 features
Hidden layer: 50 units
Output layer
H
NetMHC-4.0
NetMHCpan-2.8
MS Intrinsic
MS IntrinsicEC
A*01:01
A*02:01
A*03:01
A*24:02
A*31:01
B*51:01
PPV
0.0
0.1
0.2
0.3
0.4
0.5
0.6
HCT116
HeLa
HCT116
JY
HeLa
fibroblast
SUDB15
HCC1937
HeLa
HCC1143
SUDB15
HeLa

Figure 5E-5H

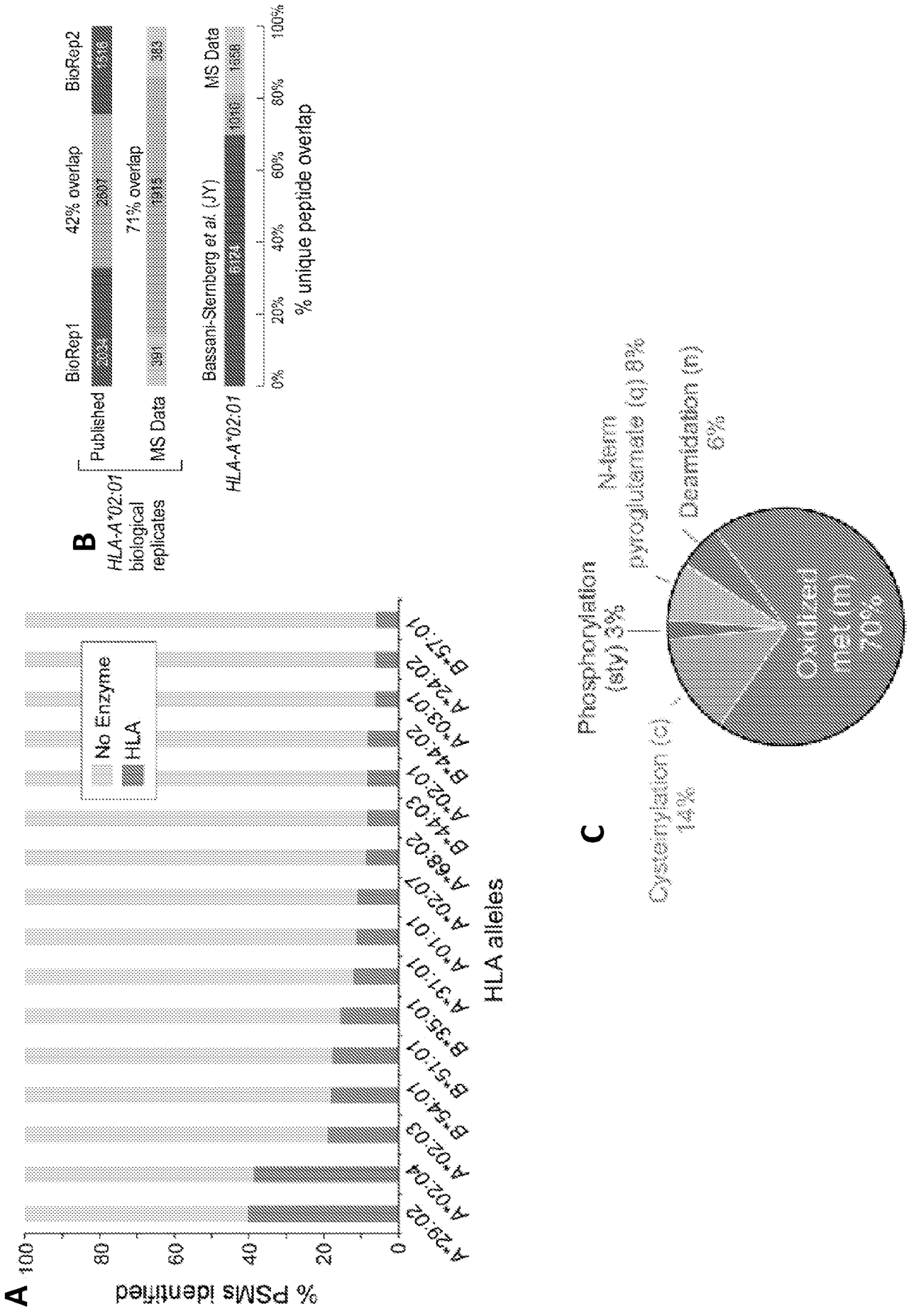
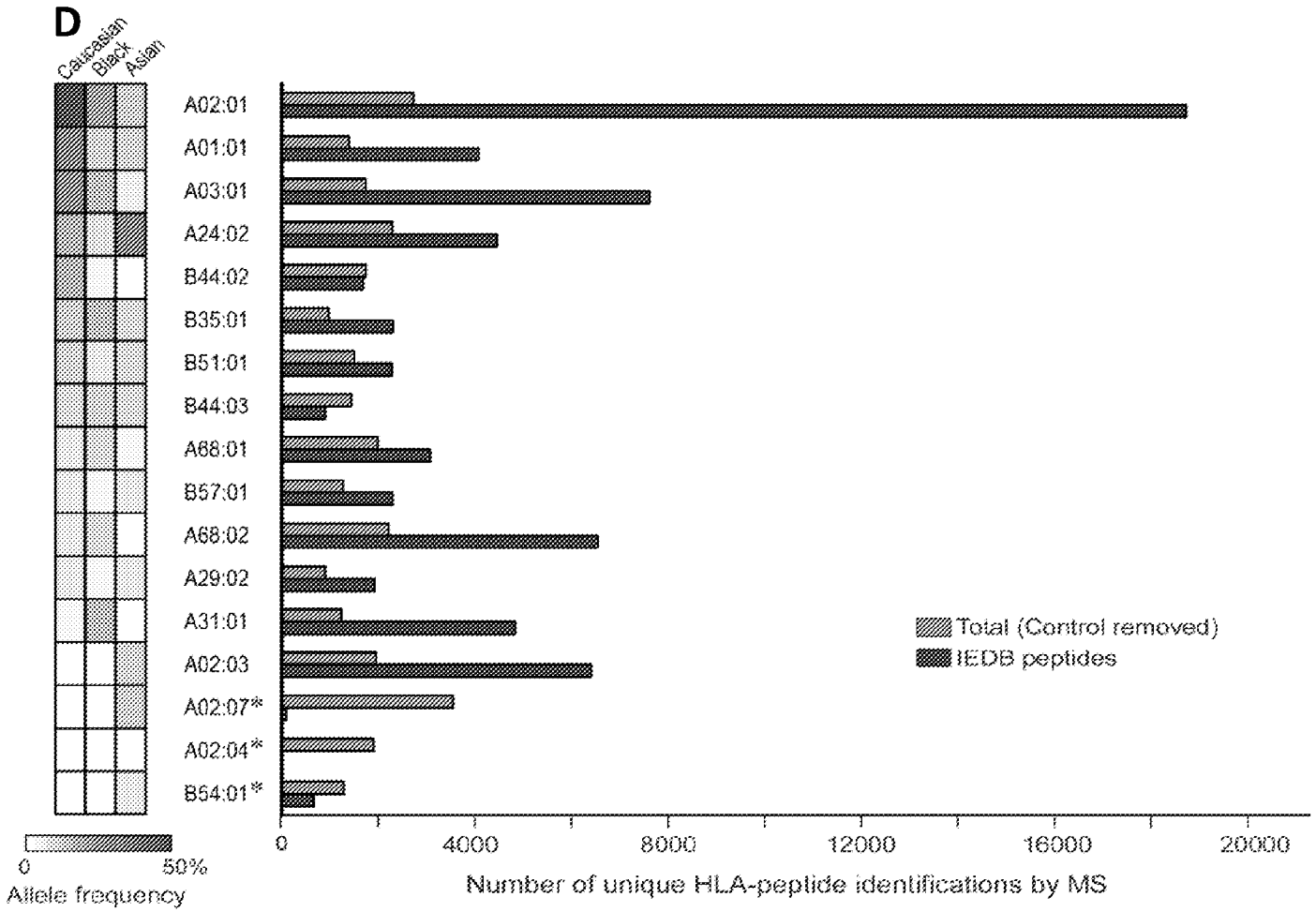

A
% PSMs identified
100
80
60
40
20
0
No Enzyme
HLA
A*29:02
A*02:04
A*02:03
B*54:01
B*51:01
B*35:01
A*31:01
A*01:01
A*02:07
A*68:02
B*44:03
A*02:01
B*44:02
A*03:01
A*24:02
B*57:01
HLA alleles
B
HLA-A*02:01 biological replicates
Published
MS Data
BioRep1
42% overlap
BioRep2
2021
2607
2330
391
71% overlap
1915
383
HLA-A*02:01
Bassani-Sternberg et al. (JY)
MS Data
6823
1866
1858
0%
20%
40%
60%
80%
100%
% unique peptide overlap
C
Phosphorylation (sty) 3%
N-term pyroglutamate (q) 8%
Deamidation (n) 6%
Cysteinylation (c) 14%
Oxidized met (m) 70%

Figure 6A-6C



E

≈ UCSC

<UCSC >UCSC

Differences in aa frequencies within all 9mers across all 16 HLA alleles compared to the natural amino acid frequency (all proteins with UCSC annotations)

AA	W	F	Y	I	V	L	M*	C*	D	E	G	A	P	H	K	R	S	T	N	Q
IEDB	1.17	3.65	2.71	2.23	-0.09	0.17	1.66	-0.50	0.85	3.34	-1.17	0.88	2.17	-0.10	-1.56	1.45	-0.95	0.82	0.75	-1.86
MS	-1.27	-0.89	-1.47	1.53	2.36	1.51	-2.26	-1.69	1.07	2.53	-1.85	-0.96	1.75	0.64	0.67	-0.47	-1.00	-0.89	-0.65	1.32

Figure 6D-6E

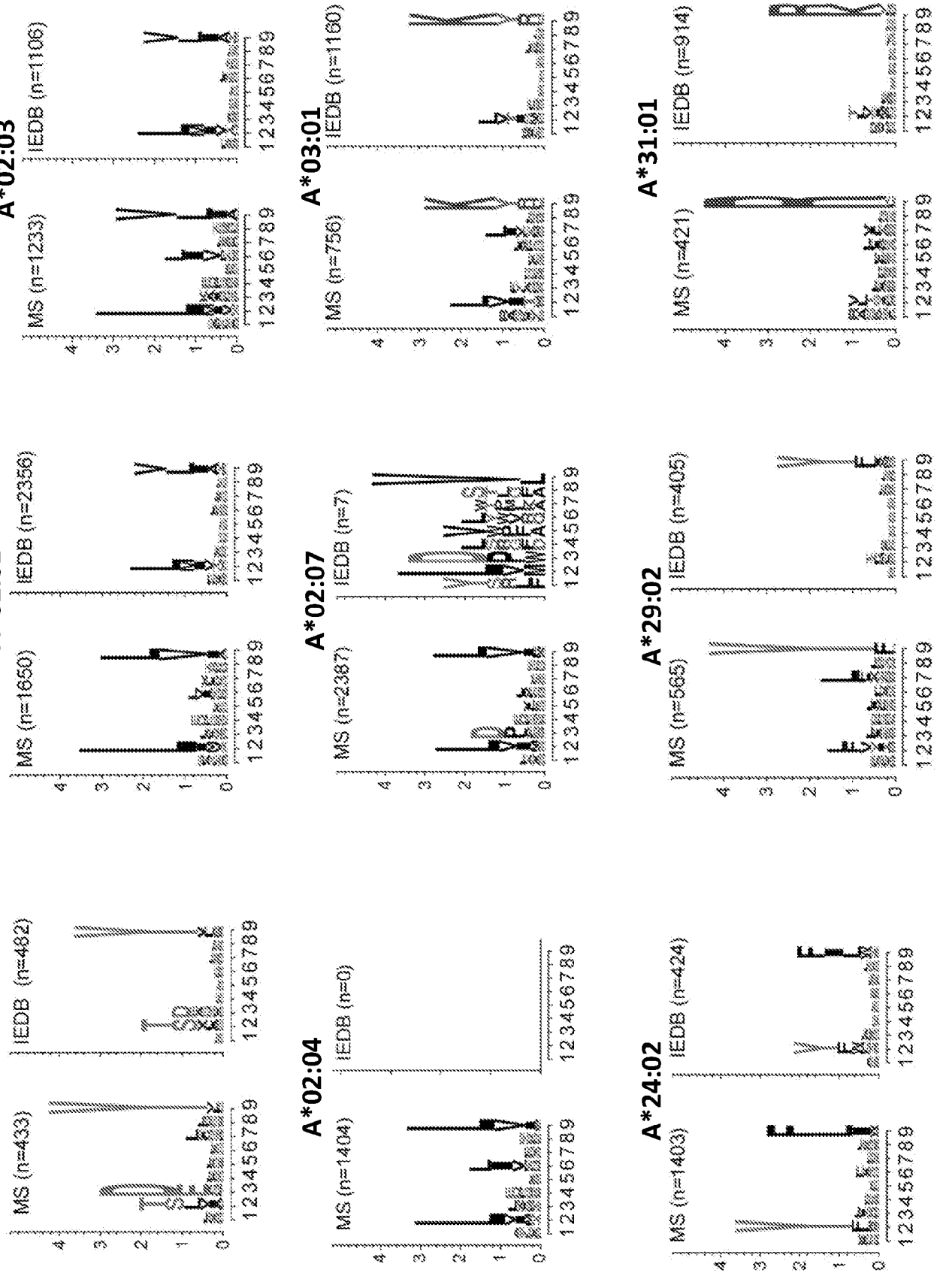

A*01:01
MS (n=433)
IEDB (n=482)
A*02:01
MS (n=1650)
IEDB (n=2356)
A*02:03
MS (n=1233)
IEDB (n=1106)
A*02:04
MS (n=1404)
IEDB (n=0)
A*02:07
MS (n=2387)
IEDB (n=7)
A*03:01
MS (n=756)
IEDB (n=1160)
A*24:02
MS (n=1403)
IEDB (n=424)
A*29:02
MS (n=565)
IEDB (n=405)
A*31:01
MS (n=421)
IEDB (n=914)
bits
position

