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CA 2393960 C 2015/06/02

(11)(21) **2 393 960**

(12) BREVET CANADIEN / CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2000/12/11
(87) **Date publication PCT/PCT Publication Date:** 2001/06/14
(45) **Date de délivrance/Issue Date:** 2015/06/02
(85) **Entrée phase nationale/National Entry:** 2002/06/10
(86) **N° demande PCT/PCT Application No.:** US 2000/033549
(87) **N° publication PCT/PCT Publication No.:** 2001/041799
(30) **Priorités/Priorities:** 1999/12/10 (US60/172,705); 2000/08/15 (US09/641,528)

(51) **Cl.Int./Int.Cl.** ***A61K 39/00*** (2006.01), ***A61K 39/12*** (2006.01), ***C07K 14/025*** (2006.01)

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(54) **Titre : REPONSE IMMUNITAIRE CELLULAIRE AU PAPILLOMAVIRUS HUMAIN INDUITE PAR UTILISATION DE COMPOSITIONS PEPTIDIQUES ET D'ACIDE NUCLEIQUE**

(54) **Title: INDUCING CELLULAR IMMUNE RESPONSES TO HUMAN PAPILLOMAVIRUS USING PEPTIDE AND NUCLEIC ACID COMPOSITIONS**

(57) **Abrégé/Abstract:**
This invention uses our knowledge of the mechanisms by which antigen is recognized by T cells to identify and prepare human papillomavirus (HPV) epitopes, and to develop epitope-based vaccines directed towards HPV. More specifically, this application communicates our discovery of pharmaceutical compositions and methods of use in the prevention and treatment of HPV infection.

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 June 2001 (14.06.2001)

PCT

(10) International Publication Number
WO 01/41799 A1

(51) International Patent Classification[7]: A61K 39/00, 39/12

(21) International Application Number: PCT/US00/33549

(22) International Filing Date:
11 December 2000 (11.12.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/172,705 10 December 1999 (10.12.1999) US
09/641,528 15 August 2000 (15.08.2000) US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *With international search report.*

— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/41799 A1

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DEMANDES OU BREVETS VOLUMINEUX

LA PRÉSENTE PARTIE DE CETTE DEMANDE OU CE BREVETS COMPREND PLUS D'UN TOME.

CECI EST LE TOME __1___ DE __3 __

NOTE: Pour les tomes additionels, veillez contacter le Bureau Canadien des Brevets.

JUMBO APPLICATIONS / PATENTS

THIS SECTION OF THE APPLICATION / PATENT CONTAINS MORE THAN ONE VOLUME.

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INDUCING CELLULAR IMMUNE RESPONSES TO HUMAN PAPILLOMAVIRUS USING PEPTIDE AND NUCLEIC ACID COMPOSITIONS

I. BACKGROUND OF THE INVENTION

Human papillomavirus (HPV) is a member of the papillomaviridae, a group of small DNA viruses that infect a variety of higher vertebrates. More than 80 types of HPVs have been identified. Of these, more than 30 can infect the genital tract. Some types, generally types 6 and 11, may cause genital warts, which are typically benign and rarely develop into cancer. Other strains of HPV, "cancer-associated", or "high-risk" types, can more frequently lead to the development of cancer. The primary mode of transmission of these strains of HPV is through sexual contact.

The main manifestations of the genital warts are cauliflower-like condylomata acuminata that usually involve moist surfaces; keratotic and smooth papular warts, usually on dry surfaces; and subclinical "flat" warts, which are found on any mucosal or cutaneous surface (Handsfield, H., *Am. J. Med.* 102(5A):16-20, 1997). These warts are typically benign but are a source of inter-individual spread of the virus (Ponten, J. & Guo, Z., *Cancer Surv.* 32:201-29, 1998). At least three HPV strains associated with genital warts have been identified: type 6a (see, *e.g.*, Hofmann, K.J., *et al., Virology 209(2):506-*518, 1995), type 6b (see, *e.g.*, Hofmann *et al.*, supra) and type 11 (see, *e.g.*, Dartmann, K. *et al.*, *Virology* 151(1):124-130, 1986).

Cancer-associated HPVs have been linked with cancer in both men and women; they include, but are not limited to, HPV-16, HPV-18, HPV-31, HPV-45, HPV-33 and HPV-56. Other HPV strains, including types 6 and 11 as well as others, *e.g.*, HPV-5 and HPV-8, are less frequently associated with cancer. The high risk types are typically associated with the development of cervical carcinoma and premalignant lesions of the cervix in women, but are also associated with similar malignant and premalignant lesions at other anatomic sites within the lower genital or anogenital tract. These lesions include neoplasia of the vagina, vulva, perineum, the penis, and the anus. HPV infection has also been associated with respiratory tract papillomas, and rarely, cancer, as well as abnormal growth or neoplasia in other epithelial tissues. *See, e.g.* VIROLOGY, 2ND ED, Fields *et al.*, Eds. Raven Press, New York, 1990, Chapters 58 and 59, for a review of HPV association with cancer.

The HPV genome consists of three functional regions, the early region, the late region, and the "long control region". The early region gene products control viral replication, transcription and cellular transformation They include the HPV E1 and E2 proteins, which play a role in HPV DNA replication, and the E6 and E7 oncoproteins, which are involved in the control of cellular proliferation. The late region include the genes that encode the structural proteins L1 and L2, which are the major and minor capsid proteins, respectively. The "long control region" contains such sequences as enhancer and promoter regulatory regions.

HPV expresses different proteins at different stages of the infection, for example early, as well as late, proteins. Even in latent infections, however, early proteins are often expressed and are therefore useful targets for vaccine-based therapies. For example, high-grade dysplasia and cervical squamous cell carcinoma continue to express E6 and E7, which therefore can be targeted to treat disease at both early and late stages of infection.

Treatment for HPV infection is often unsatisfactory because of persistence of virus after treatment and recurrence of clinically apparent disease is common. The treatment may require frequent visits to clinics and is not directed at elimination of the virus but at clearing warts. Because of persistence of virus after treatment, recurrence of clinically apparent disease is common.

Thus, a need exists for an efficacious vaccine to both prevent and treat HPV infection and to treat cancer that is associated with HPV infection. Effective HPV vaccines would be a significant advance in the control of sexually transmissable infections and could also protect against clinical disease, particularly cancers such as cervical cancer. (*see, e.g.*, Rowen, P. & Lacey, C., *Dermatologic Clinics* 16(4):835-838, 1998).

Virus-specific, human leukocyte antigen (HLA) class I-restricted cytotoxic T lymphocytes (CTL) are known to play a major role in the prevention and clearance of virus infections *in vivo* (Oldstone *et al.*, *Nature* 321:239, 1989; Jamieson *et al.*, *J. Virol.* 61:3930, 1987; Yap *et al*, *Nature* 273:238, 1978; Lukacher *et al.*, *J. Exp. Med.* 160:814, 1994; McMichael *et al.*, *N. Engl. J. Med.* 309:13, 1983; Sethi *et al.*, *J. Gen. Virol.* 64:443, 1983; Watari *et al.*, *J. Exp. Med.* 165:459, 1987; Yasukawa *et al.*, *J. Immunol.* 143:2051, 1989; Tigges *et al.*, *J. Virol.* 66:1622, 1993; Reddenhase *et al.*, *J. Virol.* 55:263, 1985; Quinnan *et al.*, *N. Engl. J. Med.* 307:6, 1982). HLA class I molecules are expressed on the surface of almost all nucleated cells. Following intracellular processing of antigens, epitopes from the antigens are presented as a complex with the HLA class I molecules on the surface of such cells. CTL recognize the peptide-HLA class I complex, which then results in the destruction of the cell bearing the HLA-peptide complex directly by the CTL and/or via the activation of non-destructive mechanisms *e.g.*, the production of interferon, that inhibit viral replication.

Virus-specific T helper lymphocytes are also known to be critical for maintaining effective immunity in chronic viral infections. Historically, HTL responses were viewed as primarily supporting the expansion of specific CTL and B cell populations; however, more recent data indicate that HTL may directly contribute to the control of virus replication. For example, a decline in $CD4^+$ T cells and a corresponding loss in HTL function characterize infection with HIV (Lane *et al.*, *New Engl. J. Med.* 313:79, 1985). Furthermore, studies in HIV infected patients have also shown that there is an inverse relationship between virus-specific HTL responses and viral load, suggesting that HTL plays a role in viremia (*see, e.g.*, Rosenberg *et al.*, *Science* 278:1447, 1997).

The development of vaccines with prophylactic and therapeutic efficacy against HPV is ongoing. Early vaccine development was hampered by the inability to culture HPV. With the introduction of cloning techniques and protein expression, however, some attempts have been made to stimulate humoral and CTL response to HPV (*See, e.g.*, Rowen, P. & Lacey, C., *Dermatologic Clinics* 16(4):835-838 (1998)). Studies to date, however, have been inconclusive.

Activation of T helper cells and cytotoxic lymphocytes (CTLs) in the development of vaccines has also been analyzed. Lehtinen, M., *et al.* for instance, has shown that some peptides from the E2 protein of HPV type 16 activate T helper cells and CTLs (*Biochem. Biophys. Res. Commun.* 209(2):541-6 (1995). Similarly, Tarpey *et al*, has shown that some peptides from HPV type 11 E7 protein can stimulate human HPV-specific CTLs *in vitro* (*Immunology* 81:222-227 (1994)) and Borysiewicz *et al.* have reported a recombinant vaccinia virus expressing HPV 16 and HPV 17 E6 and E7 that stimulated CTL responses in at least one patient (*Lancet* 347:1347-1357, 1996).

The epitope approach, as we have described, allows the incorporation of various antibody, CTL and HTL epitopes, from various proteins, in a single vaccine composition. Such a composition may simultaneously target multiple dominant and subdominant epitopes and thereby be used to achieve effective immunization in a diverse population.

The information provided in this section is intended to disclose the presently understood state of the art as of the filing date of the present application. Information is included in this section which was generated subsequent to the priority date of this application. Accordingly, information in this section is not intended, in any way, to delineate the priority date for the invention.

II. SUMMARY OF THE INVENTION

This invention applies our knowledge of the mechanisms by which antigen is recognized by T cells, for example, to develop epitope-based vaccines directed towards HPV. More specifically, this application communicates our discovery of specific epitope pharmaceutical compositions and methods of use in the prevention and treatment of HPV infection.

Upon development of appropriate technology, the use of epitope-based vaccines has several advantages over current vaccines, particularly when compared to the use of whole antigens in vaccine compositions. There is evidence that the immune response to whole antigens is directed largely toward variable regions of the antigen, allowing for immune escape due to mutations. The epitopes for inclusion in an epitope-based vaccine may be selected from conserved regions of viral or tumor-associated antigens, which thereby reduces the likelihood of escape mutants. Furthermore, immunosuppressive epitopes that may be present in whole antigens can be avoided with the use of epitope-based vaccines.

An additional advantage of an epitope-based vaccine approach is the ability to combine selected epitopes (CTL and HTL), and further, to modify the composition of the epitopes, achieving, for example, enhanced immunogenicity. Accordingly, the immune response can be modulated, as appropriate, for the target disease. Similar engineering of the response is not possible with traditional approaches.

Another major benefit of epitope-based immune-stimulating vaccines is their safety. The possible pathological side effects caused by infectious agents or whole protein antigens, which might have their own intrinsic biological activity, is eliminated.

An epitope-based vaccine also provides the ability to direct and focus an immune response to multiple selected antigens from the same pathogen. Thus, patient-by-patient variability in the immune response to a particular pathogen may be alleviated by inclusion of epitopes from multiple antigens from the pathogen in a vaccine composition. In the case of HPV, epitopes derived from multiple strains may also be included. A "pathogen" may be an infectious agent or a tumor associated molecule.

One of the most formidable obstacles to the development of broadly efficacious epitope-based immunotherapeutics, however, has been the extreme polymorphism of HLA molecules. To date, effective non-genetically biased coverage of a population has been a task of considerable complexity; such coverage has required that epitopes be used that are specific for HLA molecules corresponding to each individual HLA allele. Impractically large numbers of epitopes would therefore have to be used in order to cover ethnically diverse populations. Thus, there has existed a need for peptide epitopes that are bound by multiple HLA antigen molecules for use in epitope-based vaccines. The greater the number of HLA antigen molecules bound, the greater the breadth of population coverage by the vaccine.

Furthermore, as described herein in greater detail, a need has existed to modulate peptide binding properties, *e.g.*, so that peptides that are able to bind to multiple HLA antigens do so with an affinity that will stimulate an immune response. Identification of epitopes restricted by more than one HLA allele at an affinity that correlates with immunogenicity is important to provide thorough population coverage, and to allow the elicitation of responses of sufficient vigor to prevent or clear an infection in a diverse segment of the population. Such a response can also target a broad array of epitopes. The technology disclosed herein provides for such favored immune responses.

In a preferred embodiment, epitopes for inclusion in vaccine compositions of the invention are selected by a process whereby protein sequences of known antigens are evaluated for the presence of motif or supermotif-bearing epitopes. Peptides corresponding to a motif- or supermotif-bearing epitope are then synthesized and tested for the ability to bind to the HLA molecule that recognizes the selected motif. Those peptides that bind at an intermediate or high affinity *i.e.*, an IC_{50} (or a K_D value) of 500 nM or less for HLA class I molecules or an IC_{50} of 1000 nM or less for HLA class II molecules, are further evaluated for their ability to induce a CTL or HTL response. Immunogenic peptide epitopes are selected for inclusion in vaccine compositions.

Supermotif-bearing peptides may additionally be tested for the ability to bind to multiple alleles within the HLA supertype family. Moreover, peptide epitopes may be analogued to modify binding affinity and/or the ability to bind to multiple alleles within an HLA supertype.

The invention also includes embodiments comprising methods for monitoring or evaluating an immune response to HPV in a patient having a known HLA-type. Such methods comprise incubating a T lymphocyte sample from the patient with a peptide composition comprising an HPV epitope that has an amino acid sequence described in Tables VII to Table XX which binds the product of at least one HLA allele present in the patient, and detecting for the presence of a T lymphocyte that binds to the peptide. A CTL peptide epitope may, for example, be used as a component of a tetrameric complex for this type of analysis.

An alternative modality for defining the peptide epitopes in accordance with the invention is to recite the physical properties, such as length; primary structure; or charge, which are correlated with binding to a particular allele-specific HLA molecule or group of allele-specific HLA molecules. A further modality for defining peptide epitopes is to recite the physical properties of an HLA binding pocket, or properties shared by several allele-specific HLA binding pockets (*e.g.* pocket configuration and charge distribution) and reciting that the peptide epitope fits and binds to the pocket or pockets.

As will be apparent from the discussion below, other methods and embodiments are also contemplated. Further, novel synthetic peptides produced by any of the methods described herein are also part of the invention.

III. DETAILED DESCRIPTION OF THE INVENTION

The peptides and corresponding nucleic acid compositions of the present invention are useful for stimulating an immune response to HPV by stimulating the production of CTL or HTL responses. The peptide epitopes, which are derived directly or indirectly from native HPV protein amino acid sequences, are able to bind to HLA molecules and stimulate an immune response to HPV. The complete sequence of the HPV proteins to be analyzed can be obtained from Genbank. Epitopes and analogs thereof can also be readily determined from sequence information that may subsequently be discovered for heretofore unknown variants of HPV, as will be clear from the disclosure provided below.

The epitopes of the invention have been identified in a number of ways, as will be discussed below. Also discussed in greater detail is that analog peptides have been derived and the binding activity for HLA molecules modulated by modifying specific amino acid residues to create peptide analogs exhibiting altered immunogenicity. Further, the present invention provides compositions and combinations of compositions that enable epitope-based vaccines that are capable of interacting with HLA molecules encoded by various genetic alleles to provide broader population coverage than prior vaccines.

III.A. Definitions

The invention can be better understood with reference to the following definitions, which are listed alphabetically:

A "computer" or "computer system" generally includes: a processor; at least one information storage/retrieval apparatus such as, for example, a hard drive, a disk drive or a tape drive; at least one input apparatus such as, for example, a keyboard, a mouse, a touch screen, or a microphone; and display structure. Additionally, the computer may include a communication channel in communication with a network. Such a computer may include more or less than what is listed above.

A "construct" as used herein generally denotes a composition that does not occur in nature. A construct can be produced by synthetic technologies, *e.g.*, recombinant DNA preparation and expression or chemical synthetic techniques for nucleic or amino acids. A construct can also be produced by the addition or affiliation of one material with another such that the result is not found in nature in that form.

"Cross-reactive binding" indicates that a peptide is bound by more than one HLA molecule; a synonym is degenerate binding.

A "cryptic epitope" elicits a response by immunization with an isolated peptide, but the response is not cross-reactive *in vitro* when intact whole protein which comprises the epitope is used as an antigen.

A "dominant epitope" is an epitope that induces an immune response upon immunization with a whole native antigen (see, *e.g.*, Sercarz, *et al.*, *Annu. Rev. Immunol.* 11:729-766, 1993). Such a response is cross-reactive *in vitro* with an isolated peptide epitope.

With regard to a particular amino acid sequence, an "epitope" is a set of amino acid residues which is involved in recognition by a particular immunoglobulin, or in the context of T cells, those residues necessary for recognition by T cell receptor proteins and/or Major Histocompatibility Complex (MHC) receptors. In an immune system setting, *in vivo* or *in vitro*, an epitope is the collective features of a molecule, such as primary, secondary and tertiary peptide structure, and charge, that together form a site recognized by an immunoglobulin, T cell receptor or HLA molecule. Throughout this disclosure epitope and peptide are often used interchangeably. It is to be appreciated, however, that isolated or purified protein or peptide molecules larger than and comprising an epitope of the invention are still within the bounds of the invention.

"Human Leukocyte Antigen" or "HLA" is a human class I or class II Major Histocompatibility Complex (MHC) protein (*see, e.g.*, Stites, *et al.*, IMMUNOLOGY, 8TH ED., Lange Publishing, Los Altos, CA (1994).

An "HLA supertype or family", as used herein, describes sets of HLA molecules grouped on the basis of shared peptide-binding specificities. HLA class I molecules that share somewhat similar binding affinity for peptides bearing certain amino acid motifs are grouped into HLA supertypes. The terms HLA superfamily, HLA supertype family, HLA family, and HLA xx-like molecules (where xx denotes a particular HLA type), are synonyms.

Throughout this disclosure, results are expressed in terms of "IC_{50}'s." IC_{50} is the concentration of peptide in a binding assay at which 50% inhibition of binding of a reference peptide is observed. Given the conditions in which the assays are run (*i.e.*, limiting HLA proteins and labeled peptide concentrations), these values approximate K_D values. Assays for determining binding are described in detail, *e.g.*, in PCT publications WO 94/20127 and WO 94/03205. It should be noted that IC_{50} values can change, often dramatically, if the assay conditions are varied, and depending on the particular reagents used (*e.g.*, HLA preparation, *etc.*). For example, excessive concentrations of HLA molecules will increase the apparent measured IC_{50} of a given ligand.

Alternatively, binding is expressed relative to a reference peptide. Although as a particular assay becomes more, or less, sensitive, the IC_{50}'s of the peptides tested may change somewhat, the binding relative to the reference peptide will not significantly change. For example, in an assay run under conditions such that the IC_{50} of the reference peptide increases 10-fold, the IC_{50} values of the test peptides will also shift approximately 10-fold. Therefore, to avoid ambiguities, the assessment of whether a peptide is a good, intermediate, weak, or negative binder is generally based on its IC_{50}, relative to the IC_{50} of a standard peptide.

Binding may also be determined using other assay systems including those using: live cells (*e.g.*, Ceppellini *et al.*, *Nature* 339:392, 1989; Christnick *et al.*, *Nature* 352:67, 1991; Busch *et al.*, *Int. Immunol.* 2:443, 19990; Hill *et al.*, *J. Immunol.* 147:189, 1991; del Guercio *et al.*, *J. Immunol.* 154:685, 1995), cell free systems using detergent lysates (*e.g.*, Cerundolo *et al.*, *J. Immunol.* 21:2069, 1991), immobilized purified MHC (*e.g.*, Hill *et al.*, *J. Immunol.* 152, 2890, 1994; Marshall *et al.*, *J. Immunol.* 152:4946, 1994), ELISA systems (*e.g.*, Reay *et al.*, *EMBO J.* 11:2829, 1992), surface plasmon resonance (*e.g.*, Khilko *et al.*, *J. Biol. Chem.* 268:15425, 1993); high flux soluble phase assays (Hammer *et al.*, *J. Exp. Med.* 180:2353, 1994), and measurement of class I MHC stabilization or assembly (*e.g.*, Ljunggren *et al.*,

Nature 346:476, 1990; Schumacher *et al.*, *Cell* 62:563, 1990; Townsend *et al.*, *Cell* 62:285, 1990; Parker *et al.*, *J. Immunol.* 149:1896, 1992).

As used herein, "high affinity" with respect to HLA class I molecules is defined as binding with an IC_{50}, or K_D value, of 50 nM or less; "intermediate affinity" is binding with an IC_{50} or K_D value of between about 50 and about 500 nM. "High affinity" with respect to binding to HLA class II molecules is defined as binding with an IC_{50} or K_D value of 100 nM or less; "intermediate affinity" is binding with an IC_{50} or K_D value of between about 100 and about 1000 nM.

The terms "identical" or percent "identity," in the context of two or more peptide sequences, refer to two or more sequences or subsequences that are the same or have a specified percentage of amino acid residues that are the same, when compared and aligned for maximum correspondence over a comparison window, as measured using a sequence comparison algorithm or by manual alignment and visual inspection.

An "immunogenic peptide" or "peptide epitope" is a peptide that comprises an allele-specific motif or supermotif such that the peptide will bind an HLA molecule and induce a CTL and/or HTL response. Thus, immunogenic peptides of the invention are capable of binding to an appropriate HLA molecule and thereafter inducing a cytotoxic T cell response, or a helper T cell response, to the antigen from which the immunogenic peptide is derived.

The phrases "isolated" or "biologically pure" refer to material which is substantially or essentially free from components which normally accompany the material as it is found in its native state. Thus, isolated peptides in accordance with the invention preferably do not contain materials normally associated with the peptides in their *in situ* environment.

"Link" or "join" refers to any method known in the art for functionally connecting peptides, including, without limitation, recombinant fusion, covalent bonding, disulfide bonding, ionic bonding, hydrogen bonding, and electrostatic bonding.

"Major Histocompatibility Complex" or "MHC" is a cluster of genes that plays a role in control of the cellular interactions responsible for physiologic immune responses. In humans, the MHC complex is also known as the HLA complex. For a detailed description of the MHC and HLA complexes, *see*, Paul, FUNDAMENTAL IMMUNOLOGY, 3RD ED., Raven Press, New York, 1993.

The term "motif" refers to the pattern of residues in a peptide of defined length, usually a peptide of from about 8 to about 13 amino acids for a class I HLA motif and from about 6 to about 25 amino acids for a class II HLA motif, which is recognized by a particular HLA molecule. Peptide motifs are typically different for each protein encoded by each human HLA allele and differ in the pattern of the primary and secondary anchor residues.

A "negative binding residue" or "deleterious residue" is an amino acid which, if present at certain positions (typically not primary anchor positions) in a peptide epitope, results in decreased binding affinity of the peptide for the peptide's corresponding HLA molecule.

A "non-native" sequence or "construct" refers to a sequence that is not found in nature, *i.e.*, is "non-naturally occurring". Such sequences include, *e.g.*, peptides that are lipidated or otherwise modified, and polyepitopic compositions that contain epitopes that are not contiguous in a native protein sequence.

The term "peptide" is used interchangeably with "oligopeptide" in the present specification to designate a series of residues, typically L-amino acids, connected one to the other, typically by peptide bonds between the α-amino and carboxyl groups of adjacent amino acids. The preferred CTL-inducing peptides of the invention are 13 residues or less in length and usually consist of between about 8 and about 11 residues, preferably 9 or 10 residues. The preferred HTL-inducing oligopeptides are less than about 50 residues in length and usually consist of between about 6 and about 30 residues, more usually between about 12 and 25, and often between about 15 and 20 residues.

It is to be appreciated that protein or peptide molecules that comprise an epitope of the invention as well as additional amino acid(s) are within the bounds of the invention. In certain embodiments, there is a limitation on the length of a peptide of the invention which is not otherwise a construct as defined herein. An embodiment that is length-limited occurs when the protein/peptide comprising an epitope of the invention comprises a region (*i.e.*, a contiguous series of amino acids) having 100% identity with a native sequence. In order to avoid a recited definition of epitope from reading, *e.g.*, on whole natural molecules, the length of any region that has 100% identity with a native peptide sequence is limited. Thus, for a peptide comprising an epitope of the invention and a region with 100% identity with a native peptide sequence (and which is not otherwise a construct), the region with 100% identity to a native sequence generally has a length of: less than or equal to 600 amino acids, often less than or equal to 500 amino acids, often less than or equal to 400 amino acids, often less than or equal to 250 amino acids, often less than or equal to 100 amino acids, often less than or equal to 85 amino acids, often less than or equal to 75 amino acids, often less than or equal to 65 amino acids, and often less than or equal to 50 amino acids. In certain embodiments, an "epitope" of the invention which is not a construct is comprised by a peptide having a region with less than 51 amino acids that has 100% identity to a native peptide sequence, in any increment of (50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5) down to 5 amino acids.

Certain peptide or protein sequences longer than 600 amino acids are within the scope of the invention. Such longer sequences are within the scope of the invention so long as they do not comprise any contiguous sequence of more than 600 amino acids that have 100% identity with a native peptide sequence, or if longer than 600 amino acids, they are a construct. For any peptide that has five contiguous residues or less that correspond to a native sequence, there is no limitation on the maximal length of that peptide in order to fall within the scope of the invention. It is presently preferred that a CTL epitope of the invention be less than 600 residues long in any increment down to eight amino acid residues.

"Pharmaceutically acceptable" refers to a non-toxic, inert, and/or physiologically compatible composition.

A "pharmaceutical excipient" comprises a material such as an adjuvant, a carrier, pH-adjusting and buffering agents, tonicity adjusting agents, wetting agents, preservative, and the like.

A "primary anchor residue" is an amino acid at a specific position along a peptide sequence which is understood to provide a contact point between the immunogenic peptide and the HLA molecule. One to three, usually two, primary anchor residues within a peptide of defined length generally defines a "motif" for an immunogenic peptide. These residues are understood to fit in close contact with peptide binding grooves of an HLA molecule, with their side chains buried in specific pockets of the

binding grooves themselves. In one embodiment, for example, the primary anchor residues are located at position 2 (from the amino terminal position) and at the carboxyl terminal position of a 9-residue peptide epitope in accordance with the invention. The primary anchor positions for each motif and supermotif are set forth in Table 1. For example, analog peptides can be created by altering the presence or absence of particular residues in these primary anchor positions. Such analogs are used to modulate the binding affinity of a peptide comprising a particular motif or supermotif.

"Promiscuous recognition" is where a distinct peptide is recognized by the same T cell clone in the context of various HLA molecules. Promiscuous recognition or binding is synonymous with cross-reactive binding.

A "protective immune response" or "therapeutic immune response" refers to a CTL and/or an HTL response to an antigen derived from an infectious agent or a tumor antigen, which prevents or at least partially arrests disease symptoms or progression. The immune response may also include an antibody response which has been facilitated by the stimulation of helper T cells.

The term "residue" refers to an amino acid or amino acid mimetic incorporated into an oligopeptide by an amide bond or amide bond mimetic.

A "secondary anchor residue" is an amino acid at a position other than a primary anchor position in a peptide which may influence peptide binding. A secondary anchor residue occurs at a significantly higher frequency amongst bound peptides than would be expected by random distribution of amino acids at one position. The secondary anchor residues are said to occur at "secondary anchor positions." A secondary anchor residue can be identified as a residue which is present at a higher frequency among high or intermediate affinity binding peptides, or a residue otherwise associated with high or intermediate affinity binding. For example, analog peptides can be created by altering the presence or absence of particular residues in these secondary anchor positions. Such analogs are used to finely modulate the binding affinity of a peptide comprising a particular motif or supermotif.

A "subdominant epitope" is an epitope which evokes little or no response upon immunization with whole antigens which comprise the epitope, but for which a response can be obtained by immunization with an isolated peptide, and this response (unlike the case of cryptic epitopes) is detected when whole protein is used to recall the response *in vitro* or *in vivo*.

A "supermotif" is a peptide binding specificity shared by HLA molecules encoded by two or more HLA alleles. Preferably, a supermotif-bearing peptide is recognized with high or intermediate affinity (as defined herein) by two or more HLA antigens.

"Synthetic peptide" refers to a peptide that is man-made using such methods as chemical synthesis or recombinant DNA technology.

As used herein, a "vaccine" is a composition that contains one or more peptides of the invention. There are numerous embodiments of vaccines in accordance with the invention, such as by a cocktail of one or more peptides; one or more epitopes of the invention comprised by a polyepitopic peptide; or nucleic acids that encode such peptides or polypeptides, *e.g.*, a minigene that encodes a polyepitopic peptide. The "one or more peptides" can include any whole unit integer from 1-150, e.g., at least 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 , 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125,

130, 135, 140, 145, or 150 or more peptides of the invention. The peptides or polypeptides can optionally be modified, such as by lipidation, addition of targeting or other sequences. HLA class I-binding peptides of the invention can be admixed with, or linked to, HLA class II-binding peptides, to facilitate activation of both cytotoxic T lymphocytes and helper T lymphocytes. Vaccines can also comprise peptide-pulsed antigen presenting cells, *e.g.*, dendritic cells.

The nomenclature used to describe peptide compounds follows the conventional practice wherein the amino group is presented to the left (the N-terminus) and the carboxyl group to the right (the C-terminus) of each amino acid residue. When amino acid residue positions are referred to in a peptide epitope they are numbered in an amino to carboxyl direction with position one being the position closest to the amino terminal end of the epitope, or the peptide or protein of which it may be a part. In the formulae representing selected specific embodiments of the present invention, the amino- and carboxyl-terminal groups, although not specifically shown, are in the form they would assume at physiologic pH values, unless otherwise specified. In the amino acid structure formulae, each residue is generally represented by standard three letter or single letter designations. The L-form of an amino acid residue is represented by a capital single letter or a capital first letter of a three-letter symbol, and the D-form for those amino acids having D-forms is represented by a lower case single letter or a lower case three letter symbol. Glycine has no asymmetric carbon atom and is simply referred to as "Gly" or G. The amino acid sequences of peptides set forth herein are generally designated using the standard single letter symbol. (A, Alanine; C, Cysteine; D, Aspartic Acid; E, Glutamic Acid; F, Phenylalanine; G, Glycine; H, Histidine; I, Isoleucine; K, Lysine; L, Leucine; M, Methionine; N, Asparagine; P, Proline; Q, Glutamine; R, Arginine; S, Serine; T, Threonine; V, Valine; W, Tryptophan; and Y, Tyrosine.) In addition to these symbols, "B"in the single letter abbreviations used herein designates α-amino butyric acid.

III.B. Stimulation of CTL and HTL responses

The mechanism by which T cells recognize antigens has been delineated during the past ten years. Based on our understanding of the immune system we have developed efficacious peptide epitope vaccine compositions that can induce a therapeutic or prophylactic immune response to HPV in a broad population. For an understanding of the value and efficacy of the claimed compositions, a brief review of immunology-related technology is provided.

A complex of an HLA molecule and a peptidic antigen acts as the ligand recognized by HLA-restricted T cells (Buus, S. *et al.*, *Cell* 47:1071, 1986; Babbitt, B. P. *et al.*, *Nature* 317:359, 1985; Townsend, A. and Bodmer, H., *Annu. Rev. Immunol.* 7:601, 1989; Germain, R. N., *Annu. Rev. Immunol.* 11:403, 1993). Through the study of single amino acid substituted antigen analogs and the sequencing of endogenously bound, naturally processed peptides, critical residues that correspond to motifs required for specific binding to HLA antigen molecules have been identified and are described herein and are set forth in Tables I, II, and III (*see* also, *e.g.*, Southwood, *et al.*, *J. Immunol.* 160:3363, 1998; Rammensee, *et al.*, *Immunogenetics* 41:178, 1995; Sette, A. and Sidney, J. *Curr. Opin. Immunol.* 10:478, 1998; Engelhard, V. H., *Curr. Opin. Immunol.* 6:13, 1994; Sette, A. and Grey, H. M., *Curr. Opin. Immunol.* 4:79, 1992; Sinigaglia, F. and Hammer, J. *Curr. Biol.* 6:52, 1994; Ruppert *et al.*, *Cell* 74:929-937, 1993;

Kondo *et al.*, *J. Immunol.* 155:4307-4312, 1995; Sidney *et al.*, *J. Immunol.* 157:3480-3490, 1996; Sidney *et al.*, *Human Immunol.* 45:79-93, 1996; Sette, A. and Sidney, J. *Immunogenetics 1999 Nov;50(3-4):201-12,* Review).

Furthermore, x-ray crystallographic analysis of HLA-peptide complexes has revealed pockets within the peptide binding cleft of HLA molecules which accommodate, in an allele-specific mode, residues borne by peptide ligands; these residues in turn determine the HLA binding capacity of the peptides in which they are present. (*See, e.g.*, Madden, D.R. *Annu. Rev. Immunol.* 13:587, 1995; Smith, *et al.*, *Immunity* 4:203, 1996; Fremont *et al.*, *Immunity* 8:305, 1998; Stern *et al.*, *Structure* 2:245, 1994; Jones, E.Y. *Curr. Opin. Immunol.* 9:75, 1997; Brown, J. H. *et al.*, *Nature* 364:33, 1993; Guo, H. C. *et al.*, *Proc. Natl. Acad. Sci. USA* 90:8053, 1993; Guo, H. C. *et al.*, *Nature* 360:364, 1992; Silver, M. L. *et al.*, *Nature* 360:367, 1992; Matsumura, M. *et al.*, *Science* 257:927, 1992; Madden *et al.*, *Cell* 70:1035, 1992; Fremont, D. H. *et al.*, *Science* 257:919, 1992; Saper, M. A. , Bjorkman, P. J. and Wiley, D. C., *J. Mol. Biol.* 219:277, 1991.)

Accordingly, the definition of class I and class II allele-specific HLA binding motifs, or class I or class II supermotifs allows identification of regions within a protein that have the potential of binding particular HLA antigen(s).

The present inventors have found that the correlation of binding affinity with immunogenicity, which is disclosed herein, is an important factor to be considered when evaluating candidate peptides. Thus, by a combination of motif searches and HLA-peptide binding assays, candidates for epitope-based vaccines have been identified. After determining their binding affinity, additional confirmatory work can be performed to select, amongst these vaccine candidates, epitopes with preferred characteristics in terms of population coverage, antigenicity, and immunogenicity.

Various strategies can be utilized to evaluate immunogenicity, including:

1) Evaluation of primary T cell cultures from normal individuals (*see, e.g.*, Wentworth, P. A. *et al.*, *Mol. Immunol.* 32:603, 1995; Celis, E. *et al.*, *Proc. Natl. Acad. Sci. USA* 91:2105, 1994; Tsai, V. *et al.*, *J. Immunol.* 158:1796, 1997; Kawashima, I. *et al.*, *Human Immunol.* 59:1, 1998); This procedure involves the stimulation of peripheral blood lymphocytes (PBL) from normal subjects with a test peptide in the presence of antigen presenting cells *in vitro* over a period of several weeks. T cells specific for the peptide become activated during this time and are detected using, *e.g.*, a lymphokine- or ^{51}Cr-release assay involving peptide sensitized target cells.

2) Immunization of HLA transgenic mice (*see, e.g.*, Wentworth, P. A. *et al.*, *J. Immunol.* 26:97, 1996; Wentworth, P. A. *et al.*, *Int. Immunol.* 8:651, 1996; Alexander, J. *et al.*, *J. Immunol.* 159:4753, 1997); In this method, peptides in incomplete Freund's adjuvant are administered subcutaneously to HLA transgenic mice. Several weeks following immunization, splenocytes are removed and cultured *in vitro* in the presence of test peptide for approximately one week. Peptide-specific T cells are detected using, *e.g.*, a ^{51}Cr-release assay involving peptide sensitized target cells and target cells expressing endogenously generated antigen.

3) Demonstration of recall T cell responses from immune individuals who have effectively been vaccinated, recovered from infection, and/or from chronically infected patients (*see, e.g.*, Rehermann, B. *et al.*, *J. Exp. Med.* 181:1047, 1995; Doolan, D. L. *et al.*, *Immunity* 7:97, 1997; Bertoni, R.

et al., J. Clin. Invest. 100:503, 1997; Threlkeld, S. C. *et al., J. Immunol.* 159:1648, 1997; Diepolder, H. M. *et al., J. Virol.* 71:6011, 1997); In applying this strategy, recall responses are detected by culturing PBL from subjects that have been naturally exposed to the antigen, for instance through infection, and thus have generated an immune response "naturally", or from patients who were vaccinated against the infection. PBL from subjects are cultured *in vitro* for 1-2 weeks in the presence of test peptide plus antigen presenting cells (APC) to allow activation of "memory" T cells, as compared to "naive" T cells. At the end of the culture period, T cell activity is detected using assays for T cell activity including ^{51}Cr release involving peptide-sensitized targets, T cell proliferation, or lymphokine release.

The following describes the peptide epitopes and corresponding nucleic acids of the invention.

III.C. Binding Affinity of Peptide Epitopes for HLA Molecules

As indicated herein, the large degree of HLA polymorphism is an important factor to be taken into account with the epitope-based approach to vaccine development. To address this factor, epitope selection encompassing identification of peptides capable of binding at high or intermediate affinity to multiple HLA molecules is preferably utilized, most preferably these epitopes bind at high or intermediate affinity to two or more allele-specific HLA molecules.

CTL-inducing peptides of interest for vaccine compositions preferably include those that have an IC_{50} or binding affinity value for class I HLA molecules of 500 nM or better (*i.e.*, the value is $\leq$ 500 nM). HTL-inducing peptides preferably include those that have an IC_{50} or binding affinity value for class II HLA molecules of 1000 nM or better, (*i.e.*, the value is $\leq$ 1,000 nM). For example, peptide binding is assessed by testing the capacity of a candidate peptide to bind to a purified HLA molecule *in vitro*. Peptides exhibiting high or intermediate affinity are then considered for further analysis. Selected peptides are tested on other members of the supertype family. In preferred embodiments, peptides that exhibit cross-reactive binding are then used in cellular screening analyses or vaccines.

As disclosed herein, higher HLA binding affinity is correlated with greater immunogenicity. Greater immunogenicity can be manifested in several different ways. Immunogenicity corresponds to whether an immune response is elicited at all, and to the vigor of any particular response, as well as to the extent of a population in which a response is elicited. For example, a peptide might elicit an immune response in a diverse array of the population, yet in no instance produce a vigorous response. In accordance with these principles, close to 90% of high binding peptides have been found to be immunogenic, as contrasted with about 50% of the peptides which bind with intermediate affinity. Moreover, higher binding affinity peptides lead to more vigorous immunogenic responses. As a result, less peptide is required to elicit a similar biological effect if a high affinity binding peptide is used. Thus, in preferred embodiments of the invention, high affinity binding epitopes are particularly useful.

The relationship between binding affinity for HLA class I molecules and immunogenicity of discrete peptide epitopes on bound antigens has been determined for the first time in the art by the present inventors. The correlation between binding affinity and immunogenicity was analyzed in two different experimental approaches (*see, e.g.*, Sette, *et al., J. Immunol.* 153:5586-5592, 1994). In the first approach, the immunogenicity of potential epitopes ranging in HLA binding affinity over a 10,000-fold

range was analyzed in HLA-A*0201 transgenic mice. In the second approach, the antigenicity of approximately 100 different hepatitis B virus (HBV)-derived potential epitopes, all carrying A*0201 binding motifs, was assessed by using PBL from acute hepatitis patients. Pursuant to these approaches, it was determined that an affinity threshold value of approximately 500 nM (preferably 50 nM or less) determines the capacity of a peptide epitope to elicit a CTL response. These data are true for class I binding affinity measurements for naturally processed peptides and for synthesized T cell epitopes. These data also indicate the important role of determinant selection in the shaping of T cell responses (*see, e.g.,* Schaeffer *et al. Proc. Natl. Acad. Sci. USA* 86:4649-4653, 1989).

An affinity threshold associated with immunogenicity in the context of HLA class II DR molecules has also been delineated (*see, e.g.*, Southwood *et al. J. Immunology* 160:3363-3373,1998).