Figure 7A

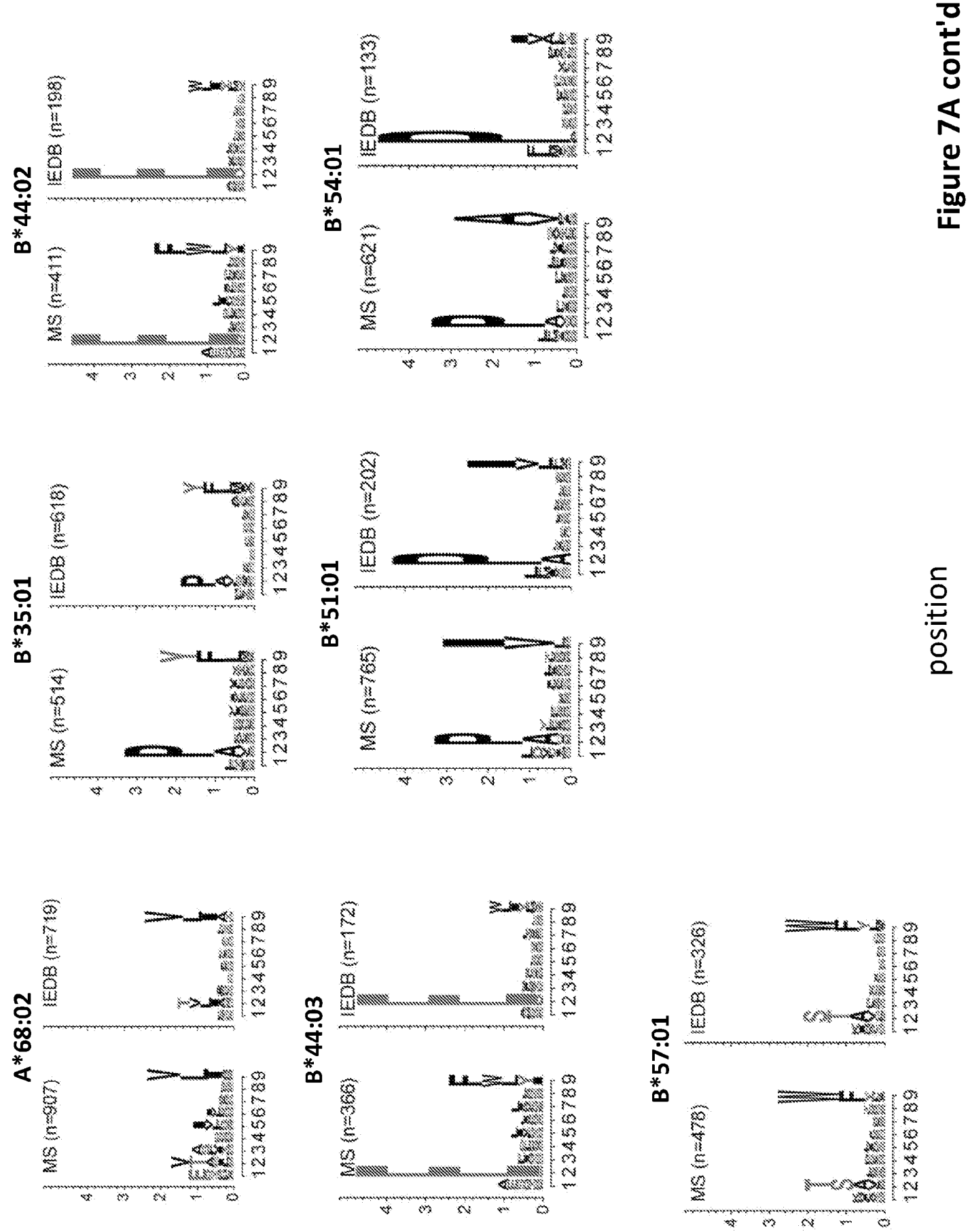


Figure 7A cont'd

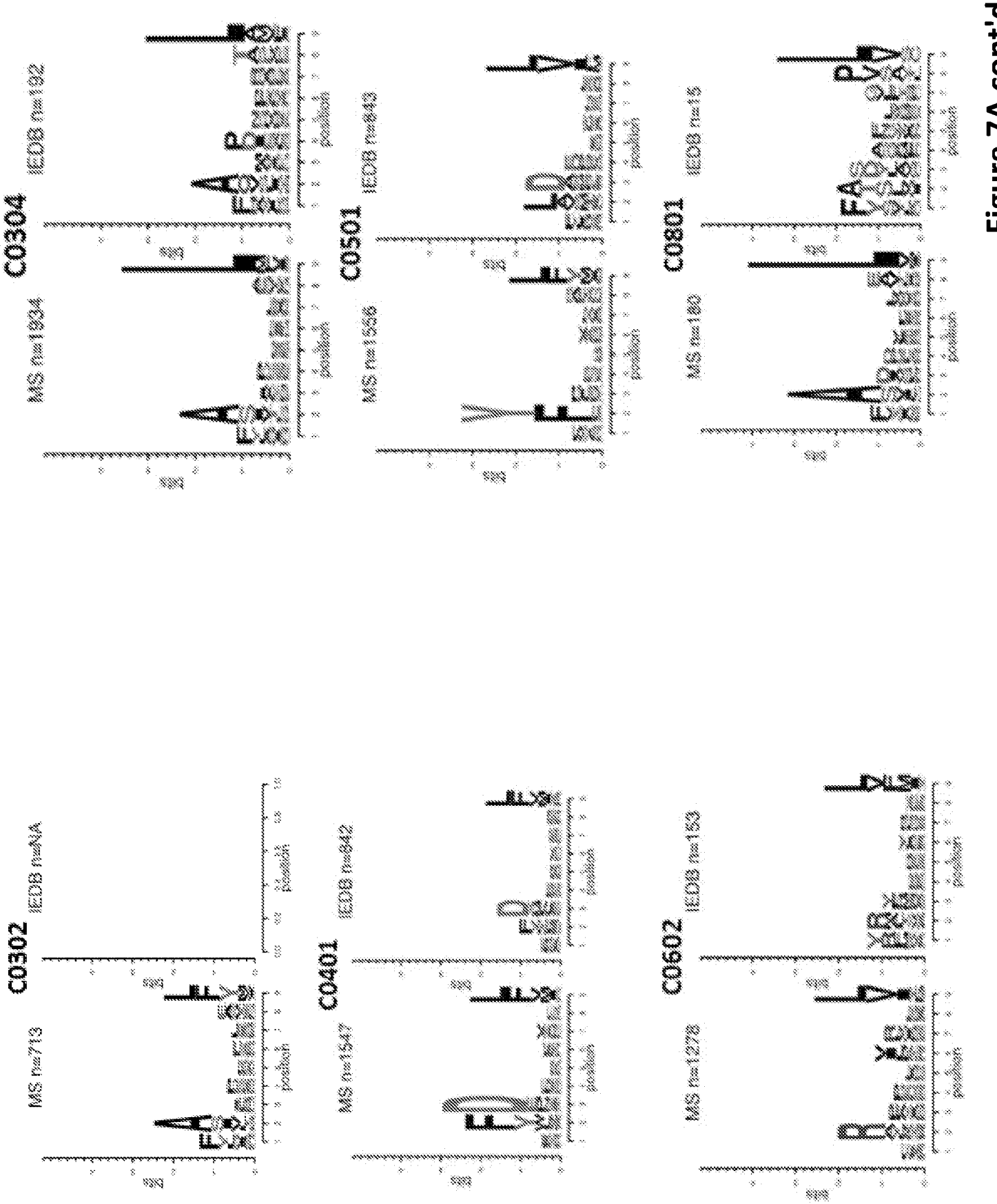


Figure 7A cont'd

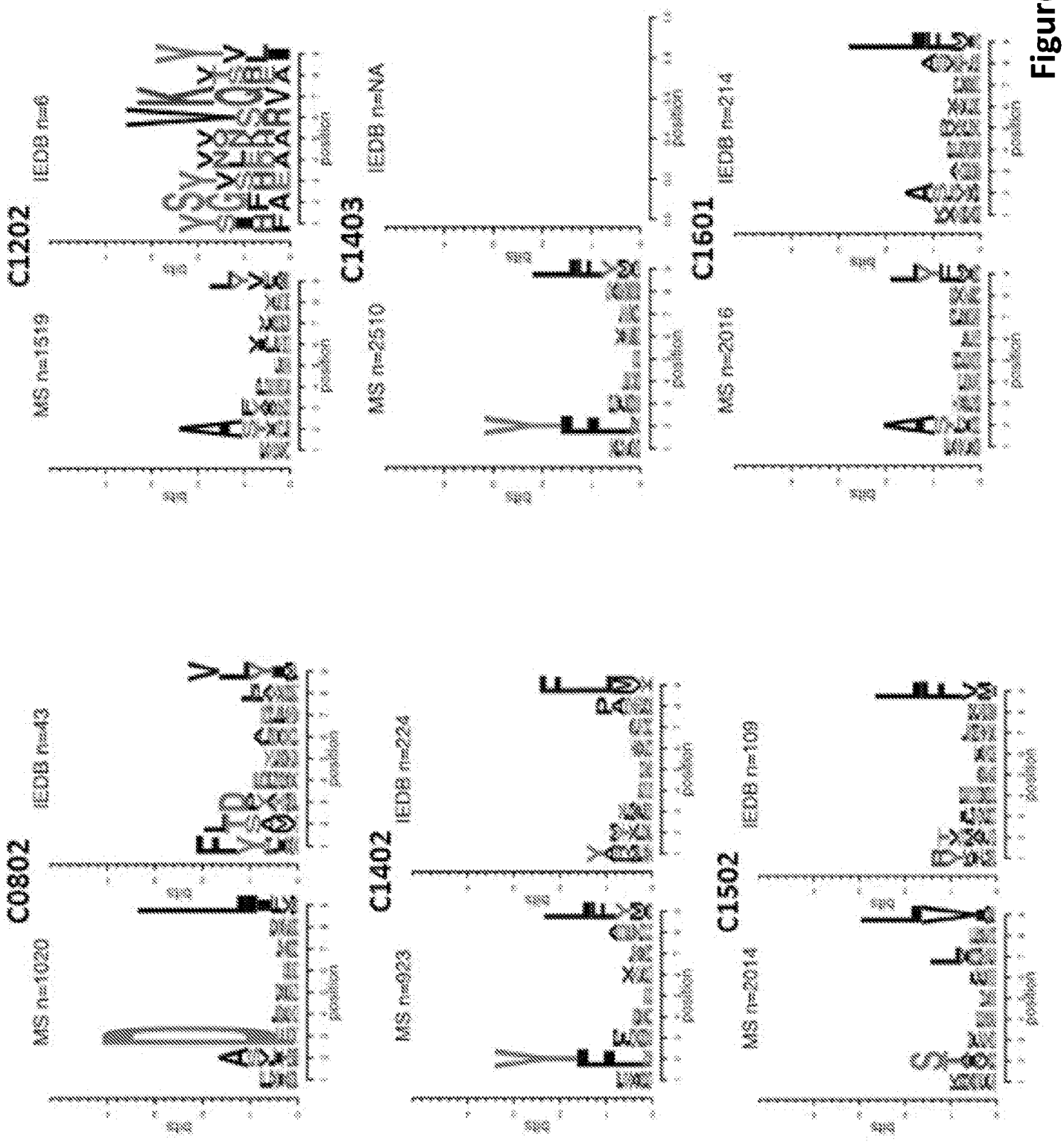


Figure 7A cont'd

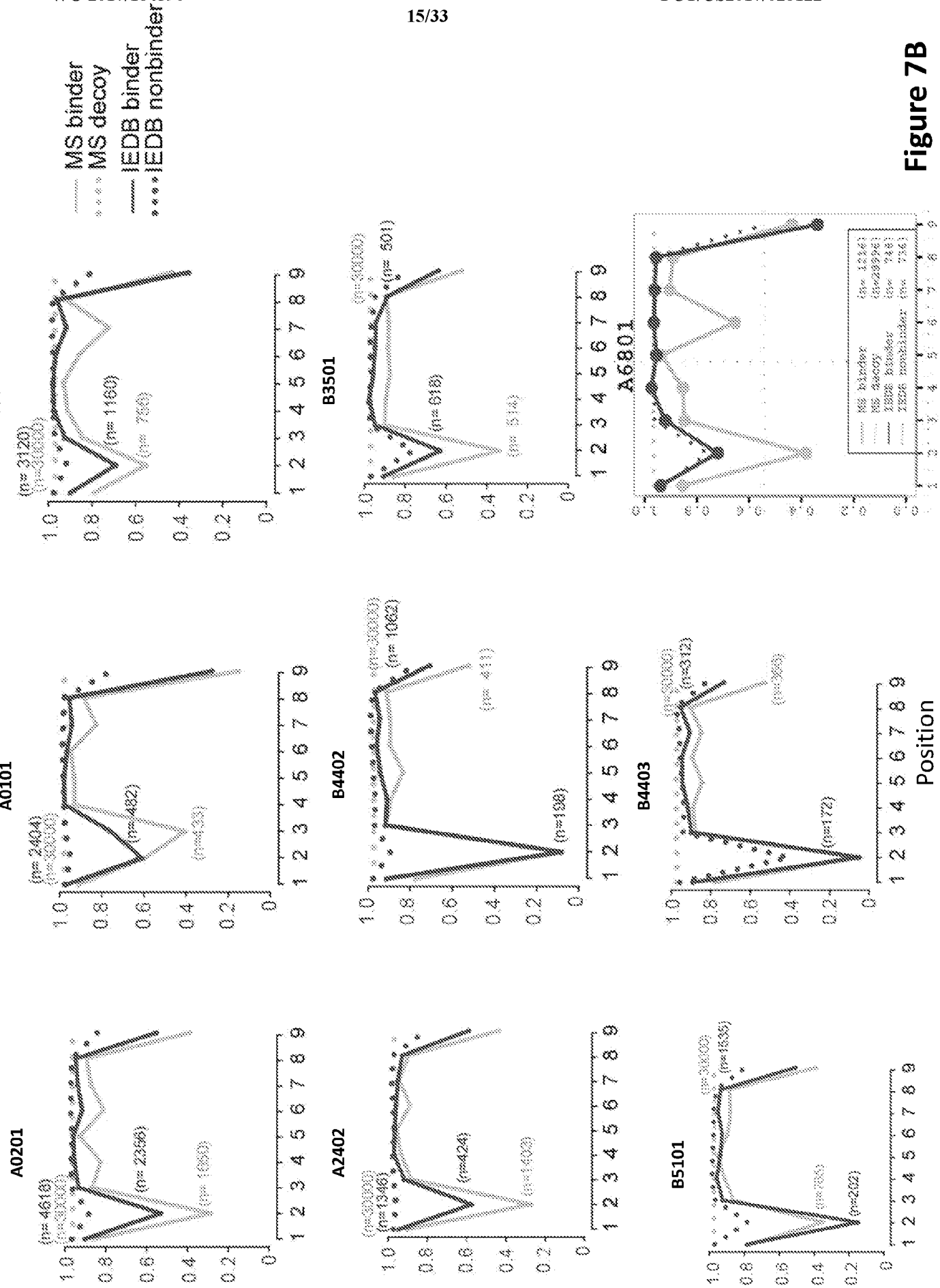

Entropy per position per allele
Entropy
Position
MS binder
MS decoy
IEDB binder
IEDB nonbinder
A0101
A0201
A0301
A2402
B3501
B4402
B4403
B5101
A6801