In order to define a biologically significant threshold of DR binding affinity, a database of the binding affinities of 32 DR-restricted epitopes for their restricting element (*i.e.*, the HLA molecule that binds the motif) was compiled. In approximately half of the cases (15 of 32 epitopes), DR restriction was associated with high binding affinities, *i.e.* binding affinity values of 100 nM or less. In the other half of the cases (16 of 32), DR restriction was associated with intermediate affinity (binding affinity values in the 100-1000 nM range). In only one of 32 cases was DR restriction associated with an IC_{50} of 1000 nM or greater. Thus, 1000 nM can be defined as an affinity threshold associated with immunogenicity in the context of DR molecules.

In the case of tumor-associated antigens (TAAs), many CTL peptide epitopes that have been shown to induce CTL that lyse peptide-pulsed target cells and tumor cell targets endogenously expressing the epitope exhibit binding affinity or IC_{50} values of 200 nM or less. In a study that evaluated the association of binding affinity and immunogenicity of a small set of such TAA epitopes, 100% (10/10) of the high binders, *i.e.*, peptide epitopes binding at an affinity of 50 nM or less, were immunogenic and 80% (8/10) of them elicited CTLs that specifically recognized tumor cells. In the 51 to 200 nM range, very similar figures were obtained. With respect to analog peptides, CTL inductions positive for wildtype peptide and tumor cells were noted for 86% (6/7) and 71% (5/7) of the peptides, respectively. In the 201-500 nM range, most peptides (4/5 wildtype) were positive for induction of CTL recognizing wildtype peptide, but tumor recognition was not detected.

The binding affinity of peptides for HLA molecules can be determined as described in Example 1, below.

III.D. Peptide Epitope Binding Motifs and Supermotifs

Through the study of single amino acid substituted antigen analogs and the sequencing of endogenously bound, naturally processed peptides, critical residues required for allele-specific binding to HLA molecules have been identified. The presence of these residues correlates with binding affinity for HLA molecules. The identification of motifs and/or supermotifs that correlate with high and intermediate affinity binding is an important issue with respect to the identification of immunogenic peptide epitopes for the inclusion in a vaccine. Kast *et al.* (*J. Immunol.* 152:3904-3912, 1994) have shown that motif-bearing peptides account for 90% of the epitopes that bind to allele-specific HLA class I molecules. In this study all possible peptides of 9 amino acids in length and overlapping by eight amino acids (240 peptides), which

cover the entire sequence of the E6 and E7 proteins of human papillomavirus type 16, were evaluated for binding to five allele-specific HLA molecules that are expressed at high frequency among different ethnic groups. This unbiased set of peptides allowed an evaluation of the predictive value of HLA class I motifs. From the set of 240 peptides, 22 peptides were identified that bound to an allele-specific HLA molecule with high or intermediate affinity. Of these 22 peptides, 20 (*i.e.* 91%) were motif-bearing. Thus, this study demonstrates the value of motifs for the identification of peptide epitopes for inclusion in a vaccine: application of motif-based identification techniques will identify about 90% of the potential epitopes in a target antigen protein sequence.

Such peptide epitopes are identified in the Tables described below.

Peptides of the present invention may also comprise epitopes that bind to MHC class II DR molecules. A greater degree of heterogeneity in both size and binding frame position of the motif, relative to the N and C termini of the peptide, exists for class II peptide ligands. This increased heterogeneity of HLA class II peptide ligands is due to the structure of the binding groove of the HLA class II molecule which, unlike its class I counterpart, is open at both ends. Crystallographic analysis of HLA class II DRB*0101-peptide complexes showed that the major energy of binding is contributed by peptide residues complexed with complementary pockets on the DRB*0101 molecules. An important anchor residue engages the deepest hydrophobic pocket (*see, e.g.*, Madden, D.R. *Ann. Rev. Immunol.* 13:587, 1995) and is referred to as position 1 (P1). P1 may represent the N-terminal residue of a class II binding peptide epitope, but more typically is flanked towards the N-terminus by one or more residues. Other studies have also pointed to an important role for the peptide residue in the 6th position towards the C-terminus, relative to P1, for binding to various DR molecules.

In the past few years evidence has accumulated to demonstrate that a large fraction of HLA class I and class II molecules can be classified into a relatively few supertypes, each characterized by largely overlapping peptide binding repertoires, and consensus structures of the main peptide binding pockets. Thus, peptides of the present invention are identified by any one of several HLA-specific amino acid motifs (*see, e.g.*, Tables I-III), or if the presence of the motif corresponds to the ability to bind several allele-specific HLA antigens, a supermotif. The HLA molecules that bind to peptides that possess a particular amino acid supermotif are collectively referred to as an HLA "supertype."

The peptide motifs and supermotifs described below, and summarized in Tables I-III, provide guidance for the identification and use of peptide epitopes in accordance with the invention.

Examples of peptide epitopes bearing a respective supermotif or motif are included in Tables as designated in the description of each motif or supermotif below. The Tables include a binding affinity ratio listing for some of the peptide epitopes. The ratio may be converted to IC_{50} by using the following formula: IC_{50} of the standard peptide/ratio = IC_{50} of the test peptide (*i.e.*, the peptide epitope). The IC_{50} values of standard peptides used to determine binding affinities for Class I peptides are shown in Table IV. The IC_{50} values of standard peptides used to determine binding affinities for Class II peptides are shown in Table V. For example, where an HLA-A2.1 motif-bearing peptide shows a relative binding ratio of 0.01 for HLA-A*0201, the IC_{50} value is 500 nM, and where an HLA-A2.1 motif-bearing peptide shows a relative binding ratio of 0.1 for HLA-A*0201, the IC_{50} value is 50 nM.

The peptides used as standards for the binding assays described herein are examples of standards; alternative standard peptides can also be used when performing binding studies.

To obtain the peptide epitope sequences listed in Tables VII-XX, protein sequence data for HPV types 6a, 6b, 11a, 16, 18, 31, 33, 45, and 56 were evaluated for the presence of the designated supermotif or motif. Seven HPV structural and regulatory proteins, E1, E2, E5, E6, E7, L1 and L2 were included in the analysis. E4 was also included in the evaluation of some of the strains. Peptide epitopes can additionally be evaluated on the basis of their conservancy (*i.e.*, the amount of variance) among the available protein sequences for each HPV antigen.

In the Tables, motif- and/or supermotif-bearing amino acids sequences identified in the indicated HPV strains are designated by position number and length of the epitope with reference to the HPV sequences and numbering provided below. For each sequence, the four columns provide the following information: column 1 indicates the HPV strain; column 2 indicates the HPV protein in which the motif-bearing sequence is found, *e.g.*, E1, E2, E4, E5, E6, E7, L1, or L2; column 3 indicates the length of the epitope, or in the case of HLA Class II epitopes, the length of the core sequence; and column 4 designates the amino acid position in the HPV protein sequence that corresponds to the first amino acid residue of the epitope. For those sections of the Tables that include only three columns, corresponding to columns 2, 3, and 4, the HPV strain is indicated in the heading at the top of the page. For example, the first peptide epitope listed in Table VII, *i.e.*, the HLA-A1 supermotif, for HPV 16, protein E1 is a sequence of 10 residues in length starting at position 206. Accordingly, the amino acid sequence of the epitope is AMLAKFKELY (SEQ ID NO:1).

For HPV strain 11, the number and position listed for protein E5 refers to either the HPV11 E5a or HPV11 E5b sequence set out below. Because the epitope must include the designated motif or supermotif, *e.g.*, HLA-A2, it can readily be determined whether the sequence refers to HPV11 E5a or E5b by checking the amino acid sequences of both E5a and E5b and selecting the sequence that conforms to the motif listed in Table I (SEQ ID NO:2).

HPV STRAINS AND AMINO ACID SEQUENCES OF HPV PROTEINS

HPV6A E1 (SEQ ID NO:2)

```
1 MADDSGTENEGSGCTGWFMVEAIVQHPTGTQISDDEDEEVEDSGYDMVDFIDDSNITHNS   60
  LEAQALFNRQEADTHYATVQDLKRKYLGSPYVSPINTIAEAVESEISPRLDAIKLTRQPK  120
  KVKRRLFQTRELTDSGYGYSEVEAGTGTQVEKHGVPENGGDGQEKDTGRDIEGEEHTEAE  180
  APTNSVREHAGTAGILELLKCKDLRAALLGKFKECFGLSFIDLIRPFKSDKTTCADWVVA  240
  GFGIHHSISEAFQKLIEPLSLYAHIQWLTNAWGMVLLVLVRFKVNKSRSTVARTLATLLN  300
  IPDNQMLIEPPKIQSGVAALYWFRTGISNASTVIGEAPEWITRQTVIEHGLADSQFKLTE  360
  MVQWAYDNDICEESEIAFEYAQRGDFDSNARAFLNSNMQAKYVKDCATMCRHYKHAEMRK  420
  MSIKQWIKHRGSKIEGTGNWKPIVQFLRHQNIEFIPFLSKFKLWLHGTPKKNCIAIVGPP  480
  DTGKSYFCMSLISFLGGTVISHVNSSSHFWLQPLVDAKVALLDDATQPCWIYMDTYMRNL  540
  LDGNPMSIDRKHKALTLIKCPPLLVTSNIDITKEEKYKYLHTRVTTFTFPNPFPFDRNGN  600
  AVYELSNANWKCFFERLSSSLDIQDSEDEEDGSNSQAFRCVPGTVVRTL   649
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HPV6A E2 (SEQ ID NO:3)

1 MEAIAKRLDACQEQLLELYEENSTDLNKHVLHWKCMRHESVLLYKAKQMGLSHIGMQVVP 60
PLKVSEAKGHNAIEMQMHLESLLKTEYSMEPWTLQETSYEMWQTPPKRCFKKRGKTVEVK 120
FDGCANNTMDYVVWTDVYVQDTDSWVKVHSMVDAKGIYYTCGQFKTYYVNFVKEAEKYGS 180
TKQWEVCYGSTVICSPASVSSTTQEVSIPESTTYTPAQTSTPVSSSTQEDAVQTPPRKRA 240
RGVQQSPCNALCVAHIGPVDSGNHNLITNNHDQHQRRNNSNSSATPIVQFQGESNCLKCF 300
RYRLNDKHRHLFDLISSTWHWASPKAPHKHAIVTVTYHSEEQRQQFLNVVKIPPTIRHKL 360
GFMSLHLL 368

HPV6A E4 (SEQ ID NO:4)

1 MAAQLYVLLHLYLALHKKYPFLNLLHTPPHRPPPLCPQAPRKTQCKRRLENEHEESNSHL 60
ATPCVWPTLDPWTVETTTSSLTITTSTKEGTTVTVQLRL 99

HPV6A E5 (SEQ ID NO:5)

1 MEVVPVQIAAGTTSTLILPVIIAFVVCFVSIILIVWISDFIVYTSVLVLTLLLYLLLWLL 60
LTTPLQFFLLTLLVCYCPALYIHHYIVNTQQ 91

HPV6A E6 (SEQ ID NO:6)

1 MESANASTSATTIDQLCKTFNLSMHTLQINCVFCKNALTTAEIYSYAYKQLKVLFRGGYP 60
YAACACCLEFHGKINQYRHFDYAGYATTVEEETKQDILDVLIRCYLCHKPLCEVEKVKHI 120
LTKARFIKLNCTWKGRCLHCWTTCMEDMLP 150

HPV6A E7 (SEQ ID NO:7)

1 MHGRHVTLKDIVLDLQPPDPVGLHCYEQLVDSSEDEVDEVDGQDSQPLKQHFQIVTCCCG 60
CDSNVRLVVQCTETDIREVQQLLLGTLDIVCPICAPKT 98

HPV6A L1 (SEQ ID NO:8)

1 MWRPSDSTVYVPPPNPVSKVVATDAYVTRTNIFYHASSSRLLAVGHPYFSIKRANKTVVP 60
KVSGYQYRVFKVVLPDPNKFALPDSSLFDPTTQRLVWACTGLEVGRGQPLGVGVSGHPFL 120
NKYDDVENSGSGGNPGQDNRVNVGMDYKQTQLCMVGCAPPLGEHWGKGKQCTNTPVQAGD 180
CPPLELITSVIQDGDMVDTGFGAMNFADLQTNKSDVPIDICGTTCKYPDYLQMAADPYGD 240
RLFFFLRKEQMFARHFFNRAGEVGEPVPDTLIIKGSGNRTSVGSSIYVNTPSGSLVSSEA 300
QLFNKPYWLQKAQGHNNGICWGNQLFVTVVDTTRSTNMTLCASVTTSSTYTNSDYKEYMR 360
HVEEYDLQFIFQLCSITLSAEVMAYIHTMNPSVLEDWNFGLSPPPNGTLEDTYRYVQSQA 420
ITCQKPTPEKEKPDPYKNLSFWEVNLKEKFSSELDQYPLGRKFLLQSGYRGRSSIRTGVK 480
RPAVSKASAAPKRKRAKTKR 500

HPV6A L2 (SEQ ID NO:9)

1 MAHSRARRRKRASATQLYQTCKLTGTCPPDVIPKVEHNTIADQILKWGSLGVFFGGLGIG 60
TGSGTGGRTGYVPLGTSAKPSITSGPMARPPVVVEPVAPSDPSIVSLIEESAIINAGAPE 120
IVPPAHGGFTITSSETTTPAILDVSVTSHTTTSIFRNPVFTEPSVTQPQPPVEANGHILI 180

SAPTITSHPIEEIPLDTFVISSSDSGPTSSTPVPGTAPRPRVGLYSRALHQVQVTDPAFL 240
STPQRLITYDNPVYEGEDVSVQFSHDSIHNAPDEAFMDIIRLHRPAIASRRGLVRYSRIG 300
QRGSMHTRSGKHIGARIHYFYDISPIAQAAEEIEMHPLVAAQDDTFDIYAESFEPDINPT 360
QHPVTNISDTYLTSTPNTVTQPWGNTTVPLSSIPNDLFLQSGPDITFPTAPMGTPFSPVT 420
ALPTGPVFITGSGFYLHPAWYFARKRRKRIPLFFSDVAA 459

HPV6B E1 (SEQ ID NO:10)

1 MADDSGTENEGSGCTGWFMVEAIVQHPTGTQISDDEDEEVEDSGYDMVDFIDDSNITHNS 60
LEAQALFNRQEADTHYATVQDLKRKYLGSPYVSPINTIAEAVESEISPRLDAIKLTRQPK 120
KVKRRLFQTRELTDSGYGYSEVEAGTGTQVEKHGVPENGGDGQEKDTGRDIEGEEHTEAE 180
APTNSVREHAGTAGILELLKCKDIRAALLGKFKECFGLSFIDLIRPFKSDKTTCLDWVVA 240
GFGIHHSISEAFQKLIEPLSLYAHIQWLTNAWGMVLLVLLRFKVNKSRSTVARTLATLLN 300
IPENQMLIEPPKIQSGVAALYWFRTGISNASTVIGEAPEWITRQTVIEHGLADSQFKLTE 360
MVQWAYDNDICEESEIAFEYAQRGDFDSNARAFLNSNMQAKYVKDCATMCRHYKHAEMRK 420
MSIKQWIKHRGSKIEGTGNWKPIVQFLRHQNIEFIPFLTKFKLWLHGTPKKNCIAIVGPP 480
DTGKSYFCMSLISFLGGTVISHVNSSSHFWLQPLVDAKVALLDDATQPCWIYMDTYMRNL 540
LDGNPMSIDRKHKALTLIKCPPLLVTSNIDITKEDKYKYLHTRVTTFTFPNPFPFDRNGN 600
AVYELSNTNWKCFFERLSSSLDIQDSEDEEDGSNSQAFRCVPGTVVRTL 649

HPV6B E2 (SEQ ID NO:11)

1 MEAIAKRLDACQEQLLELYEENSTDLHKHVLHWKCMRHESVLLYKAKQMGLSHIGMQVVP 60
PLKVSEAKGHNAIEMQMHLESLLRTEYSMEPWTLQETSYEMWQTPPKRCFKKRGKTVEVK 120
FDGCANNTMDYVVWTDVYVQDNDTWVKVHSMVDAKGIYYTCGQFKTYYVNFVKEAEKYGS 180
TKHWEVCYGSTVICSPASVSSTTQEVSIPESTTYTPAQTSTLVSSSTKEDAVQTPPRKRA 240
RGVQQSPCNALCVAHIGPVDSGNHNLITNNHDQHQRRNNSNSSATPIVQFQGESNCLKCF 300
RYRLNDRHRHLFDLISSTWHWASSKAPHKHAIVTVTYDSEEQRQQFLDVVKIPPTISHKL 360
GFMSLHLL 368

HPV6B E4 (SEQ ID NO:12)

1 MGAPNIGKYVMAAQLYVLLHLYLALHKKYPFLNLLHTPPHRPPPLCPQAPRKTQCKRRLG 60
NEHEESNSPLATPCVWPTLDPWTVETTTSSLTITTSTKDGTTVTVQLRL 109

HPV6B E5A (SEQ ID NO:13)

1 MEVVPVQIAAGTTSTFILPVIIAFVVCFVSIILIVWISEFIVYTSVLVLTLLLYLLLWLL 60
LTTPLQFFLLTLLVCYCPALYIHYYIVTTQQ 91

HPV6B E5B (SEQ ID NO:14)

1 MMLTCQFNDGDTWLGLWLLCAFIVGMLGLLLMHYRAVQGDKHTKCKKCNKHNCNDDYVTM 60
HYTTDGDYIYMN 72

HPV6B E6 (SEQ ID NO:15)

1 MESANASTSATTIDQLCKTFNLSMHTLQINCVFCKNALTTAEIYSYAYKHLKVLFRGGYP 60
YAACACCLEFHGKINQYRHFDYAGYATTVEEETKQDILDVLIRCYLCHKPLCEVEKVKHI 120
LTKARFIKLNCTWKGRCLHCWTTCMEDMLP 150

HPV6B E7 (SEQ ID NO:16)

1 MHGRHVTLKDIVLDLQPPDPVGLHCYEQLVDSSEDEVDEVDGQDSQPLKQHFQIVTCCCG 60
CDSNVRLVVQCTETDIREVQQLLLGTLNIVCPICAPKT 98

HPV6A L1 (SEQ ID NO:17)

1 MWRPSDSTVYVPPPNPVSKVVATDAYVTRTNIFYHASSSRLLAVGHPYFSIKRANKTVVP 60
KVSGYQYRVFKVVLPDPNKFALPDSSLFDPTTQRLVWACTGLEVGRGQPLGVGVSGHPFL 120
NKYDDVENSGSGGNPGQDNRVNVGMDYKQTQLCMVGCAPPLGEHWGKGKQCTNTPVQAGD 180
CPPLELITSVIQDGDMVDTGFGAMNFADLQTNKSDVPIDICGTTCKYPDYLQMAADPYGD 240
RLFFFLRKEQMFARHFFNRAGEVGEPVPDTLIIKGSGNRTSVGSSIYVNTPSGSLVSSEA 300
QLFNKPYWLQKAQGHNNGICWGNQLFVTVVDTTRSTNMTLCASVTTSSTYTNSDYKEYMR 360
HVEEYDLQFIFQLCSITLSAEVMAYIHTMNPSVLEDWNFGLSPPPNGTLEDTYRYVQSQA 420
ITCQKPTPEKEKPDPYKNLSFWEVNLKEKFSSELDQYPLGRKFLLQSGYRGRSSIRTGVK 480
RPAVSKASAAPKRKRAKTKR 500

HPV6B L2 (SEQ ID NO:18)

1 MAHSRARRRKRASATQLYQTCKLTGTCPPDVIPKVEHNTIADQILKWGSLGVFFGGLGIG 60
TGSGTGGRTGYVPLQTSAKPSITSGPMARPPVVVEPVAPSDPSIVSLIEESAIINAGAPE 120
IVPPAHGGFTITSSETTTPAILDVSVTSHTTTSIFRNPVFTEPSVTQPQPPVEANGHILI 180
SAPTVTSHPIEEIPLDTFVVSSSDSGPTSSTPVPGTAPRPRVGLYSRALHQVQVTDPAFL 240
STPQRLITYDNPVYEGEDVSVQFSHDSIHNAPDEAFMDIIRLHRPAIASRRGLVRYSRIG 300
QRGSMHTRSGKHIGARIHYFYDISPIAQAAEEIEMHPLVAAQDDTFDIYAESFEPGINPT 360
QHPVTNISDTYLTSTPNTVTQPWGNTTVPLSLPNDLFLQSGPDITFPTAPMGTPFSPVTP 420
ALPTGPVFITGSGFYLHPAWYFARKRRKRIPLFFSDVAA 453

HPV11 E1 (SEQ ID NO:19)

1 MADDSGTENEGSGCTGWFMVEAIVEHTTGTQISEDEEEEVEDSGYDMVDFIDDRHITQNS 60
VEAQALFNRQEADAHYATVQDLKRKYLGSPYVSPISNVANAVESEISPRLDAIKLTTQPK 120
KVKRRLFETRELTDSGYGYSEVEAATQVEKHGDPENGGDGQERDTGRDIEGEGVEHREAE 180
AVDDSTREHADTSGILELLKCKDIRSTLHGKFKDCFGLSFVDLIRPFKSDRTTCADWVVA 240
GFGIHHSIADAFQKLIEPLSLYAHIQWLTNAWGMVLLVLIRFKVNKSRCTVARTLGTLLN 300
IPENHMLIEPPKIQSGVRALYWFRTGISNASTVIGEAPEWITRQTVIEHSLADSQFKLTE 360
MVQWAYDNDICEESEIAFEYAQRGDFDSNARAFLNSNMQAKYVKDCAIMCRHYKHAEMKK 420
MSIKQWIKYRGTKVDSVGNWKPIVQFLRHQNIEFIPFLSKLKLWLHGTPKKNCIAIVGPP 480
DTGKSCFCMSLIKFLGGTVISYVNSCSHFWLQPLTDAKVALLDDATQPCWTYMDTYMRNL 540
LDGNPMSIDRKHRALTLIKCPPLLVTSNIDISKEEKYKYLHSRVTTFTFPNPFPFDRNGN 600

AVYELSDANWKCFFERLSSSLDIEDSEDEEDGSNSQAFRCVPGSVVRTL 649

HPV11 E2 (SEQ ID NO:20)

1 MEAIAKRLDACQDQLLELYEENSIDIHKHIMHWKCIRLESVLLHKAKQMGLSHIGLQVVP 60
PLTVSETKGHNAIEMQMHLESLAKTQYGVEPWTLQDTSYEMWLTPPKRCFKKQGNTVEVK 120
FDGCEDNVMEYVVWTHIYLQDNDSWVKVTSSVDAKGIYYTCGQFKTYYVNFNKEAQKYGS 180
TNHWEVCYGSTVICSPASVSSTVREVSIAEPTTYTPAQTTAPTVSACTTEDGVSAPPRKR 240
ARGPSTNNTLCVANIRSVDSTINNIVTDNYNKHQRRNNCHSAATPIVQLQGDSNCLKCFR 300
YRLNDKYKHLFELASSTWHWASPEAPHKNAIVTLTYSSEEQRQQFLNSVKIPPTIRHKVG 360
FMSLHLL 367

HPV11 E4 (SEQ ID NO:21)

1 MVVPIIGKYVMAAQLYVLLHLYLALYEKYPLLNLLHTPPHRPPPLQCPPAPRKTACRRRL 60
GSEHVDRPLTTPCVWPTSDPWTVQSTTSSLTITTSTKEGTTVTVQLRL 108

HPV11 E5A (SEQ ID NO:22)

1 MEVVPVQIAAATTTTLILPVVIAFAVCILSIVLIILISDFVVYTSVLVLTLLLYLLLWLL 60
LTTPLQFFLLTLCVCYFPAFYIHIYIVQTQQ 91

HPV11 E5B (SEQ ID NO:23)

1 MVMLTCHLNDGDTWLFLWLFTAFVVAVLGLLLLHYRAVHGTEKTKCAKCKSNRNTTVDYV 60
YMSHGDNGDYVYMN 74

HPV11 E6 (SEQ ID NO:24)

1 MESKDASTSATSIDQLCKTFNLSLHTLQIQCVFCRNALTTAEIYAYAYKNLKVVWRDNFP 60
FAACACCLELQGKINQYRHFNYAAYAPTVEEETNEDILKVLIRCYLCHKPLCEIEKLKHI 120
LGKARFIKLNNQWKGRCLHCWTTCMEDLLP 150

HPV11 E7 (SEQ ID NO:25)

1 MHGRLVTLKDIVLDLQPPDPVGLHCYEQLEDSSEDEVDKVDKQDAQPLTQHYQILTCCCG 60
CDSNVRLVVECTDGDIRQLQDLLLGTLNIVCPICAPKP 98

HPV11 L1 (SEQ ID NO:26)

1 MWRPSDSTVYVPPPNPVSKVVATDAYVKRTNIFYHASSSRLLAVGHPYYSIKKVNKTVVP 60
KVSGYQYRVFKVVLPDPNKFALPDSSLFDPTTQRLVWACTGLEVGRGQPLGVGVSGHPLL 120
NKYDDVENSGGYGGNPGQDNRVNVGMDYKQTQLCMVGCAPPLGEHWGKGTQCSNTSVQNG 180
DCPPLELITSVIQDGDMVDTGFGAMNFADLQTNKSDVPLDICGTVCKYPDYLQMAADPYG 240
DRLFFYLRKEQMFARHFFNRAGTVGEPVPDDLLVKGGNNRSSVASSIYVHTPSGSLVSSE 300
AQLFNKPYWLQKAQGHNNGICWGNHLFVTVVDTTRSTNMTLCASVSKSATYTNSDYKEYM 360
RHVEEFDLQFIFQLCSITLSAEVMAYIHTMNPSVLEDWNFGLSPPPNGTLEDTYRYVQSQ 420
AITCQKPTPEKEKQDPYKDMSFWEVNLKEKFSSELDQFPLGRKFLLQSGYRGRTSARTGI 480

KRPAVSKPSTAPKRKRTKTKK 501

HPV11 L2 (SEQ ID NO:27)

1 MKPRARRRKRASATQLYQTCKATGTCPPDVIPKVEHTTIADQILKWGSLGVFFGGLGIGT 60
GAGSGGRAGYIPLGSSPKPAITGGPAARPPVLVEPVAPSDPSIVSLIEESAIINAGAPEV 120
VPPTQGGFTITSSESTTPAILDVSVTNHTTTSVFQNPLFTEPSVIQPQPPVEASGHILIS 180
APTITSQHVEDIPLDTFVVSSSDSGPTSSTPLPRAFPRPRVGLYSRALQQVQVTDPAFLS 240
TPQRLVTYDNPVYEGEDVSLQFTHESIHNAPDEAFMDIIRLHRPAITSRRGLVRFSRIGQ 300
RGSMYTRSGQHIGARIHYFQDISPVTQAAEEIELHPLVAAENDTFDIYAEPFDPIPDPVQ 360
HSVTQSYLTSTPNTLSQSWGNTTVPLSIPSDWFVQSGPDITFPTASMGTPFSPVTPALPT 420
GPVFITGSDFYLHPTWYFARRRRKRIPLFFTDVAA 455

HPV16 E1 (SEQ ID NO:28)

1 MADPAGTNGEEGTGCNGWFYVEAVVEKKTGDAISDDENENDSDTGEDLVDFIVNDNDYLT 60
QAETETAHALFTAQEAKQHRDAVQVLKRKYLVSPLSDISGCVDNNISPRLKAICIEKQSR 120
AAKRRLFESEDSGYGNTEVETQQMLQVEGRHETETPCSQYSGGSGGGCSQYSSGSGGEGV 180
SERHTICQTPLTNILNVLKTSNAKAAMLAKFKELYGVSFSELVRPFKSNKSTCCDWCIAA 240
FGLTPSIADSIKTLLQQYCLYLHIQSLACSWGMVVLLLVRYKCGKNRETIEKLLSKLLCV 300
SPMCMMIEPPKLRSTAAALYWYKTGISNISEVYGDTPEWIQRQTVLQHSFNDCTFELSQM 360
VQWAYDNDIVDDSEIAYKYAQLADTNSNASAFLKSNSQAKIVKDCATMCRHYKRAEKKQM 420
SMSQWIKYRCDRVDDGGDWKQIVMFLRYQGVEFMSFLTALKRFLQGIPKKNCILLYGAAN 480
TGKSLFGMSLMKFLQGSVICFVNSKSHFWLQPLADAKIGMLDDATVPCWNYIDDNLRNAL 540
DGNLVSMDVKHRPLVQLKCPPLLITSNINAGTDSRWPYLHNRLVVFTFPNEFPFDENGNP 600
VYELNDKNWKSFFSRTWSRLSLHEDEDKENDGDSLPTFKCVSGQNTNTL 649

HPV16 E2 Accession number W2WLHS (SEQ ID NO:29)

1 METLCQRLNVCQDKILTHYENDSTDLRDHIDYWKHMRLECAIYYKAREMGFKHINHQVVP 60
TLAVSKNKALQAIELQLTLETIYNSQYSNEKWTLQDVSLEVYLTAPTGCIKKHGYTVEVQ 120
FDGDICNTMHYTNWTHIYICEEASVTVVEGQVDYYGLYYVHEGIRTYFVQFKDDAEKYSK 180
NKVWEVHAGGQVILCPTSVFSSNEVSSPEIIRQHLANHPAATHTKAVALGTEETQTTIQR 240
PRSEPDTGNPCHTTKLLHRDSVDSAPILTAFNSSHKGRINCNSNTTPIVHLKGDANTLKC 300
LRYRFKKHCTLYTAVSSTWHWTGHNVKHKSAIVTLTYDSEWQRDQFLSQVKIPKTITVST 360
GFMSI 365

HPV16 E5 Accession number W5WLHS (SEQ ID NO:30)

1 MTNLDTASTTLLACFLLCFCVLLCVCLLIRPLLLSVSTYTSLIILVLLLWITAASAFRCF 60
IVYIIFVYIPLFLIHTHARFLIT 83

HPV16 E6 (SEQ ID NO:31)

1 MHQKRTAMFQDPQERPRKLPQLCTELQTTIHDIILECVYCKQQLLRREVYDFAFRDLCIV 60
YRDGNPYAVCDKCLKFYSKISEYRHYCYSLYGTTLEQQYNKPLCDLLIRCINCQKPLCPE 120

EKQRHLDKKQRFHNIRGRWTGRCMSCCRSSRTRRETQL 158

HPV16 E7 (SEQ ID NO:32)

1 MHGDTPTLHEYMLDLQPETTDLYCYEQLNDSSEEEDEIDGPAGQAEPDRAHYNIVTFCCK 60

CDSTLRLCVQSTHVDIRTLEDLLMGTLGIVCPICSQKP 98

HPV16 L1 Accession number AAD33259 (SEQ ID NO:33)

1 MQVTFIYILVITCYENDVNVYHIFFQMSLWLPSEATVYLPPVPVSKVVSTDEYVARTNIY 60

YHAGTSRLLAVGHPYFPIKKPNNNKILVPKVSGLQYRVFRIHLPDPNKFGFPDTSFYNPD 120

TQRLVWACVGVEVGRGQPLGVGISGHPLLNKLDDTENASAYAANAGVDNRECISMDYKQT 180

QLCLIGCKPPIGEHWGKGSPCTNVAVNPGDCPPLELINTVIQDGDMVDTGFGAMDFTTLQ 240

ANKSEVPLDICTSICKYPDYIKMVSEPYGDSLFFYLRREQMFVRHLFNRAGAVGENVPDD 300

LYIKGSGSTANLASSNYFPTPSGSMVTSDAQIFNKPYWLQRAQGHNNGICWGNQLFVTVV 360

DTTRSTNMSLCAAISTSETTYKNTNFKEYLRHGEEYDLQFIFQLCKITLTADVMTYIHSM 420

NSTILEDWNFGLQPPPGGTLEDTYRFVTSQAIACQKHTPPAPKEDPLKKYTFWEVNLKEK 480

FSADLDQFPLGRKFLLQAGLKAKPKFTLGKRKATPTTSSTSTTAKRKKRKL 531

HPV16 L2 Accession number AAD33258 (SEQ ID NO:34)

1 MRHKRSAKRTKRASATQLYKTCKQAGTCPPDIIPKVEGKTIADQILQYGSMGVFFGGLGI 60

GTGSGTGGRTGYIPLGTRPPTATDTLAPVRPPLTVDPVGPSDPSIVSLVEETSFIDAGAP 120

TSVPSIPPDVSGFSITTSTDTTPAILDINNTVTTVTTHNNPTFTDPSVLQPPTPAETGGH 180

FTLSSSTISTHNYEEIPMDTFIVSTNPNTVTSSTPIPGSRPVARLGLYSRTTQQVKVVDP 240

AFITTPTKLITYDNPAYEGIDVDNTLYFSSNDNSINIAPDPDFLDIVALHRPALTSRRTG 300

IRYSRIGNKQTLRTRSGKSIGAKVHYYYDFSTIDSAEEIELQTITPSTYTTTSHAALPTS 360

INNGLYDIYADDFITDTSTTPVPSVPSTSLSGYIPANTTIPFGGAYNIPLVSGPDIPINI 420

TDQAPSLIPIVPGSPQYTIIADAGDFYLHPSYYMLRKRRKRLPYFFSDVSLAA 473

HPV18 E1 (SEQ ID NO:35)

1 MADPEGTDGEGTGCNGWFYVQAIVDKKTGDVISDDEDENATDTGSDMVDFIDTQGTFCEQ 60

AELETAQALFHAQEVHNDAQVLHVLKRKFAGGSTENSPLGERLEVDTELSPRLQEISLNS 120

GQKKAKRRLFTISDSGYGCSEVEATQIQVTTNGEHGGNVCSGGSTEAIDNGGTEGNNSSV 180

DGTSDNSNIENVNPQCTIAQLKDLLKVNNKQGAMLAVFKDTYGLSFTDLVRNFKSDKTTC 240

TDWVTAIFGVNPTIAEGFKTLIQPFILYAHIQCLDCKWGVLILALLRYKCGKSRLTVAKG 300

LSTLLHVPETCMLIQPPKLRSSVAALYWYRTGISNISEVMGDTPEWIQRLTIIQHGIDDS 360

NFDLSEMVQWAFDNELTDESDMAFEYALLADSNSNAAAFLKSNCQAKYLKDCATMCKHYR 420

RAQKRQMNMSQWIRFRCSKIDEGGDWRPIVQFLRYQQIEFITFLGALKSFLKGTPKKNCL 480

VFCGPANTGKSYFGMSFIHFIQGAVISFVNSTSHFWLEPLTDTKVAMLDDATTTCWTYFD 540

TYMRNALDGNPISIDRKHKPLIQLKCPPILLTTNIHPAKDNRWPYLESRITVFEFPNAFP 600

FDKNGNPVYEINDKNWKCFFERTWSRLDLHEEEEDADTEGNPFGTFKLRAGQNHRPL 657

HPV18 E2 Accession number W2WL18 (SEQ ID NO:36)

1 MQTPKETLSERLSCVQDKIIDHYENDSKDIDSQIQYWQLIRWENAIFFAAREHGIQTLNH 60
QVVPAYNISKSKAHKAIELQMALQGLAQSRYKTEDWTLQDTCEELWNTEPTHCFKKGGQT 120
VQVYFDGNKDNCMTYVAWDSVYYMTDAGTWDKTATCVSHRGLYYVKEGYNTFYIEFKSEC 180
EKYGNTGTWEVHFGNNVIDCNDSMCSTSDDTVSATQLVKQLQHTPSPYSSTVSVGTAKTY 240
GQTSAATRPGHCGLAEKQHCGPVNPLLGAATPTGNNKRRKLCSGNTTPIIHLKGDRNSLK 300
CLRYRLRKHSDHYRDISSTWHWTGAGNEKTGILTVTYHSETQRTKFLNTVAIPDSVQILV 360
GYMTM 365

HPV18 E5 Accession number W5WL18 (SEQ ID NO:37)

1 MLSLIFLFCFCVCMYVCCHVPLLPSVCMCAYAWVLVFVYIVVITSPATAFTVYVFCFLLP 60
MLLLHIHAILSLQ 73

HPV18 E6 (SEQ ID NO:38)

1 MARFEDPTRRPYKLPDLCTELNTSLQDIEITCVYCKTVLELTEVFEFAFKDLFVVYRDSI 60
PHAACHKCIDFYSRIRELRHYSDSVYGDTLEKLTNTGLYNLLIRCLRCQKPLNPAEKLRH 120
LNEKRRFHNIAGHYRGQCHSCCNRARQERLQRRRETQV 158

HPV18 E7 (SEQ ID NO:39)

1 MHGPKATLQDIVLHLEPQNEIPVDLLCHEQLSDSEEENDEIDGVNHQHLPARRAEPQRHT 60
MLCMCCKCEARIKLVVESSADDLRAFQQLFLNTLSFVCPWCASQQ 105

HPV18 L1 Accession number CAA28671 (SEQ ID NO:40)

1 MCLYTRVLILHYHLLPLYGPLYHPRPLPLHSILVYMVHIIICGHYIILFLRNVNVFPIFL 60
QMALWRPSDNTVYLPPPSVARVVNTDDYVTPTSIFYHAGSSRLLTVGNPYFRVPAGGGNK 120
QDIPKVSAYQYRVFRVQLPDPNKFGLPDTSIYNPETQRLVWACAGVEIGRGQPLGVGLSG 180
HPFYNKLDDTESSHAATSNVSEDVRDNVSVDYKQTQLCILGCAPAIGEHWAKGTACKSRP 240
LSQGDCPPLELKNTVLEDGDMVDTGYGAMDFSTLQDTKCEVPLDICQSICKYPDYLQMSA 300
DPYGDSMFFCLRREQLFARHFWNRAGTMGDTVPQSLYIKGTGMPASPGSCVYSPSPSGSI 360
VTSDSQLFNKPYWLHKAQGHNNGVCWHNQLFVTVVDTTPSTNLTICASTQSPVPGQYDAT 420
KFKQYSRHVEEYDLQFIFQLCTITLTADVMSYIHSMNSSILEDWNFGVPPPPTTSLVDTY 480
RFVQSVAITCQKDAAPAENKDPYDKLKFWNVDLKEKFSLDLDQYPLGRKFLVQAGLRRKP 540
TIGPRKRSAPSATTSSKPAKRVRVRARK 568

HPV18 L2 Accession number P2WL18 (SEQ ID NO:41)

1 MVSHRAARRKRASVTDLYKTCKQSGTCPPDVVPKVEGTTLADKILQWSSLGIFLGGLGIG 60
TGSGTGGRTGYIPLGGRSNTVVDVGPTRPPVVIEPVGPTDPSIVTLIEDSSVVTSGAPRP 120
TFTGTSGFDITSAGTTTPAVLDITPSSTSVSISTTNFTNPAFSDPSIIEVPQTGEVAGNV 180
FVGTPTSGTHGYEEIPLQTFASSGTGEEPISSTPLPTVRRVAGPRLYSRAYQQVSVANPE 240
FLTRPSSLITYDNPAFEPVDTTLTFDPRSDVPDSDFMDIIRLHRPALTSRRGTVRFSRLG 300
QRATMFTRSGTQIGARVHFYHDISPIAPSPEYIELQPLVSATEDNDLFDIYADDMDPAVP 360

VPSRSTTSFAFFKYSPTISSASSYSNVTVPLTSSWDVPVYTGPDITLPSTTSVWPIVSPT 420
APASTQYIGIHGTHYYLWPLYYFIPKKRKRVPYFFADGFVAA 462

HPV31 E1 Accession number W1WL31 (SEQ ID NO:42)

1 MADPAGTDGEGTGCNGWFYVEAVIDRQTGDNISEDENEDSSDTGEDMVDFIDNCNVYNNQ 60
AEAETAQALFHAQEAEEHAEAVQVLKRKYVGSPLSDISSCVDYNISPRLKAICIENNSKT 120
AKRRLFELPDSGYGNTEVETQQMVQVEEQQTTLSCNGSDGTHSERENETPTRNILQVLKT 180
SNGKAAMLGKFKELYGVSFMELIRPFQSNKSTCTDWCVAAFGVTGTVAEGFKTLLQPYCL 240
YCHLQSLACSWGMVMLMLVRFKCAKNRITIEKLLEKLLCISTNCMLIQPPKLRSTAAALY 300
WYRTGMSNISDVYGETPEWIERQTVLQHSFNDTTFDLSQMVQWAYDNDVMDDSEIAYKYA 360
QLADSDSNACAFLKSNSQAKIVKDCGTMCRHYKRAEKRQMSMGQWIKSRCDKVSDEGDWR 420
DIVKFLRYQQIEFVSFLSALKLFLKGVPKKNCILIHGAPNTGKSYFGMSLISFLQGCIIS 480
YANSKSHFWLQPLADAKIGMLDDATTPCWHYIDNYLRNALDGNPVSIDVKHKALMQLKCP 540
PLLITSNINAGKDDRWPYLHSRLVVFTFPNPFPFDKNGNPVYELSDKNWKSFFSRTWCRL 600
NLHEEEDKENDGDSFSTFKCVSGQNIRTL 629

HPV31 E2 Accession number W2WL31 (SEQ ID NO:43)

1 METLSQRLNVCQDKILEHYENDSKRLCDHIDYWKHIRLECVLMYKAREMGIHSINHQVVP 60
ALSVSKAKALQAIELQMMLETLNNTEYKNEDWTMQQTSLELYLTAPTGCLKKHGYTVEVQ 120
FDGDVHNTMHYTNWKFIYLCIDGQCTVVEGQVNCKGIYYVHEGHITYFVNFTEEAKKYGT 180
GKKWEVHAGGQVIVFPESVFSSDEISFAGIVTKLPTANNTTTSNSKTCALGTSEGVRRAT 240
TSTKRPRTEPEHRNTHHPNKLLRGDSVDSVNCGVISAAACTNQTRAVSCPATTPIIHLKG 300
DANILKCLRYRLSKYKQLYEQVSSTWHWTCTDGKHKNAIVTLTYISTSQRDDFLNTVKIP 360
NTVSVSTGYMTI 372

HPV31 E5 Accession number W5WL31 (SEQ ID NO:44)

1 MIELNISTVSIVLCFLLCFCVLLFVCLVIRPLVLSVSVYATLLLLIVILWVIATSPLRCF 60
CIYVVFIYIPLFVIHTHASFLSQQ 84

HPV31 E6 Accession number W6WL31 (SEQ ID NO:45)

1 MFKNPAERPRKLHELSSALEIPYDELRLNCVYCKGQLTETEVLDFAFTDLTIVYRDDTPH 60
GVCTKCLRFYSKVSEFRWYRYSVYGTTLEKLTNKGICDLLIRCITCQRPLCPEEKQRHLD 120
KKKRFHNIGGRWTGRCIACWRRPFTETQV 149

HPV31 E7 Accession number W7WL31 (SEQ ID NO:46)

1 MRGETPTLQDYVLDLQPEATDLHCYEQLPDSSDEEDVIDSPAGQAEPDTSNYNIVTFCCQ 60
CKSTLRLCVQSTQVDIRILQELLMGSFGIVCPNCSTRL 98

HPV31 L1 Accession number P1WL31 (SEQ ID NO:47)

1 MSLWRPSEATVYLPPVPVSKVVSTDEYVTRTNIYYHAGSARLLTVGHPYYSIPKSDNPKK 60
IVVPKVSGLQYRVFRVRLPDPNKFGFPDTSFYNPETQRLVWACVGLEVGRGQPLGVGISG 120

HPLLNKFDDTENSNRYAGGPGTDNRECISMDYKQTQLCLLGCKPPIGEHWGKGSPCSNNA 180
ITPGDCPPLELKNSVIQDGDMVDTGFGAMDFTALQDTKSNVPLDICNSICKYPDYLKMVA 240
EPYGDTLFFYLRREQMFVRHFFNRSGTVGESVPTDLYIKGSGSTATLANSTYFPTPSGSM 300
VTSDAQIFNKPYWMQRAQGHNNGICWGNQLFVTVVDTTRSTNMSVCAAIANSDTTFKSSN 360
FKEYLRHGEEFDLQFIFQLCKITLSADIMTYIHSMNPAILEDWNFGLTTPPSGSLEDTYR 420
FVTSQAITCQKTAPQKPKEDPFKDYVFWEVNLKEKFSADLDQFPLGRKFLLQAGYRARPK 480
FKAGKRSAPSASTTTPAKRKKTKK 504

HPV31 L2 Accession number P2WL31 (SEQ ID NO:48)

1 MRSKRSTKRTKRASATQLYQTCKAAGTCPSDVIPKIEHTTIADQILRYGSMGVFFGGLGI 60
GSGSGTGGRTGYVPLSTRPSTVSEASIPIRPPVSIDPVGPLDPSIVSLVEESGIVDVGAP 120
APIPHPPTTSGFDIATTADTTPAILDVTSVSTHENPTFTDPSVLQPPTPAETSGHLLLSS 180
SSISTHNYEEIPMDTFIVSTNNENITSSTPIPGVRRPARLGLYSKATQQVKVIDPTFLSA 240
PKQLITYENPAYETVNAEESLYFSNTSHNIAPDPDFLDIIALHRPALTSRRNTVRYSRLG 300
NKQTLRTRSGATIGARVHYYYDISSINPAGESIEMQPLGASATTTSTLNDGLYDIYADTD 360
FTVDTPATHNVSPSTAVQSTSAVSAYVPTNTTVPLSTGFDIPIFSGPDVPIEHAPTQVFP 420
FPLAPTTPQVSIFVDGGDFYLHPSYYMLKRRRKRVSYFFTDVSVAA 466

HPV45 E1 Accession number S36563 (SEQ ID NO:49)

1 MADPEGTDGEGTGCNGWFFVETIVEKKTGDVISDDEDETATDTGSDMVDFIDTQLSICEQ 60
AEQETAQALFHAQEVQNDAQVLHLLKRKFAGGSKENSPLGEQLSVDTDLSPRLQEISLNS 120
GHKKAKRRLFTISDSGYGCSEVEAAETQVTVNTNAENGGSVHSTQSSGGDSSDNAENVDP 180
HCSITELKELLQASNKKAAMLAVFKDIYGLSFTDLVRNFKSDKTTCTDWVMAIFGVNPTV 240
AEGFKTLIKPATLYAHIQCLDCKWGVLILALLRYKCGKNRLTVAKGLSTLLHVPETCMLI 300
EPPKLRSSVAALYWYRTGISNISEVSGDTPEWIQRLTIIQHGIDDSNFDLSDMVQWAFDN 360
DLTDESDMAFQYAQLADCNSNAAAFLKSNCQAKYLKDCAVMCRHYKRAQKRQMNMSQWIK 420
YRCSKIDEGGDWRPIVQFLRYQGVEFISFLRALKEFLKGTPKKNCILLYGPANTGKSYFG 480
MSFIHFLQGAIISFVNSNSHFWLEPLADTKVAMLDDATHTCWTYFDNYMRNALDGNPISI 540
DRKHKPLLQLKCPPILLTSNIDPAKDNKWPYLESRVTVFTFPHAFPFDKNGNPVYEINDK 600
NWKCFFERTWSRLDLHEDDEDADTEGIPFGTFKCVTGQNTRPL 643

HPV45 E2 Accession number S36564 (SEQ ID NO:50)

MKMQTPKESLSERLSALQDKILDHYENDSKDINSQISYWQLIRLENAILFTAREHGITKL 60
NHQVVPPINISKSKAHKAIELQMALKGLAQSKYNNEEWTLQDTCEELWNTEPSQCFKKGG 120
KTVHVYFDGNKDNCMNYVVWDSIYYITETGIWDKTAACVSYWGVYYIKDGDTTYYVQFKS 180
ECEKYGNSNTWEVQYGGNVIDCNDSMCSTSDDTVSATQIVRQLQHASTSTPKTASVGTPK 240
PHIQTPATKRPRQCGLTEQHHGRVNTHVHNPLLCSSTSNNKRRKVCSGNTTPIIHLKGDK 300
NSLKCLRYRLRKYADHYSEISSTWHWTGCNKNTGILTVTYNSEVQRNTFLDVVTIPNSVQ 360
ISVGYMTI 368

HPV45 E6 Accession number CAB44706 (SEQ ID NO:51)

1 MARFDDPTQRPYKLPDLCTELNTSLQDVSIACVYCKATLERTEVYQFAFKDLFIVYRDCI 60
AYAACHKCIDFYSRIRELRYYSNSVYGETLEKITNTELYNLLIRCLRCQKPLNPAEKRRH 120
LKDKRRFHSIAGQYRGQCNTCCDQARQERLRRRRETQV 158

HPV45 E7 Accession number CAB44707 (SEQ ID NO:52)

1 MHGPRATLQEIVLHLEPQNELDPVDLLCYEQLSESEEENDEADGVSHAQLPARRAEPQRH 60
KILCVCCKCDGRIELTVESSADDLRTLQQLFLSTLSFVCPWCATNQ 106

HPV45 L1 Accession number CAB44705 (SEQ ID NO:53)

1 MAHNIIYGHGIIIFLKNVNVFPIFLQMALWRPSDSTVYLPPPSVARVVNTDDYVSRTSIF 60
YHAGSSRLLTVGNPYFRVVPSGAGNKQAVPKVSAYQYRVFRVALPDPNKFGLPDSTIYNP 120
ETQRLVWACVGMEIGRGQPLGIGLSGHPFYNKLDDTESAHAATAVITQDVRDNVSVDYKQ 180
TQLCILGCVPAIGEHWAKGTLCKPAQLQPGDCPPLELKNTIIEDGDMVDTGYGAMDFSTL 240
QDTKCEVPLDICQSICKYPDYLQMSADPYGDSMFFCLRREQLFARHFWNRAGVMGDTVPT 300
DLYIKGTSANMRETPGSCVYSPSPSGSITTSDSQLFNKPYWLHKAQGHNNGICWHNQLFV 360
TVVDTTRSTNLTLCASTQNPVPNTYDPTKFKHYSRHVEEYDLQFIFQLCTITLTAEVMSY 420
IHSMNSSILENWNFGVPPPPTTSLVDTYRFVQSVAVTCQKDTTPPEKQDPYDKLKFWTVD 480
LKEKFSSDLDQYPLGRKFLVQAGLRRRPTIGPRKRPAASTSTASRPAKRVRIRSKK 536

HPV45 L2 Accession number S36565 (SEQ ID NO:54)

1 MVSHRAARRKRASATDLYRTCKQSGTCPPDVINKVEGTTLADKILQWSSLGIFLGGLGIG 60
TGSGSGGRTGYVPLGGRSNTVVDVGPTRPPVVIEPVGPTDPSIVTLVEDSSVVASGAPVP 120
TFTGTSGFEITSSGTTTPAVLDITPTVDSVSISSTSFTNPAFSDPSIIEVPQTGEVSGNI 180
FVGTPTSGSHGYEEIPLQTFASSGSGTEPISSTPLPTVRRVRGPRLYSRANQQVRVSTSQ 240
FLTHPSSLVTFDNPAYEPLDTTLSFEPTSNVPDSDFMDIIRLHRPALSSRRGTVRFSRLG 300
QRATMFTRSGKQIGGRVHFYHDISPIAATEEIELQPLISATNDSDLFDVYADFPPPASTT 360
PSTIHKSFTYPKYSLTMPSTAASSYSNVTVPLTSAWDVPIYTGPDIILPSHTPMWPSTSP 420
TNASTTTYIGIHGTQYYLWPWYYYFPKKRKRIPYFFADGFVAA 463

HPV33 E1 Accession number W1WL33 (SEQ ID NO:55)

1 MADPEGTNGAGMGCTGWFEVEAVIERRTGDNISEDEDETADDSGTDLLEFIDDSMENSIQ 60
ADTEAARALFNIQEGEDDLNAVCALKRKFAACSQSAAEDVVDRAANPCRTSINKNKECTY 120
RKRKIDELEDSGYGNTEVETQQMVQQVESQNGDTNLNDLESSGVGDDSEVSCETNVDSCE 180
NVTLQEISNVLHSSNTKANILYKFKEAYGISFMELVRPFKSDKTSCTDWCITGYGISPSV 240
AESLKVLIKQHSLYTHLQCLTCDRGIIILLLIRFRCSKNRLTVAKLMSNLLSIPETCMVI 300
EPPKLRSQTCALYWFRTAMSNISDVQGTTPEWIDRLTVLQHSFNDNIFDLSEMVQWAYDN 360
ELTDDSDIAYYYAQLADSNSNAAAFLKSNSQAKIVKDCGIMCRHYKKAEKRKMSIGQWIQ 420
SRCEKTNDGGNWRPIVQLLRYQNIEFTAFLGAFKKFLKGIPKKSCMLICGPANTGKSYFG 480
MSLIQFLKGCVISCVNSKSHFWLQPLSDAKIGMIDDVTPISWTYIDDYMRNALDGNEISI 540
DVKHRALVQLKCPPLLLTSNTNAGTDSRWPYLHSRLTVFEFKNPFPFDENGNPVYAINDE 600

NWKSFFSRTWCKLDLIEEEDKENHGGNISTFKCSAGENTRSLRS 644

HPV33 E2 Accession number W2WL33 (SEQ ID NO:56)

1 MEEISARLNAVQEKILDLYEADKTDLPSQIEHWKLIRMECALLYTAKQMGFSHLCHQVVP 60
SLLASKTKAFQVIELQMALETLSKSQYSTSQWTLQQTSLEVWLCEPPKCFKKQGETVTVQ 120
YDNDKKNTMDYTNWGEIYIIEEDTCTMVTGKVDYIGMYYIHNCEKVYFKYFKEDAAKYSK 180
TQMWEVHVGGQVIVCPTSISSNQISTTETADIQTDNDNRPPQAAAKRRRPADTTDTAQPL 240
TKLFCADPALDNRTARTATNCTNKQRTVCSSNVAPIVHLKGESNSLKCLRYRLKPYKELY 300
SSMSSTWHWTSDNKNSKNGIVTVTFVTEQQQQMFLGTVKIPPTVQISTGFMTL 353

HPV33 E5 Accession number W5WL33 (SEQ ID NO:57)

1 MIFVFVLCFILFLCLSLLLRPLILSISTYAWLLVLVLLLWVFVGSPLKIFFCYLLFLYLP 60
MMCINFHAQHMTQQE 75

HPV33 E6 Accession number W6WL33 (SEQ ID NO:58)

1 MFQDTEEKPRTLHDLCQALETTIHNIELQCVECKKPLQRSEVYDFAFADLTVVYREGNPF 60
GICKLCLRFLSKISEYRHYNYSVYGNTLEQTVKKPLNEILIRCIICQRPLCPQEKKRHVD 120
LNKRFHNISGRWAGRCAACWRSRRRETAL 149

HPV33 E7 Accession number W7WL33 (SEQ ID NO:59)

1 MRGHKPTLKEYVLDLYPEPTDLYCYEQLSDSSDEDEGLDRPDGQAQPATADYYIVTCCHT 60
CNTTVRLCVNSTASDLRTIQQLLMGTVNIVCPTCAQQ 97

HPV33 L1 Accession number P1WL33 (SEQ ID NO:60)

1 MSVWRPSEATVYLPPVPVSKVVSTDEYVSRTSIYYYAGSSRLLAVGHPYFSIKNPTNAKK 60
LLVPKVSGLQYRVFRVRLPDPNKFGFPDTSFYNPDTQRLVWACVGLEIGRGQPLGVGISG 120
HPLLNKFDDTETGNKYPGQPGADNRECLSMDYKQTQLCLLGCKPPTGEHWGKGVACTNAA 180
PANDCPPLELINTIIEDGDMVDTGFGCMDFKTLQANKSDVPIDICGSTCKYPDYLKMTSE 240
PYGDSLFFFLRREQMFVRHFFNRAGTLGEAVPDDLYIKGSGTTASIQSSAFFPTPSGSMV 300
TSESQLFNKPYWLQRAQGHNNGICWGNQVFVTVVDTTRSTNMTLCTQVTSDSTYKNENFK 360
EYIRHVEEYDLQFVFQLCKVTLTAEVMTYIHAMNPDILEDWQFGLTPPPSASLQDTYRFV 420
TSQAITCQKTVPPKEKEDPLGKYTFWEVDLKEKFSADLDQFPLGRKFLLQAGLKAKPKLK 480
RAAPTSTRTSSAKRKKVKK 499

HPV33 L2 Accession number P2WL33 (SEQ ID NO:61)

1 MRHKRSTRRKRASATQLYQTCKATGTCPPDVIPKVEGSTIADQILKYGSLGVFFGGLGIG 60
TGSGSGGRTGYVPIGTDPPTAAIPLQPIRPPVTVDTVGPLDSSIVSLIEETSFIEAGAPA 120
PSIPTPSGFDVTTSADTTPAIINVSSVGESSIQTISTHLNPTFTEPSVLHPPAPAEASGH 180
FIFSSPTVSTQSYENIPMDTFVVSTDSSNVTSSTPIPGSRPVARLGLYSRNTQQVKVVDP 240
AFLTSPHKLITYDNPAFESFDPEDTLQFQHSDISPAPDPDFLDIIALHRPAITSRRHTVR 300
FSRVGQKATLKTRSGKQIGARIHYYQDLSPIVPLDHTVPNEQYELQPLHDTSTSSYSIND 360

GLYDVYADDVDNVHTPMQHSYSTFATTRTSNVSIPLNTGFDTPVMSGPDIPSPLFPTSSP 420
FVPISPFFPFDTIVVDGADFVLHPSYFILRRRRKRFPYFFTDVRVAA 467

HPV56 E2 Accession number S36581 (SEQ ID NO:62)

1 MVPCLQVCKAKACSAIEVQIALESLSTTIYNNEEWTLRDTCEELWLTEPKKCFKKEGQHI 60
EVWFDGSKNNCMQYVAWKYIYYNGDCGWQKVCSGVDYRGIYYVHDGHKTYYTDFEQEAKK 120
FGCKNIWEVHMENESIYCPDSVSSTCRYNVSPVETVNEYNTHKTTTTTSTSVGNQDAAVS 180
HRPGKRPRLRESEFDSSRESHAKCVTTHTHISDTDNTDSRSRSINNNNHPGDKTTPVVHL 240
KGEPNRLKCCRYRFQKYKTLFVDVTSTYHWTSTDNKNYSIITIIYKDETQRNSFLSHVKI 300
PVVYRLVWDK 310

HPV56 E6 Accession number W6WL56 (SEQ ID NO:63)

1 MEPQFNNPQERPRSLHHLSEVLEIPLIDLRLSCVYCKKELTRAEVYNFACTELKLVYRDD 60
FPYAVCRVCLLFYSKVRKYRYYDYSVYGATLESITKKQLCDLLIRCYRCQSPLTPEEKQL 120
HCDRKRRFHLIAHGWTGSCLGCWRQTSREPRESTV 155

HPV56 E7 Accession number S36580 (SEQ ID NO:64)

1 MHGKVPTLQDVVLELTPQTEIDLQCNEQLDSSEDEDEDEVDHLQERPQQARQAKQHTCYL 60
IHVPCCECKFVVQLDIQSTKEDLRVVQQLLMGALTVTCPLCASSN 105

HPV56 L1 Accession number S38563 (SEQ ID NO:65)

1 MMLPMMYIYRDPPLHYGLCIFLDVGAVNVFPIFLQMATWRPSENKVYLPPTPVSKVVATD 60
SYVKRTSIFYHAGSSRLLAVGHPYYSVTKDNTKTNIPKVSAYQYRVFRVRLPDPNKFGLP 120
DTNIYNPDQERLVWACVGLEVGRGQPLGAGLSGHPLFNRLDDTESSNLANNNVIEDSRDN 180
ISVDGKQTQLCIVGCTPAMGEHWTKGAVCKSTQVTTGDCPPLALINTPIEDGDMIDTGFG 240
AMDFKVLQESKAEVPLDIVQSTCKYPDYLKMSADAYGDSMWFYLRREQLFARHYFNRAGK 300
VGETIPAELYLKGSNGREPPPSSVYVATPSGSMITSEAQLFNKPYWLQRAQGHNNGICWG 360
NQLFVTVVDTTRSTNMTISTATEQLSKYDARKINQYLRHVEEYELQFVFQLCKITLSAEV 420
MAYLHNMNANLLEDWNIGLSPPVATSLEDKYRYVRSTAITCQREQPPTEKQDPLAKYKFW 480
DVNLQDSFSTDLDQFPLGRKFLMQLGTRSKPAVATSKKRSAPTSTSTPAKRKRR 534

HPV56 L2 Accession number S36582 (SEQ ID NO:66)

1 MVAHRATRRKRASATQLYKTCKLSGTCPEDVVNKIEQKTWADKILQWGSLFTYFGGLGIG 60
TGTGSGGRAGYVPLGSRPSTIVDVTPARPPIVVESVGPTDPSIVTLVEESSVIESGAGIP 120
NFTGSGGFEITSSSTTTPAVLDITPTSSTVHVSSTHITNPLFIDPPVIEAPQTGEVSGNI 180
LISTPTSGIHSYEEIPMQTFAVHGSGTEPISSTPIPGFRRIAAPRLYRKAFQQVKVTDPA 240
FLDRPATLVSADNPLFEGTDTSLAFSPSGVAPDPDFMNIVALHRPAFTTRRGGVRFSRLG 300
RKATIQTRRGTQIGARVHYYYDISPIAQAEEIEMQPLLSANNSFDGLYDIYANIDDEAPG 360
LSSQSVATPSAHLPIKPSTLSFASNTTNVTAPLGNVWETPFYSGPDIVLPTGPSTWPFVP 420
QSPYDVTHDVYIQGSSFALWPVYFFRRRRRKRIPYFFADGDVAA 464

HLA Class I Motifs Indicative of CTL Inducing Peptide Epitopes:

The primary anchor residues of the HLA class I peptide epitope supermotifs and motifs delineated below are summarized in Table I. The HLA class I motifs set out in Table I(a) are those most particularly relevant to the invention claimed here. Primary and secondary anchor positions are summarized in Table II. Allele-specific HLA molecules that comprise HLA class I supertype families are listed in Table VI. In some cases, peptide epitopes may be listed in both a motif and a supermotif Table. The relationship of a particular motif and respective supermotif is indicated in the description of the individual motifs.

III.D.1. HLA-A1 supermotif

The HLA-A1 supermotif is characterized by the presence in peptide ligands of a small (T or S) or hydrophobic (L, I, V, or M) primary anchor residue in position 2, and an aromatic (Y, F, or W) primary anchor residue at the C-terminal position of the epitope. The corresponding family of HLA molecules that bind to the A1 supermotif (*i.e.*, the HLA-A1 supertype) is comprised of at least A*0101, A*2601, A*2602, A*2501, and A*3201 (*see, e.g.*, DiBrino, M. *et al.*, *J. Immunol.* 151:5930, 1993; DiBrino, M. *et al.*, *J. Immunol.* 152:620, 1994; Kondo, A. *et al.*, *Immunogenetics* 45:249, 1997). Other allele-specific HLA molecules predicted to be members of the A1 superfamily are shown in Table VI. Peptides binding to each of the individual HLA proteins can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the A1 supermotif are set forth in Table VII.

III.D.2. HLA-A2 supermotif

Primary anchor specificities for allele-specific HLA-A2.1 molecules (*see, e.g.*, Falk *et al.*, *Nature* 351:290-296, 1991; Hunt *et al.*, *Science* 255:1261-1263, 1992; Parker *et al.*, *J. Immunol.* 149:3580-3587, 1992; Ruppert *et al.*, *Cell* 74:929-937, 1993) and cross-reactive binding among HLA-A2 and -A28 molecules have been described. (*See, e.g.*, Fruci *et al.*, *Human Immunol.* 38:187-192, 1993; Tanigaki *et al.*, *Human Immunol.* 39:155-162, 1994; Del Guercio *et al.*, *J. Immunol.* 154:685-693, 1995; Kast *et al.*, *J. Immunol.* 152:3904-3912, 1994 for reviews of relevant data.) These primary anchor residues define the HLA-A2 supermotif; which presence in peptide ligands corresponds to the ability to bind several different HLA-A2 and -A28 molecules. The HLA-A2 supermotif comprises peptide ligands with L, I, V, M, A, T, or Q as a primary anchor residue at position 2 and L, I, V, M, A, or T as a primary anchor residue at the C-terminal position of the epitope.

The corresponding family of HLA molecules (*i.e.*, the HLA-A2 supertype that binds these peptides) is comprised of at least: A*0201, A*0202, A*0203, A*0204, A*0205, A*0206, A*0207, A*0209, A*0214, A*6802, and A*6901. Other allele-specific HLA molecules predicted to be members of the A2 superfamily are shown in Table VI. As explained in detail below, binding to each of the individual allele-specific HLA molecules can be modulated by substitutions at the primary anchor and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise an A2 supermotif are set forth in Table VIII. The motifs comprising the primary anchor residues V, A, T, or Q at position 2 and L, I, V, A, or T at the C-terminal position are those most particularly relevant to the invention claimed herein.

III.D.3. HLA-A3 supermotif

The HLA-A3 supermotif is characterized by the presence in peptide ligands of A, L, I, V, M, S, or, T as a primary anchor at position 2, and a positively charged residue, R or K, at the C-terminal position of the epitope, *e.g.*, in position 9 of 9-mers (*see, e.g.*, Sidney *et al.*, *Hum. Immunol.* 45:79, 1996). Exemplary members of the corresponding family of HLA molecules (the HLA-A3 supertype) that bind the A3 supermotif include at least A*0301, A*1101, A*3101, A*3301, and A*6801. Other allele-specific HLA molecules predicted to be members of the A3 supertype are shown in Table VI. As explained in detail below, peptide binding to each of the individual allele-specific HLA proteins can be modulated by substitutions of amino acids at the primary and/or secondary anchor positions of the peptide, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the A3 supermotif are set forth in Table IX.

III.D.4. HLA-A24 supermotif

The HLA-A24 supermotif is characterized by the presence in peptide ligands of an aromatic (F, W, or Y) or hydrophobic aliphatic (L, I, V, M, or T) residue as a primary anchor in position 2, and Y, F, W, L, I, or M as primary anchor at the C-terminal position of the epitope (*see, e.g.*, Sette and Sidney, *Immunogenetics 1999 Nov;50(3-4):201-12,* Review). The corresponding family of HLA molecules that bind to the A24 supermotif (*i.e.*, the A24 supertype) includes at least A*2402, A*3001, and A*2301. Other allele-specific HLA molecules predicted to be members of the A24 supertype are shown in Table VI. Peptide binding to each of the allele-specific HLA molecules can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the A24 supermotif are set forth in Table X.

III.D.5. HLA-B7 supermotif

The HLA-B7 supermotif is characterized by peptides bearing proline in position 2 as a primary anchor, and a hydrophobic or aliphatic amino acid (L, I, V, M, A, F, W, or Y) as the primary anchor at the C-terminal position of the epitope. The corresponding family of HLA molecules that bind the B7 supermotif (*i.e.*, the HLA-B7 supertype) is comprised of at least twenty six HLA-B proteins including: B*0702, B*0703, B*0704, B*0705, B*1508, B*3501, B*3502, B*3503, B*3504, B*3505, B*3506, B*3507, B*3508, B*5101, B*5102, B*5103, B*5104, B*5105, B*5301, B*5401, B*5501, B*5502, B*5601, B*5602, B*6701, and B*7801 (*see, e.g.*, Sidney, *et al., J. Immunol.* 154:247, 1995; Barber, *et al., Curr. Biol.* 5:179, 1995; Hill, *et al., Nature* 360:434, 1992; Rammensee, *et al., Immunogenetics* 41:178, 1995 for reviews of relevant data). Other allele-specific HLA molecules predicted to be members of the B7 supertype are shown in Table VI. As explained in detail below, peptide binding to each of the individual

allele-specific HLA proteins can be modulated by substitutions at the primary and/or secondary anchor positions of the peptide, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the B7 supermotif are set forth in Table XI.

III.D.6. HLA-B27 supermotif

The HLA-B27 supermotif is characterized by the presence in peptide ligands of a positively charged (R, H, or K) residue as a primary anchor at position 2, and a hydrophobic (F, Y, L, W, M, I, A, or V) residue as a primary anchor at the C-terminal position of the epitope (*see, e.g.*, Sidney and Sette, *Immunogenetics 1999 Nov;50(3-4):201-12,* Review). Exemplary members of the corresponding family of HLA molecules that bind to the B27 supermotif (*i.e.*, the B27 supertype) include at least B*1401, B*1402, B*1509, B*2702, B*2703, B*2704, B*2705, B*2706, B*3801, B*3901, B*3902, and B*7301. Other allele-specific HLA molecules predicted to be members of the B27 supertype are shown in Table VI. Peptide binding to each of the allele-specific HLA molecules can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the B27 supermotif are set forth in Table XII.

III.D.7. HLA-B44 supermotif

The HLA-B44 supermotif is characterized by the presence in peptide ligands of negatively charged (D or E) residues as a primary anchor in position 2, and hydrophobic residues (F, W, Y, L, I, M, V, or A) as a primary anchor at the C-terminal position of the epitope (*see, e.g.*, Sidney et al., *Immunol. Today* 17:261, 1996). Exemplary members of the corresponding family of HLA molecules that bind to the B44 supermotif (*i.e.*, the B44 supertype) include at least: B*1801, B*1802, B*3701, B*4001, B*4002, B*4006, B*4402, B*4403, and B*4006. Peptide binding to each of the allele-specific HLA molecules can be modulated by substitutions at primary and/or secondary anchor positions; preferably choosing respective residues specified for the supermotif.

III.D.8. HLA-B58 supermotif

The HLA-B58 supermotif is characterized by the presence in peptide ligands of a small aliphatic residue (A, S, or T) as a primary anchor residue at position 2, and an aromatic or hydrophobic residue (F, W, Y, L, I, V, M, or A) as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, Sidney and Sette, *Immunogenetics 1999 Nov;50(3-4):201-12,* Review). Exemplary members of the corresponding family of HLA molecules that bind to the B58 supermotif (*i.e.*, the B58 supertype) include at least: B*1516, B*1517, B*5701, B*5702, and B*5801. Other allele-specific HLA molecules predicted to be members of the B58 supertype are shown in Table VI. Peptide binding to each of the allele-specific HLA molecules can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the B58 supermotif are set forth in Table XIII.

III.D.9. HLA-B62 supermotif

The HLA-B62 supermotif is characterized by the presence in peptide ligands of the polar aliphatic residue Q or a hydrophobic aliphatic residue (L, V, M, I, or P) as a primary anchor in position 2, and a hydrophobic residue (F, W, Y, M, I, V, L, or A) as a primary anchor at the C-terminal position of the epitope (*see, e.g.*, Sidney and Sette, *Immunogenetics 1999 Nov;50(3-4):201-12,* Review). Exemplary members of the corresponding family of HLA molecules that bind to the B62 supermotif (*i.e.*, the B62 supertype) include at least: B*1501, B*1502, B*1513, and B5201. Other allele-specific HLA molecules predicted to be members of the B62 supertype are shown in Table VI. Peptide binding to each of the allele-specific HLA molecules can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative peptide epitopes that comprise the B62 supermotif are set forth in Table XIV.

III.D.10. HLA-A1 motif

The HLA-A1 motif is characterized by the presence in peptide ligands of T, S, or M as a primary anchor residue at position 2 and the presence of Y as a primary anchor residue at the C-terminal position of the epitope. An alternative allele-specific A1 motif is characterized by a primary anchor residue at position 3 rather than position 2. This motif is characterized by the presence of D, E, A, or S as a primary anchor residue in position 3, and a Y as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, DiBrino *et al.*, J. Immunol.; 152:620, 1994; Kondo *et al.*, *Immunogenetics* 45:249, 1997; and Kubo *et al.*, *J. Immunol.* 152:3913, 1994 for reviews of relevant data). Peptide binding to HLA A1 can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the motif.

Representative peptide epitopes that comprise either A1 motif are set forth in Table XV. Those epitopes comprising T, S, or M at position 2 and Y at the C-terminal position are also included in the listing of HLA-A1 supermotif-bearing peptides listed in Table VII, as these residues are a subset of the A1 supermotif primary anchors.

III.D.11. HLA-A*0201 motif

An HLA-A2*0201 motif was determined to be characterized by the presence in peptide ligands of L or M as a primary anchor residue in position 2, and L or V as a primary anchor residue at the C-terminal position of a 9-residue peptide (*see, e.g.*, Falk *et al.*, *Nature* 351:290-296, 1991) and was further found to comprise an I at position 2 and I or A at the C-terminal position of a nine amino acid peptide (*see, e.g.*, Hunt *et al.*, Science 255:1261-1263, March 6, 1992; Parker *et al.*, *J. Immunol.* 149:3580-3587, 1992). The A*0201 allele-specific motif has also been defined by the present inventors to additionally comprise V, A, T, or Q as a primary anchor residue at position 2, and M or T as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, Kast *et al.*, *J. Immunol.* 152:3904-3912, 1994). Thus, the HLA-A*0201 motif comprises peptide ligands with L, I, V, M, A, T, or Q as primary anchor residues at position 2 and L, I, V, M, A, or T as a primary anchor residue at the C-terminal position of the epitope. The preferred and tolerated residues that characterize the primary anchor positions of the HLA-A*0201 motif

are identical to the residues describing the A2 supermotif. (For reviews of relevant data, *see, e.g.*, Del Guercio *et al.*, *J. Immunol.* 154:685-693, 1995; Ruppert *et al.*, *Cell* 74:929-937, 1993; Sidney *et al.*, *Immunol. Today* 17:261-266, 1996; Sette and Sidney, *Curr. Opin. in Immunol.* 10:478-482, 1998). Secondary anchor residues that characterize the A*0201 motif have additionally been defined (*see, e.g.*, Ruppert *et al.*, *Cell* 74:929-937, 1993). These are shown in Table II. Peptide binding to HLA-A*0201 molecules can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the motif.

Representative peptide epitopes that comprise an A*0201 motif are set forth in Table VIII. The A*0201 motifs comprising the primary anchor residues V, A, T, or Q at position 2 and L, I, V, A, or T at the C-terminal position are those most particularly relevant to the invention claimed herein.

III.D.12. HLA-A3 motif

The HLA-A3 motif is characterized by the presence in peptide ligands of L, M, V, I, S, A, T, F, C, G, or D as a primary anchor residue at position 2, and the presence of K, Y, R, H, F, or A as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, DiBrino *et al.*, *Proc. Natl. Acad. Sci USA* 90:1508, 1993; and Kubo *et al.*, *J. Immunol.* 152:3913-3924, 1994). Peptide binding to HLA-A3 can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the motif.

Representative peptide epitopes that comprise the A3 motif are set forth in Table XVI. Those epitopes that also comprise the A3 supermotif are also listed in Table IX. The A3 supermotif primary anchor residues comprise a subset of the A3- and A11-allele specific motif primary anchor residues.

III.D.13. HLA-A11 motif

The HLA-A11 motif is characterized by the presence in peptide ligands of V, T, M, L, I, S, A, G, N, C, D, or F as a primary anchor residue in position 2, and K, R, Y, or H as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, Zhang *et al.*, *Proc. Natl. Acad. Sci USA* 90:2217-2221, 1993; and Kubo *et al.*, *J. Immunol.* 152:3913-3924, 1994). Peptide binding to HLA-A11 can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the motif.

Representative peptide epitopes that comprise the A11 motif are set forth in Table XVII; peptide epitopes comprising the A3 allele-specific motif are also present in this Table because of the extensive overlap between the A3 and A11 motif primary anchor specificities. Further, those peptide epitopes that comprise the A3 supermotif are also listed in Table IX.

III.D.14. HLA-A24 motif

The HLA-A24 motif is characterized by the presence in peptide ligands of Y, F, W, or M as a primary anchor residue in position 2, and F, L, I, or W as a primary anchor residue at the C-terminal position of the epitope (*see, e.g.*, *Kondo et al.*, *J. Immunol.* 155:4307-4312, 1995; and Kubo *et al.*, *J. Immunol.* 152:3913-3924, 1994). Peptide binding to HLA-A24 molecules can be modulated by

substitutions at primary and/or secondary anchor positions; preferably choosing respective residues specified for the motif.

Representative peptide epitopes that comprise the A24 motif are set forth in Table XVIII. These epitopes are also listed in Table X, which sets forth HLA-A24-supermotif-bearing peptides, as the primary anchor residues characterizing the A24 allele-specific motif comprise a subset of the A24 supermotif primary anchor residues.

Motifs Indicative of Class II HTL Inducing Peptide Epitopes

The primary and secondary anchor residues of the HLA class II peptide epitope supermotifs and motifs delineated below are summarized in Table III.

III.D.15. HLA DR-1-4-7 supermotif

Motifs have also been identified for peptides that bind to three common HLA class II allele-specific HLA molecules: HLA DRB1*0401, DRB1*0101, and DRB1*0701 (*see, e.g.*, the review by Southwood *et al. J. Immunology* 160:3363-3373,1998). Collectively, the common residues from these motifs delineate the HLA DR-1-4-7 supermotif. Peptides that bind to these DR molecules carry a supermotif characterized by a large aromatic or hydrophobic residue (Y, F, W, L, I, V, or M) as a primary anchor residue in position 1, and a small, non-charged residue (S, T, C, A, P, V, I, L, or M) as a primary anchor residue in position 6 of a 9-mer core region. Allele-specific secondary effects and secondary anchors for each of these HLA types have also been identified (Southwood *et al., supra*). These are set forth in Table III. Peptide binding to HLA- DRB1*0401, DRB1*0101, and/or DRB1*0701 can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the supermotif.