Figure 7B

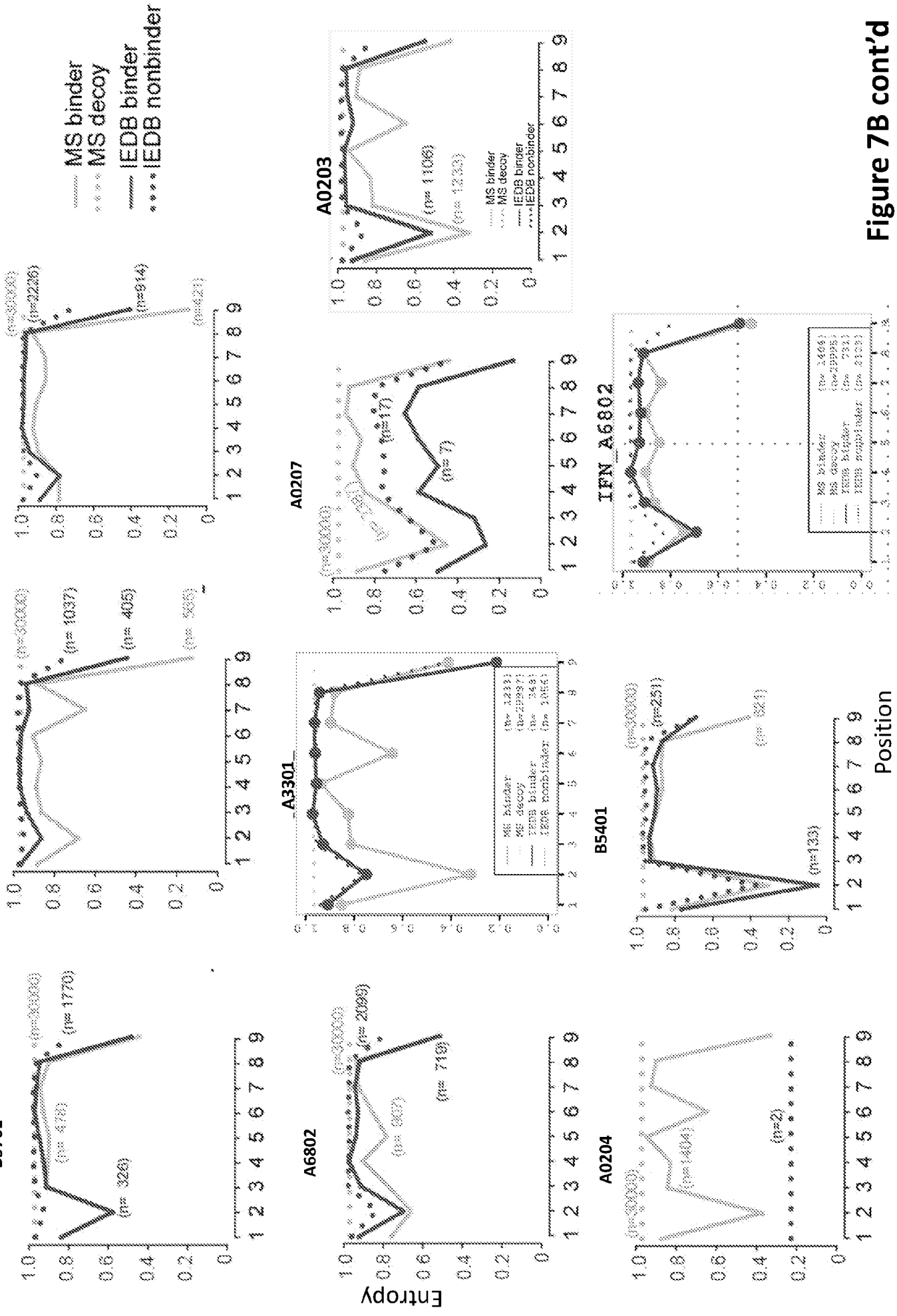


Figure 7B cont'd

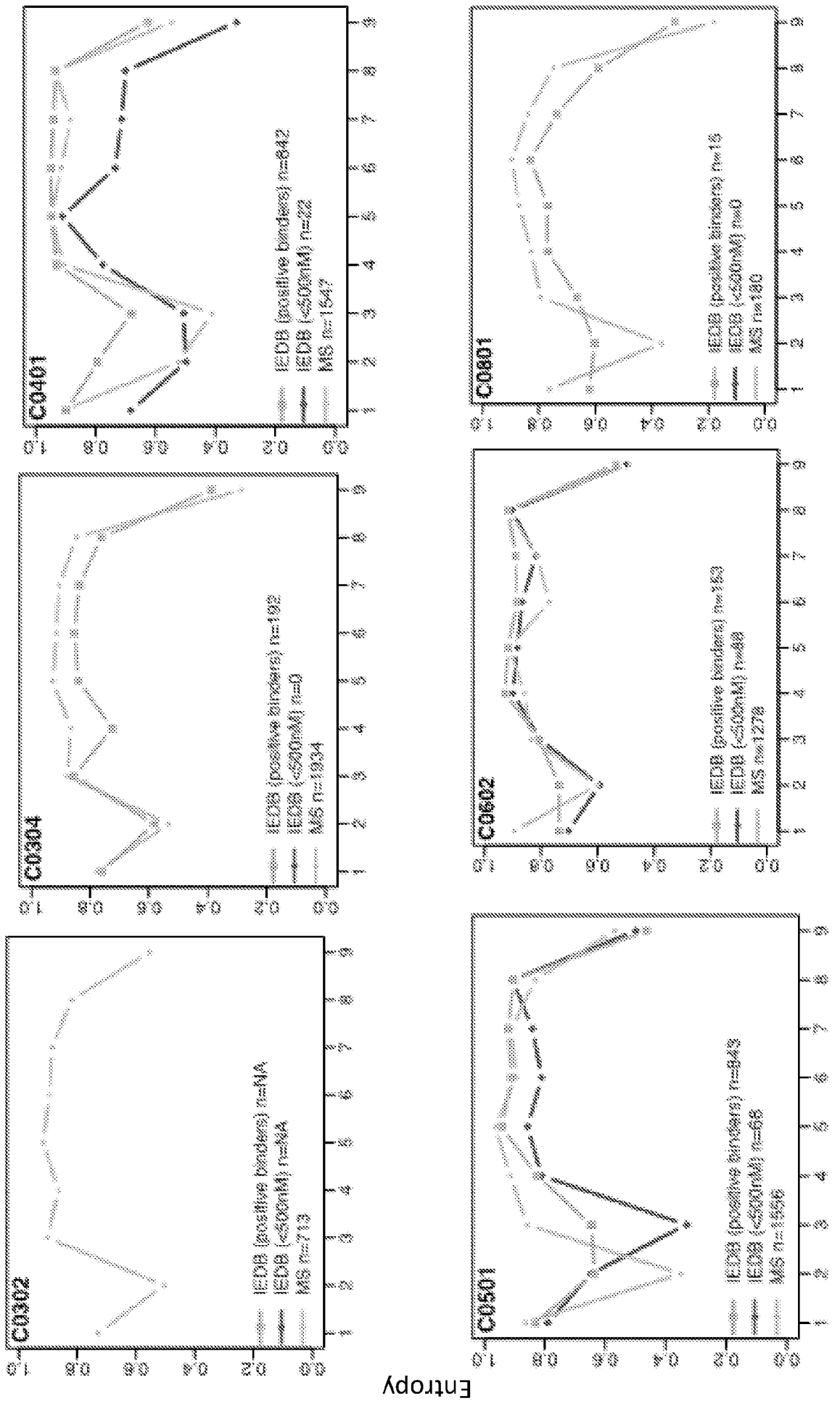


Figure 7B cont'd

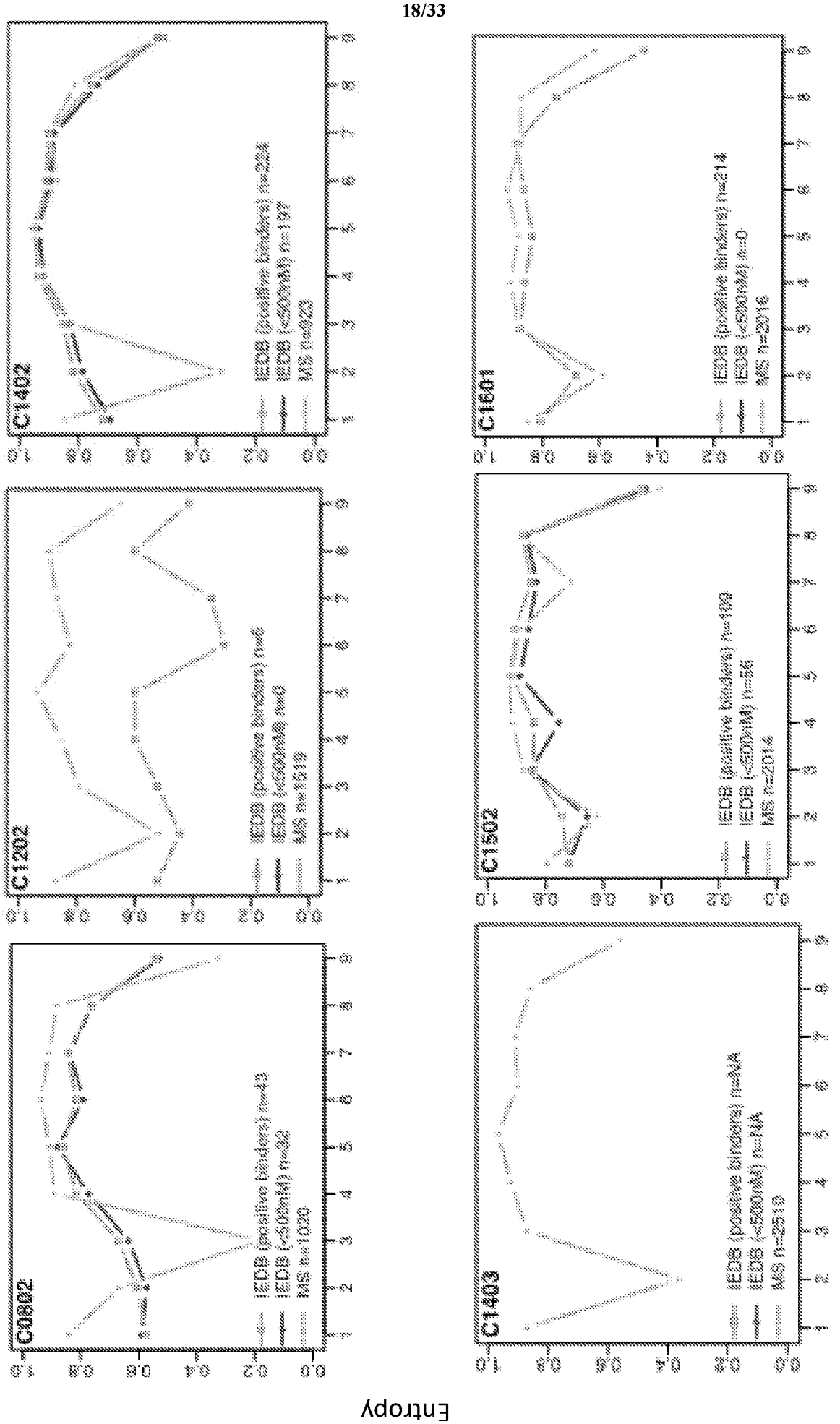


Figure 7B cont'd

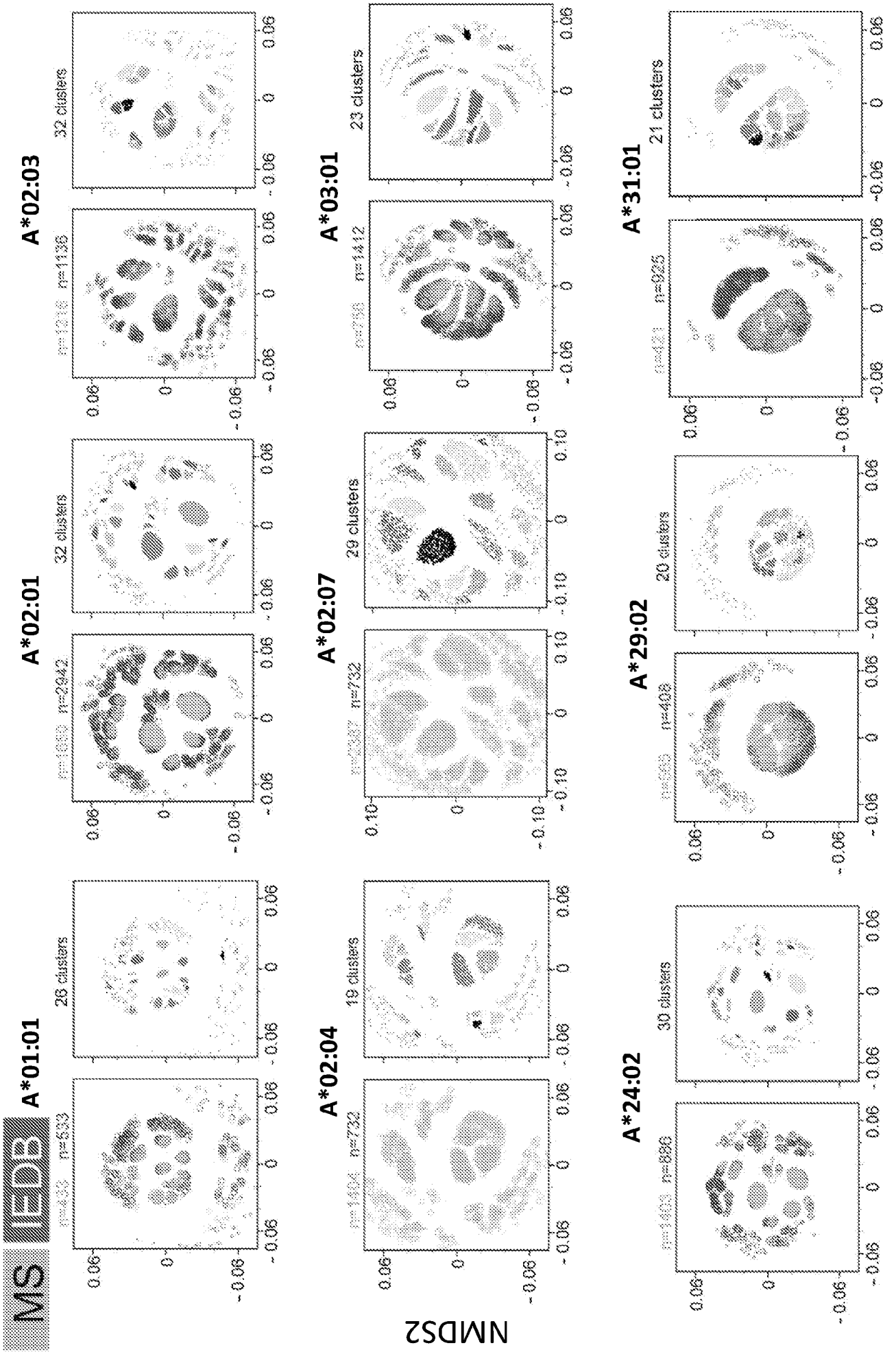

MS IEDB
A*01:01
A*02:01
A*02:03
A*02:04
A*02:07
A*03:01
A*24:02
A*29:02
A*31:01
NMDS2
NMDS1

Figure 8

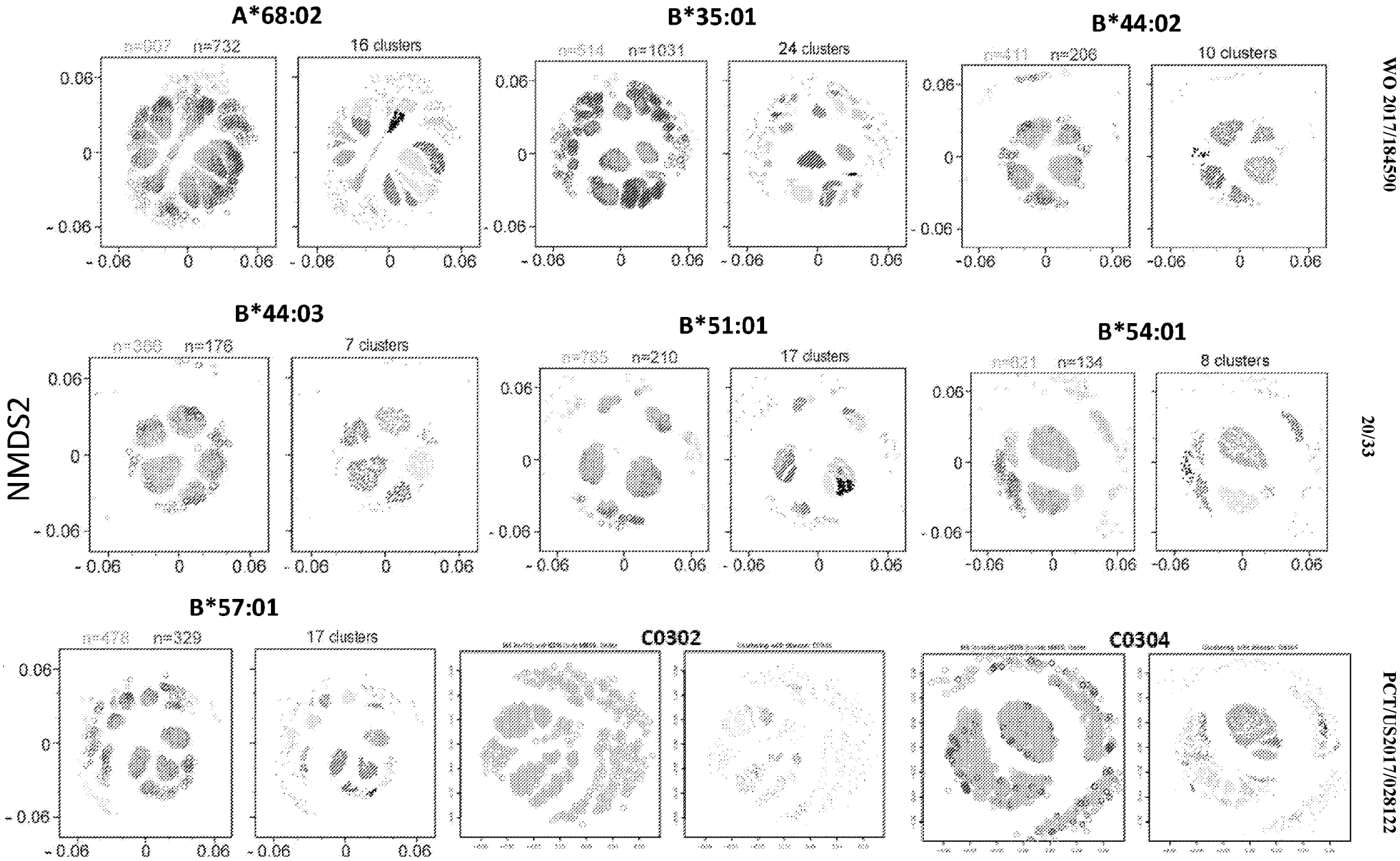


Figure 8 cont'd

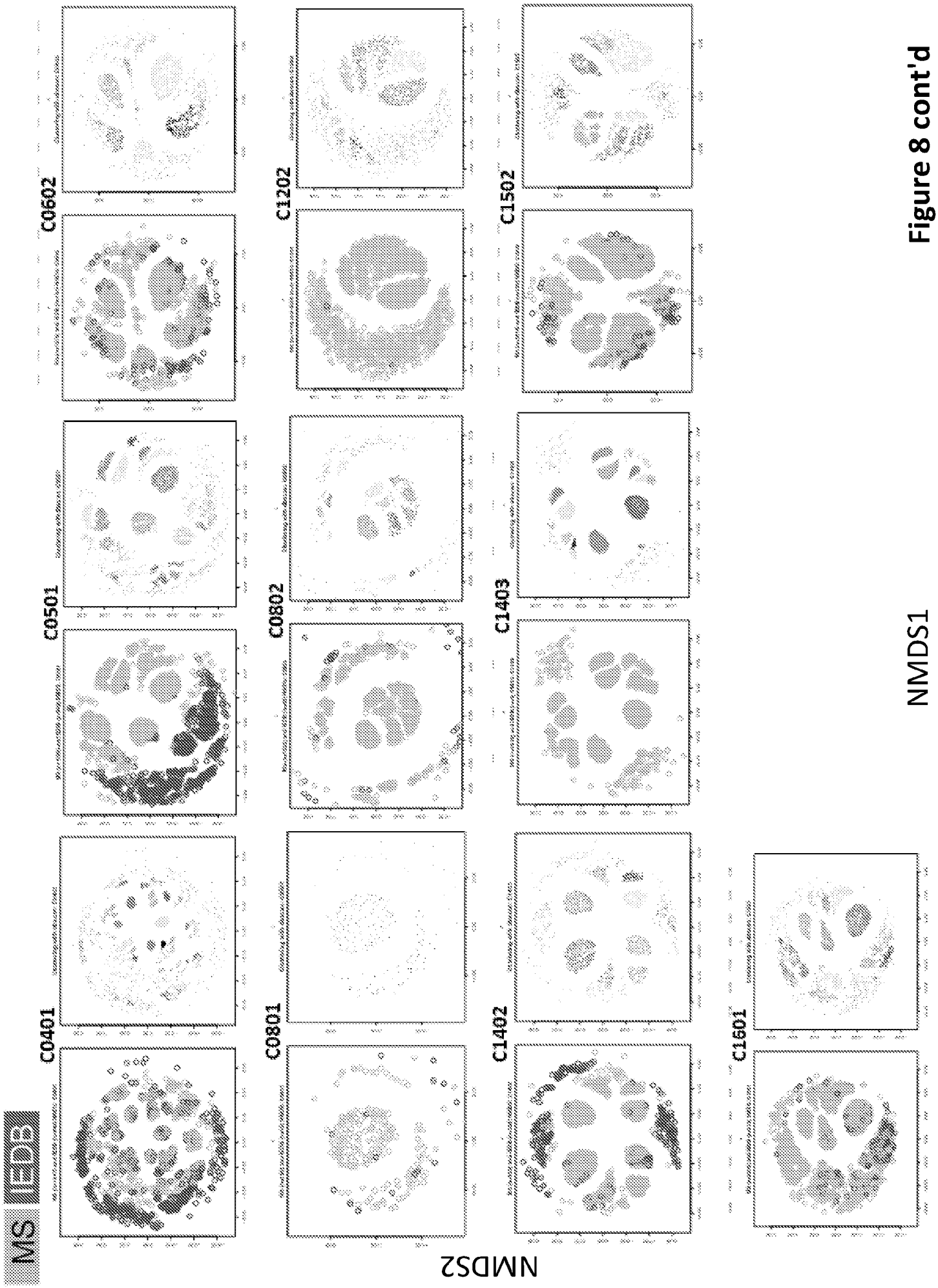


Figure 8 cont'd

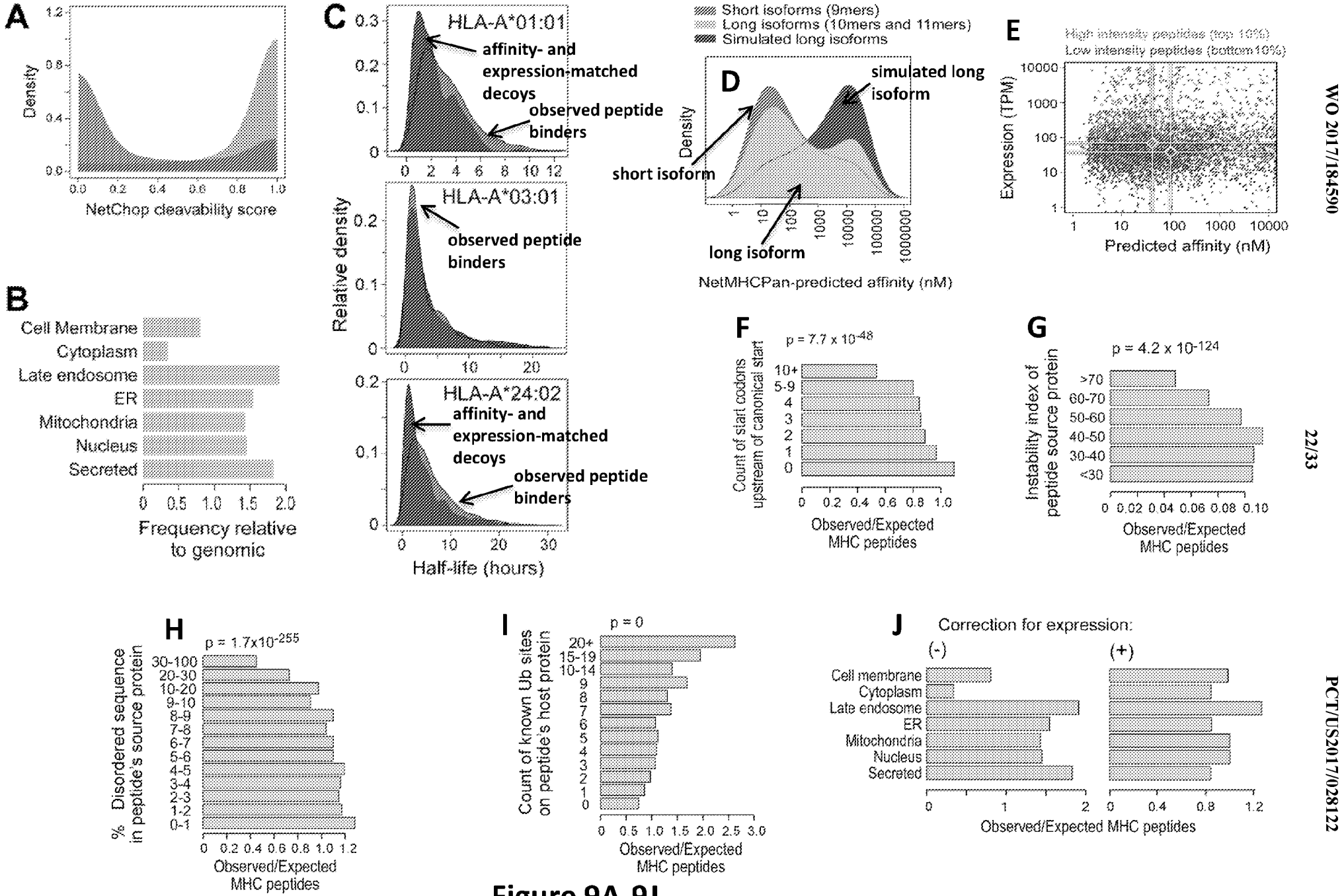
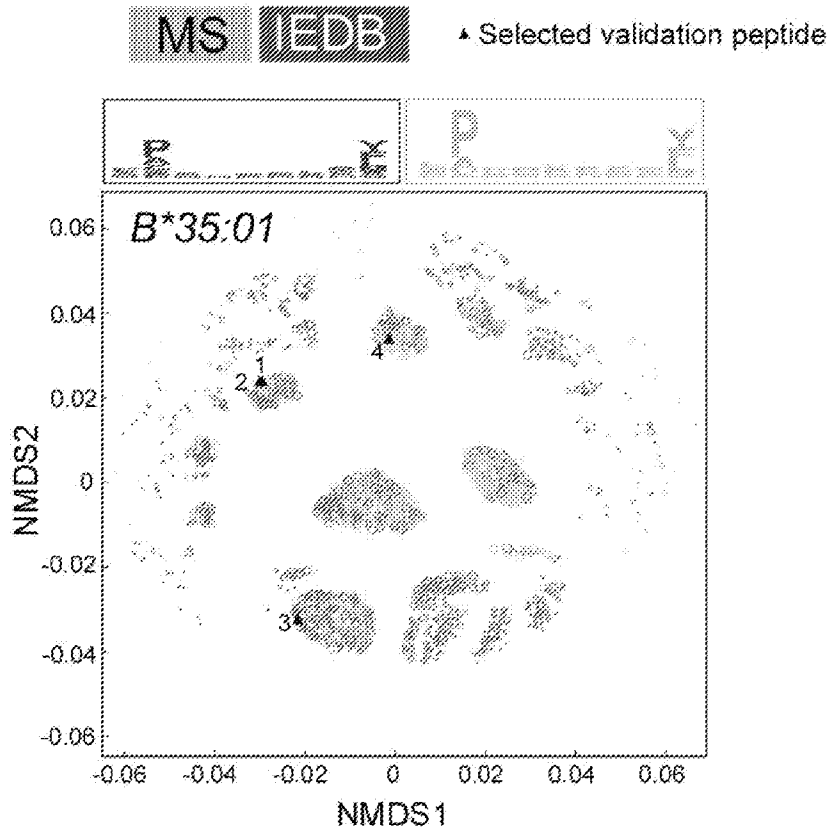

A
Density
NetChop cleavability score
B
Cell Membrane
Cytoplasm
Late endosome
ER
Mitochondria
Nucleus
Secreted
Frequency relative to genomic
C
HLA-A*01:01
affinity- and expression-matched decoys
observed peptide binders
HLA-A*03:01
observed peptide binders
HLA-A*24:02
affinity- and expression-matched decoys
observed peptide binders