Representative 9-mer epitopes comprising the DR-1-4-7 supermotif, wherein position 1 of the supermotif is at position 1 of the nine-residue core, are set forth in Table XIX. Exemplary epitopes of 15 amino acids in length that comprises the nine residue core include the three residues on either side that flank the nine residue core. HTL epitopes that comprise the core sequences can also be of lengths other than 15 amino acids, *supra*. Accordingly, epitopes of the invention include sequnces that typically comprise the nine residue core plus 1, 2, 3 (as in the exemplary 15-mer), 4, or 5 flanking residues on either side of the nine residue core.

III.D.16. HLA DR3 motifs

Two alternative motifs (*i.e.*, submotifs) characterize peptide epitopes that bind to HLA-DR3 molecules (*see, e.g.*, Geluk *et al.*, *J. Immunol.* 152:5742, 1994). In the first motif (submotif DR3A) a large, hydrophobic residue (L, I, V, M, F, or Y) is present in anchor position 1 of a 9-mer core, and D is present as an anchor at position 4, towards the carboxyl terminus of the epitope. As in other class II motifs, core position 1 may or may not occupy the peptide N-terminal position.

The alternative DR3 submotif provides for lack of the large, hydrophobic residue at anchor position 1, and/or lack of the negatively charged or amide-like anchor residue at position 4, by the presence of a positive charge at position 6 towards the carboxyl terminus of the epitope. Thus, for the

alternative allele-specific DR3 motif (submotif DR3B): L, I, V, M, F, Y, A, or Y is present at anchor position 1; D, N, Q, E, S, or T is present at anchor position 4; and K, R, or H is present at anchor position 6. Peptide binding to HLA-DR3 can be modulated by substitutions at primary and/or secondary anchor positions, preferably choosing respective residues specified for the motif.

Representative 9-mer epitopes corresponding to a nine residue sequence comprising the DR3a and DR3b submotifs (wherein position 1 of the motif is at position 1 of the nine residue core) are set forth in Table XXa and b. Exemplary epitopes of 15 amino acids in length that comprises the nine residue core include the three residues on either side that flank the nine residue core. HTL epitopes that comprises the cores sequences can also be of lengths other than 15 amino acids, *supra*. Accordingly, epitopes of the invention include sequnces that typically comprise the nine residue core plus 1, 2, 3 (as in the exemplary 15-mer), 4, or 5 flanking residues on either side of the nine residue core..

Each of the HLA class I or class II epitopes set out in the Tables herein are deemed singly to be an inventive aspect of this application. Further, it is also an inventive aspect of this application that each epitope may be used in combination with any other epitope.

III.E. Enhancing Population Coverage of the Vaccine

Vaccines that have broad population coverage are preferred because they are more commercially viable and generally applicable to the most people. Broad population coverage can be obtained using the peptides of the invention (and nucleic acid compositions that encode such peptides) through selecting peptide epitopes that bind to HLA alleles which, when considered in total, are present in most of the population. The Table below lists the overall frequencies of the HLA class I supertypes in various ethnicities (section a) and the combined population coverage achieved by the A2-, A3-, and B7-supertypes (section b). The A2-, A3-, and B7 supertypes are each present on the average of over 40% in each of these five major ethnic groups. Coverage in excess of 80% is achieved with a combination of these supermotifs. These results suggest that effective and non-ethnically biased population coverage is achieved upon use of a limited number of cross-reactive peptides. Although the population coverage reached with these three main peptide specificities is high, coverage can be expanded to reach 95% population coverage and above, and more easily achieve truly multispecific responses upon use of additional supermotif or allele-specific motif bearing peptides.

The B44-, A1-, and A24-supertypes are each present, on average, in a range from 25% to 40% in these major ethnic populations (section a). While less prevalent overall, the B27-, B58-, and B62 supertypes are each present with a frequency >25% in at least one major ethnic group (section a). In section b, the Table summarizes the estimated prevalence of combinations of HLA supertypes that have been identified in five major ethnic groups. The incremental coverage obtained by the inclusion of A1,- A24-, and B44-supertypes to the A2, A3, and B7 coverage and coverage obtained with all of the supertypes described herein, is shown.

The data presented herein, together with the previous definition of the A2-, A3-, and B7-supertypes, indicates that all antigens, with the possible exception of A29, B8, and B46, can be classified into a total of nine HLA supertypes. By including epitopes from the six most frequent supertypes, an average population coverage of 99% is obtained for five major ethnic groups.

Population coverage with combined HLA Supertypes

HLA-SUPERTYPES	PHENOTYPIC FREQUENCY					
	Caucasian	North American Black	Japanese	Chinese	Hispanic	Average
a. Individual Supertypes						
A2	45.8	39.0	42.4	45.9	43.0	43.2
A3	37.5	42.1	45.8	52.7	43.1	44.2
B7	43.2	55.1	57.1	43.0	49.3	49.5
A1	47.1	16.1	21.8	14.7	26.3	25.2
A24	23.9	38.9	58.6	40.1	38.3	40.0
B44	43.0	21.2	42.9	39.1	39.0	37.0
B27	28.4	26.1	13.3	13.9	35.3	23.4
B62	12.6	4.8	36.5	25.4	11.1	18.1
B58	10.0	25.1	1.6	9.0	5.9	10.3
b. Combined Supertypes						
A2, A3, B7	84.3	86.8	89.5	89.8	86.8	87.4
A2, A3, B7, A24, B44, A1	99.5	98.1	100.0	99.5	99.4	99.3
A2, A3, B7, A24, B44, A1, B27, B62, B58	99.9	99.6	100.0	99.8	99.9	99.8

III.F. Immune Response-Stimulating Peptide Analogs

In general, CTL and HTL responses to whole antigens are not directed against all possible epitopes. Rather, they are restricted to a few "immunodominant" determinants (Zinkernagel, *et al., Adv. Immunol.* 27:5159, 1979; Bennink, *et al., J. Exp. Med.* 168:19351939, 1988; Rawle, *et al., J. Immunol.* 146:3977-3984, 1991). It has been recognized that immunodominance (Benacerraf, *et al., Science* 175:273-279, 1972) could be explained by either the ability of a given epitope to selectively bind a particular HLA protein (determinant selection theory) (Vitiello, *et al., J. Immunol.* 131:1635, 1983); Rosenthal, *et al., Nature* 267:156-158, 1977), or to be selectively recognized by the existing TCR (T cell receptor) specificities (repertoire theory) (Klein, J., IMMUNOLOGY, THE SCIENCE OF SELFNONSELF DISCRIMINATION, John Wiley & Sons, New York, pp. 270-310, 1982). It has been demonstrated that additional factors, mostly linked to processing events, can also play a key role in dictating, beyond strict immunogenicity, which of the many potential determinants will be presented as immunodominant (Sercarz, *et al., Annu. Rev. Immunol.* 11:729-766, 1993).

The concept of dominance and subdominance is relevant to immunotherapy of both infectious diseases and cancer. For example, in the course of chronic viral disease, recruitment of subdominant epitopes can be important for successful clearance of the infection, especially if dominant CTL or HTL specificities have been inactivated by functional tolerance, suppression, mutation of viruses and other mechanisms (Franco, *et al., Curr. Opin. Immunol.* 7:524-531, 1995). In the case of cancer and tumor antigens, CTLs recognizing at least some of the highest binding affinity peptides might be functionally inactivated. Lower binding affinity peptides are preferentially recognized at these times, and may therefore be preferred in therapeutic or prophylactic anti-cancer vaccines.

In particular, it has been noted that a significant number of epitopes derived from known non-viral tumor associated antigens (TAA) bind HLA class I with intermediate affinity (IC_{50} in the 50-500

nM range). For example, it has been found that 8 of 15 known TAA peptides recognized by tumor infiltrating lymphocytes (TIL) or CTL bound in the 50-500 nM range. (These data are in contrast with estimates that 90% of known viral antigens were bound by HLA class I molecules with IC_{50} of 50 nM or less, while only approximately 10% bound in the 50-500 nM range (Sette, *et al., J. Immunol.*, 153:558-5592, 1994). In the cancer setting this phenomenon is probably due to elimination or functional inhibition of the CTL recognizing several of the highest binding peptides, presumably because of T cell tolerization events.

Without intending to be bound by theory, it is believed that because T cells to dominant epitopes may have been clonally deleted, selecting subdominant epitopes may allow existing T cells to be recruited, which will then lead to a therapeutic or prophylactic response. However, the binding of HLA molecules to subdominant epitopes is often less vigorous than to dominant ones. Accordingly, there is a need to be able to modulate the binding affinity of particular immunogenic epitopes for one or more HLA molecules, and thereby to modulate the immune response elicited by the peptide, for example to prepare analog peptides which elicit a more vigorous response. This ability would greatly enhance the usefulness of peptide epitope-based vaccines and therapeutic agents.

Although peptides with suitable cross-reactivity among all alleles of a superfamily are identified by the screening procedures described above, cross-reactivity is not always as complete as possible, and in certain cases procedures to increase cross-reactivity of peptides can be useful; moreover, such procedures can also be used to modify other properties of the peptides such as binding affinity or peptide stability. Having established the general rules that govern cross-reactivity of peptides for HLA alleles within a given motif or supermotif, modification (*i.e.*, analoging) of the structure of peptides of particular interest in order to achieve broader (or otherwise modified) HLA binding capacity can be performed. More specifically, peptides which exhibit the broadest cross-reactivity patterns, can be produced in accordance with the teachings herein. The present concepts related to analog generation are set forth in greater detail in related inventor-derived previously disclosed subject matter.

In brief, the strategy employed utilizes the motifs or supermotifs which correlate with binding to certain HLA molecules. The motifs or supermotifs are defined by having primary anchors, and in many cases secondary anchors. Analog peptides can be created by substituting amino acid residues at primary anchor, secondary anchor, or at primary and secondary anchor positions. Generally, analogs are made for peptides that already bear a motif or supermotif. Preferred secondary anchor residues of supermotifs and motifs that have been defined for HLA class I and class II binding peptides are shown in Tables II and III, respectively.

For a number of the motifs or supermotifs in accordance with the invention, residues are defined which are deleterious to binding to allele-specific HLA molecules or members of HLA supertypes that bind the respective motif or supermotif (Tables II and III). Accordingly, removal of such residues that are detrimental to binding can be performed in accordance with the present invention. For example, in the case of the A3 supertype, when all peptides that have such deleterious residues are removed from the population of peptides used in the analysis, the incidence of cross-reactivity increased from 22% to 37% (*see, e.g.*, Sidney, J. *et al.*, *Hu. Immunol.* 45:79, 1996). Thus, one strategy to improve the cross-reactivity of peptides within a given supermotif is simply to delete one or more of the deleterious residues present

within a peptide and substitute a small "neutral" residue such as Ala (that may not influence T cell recognition of the peptide). An enhanced likelihood of cross-reactivity is expected if, together with elimination of detrimental residues within a peptide, "preferred" residues associated with high affinity binding to an allele-specific HLA molecule or to multiple HLA molecules within a superfamily are inserted.

To ensure that an analog peptide, when used as a vaccine, actually elicits a CTL response to the native epitope *in vivo* (or, in the case of class II epitopes, elicits helper T cells that cross-react with the wild type peptides), the analog peptide may be used to immunize T cells *in vitro* from individuals of the appropriate HLA allele. Thereafter, the immunized cells' capacity to induce lysis of wild type peptide sensitized target cells is evaluated. It will be desirable to use as antigen presenting cells, cells that have been either infected, or transfected with the appropriate genes, or, in the case of class II epitopes only, cells that have been pulsed with whole protein antigens, to establish whether endogenously produced antigen is also recognized by the relevant T cells.

Another embodiment of the invention is to create analogs of weak binding peptides, to thereby ensure adequate numbers of cross-reactive cellular binders. Class I binding peptides exhibiting binding affinities of 500-5000 nM, and carrying an acceptable but suboptimal primary anchor residue at one or both positions can be "fixed" by substituting preferred anchor residues in accordance with the respective supertype. The analog peptides can then be tested for crossbinding activity.

Another embodiment for generating effective peptide analogs involves the substitution of residues that have an adverse impact on peptide stability or solubility in, *e.g.*, a liquid environment. This substitution may occur at any position of the peptide epitope. For example, a cysteine (C) can be substituted out in favor of α-amino butyric acid. Due to its chemical nature, cysteine has the propensity to form disulfide bridges and sufficiently alter the peptide structurally so as to reduce binding capacity. Substituting α-amino butyric acid for C not only alleviates this problem, but actually improves binding and crossbinding capability in certain instances (*see, e.g.*, the review by Sette *et al.*, In: Persistent Viral Infections, Eds. R. Ahmed and I. Chen, John Wiley & Sons, England, 1999). Substitution of cysteine with α-amino butyric acid may occur at any residue of a peptide epitope, *i.e.* at either anchor or non-anchor positions.

III.G. Computer Screening of Protein Sequences from Disease-Related Antigens for Supermotif- or Motif-Bearing Peptides

In order to identify supermotif- or motif-bearing epitopes in a target antigen, a native protein sequence, *e.g.*, a tumor-associated antigen, or sequences from an infectious organism, or a donor tissue for transplantation, is screened using a means for computing, such as an intellectual calculation or a computer, to determine the presence of a supermotif or motif within the sequence. The information obtained from the analysis of native peptide can be used directly to evaluate the status of the native peptide or may be utilized subsequently to generate the peptide epitope.

Computer programs that allow the rapid screening of protein sequences for the occurrence of the subject supermotifs or motifs are encompassed by the present invention; as are programs that permit the generation of analog peptides. These programs are implemented to analyze any identified amino acid sequence or operate on an unknown sequence and simultaneously determine the sequence and identify

motif-bearing epitopes thereof; analogs can be simultaneously determined as well. Generally, the identified sequences will be from a pathogenic organism or a tumor-associated peptide. For example, the target molecules considered herein include, without limitation, the E1, E2, E4, E5a, E5b, E6, E7, L1 and L2 proteins of HPV.

In cases where the sequences of multiple variants of the same target protein are available, potential peptide epitopes can also be selected on the basis of their conservancy. For example, a criterion for conservancy may define that the entire sequence of an HLA class I binding peptide or the entire 9-mer core of a class II binding peptide, be conserved in a designated percentage, of the sequences evaluated for a specific protein antigen.

To target a broad population that may be infected with a number of different strains, it is preferable to include in vaccine compositions epitopes that are representative of HPV antigen sequences from different HPV strains. As appreciated by those in the art, regions with greater or lessor degrees of conservancy among HPv strains can be employed as appropriate for a given antigenic target.

It is important that the selection criteria utilized for prediction of peptide binding are as accurate as possible, to correlate most efficiently with actual binding. Prediction of peptides that bind, for example, to HLA-A*0201, on the basis of the presence of the appropriate primary anchors, is positive at about a 30% rate (*see, e.g.*, Ruppert, J. *et al. Cell* 74:929, 1993). However, by extensively analyzing peptide-HLA binding data disclosed herein, data in related patent applications, and data in the art, the present inventors have developed a number of allele-specific polynomial algorithms that dramatically increase the predictive value over identification on the basis of the presence of primary anchor residues alone. These algorithms take into account not only the presence or absence of primary anchors, but also consider the positive or deleterious presence of secondary anchor residues (to account for the impact of different amino acids at different positions). The algorithms are essentially based on the premise that the overall affinity (or ΔG) of peptide-HLA interactions can be approximated as a linear polynomial function of the type:

$$\Delta G = a_{1i} \times a_{2i} \times a_{3i} \ldots \times a_{ni}$$

where a_{ji} is a coefficient that represents the effect of the presence of a given amino acid (j) at a given position (i) along the sequence of a peptide of n amino acids. An important assumption of this method is that the effects at each position are essentially independent of each other. This assumption is justified by studies that demonstrated that peptides are bound to HLA molecules and recognized by T cells in essentially an extended conformation. Derivation of specific algorithm coefficients has been described, for example, in Gulukota, K. *et al., J. Mol. Biol.* 267:1258, 1997.

Additional methods to identify preferred peptide sequences, which also make use of specific motifs, include the use of neural networks and molecular modeling programs (*see, e.g.*, Milik *et al., Nature Biotechnology* 16:753, 1998; Altuvia *et al., Hum. Immunol.* 58:1, 1997; Altuvia *et al, J. Mol. Biol.* 249:244, 1995; Buus, S. *Curr. Opin. Immunol.* 11:209-213, 1999; Brusic, V. *et al., Bioinformatics* 14:121-130, 1998; Parker *et al., J. Immunol.* 152:163, 1993; Meister *et al., Vaccine* 13:581, 1995; Hammer *et al., J. Exp. Med.* 180:2353, 1994; Sturniolo *et al., Nature Biotechnol.* 17:555 1999).

For example, it has been shown that in sets of A*0201 motif-bearing peptides containing at least one preferred secondary anchor residue while avoiding the presence of any deleterious secondary

anchor residues, 69% of the peptides will bind A*0201 with an IC_{50} less than 500 nM (Ruppert, J. *et al. Cell* 74:929, 1993). These algorithms are also flexible in that cut-off scores may be adjusted to select sets of peptides with greater or lower predicted binding properties, as desired.

In utilizing computer screening to identify peptide epitopes, a protein sequence or translated sequence may be analyzed using software developed to search for motifs, for example the "FINDPATTERNS' program (Devereux, *et al. Nucl. Acids Res.* 12:387-395, 1984) or MotifSearch 1.4 software program (D. Brown, San Diego, CA) to identify potential peptide sequences containing appropriate HLA binding motifs. The identified peptides can be scored using customized polynomial algorithms to predict their capacity to bind specific HLA class I or class II alleles. As appreciated by one of ordinary skill in the art, a large array of computer programming software and hardware options are available in the relevant art which can be employed to implement the motifs of the invention in order to evaluate (*e.g.*, without limitation, to identify epitopes, identify epitope concentration per peptide length, or to generate analogs) known or unknown peptide sequences.

In accordance with the procedures described above, HPV peptide epitopes that are able to bind HLA supertype groups or allele-specific HLA molecules have been identified (Tables VII-XX).

III.H. Preparation of Peptide Epitopes

Peptides in accordance with the invention can be prepared synthetically, by recombinant DNA technology or chemical synthesis, or from natural sources such as native tumors or pathogenic organisms. Peptide epitopes may be synthesized individually or as polyepitopic peptides. Although the peptide will preferably be substantially free of other naturally occurring host cell proteins and fragments thereof, in some embodiments the peptides may be synthetically conjugated to native fragments or particles.

The peptides in accordance with the invention can be a variety of lengths, and either in their neutral (uncharged) forms or in forms which are salts. The peptides in accordance with the invention are either free of modifications such as glycosylation, side chain oxidation, or phosphorylation; or they contain these modifications, subject to the condition that modifications do not destroy the biological activity of the peptides as described herein.

When possible, it may be desirable to optimize HLA class I binding epitopes of the invention, such as can be used in a polyepitopic construct, to a length of about 8 to about 13 amino acid residues, often 8 to 11, preferably 9 to 10. HLA class II binding peptide epitopes of the invention may be optimized to a length of about 6 to about 30 amino acids in length, preferably to between about 13 and about 20 residues. Preferably, the peptide epitopes are commensurate in size with endogenously processed pathogen-derived peptides or tumor cell peptides that are bound to the relevant HLA molecules, however, the identification and preparation of peptides that comprise epitopes of the invention can also be carried out using the techniques described herein.

In alternative embodiments, epitopes of the invention can be linked as a polyepitopic peptide, or as a minigene that encodes a polyepitopic peptide.

In another embodiment, it is preferred to identify native peptide regions that contain a high concentration of class I and/or class II epitopes. Such a sequence is generally selected on the basis that it contains the greatest number of epitopes per amino acid length. It is to be appreciated that epitopes can

be present in a nested or overlapping manner, *e.g.* a 10 amino acid long peptide could contain two 9 amino acid long epitopes and one 10 amino acid long epitope; upon intracellular processing, each epitope can be exposed and bound by an HLA molecule upon administration of such a peptide. This larger, preferably multi-epitopic, peptide can be generated synthetically, recombinantly, or via cleavage from the native source.

The peptides of the invention can be prepared in a wide variety of ways. For the preferred relatively short size, the peptides can be synthesized in solution or on a solid support in accordance with conventional techniques. Various automatic synthesizers are commercially available and can be used in accordance with known protocols. (*See*, for example, Stewart & Young, SOLID PHASE PEPTIDE SYNTHESIS, 2D. ED., Pierce Chemical Co., 1984). Further, individual peptide epitopes can be joined using chemical ligation to produce larger peptides that are still within the bounds of the invention.

Alternatively, recombinant DNA technology can be employed wherein a nucleotide sequence which encodes an immunogenic peptide of interest is inserted into an expression vector, transformed or transfected into an appropriate host cell and cultivated under conditions suitable for expression. These procedures are generally known in the art, as described generally in Sambrook *et al.*, MOLECULAR CLONING, A LABORATORY MANUAL, Cold Spring Harbor Press, Cold Spring Harbor, New York (1989). Thus, recombinant polypeptides which comprise one or more peptide sequences of the invention can be used to present the appropriate T cell epitope.

The nucleotide coding sequence for peptide epitopes of the preferred lengths contemplated herein can be synthesized by chemical techniques, for example, the phosphotriester method of Matteucci, *et al., J. Am. Chem. Soc.* 103:3185 (1981). Peptide analogs can be made simply by substituting the appropriate and desired nucleic acid base(s) for those that encode the native peptide sequence; exemplary nucleic acid substitutions are those that encode an amino acid defined by the motifs/supermotifs herein. The coding sequence can then be provided with appropriate linkers and ligated into expression vectors commonly available in the art, and the vectors used to transform suitable hosts to produce the desired fusion protein. A number of such vectors and suitable host systems are now available. For expression of the fusion proteins, the coding sequence will be provided with operably linked start and stop codons, promoter and terminator regions and usually a replication system to provide an expression vector for expression in the desired cellular host. For example, promoter sequences compatible with bacterial hosts are provided in plasmids containing convenient restriction sites for insertion of the desired coding sequence. The resulting expression vectors are transformed into suitable bacterial hosts. Of course, yeast, insect or mammalian cell hosts may also be used, employing suitable vectors and control sequences.

III.I. Assays to Detect T-Cell Responses

Once HLA binding peptides are identified, they can be tested for the ability to elicit a T-cell response. The preparation and evaluation of motif-bearing peptides are described in PCT publications WO 94/20127 and WO 94/03205. Briefly, peptides comprising epitopes from a particular antigen are synthesized and tested for their ability to bind to the appropriate HLA proteins. These assays may involve evaluating the binding of a peptide of the invention to purified HLA class I molecules in relation to the binding of a radioiodinated reference peptide. Alternatively, cells expressing empty class I molecules (*i.e.*

lacking peptide therein) may be evaluated for peptide binding by immunofluorescent staining and flow microfluorimetry. Other assays that may be used to evaluate peptide binding include peptide-dependent class I assembly assays and/or the inhibition of CTL recognition by peptide competition. Those peptides that bind to the class I molecule, typically with an affinity of 500 nM or less, are further evaluated for their ability to serve as targets for CTLs derived from infected or immunized individuals, as well as for their capacity to induce primary *in vitro* or *in vivo* CTL responses that can give rise to CTL populations capable of reacting with selected target cells associated with a disease.

Analogous assays are used for evaluation of HLA class II binding peptides. HLA class II motif-bearing peptides that are shown to bind, typically at an affinity of 1000 nM or less, are further evaluated for the ability to stimulate HTL responses.

Conventional assays utilized to detect T cell responses include proliferation assays, lymphokine secretion assays, direct cytotoxicity assays, and limiting dilution assays. For example, antigen-presenting cells that have been incubated with a peptide can be assayed for the ability to induce CTL responses in responder cell populations. Antigen-presenting cells can be normal cells such as peripheral blood mononuclear cells or dendritic cells. Alternatively, mutant non-human mammalian cell lines that are deficient in their ability to load class I molecules with internally processed peptides and that have been transfected with the appropriate human class I gene, may be used to test for the capacity of the peptide to induce *in vitro* primary CTL responses.

Peripheral blood mononuclear cells (PBMCs) may be used as the responder cell source of CTL precursors. The appropriate antigen-presenting cells are incubated with peptide, after which the peptide-loaded antigen-presenting cells are then incubated with the responder cell population under optimized culture conditions. Positive CTL activation can be determined by assaying the culture for the presence of CTLs that kill radio-labeled target cells, both specific peptide-pulsed targets as well as target cells expressing endogenously processed forms of the antigen from which the peptide sequence was derived.

Additionally, a method has been devised which allows direct quantification of antigen-specific T cells by staining with Fluorescein-labelled HLA tetrameric complexes (Altman, J. D. *et al.*, *Proc. Natl. Acad. Sci. USA* 90:10330, 1993; Altman, J. D. *et al.*, *Science* 274:94, 1996). Other relatively recent technical developments include staining for intracellular lymphokines, and interferon release assays or ELISPOT assays. Tetramer staining, intracellular lymphokine staining and ELISPOT assays all appear to be at least 10-fold more sensitive than more conventional assays (Lalvani, A. *et al.*, *J. Exp. Med.* 186:859, 1997; Dunbar, P. R. *et al.*, *Curr. Biol.* 8:413, 1998; Murali-Krishna, K. *et al.*, *Immunity* 8:177, 1998).

HTL activation may also be assessed using such techniques known to those in the art such as T cell proliferation and secretion of lymphokines, *e.g.* IL-2 (*see*, *e.g.* Alexander *et al.*, Immunity 1:751-761, 1994).

Alternatively, immunization of HLA transgenic mice can be used to determine immunogenicity of peptide epitopes. Several transgenic mouse models including mice with human A2.1, A11 (which can additionally be used to analyze HLA-A3 epitopes), and B7 alleles have been characterized and others (*e.g.*, transgenic mice for HLA-A1 and A24) are being developed. HLA-DR1 and HLA-DR3 mouse models have also been developed. Additional transgenic mouse models with other HLA alleles may

be generated as necessary. Mice may be immunized with peptides emulsified in Incomplete Freund's Adjuvant and the resulting T cells tested for their capacity to recognize peptide-pulsed target cells and target cells transfected with appropriate genes. CTL responses may be analyzed using cytotoxicity assays described above. Similarly, HTL responses may be analyzed using such assays as T cell proliferation or secretion of lymphokines.

III.J. Use of Peptide Epitopes as Diagnostic Agents and for Evaluating Immune Responses

In one aspect of the invention, HLA class I and class II binding peptides as described herein can be used as reagents to evaluate an immune response. The immune response to be evaluated is induced by using as an immunogen any agent that may result in the production of antigen-specific CTLs or HTLs that recognize and bind to the peptide epitope(s) to be employed as the reagent. The peptide reagent need not be used as the immunogen. Assay systems that are used for such an analysis include relatively recent technical developments such as tetramers, staining for intracellular lymphokines and interferon release assays, or ELISPOT assays.

For example, a peptide of the invention is used in a tetramer staining assay to assess peripheral blood mononuclear cells for the presence of antigen-specific CTLs following exposure to a pathogen or immunogen. The HLA-tetrameric complex is used to directly visualize antigen-specific CTLs (*see, e.g.*, Ogg *et al.*, *Science* 279:2103-2106, 1998; and Altman *et al.*, *Science* 174:94-96, 1996) and determine the frequency of the antigen-specific CTL population in a sample of peripheral blood mononuclear cells.

A tetramer reagent using a peptide of the invention is generated as follows: A peptide that binds to an HLA molecule is refolded in the presence of the corresponding HLA heavy chain and β_2-microglobulin to generate a trimolecular complex. The complex is biotinylated at the carboxyl terminal end of the heavy chain at a site that was previously engineered into the protein. Tetramer formation is then induced by the addition of streptavidin. By means of fluorescently labeled streptavidin, the tetramer can be used to stain antigen-specific cells. The cells can then be readily identified, for example, by flow cytometry. Such procedures are used for diagnostic or prognostic purposes. Cells identified by the procedure can also be used for therapeutic purposes.

Peptides of the invention are also used as reagents to evaluate immune recall responses. (*see, e.g.*, Bertoni *et al.*, *J. Clin. Invest.* 100:503-513, 1997 and Penna *et al.*, *J. Exp. Med.* 174:1565-1570, 1991.) For example, patient PBMC samples from individuals infected with HPV are analyzed for the presence of antigen-specific CTLs or HTLs using specific peptides. A blood sample containing mononuclear cells may be evaluated by cultivating the PBMCs and stimulating the cells with a peptide of the invention. After an appropriate cultivation period, the expanded cell population may be analyzed, for example, for CTL or for HTL activity.

The peptides are also used as reagents to evaluate the efficacy of a vaccine. PBMCs obtained from a patient vaccinated with an immunogen are analyzed using, for example, either of the methods described above. The patient is HLA typed, and peptide epitope reagents that recognize the allele-specific molecules present in that patient are selected for the analysis. The immunogenicity of the vaccine is indicated by the presence of HPV epitope-specific CTLs and/or HTLs in the PBMC sample.

The peptides of the invention are also be used to make antibodies, using techniques well known in the art (see, *e.g. CURRENT PROTOCOLS IN IMMUNOLOGY*, Wiley/Greene, NY; and *Antibodies A Laboratory Manual Harlow,* Harlow and Lane, Cold Spring Harbor Laboratory Press, 1989), which may be useful as reagents to diagnose HPV infection. Such antibodies include those that recognize a peptide in the context of an HLA molecule, *i.e.*, antibodies that bind to a peptide-MHC complex.

III.K. Vaccine Compositions

Vaccines and methods of preparing vaccines that contain an immunogenically effective amount of one or more peptides as described herein are further embodiments of the invention. Once appropriately immunogenic epitopes have been defined, they can be sorted and delivered by various means, herein referred to as "vaccine" compositions. Such vaccine compositions can include, for example, lipopeptides (*e.g.*,Vitiello, A. *et al.*, *J. Clin. Invest.* 95:341, 1995), peptide compositions encapsulated in poly(DL-lactide-co-glycolide) ("PLG") microspheres (*see, e.g.*, Eldridge, *et al.*, *Molec. Immunol.* 28:287-294, 1991: Alonso *et al.*, *Vaccine* 12:299-306, 1994; Jones *et al.*, *Vaccine* 13:675-681, 1995), peptide compositions contained in immune stimulating complexes (ISCOMS) (*see, e.g.*, Takahashi *et al.*, *Nature* 344:873-875, 1990; Hu *et al.*, *Clin Exp Immunol.* 113:235-243, 1998), multiple antigen peptide systems (MAPs) (*see e.g.*, Tam, J. P., *Proc. Natl. Acad. Sci. U.S.A.* 85:5409-5413, 1988; Tam, J.P., *J. Immunol. Methods* 196:17-32, 1996), peptides formulated as multivalent peptides; peptides for use in ballistic delivery systems, typically crystallized peptides, viral delivery vectors (Perkus, M. E. *et al.*, In: *Concepts in vaccine development*, Kaufmann, S. H. E., ed., p. 379, 1996; Chakrabarti, S. *et al.*, *Nature* 320:535, 1986; Hu, S. L. *et al.*, *Nature* 320:537, 1986; Kieny, M.-P. *et al.*, *AIDS Bio/Technology* 4:790, 1986; Top, F. H. *et al.*, *J. Infect. Dis.* 124:148, 1971; Chanda, P. K. *et al.*, *Virology* 175:535, 1990), particles of viral or synthetic origin (*e.g.*, Kofler, N. *et al.*, *J. Immunol. Methods.* 192:25, 1996; Eldridge, J. H. *et al.*, *Sem. Hematol.* 30:16, 1993; Falo, L. D., Jr. *et al.*, *Nature Med.* 7:649, 1995), adjuvants (Warren, H. S., Vogel, F. R., and Chedid, L. A. *Annu. Rev. Immunol.* 4:369, 1986; Gupta, R. K. *et al.*, *Vaccine* 11:293, 1993), liposomes (Reddy, R. *et al.*, *J. Immunol.* 148:1585, 1992; Rock, K. L., *Immunol. Today* 17:131, 1996), or, naked or particle absorbed cDNA (Ulmer, J. B. *et al.*, *Science* 259:1745, 1993; Robinson, H. L., Hunt, L. A., and Webster, R. G., *Vaccine* 11:957, 1993; Shiver, J. W. *et al.*, In: *Concepts in vaccine development*, Kaufmann, S. H. E., ed., p. 423, 1996; Cease, K. B., and Berzofsky, J. A., *Annu. Rev. Immunol.* 12:923, 1994 and Eldridge, J. H. *et al.*, *Sem. Hematol.* 30:16, 1993). Toxin-targeted delivery technologies, also known as receptor mediated targeting, such as those of Avant Immunotherapeutics, Inc. (Needham, Massachusetts) may also be used.

Vaccine compositions of the invention include nucleic acid-mediated modalities. DNA or RNA encoding one or more of the peptides of the invention can also be administered to a patient. This approach is described, for instance, in Wolff *et. al.*, *Science* 247:1465 (1990) as well as U.S. Patent Nos. 5,580,859; 5,589,466; 5,804,566; 5,739,118; 5,736,524; 5,679,647; WO 98/04720; and in more detail below. Examples of DNA-based delivery technologies include "naked DNA", facilitated (bupivicaine, polymers, peptide-mediated) delivery, cationic lipid complexes, and particle-mediated ("gene gun") or pressure-mediated delivery (*see, e.g.*, U.S. Patent No. 5,922,687).

For therapeutic or prophylactic immunization purposes, the peptides of the invention can be expressed by viral or bacterial vectors. Examples of expression vectors include attenuated viral hosts, such as vaccinia or fowlpox. This approach involves the use of vaccinia virus, for example, as a vector to express nucleotide sequences that encode the peptides of the invention. Upon introduction into an acutely or chronically infected host or into a non-infected host, the recombinant vaccinia virus expresses the immunogenic peptide, and thereby elicits a host CTL and/or HTL response. Vaccinia vectors and methods useful in immunization protocols are described in, *e.g.*, U.S. Patent No. 4,722,848. Another vector is BCG (Bacille Calmette Guerin). BCG vectors are described in Stover *et al.*, *Nature* 351:456-460 (1991). A wide variety of other vectors useful for therapeutic administration or immunization of the peptides of the invention, *e.g.* adeno and adeno-associated virus vectors, retroviral vectors, *Salmonella typhi* vectors, detoxified anthrax toxin vectors, and the like, will be apparent to those skilled in the art from the description herein.

Furthermore, vaccines in accordance with the invention encompass compositions of one or more of the claimed peptides. A peptide can be present in a vaccine individually. Alternatively, the peptide can exist as a homopolymer comprising multiple copies of the same peptide, or as a heteropolymer of various peptides. Polymers have the advantage of increased immunological reaction and, where different peptide epitopes are used to make up the polymer, the additional ability to induce antibodies and/or CTLs that react with different antigenic determinants of the pathogenic organism or tumor-related peptide targeted for an immune response. The composition can be a naturally occurring region of an antigen or can be prepared, *e.g.*, recombinantly or by chemical synthesis.

Carriers that can be used with vaccines of the invention are well known in the art, and include, *e.g.*, thyroglobulin, albumins such as human serum albumin, tetanus toxoid, polyamino acids such as poly L-lysine, poly L-glutamic acid, influenza, hepatitis B virus core protein, and the like. The vaccines can contain a physiologically tolerable (*i.e.*, acceptable) diluent such as water, or saline, preferably phosphate buffered saline. The vaccines also typically include an adjuvant. Adjuvants such as incomplete Freund's adjuvant, aluminum phosphate, aluminum hydroxide, or alum are examples of materials well known in the art. Additionally, as disclosed herein, CTL responses can be primed by conjugating peptides of the invention to lipids, such as tripalmitoyl-S-glycerylcysteinlyseryl- serine (P_3CSS).

Upon immunization with a peptide composition in accordance with the invention, via injection, aerosol, oral, transdermal, transmucosal, intrapleural, intrathecal, or other suitable routes, the immune system of the host responds to the vaccine by producing large amounts of CTLs and/or HTLs specific for the desired antigen. Consequently, the host becomes at least partially immune to later infection, or at least partially resistant to developing an ongoing chronic infection, or derives at least some therapeutic benefit when the antigen was tumor-associated.

In some embodiments, it may be desirable to combine the class I peptide components with components that induce or facilitate neutralizing antibody and or helper T cell responses to the target antigen of interest. A preferred embodiment of such a composition comprises class I and class II epitopes in accordance with the invention. An alternative embodiment of such a composition comprises a class I and/or class II epitope in accordance with the invention, along with a cross reactive HTL epitope such as PADRE™ (Epimmune, San Diego, CA) molecule(described *e.g.*, in U.S. Patent Number 5,736,142).

A vaccine of the invention can also include antigen-presenting cells (APC), such as dendritic cells (DC), as a vehicle to present peptides of the invention. Vaccine compositions can be created *in vitro*, following dendritic cell mobilization and harvesting, whereby loading of dendritic cells occurs *in vitro*. For example, dendritic cells are transfected, *e.g.*, with a minigene in accordance with the invention, or are pulsed with peptides. The dendritic cell can then be administered to a patient to elicit immune responses *in vivo*.

Vaccine compositions, either DNA- or peptide-based, can also be administered *in vivo* in combination with dendritic cell mobilization whereby loading of dendritic cells occurs *in vivo*.

Antigenic peptides are used to elicit a CTL and/or HTL response *ex vivo*, as well. The resulting CTL or HTL cells, can be used to treat chronic infections, or tumors in patients that do not respond to other conventional forms of therapy, or will not respond to a therapeutic vaccine peptide or nucleic acid in accordance with the invention. *Ex vivo* CTL or HTL responses to a particular antigen (infectious or tumor-associated antigen) are induced by incubating in tissue culture the patient's, or genetically compatible, CTL or HTL precursor cells together with a source of antigen-presenting cells (APC), such as dendritic cells, and the appropriate immunogenic peptide. After an appropriate incubation time (typically about 7-28 days), in which the precursor cells are activated and expanded into effector cells, the cells are infused back into the patient, where they will destroy (CTL) or facilitate destruction (HTL) of their specific target cell (an infected cell or a tumor cell). Transfected dendritic cells may also be used as antigen presenting cells.

The vaccine compositions of the invention may also be used in combination with other procedures to remove warts or treat HPV infections. Such procedures include cryosurgery, application of caustic agents, electrodessication, surgical excision and laser ablation (Fauci et al. HARRISON'S PRINCIPLES OF INTERNAL MEDICINE, 14th ED., McGraw-Hill Co., Inc, 1998), as well as treatment with antiviral drugs such as interferon-α (see, e.g., Stellato, G., et al., Clin. Diagn. Virol. 7(3):167-72 (1997)) or interferon-inducing drugs such as imiquimod. Topical antimetabolites such a 5-fluorouracil may also be applied.

In patients with HPV-associated cancer, the vaccine compositions of the invention can also be used in conjunction with other treatments used for cancer, *e.g.*, surgery, chemotherapy, drug therapies, radiation therapies, *etc.* including use in combination with immune adjuvants such as IL-2, IL-12, GM-CSF, and the like.

Preferably, the following principles are utilized when selecting an array of epitopes for inclusion in a polyepitopic composition for use in a vaccine, or for selecting discrete epitopes to be included in a vaccine and/or to be encoded by nucleic acids such as a minigene. It is preferred that each of the following principles are balanced in order to make the selection. The multiple epitopes to be incorporated in a given vaccine composition may be, but need not be, contiguous in sequence in the native antigen from which the epitopes are derived.

1.) Epitopes are selected which, upon administration, mimic immune responses that have been observed to be correlated with clearance of HPV infection or tumor clearance. For HLA Class I this includes 3-4 epitopes that come from at least one TAA. For HLA Class II a similar rationale is employed; again 3-4 epitopes are selected from at least one TAA (*see*, *e.g.*, Rosenberg *et al.*, *Science*

278:1447-1450). Epitopes from one TAA may be used in combination with epitopes from one or more additional TAAs to produce a vaccine that targets tumors with varying expression patterns of frequently-expressed TAAs as described, *e.g.*, in Example 15.

2.) Epitopes are selected that have the requisite binding affinity established to be correlated with immunogenicity: for HLA Class I an IC_{50} of 500 nM or less, often 200 nM or less; and for Class II an IC_{50} of 1000 nM or less.

3.) Sufficient supermotif bearing-peptides, or a sufficient array of allele-specific motif-bearing peptides, are selected to give broad population coverage. For example, it is preferable to have at least 80% population coverage. A Monte Carlo analysis, a statistical evaluation known in the art, can be employed to assess the breadth, or redundancy of, population coverage.

4.) When selecting epitopes from cancer-related antigens it is often useful to select analogs because the patient may have developed tolerance to the native epitope. When selecting epitopes for infectious disease-related antigens it is preferable to select either native or analoged epitopes.

5.) Of particular relevance are epitopes referred to as "nested epitopes." Nested epitopes occur where at least two epitopes overlap in a given peptide sequence. A nested peptide sequence can comprise both HLA class I and HLA class II epitopes. When providing nested epitopes, a general objective is to provide the greatest number of epitopes per sequence. Thus, an aspect is to avoid providing a peptide that is any longer than the amino terminus of the amino terminal epitope and the carboxyl terminus of the carboxyl terminal epitope in the peptide. When providing a multi-epitopic sequence, such as a sequence comprising nested epitopes, it is generally important to screen the sequence in order to insure that it does not have pathological or other deleterious biological properties.

6.) If a polyepitopic protein is created, or when creating a minigene, an objective is to generate the smallest peptide that encompasses the epitopes of interest. This principle is similar, if not the same as that employed when selecting a peptide comprising nested epitopes. However, with an artificial polyepitopic peptide, the size minimization objective is balanced against the need to integrate any spacer sequences between epitopes in the polyepitopic protein. Spacer amino acid residues can, for example, be introduced to avoid junctional epitopes (an epitope recognized by the immune system, not present in the target antigen, and only created by the man-made juxtaposition of epitopes), or to facilitate cleavage between epitopes and thereby enhance epitope presentation. Junctional epitopes are generally to be avoided because the recipient may generate an immune response to that non-native epitope. Of particular concern is a junctional epitope that is a "dominant epitope." A dominant epitope may lead to such a zealous response that immune responses to other epitopes are diminished or suppressed.

7.) In cases where the sequences of multiple variants of the same target protein are available, potential peptide epitopes can also be selected on the basis of their conservancy. For example, a criterion for conservancy may define that the entire sequence of an HLA class I binding peptide or the entire 9-mer core of a class II binding peptide be conserved in a designated percentage of the sequences evaluated for a specific protein antigen.

8.) When selecting an array of epitopes of an infectious agent, it is preferred that at least some of the epitopes are derived from early and late proteins. The early proteins of HPV are expressed when the virus is replicating, either following acute or dormant infection. Therefore, it is

particularly preferred to use epitopes from early stage proteins to alleviate disease manifestations at the earliest stage possible.

III.K.1. Minigene Vaccines

A number of different approaches are available which allow simultaneous delivery of multiple epitopes. Nucleic acids encoding the peptides of the invention are a particularly useful embodiment of the invention. Epitopes for inclusion in a minigene are preferably selected according to the guidelines set forth in the previous section. A preferred means of administering nucleic acids encoding the peptides of the invention uses minigene constructs encoding a peptide comprising one or multiple epitopes of the invention.

The use of multi-epitope minigenes is described below and in, *e.g.*, Ishioka *et al.*, *J. Immunol.* 162:3915-3925, 1999; An, L. and Whitton, J. L., *J. Virol.* 71:2292, 1997; Thomson, S. A. *et al.*, *J. Immunol.* 157:822, 1996; Whitton, J. L. *et al.*, *J. Virol.* 67:348, 1993; Hanke, R. *et al.*, *Vaccine* 16:426, 1998. For example, a multi-epitope DNA plasmid encoding supermotif- and/or motif-bearing epitopes derived from multiple regions of one or more HPV antigens, the PADRE universal helper T cell epitope (or multiple HTL epitopes from HPV antigens), and an endoplasmic reticulum-translocating signal sequence can be engineered. A vaccine may also comprise epitopes that are derived from other TAAs.

The immunogenicity of a multi-epitopic minigene can be tested in transgenic mice to evaluate the magnitude of CTL induction responses against the epitopes tested. Further, the immunogenicity of DNA-encoded epitopes *in vivo* can be correlated with the *in vitro* responses of specific CTL lines against target cells transfected with the DNA plasmid. Thus, these experiments can show that the minigene serves to both: 1.) generate a CTL response and 2.) that the induced CTLs recognized cells expressing the encoded epitopes.

For example, to create a DNA sequence encoding the selected epitopes (minigene) for expression in human cells, the amino acid sequences of the epitopes may be reverse translated. A human codon usage table can be used to guide the codon choice for each amino acid. These epitope-encoding DNA sequences may be directly adjoined, so that when translated, a continuous polypeptide sequence is created. To optimize expression and/or immunogenicity, additional elements can be incorporated into the minigene design. Examples of amino acid sequences that can be reverse translated and included in the minigene sequence include: HLA class I epitopes, HLA class II epitopes, a ubiquitination signal sequence, and/or an endoplasmic reticulum targeting signal. In addition, HLA presentation of CTL and HTL epitopes may be improved by including synthetic (*e.g.* poly-alanine) or naturally-occurring flanking sequences adjacent to the CTL or HTL epitopes; these larger peptides comprising the epitope(s) are within the scope of the invention.

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

Standard regulatory sequences well known to those of skill in the art are preferably included in the vector to ensure expression in the target cells. Several vector elements are desirable: 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, *e.g.*, U.S. Patent Nos. 5,580,859 and 5,589,466 for other suitable promoter sequences.

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 and sequences for replication in mammalian cells may also be considered for increasing minigene expression.

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.

In addition, immunostimulatory sequences (ISSs or CpGs) appear to play a role in the immunogenicity of DNA vaccines. These sequences may be included in the vector, outside the minigene coding sequence, if desired to enhance immunogenicity.

In some embodiments, a bi-cistronic expression vector which allows production of both 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.*, IL-2, IL-12, GM-CSF), cytokine-inducing molecules (*e.g.*, LeIF), costimulatory molecules, or for HTL responses, pan-DR binding proteins (PADRE™, Epimmune, San Diego, CA). Helper (HTL) epitopes can be joined to intracellular targeting signals and expressed separately from expressed CTL epitopes; this allows direction of the HTL epitopes to a cell compartment different than that of the CTL epitopes. If required, this could facilitate more efficient entry of HTL epitopes into the HLA class II pathway, thereby improving HTL induction. In contrast to HTL or CTL induction, specifically decreasing the immune response by co-expression of immunosuppressive molecules (*e.g.* TGF-β) may be beneficial in certain diseases.

Therapeutic quantities of plasmid DNA can be produced for example, by fermentation in *E. coli*, followed by purification. Aliquots from the working cell bank are used to inoculate growth medium, and grown to saturation in shaker flasks or a bioreactor according to well known techniques. Plasmid DNA can be purified using standard bioseparation technologies such as solid phase anion-exchange resins supplied by QIAGEN, Inc. (Valencia, California). If required, supercoiled DNA can be isolated from the open circular and linear forms using gel electrophoresis or other methods.

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). This approach, known as "naked DNA," is currently being used for intramuscular (IM) administration in clinical

trials. To maximize the immunotherapeutic effects of minigene DNA vaccines, an alternative method for formulating purified plasmid DNA may be desirable. A variety of methods have been described, and new techniques may become available. Cationic lipids, glycolipids, and fusogenic liposomes can also be used in the formulation (see, *e.g.*, as described by WO 93/24640; Mannino & Gould-Fogerite, *BioTechniques* 6(7): 682 (1988); U.S. Pat No. 5,279,833; WO 91/06309; and Felgner, *et al., Proc. Nat'l Acad. Sci. USA* 84:7413 (1987). In addition, peptides and compounds referred to collectively as protective, interactive, non-condensing compounds (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.

Target cell sensitization can be used as a functional assay for expression and HLA class I presentation of minigene-encoded CTL epitopes. For example, 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 will be 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 (^{51}Cr) labeled and used as target cells for epitope-specific CTL lines; cytolysis, detected by ^{51}Cr release, indicates both production of, and HLA presentation of, minigene-encoded CTL epitopes. Expression of HTL epitopes may be evaluated in an analogous manner using assays to assess HTL activity.

In vivo immunogenicity is a second approach for functional testing of minigene DNA formulations. Transgenic mice expressing appropriate human HLA proteins are immunized with the DNA product. The dose and route of administration are formulation dependent (*e.g.*, IM for DNA in PBS, intraperitoneal (i.p.) for lipid-complexed DNA). Twenty-one days after immunization, splenocytes are harvested and restimulated for one week in the presence of peptides encoding each epitope being tested. Thereafter, for CTL effector cells, assays are conducted for cytolysis of peptide-loaded, ^{51}Cr-labeled target cells using standard techniques. Lysis of target cells that were sensitized by HLA loaded with peptide epitopes, corresponding to minigene-encoded epitopes, demonstrates DNA vaccine function for *in vivo* induction of CTLs. Immunogenicity of HTL epitopes is evaluated in transgenic mice in an analogous manner.

Alternatively, the nucleic acids can be administered using ballistic delivery as described, for instance, in U.S. Patent No. 5,204,253. Using this technique, particles comprised solely of DNA are administered. In a further alternative embodiment, DNA can be adhered to particles, such as gold particles.

Minigenes can also be delivered using other bacterial or viral delivery systems well known in the art, *e.g.*, an expression construct encoding epitopes of the invention can be incorporated into a viral vector such as vaccinia.

III.K.2. Combinations of CTL Peptides with Helper Peptides

Vaccine compositions comprising CTL peptides of the invention can be modified to provide desired attributes, such as improved serum half life, broadened population coverage or enhanced immunogenicity.

For instance, the ability of a peptide to induce CTL activity can be enhanced by linking the peptide to a sequence which contains at least one epitope that is capable of inducing a T helper cell response. The use of T helper epitopes in conjunction with CTL epitopes to enhance immunogenicity is illustrated, for example, in related PCT publication WO 95/22317.

Although a CTL peptide can be directly linked to a T helper peptide, often CTL epitope/HTL epitope conjugates are linked by a spacer molecule. The spacer is typically comprised of relatively small, neutral molecules, such as amino acids or amino acid mimetics, which are substantially uncharged under physiological conditions. The spacers are typically selected from, *e.g.*, Ala, Gly, or other neutral spacers of nonpolar amino acids or neutral polar amino acids. It will be understood that the optionally present spacer need not be comprised of the same residues and thus may be a hetero- or homo-oligomer. When present, the spacer will usually be at least one or two residues, more usually three to six residues and sometimes 10 or more residues. The CTL peptide epitope can be linked to the T helper peptide epitope either directly or via a spacer either at the amino or carboxy terminus of the CTL peptide. The amino terminus of either the immunogenic peptide or the T helper peptide may be acylated.

In certain embodiments, the T helper peptide is one that is recognized by T helper cells present in the majority of the population. This can be accomplished by selecting peptides that bind to many, most, or all of the HLA class II molecules. These are known as "loosely HLA-restricted" or "promiscuous" T helper sequences. Examples of amino acid sequences that are promiscuous include sequences from antigens such as tetanus toxoid at positions 830-843 (QYIKANSKFIGITE; SEQ ID NO:67), *Plasmodium falciparum* circumsporozoite (CS) protein at positions 378-398 (DIEKKIAKMEKASSVFNVVNS; SEQ ID NO:68), and *Streptococcus* 18kD protein at positions 116 (GAVDSILGGVATYGAA; SEQ ID NO:69). Other examples include peptides bearing a DR 1-4-7 supermotif, or either of the DR3 motifs.

Alternatively, it is possible to prepare synthetic peptides capable of stimulating T helper lymphocytes, in a loosely HLA-restricted fashion, using amino acid sequences not found in nature (*see, e.g.*, PCT publication WO 95/07707). These synthetic compounds called Pan-DR-binding epitopes (*e.g.*, PADRE™, Epimmune, Inc., San Diego, CA) are designed to most preferrably bind most HLA-DR (human HLA class II) molecules. For instance, a pan-DR-binding epitope peptide having the formula: aKXVAAWTLKAAa (SEQ ID NO:70), where "X" is either cyclohexylalanine, phenylalanine, or tyrosine, and a is either D-alanine or L-alanine, has been found to bind to most HLA-DR alleles, and to stimulate the response of T helper lymphocytes from most individuals, regardless of their HLA type. An alternative of a pan-DR binding epitope comprises all "L" natural amino acids and can be provided in the form of nucleic acids that encode the epitope.

HTL peptide epitopes can also be modified to alter their biological properties. For example, they can be modified to include D-amino acids to increase their resistance to proteases and thus extend their serum half life, or they can be conjugated to other molecules such as lipids, proteins, carbohydrates, and the like to increase their biological activity. For example, a T helper peptide can be conjugated to one or more palmitic acid chains at either the amino or carboxyl termini.

III.K.3. Combinations of CTL Peptides with T Cell Priming Agents

In some embodiments it may be desirable to include in the pharmaceutical compositions of the invention at least one component which primes cytotoxic T lymphocytes. Lipids have been identified as agents capable of priming CTL *in vivo* against viral antigens. For example, palmitic acid residues can be attached to the ε-and α- amino groups of a lysine residue and then linked, *e.g.,* via one or more linking residues such as Gly, Gly-Gly-, Ser, Ser-Ser, or the like, to an immunogenic peptide. The lipidated peptide can then be administered either directly in a micelle or particle, incorporated into a liposome, or emulsified in an adjuvant, *e.g.,* incomplete Freund's adjuvant. In a preferred embodiment, a particularly effective immunogenic composition comprises palmitic acid attached to ε- and α- amino groups of Lys, which is attached via linkage, *e.g.,* Ser-Ser, to the amino terminus of the immunogenic peptide.

As another example of lipid priming of CTL responses, *E. coli* lipoproteins, such as tripalmitoyl-S-glycerylcysteinlyseryl- serine (P_3CSS) can be used to prime virus specific CTL when covalently attached to an appropriate peptide (*see, e.g.*, Deres, *et al., Nature* 342:561, 1989). Peptides of the invention can be coupled to P_3CSS, for example, and the lipopeptide administered to an individual to specifically prime a CTL response to the target antigen. Moreover, because the induction of neutralizing antibodies can also be primed with P_3CSS-conjugated epitopes, two such compositions can be combined to more effectively elicit both humoral and cell-mediated responses.

CTL and/or HTL peptides can also be modified by the addition of amino acids to the termini of a peptide to provide for ease of linking peptides one to another, for coupling to a carrier support or larger peptide, for modifying the physical or chemical properties of the peptide or oligopeptide, or the like. Amino acids such as tyrosine, cysteine, lysine, glutamic or aspartic acid, or the like, can be introduced at the C- or N-terminus of the peptide or oligopeptide, particularly class I peptides. However, it is to be noted that modification at the carboxyl terminus of a CTL epitope may, in some cases, alter binding characteristics of the peptide. In addition, the peptide or oligopeptide sequences can differ from the natural sequence by being modified by terminal-NH_2 acylation, *e.g.*, by alkanoyl (C1-C20) or thioglycolyl acetylation, terminal-carboxyl amidation, *e.g.*, ammonia, methylamine, *etc.* In some instances these modifications may provide sites for linking to a support or other molecule.

IV.J.4. Vaccine Compositions Comprising DC Pulsed with CTL and/or HTL Peptides

An embodiment of a vaccine composition in accordance with the invention comprises *ex vivo* administration of a cocktail of epitope-bearing peptides to PBMC, or isolated DC therefrom, from the patient's blood. A pharmaceutical to facilitate harvesting of DC can be used, such as Progenipoietin (Monsanto, St. Louis, MO) or GM-CSF/IL-4. After pulsing the DC with peptides and prior to reinfusion into patients, the DC are washed to remove unbound peptides. In this embodiment, a vaccine comprises peptide-pulsed DCs which present the pulsed peptide epitopes complexed with HLA molecules on their surfaces.

The DC can be pulsed *ex vivo* with a cocktail of peptides, some of which stimulate CTL responses to one or more HPV antigens of interest. Optionally, a helper T cell (HTL) peptide such as a PADRE family molecule, can be included to facilitate the CTL response. Thus, a vaccine in accordance

with the invention, preferably comprising epitopes from multiple HPV antigens, is used to treat HPV infection or cancer resulting from HPV infection.

III.L. Administration of Vaccines for Therapeutic or Prophylactic Purposes

The peptides of the present invention and pharmaceutical and vaccine compositions of the invention are typically used to treat and/or prevent cancer associated with HPV infection. Vaccine compositions containing the peptides of the invention are administered to a patient infected with HPV or to an individual susceptible to, or otherwise at risk for, HPV infection to elicit an immune response against HPV antigens and thus enhance the patient's own immune response capabilities.

As noted above, peptides comprising CTL and/or HTL epitopes of the invention induce immune responses when presented by HLA molecules and contacted with a CTL or HTL specific for an epitope comprised by the peptide. The peptides (or DNA encoding them) can be administered individually or as fusions of one or more peptide sequences. The manner in which the peptide is contacted with the CTL or HTL is not critical to the invention. For instance, the peptide can be contacted with the CTL or HTL either *in vivo* or *in vitro*. If the contacting occurs *in vivo*, the peptide itself can be administered to the patient, or other vehicles, *e.g.*, DNA vectors encoding one or more peptides, viral vectors encoding the peptide(s), liposomes and the like, can be used, as described herein.

When the peptide is contacted *in vitro*, the vaccinating agent can comprise a population of cells, *e.g.*, peptide-pulsed dendritic cells, or HPV-specific CTLs, which have been induced by pulsing antigen-presenting cells *in vitro* with the peptide or by transfecting antigen-presenting cells with a minigene of the invention. Such a cell population is subsequently administered to a patient in a therapeutically effective dose.

In therapeutic applications, peptide and/or nucleic acid compositions are administered to a patient in an amount sufficient to elicit an effective CTL and/or HTL response to the virus antigen and to cure or at least partially arrest or slow symptoms and/or complications. An amount adequate to accomplish this is defined as "therapeutically effective dose." Amounts effective for this use will depend on, *e.g.*, the particular composition administered, 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.

For pharmaceutical compositions, the immunogenic peptides of the invention, or DNA encoding them, are generally administered to an individual already infected with HPV. The peptides or DNA encoding them can be administered individually or as fusions of one or more peptide sequences. HPV-infected patients, with or without neoplasia, can be treated with the immunogenic peptides separately or in conjunction with other treatments, such as surgery, as appropriate.

For therapeutic use, administration should generally begin at the first diagnosis of HPV infection or HPV-associated cancer. This is followed by boosting doses until at least symptoms are substantially abated and for a period thereafter. The embodiment of the vaccine composition (*i.e.*, including, but not limited to embodiments such as peptide cocktails, polyepitopic polypeptides, minigenes, or TAA-specific CTLs or pulsed dendritic cells) delivered to the patient may vary according to the stage of the disease or the patient's health status. For example, in a patient with a tumor that expresses HPV

antigens, a vaccine comprising HPV-specific CTL may be more efficacious in killing tumor cells in patient with advanced disease than alternative embodiments.

Where susceptible individuals are identified prior to or during infection, the composition can be targeted to them, thus minimizing the need for administration to a larger population. Susceptible populations include those individuals who are sexually active.

The peptide or other compositions used for the treatment or prophylaxis of HPV infection can be used, *e.g.,* in persons who have not manifested symptoms, *e.g.*, genital warts or neoplastic growth. In this context, it is generally important to provide an amount of the peptide epitope delivered by a mode of administration sufficient to effectively stimulate a cytotoxic T cell response; compositions which stimulate helper T cell responses can also be given in accordance with this embodiment of the invention.

The dosage for an initial therapeutic immunization generally occurs in a unit dosage range where the lower value is about 1, 5, 50, 500, or 1,000 µg and the higher value is about 10,000; 20,000; 30,000; or 50,000 µg. Dosage values for a human typically range from about 500 µg to about 50,000 µg per 70 kilogram patient. Boosting dosages of between about 1.0 µg to about 50,000 µg of peptide pursuant to a boosting regimen over weeks to months may be administered depending upon the patient's response and condition as determined by measuring the specific activity of CTL and HTL obtained from the patient's blood. Administration should continue until at least clinical symptoms or laboratory tests indicate that the viral infection, or neoplasia, has been eliminated or reduced and for a period thereafter. The dosages, routes of administration, and dose schedules are adjusted in accordance with methodologies known in the art.

In certain embodiments, the peptides and compositions of the present invention are employed in serious disease states, that is, life-threatening or potentially life threatening situations. In such cases, as a result of the minimal amounts of extraneous substances and the relative nontoxic nature of the peptides in preferred compositions of the invention, it is possible and may be felt desirable by the treating physician to administer substantial excesses of these peptide compositions relative to these stated dosage amounts.

The vaccine compositions of the invention can also be used purely as prophylactic agents. Generally the dosage for an initial prophylactic immunization generally occurs in a unit dosage range where the lower value is about 1, 5, 50, 500, or 1000 µg and the higher value is about 10,000; 20,000; 30,000; or 50,000 µg. Dosage values for a human typically range from about 500 µg to about 50,000 µg per 70 kilogram patient. This is followed by boosting dosages of between about 1.0 µg to about 50,000 µg of peptide administered at defined intervals from about four weeks to six months after the initial administration of vaccine. The immunogenicity of the vaccine can be assessed by measuring the specific activity of CTL and HTL obtained from a sample of the patient's blood.

The pharmaceutical compositions for therapeutic treatment are intended for parenteral, topical, oral, intrathecal, or local (*e.g.* as a cream or topical ointment) administration. Preferably, the pharmaceutical compositions are administered parentally, *e.g.,* intravenously, subcutaneously, intradermally, or intramuscularly. Thus, the invention provides compositions for parenteral administration which comprise a solution of the immunogenic peptides dissolved or suspended in an acceptable carrier, preferably an aqueous carrier. A variety of aqueous carriers may be used, *e.g.,* water, buffered water, 0.8% 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, preservatives, and the like, for example, sodium acetate, sodium lactate, sodium chloride, potassium chloride, calcium chloride, sorbitan monolaurate, triethanolamine oleate, *etc.*

The concentration of peptides of the invention in the pharmaceutical formulations can vary widely, *i.e.*, from less than about 0.1%, usually at or at least about 2% to as much as 20% to 50% or more by weight, and will be selected primarily by fluid volumes, viscosities, *etc.*, in accordance with the particular mode of administration selected.

A human unit dose form of the peptide composition is typically included in a pharmaceutical composition that comprises a human unit dose of an acceptable carrier, preferably an aqueous carrier, and is administered in a volume of fluid that is known by those of skill in the art to be used for administration of such compositions to humans (*see*, *e.g.*, Remington's Pharmaceutical Sciences, 17th Edition, A. Gennaro, Editor, Mack Publising Co., Easton, Pennsylvania, 1985).

The peptides of the invention, and/or nucleic acids encoding the peptides, can also be administered via liposomes, which may also serve to target the peptides to a particular tissue, such as lymphoid tissue, or to target selectively to infected cells, as well as to increase the half-life of the peptide composition. Liposomes include emulsions, foams, micelles, insoluble monolayers, liquid crystals, phospholipid dispersions, lamellar layers and the like. In these preparations, the peptide to be delivered is incorporated as part of a liposome, alone or in conjunction with a molecule which binds to a receptor prevalent among lymphoid cells, such as monoclonal antibodies which bind to the CD45 antigen, or with other therapeutic or immunogenic compositions. Thus, liposomes either filled or decorated with a desired peptide of the invention can be directed to the site of lymphoid cells, where the liposomes then deliver the peptide compositions. Liposomes for use in accordance with the invention are formed from standard vesicle-forming lipids, which generally include neutral and negatively charged phospholipids and a sterol, such as cholesterol. The selection of lipids is generally guided by consideration of, *e.g.*, liposome size, acid lability and stability of the liposomes in the blood stream. A variety of methods are available for preparing liposomes, as described in, *e.g.*, Szoka, *et al., Ann. Rev. Biophys. Bioeng.* 9:467 (1980), and U.S. Patent Nos. 4,235,871, 4,501,728, 4,837,028, and 5,019,369.

For targeting cells of the immune system, a ligand to be incorporated into the liposome can include, *e.g.*, antibodies or fragments thereof specific for cell surface determinants of the desired immune system cells. 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 solid compositions, conventional 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%.

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 must, 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.

III.M. HLA EXPRESSION: IMPLICATIONS FOR T CELL-BASED IMMUNOTHERAPY

Disease progression in cancer and infectious disease

It is well recognized that a dynamic interaction between exists between host and disease, both in the cancer and infectious disease settings. In the infectious disease setting, it is well established that pathogens evolve during disease. The strains that predominate early in HIV infection are different from the ones that are associated with AIDS and later disease stages (NS versus S strains). It has long been hypothesized that pathogen forms that are effective in establishing infection may differ from the ones most effective in terms of replication and chronicity.

Similarly, it is widely recognized that the pathological process by which an individual succumbs to a neoplastic disease is complex. During the course of disease, many changes occur in cancer cells. The tumor accumulates alterations which are in part related to dysfunctional regulation of growth and differentiation, but also related to maximizing its growth potential, escape from drug treatment and/or the body's immunosurveillance. Neoplastic disease results in the accumulation of several different biochemical alterations of cancer cells, as a function of disease progression. It also results in significant levels of intra- and inter- cancer heterogeneity, particularly in the late, metastatic stage.

Familiar examples of cellular alterations affecting treatment outcomes include the outgrowth of radiation or chemotherapy resistant tumors during the course of therapy. These examples parallel the emergence of drug resistant viral strains as a result of aggressive chemotherapy, *e.g.*, of chronic HBV and HIV infection, and the current resurgence of drug resistant organisms that cause Tuberculosis and Malaria. It appears that significant heterogeneity of responses is also associated with other approaches to cancer therapy, including anti-angiogenesis drugs, passive antibody immunotherapy, and active T cell-based immunotherapy. Thus, in view of such phenomena, epitopes from multiple disease-related antigens can be used in vaccines and therapeutics thereby counteracting the ability of diseased cells to mutate and escape treatment.

The interplay between disease and the immune system

One of the main factors contributing to the dynamic interplay between host and disease is the immune response mounted against the pathogen, infected cell, or malignant cell. In many conditions

such immune responses control the disease. Several animal model systems and prospective studies of natural infection in humans suggest that immune responses against a pathogen can control the pathogen, prevent progression to severe disease and/or eliminate the pathogen. A common theme is the requirement for a multispecific T cell response, and that narrowly focused responses appear to be less effective. These observations guide skilled artisan as to embodiments of methods and compositions of the present invention that provide for a broad immune response.

In the cancer setting there are several findings that indicate that immune responses can impact neoplastic growth:

First, the demonstration in many different animal models, that anti-tumor T cells, restricted by MHC class I, can prevent or treat tumors.

Second, encouraging results have come from immunotherapy trials.

Third, observations made in the course of natural disease correlated the type and composition of T cell infiltrate within tumors with positive clinical outcomes (Coulie PG, *et al.* Antitumor immunity at work in a melanoma patient In *Advances in Cancer Research*, 213-242, 1999).

Finally, tumors commonly have the ability to mutate, thereby changing their immunological recognition. For example, the presence of monospecific CTL was also correlated with control of tumor growth, until antigen loss emerged (Riker A, *et al.*, Immune selection after antigen-specific immunotherapy of melanoma *Surgery*, Aug: 126(2):112-20, 1999; Marchand M, *et al.*, Tumor regressions observed in patients with metastatic melanoma treated with an antigenic peptide encoded by gene MAGE-3 and presented by HLA-A1 *Int. J. Cancer* 80(2):219-30, Jan. 18, 1999). Similarly, loss of beta 2 microglobulin was detected in 5/13 lines established from melanoma patients after receiving immunotherapy at the NCI (Restifo NP, *et al.*, Loss of functional Beta2 - microglobulin in metastatic melanomas from five patients receiving immunotherapy *Journal of the National Cancer Institute*, Vol. 88 (2), 100-108, Jan. 1996). It has long been recognized that HLA class I is frequently altered in various tumor types. This has led to a hypothesis that this phenomenon might reflect immune pressure exerted on the tumor by means of class I restricted CTL. The extent and degree of alteration in HLA class I expression appears to be reflective of past immune pressures, and may also have prognostic value (van Duinen SG, *et al.*, Level of HLA antigens in locoregional metastases and clinical course of the disease in patients with melanoma *Cancer Research* 48, 1019-1025, Feb. 1988; Möller P, *et al.*, Influence of major histocompatibility complex class I and II antigens on survival in colorectal carcinoma *Cancer Research* 51, 729-736, Jan. 1991). Taken together, these observations provide a rationale for immunotherapy of cancer and infectious disease, and suggest that effective strategies need to account for the complex series of pathological changes associated with disease.

The three main types of alterations in HLA expression in tumors and their functional significance

The level and pattern of expression of HLA class I antigens in tumors has been studied in many different tumor types and alterations have been reported in all types of tumors studied. The molecular mechanisms underlining HLA class I alterations have been demonstrated to be quite heterogeneous. They include alterations in the TAP/processing pathways, mutations of β2-microglobulin and specific HLA heavy chains, alterations in the regulatory elements controlling over class I expression and loss of entire

chromosome sections. There are several reviews on this topic, *see, e.g.*, : Garrido F, *et al.*, Natural history of HLA expression during tumour development *Immunol Today* 14(10):491-499, 1993; Kaklamanis L, *et al.*, Loss of HLA class-I alleles, heavy chains and β2-microglobulin in colorectal cancer *Int. J. Cancer*, 51(3):379-85, May 28,1992. There are three main types of HLA Class I alteration (complete loss, allele-specific loss and decreased expression). The functional significance of each alteration is discussed separately:

Complete loss of HLA expression

Complete loss of HLA expression can result from a variety of different molecular mechanisms, reviewed in (Algarra I, *et al.*, The HLA crossroad in tumor immunology *Human Immunology* 61, 65-73, 2000; Browning M, *et al.*, Mechanisms of loss of HLA class I expression on colorectal tumor cells *Tissue Antigens* 47:364-371, 1996; Ferrone S, et al., Loss of HLA class I antigens by melanoma cells: molecular mechanisms, functional significance and clinical relevance *Immunology Today*, 16(10): 487-494, 1995; Garrido F, *et al.*, Natural history of HLA expression during tumour development *Immunology Today* 14(10):491-499, 1993; Tait, BD, HLA Class I expression on human cancer cells: Implications for effective immunotherapy *Hum Immunol* 61, 158-165, 2000). In functional terms, this type of alteration has several important implications.

While the complete absence of class I expression will eliminate CTL recognition of those tumor cells, the loss of HLA class I will also render the tumor cells extraordinary sensitive to lysis from NK cells (Ohnmacht, GA, *et al.*, Heterogeneity in expression of human leukocyte antigens and melanoma-associated antigens in advanced melanoma *J Cellular Phys* 182:332-338, 2000; Liunggren HG, *et al.*, Host resistance directed selectively against H-2 deficient lymphoma variants: Analysis of the mechanism *J. Exp. Med.*, Dec 1;162(6):1745-59, 1985; Maio M, *et al.*, Reduction in susceptibility to natural killer cell-mediated lysis of human FO-1 melanoma cells after induction of HLA class I antigen expression by transfection with B2m gene *J. Clin. Invest.* 88(1):282-9, July 1991; Schrier PI, *et al.*, Relationship between myc oncogene activation and MHC class I expression *Adv. Cancer Res.*, 60:181-246, 1993).