Relative density
Half-life (hours)
D
Short isoforms (9mers)
Long isoforms (10mers and 11mers)
Simulated long isoforms
simulated long isoform
short isoform
long isoform
Density
NetMHCPan-predicted affinity (nM)
E
High intensity peptides (top 10%)
Low intensity peptides (bottom10%)
Expression (TPM)
Predicted affinity (nM)
F
p = 7.7 x 10-48
Count of start codons upstream of canonical start
Observed/Expected MHC peptides
G
p = 4.2 x 10-124
Instability index of peptide source protein
Observed/Expected MHC peptides
H
p = 1.7x10-255
% Disordered sequence in peptide's source protein
Observed/Expected MHC peptides
I
p = 0
Count of known Ub sites on peptide's host protein
Observed/Expected MHC peptides
J
Correction for expression:
(-)
(+)
Cell membrane
Cytoplasm
Late endosome
ER
Mitochondria
Nucleus
Secreted
Observed/Expected MHC peptides

Figure 9A-9J



B*35:01	Peptide	netMHCPan 2.8 (nM)	netMHC 4.0 (nM)	nM (measured)	MS Score
1	DPFRDLHSL	1204.1	674.5	1.0	0.86
2	NAWADIERF	313.7	491.0	1.2	0.90
3	GAHGIIVVY	289.0	186.6	79.7	0.95
4	DAYPEIEKF	334.4	2645.5	84.3	0.70

Figure 10A

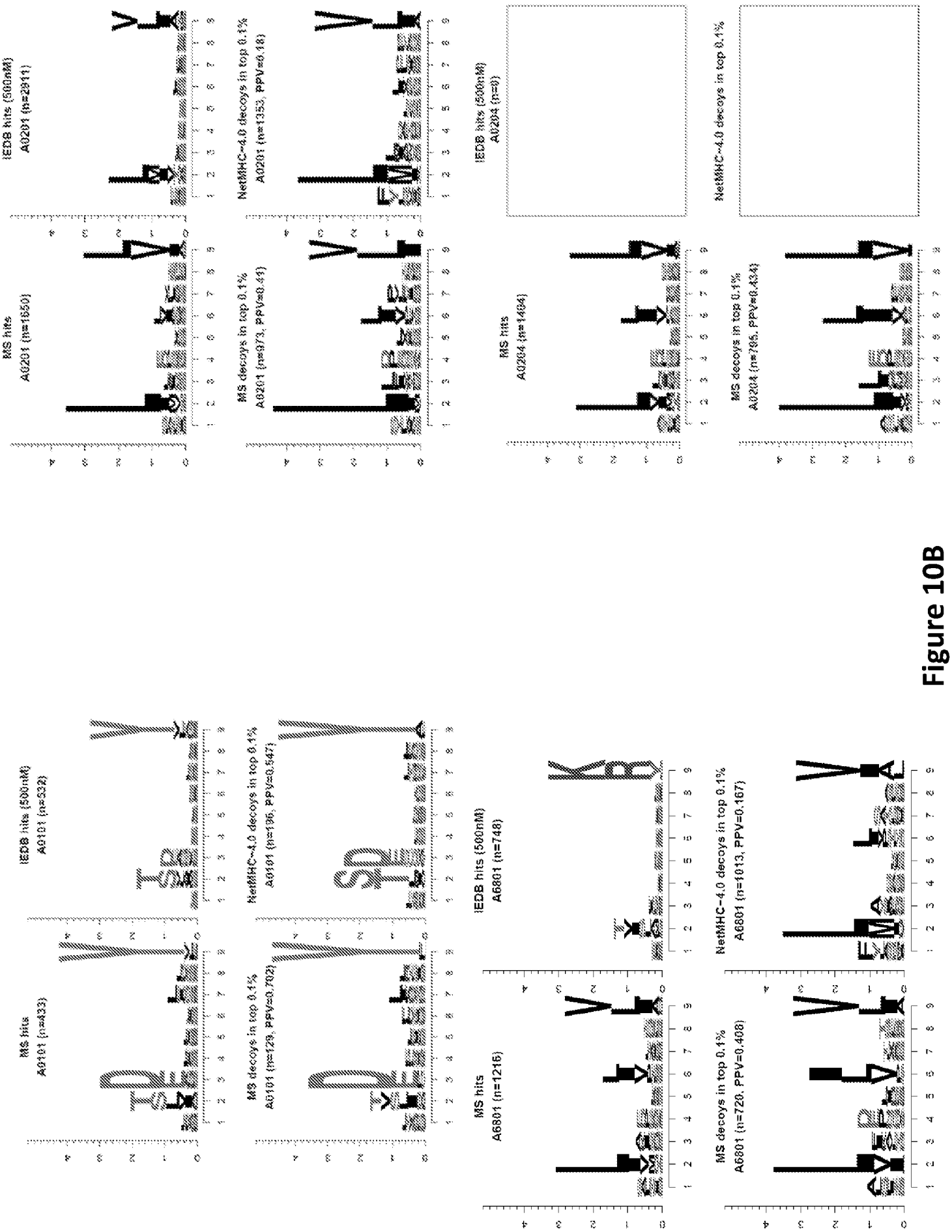

MS hits
A0201 (n=1650)
IEDB hits (500nM)
A0201 (n=2911)
MS decoys in top 0.1%
A0201 (n=973, PPV=0.44)
NetMHC-4.0 decoys in top 0.1%
A0201 (n=1353, PPV=0.18)
MS hits
A0204 (n=1494)
IEDB hits (500nM)
A0204 (n=0)
MS decoys in top 0.1%
A0204 (n=785, PPV=0.434)
NetMHC-4.0 decoys in top 0.1%
MS hits
A0101 (n=433)
IEDB hits (500nM)
A0101 (n=532)
MS decoys in top 0.1%
A0101 (n=129, PPV=0.702)
NetMHC-4.0 decoys in top 0.1%
A0101 (n=196, PPV=0.547)
MS hits
A6801 (n=1216)
IEDB hits (500nM)
A6801 (n=748)
MS decoys in top 0.1%
A6801 (n=720, PPV=0.408)
NetMHC-4.0 decoys in top 0.1%
A6801 (n=1013, PPV=0.167)