The complementary interplay between loss of HLA expression and gain in NK sensitivity is exemplified by the classic studies of Coulie and coworkers (Coulie, PG, *et al.*, Antitumor immunity at work in a melanoma patient. In *Advances in Cancer Research*, 213-242, 1999) which described the evolution of a patient's immune response over the course of several years. Because of increased sensitivity to NK lysis, it is predicted that approaches leading to stimulation of innate immunity in general and NK activity in particular would be of special significance. An example of such approach is the induction of large amounts of dendritic cells (DC) by various hematopoietic growth factors, such as Flt3 ligand or ProGP. The rationale for this approach resides in the well known fact that dendritic cells produce large amounts of IL-12, one of the most potent stimulators for innate immunity and NK activity in particular. Alternatively, IL-12 is administered directly, or as nucleic acids that encode it. In this light, it is interesting to note that Flt3 ligand treatment results in transient tumor regression of a class I negative prostate murine cancer model (Ciavarra RP, *et al.*, Flt3-Ligand induces transient tumor regression in an ectopic treatment model of major histocompatibility complex-negative prostate cancer *Cancer Res* 60:2081-84, 2000). In this context, specific anti-tumor vaccines in accordance with the invention synergize with these types of

hematopoietic growth factors to facilitate both CTL and NK cell responses, thereby appreciably impairing a cell's ability to mutate and thereby escape efficacious treatment. Thus, an embodiment of the present invention comprises a composition of the invention together with a method or composition that augments functional activity or numbers of NK cells. Such an embodiment can comprise a protocol that provides a composition of the invention sequentially with an NK-inducing modality, or contemporaneous with an NK-inducing modality.

Secondly, complete loss of HLA frequently occurs only in a fraction of the tumor cells, while the remainder of tumor cells continue to exhibit normal expression. In functional terms, the tumor would still be subject, in part, to direct attack from a CTL response; the portion of cells lacking HLA subject to an NK response. Even if only a CTL response were used, destruction of the HLA expressing fraction of the tumor has dramatic effects on survival times and quality of life.

It should also be noted that in the case of heterogeneous HLA expression, both normal HLA-expressing as well as defective cells are predicted to be susceptible to immune destruction based on "bystander effects." Such effects were demonstrated, e.g., in the studies of Rosendahl and colleagues that investigated in vivo mechanisms of action of antibody targeted superantigens (Rosendahl A, *et al.*, Perforin and IFN-gamma are involved in the antitumor effects of antibody-targeted superantigens *J. Immunol.* 160(11):5309-13, June 1, 1998). The bystander effect is understood to be mediated by cytokines elicited from, *e.g.*, CTLs acting on an HLA-bearing target cell, whereby the cytokines are in the environment of other diseased cells that are concomitantly killed.

Allele-specific loss

One of the most common types of alterations in class I molecules is the selective loss of certain alleles in individuals heterozygous for HLA. Allele-specific alterations might reflect the tumor adaptation to immune pressure, exerted by an immunodominant response restricted by a single HLA restriction element. This type of alteration allows the tumor to retain class I expression and thus escape NK cell recognition, yet still be susceptible to a CTL-based vaccine in accordance with the invention which comprises epitopes corresponding to the remaining HLA type. Thus, a practical solution to overcome the potential hurdle of allele-specific loss relies on the induction of multispecific responses. Just as the inclusion of multiple disease-associated antigens in a vaccine of the invention guards against mutations that yield loss of a specific disease antigens, simultaneously targeting multiple HLA specificities and multiple disease-related antigens prevents disease escape by allele-specific losses.

Decrease in expression (allele-specific or not)

The sensitivity of effector CTL has long been demonstrated (Brower, RC, *et al.*, Minimal requirements for peptide mediated activation of CD8+ CTL *Mol. Immunol.*, 31;1285-93, 1994; Chriustnick, ET, *et al.* Low numbers of MHC class I-peptide complexes required to trigger a T cell response *Nature* 352:67-70, 1991; Sykulev, Y, *et al.*, Evidence that a single peptide-MHC complex on a target cell can elicit a cytolytic T cell response *Immunity*, 4(6):565-71, June 1996). Even a single peptide/MHC complex can result in tumor cells lysis and release of anti-tumor lymphokines. The biological significance of decreased HLA expression and possible tumor escape from immune recognition is not fully known. Nevertheless, it

has been demonstrated that CTL recognition of as few as one MHC/peptide complex is sufficient to lead to tumor cell lysis.

Further, it is commonly observed that expression of HLA can be upregulated by gamma IFN, commonly secreted by effector CTL. Additionally, HLA class I expression can be induced in vivo by both alpha and beta IFN (Halloran, *et al.* Local T cell responses induce widespread MHC expression. *J Immunol* 148:3837, 1992; Pestka, S, *et al.*, Interferons and their actions *Annu. Rev. Biochem.* 56:727-77, 1987). Conversely, decreased levels of HLA class I expression also render cells more susceptible to NK lysis.

With regard to gamma IFN, Torres et al (Torres, MJ, *et al.*, Loss of an HLA haplotype in pancreas cancer tissue and its corresponding tumor derived cell line. *Tissue Antigens* 47:372-81, 1996) note that HLA expression is upregulated by gamma IFN in pancreatic cancer, unless a total loss of haplotype has occurred. Similarly, Rees and Mian note that allelic deletion and loss can be restored, at least partially, by cytokines such as IFN-gamma (Rees, R., *et al.* Selective MHC expression in tumours modulates adaptive and innate antitumour responses *Cancer Immunol Immunother* 48:374-81, 1999). It has also been noted that IFN-gamma treatment results in upregulation of class I molecules in the majority of the cases studied (Browning M, *et al.*, Mechanisms of loss of HLA class I expression on colorectal tumor cells. *Tissue Antigens* 47:364-71, 1996). Kaklamakis, et al. also suggested that adjuvant immunotherapy with IFN-gamma may be beneficial in the case of HLA class I negative tumors (Kaklamanis L, Loss of transporter in antigen processing 1 transport protein and major histocompatibility complex class I molecules in metastatic versus primary breast cancer. *Cancer Research* 55:5191-94, November 1995). It is important to underline that IFN-gamma production is induced and self-amplified by local inflammation/immunization (Halloran, *et al.* Local T cell responses induce widespread MHC expression *J. Immunol* 148:3837, 1992), resulting in large increases in MHC expressions even in sites distant from the inflammatory site.

Finally, studies have demonstrated that decreased HLA expression can render tumor cells more susceptible to NK lysis (Ohnmacht, GA, *et al.*, Heterogeneity in expression of human leukocyte antigens and melanoma-associated antigens in advanced melanoma *J Cellular Phys* 182:332-38, 2000; Liunggren HG, *et al.*, Host resistance directed selectively against H-2 deficient lymphoma variants: Analysis of the mechanism *J. Exp. Med.*, 162(6):1745-59, December 1, 1985; Maio M, *et al.*, Reduction in susceptibility to natural killer cell-mediated lysis of human FO-1 melanoma cells after induction of HLA class I antigen expression by transfection with β2m gene *J. Clin. Invest.* 88(1):282-9, July 1991; Schrier PI, *et al.*, Relationship between myc oncogene activation and MHC class I expression *Adv. Cancer Res.*, 60:181-246, 1993). If decreases in HLA expression benefit a tumor because it facilitates CTL escape, but render the tumor susceptible to NK lysis, then a minimal level of HLA expression that allows for resistance to NK activity would be selected for (Garrido F, *et al.*, Implications for immunosurveillance of altered HLA class I phenotypes in human tumours *Immunol Today* 18(2):89-96, February 1997). Therefore, a therapeutic compositions or methods in accordance with the invention together with a treatment to upregulate HLA expression and/or treatment with high affinity T-cells renders the tumor sensitive to CTL destruction.

Frequency of alterations in HLA expression

The frequency of alterations in class I expression is the subject of numerous studies (Algarra I, *et al.*, The HLA crossroad in tumor immunology *Human Immunology* 61, 65-73, 2000). Rees and Mian estimate allelic loss to occur overall in 3-20% of tumors, and allelic deletion to occur in 15-50% of tumors. It should be noted that each cell carries two separate sets of class I genes, each gene carrying one HLA-A and one HLA-B locus. Thus, fully heterozygous individuals carry two different HLA-A molecules and two different HLA-B molecules. Accordingly, the actual frequency of losses for any specific allele could be as little as one quarter of the overall frequency. They also note that, in general, a gradient of expression exists between normal cells, primary tumors and tumor metastasis. In a study from Natali and coworkers (Natali PG, *et al.*, Selective changes in expression of HLA class I polymorphic determinants in human solid tumors *PNAS USA* 86:6719-6723, September 1989), solid tumors were investigated for total HLA expression, using W6/32 antibody, and for allele-specific expression of the A2 antigen, as evaluated by use of the BB7.2 antibody. Tumor samples were derived from primary cancers or metastasis, for 13 different tumor types, and scored as negative if less than 20%, reduced if in the 30-80% range, and normal above 80%. All tumors, both primary and metastatic, were HLA positive with W6/32. In terms of A2 expression, a reduction was noted in 16.1 % of the cases, and A2 was scored as undetectable in 39.4 % of the cases. Garrido and coworkers (Garrido F, *et al.*, Natural history of HLA expression during tumour development *Immunol Today* 14(10):491-99, 1993) emphasize that HLA changes appear to occur at a particular step in the progression from benign to most aggressive. Jiminez *et al* (Jiminez P, *et al.*, Microsatellite instability analysis in tumors with different mechanisms for total loss of HLA expression. *Cancer Immunol* Immunother 48:684-90, 2000) have analyzed 118 different tumors (68 colorectal, 34 laryngeal and 16 melanomas). The frequencies reported for total loss of HLA expression were 11% for colon, 18% for melanoma and 13 % for larynx. Thus, HLA class I expression is altered in a significant fraction of the tumor types, possibly as a reflection of immune pressure, or simply a reflection of the accumulation of pathological changes and alterations in diseased cells.

Immunotherapy in the context of HLA loss

A majority of the tumors express HLA class I, with a general tendency for the more severe alterations to be found in later stage and less differentiated tumors. This pattern is encouraging in the context of immunotherapy, especially considering that: 1) the relatively low sensitivity of immunohistochemical techniques might underestimate HLA expression in tumors; 2) class I expression can be induced in tumor cells as a result of local inflammation and lymphokine release; and, 3) class I negative cells are sensitive to lysis by NK cells.

Accordingly, various embodiments of the present invention can be selected in view of the fact that there can be a degree of loss of HLA molecules, particularly in the context of neoplastic disease. For example, the treating physician can assay a patient's tumor to ascertain whether HLA is being expressed. If a percentage of tumor cells express no class I HLA, then embodiments of the present invention that comprise methods or compositions that elicit NK cell responses can be employed. As noted herein, such NK-inducing methods or composition can comprise a Flt3 ligand or ProGP which facilitate mobilization of dendritic cells, the rationale being that dendritic cells produce large amounts of IL-12. IL-

12 can also be administered directly in either amino acid or nucleic acid form. It should be noted that compositions in accordance with the invention can be administered concurrently with NK cell-inducing compositions, or these compositions can be administered sequentially.

In the context of allele-specific HLA loss, a tumor retains class I expression and may thus escape NK cell recognition, yet still be susceptible to a.CTL-based vaccine in accordance with the invention which comprises epitopes corresponding to the remaining HLA type. The concept here is analogous to embodiments of the invention that include multiple disease antigens to guard against mutations that yield loss of a specific antigen. Thus, one can simultaneously target multiple HLA specificities and epitopes from multiple disease-related antigens to prevent tumor escape by allele-specific loss as well as disease-related antigen loss. In addition, embodiments of the present invention can be combined with alternative therapeutic compositions and methods. Such alternative compositions and methods comprise, without limitation, radiation, cytotoxic pharmaceuticals, and/or compositions/methods that induce humoral antibody responses.

Moreover, it has been observed that expression of HLA can be upregulated by gamma IFN, which is commonly secreted by effector CTL, and that HLA class I expression can be induced in vivo by both alpha and beta IFN. Thus, embodiments of the invention can also comprise alpha, beta and/or gamma IFN to facilitate upregualtion of HLA.

III.N. REPRIEVE PERIODS FROM THERAPIES THAT INDUCE SIDE EFFECTS: "Scheduled Treatment Interruptions or Drug Holidays"

Recent evidence has shown that certain patients infected with a pathogen, whom are initially treated with a therapeutic regimen to reduce pathogen load, have been able to maintain decreased pathogen load when removed from the therapeutic regimen, i.e., during a "drug holiday" (Rosenberg, E., *et al.*, Immune control of HIV-1 after early treatment of acute infection Nature 407:523-26, Sept. 28, 2000) As appreciated by those skilled in the art, many therapeutic regimens for both pathogens and cancer have numerous, often severe, side effects. During the drug holiday, the patient's immune system is keeping the disease in check. Methods for using compositions of the invention are used in the context of drug holidays for cancer and pathogenic infection.

For treatment of an infection, where therapies are not particularly immunosuppressive, compositions of the invention are administered concurrently with the standard therapy. During this period, the patient's immune system is directed to induce responses against the epitopes comprised by the present inventive compositions. Upon removal from the treatment having side effects, the patient is primed to respond to the infectious pathogen should the pathogen load begin to increase. Composition of the invention can be provided during the drug holiday as well.

For patients with cancer, many therapies are immunosuppressive. Thus, upon achievement of a remission or identification that the patient is refractory to standard treatment, then upon removal from the immunosuppressive therapy, a composition in accordance with the invention is administered. Accordingly, as the patient's immune system reconstitutes, precious immune resources are simultaneously directed against the cancer. Composition of the invention can also be administered concurrently with an immunosuppressive regimen if desired.

III.O. Kits

The peptide and nucleic acid compositions of this invention can be provided in kit form together with instructions for vaccine administration. Typically the kit would include desired peptide compositions in a container, preferably in unit dosage form and instructions for administration. An alternative kit would include a minigene construct with desired nucleic acids of the invention in a container, preferably in unit dosage form together with instructions for administration. Lymphokines such as IL-2 or IL-12 may also be included in the kit. Other kit components that may also be desirable include, for example, a sterile syringe, booster dosages, and other desired excipients.

III.P. Overview

Epitopes in accordance with the present invention were successfully used to induce an immune response. Immune responses with these epitopes have been induced by administering the epitopes in various forms. The epitopes have been administered as peptides, as nucleic acids, and as viral vectors comprising nucleic acids that encode the epitope(s) of the invention. Upon administration of peptide-based epitope forms, immune responses have been induced by direct loading of an epitope onto an empty HLA molecule that is expressed on a cell, and via internalization of the epitope and processing via the HLA class I pathway; in either event, the HLA molecule expressing the epitope was then able to interact with and induce a CTL response. Peptides can be delivered directly or using such agents as liposomes. They can additionally be delivered using ballistic delivery, in which the peptides are typically in a crystalline form. When DNA is used to induce an immune response, it is administered either as naked DNA, generally in a dose range of approximately 1-5mg, or via the ballistic "gene gun" delivery, typically in a dose range of approximately 10-100 μg. The DNA can be delivered in a variety of conformations, *e.g.*, linear, circular *etc*. Various viral vectors have also successfully been used that comprise nucleic acids which encode epitopes in accordance with the invention.

Accordingly compositions in accordance with the invention exist in several forms. Embodiments of each of these composition forms in accordance with the invention have been successfully used to induce an immune response.

One composition in accordance with the invention comprises a plurality of peptides. This plurality or cocktail of peptides is generally admixed with one or more pharmaceutically acceptable excipients. The peptide cocktail can comprise multiple copies of the same peptide or can comprise a mixture of peptides. The peptides can be analogs of naturally occurring epitopes. The peptides can comprise artificial amino acids and/or chemical modifications such as addition of a surface active molecule, *e.g.*, lipidation; acetylation, glycosylation, biotinylation, phosphorylation etc. The peptides can be CTL or HTL epitopes. In a preferred embodiment the peptide cocktail comprises a plurality of different CTL epitopes and at least one HTL epitope. The HTL epitope can be naturally or non-naturally (*e.g.*, PADRE®, Epimmune Inc., San Diego, CA). The number of distinct epitopes in an embodiment of the invention is generally a whole unit integer from one through one hundred fifty (e.g., 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, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70,

71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, or 150).

An additional embodiment of a composition in accordance with the invention comprises a polypeptide multi-epitope construct, *i.e.*, a polyepitopic peptide. Polyepitopic peptides in accordance with the invention are prepared by use of technologies well-known in the art. By use of these known technologies, epitopes in accordance with the invention are connected one to another. The polyepitopic peptides can be linear or non-linear, *e.g.*, multivalent. These polyepitopic constructs can comprise artificial amino acids, spacing or spacer amino acids, flanking amino acids, or chemical modifications between adjacent epitope units. The polyepitopic construct can be a heteropolymer or a homopolymer. The polyepitopic constructs generally comprise epitopes in a quantity of any whole unit integer between 2-150 (*e.g.*, 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, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, or 150). The polyepitopic construct can comprise CTL and/or HTL epitopes. One or more of the epitopes in the construct can be modified, *e.g.*, by addition of a surface active material, *e.g.* a lipid, or chemically modified, *e.g.*, acetylation, *etc*. Moreover, bonds in the multiepitopic construct can be other than peptide bonds, *e.g.*, covalent bonds, ester or ether bonds, disulfide bonds, hydrogen bonds, ionic bonds *etc.*

Alternatively, a composition in accordance with the invention comprises construct which comprises a series, sequence, stretch, *etc.*, of amino acids that have homology to (*i.e.*, corresponds to or is contiguous with) to a native sequence. This stretch of amino acids comprises at least one subsequence of amino acids that, if cleaved or isolated from the longer series of amino acids, functions as an HLA class I or HLA class II epitope in accordance with the invention. In this embodiment, the peptide sequence is modified, so as to become a construct as defined herein, by use of any number of techniques known or to be provided in the art. The polyepitopic constructs can contain homology to a native sequence in any whole unit integer increment from 70-100%, e.g., 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or, 100 percent.

A further embodiment of a composition in accordance with the invention is an antigen presenting cell that comprises one or more epitopes in accordance with the invention. The antigen presenting cell can be a "professional" antigen presenting cell, such as a dendritic cell. The antigen presenting cell can comprise the epitope of the invention by any means known or to be determined in the art. Such means include pulsing of dendritic cells with one or more individual epitopes or with one or more peptides that comprise multiple epitopes, by nucleic acid administration such as ballistic nucleic acid delivery or by other techniques in the art for administration of nucleic acids, including vector-based, *e.g.* viral vector, delivery of nucleic acids.

Further embodiments of compositions in accordance with the invention comprise nucleic acids that encode one or more peptides of the invention, or nucleic acids which encode a polyepitopic peptide in accordance with the invention. As appreciated by one of ordinary skill in the art, various nucleic acids compositions will encode the same peptide due to the redundancy of the genetic code. Each of these nucleic acid compositions falls within the scope of the present invention. This embodiment of the invention

comprises DNA or RNA, and in certain embodiments a combination of DNA and RNA. It is to be appreciated that any composition comprising nucleic acids that will encode a peptide in accordance with the invention or any other peptide based composition in accordance with the invention, falls within the scope of this invention.

It is to be appreciated that peptide-based forms of the invention (as well as the nucleic acids that encode them) can comprise analogs of epitopes of the invention generated using priniciples already known, or to be known, in the art. Principles related to analoging are now known in the art, and are disclosed herein; moreover, analoging principles (heteroclitic analoging) are disclosed in related inventor-derived previously disclosed subject matter. Generally the compositions of the invention are isolated or purified.

The invention will be described in greater detail by way of specific examples. The following examples are offered for illustrative purposes, and are not intended to limit the invention in any manner. Those of skill in the art will readily recognize a variety of non-critical parameters that can be changed or modified to yield alternative embodiments in accordance with the invention.

IV. EXAMPLES

The following example of peptide binding to HLA molecules demonstrates quantification of binding affinities of HLA class I and class II peptides. Binding assays can be performed with peptides that are either motif-bearing or not motif-bearing.

Example 1. HLA Class I and Class II Binding Assays

The following example of peptide binding to HLA molecules demonstrates quantification of binding affinities of HLA class I and class II peptides. Binding assays can be performed with peptides that are either motif-bearing or not motif-bearing.

HLA class I and class II binding assays using purified HLA molecules were performed in accordance with disclosed protocols (*e.g.*, PCT publications WO 94/20127 and WO 94/03205; Sidney *et al.*, *Current Protocols in Immunology* 18.3.1 (1998); Sidney, *et al., J. Immunol.* 154:247 (1995); Sette, *et al., Mol. Immunol.* 31:813 (1994)). Briefly, purified MHC molecules (5 to 500nM) were incubated with various unlabeled peptide inhibitors and 1-10nM ^{125}I-radiolabeled probe peptides as described. Following incubation, MHC-peptide complexes were separated from free peptide by gel filtration and the fraction of peptide bound was determined. Typically, in preliminary experiments, each MHC preparation was titered in the presence of fixed amounts of radiolabeled peptides to determine the concentration of HLA molecules necessary to bind 10-20% of the total radioactivity. All subsequent inhibition and direct binding assays were performed using these HLA concentrations.

Since under these conditions [label]<[HLA] and $IC_{50} \geq$[HLA], the measured IC_{50} values are reasonable approximations of the true K_D values. Peptide inhibitors are typically tested at concentrations ranging from 120 μg/ml to 1.2 ng/ml, and are tested in two to four completely independent experiments. To allow comparison of the data obtained in different experiments, a relative binding figure is calculated for each peptide by dividing the IC_{50} of a positive control for inhibition by the IC_{50} for each

tested peptide (typically unlabeled versions of the radiolabeled probe peptide). For database purposes, and inter-experiment comparisons, relative binding values are compiled. These values can subsequently be converted back into IC_{50} nM values by dividing the IC_{50} nM of the positive controls for inhibition by the relative binding of the peptide of interest. This method of data compilation has proven to be the most accurate and consistent for comparing peptides that have been tested on different days, or with different lots of purified MHC.

Binding assays as outlined above may be used to analyze supermotif and/or motif-bearing epitopes as, for example, described in Example 2.

Example 2. Identification of HLA Supermotif- and Motif-Bearing CTL Candidate Epitopes

Vaccine compositions of the invention can include multiple epitopes that comprise multiple HLA supermotifs or motifs to achieve broad population coverage. This example illustrates the identification of supermotif- and motif-bearing epitopes for the inclusion in such a vaccine composition. Calculation of population coverage was performed using the strategy described below.

Computer searches and algorthims for identification of supermotif and/or motif-bearing epitopes

The searches performed to identify the motif-bearing peptide sequences in Examples 2 and 5 employed the protein sequence data from seven proteins (E1, E2, E5, E6, E7, L1 and L2) from HPV types 16, 18, 31, 33, 45, and 56.

Accession numbers for HPV types			
Protein	**6a**	**6b**	**11**
E1	Q84293 AAA74213	P03113 CAA25020 W1WL6	W1WL11 P04014 AAA46929
E2	Q84294 AAA74214	P03119 CAA25021 W2WL6	AAA46930 W2WLI1 P04015
E4	Q84295 AAA74215	CAA25022 W4WL6	P04016 W4WL11 AAA46931
E5a	Q84296 AAA74216	P06460 CAA25023 W5WL6A	W5WL11 P04017 AAA46932
E5b	N.A.	P06461 CAA25024 W5WLB	W5WL1B P04018 AAA46933
E6	Q84291 AAA74211	P06462 CAA250I8 W6WL6	W6WL11 P04019 AAA21703 AAA46927
E7	Q84929 AAA74212	P06464 CAA25019 W7WL6	AAA46928 AAA21704 W7WL11 P04020
L1	P03100 AAA74218	P03100 CAA25026 P1WL6	P04012 P1WL11 AAA4635
L2	Q84297	P03106 CAA25025	P2WL11 AAA46934

		P2WL6	P040I3

Strain	Protein Antigen	Accession number
HPV16	E1	W1SLHS
HPV16	E2	W2WLHS
HPV16	E5	W5WLHS
HPV16	E6	W6WLHS
HPV16	E7	W7WLHS
HPV16	L1	AAD33259
HPV16	L2	AAD33258
HPV18	E1	W1WL18
HPV18	E2	WL18
HPV18	E5	W5WL18
HPV18	E6	W6WL18
HPV18	E7	PO6788
HPV18	L1	CAA28671
HPV18	L2	P2WL18
HPV31	E1	W1WL31
HPV31	E2	W2WL3
HPV31	E5	W5WL31
HPV31	E6	W6WL31
HPV31	E7	W7WL31
HPV31	L1	P1WL31
HPV31	L2	P2WL31
HPV45	E1	S36563
HPV45	E2	S36564
HPV45	E6	CAB44706
HPV45	E7	CAB44707
HPV45	L1	CAB44705
HPV45	L2	S36565
HPV33	E1	W1WL33
HPV33	E2	W2WL33
HPV33	E5	W5WL33
HPV33	E6	W6WL33
HPV33	E7	W7WL33
HPV33	L1	P1WL33
HPV33	L2	P2WL33
HPV56	E2	S36581
HPV56	E6	W6WL56
HPV56	E7	S36580
HPV56	L1	S38563

HPV56 L2 S36582

Computer searches for epitopes bearing HLA Class I or Class II supermotifs or motifs were performed as follows. All translated HPV protein sequences were analyzed using a text string search software program, *e.g.*, MotifSearch 1.4 (D. Brown, San Diego) to identify potential peptide sequences containing appropriate HLA binding motifs; alternative programs are readily produced in accordance with information in the art in view of the motif/supermotif disclosure herein. Furthermore, such calculations can be made mentally.

Identified A2-, A3-, and DR-supermotif sequences were scored using polynomial algorithms to predict their capacity to bind to specific HLA-Class I or Class II molecules. These polynomial algorithms take into account both extended and refined motifs (that is, to account for the impact of different amino acids at different positions), and are essentially based on the premise that the overall affinity (or ΔG) of peptide-HLA molecule interactions can be approximated as a linear polynomial function of the type:

$$\text{“}\Delta G\text{”} = a_{1i} \times a_{2i} \times a_{3i} \ldots\ldots \times a_{ni}$$

where a_{ji} is a coefficient which represents the effect of the presence of a given amino acid (j) at a given position (i) along the sequence of a peptide of n amino acids. The crucial assumption of this method is that the effects at each position are essentially independent of each other (i.e., independent binding of individual side-chains). When residue j occurs at position i in the peptide, it is assumed to contribute a constant amount j_i to the free energy of binding of the peptide irrespective of the sequence of the rest of the peptide. This assumption is justified by studies from our laboratories that demonstrated that peptides are bound to MHC and recognized by T cells in essentially an extended conformation (data omitted herein).

The method of derivation of specific algorithm coefficients has been described in Gulukota *et al.*, *J. Mol. Biol.* 267:1258-126, 1997; (see also Sidney *et al.*, *Human Immunol.* 45:79-93, 1996; and Southwood *et al.*, *J. Immunol.* 160:3363-3373, 1998). Briefly, for all i positions, anchor and non-anchor alike, the geometric mean of the average relative binding (ARB) of all peptides carrying j is calculated relative to the remainder of the group, and used as the estimate of j_i. For Class II peptides, if multiple alignments are possible, only the highest scoring alignment is utilized, following an iterative procedure. To calculate an algorithm score of a given peptide in a test set, the ARB values corresponding to the sequence of the peptide are multiplied. If this product exceeds a chosen threshold, the peptide is predicted to bind. Appropriate thresholds are chosen as a function of the degree of stringency of prediction desired.

Selection of HLA-A2 supertype cross-reactive peptides

Complete protein sequences from the seven HPV structural and regulatory proteins of the HPV strains listed above were aligned, then scanned, utilizing motif identification software, to identify 9- and 10-mer sequences containing the HLA-A2-supermotif main anchor specificity.

HLA-A2 supermotif-bearing sequences are shown in Table VIII. Typically, these sequences are then scored using the A2 algorithm and the peptides corresponding to the positive-scoring

sequences are synthesized and tested for their capacity to bind purified HLA-A*0201 molecules *in vitro* (HLA-A*0201 is considered a prototype A2 supertype molecule).

Examples of peptides that bind to HLA-A*0201 with IC_{50} values ≤500 nM are shown in Table VIII. These peptides are then tested for the capacity to bind to additional A2-supertype molecules (A*0202, A*0203, A*0206, and A*6802). Peptides that bind to at least three of the five A2-supertype alleles tested are typically deemed A2-supertype cross-reactive binders. Preferred peptides bind at an affinity equal to or less than 500 nM to three or more HLA-A2 supertype molecules.

Selection of HLA-A3 supermotif-bearing epitopes

The HPV protein sequences scanned above were also examined for the presence of peptides with the HLA-A3-supermotif primary anchors (Table IX).

Peptides corresponding to the supermotif-bearing sequences are then synthesized and tested for binding to HLA-A*0301 and HLA-A*1101 molecules, the two most prevalent A3-supertype alleles. The peptides that are found to bind one of the two alleles with binding affinities of ≤500 nM, often ≤ 200 nM, are then tested for binding cross-reactivity to the other common A3-supertype alleles (A*3101, A*3301, and A*6801) to identify those that can bind at least three of the five HLA-A3-supertype molecules tested.

Selection of HLA-B7 supermotif bearing epitopes

The same HPV target antigen protein sequences were also analyzed for the presence of 9- or 10-mer peptides with the HLA-B7-supermotif (Table XI).

Corresponding peptides are synthesized and tested for binding to HLA-B*0702, the most common B7-supertype allele (*i.e.*, the prototype B7 supertype allele). Peptides binding B*0702 with IC_{50} of ≤500 nM are identified using standard methods. These peptides are then tested for binding to other common B7-supertype molecules (B*3501, B*5101, B*5301, and B*5401). Peptides capable of binding to three or more of the five B7-supertype alleles tested are thereby identified.

Selection of A1 and A24 motif-bearing epitopes

To further increase population coverage, HLA-A1 and -A24 epitopes can, for example, also be incorporated into potential vaccine constructs. An analysis of the protein sequence data from the HPV target antigens utilized above can also be performed to identify HLA-A1- and A24-motif-containing sequences.

High affinity and/or cross-reactive binding epitopes that bear other motif and/or supermotifs are identified using analogous methodology.

Example 3. Confirmation of Immunogenicity

Cross-reactive candidate CTL A2-supermotif-bearing peptides that are identified as described in Example 2 were selected for *in vitro* immunogenicity testing. Testing was performed using the following methodology:

Target Cell Lines for Cellular Screening:

The .221A2.1 cell line, produced by transferring the HLA-A2.1 gene into the HLA-A, -B, -C null mutant human B-lymphoblastoid cell line 721.221, is used as the peptide-loaded target to measure activity of HLA-A2.1-restricted CTL. This cell line is grown in RPMI-1640 medium supplemented with antibiotics, sodium pyruvate, nonessential amino acids and 10% (v/v) heat inactivated FCS. Cells that express an antigen of interest, or transfectants comprising the gene encoding the antigen of interest, can be used as target cells to test the ability of peptide-specific CTLs to recognize endogenous antigen.

Primary CTL Induction Cultures:

Generation of Dendritic Cells (DC): PBMCs are thawed in RPMI with 30 g/ml DNAse, washed twice and resuspended in complete medium (RPMI-1640 plus 5% AB human serum, non-essential amino acids, sodium pyruvate, L-glutamine and penicillin/strpetomycin). The monocytes are purified by plating 10 x 10^6 PBMC/well in a 6-well plate. After 2 hours at 37°C, the non-adherent cells are removed by gently shaking the plates and aspirating the supernatants. The wells are washed a total of three times with 3 ml RPMI to remove most of the non-adherent and loosely adherent cells. Three ml of complete medium containing 50 ng/ml of GM-CSF and 1,000 U/ml of IL-4 are then added to each well. TNF is added to the DCs on day 6 at 75 ng/ml and the cells are used for CTL induction cultures on day 7.

Induction of CTL with DC and Peptide: CD8+ T-cells are isolated by positive selection with Dynal immunomagnetic beads (Dynabeads® M-450) and the detacha-bead® reagent. Typically about 200-250x10^6 PBMC are processed to obtain 24x10^6 $CD8^+$ T-cells (enough for a 48-well plate culture). Briefly, the PBMCs are thawed in RPMI with 30µg/ml DNAse, washed once with PBS containing 1% human AB serum and resuspended in PBS/1% AB serum at a concentration of 20x10^6cells/ml. The magnetic beads are washed 3 times with PBS/AB serum, added to the cells (140µl beads/20x10^6 cells) and incubated for 1 hour at 4°C with continuous mixing. The beads and cells are washed 4x with PBS/AB serum to remove the nonadherent cells and resuspended at 100x10^6 cells/ml (based on the original cell number) in PBS/AB serum containing 100µl/ml detacha-bead® reagent and 30µg/ml DNAse. The mixture is incubated for 1 hour at room temperature with continuous mixing. The beads are washed again with PBS/AB/DNAse to collect the CD8+ T-cells. The DC are collected and centrifuged at 1300 rpm for 5-7 minutes, washed once with PBS with 1% BSA, counted and pulsed with 40µg/ml of peptide at a cell concentration of 1-2x10^6/ml in the presence of 3µg/ml $ß_2$- microglobulin for 4 hours at 20°C. The DC are then irradiated (4,200 rads), washed 1 time with medium and counted again.

Setting up induction cultures: 0.25 ml cytokine-generated DC (@1x10^5 cells/ml) are co-cultured with 0.25ml of CD8+ T-cells (@2x10^6 cell/ml) in each well of a 48-well plate in the presence of 10 ng/ml of IL-7. Recombinant human IL10 is added the next day at a final concentration of 10 ng/ml and rhuman IL2 is added 48 hours later at 10IU/ml.

Restimulation of the induction cultures with peptide-pulsed adherent cells: Seven and fourteen days after the primary induction the cells are restimulated with peptide-pulsed adherent cells. The PBMCS are thawed and washed twice with RPMI and DNAse. The cells are resuspended at 5x10^6 cells/ml and irradiated at ~4200 rads. The PBMCs are plated at 2x10^6 in 0.5ml complete medium per well and incubated for 2 hours at 37°C. The plates are washed twice with RPMI by tapping the plate gently to

remove the nonadherent cells and the adherent cells pulsed with 10μg/ml of peptide in the presence of 3 μg/ml $ß_2$ microglobulin in 0.25ml RPMI/5%AB per well for 2 hours at 37°C. Peptide solution from each well is aspirated and the wells are washed once with RPMI. Most of the media is aspirated from the induction cultures (CD8+ cells) and brought to 0.5 ml with fresh media. The cells are then transferred to the wells containing the peptide-pulsed adherent cells. Twenty four hours later rhuman IL10 is added at a final concentration of 10ng/ml and rhuman IL2 is added the next day and again 2-3 days later at 50IU/ml (Tsai *et al., Critical Reviews in Immunology* 18(1-2):65-75, 1998). Seven days later the cultures are assayed for CTL activity in a ^{51}Cr release assay. In some experiments the cultures are assayed for peptide-specific recognition in the *in situ* IFNγ ELISA at the time of the second restimulation followed by assay of endogenous recognition 7 days later. After expansion, activity is measured in both assays for a side by side comparison.

Measurement of CTL lytic activity by ^{51}Cr release.

Seven days after the second restimulation, cytotoxicity is determined in a standard (5hr) ^{51}Cr release assay by assaying individual wells at a single E:T. Peptide-pulsed targets are prepared by incubating the cells with 10μg/ml peptide overnight at 37°C.

Adherent target cells are removed from culture flasks with trypsin-EDTA. Target cells are labelled with 200μCi of ^{51}Cr sodium chromate (Dupont, Wilmington, DE) for 1 hour at 37°C. Labelled target cells are resuspended at 10^6 per ml and diluted 1:10 with K562 cells at a concentration of $3.3x10^6$/ml (an NK-sensitive erythroblastoma cell line used to reduce non-specific lysis). Target cells (100 μl) and 100μl of effectors are plated in 96 well round-bottom plates and incubated for 5 hours at 37°C. At that time, 100 μl of supernatant are collected from each well and percent lysis is determined according to the formula: [(cpm of the test sample- cpm of the spontaneous ^{51}Cr release sample)/(cpm of the maximal ^{51}Cr release sample- cpm of the spontaneous ^{51}Cr release sample)] x 100. Maximum and spontaneous release are determined by incubating the labelled targets with 1% Trition X-100 and media alone, respectively. A positive culture is defined as one in which the specific lysis (sample- background) is 10% or higher in the case of individual wells and is 15% or more at the 2 highest E:T ratios when expanded cultures are assayed.

***In situ* Measurement of Human γIFN Production as an Indicator of Peptide-specific and Endogenous Recognition**

Immulon 2 plates are coated with mouse anti-human IFNγ monoclonal antibody (4 μg/ml 0.1M $NaHCO_3$, pH8.2) overnight at 4°C. The plates are washed with Ca^{2+}, Mg^{2+}-free PBS/0.05% Tween 20 and blocked with PBS/10% FCS for 2 hours, after which the CTLs (100 μl/well) and targets (100 μl/well) are added to each well, leaving empty wells for the standards and blanks (which received media only). The target cells, either peptide-pulsed or endogenous targets, are used at a concentration of $1x10^6$ cells/ml. The plates are incubated for 48 hours at 37°C with 5% CO_2.

Recombinant human IFNγ is added to the standard wells starting at 400 pg or 1200pg/100μl/well and the plate incubated for 2 hours at 37°C. The plates are washed and 100 l of biotinylated mouse anti-human IFNγ monoclonal antibody (2μg/ml in PBS/3%FCS/0.05% Tween 20) are added and incubated for 2 hours at room temperature. After washing again, 100 μl HRP-streptavidin

(1:4000) are added and the plates incubated for 1 hour at room temperature. The plates are then washed 6x with wash buffer, 100µl/well developing solution (TMB 1:1) are added, and the plates allowed to develop for 5-15 minutes. The reaction is stopped with 50 µl/well 1M H_3PO_4 and read at OD450. A culture is considered positive if it measured at least 50 pg of IFNγ/well above background and is twice the background level of expression.

CTL Expansion. Those cultures that demonstrate specific lytic activity against peptide-pulsed targets and/or tumor targets are expanded over a two week period with anti-CD3. Briefly, $5x10^4$ CD8+ cells are added to a T25 flask containing the following: $1x10^6$ irradiated (4,200 rad) PBMC (autologous or allogeneic) per ml, $2x10^5$ irradiated (8,000 rad) EBV- transformed cells per ml, and OKT3 (anti-CD3) at 30ng per ml in RPMI-1640 containing 10% (v/v) human AB serum, non-essential amino acids, sodium pyruvate, 25µM 2-mercaptoethanol, L-glutamine and penicillin/streptomycin. Rhuman IL2 is added 24 hours later at a final concentration of 200IU/ml and every 3 days thereafter with fresh media at 50IU/ml. The cells are split if the cell concentration exceeded $1x10^6$/ml and the cultures are assayed between days 13 and 15 at E:T ratios of 30, 10, 3 and 1:1 in the ^{51}Cr release assay or at $1x10^6$/ml in the *in situ* IFN assay using the same targets as before the expansion.

Cultures are expanded in the absence of anti-$CD3^+$ as follows. Those cultures that demonstrate specific lytic activity against peptide and endogenous targets are selected and $5x10^4$ $CD8^+$ cells are added to a T25 flask containing the following: $1x10^6$ autologous PBMC per ml which have been peptide-pulsed with 10µg/ml peptide for 2 hours at 37°C and irradiated (4,200 rad); $2x10^5$ irradiated (8,000 rad) EBV-transformed cells per ml RPMI-1640 containing 10%(v/v) human AB serum, non-essential AA, sodium pyruvate, 25mM 2-ME, L-glutamine and gentamicin.

Immunogenicity of A2 supermotif-bearing peptides

A2-supermotif cross-reactive binding peptides are tested in the cellular assay for the ability to induce peptide-specific CTL in normal individuals. In this analysis, a peptide is typically considered to be an epitope if it induces peptide-specific CTLs in at least 2 donors (unless otherwise noted) and preferably, also recognizes the endogenously expressed peptide.

Immunogenicity is additionally confirmed using PBMCs isolated from HPV-infected patients. Briefly, PBMCs are isolated from patients, re-stimulated with peptide-pulsed monocytes and assayed for the ability to recognize peptide-pulsed target cells as well as transfected cells endogenously expressing the antigen.

*Evaluation of A*03/A11 immunogenicity*

HLA-A3 supermotif-bearing cross-reactive binding peptides are also evaluated for immunogenicity using methodology analogous for that used to evaluate the immunogenicity of the HLA-A2 supermotif peptides.

Evaluation of B7 immunogenicity

Immunogenicity screening of the B7-supertype cross-reactive binding peptides identified in Example 2 are evaluated in a manner analogous to the evaluation of A2-and A3-supermotif-bearing peptides.

Peptides bearing other supermotifs/motifs, *e.g.*, HLA-A1, HLA-A24 *etc.* are also evaluated using similar methodology

Example 4. Implementation of the Extended Supermotif to Improve the Binding Capacity of Native Epitopes by Creating Analogs

HLA motifs and supermotifs (comprising primary and/or secondary residues) are useful in the identification and preparation of highly cross-reactive native peptides, as demonstrated herein. Moreover, the definition of HLA motifs and supermotifs also allows one to engineer highly cross-reactive epitopes by identifying residues within a native peptide sequence which can be analoged, or "fixed" to confer upon the peptide certain characteristics, *e.g.* greater cross-reactivity within the group of HLA molecules that comprise a supertype, and/or greater binding affinity for some or all of those HLA molecules. Examples of analoging peptides to exhibit modulated binding affinity are set forth in this example.

Analoging at Primary Anchor Residues

Peptide engineering strategies are implemented to further increase the cross-reactivity of the epitopes. For example, on the basis of the data disclosed, the main anchors of A2-supermotif-bearing peptides are altered, for example, to introduce a preferred L, I, V, or M at position 2, and I or V at the C-terminus.

To analyze the cross-reactivity of the analog peptides, each engineered analog is initially tested for binding to the prototype A2 supertype allele A*0201, then, if A*0201 binding capacity is maintained, for A2-supertype cross-reactivity.

Alternatively, a peptide is tested for binding to one or all supertype members and then analogued to modulate binding affinity to any one (or more) of the supertype members to add population coverage.

The selection of analogs for immunogenicity in a cellular screening analysis is typically further restricted by the capacity of the parent peptide to bind at least weakly, *i.e.*, bind at an IC_{50} of 5000nM or less, to three of more A2 supertype alleles. The rationale for this requirement is that the WT peptides must be present endogenously in sufficient quantity to be biologically relevant. Analoged peptides have been shown to have increased immunogenicity and cross-reactivity by T cells specific for the parent epitope (*see, e.g.*, Parkhurst *et al.*, *J. Immunol.* 157:2539, 1996; and Pogue *et al.*, *Proc. Natl. Acad. Sci. USA* 92:8166, 1995).

In the cellular screening of these peptide analogs, it is important to demonstrate that analog-specific CTLs are also able to recognize the wild-type peptide and, when possible, target cells that endogenously express the epitope.

Analoging of HLA-A3 and B7-supermotif-bearing peptides

Analogs of HLA-A3 supermotif-bearing epitopes are generated using strategies similar to those employed in analoging HLA-A2 supermotif-bearing peptides. For example, peptides binding to 3/5 of the A3-supertype molecules are engineered at primary anchor residues to possess a preferred residue (V, S, M, or A) at position 2.

The analog peptides are then tested for the ability to bind A*03 and A*11 (prototype A3 supertype alleles). Those peptides that demonstrate ≤ 500 nM binding capacity are then tested for A3-supertype cross-reactivity.

Similarly to the A2- and A3- motif bearing peptides, peptides binding 3 or more B7-supertype alleles can be improved, where possible, to achieve increased cross-reactive binding. B7 supermotif-bearing peptides are, for example, engineered to possess a preferred residue (V, I, L, or F) at the C-terminal primary anchor position, as demonstrated by Sidney *et al.* (*J. Immunol.* 157:3480-3490, 1996).

Analoguing at primary anchor residues of other motif and/or supermotif-bearing epitopes is performed in a like manner.

The analog peptides are then be tested for immunogenicity, typically in a cellular screening assay. Again, it is generally important to demonstrate that analog-specific CTLs are also able to recognize the wild-type peptide and, when possible, targets that endogenously express the epitope.

Analoging at Secondary Anchor Residues

Moreover, HLA supermotifs are of value in engineering highly cross-reactive peptides and/or peptides that bind HLA molecules with increased affinity by identifying particular residues at secondary anchor positions that are associated with such properties. For example, the binding capacity of a B7 supermotif-bearing peptide with an F residue at postion 1 is analyzed. The peptide is then analoged to, for example, substitute L for F at position 1. The analoged peptide is evaluated for increased binding affinity/ and or increased cross-reactivity. Such a procedure identifies analoged peptides with modulated binding affinity.

Engineered analogs with sufficiently improved binding capacity or cross-reactivity can also be tested for immunogenicity in HLA-B7-transgenic mice, following for example, IFA immunization or lipopeptide immunization. Analogued peptides are additionally tested for the ability to stimulate a recall response using PBMC from HPV-infected patients.

Other analoguing strategies

Another form of peptide analoguing, unrelated to the anchor positions, involves the substitution of a cysteine with α-amino butyric acid. Due to its chemical nature, cysteine has the propensity to form disulfide bridges and sufficiently alter the peptide structurally so as to reduce binding capacity. Subtitution of α-amino butyric acid for cysteine not only alleviates this problem, but has been shown to improve binding and crossbinding capabilities in some instances (*see, e.g.*, the review by Sette *et al.*, In: Persistent Viral Infections, Eds. R. Ahmed and I. Chen, John Wiley & Sons, England, 1999).

Thus, by the use of even single amino acid substitutions, the binding affinity and/or cross-reactivity of peptide ligands for HLA supertype molecules can be modulated.

Example 5. Identification of HPV-derived sequences with HLA-DR binding motifs

Peptide epitopes bearing an HLA class II supermotif or motif are identified as outlined below using methodology similar to that described in Examples 1-3.

Selection of HLA-DR-supermotif-bearing epitopes.

To identify HPV-derived, HLA class II HTL epitopes, the protein sequences from the same HPV antigens used for the identification of HLA Class I supermotif/motif sequences were analyzed for the presence of sequences bearing an HLA-DR-motif or supermotif. Specifically, 15-mer sequences were selected comprising a DR-supermotif, further comprising a 9-mer core, and three-residue N- and C-terminal flanking regions (15 amino acids total).

Protocols for predicting peptide binding to DR molecules have been developed (Southwood *et al.*, *J. Immunol.* 160:3363-3373, 1998). These protocols, specific for individual DR molecules, allow the scoring, and ranking, of 9-mer core regions. Each protocol not only scores peptide sequences for the presence of DR-supermotif primary anchors (i.e., at position 1 and position 6) within a 9-mer core, but additionally evaluates sequences for the presence of secondary anchors. Using allele specific selection tables (see, *e.g.*, Southwood *et al.*, *ibid.*), it has been found that these protocols efficiently select peptide sequences with a high probability of binding a particular DR molecule. Additionally, it has been found that performing these protocols in tandem, specifically those for DR1, DR4w4, and DR7, can efficiently select DR cross-reactive peptides.

The HPV-derived peptides identified above are tested for their binding capacity for various common HLA-DR molecules. All peptides are initially tested for binding to the DR molecules in the primary panel: DR1, DR4w4, and DR7. Peptides binding at least 2 of these 3 DR molecules are then tested for binding to DR2w2 β1, DR2w2 β2, DR6w19, and DR9 molecules in secondary assays. Finally, peptides binding at least 2 of the 4 secondary panel DR molecules, and thus cumulatively at least 4 of 7 different DR molecules, are screened for binding to DR4w15, DR5w11, and DR8w2 molecules in tertiary assays. Peptides binding at least 7 of the 10 DR molecules comprising the primary, secondary, and tertiary screening assays are considered cross-reactive DR binders. HPV-derived peptides found to bind common HLA-DR alleles are of particular interest.

Selection of DR3 motif peptides

Because HLA-DR3 is an allele that is prevalent in Caucasian, Black, and Hispanic populations, DR3 binding capacity is an important criterion in the selection of HTL epitopes. However, data generated previously indicated that DR3 only rarely cross-reacts with other DR alleles (Sidney *et al.*, *J. Immunol.* 149:2634-2640, 1992; Geluk *et al.*, *J. Immunol.* 152:5742-5748, 1994; Southwood *et al.*, *J. Immunol.* 160:3363-3373, 1998). This is not entirely surprising in that the DR3 peptide-binding motif appears to be distinct from the specificity of most other DR alleles. For maximum efficiency in developing vaccine candidates it would be desirable for DR3 motifs to be clustered in proximity with DR supermotif

regions. Thus, peptides shown to be candidates may also be assayed for their DR3 binding capacity. However, in view of the distinct binding specificity of the DR3 motif, peptides binding only to DR3 can also be considered as candidates for inclusion in a vaccine formulation.

To efficiently identify peptides that bind DR3, target HPV antigens are analyzed for sequences carrying one of the two DR3 specific binding motifs reported by Geluk *et al.* (*J. Immunol.* 152:5742-5748, 1994). The corresponding peptides are then synthesized and tested for the ability to bind DR3 with an affinity of 1μM or better, i.e., less than 1 μM. Peptides are found that meet this binding criterion and qualify as HLA class II high affinity binders.

DR3 binding epitopes identified in this manner are included in vaccine compositions with DR supermotif-bearing peptide epitopes.

Similarly to the case of HLA class I motif-bearing peptides, the class II motif-bearing peptides are analoged to improve affinity or cross-reactivity. For example, aspartic acid at position 4 of the 9-mer core sequence is an optimal residue for DR3 binding, and substitution for that residue often improves DR 3 binding.

Example 6. Immunogenicity of HPV-derived HTL epitopes

This example determines immunogenic DR supermotif- and DR3 motif-bearing epitopes among those identified using the methodology in Example 5.

Immunogenicity of HTL epitopes are evaluated in a manner analogous to the determination of immunogenicity of CTL epitopes by assessing the ability to stimulate HTL responses and/or by using appropriate transgenic mouse models. Immunogenicity is determined by screening for: 1.) *in vitro* primary induction using normal PBMC or 2.) recall responses from cancer patient PBMCs.

Example 7. Calculation of phenotypic frequencies of HLA-supertypes in various ethnic backgrounds to determine breadth of population coverage

This example illustrates the assessment of the breadth of population coverage of a vaccine composition comprised of multiple epitopes comprising multiple supermotifs and/or motifs.

In order to analyze population coverage, gene frequencies of HLA alleles were determined. Gene frequencies for each HLA allele were calculated from antigen or allele frequencies utilizing the binomial distribution formulae gf=1-(SQRT(1-af)) (see, *e.g.*, Sidney *et al.*, *Human Immunol.* 45:79-93, 1996). To obtain overall phenotypic frequencies, cumulative gene frequencies were calculated, and the cumulative antigen frequencies derived by the use of the inverse formula [af=1-(1-Cgf)^2].

Where frequency data was not available at the level of DNA typing, correspondence to the serologically defined antigen frequencies was assumed. To obtain total potential supertype population coverage no linkage disequilibrium was assumed, and only alleles confirmed to belong to each of the supertypes were included (minimal estimates). Estimates of total potential coverage achieved by inter-loci combinations were made by adding to the A coverage the proportion of the non-A covered population that could be expected to be covered by the B alleles considered (e.g., total=A+B*(1-A)). Confirmed members of the A3-like supertype are A3, A11, A31, A*3301, and A*6801. Although the A3-like supertype may also include A34, A66, and A*7401, these alleles were not included in overall frequency calculations.

Likewise, confirmed members of the A2-like supertype family are A*0201, A*0202, A*0203, A*0204, A*0205, A*0206, A*0207, A*6802, and A*6901. Finally, the B7-like supertype-confirmed alleles are: B7, B*3501-03, B51, B*5301, B*5401, B*5501-2, B*5601, B*6701, and B*7801 (potentially also B*1401, B*3504-06, B*4201, and B*5602).

Population coverage achieved by combining the A2-, A3- and B7-supertypes is approximately 86% in five major ethnic groups, *supra*. Coverage may be extended by including peptides bearing the A1 and A24 motifs. On average, A1 is present in 12% and A24 in 29% of the population across five different major ethnic groups (Caucasian, North American Black, Chinese, Japanese, and Hispanic). Together, these alleles are represented with an average frequency of 39% in these same ethnic populations. The total coverage across the major ethnicities when A1 and A24 are combined with the coverage of the A2-, A3- and B7-supertype alleles is >95%. An analagous approach can be used to estimate population coverage achieved with combinations of class II motif-bearing epitopes.

Immunogenicity studies in humans (*e.g.*, Bertoni *et al.*, *J. Clin. Invest.* 100:503, 1997; Doolan *et al.*, *Immunity* 7:97, 1997; and Threlkeld *et al.*, *J. Immunol.* 159:1648, 1997) have shown that highly cross-reactive binding peptides are almost always recognized as epitopes. The use of highly cross-reactive binding peptides is an important selection criterion in identifying candidate epitopes for inclusion in a vaccine that is immunogenic in a diverse population.

With a sufficient number of epitopes (as disclosed herein and from the art), an average population coverage is predicted to be greater than 95% in each of five major ethnic populations. The game theory Monte Carlo simulation analysis, which is known in the art (see *e.g.*, Osborne, M.J. and Rubinstein, A. "A course in game theory" MIT Press, 1994), can be used to estimate what percentage of the individuals in a population comprised of the Caucasian, North American Black, Japanese, Chinese, and Hispanic ethnic groups would recognize the vaccine epitopes described herein. A preferred percentage is 90%. A more preferred percentage is 95%.

Example 8. CTL Recognition Of Endogenous Processed Antigens After Priming

This example determines that CTL induced by native or analogued peptide epitopes identified and selected as described in Examples 1-6 recognize endogenously synthesized, *i.e.*, native antigens.

Effector cells isolated from transgenic mice that are immunized with peptide epitopes as in Example 3, for example HLA-A2 supermotif-bearing epitopes, are re-stimulated *in vitro* using peptide-coated stimulator cells. Six days later, effector cells are assayed for cytotoxicity and the cell lines that contain peptide-specific cytotoxic activity are further re-stimulated. An additional six days later, these cell lines are tested for cytotoxic activity on ^{51}Cr labeled Jurkat-A2.1/K^b target cells in the absence or presence of peptide, and also tested on ^{51}Cr labeled target cells bearing the endogenously synthesized antigen, *i.e.* cells that are stably transfected with HPV expression vectors.

The result will demonstrate that CTL lines obtained from animals primed with peptide epitope recognize endogenously synthesized HPV antigen. The choice of transgenic mouse model to be used for such an analysis depends upon the epitope(s) that is being evaluated. In addition to HLA-A*0201/K^b transgenic mice, several other transgenic mouse models including mice with human A11, which

may also be used to evaluate A3 epitopes, and B7 alleles have been characterized and others (*e.g.*, transgenic mice for HLA-A1 and A24) are being developed. HLA-DR1 and HLA-DR3 mouse models have also been developed, which may be used to evaluate HTL epitopes.

Example 9. Activity Of CTL-HTL Conjugated Epitopes In Transgenic Mice

This example illustrates the induction of CTLs and HTLs in transgenic mice by use of a tumor associated antigen CTL/HTL peptide conjugate whereby the vaccine composition comprises peptides to be administered to an HPV-infected patient. The peptide composition can comprise multiple CTL and/or HTL epitopes and further, can comprise epitopes selected from multiple HPV target antigens. The epitopes are identified using methodology as described in Examples 1-6 This analysis demonstrates the enhanced immunogenicity that can be achieved by inclusion of one or more HTL epitopes in a vaccine composition. Such a peptide composition can comprise an HTL epitope conjugated to a preferred CTL epitope containing, for example, at least one CTL epitope that binds to multiple HLA family members at an affinity of 500 nM or less, or analogs of that epitope. The peptides may be lipidated, if desired.

Immunization procedures: Immunization of transgenic mice is performed as described (Alexander *et al.*, *J. Immunol.* 159:4753-4761, 1997). For example, A2/K^b mice, which are transgenic for the human HLA A2.1 allele and are useful for the assessment of the immunogenicity of HLA-A*0201 motif- or HLA-A2 supermotif-bearing epitopes, are primed subcutaneously (base of the tail) with a 0.1 ml of peptide in Incomplete Freund's Adjuvant, or if the peptide composition is a lipidated CTL/HTL conjugate, in DMSO/saline or if the peptide composition is a polypeptide, in PBS or Incomplete Freund's Adjuvant. Seven days after priming, splenocytes obtained from these animals are restimulated with syngenic irradiated LPS-activated lymphoblasts coated with peptide.

Cell lines: Target cells for peptide-specific cytotoxicity assays are Jurkat cells transfected with the HLA-A2.1/K^b chimeric gene (*e.g.*, Vitiello *et al., J. Exp. Med.* 173:1007, 1991)

In vitro CTL activation: One week after priming, spleen cells ($30x10^6$ cells/flask) are co-cultured at 37°C with syngeneic, irradiated (3000 rads), peptide coated lymphoblasts ($10x10^6$ cells/flask) in 10 ml of culture medium/T25 flask. After six days, effector cells are harvested and assayed for cytotoxic activity.

Assay for cytotoxic activity: Target cells (1.0 to $1.5x10^6$) are incubated at 37°C in the presence of 200 µl of ^{51}Cr. After 60 minutes, cells are washed three times and resuspended in R10 medium. Peptide is added where required at a concentration of 1 µg/ml. For the assay, 10^4 ^{51}Cr-labeled target cells are added to different concentrations of effector cells (final volume of 200 µl) in U-bottom 96-well plates. After a 6 hour incubation period at 37°C, a 0.1 ml aliquot of supernatant is removed from each well and radioactivity is determined in a Micromedic automatic gamma counter. The percent specific lysis is determined by the formula: percent specific release = 100 x (experimental release - spontaneous release)/(maximum release - spontaneous release). To facilitate comparison between separate CTL assays run under the same conditions, % ^{51}Cr release data is expressed as lytic units/10^6 cells. One lytic unit is arbitrarily defined as the number of effector cells required to achieve 30% lysis of 10,000 target cells in a 6 hour ^{51}Cr release assay. To obtain specific lytic units/10^6, the lytic units/10^6 obtained in the absence of peptide is subtracted from the lytic units/10^6 obtained in the presence of peptide. For example, if 30% ^{51}Cr

release is obtained at the effector (E): target (T) ratio of 50:1 (i.e., $5x10^5$ effector cells for 10,000 targets) in the absence of peptide and 5:1 (i.e., $5x10^4$ effector cells for 10,000 targets) in the presence of peptide, the specific lytic units would be: $[(1/50,000)-(1/500,000)] \times 10^6 = 18$ LU.

The results are analyzed to assess the magnitude of the CTL responses of animals injected with the immunogenic CTL/HTL conjugate vaccine preparation and are compared to the magnitude of the CTL response achieved using the CTL epitope as outlined in Example 3. Analyses similar to this may be performed to evaluate the immunogenicity of peptide conjugates containing multiple CTL epitopes and/or multiple HTL epitopes. In accordance with these procedures it is found that a CTL response is induced, and concomitantly that an HTL response is induced upon administration of such compositions.

Example 10. Selection of CTL and HTL epitopes for inclusion in an HPV-specific vaccine.

This example illustrates the procedure for the selection of peptide epitopes for vaccine compositions of the invention. The peptides in the composition can be in the form of a nucleic acid sequence, either single or one or more sequences (*i.e.*, minigene) that encodes peptide(s), or can be single and/or polyepitopic peptides.

The following principles are utilized when selecting an array of epitopes for inclusion in a vaccine composition. Each of the following principles is balanced in order to make the selection.

Epitopes are selected which, upon administration, mimic immune responses that have been observed to be correlated with HPV clearance. The number of epitopes used depends on observations of patients who spontaneously clear HPV. For example, if it has been observed that patients who spontaneously clear HPV generate an immune response to at least 3 epitopes on at least one HPV antigen, then 3-4 epitopes should be included for HLA class I. A similar rationale is used to determine HLA class II epitopes.

When selecting an array of HPV epitopes, it is preferred that at least some of the epitopes are derived from early and late proteins. The early proteins of HPV are expressed when the virus is replicating, either following acute or dormant infection. Therefore, it is particularly preferred to use epitopes from early stage proteins to alleviate disease manifestations at the earliest stage possible.

Epitopes are often selected that have a binding affinity of an IC_{50} of 500 nM or less for an HLA class I molecule, or for class II, an IC_{50} of 1000 nM or less.

Sufficient supermotif bearing peptides, or a sufficient array of allele-specific motif bearing peptides, are selected to give broad population coverage. For example, epitopes are selected to provide at least 80% population coverage. A Monte Carlo analysis, a statistical evaluation known in the art, can be employed to assess breadth, or redundancy, of population coverage.

When creating a polyepitopic compositions, *e.g.* a minigene, it is typically desirable to generate the smallest peptide possible that encompasses the epitopes of interest. The principles employed are similar, if not the same, as those employed when selecting a peptide comprising nested epitopes.

In cases where the sequences of multiple variants of the same target protein are available, potential peptide epitopes can also be selected on the basis of their conservancy. For example, a criterion for conservancy may define that the entire sequence of an HLA class I binding peptide or the entire 9-mer

core of a class II binding peptide be conserved in a designated percentage of the sequences evaluated for a specific protein antigen.

A vaccine composition comprised of selected peptides, when administered, is safe, efficacious, and elicits an immune response similar in magnitude to an immune response that controls or clears an acute HPV infection.

Example 11. Construction of Minigene Multi-Epitope DNA Plasmids

This example provides general guidance for the construction of a minigene expression plasmid. Minigene plasmids may, of course, contain various configurations of CTL and/or HTL epitopes or epitope analogs as described herein. Examples of the construction and evaluation of expression plasmids are described in related inventor-derived previously disclosed subject matter.

A minigene expression plasmid typically includes multiple CTL and HTL peptide epitopes. In the present example, HLA-A2, -A3, -B7 supermotif-bearing peptide epitopes and HLA-A1 and -A24 motif-bearing peptide epitopes are used in conjunction with DR supermotif-bearing epitopes and/or DR3 epitopes. HLA class I supermotif or motif-bearing peptide epitopes derived from multiple HPV antigens, preferably including both early and late phase antigens, are selected such that multiple supermotifs/motifs are represented to ensure broad population coverage. Similarly, HLA class II epitopes are selected from multiple HPV antigens to provide broad population coverage, *i.e.* both HLA DR-1-4-7 supermotif-bearing epitopes and HLA DR-3 motif-bearing epitopes are selected for inclusion in the minigene construct. The selected CTL and HTL epitopes are then incorporated into a minigene for expression in an expression vector.

Such a construct may additionally include sequences that direct the HTL epitopes to the endoplasmic reticulum. For example, the Ii protein may be fused to one or more HTL epitopes as described in related inventor-derived previously disclosed subject matter, wherein the CLIP sequence of the Ii protein is removed and replaced with an HLA class II epitope sequence so that HLA class II epitope is directed to the endoplasmic reticulum, where the epitope binds to an HLA class II molecules.

This example illustrates the methods to be used for construction of a minigene-bearing expression plasmid. Other expression vectors that may be used for minigene compositions are available and known to those of skill in the art.

The minigene DNA plasmid of this example contains a consensus Kozak sequence and a consensus murine kappa Ig-light chain signal sequence followed by CTL and/or HTL epitopes selected in accordance with principles disclosed herein. The sequence encodes an open reading frame fused to the Myc and His antibody epitope tag coded for by the pcDNA 3.1 Myc-His vector.

Overlapping oligonucleotides that can, for example, average about 70 nucleotides in length with 15 nucleotide overlaps, are synthesized and HPLC-purified. The oligonucleotides encode the selected peptide epitopes as well as appropriate linker nucleotides, Kozak sequence, and signal sequence. The final multiepitope minigene is assembled by extending the overlapping oligonucleotides in three sets of reactions using PCR. A Perkin/Elmer 9600 PCR machine is used and a total of 30 cycles are performed using the following conditions: 95°C for 15 sec, annealing temperature (5° below the lowest calculated Tm of each primer pair) for 30 sec, and 72°C for 1 min.

For example, a minigene can be prepared as follows. For a first PCR reaction, 5 µg of each of two oligonucleotides are annealed and extended: In an example using eight oligonucleotides, i.e., four pairs of primers, oligonucleotides 1+2, 3+4, 5+6, and 7+8 are combined in 100 µl reactions containing *Pfu* polymerase buffer (1x= 10 mM KCL, 10 mM $(NH4)_2SO_4$, 20 mM Tris-chloride, pH 8.75, 2 mM $MgSO_4$, 0.1% Triton X-100, 100 µg/ml BSA), 0.25 mM each dNTP, and 2.5 U of *Pfu* polymerase. The full-length dimer products are gel-purified, and two reactions containing the product of 1+2 and 3+4, and the product of 5+6 and 7+8 are mixed, annealed, and extended for 10 cycles. Half of the two reactions are then mixed, and 5 cycles of annealing and extension carried out before flanking primers are added to amplify the full length product. The full-length product is gel-purified and cloned into pCR-blunt (Invitrogen) and individual clones are screened by sequencing.

Example 12. The plasmid construct and the degree to which it induces immunogenicity.

The degree to which a plasmid construct, for example a plasmid constructed in accordance with Example 11, is able to induce immunogenicity can be evaluated *in vitro* by testing for epitope presentation by APC following transduction or transfection of the APC with an epitope-expressing nucleic acid construct. Such a study determines "antigenicity" and allows the use of human APC. The assay determines the ability of the epitope to be presented by the APC in a context that is recognized by a T cell by quantifying the density of epitope-HLA class I complexes on the cell surface. Quantitation can be performed by directly measuring the amount of peptide eluted from the APC (*see, e.g.*, Sijts *et al.*, *J. Immunol.* 156:683-692, 1996; Demotz *et al.*, *Nature* 342:682-684, 1989); or the number of peptide-HLA class I complexes can be estimated by measuring the amount of lysis or lymphokine release induced by infected or transfected target cells, and then determining the concentration of peptide necessary to obtained equivalent levels of lysis or lymphokine release (*see, e.g.*, Kageyama *et al.*, *J. Immunol.* 154:567-576, 1995).

Alternatively, immunogenicity can be evaluated through *in vivo* injections into mice and subsequent *in vitro* assessment of CTL and HTL activity, which are analysed using cytotoxicity and proliferated assays, respectively, as detailed, *e.g.*, in Alexander *et al.*, *Immunity* 1:751-761, 1994.

For example, to assess the capacity of a DNA minigene construct (*e.g.*, a pMin minigene construct generated as described in related inventor-derived previously disclosed subject matter) containing at least one HLA-A2 supermotif peptide to induce CTLs *in vivo,* HLA-A2.1/K^b transgenic mice, for example, are immunized intramuscularly with 100 µg of naked cDNA. As a means of comparing the level of CTLs induced by cDNA immunization, a control group of animals is also immunized with an actual peptide composition that comprises multiple epitopes synthesized as a single polypeptide as they would be encoded by the minigene.

Splenocytes from immunized animals are stimulated twice with each of the respective compositions (peptide epitopes encoded in the minigene or the polyepitopic peptide), then assayed for peptide-specific cytotoxic activity in a ^{51}Cr release assay. The results indicate the magnitude of the CTL response directed against the A2-restricted epitope, thus indicating the *in vivo* immunogenicity of the minigene vaccine and polyepitopic vaccine. It is, therefore, found that the minigene elicits immune responses directed toward the HLA-A2 supermotif peptide epitopes as does the polyepitopic peptide

vaccine. A similar analysis is also performed using other HLA-A3 and HLA-B7 transgenic mouse models to assess CTL induction by HLA-A3 and HLA-B7 motif or supermotif epitopes.

To assess the capacity of a class II epitope encoding minigene to induce HTLs *in vivo*, DR transgenic mice, or for those epitope that cross react with the appropriate mouse MHC molecule, I-A^b-restricted mice, for example, are immunized intramuscularly with 100 µg of plasmid DNA. As a means of comparing the level of HTLs induced by DNA immunization, a group of control animals is also immunized with an actual peptide composition emulsified in complete Freund's adjuvant. CD4+ T cells, *i.e.* HTLs, are purified from splenocytes of immunized animals and stimulated with each of the respective compositions (peptides encoded in the minigene). The HTL response is measured using a ^{3}H-thymidine incorporation proliferation assay, (*see, e.g.*, Alexander et al. Immunity 1:751-761, 1994). The results indicate the magnitude of the HTL response, thus demonstrating the *in vivo* immunogenicity of the minigene.

DNA minigenes, constructed as described in Example 11, may also be evaluated as a vaccine in combination with a boosting agent using a prime boost protocol. The boosting agent can consist of recombinant protein (*e.g.*, Barnett *et al.*, *Aids Res. and Human Retroviruses* 14, Supplement 3:S299-S309, 1998) or recombinant vaccinia, for example, expressing a minigene or DNA encoding the complete protein of interest (*see, e.g.*, Hanke *et al.*, *Vaccine* 16:439-445, 1998; Sedegah *et al.*, *Proc. Natl. Acad. Sci USA* 95:7648-53, 1998; Hanke and McMichael, *Immunol. Letters* 66:177-181, 1999; and Robinson *et al.*, *Nature Med.* 5:526-34, 1999).

For example, the efficacy of the DNA minigene used in a prime boost protocol is initially evaluated in transgenic mice. In this example, A2.1/K^b transgenic mice are immunized IM with 100 g of a DNA minigene encoding the immunogenic peptides including at least one HLA-A2 supermotif-bearing peptide. After an incubation period (ranging from 3-9 weeks), the mice are boosted IP with 10^7 pfu/mouse of a recombinant vaccinia virus expressing the same sequence encoded by the DNA minigene. Control mice are immunized with 100 g of DNA or recombinant vaccinia without the minigene sequence, or with DNA encoding the minigene, but without the vaccinia boost. After an additional incubation period of two weeks, splenocytes from the mice are immediately assayed for peptide-specific activity in an ELISPOT assay. Additionally, splenocytes are stimulated *in vitro* with the A2-restricted peptide epitopes encoded in the minigene and recombinant vaccinia, then assayed for peptide-specific activity in an IFN- ELISA.

It is found that the minigene utilized in a prime-boost protocol elicits greater immune responses toward the HLA-A2 supermotif peptides than with DNA alone. Such an analysis can also be performed using HLA-A11 or HLA-B7 transgenic mouse models to assess CTL induction by HLA-A3 or HLA-B7 motif or supermotif epitopes.

The use of prime boost protocols in humans is described in Example 20.

Example 13. Peptide Composition for Prophylactic Uses

Vaccine compositions of the present invention can be used to prevent HPV infection in persons who are at risk for such infection. For example, a polyepitopic peptide epitope composition (or a nucleic acid comprising the same) containing multiple CTL and HTL epitopes such as those selected in Examples 9 and/or 10, which are also selected to target greater than 80% of the population, is administered to individuals at risk for HPV infection.

For example, a peptide-based composition can be provided as a single polypeptide that encompasses multiple epitopes. The vaccine is typically administered in a physiological solution that comprises an adjuvant, such as Incomplete Freunds Adjuvant. The dose of peptide for the initial immunization is from about 1 to about 50,000 μg, generally 100-5,000 μg, for a 70 kg patient. The initial administration of vaccine is followed by booster dosages at 4 weeks followed by evaluation of the magnitude of the immune response in the patient, by techniques that determine the presence of epitope-specific CTL populations in a PBMC sample. Additional booster doses are administered as required. The composition is found to be both safe and efficacious as a prophylaxis against HPV infection.

Alternatively, a composition typically comprising transfecting agents can be used for the administration of a nucleic acid-based vaccine in accordance with methodologies known in the art and disclosed herein.

Example 14. Polyepitopic Vaccine Compositions Derived from Native HPV Sequences

A native HPV polyprotein sequence is screened, preferably using computer algorithms defined for each class I and/or class II supermotif or motif, to identify "relatively short" regions of the polyprotein that comprise multiple epitopes and is preferably less in length than an entire native antigen. This relatively short sequence that contains multiple distinct, even overlapping, epitopes is selected and used to generate a minigene construct. The construct is engineered to express the peptide, which corresponds to the native protein sequence. The "relatively short" peptide is generally less than 250 amino acids in length, often less than 100 amino acids in length, preferably less than 75 amino acids in length, and more preferably less than 50 amino acids in length. The protein sequence of the vaccine composition is selected because it has maximal number of epitopes contained within the sequence, *i.e.*, it has a high concentration of epitopes. As noted herein, epitope motifs may be nested or overlapping (*i.e.*, frame shifted relative to one another). For example, with f overlapping epitopes, two 9-mer epitopes and one 10-mer epitope can be present in a 10 amino acid peptide. Such a vaccine composition is administered for therapeutic or prophylactic purposes.

The vaccine composition will include, for example, three CTL epitopes from at least one HPV target antigen and at least one HTL epitope. This polyepitopic native sequence is administered either as a peptide or as a nucleic acid sequence which encodes the peptide. Alternatively, an analog can be made of this native sequence, whereby one or more of the epitopes comprise substitutions that alter the cross-reactivity and/or binding affinity properties of the polyepitopic peptide.

The embodiment of this example provides for the possibility that an as yet undiscovered aspect of immune system processing will apply to the native nested sequence and thereby facilitate the production of therapeutic or prophylactic immune response-inducing vaccine compositions. Additionally such an embodiment provides for the possibility of motif-bearing epitopes for an HLA makeup that is presently unknown. Furthermore, this embodiment (absent analogs) directs the immune response to multiple peptide sequences that are actually present in native HPV antigens thus avoiding the need to evaluate any junctional epitopes. Lastly, the embodiment provides an economy of scale when producing nucleic acid vaccine compositions.

Related to this embodiment, computer programs can be derived in accordance with principles in the art, which identify in a target sequence, the greatest number of epitopes per sequence length.

Example 15. Polyepitopic Vaccine Compositions From Multiple Antigens

The HPV peptide epitopes of the present invention are used in conjunction with peptide epitopes from other target tumor-associated antigens to create a vaccine composition that is useful for the prevention or treatment of cancer resulting from HPV infection in multiple patients.

For example, a vaccine composition can be provided as a single polypeptide that incorporates multiple epitopes from HPV antigens as well as tumor-associated antigens that are often expressed with a target cancer, *e.g.*, cervical cancer, associated with HPV infection, or can be administered as a composition comprising one or more discrete epitopes. Alternatively, the vaccine can be administered as a minigene construct or as dendritic cells which have been loaded with the peptide epitopes *in vitro*.

Example 16. Use of peptides to evaluate an immune response