Figure 10B

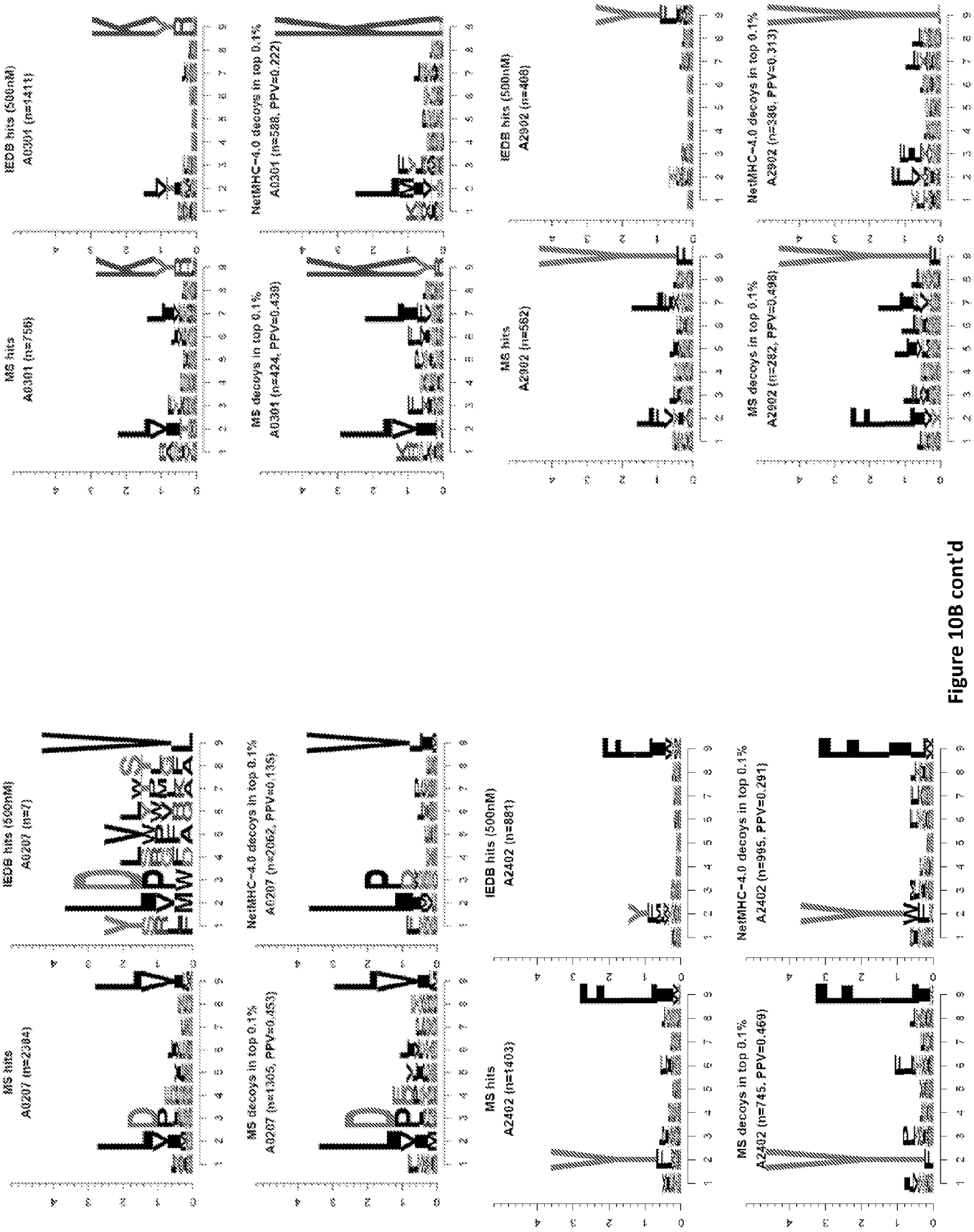


Figure 10B cont'd

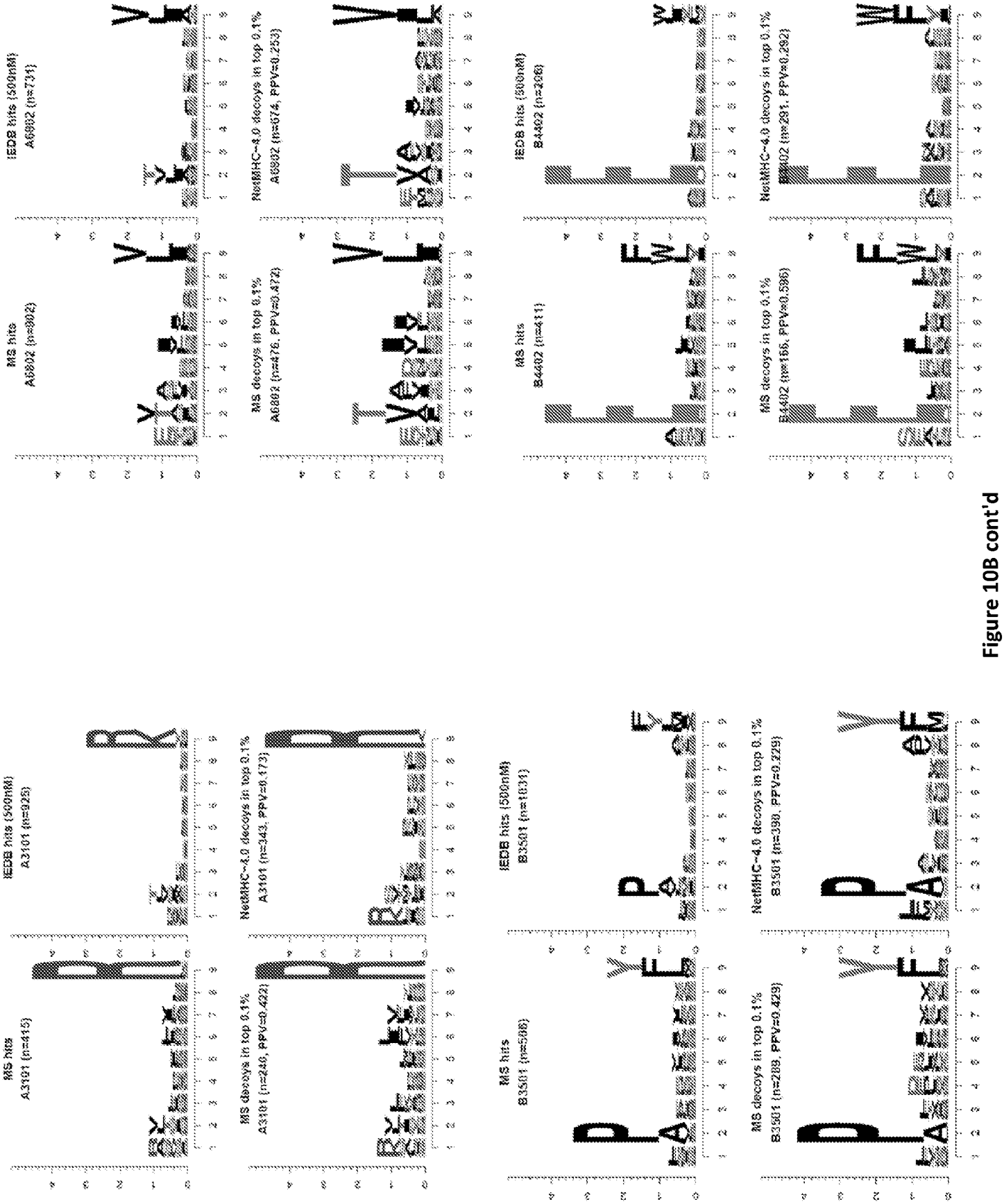


Figure 10B cont'd

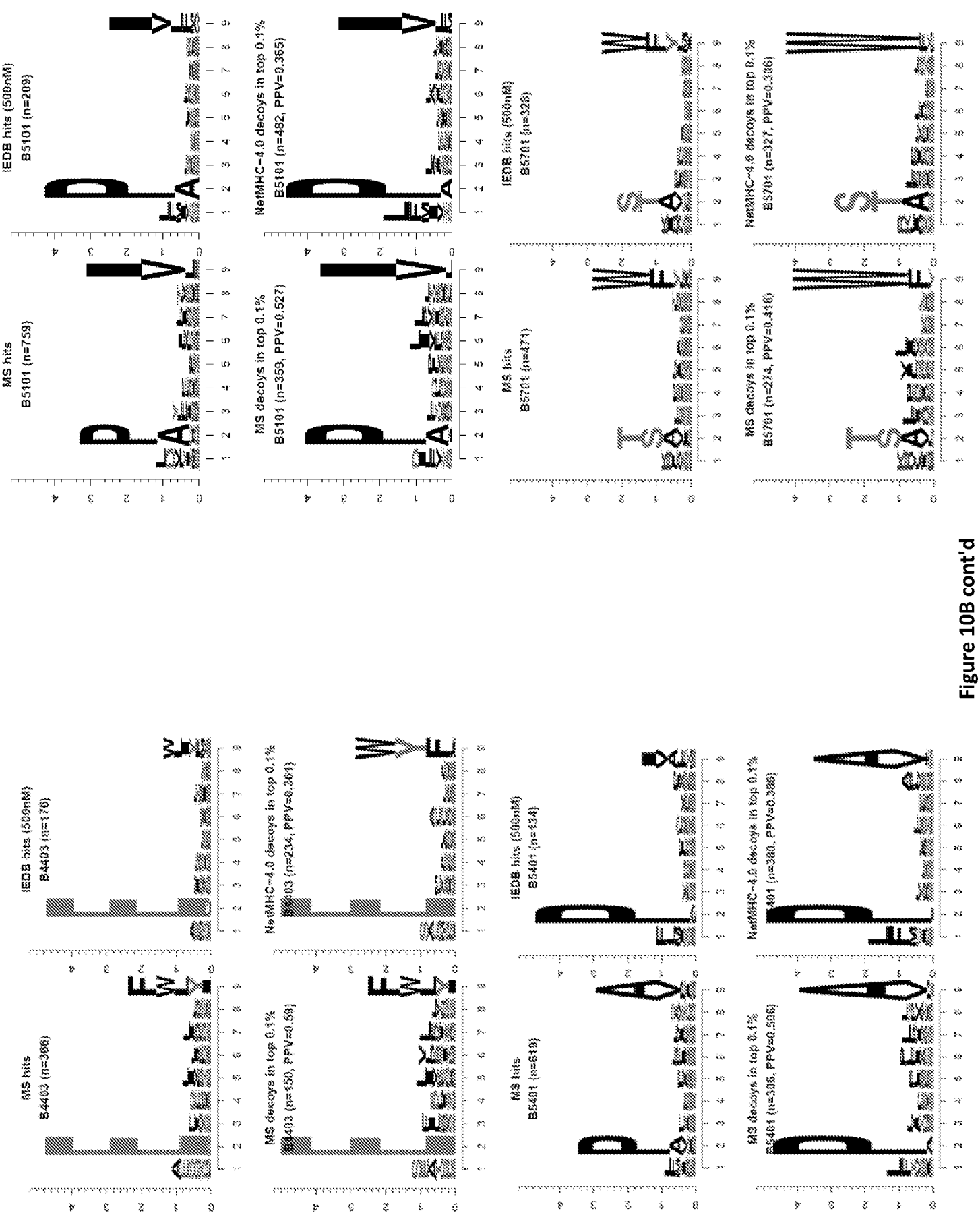


Figure 10B cont'd

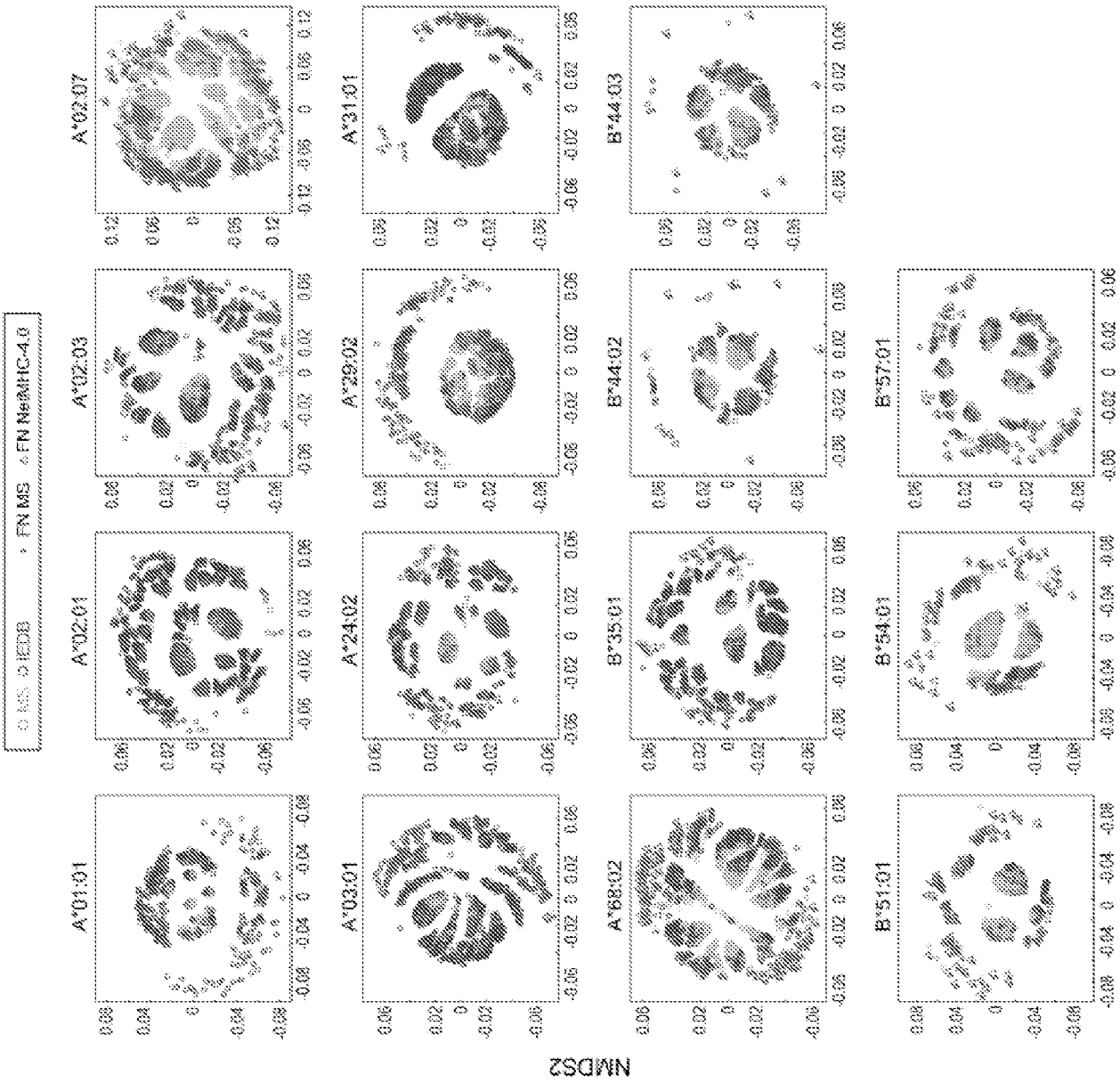

False Negatives (lowest 10% ranks)
IEDB
FN MS
FN NetMHC-4.0
A*01:01
A*02:01
A*02:03
A*02:07
A*03:01
A*24:02
A*29:02
A*31:01
A*68:02
B*35:01
B*44:02
B*44:03
B*51:01
B*54:01
B*57:01
NMDS2
NMDS1

Figure 10C

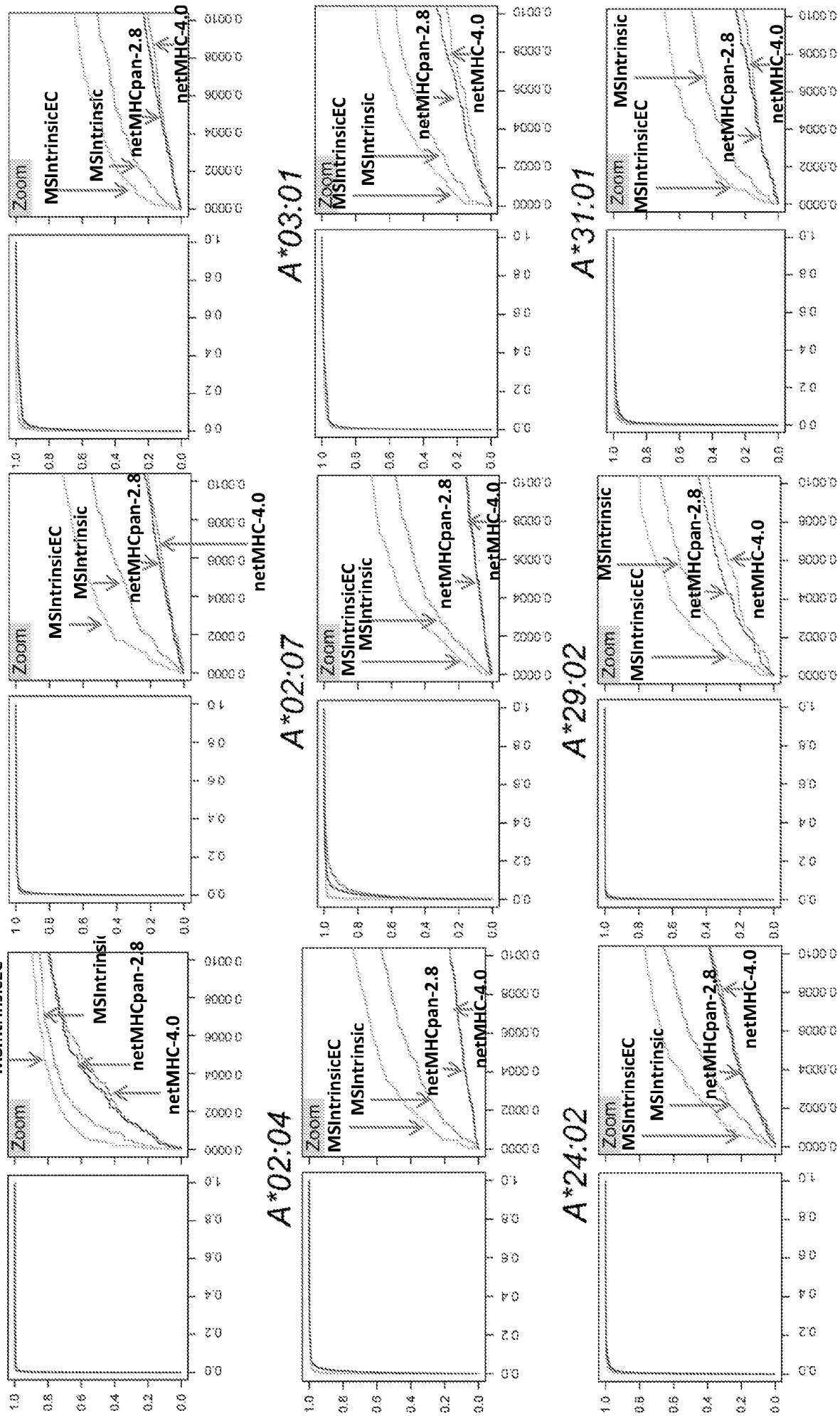

A*01:01
A*02:01
A*02:03
A*02:04
A*02:07
A*03:01
A*24:02
A*29:02
A*31:01
Zoom
MSIntrinsicEC
MSIntrinsic
netMHCpan-2.8
netMHC-4.0

Figure 10D

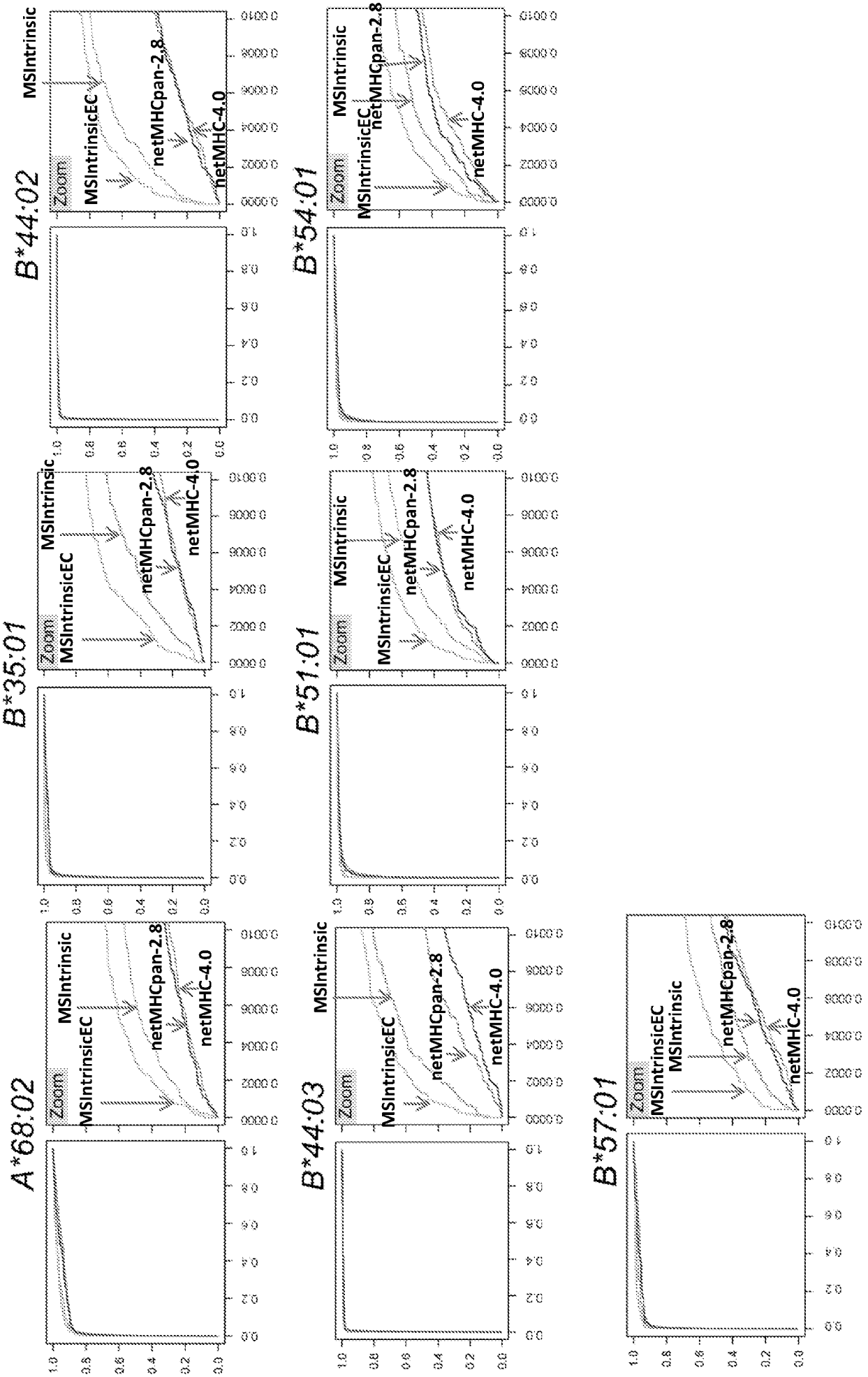
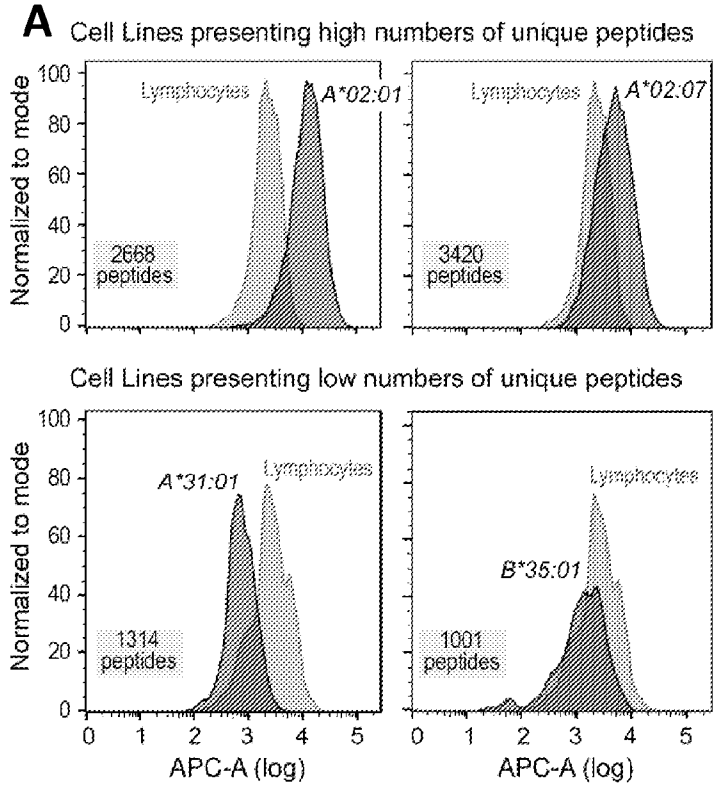
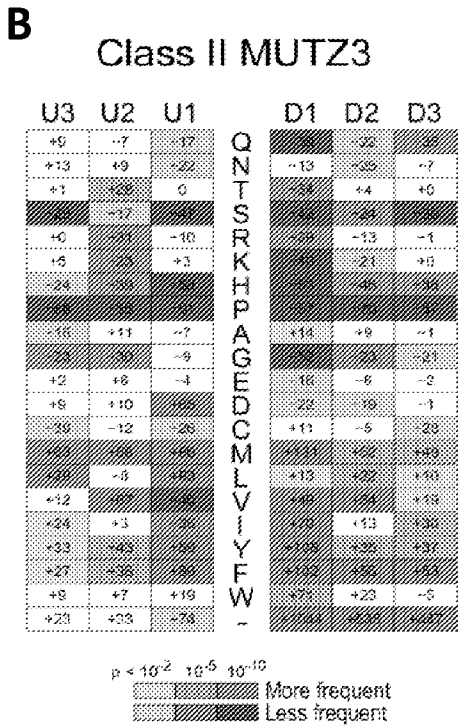


Figure 10D cont'd





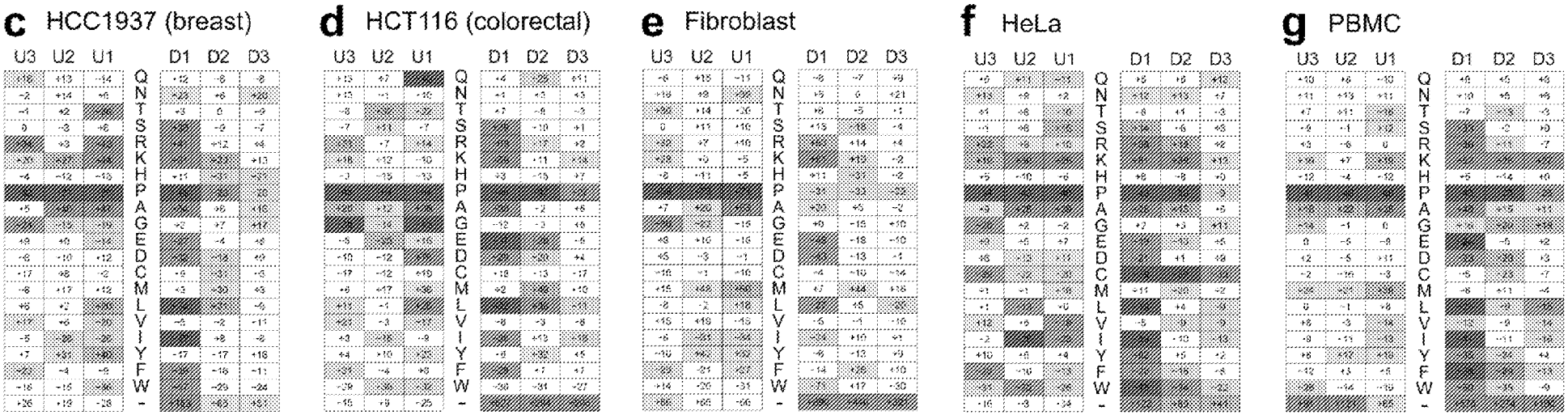


Figure 11A-11G

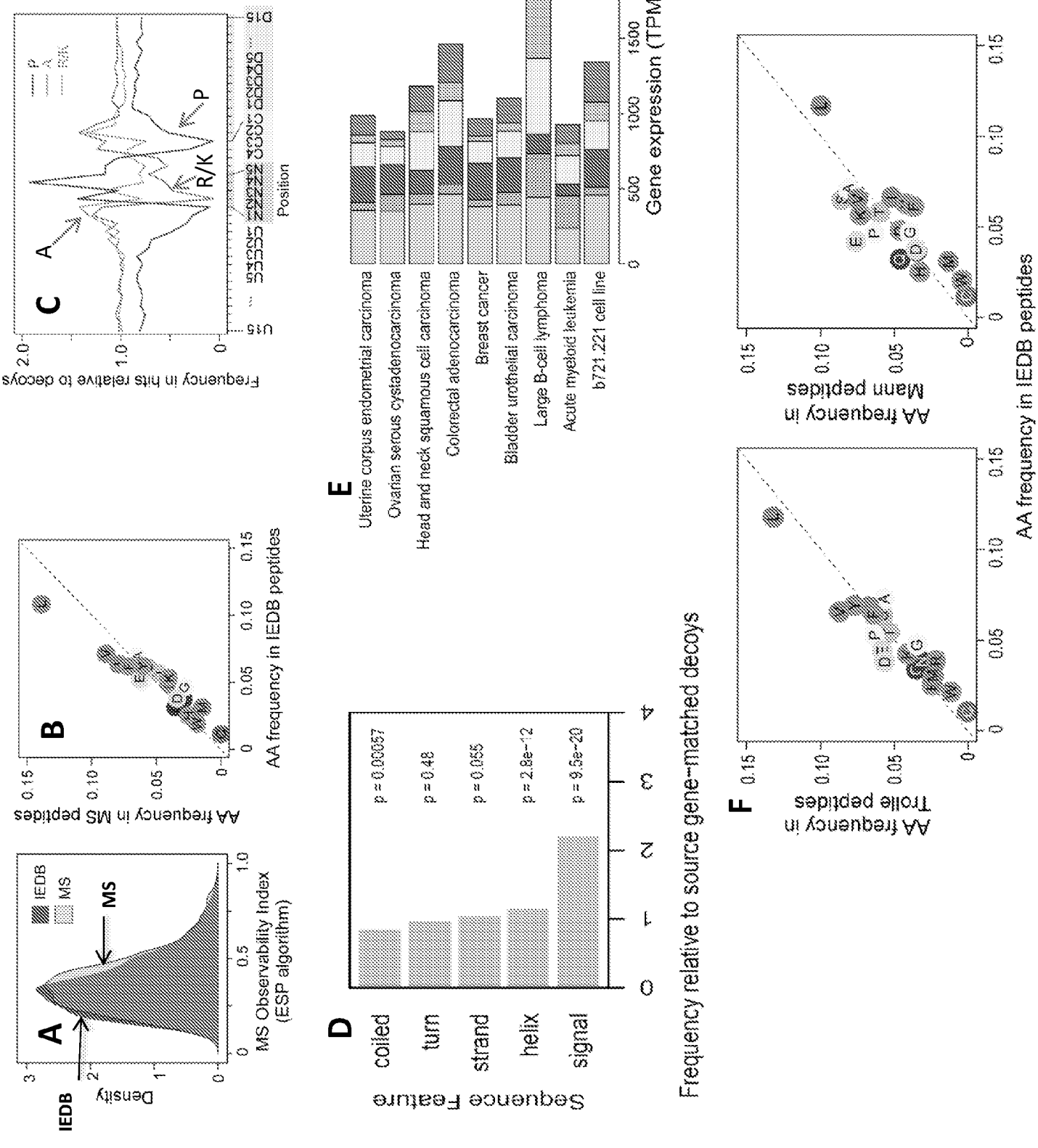


Figure 12A-12F

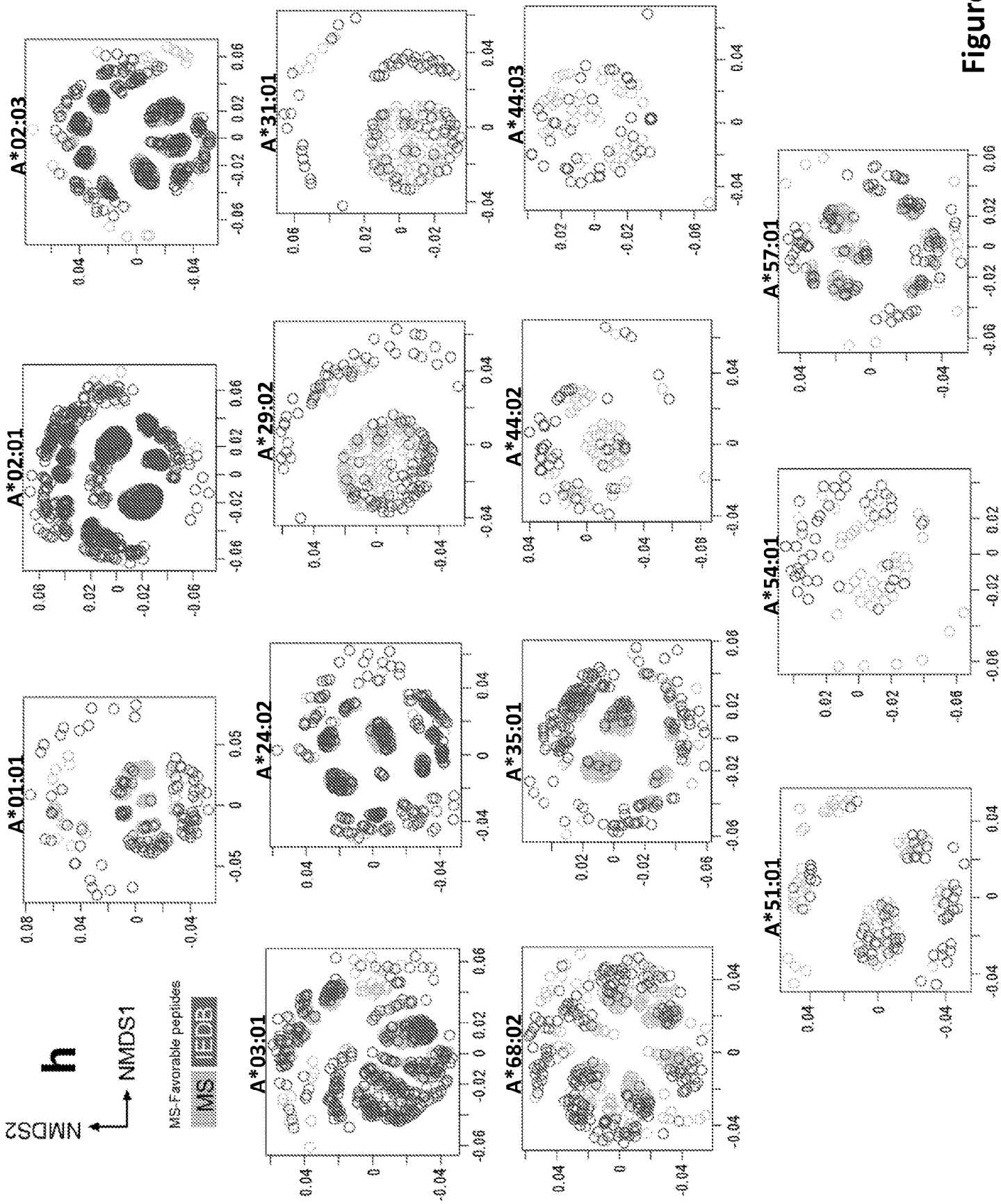

h
NMDS2
NMDS1
MS-Favorable peptides
MS
A*02:03
A*31:01
A*44:03
A*02:01
A*29:02
A*44:02
A*57:01
A*01:01
A*24:02
A*35:01
A*54:01
A*03:01
A*68:02
A*51:01

Figure 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/028122

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N33/569
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, CHEM ABS Data, BIOSIS, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/055049 A1 (GREY HOWARD M [US] ET AL) 8 March 2007 (2007-03-08) Paragraphs 89-92, 101, 113; figures 14,49; example 2	1-23, 26-31
X	WO 2014/168874 A2 (BROAD INST INC [US]; DANA FARBER CANCER INST INC [US]; GEN HOSPITAL CO) 16 October 2014 (2014-10-16) figures 1,2; examples 5,6	1-31
X	US 2011/257890 A1 (WEINSCHENK TONI [DE] ET AL) 20 October 2011 (2011-10-20) paragraphs [0035], [0060]; figure 9; examples 1,2	1-31

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 August 2017	14/08/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Pinheiro Vieira, E

1

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/028122

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FELIX KLUG ET AL: "Characterization of MHC Ligands for Peptide Based Tumor Vaccination", CURRENT PHARMACEUTICAL DESIGN, vol. 15, no. 28, 1 October 2009 (2009-10-01), pages 3221-3236, XP055006049, ISSN: 1381-6128, DOI: 10.2174/138161209789105180 tables S1,S3	1-15, 26-31

X	LATA SNEH ET AL: "MHCBN 4.0: A database of MHC/TAP binding peptides and T-cell epitopes", BMC RESEARCH NOTES, BIOMED CENTRAL LTD, GB, vol. 2, no. 1, 20 April 2009 (2009-04-20), page 61, XP021052825, ISSN: 1756-0500, DOI: 10.1186/1756-0500-2-61 the whole document	1-15, 26-31

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/028122

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007055049 A1	08-03-2007	US 2007055049 A1	08-03-2007
		US 2008260762 A1	23-10-2008
WO 2014168874 A2	16-10-2014	AU 2014251207 A1	05-11-2015
		CA 2908434 A1	16-10-2014
		CN 105377292 A	02-03-2016
		EP 2983702 A2	17-02-2016
		JP 2016518355 A	23-06-2016
		KR 20150143597 A	23-12-2015
		US 2016101170 A1	14-04-2016
		WO 2014168874 A2	16-10-2014
US 2011257890 A1	20-10-2011	AU 2011239959 A1	09-08-2012
		CA 2793490 A1	20-10-2011
		CN 102939540 A	20-02-2013
		EP 2558867 A1	20-02-2013
		JP 6010019 B2	19-10-2016
		JP 2013525759 A	20-06-2013
		KR 20130095186 A	27-08-2013
		SG 183814 A1	29-11-2012
		US 2011257890 A1	20-10-2011
		US 2013096016 A1	18-04-2013
		WO 2011128448 A1	20-10-2011