Peptides of the invention may be used to analyze an immune response for the presence of specific CTL or HTL populations directed to HPV. Such an analysis may be performed in a manner as that described by Ogg *et al., Science* 279:2103-2106, 1998. In the following example, peptides in accordance with the invention are used as a reagent for diagnostic or prognostic purposes, not as an immunogen.

In this example highly sensitive human leukocyte antigen tetrameric complexes ("tetramers") are used for a cross-sectional analysis of, for example, HPV HLA-A*0201-specific CTL frequencies from HLA A*0201-positive individuals at different stages of infection or following immunization using an HPV peptide containing an A*0201 motif. Tetrameric complexes are synthesized as described (Musey *et al., N. Engl. J. Med.* 337:1267, 1997). Briefly, purified HLA heavy chain (A*0201 in this example) and β2-microglobulin are synthesized by means of a prokaryotic expression system. The heavy chain is modified by deletion of the transmembrane-cytosolic tail and COOH-terminal addition of a sequence containing a BirA enzymatic biotinylation site. The heavy chain, β2-microglobulin, and peptide are refolded by dilution. The 45-kD refolded product is isolated by fast protein liquid chromatography and then biotinylated by BirA in the presence of biotin (Sigma, St. Louis, Missouri), adenosine 5'triphosphate and magnesium. Streptavidin-phycoerythrin conjugate is added in a 1:4 molar ratio, and the tetrameric product is concentrated to 1 mg/ml. The resulting product is referred to as tetramer-phycoerythrin.

For the analysis of patient blood samples, approximately one million PBMCs are centrifuged at 300g for 5 minutes and resuspended in 50 μl of cold phosphate-buffered saline. Tri-color analysis is performed with the tetramer-phycoerythrin, along with anti-CD8-Tricolor, and anti-CD38. The PBMCs are incubated with tetramer and antibodies on ice for 30 to 60 min and then washed twice before formaldehyde fixation. Gates are applied to contain >99.98% of control samples. Controls for the tetramers include both A*0201-negative individuals and A*0201-positive uninfected donors. The percentage of cells stained with the tetramer is then determined by flow cytometry. The results indicate the number of cells in the PBMC sample that contain epitope-restricted CTLs, thereby readily indicating the

extent of immune response to the HPV epitope, and thus the stage of infection with HPV, the status of exposure to HPV, or exposure to a vaccine that elicits a protective or therapeutic response.

Example 17. Use of Peptide Epitopes to Evaluate Recall Responses

The peptide epitopes of the invention are used as reagents to evaluate T cell responses, such as acute or recall responses, in patients. Such an analysis may be performed on patients who have recovered from infection, who are chronically infected with HPV, or who have been vaccinated with an HPV vaccine.

For example, the class I restricted CTL response of persons who have been vaccinated may be analyzed. The vaccine may be any HPV vaccine. PBMC are collected from vaccinated individuals and HLA typed. Appropriate peptide epitopes of the invention that, optimally, bear supermotifs to provide cross-reactivity with multiple HLA supertype family members, are then used for analysis of samples derived from individuals who bear that HLA type.

PBMC from vaccinated individuals are separated on Ficoll-Histopaque density gradients (Sigma Chemical Co., St. Louis, MO), washed three times in HBSS (GIBCO Laboratories), resuspended in RPMI-1640 (GIBCO Laboratories) supplemented with L-glutamine (2mM), penicillin (50U/ml), streptomycin (50 μg/ml), and Hepes (10mM) containing 10% heat-inactivated human AB serum (complete RPMI) and plated using microculture formats. A synthetic peptide comprising an epitope of the invention is added at 10 μg/ml to each well and HBV core 128-140 epitope is added at 1 μg/ml to each well as a source of T cell help during the first week of stimulation.

In the microculture format, 4 x 10^5 PBMC are stimulated with peptide in 8 replicate cultures in 96-well round bottom plate in 100 μl/well of complete RPMI. On days 3 and 10, 100 ul of complete RPMI and 20 U/ml final concentration of rIL-2 are added to each well. On day 7 the cultures are transferred into a 96-well flat-bottom plate and restimulated with peptide, rIL-2 and 10^5 irradiated (3,000 rad) autologous feeder cells. The cultures are tested for cytotoxic activity on day 14. A positive CTL response requires two or more of the eight replicate cultures to display greater than 10% specific ^{51}Cr release, based on comparison with uninfected control subjects as previously described (Rehermann, *et al., Nature Med.* 2:1104,1108, 1996; Rehermann *et al., J. Clin. Invest.* 97:1655-1665, 1996; and Rehermann *et al. J. Clin. Invest.* 98:1432-1440, 1996).

Target cell lines are autologous and allogeneic EBV-transformed B-LCL that are either purchased from the American Society for Histocompatibility and Immunogenetics (ASHI, Boston, MA) or established from the pool of patients as described (Guilhot, *et al. J. Virol.* 66:2670-2678, 1992).

Cytotoxicity assays are performed in the following manner. Target cells consist of either allogeneic HLA-matched or autologous EBV-transformed B lymphoblastoid cell line that are incubated overnight with the synthetic peptide epitope of the invention at 10 μM, and labeled with 100 μCi of ^{51}Cr (Amersham Corp., Arlington Heights, IL) for 1 hour after which they are washed four times with HBSS.

Cytolytic activity is determined in a standard 4-h, split well ^{51}Cr release assay using U-bottomed 96 well plates containing 3,000 targets/well. Stimulated PBMC are tested at effector/target (E/T) ratios of 20-50:1 on day 14. Percent cytotoxicity is determined from the formula: 100 x [(experimental release-spontaneous release)/maximum release-spontaneous release)]. Maximum release is determined by

lysis of targets by detergent (2% Triton X-100; Sigma Chemical Co., St. Louis, MO). Spontaneous release is <25% of maximum release for all experiments.

The results of such an analysis indicate the extent to which HLA-restricted CTL populations have been stimulated by previous exposure to HPV or an HPV vaccine.

The class II restricted HTL responses may also be analyzed. Purified PBMC are cultured in a 96-well flat bottom plate at a density of $1.5x10^5$ cells/well and are stimulated with 10 µg/ml synthetic peptide, whole antigen, or PHA. Cells are routinely plated in replicates of 4-6 wells for each condition. After seven days of culture, the medium is removed and replaced with fresh medium containing 10U/ml IL-2. Two days later, 1 µCi ^{3}H-thymidine is added to each well and incubation is continued for an additional 18 hours. Cellular DNA is then harvested on glass fiber mats and analyzed for ^{3}H-thymidine incorporation. Antigen-specific T cell proliferation is calculated as the ratio of ^{3}H-thymidine incorporation in the presence of antigen divided by the ^{3}H-thymidine incorporation in the absence of antigen.

Example 18. Induction Of Specific CTL Response In Humans

A human clinical trial for an immunogenic composition comprising CTL and HTL epitopes of the invention is set up as an IND Phase I, dose escalation study and carried out as a randomized, double-blind, placebo-controlled trial. Such a trial is designed, for example, as follows:

A total of about 27 individuals are enrolled and divided into 3 groups:

Group I: 3 subjects are injected with placebo and 6 subjects are injected with 5 µg of peptide composition;

Group II: 3 subjects are injected with placebo and 6 subjects are injected with 50 µg peptide composition;

Group III: 3 subjects are injected with placebo and 6 subjects are injected with 500 µg of peptide composition.

After 4 weeks following the first injection, all subjects receive a booster inoculation at the same dosage.

The endpoints measured in this study relate to the safety and tolerability of the peptide composition as well as its immunogenicity. Cellular immune responses to the peptide composition are an index of the intrinsic activity of this the peptide composition, and can therefore be viewed as a measure of biological efficacy. The following summarize the clinical and laboratory data that relate to safety and efficacy endpoints.

Safety: The incidence of adverse events is monitored in the placebo and drug treatment group and assessed in terms of degree and reversibility.

Evaluation of Vaccine Efficacy: For evaluation of vaccine efficacy, subjects are bled before and after injection. Peripheral blood mononuclear cells are isolated from fresh heparinized blood by Ficoll-Hypaque density gradient centrifugation, aliquoted in freezing media and stored frozen. Samples are assayed for CTL and HTL activity.

The vaccine is found to be both safe and efficacious.

Example 19. Phase II Trials In Patients Infected With HPV

Phase II trials are performed to study the effect of administering the CTL-HTL peptide compositions to patients having cancer associated with HPV infection. The main objectives of the trials are to determine an effective dose and regimen for inducing CTLs in HPV-infected patients with cancer, to establish the safety of inducing a CTL and HTL response in these patients, and to see to what extent activation of CTLs improves the clinical picture of chronically infected HPV patients, as manifested by a reduction in viral load, *e.g.*, the reduction and/or shrinking of lesions. Such a study is designed, for example, as follows:

The studies are performed in multiple centers. The trial design is an open-label, uncontrolled, dose escalation protocol wherein the peptide composition is administered as a single dose followed six weeks later by a single booster shot of the same dose. The dosages are 50, 500 and 5,000 micrograms per injection. Drug-associated adverse effects (severity and reversibility) are recorded.

There are three patient groupings. The first group is injected with 50 micrograms of the peptide composition and the second and third groups with 500 and 5,000 micrograms of peptide composition, respectively. The patients within each group range in age from 21-65 and represent diverse ethnic backgrounds. All of them are infected with HPV and are HIV, HCV, HBV and delta hepatitis virus (HDV) negative, but are positive for HPV DNA as monitered by PCR.

Clinical manifestations or antigen-specific T-cell responses are monitored to assess the effects of administering the peptide compositions. The vaccine composition is found to be both safe and efficacious in the treatment of HPV infection.

Example 20. Induction of CTL Responses Using a Prime Boost Protocol

A prime boost protocol similar in its underlying principle to that used to evaluate the efficacy of a DNA vaccine in transgenic mice, such as described in Example 12, can also be used for the administration of the vaccine to humans. Such a vaccine regimen can include an initial administration of, for example, naked DNA followed by a boost using recombinant virus encoding the vaccine, or recombinant protein/polypeptide or a peptide mixture administered in an adjuvant.

For example, the initial immunization may be performed using an expression vector, such as that constructed in Example 11, in the form of naked nucleic acid administered IM (or SC or ID) in the amounts of 0.5-5 mg at multiple sites. The nucleic acid (0.1 to 1000 μg) can also be administered using a gene gun. Following an incubation period of 3-4 weeks, a booster dose is then administered. The booster can be recombinant fowlpox virus administered at a dose of $5\text{-}10^7$ to $5\text{x}10^9$ pfu. An alternative recombinant virus, such as an MVA, canarypox, adenovirus, or adeno-associated virus, can also be used for the booster, or the polyepitopic protein or a mixture of the peptides can be administered. For evaluation of vaccine efficacy, patient blood samples will be obtained before immunization as well as at intervals following administration of the initial vaccine and booster doses of the vaccine. Peripheral blood mononuclear cells are isolated from fresh heparinized blood by Ficoll-Hypaque density gradient centrifugation, aliquoted in freezing media and stored frozen. Samples are assayed for CTL and HTL activity.

Analysis of the results indicates that a magnitude of response sufficient to achieve protective immunity against HPV is generated.

Example 21. Administration of Vaccine Compositions Using Dendritic Cells (DC)

Vaccines comprising peptide epitopes of the invention can be administered using APCs, or "professional" APCs such as DC. In this example, the peptide-pulsed DC are administered to a patient to stimulate a CTL response *in vivo*. In this method, dendritic cells are isolated, expanded, and pulsed with a vaccine comprising peptide CTL and HTL epitopes of the invention. The dendritic cells are infused back into the patient to elicit CTL and HTL responses *in vivo*. The induced CTL and HTL then destroy or facilitate destruction of the specific target cells that bear the proteins from which the epitopes in the vaccine are derived.

For example, a cocktail of epitope-bearing peptides is administered *ex vivo* to PBMC, or isolated DC therefrom. A pharmaceutical to facilitate harvesting of DC can be used, such as Progenipoietin (Monsanto, St. Louis, MO) or GM-CSF/IL-4. After pulsing the DC with peptides and prior to reinfusion into patients, the DC are washed to remove unbound peptides.

As appreciated clinically, and readily determined by one of skill based on clinical outcomes, the number of DC reinfused into the patient can vary (*see, e.g., Nature Med.* 4:328, 1998; *Nature Med.* 2:52, 1996 and *Prostate* 32:272, 1997). Although 2-50 x 10^6 DC per patient are typically administered, larger number of DC, such as 10^7 or 10^8 can also be provided. Such cell populations typically contain between 50-90% DC.

In some embodiments, peptide-loaded PBMC are injected into patients without purification of the DC. For example, PBMC containing DC generated after treatment with an agent such as Progenipoietin are injected into patients without purification of the DC. The total number of PBMC that are administered often ranges from 10^8 to 10^{10}. Generally, the cell doses injected into patients is based on the percentage of DC in the blood of each patient, as determined, for example, by immunofluorescence analysis with specific anti-DC antibodies. Thus, for example, if Progenipoietin™ mobilizes 2% DC in the peripheral blood of a given patient, and that patient is to receive 5 x 10^6 DC, then the patient will be injected with a total of 2.5 x 10^8 peptide-loaded PBMC. The percent DC mobilized by an agent such as Progenipoietin™ is typically estimated to be between 2-10%, but can vary as appreciated by one of skill in the art.

Ex vivo activation of CTL/HTL responses

Alternatively, *ex vivo* CTL or HTL responses to HPV antigens can be induced by incubating in tissue culture the patient's, or genetically compatible, CTL or HTL precursor cells together with a source of APC, such as DC, and the appropriate immunogenic peptides. After an appropriate incubation time (typically about 7-28 days), in which the precursor cells are activated and expanded into effector cells, the cells are infused back into the patient, where they will destroy (CTL) or facilitate destruction (HTL) of their specific target cells, *i.e.*, tumor cells.

Example 22. Alternative Method of Identifying Motif-Bearing Peptides

Another method of identifying motif-bearing peptides is to elute them from cells bearing defined MHC molecules. For example, EBV transformed B cell lines used for tissue typing have been

extensively characterized to determine which HLA molecules they express. In certain cases these cells express only a single type of HLA molecule. These cells can be infected with a pathogenic organism or transfected with nucleic acids that express the antigen of interest, *e.g.* HPV regulatory or structural proteins. Peptides produced by endogenous antigen processing of peptides produced consequent to infection (or as a result of transfection) will then bind to HLA molecules within the cell and be transported and displayed on the cell surface. Peptides are then eluted from the HLA molecules by exposure to mild acid conditions and their amino acid sequence determined, *e.g.*, by mass spectral analysis (*e.g.*, Kubo *et al.*, *J. Immunol.* 152:3913, 1994). Because the majority of peptides that bind a particular HLA molecule are motif-bearing, this is an alternative modality for obtaining the motif-bearing peptides correlated with the particular HLA molecule expressed on the cell.

Alternatively, cell lines that do not express endogenous HLA molecules can be transfected with an expression construct encoding a single HLA allele. These cells can then be used as described, *i.e.*, they can be infected with a pathogen or transfected with nucleic acid encoding an antigen of interest to isolate peptides corresponding to the pathogen or antigen of interest that have been presented on the cell surface. Peptides obtained from such an analysis will bear motif(s) that correspond to binding to the single HLA allele that is expressed in the cell.

As appreciated by one in the art, one can perform a similar analysis on a cell bearing more than one HLA allele and subsequently determine peptides specific for each HLA allele expressed. Moreover, one of skill would also recognize that means other than infection or transfection, such as loading with a protein antigen, can be used to provide a source of antigen to the cell.

The above examples are provided to illustrate the invention but not to limit its scope. For example, the human terminology for the Major Histocompatibility Complex, namely HLA, is used throughout this document. It is to be appreciated that these principles can be extended to other species as well. Thus, other variants of the invention will be readily apparent to one of ordinary skill in the art and are encompassed by the appended claims.

TABLE I

SUPERMOTIFS	POSITION	POSITION	POSITION
	2 (Primary Anchor)	3 (Primary Anchor)	C Terminus (Primary Anchor)
A1	**T, I,** *L, V, M, S*		**F, W, Y**
A2	**L, I, V, M,** *A, T, Q*		**I, V,** *M, A, T, L*
A3	**V, S, M, A,** *T, L, I*		**R,K**
A24	**Y, F,** *W, I, V, L, M, T*		**F, I,** *Y, W, L, M*
B7	**P**		**V, I, L, F,** *M, W, Y, A*
B27	**R, H, K**		**F, Y, L,** *W, M, I, V, A*
B44	**E,** *D*		**F, W, L, I, M, V, A**
B58	**A, T, S**		**F, W, Y,** *L, I, V, M, A*
B62	**Q, L,** *I, V, M, P*		**F, W, Y,** *M, I, V, L, A*
MOTIFS			
A1	**T, S, M**		**Y**
A1		**D, E,** *A, S*	**Y**
A2.1	**L, M,** *V, Q, I, A, T*		**V,** *L, I, M, A, T*
A3	**L, M, V, I, S, A, T, F,** *C, G, D*		**K, Y, R,** *H, F, A*
A11	**V, T, M, L, I, S, A, G, N,** *C, D, F*		**K,** *R, Y, H*
A24	**Y, F, W,** *M*		**F, L, I, W**
A*3101	**M, V, T,** *A ,L, I, S*		**R,** *K*
A*3301	**M, V, A, L, F,** *I, S, T*		**R, K**
A*6801	**A, V, T,** *M, S, L, I*		**R, K**
B*0702	**P**		**L, M, F,** *W, Y, A, I, V*
B*3501	**P**		**L, M, F, W, Y,** *I, V, A*
B51	**P**		**L, I, V, F,** *W, Y, A, M*
B*5301	**P**		**I, M, F, W, Y,** *A, L, V*
B*5401	**P**		**A, T, I, V,** *L, M, F, W, Y*

Bolded residues are preferred, italicized residues are less preferred: A peptide is considered motif-bearing if it has primary anchors at each primary anchor position for a motif or supermotif as specified in the above table.

TABLE Ia

SUPERMOTIFS	POSITION 2 (Primary Anchor)	POSITION 3 (Primary Anchor)	POSITION C Terminus (Primary Anchor)
A1	**T, I,** *L, V, M, S*		**F, W, Y**
A2	**V,** *Q, A, T*		**I, V,** *L, M, A, T*
A3	**V, S, M, A,** *T, L, I*		**R, K**
A24	**Y, F,** *W, I, V, L, M, T*		**F, I,** *Y, W, L, M*
B7	**P**		**V, I, L, F,** *M, W, Y, A*
B27	**R, H, K**		**F, Y, L,** *W, M, I, V, A*
B58	**A, T, S**		**F, W, Y,** *L, I, V, M, A*
B62	**Q, L,** *I, V, M, P*		**F, W, Y,** *M, I, V, L, A*
MOTIFS			
A1	**T, S, M**		**Y**
A1		**D, E,***A, S*	**Y**
A2.1	*V, Q, A, T**		**V,** *L, I, M, A, T*
A3.2	**L, M, V, I, S, A, T, F,** *C, G, D*		**K, Y, R,** *H, F, A*
A11	**V, T, M, L, I, S, A, G, N,** *C, D, F*		**K,** *R, H, Y*
A24	**Y ,F, W**		**F, L, I, W**

*If 2 is V, or Q, the C-term is not L

Bolded residues are preferred, italicized residues are less preferred: A peptide is considered motif-bearing if it has primary anchors at each primary anchor position for a motif or supermotif as specified in the above table.

TABLE II

		POSITION 1	2	3	4	5	6	7	8	C-terminus
SUPERMOTIFS										
A1			1° Anchor T,I,*L,V,M,S*							1° Anchor F,W,Y
A2			1° Anchor L,I,V,M,*A, T,Q*							1° Anchor L,I,V,M,A,T
A3	preferred		1° Anchor V,S,M,A,*T, L,I*	Y,F,W, (4/5)			Y,F,W, (3/5)	Y,F,W, (4/5)	P, (4/5)	1°Anchor R,K
	deleterious	D,E (3/5); P, (5/5)		D,E, (4/5)						
A24			1° Anchor Y,F,*W,I,V, L,M,T*							1° Anchor F,I,*Y,W,L,M*
B7	preferred	F,W,Y (5/5) L,I,V,M, (3/5)	1°Anchor P	F,W,Y (4/5)					F,W,Y, (3/5)	1°Anchor V,I,L,F,*M,W,Y,A*
	deleterious	D,E (3/5); P(5/5); G(4/5); A(3/5); Q,N, (3/5)				D,E, (3/5)	G, (4/5)	Q,N, (4/5)	D,E, (4/5)	
B27			1° Anchor R,H,K							1° Anchor F,Y,L,*W,M,V,A*
B44			1° Anchor E,*D*							1° Anchor F,W,Y,L,I,M,V,A
B58			1° Anchor A,T,S							1° Anchor F,W,Y,*L,I,V,M,A*
B62			1° Anchor Q,L,*I,V,M, P*							1° Anchor F,W,Y,*M,I,V,L,A*

		POSITION								
		1	2	3	4	5	6	7	8	C-terminus
MOTIFS										
A1 9-mer	preferred	G,F,Y,W,	1°Anchor S,T,M,	D,E,A,	Y,F,W,		P,	D,E,Q,N,	Y,F,W,	1°Anchor Y
	deleterious	D,E,		R,H,K,L,I,V M,P,	A,	G,	A,			
A1 9-mer	preferred	G,R,H,K	A,S,T,C,L,I V,M,	1°Anchor D,E,*A,S*	G,S,T,C,		A,S,T,C,	L,I,V,M,	D,E,	1°Anchor Y
	deleterious A		R,H,K,D,E, P,Y,F,W,	D,E,	P,Q,N,		R,H,K,	P,G,	G,P,	

		POSITION									
		1	2	3	4	5	6	7	8	9 or C-terminus	C-terminus
A1 10-mer	peferred	Y,F,W,	1°Anchor S,T,M	D,E,A,Q,N,	A,	Y,F,W,Q,N,		P,A,S,T,C,	G,D,E,	P,	1°Anchor Y
	deleterious	G,P,		R,H,K,G,L,I V,M,	D,E,	R,H,K,	Q,N,A	R,H,K,Y,F, W,	R,H,K,	A	
A1 10-mer	preferred	Y,F,W,	S,T,C,L,I,V M,	1°Anchor D,E,*A,S*	A,	Y,F,W,		P,G,	G,	Y,F,W,	1°Anchor Y
	deleterious	R,H,K,	R,H,K,D,E, P,Y,F,W,			P,	G,		P,R,H,K,	Q,N,	
A2.1 9-mer	preferted	Y,F,W,	1°Anchor L,M,*I,V,Q, A,T*	Y,F,W,	S,T,C,	Y,F,W,		A,	P	1°Anchor V,*L,I,M,A,T*	
	deleterious	D,E,P,		D,E,R,K,H			R,K,H	D,E,R,K,H			
A2.1 10-mer	preferred	A,Y,F,W,	1°Anchor L,M,*I,V,Q, A,T*	L,V,I,M,	G,		G,		F,Y,W,L, V,I,M,		1°Anchor V,*L,I,M,A,T*
	deleterious	D,E,P,		D,E,	R,K,H,A,	P,		R,K,H,	D,E,R,K, H,	R,K,H,	

		POSITION									
		1	2	3	4	5	6	7	8	9 or C-terminus	C-terminus
A3	preferred	R,H,K,	1°Anchor L,M,V,I,S, A,T,F,*C,G D*	Y,F,W,	P,R,H,K,Y, F,W,	A,	Y,F,W,		P,	1°Anchor K,Y,R,*H,F,A*	
	deleterious	D,E,P,		D,E							
A11	preferred	A,	1°Anchor V,T,L,M,I, S,A,G,N,*C, D,F*	Y,F,W,	Y,FW,	A,	Y,F,W,	Y,FW,	P,	1°Anchor K,,*RY,H*	
	deleterious	D,E,P,						A	G,		
A24 9-mer	preferred	Y,F,W,R,H,K,	1°Anchor Y,F,W,*M*		S,T,C			Y,F,W,	Y,F,W,	1°Anchor F,L,I,W	
	deleterious	D,E,G,		D,E,	G,	Q,N,P,	D,E,R,H,K,	G,	A,Q,N,		
A24 10-mer	preferred		1°Anchor Y,F,W,*M*		P,	Y,F,W,P,		P,			1°Anchor F,L,I,W
	deleterious			G,D,E	Q,N	R,H,K	D,E	A	Q,N,	D,E,A,	
A3101	preferred	R,H,K,	1°Anchor M,V,T,*A,L, I,S*	Y,F,W,	P,		Y,F,W,	Y,F,W,	A,P,	1°Anchor R,*K*	
	deleterious	D,E,P,		D,E,		A,D,E,	D,E,	D,E,	D,E,		

		POSITION									
		1	2	3	4	5	6	7	8	9 or C-terminus	C-terminus
A3301	preferred		1°Anchor M,V,A,L,F, *I,S,T*	Y,F,W				A,Y,F,W		1°Anchor R,K	
	deleterious	G,P		D,E							
A6801	preferred	Y,F,W,S,T,C,	1°Anchor A,V,T,*M,S, L,I*			Y,F,W,L,I, V,M		Y,F,W,	P,	1°Anchor R,K	
	deleterious	G,P,		D,E,G,		R,H,K,			A,		
B0702	preferred	R,H,K,F,W,Y,	1°Anchor P	R,H,K,		R,H,K,	R,H,K,	R,H,K,	P,A,	1°Anchor L,M,F,*W,Y,A, I,V*	
	deleterious	D,E,Q,N,P,		D,E,P,	D,E,	D,E,	G,D,E,	Q,N,	D,E,		
B3501	preferred	F,W,Y,L,I,V,M,	1°Anchor P	F,W,Y,				F,W,Y,		1°Anchor L,M,F,W,Y,*I, V,A*	
	deleterious	A,G,P,				G,	G,				

		POSITION								
		1	2	3	4	5	6	7	8	9 or C-terminus	C-terminus
B51	preferred	L,I,V,M,F,W,Y,	1°Anchor P	F,W,Y,	S,T,C,	F,W,Y,		G,	F,W,Y,	1°Anchor L,I,V,F,*W, Y,A,M*	
	deleterious	A,G,P,D,E,R,H,K, S,T,C,				D,E,	G,	D,E,Q,N,	G,D,E,		
B5301	preferred	L,I,V,M,F,W,Y,	1°Anchor P	F,W,Y,	S,T,C,	F,W,Y,		L,I,V,M,F, W,Y,	F,W,Y,	1°Anchor I,M,F,W,Y, *A,L,V*	
	deleterious	A,G,P,Q,N,					G,	R,H,K,Q,N,	D,E,		
B5401	preferred	F,W,Y,	1°Anchor P	F,W,Y,L,I,V M,		L,I,V,M,		A,L,I,V,M,	F,W,Y,A,P,	1°Anchor A,T,I,V,*L, M,F,W,Y*	
	deleterious	G,P,Q,N,D,E,		G,D,E,S,T,C,		R,H,K,D,E,	D,E,	Q,N,D,G,E,	D,E,		

Italicized residues indicate less preferred or "tolerated" residues.
The information in Table II is specific for 9-mers unless otherwise specified.
Secondary anchor specificities are designated for each position independently.

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Table III

MOTIFS		POSITION 1° anchor 1	2	3	4	5	1° anchor 6	7	8	9
DR4	preferred	F, M, Y, *L, I, V, W,*	M,	T,		I,	V, S, T, *C, P, A, L, I, M,*	M, H,		M, H
	deleterious				W,			R,		W, D, E
DR1	preferred	M, F, *L, I, V, W, Y,*			P, A, M, Q,		V, M, A, T, *S, P, L, I, C,*	M,		A, V, M
	deleterious		C	C, H	F, D	C, W, D		G, D, E,	D	
DR7	preferred	M, F, *L, I, V, W, Y,*	M,	W,	A,		I, V, M, S, A, *C, T, P, L,*	M,		I, V
	deleterious		C,		G,			G, R, D,	N	G
DR Supermotif		M, F, *L, I, V, W, Y,*					V, M, S, T, A, *C, P, L, I,*			

DR3 MOTIFS	1° anchor 1	2	3	1° anchor 4	5	1° anchor 6
motif a preferred	L, I, V, M, F, Y,			D		
motif b preferred	L, I, V, M, F, A, Y,			D, N, Q, E, S, T		K, R, H

Italicized residues indicate less preferred or "tolerated" residues. Secondary anchor specificities are designated for each position independently.

Table IV: HLA Class I Standard Peptide Binding Affinity.

ALLELE	STANDARD PEPTIDE	SEQUENCE	SEQ ID NO:	STANDARD BINDING AFFINITY (nM)
A*0101	944.02	YLEPAIAKY	71	25
A*0201	941.01	FLPSDYFPSV	72	5.0
A*0202	941.01	FLPSDYFPSV	72	4.3
A*0203	941.01	FLPSDYFPSV	72	10
A*0205	941.01	FLPSDYFPSV	72	4.3
A*0206	941.01	FLPSDYFPSV	72	3.7
A*0207	941.01	FLPSDYFPSV	72	23
A*6802	1072.34	YVIKVSARV	73	8.0
A*0301	941.12	KVFPYALINK	74	11
A*1101	940.06	AVDLYHFLK	75	6.0
A*3101	941.12	KVFPYALINK	74	18
A*3301	1083.02	STLPETYVVRR	76	29
A*6801	941.12	KVFPYALINK	74	8.0
A*2402	979.02	AYIDNYNKF	77	12
B*0702	1075.23	APRTLVYLL	78	5.5
B*3501	1021.05	FPFKYAAAF	79	7.2
B51	1021.05	FPFKYAAAF	79	5.5
B*5301	1021.05	FPFKYAAAF	79	9.3
B*5401	1021.05	FPFKYAAAF	79	10

Table V. HLA Class II Standard Peptide Binding Affinity.

Allele	Nomenclature	Standard Peptide	Sequence	SEQ ID NO:	Binding Affinity (nM)
DRB1*0101	DR1	515.01	PKYVKQNTLKLAT	80	5.0
DRB1*0301	DR3	829.02	YKTIAFDEEARR	81	300
DRB1*0401	DR4w4	515.01	PKYVKQNTLKLAT	80	45
DRB1*0404	DR4w14	717.01	YARFQSQTTLKQKT	82	50
DRB1*0405	DR4w15	717.01	YARFQSQTTLKQKT	82	38
DRB1*0701	DR7	553.01	QYIKANSKFIGITE	67	25
DRB1*0802	DR8w2	553.01	QYIKANSKFIGITE	67	49
DRB1*0803	DR8w3	553.01	QYIKANSKFIGITE	67	1600
DRB1*0901	DR9	553.01	QYIKANSKFIGITE	67	75
DRB1*1101	DR5w11	553.01	QYIKANSKFIGITE	67	20
DRB1*1201	DR5w12	1200.05	EALIHQLKINPYVLS	83	298
DRB1*1302	DR6w19	650.22	QYIKANAKFIGITE	84	3.5
DRB1*1501	DR2w2β1	507.02	GRTQDENPVVHFFKNI VTPRTPPP	85	9.1
DRB3*0101	DR52a	511	NGQIGNDPNRDIL	86	470
DRB4*0101	DRw53	717.01	YARFQSQTTLKQKT	82	58
DRB5*0101	DR2w2β2	553.01	QYIKANSKFIGITE	67	20

Table VI

HLA-supertype	Allelle-specific HLA-supertype members	
	Verified[a]	Predicted[b]
A1	A*0101, A*2501, A*2601, A*2602, A*3201	A*0102, A*2604, A*3601, A*4301, A*8001
A2	A*0201, A*0202, A*0203, A*0204, A*0205, A*0206, A*0207, A*0209, A*0214, A*6802, A*6901	A*0208, A*0210, A*0211, A*0212, A*0213
A3	A*0301, A*1101, A*3101, A*3301, A*6801	A*0302, A*1102, A*2603, A*3302, A*3303, A*3401, A*3402, A*6601, A*6602, A*7401
A24	A*2301, A*2402, A*3001	A*2403, A*2404, A*3002, A*3003
B7	B*0702, B*0703, B*0704, B*0705, B*1508, B*3501, B*3502, B*3503, B*3503, B*3504, B*3505, B*3506, B*3507, B*3508, B*5101, B*5102, B*5103, B*5104, B*5105, B*5301, B*5401, B*5501, B*5502, B*5601, B*5602, B*6701, B*7801	B*1511, B*4201, B*5901
B27	B*1401, B*1402, B*1509, B*2702, B*2703, B*2704, B*2705, B*2706, B*3801, B*3901, B*3902, B*7301	B*2701, B*2707, B*2708, B*3802, B*3903, B*3904, B*3905, B*4801, B*4802, B*1510, B*1518, B*1503
B44	B*1801, B*1802, B*3701, B*4402, B*4403, B*4404, B*4001, B*4002, B*4006	B*4101, B*4501, B*4701, B*4901, B*5001
B58	B*5701, B*5702, B*5801, B*5802, B*1516, B*1517	
B62	B*1501, B*1502, B*1513, B*5201	B*1301, B*1302, B*1504, B*1505, B*1506, B*1507, B*1515, B*1520, B*1521, B*1512, B*1514, B*1510

a. Verified alleles include alleles whose specificity has been determined by pool sequencing analysis, peptide binding assays, or by analysis of the sequences of CTL epitopes.

b. Predicted alleles are alleles whose specificity is predicted on the basis of B and F pocket structure to overlap with the supertype specificity.

Table VII
HLA-A1 Supermotif Peptides

1	2	3	4
HPV16	E1	10	206
HPV16	E1	8	524
HPV16	E1	9	82
HPV16	E1	11	353
HPV16	E1	10	368
HPV16	E1	11	41
HPV16	E1	8	372
HPV16	E1	10	249
HPV16	E1	9	43
HPV16	E1	9	384
HPV16	E1	10	603
HPV16	E1	11	603
HPV16	E1	8	356
HPV16	E1	10	356
HPV16	E1	9	63
HPV16	E1	9	152
HPV16	E1	9	331
HPV16	E1	8	51
HPV16	E1	9	493
HPV16	E1	9	445
HPV16	E1	8	456
HPV16	E1	11	453
HPV16	E1	8	219
HPV16	E1	9	586
HPV16	E1	8	501
HPV16	E1	9	501
HPV16	E1	11	466
HPV16	E1	9	325
HPV16	E1	11	519
HPV16	E1	10	272
HPV16	E1	9	163
HPV16	E1	8	571
HPV16	E1	8	12
HPV16	E1	9	12
HPV16	E1	11	216
HPV16	E1	9	263
HPV16	E1	8	348
HPV16	E1	11	329
HPV16	E1	8	326
HPV16	E1	9	369
HPV16	E1	11	369
HPV16	E1	10	311
HPV16	E1	11	311
HPV16	E1	8	610
HPV16	E1	11	483
HPV16	E1	10	227
HPV16	E1	11	323
HPV16	E1	10	252
HPV16	E1	8	254
HPV16	E1	9	357
HPV16	E1	11	48
HPV16	E1	10	583
HPV16	E1	9	207
HPV16	E1	10	520
HPV16	E1	10	454
HPV16	E1	9	420
HPV16	E1	9	273
HPV16	E1	10	567
HPV16	E1	10	600
HPV16	E1	8	441
HPV16	E1	10	419
HPV16	E1	10	118
HPV16	E1	8	343
HPV16	E1	10	125
HPV16	E1	11	582
HPV16	E1	8	313
HPV16	E1	9	313
HPV16	E1	10	313
HPV16	E1	8	432
HPV16	E1	9	250
HPV16	E1	10	484
HPV16	E1	8	421
HPV16	E1	8	314
HPV16	E1	9	314
HPV16	E1	11	231
HPV16	E1	9	253
HPV16	E1	11	498
HPV16	E1	11	345
HPV16	E1	11	443
HPV16	E1	10	217
HPV16	E1	9	584
HPV16	E1	11	584
HPV16	E1	8	274
HPV16	E1	11	261
HPV16	E1	9	578
HPV16	E1	11	578
HPV16	E2	11	331
HPV16	E2	11	41
HPV16	E2	8	314
HPV16	E2	11	309
HPV16	E2	8	124
HPV16	E2	11	124
HPV16	E2	8	25
HPV16	E2	9	25
HPV16	E2	9	263
HPV16	E2	9	338
HPV16	E2	11	22
HPV16	E2	10	74
HPV16	E2	8	80
HPV16	E2	11	168
HPV16	E2	9	163
HPV16	E2	9	35
HPV16	E2	10	35
HPV16	E2	8	193
HPV16	E2	10	332
HPV16	E2	9	329
HPV16	E2	9	354
HPV16	E2	11	77
HPV16	E2	9	84
HPV16	E2	8	296
HPV16	E2	10	296
HPV16	E2	8	127
HPV16	E2	11	9
HPV16	E2	10	106
HPV16	E2	8	76
HPV16	E2	8	151
HPV16	E2	9	151
HPV16	E2	10	191
HPV16	E2	8	37

Table VII
HLA-A1 Supermotif Peptides

HPV16	E2	10	23
HPV16	E2	11	23
HPV16	E2	11	261
HPV16	E2	11	144
HPV16	E2	8	355
HPV16	E2	10	78
HPV16	E2	9	297
HPV16	E2	10	93
HPV16	E2	8	334
HPV16	E2	10	310
HPV16	E2	11	128
HPV16	E2	9	146
HPV16	E2	10	146
HPV16	E2	9	192
HPV16	E2	9	333
HPV16	E2	10	145
HPV16	E2	11	145
HPV16	E2	8	147
HPV16	E2	9	147
HPV16	E2	11	92
HPV16	E2	8	312
HPV16	E2	10	312
HPV16	E2	8	131
HPV16	E2	9	159
HPV16	E2	10	159
HPV16	E5	10	54
HPV16	E5	9	7
HPV16	E5	11	5
HPV16	E5	9	60
HPV16	E5	9	72
HPV16	E5	9	64
HPV16	E5	8	43
HPV16	E5	10	51
HPV16	E5	8	61
HPV16	E5	8	73
HPV16	E5	9	42
HPV16	E5	9	11
HPV16	E5	8	32
HPV16	E5	11	47
HPV16	E5	10	48
HPV16	E5	11	70
HPV16	E5	9	31
HPV16	E5	10	41
HPV16	E5	8	8
HPV16	E5	10	10
HPV16	E5	11	40
HPV16	E5	11	9
HPV16	E5	8	50
HPV16	E5	11	50
HPV16	E5	10	63
HPV16	E6	9	68
HPV16	E6	10	68
HPV16	E6	10	58
HPV16	E6	11	73
HPV16	E6	8	32
HPV16	E6	8	92
HPV16	E6	8	125
HPV16	E6	9	80
HPV16	E6	9	59
HPV16	E6	8	79
HPV16	E6	10	79
HPV16	E6	9	44
HPV16	E6	11	44
HPV16	E6	8	43
HPV16	E6	10	43
HPV16	E6	11	89
HPV16	E6	11	29
HPV16	E6	10	77
HPV16	E7	10	14
HPV16	E7	8	4
HPV16	E7	8	18
HPV16	L1	9	373
HPV16	L1	11	292
HPV16	L1	10	251
HPV16	L1	9	249
HPV16	L1	11	484
HPV16	L1	8	154
HPV16	L1	9	228
HPV16	L1	8	17
HPV16	L1	9	17
HPV16	L1	9	378
HPV16	L1	8	474
HPV16	L1	10	5
HPV16	L1	8	481
HPV16	L1	9	348
HPV16	L1	8	499
HPV16	L1	11	323
HPV16	L1	11	307
HPV16	L1	9	438
HPV16	L1	9	22
HPV16	L1	8	102
HPV16	L1	10	102
HPV16	L1	11	418
HPV16	L1	11	86
HPV16	L1	8	374
HPV16	L1	11	11
HPV16	L1	10	407
HPV16	L1	11	406
HPV16	L1	11	151
HPV16	L1	10	90
HPV16	L1	8	46
HPV16	L1	8	68
HPV16	L1	9	68
HPV16	L1	8	409
HPV16	L1	10	87
HPV16	L1	11	226
HPV16	L1	11	263
HPV16	L1	9	325
HPV16	L1	8	311
HPV16	L1	8	421
HPV16	L1	10	421
HPV16	L1	11	247
HPV16	L1	8	466
HPV16	L1	11	43
HPV16	L1	8	331
HPV16	L1	8	280
HPV16	L1	10	100
HPV16	L1	9	67
HPV16	L1	10	67
HPV16	L1	8	253

Table VII
HLA-A1 Supermotif Peptides

HPV16	L1	11	28
HPV16	L1	10	419
HPV16	L1	10	324
HPV16	L1	10	308
HPV16	L1	11	308
HPV16	L1	9	422
HPV16	L1	8	423
HPV16	L1	8	439
HPV16	L1	9	408
HPV16	L1	11	327
HPV16	L1	11	376
HPV16	L1	9	252
HPV16	L1	11	65
HPV16	L1	8	379
HPV16	L1	11	379
HPV16	L1	10	264
HPV16	L1	11	264
HPV16	L1	9	91
HPV16	L1	10	44
HPV16	L1	8	326
HPV16	L1	9	30
HPV16	L1	9	260
HPV16	L1	8	7
HPV16	L1	8	389
HPV16	L1	8	275
HPV16	L1	8	53
HPV16	L1	9	53
HPV16	L2	11	356
HPV16	L2	11	293
HPV16	L2	8	261
HPV16	L2	10	340
HPV16	L2	11	242
HPV16	L2	9	259
HPV16	L2	10	259
HPV16	L2	10	364
HPV16	L2	10	63
HPV16	L2	11	218
HPV16	L2	8	65
HPV16	L2	8	439
HPV16	L2	9	439
HPV16	L2	10	45
HPV16	L2	11	45
HPV16	L2	10	243
HPV16	L2	8	250
HPV16	L2	8	430
HPV16	L2	10	105
HPV16	L2	10	248
HPV16	L2	9	318
HPV16	L2	10	318
HPV16	L2	11	318
HPV16	L2	10	39
HPV16	L2	8	323
HPV16	L2	11	427
HPV16	L2	9	249
HPV16	L2	11	183
HPV16	L2	10	294
HPV16	L2	11	454
HPV16	L2	8	276
HPV16	L2	11	273
HPV16	L2	10	397
HPV16	L2	9	429
HPV16	L2	10	124
HPV16	L2	8	386
HPV16	L2	11	383
HPV16	L2	10	172
HPV16	L2	9	358
HPV16	L2	8	221
HPV16	L2	11	44
HPV16	L2	8	342
HPV16	L2	9	234
HPV16	L2	11	9
HPV16	L2	8	319
HPV16	L2	9	319
HPV16	L2	10	319
HPV16	L2	10	274
HPV16	L2	10	360
HPV16	L2	9	125
HPV16	L2	11	104
HPV16	L2	8	107
HPV16	L2	10	184
HPV16	L2	9	185
HPV16	L2	8	186
HPV16	L2	10	384
HPV16	L2	9	40
HPV16	L2	9	438
HPV16	L2	10	438
HPV16	L2	8	399
HPV16	L2	8	359
HPV16	L2	11	359
HPV16	L2	9	295
HPV16	L2	8	156
HPV16	L2	9	398
HPV16	L2	9	244
HPV16	L2	11	153
HPV16	L2	10	154
HPV16	L2	9	106
HPV16	L2	9	155
HPV16	L2	10	393
HPV16	L2	10	437
HPV16	L2	11	437
HPV18	E1	10	213
HPV18	E1	11	526
HPV18	E1	11	40
HPV18	E1	8	531
HPV18	E1	9	531
HPV18	E1	11	216
HPV18	E1	10	437
HPV18	E1	9	240
HPV18	E1	8	363
HPV18	E1	10	363
HPV18	E1	9	391
HPV18	E1	10	637
HPV18	E1	9	42
HPV18	E1	10	610
HPV18	E1	11	610
HPV18	E1	9	62
HPV18	E1	10	375
HPV18	E1	8	379
HPV18	E1	9	587
HPV18	E1	9	338

Table VII
HLA-A1 Supermotif Peptides

HPV18	E1	8	50	HPV18	E1	9	591
HPV18	E1	9	500	HPV18	E1	11	591
HPV18	E1	11	460	HPV18	E1	11	505
HPV18	E1	8	463	HPV18	E1	9	81
HPV18	E1	10	399	HPV18	E1	9	280
HPV18	E1	9	452	HPV18	E1	8	339
HPV18	E1	8	226	HPV18	E1	9	585
HPV18	E1	8	130	HPV18	E1	11	585
HPV18	E1	8	508	HPV18	E2	10	82
HPV18	E1	9	508	HPV18	E2	10	154
HPV18	E1	11	223	HPV18	E2	11	154
HPV18	E1	8	11	HPV18	E2	11	132
HPV18	E1	9	11	HPV18	E2	10	14
HPV18	E1	10	473	HPV18	E2	8	156
HPV18	E1	10	279	HPV18	E2	9	156
HPV18	E1	10	249	HPV18	E2	8	29
HPV18	E1	9	270	HPV18	E2	9	29
HPV18	E1	11	352	HPV18	E2	8	315
HPV18	E1	11	336	HPV18	E2	11	26
HPV18	E1	10	506	HPV18	E2	9	354
HPV18	E1	11	506	HPV18	E2	11	104
HPV18	E1	10	461	HPV18	E2	9	161
HPV18	E1	10	590	HPV18	E2	9	338
HPV18	E1	8	439	HPV18	E2	9	329
HPV18	E1	10	318	HPV18	E2	9	39
HPV18	E1	11	318	HPV18	E2	10	39
HPV18	E1	10	234	HPV18	E2	10	133
HPV18	E1	8	401	HPV18	E2	11	133
HPV18	E1	8	490	HPV18	E2	8	297
HPV18	E1	11	490	HPV18	E2	8	107
HPV18	E1	10	259	HPV18	E2	9	185
HPV18	E1	8	281	HPV18	E2	10	33
HPV18	E1	8	261	HPV18	E2	10	38
HPV18	E1	9	364	HPV18	E2	11	38
HPV18	E1	10	224	HPV18	E2	9	220
HPV18	E1	9	376	HPV18	E2	9	88
HPV18	E1	11	376	HPV18	E2	11	56
HPV18	E1	9	214	HPV18	E2	9	305
HPV18	E1	10	527	HPV18	E2	11	230
HPV18	E1	11	47	HPV18	E2	8	233
HPV18	E1	10	574	HPV18	E2	8	355
HPV18	E1	8	428	HPV18	E2	11	140
HPV18	E1	11	487	HPV18	E2	10	57
HPV18	E1	8	448	HPV18	E2	10	97
HPV18	E1	10	607	HPV18	E2	10	231
HPV18	E1	10	426	HPV18	E2	8	157
HPV18	E1	10	80	HPV18	E2	9	232
HPV18	E1	11	589	HPV18	E2	11	96
HPV18	E1	10	128	HPV18	E2	11	173
HPV18	E1	8	320	HPV18	E2	8	143
HPV18	E1	9	320	HPV18	E2	8	135
HPV18	E1	10	320	HPV18	E2	9	135
HPV18	E1	8	321	HPV18	E2	9	164
HPV18	E1	9	321	HPV18	E2	10	164
HPV18	E1	8	322	HPV18	E5	9	47
HPV18	E1	9	260	HPV18	E5	11	47
HPV18	E1	11	238	HPV18	E5	11	27
HPV18	E1	10	533	HPV18	E5	10	6
HPV18	E1	8	532	HPV18	E5	8	50
HPV18	E1	11	532	HPV18	E5	8	43

Table VII
HLA-A1 Supermotif Peptides

HPV18	E5	11	43	HPV18	L1	9	383
HPV18	E5	11	40	HPV18	L1	9	175
HPV18	E5	10	22	HPV18	L1	10	175
HPV18	E5	9	2	HPV18	L1	8	38
HPV18	E5	8	1	HPV18	L1	10	13
HPV18	E5	10	1	HPV18	L1	11	454
HPV18	E5	11	21	HPV18	L1	9	428
HPV18	E5	8	24	HPV18	L1	11	428
HPV18	E5	10	24	HPV18	L1	10	40
HPV18	E5	8	3	HPV18	L1	11	39
HPV18	E5	9	25	HPV18	L1	11	46
HPV18	E5	10	44	HPV18	L1	10	47
HPV18	E5	9	42	HPV18	L1	10	9
HPV18	E5	10	41	HPV18	L1	10	443
HPV18	E6	8	27	HPV18	L1	9	360
HPV18	E6	10	77	HPV18	L1	10	125
HPV18	E6	8	40	HPV18	L1	11	8
HPV18	E6	10	40	HPV18	L1	9	14
HPV18	E6	11	43	HPV18	L1	8	103
HPV18	E6	8	120	HPV18	L1	9	103
HPV18	E6	11	117	HPV18	L1	8	445
HPV18	E6	8	92	HPV18	L1	8	104
HPV18	E6	10	36	HPV18	L1	11	298
HPV18	E6	9	41	HPV18	L1	11	261
HPV18	E6	8	74	HPV18	L1	10	36
HPV18	E6	11	24	HPV18	L1	8	457
HPV18	E6	11	89	HPV18	L1	10	457
HPV18	E6	9	37	HPV18	L1	8	510
HPV18	E6	11	37	HPV18	L1	8	52
HPV18	E6	8	38	HPV18	L1	9	57
HPV18	E6	10	38	HPV18	L1	11	282
HPV18	E6	10	72	HPV18	L1	11	173
HPV18	E7	9	82	HPV18	L1	8	28
HPV18	E7	10	77	HPV18	L1	10	26
HPV18	E7	11	90	HPV18	L1	9	472
HPV18	E7	9	92	HPV18	L1	11	472
HPV18	E7	9	88	HPV18	L1	11	412
HPV18	E7	9	78	HPV18	L1	8	315
HPV18	E7	8	93	HPV18	L1	8	366
HPV18	L1	11	63	HPV18	L1	8	137
HPV18	L1	8	345	HPV18	L1	9	287
HPV18	L1	11	407	HPV18	L1	8	410
HPV18	L1	8	310	HPV18	L1	9	102
HPV18	L1	11	2	HPV18	L1	10	102
HPV18	L1	9	284	HPV18	L1	10	135
HPV18	L1	8	122	HPV18	L1	8	81
HPV18	L1	10	122	HPV18	L1	8	288
HPV18	L1	11	520	HPV18	L1	8	459
HPV18	L1	9	364	HPV18	L1	10	359
HPV18	L1	10	364	HPV18	L1	8	475
HPV18	L1	9	263	HPV18	L1	10	455
HPV18	L1	8	330	HPV18	L1	9	458
HPV18	L1	10	203	HPV18	L1	11	100
HPV18	L1	8	49	HPV18	L1	10	408
HPV18	L1	11	49	HPV18	L1	11	78
HPV18	L1	8	517	HPV18	L1	11	442
HPV18	L1	8	145	HPV18	L1	9	444
HPV18	L1	8	177	HPV18	L1	11	327
HPV18	L1	11	342	HPV18	L1	11	362
HPV18	L1	11	358	HPV18	L1	9	474

Table VII
HLA-A1 Supermotif Peptides

HPV18	L1	8	473
HPV18	L1	10	473
HPV18	L1	9	126
HPV18	L1	8	89
HPV18	L1	8	361
HPV18	L1	9	295
HPV18	L1	11	35
HPV18	L1	8	425
HPV18	L1	9	4
HPV18	L1	8	88
HPV18	L1	9	88
HPV18	L2	11	286
HPV18	L2	8	341
HPV18	L2	11	341
HPV18	L2	11	322
HPV18	L2	11	404
HPV18	L2	11	443
HPV18	L2	11	241
HPV18	L2	11	296
HPV18	L2	8	429
HPV18	L2	10	429
HPV18	L2	10	62
HPV18	L2	8	64
HPV18	L2	10	432
HPV18	L2	11	432
HPV18	L2	10	183
HPV18	L2	10	310
HPV18	L2	11	310
HPV18	L2	11	37
HPV18	L2	10	44
HPV18	L2	10	323
HPV18	L2	11	152
HPV18	L2	10	405
HPV18	L2	8	249
HPV18	L2	11	43
HPV18	L2	9	248
HPV18	L2	10	242
HPV18	L2	10	287
HPV18	L2	10	391
HPV18	L2	11	338
HPV18	L2	10	386
HPV18	L2	8	325
HPV18	L2	11	390
HPV18	L2	8	362
HPV18	L2	10	362
HPV18	L2	11	362
HPV18	L2	9	419
HPV18	L2	9	120
HPV18	L2	9	376
HPV18	L2	8	185
HPV18	L2	8	258
HPV18	L2	10	360
HPV18	L2	8	312
HPV18	L2	9	312
HPV18	L2	10	172
HPV18	L2	9	233
HPV18	L2	9	298
HPV18	L2	9	268
HPV18	L2	8	364
HPV18	L2	9	364
HPV18	L2	11	364
HPV18	L2	8	220
HPV18	L2	10	450
HPV18	L2	10	247
HPV18	L2	11	246
HPV18	L2	8	393
HPV18	L2	11	147
HPV18	L2	10	153
HPV18	L2	8	365
HPV18	L2	10	365
HPV18	L2	9	149
HPV18	L2	8	377
HPV18	L2	9	39
HPV18	L2	9	406
HPV18	L2	8	367
HPV18	L2	9	114
HPV18	L2	9	288
HPV18	L2	9	392
HPV18	L2	10	148
HPV18	L2	10	38
HPV18	L2	9	154
HPV18	L2	9	366
HPV18	L2	8	388
HPV18	L2	11	217
HPV18	L2	10	339
HPV18	L2	8	150
HPV18	L2	11	417
HPV18	L2	8	234
HPV18	L2	10	113
HPV18	L2	9	387
HPV18	L2	11	112
HPV18	L2	9	427
HPV18	L2	10	427
HPV18	L2	8	436
HPV18	L2	11	374
HPV31	E1	10	186
HPV31	E1	8	504
HPV31	E1	9	81
HPV31	E1	9	213
HPV31	E1	8	96
HPV31	E1	8	421
HPV31	E1	8	336
HPV31	E1	10	336
HPV31	E1	9	364
HPV31	E1	8	352
HPV31	E1	9	42
HPV31	E1	10	348
HPV31	E1	9	311
HPV31	E1	10	583
HPV31	E1	11	583
HPV31	E1	8	50
HPV31	E1	9	473
HPV31	E1	9	425
HPV31	E1	8	436
HPV31	E1	8	199
HPV31	E1	9	566
HPV31	E1	11	433
HPV31	E1	11	499
HPV31	E1	9	305
HPV31	E1	10	252

Table VII
HLA-A1 Supermotif Peptides

HPV31	E1	8	11	HPV31	E2	9	307
HPV31	E1	9	11	HPV31	E2	11	22
HPV31	E1	11	196	HPV31	E2	8	124
HPV31	E1	10	222	HPV31	E2	11	124
HPV31	E1	9	243	HPV31	E2	11	197
HPV31	E1	8	328	HPV31	E2	8	80
HPV31	E1	9	560	HPV31	E2	11	185
HPV31	E1	11	478	HPV31	E2	8	200
HPV31	E1	11	309	HPV31	E2	8	171
HPV31	E1	11	471	HPV31	E2	11	168
HPV31	E1	10	479	HPV31	E2	10	35
HPV31	E1	11	479	HPV31	E2	8	164
HPV31	E1	10	291	HPV31	E2	9	345
HPV31	E1	11	291	HPV31	E2	8	193
HPV31	E1	8	590	HPV31	E2	8	312
HPV31	E1	11	463	HPV31	E2	10	78
HPV31	E1	8	119	HPV31	E2	11	77
HPV31	E1	10	232	HPV31	E2	8	303
HPV31	E1	8	412	HPV31	E2	9	84
HPV31	E1	8	234	HPV31	E2	8	127
HPV31	E1	10	94	HPV31	E2	10	127
HPV31	E1	9	584	HPV31	E2	9	361
HPV31	E1	10	584	HPV31	E2	11	9
HPV31	E1	9	337	HPV31	E2	10	106
HPV31	E1	10	563	HPV31	E2	10	317
HPV31	E1	10	500	HPV31	E2	10	191
HPV31	E1	9	187	HPV31	E2	8	151
HPV31	E1	8	306	HPV31	E2	9	151
HPV31	E1	11	47	HPV31	E2	8	321
HPV31	E1	9	253	HPV31	E2	8	25
HPV31	E1	10	547	HPV31	E2	9	25
HPV31	E1	10	117	HPV31	E2	8	37
HPV31	E1	11	93	HPV31	E2	9	311
HPV31	E1	10	580	HPV31	E2	8	346
HPV31	E1	10	207	HPV31	E2	10	198
HPV31	E1	8	323	HPV31	E2	9	128
HPV31	E1	10	124	HPV31	E2	11	128
HPV31	E1	11	562	HPV31	E2	10	93
HPV31	E1	8	293	HPV31	E2	8	362
HPV31	E1	9	293	HPV31	E2	9	192
HPV31	E1	10	293	HPV31	E2	11	92
HPV31	E1	11	303	HPV31	E2	10	344
HPV31	E1	11	40	HPV31	E2	8	131
HPV31	E1	8	294	HPV31	E2	9	159
HPV31	E1	9	294	HPV31	E2	10	159
HPV31	E1	11	211	HPV31	E5	11	40
HPV31	E1	9	233	HPV31	E5	8	53
HPV31	E1	11	333	HPV31	E5	11	53
HPV31	E1	11	505	HPV31	E5	8	61
HPV31	E1	11	325	HPV31	E5	10	15
HPV31	E1	9	349	HPV31	E5	9	72
HPV31	E1	11	349	HPV31	E5	10	6
HPV31	E1	8	254	HPV31	E5	9	11
HPV31	E1	10	434	HPV31	E5	9	16
HPV31	E1	10	197	HPV31	E5	8	43
HPV31	E1	9	223	HPV31	E5	9	42
HPV31	E1	9	564	HPV31	E5	8	32
HPV31	E1	11	564	HPV31	E5	11	5
HPV31	E1	9	558	HPV31	E5	11	70
HPV31	E1	11	558	HPV31	E5	8	56

Table VII
HLA-A1 Supermotif Peptides

HPV31	E5	11	56
HPV31	E5	9	31
HPV31	E5	10	10
HPV31	E5	9	7
HPV31	E5	10	41
HPV31	E5	10	54
HPV31	E5	8	8
HPV31	E5	10	51
HPV31	E5	8	73
HPV31	E5	8	12
HPV31	E5	11	9
HPV31	E5	9	64
HPV31	E5	11	50
HPV31	E5	10	63
HPV31	E6	11	66
HPV31	E6	8	63
HPV31	E6	8	25
HPV31	E6	10	14
HPV31	E6	9	39
HPV31	E6	8	47
HPV31	E6	9	61
HPV31	E6	10	61
HPV31	E6	8	118
HPV31	E6	8	72
HPV31	E6	10	72
HPV31	E6	9	15
HPV31	E6	9	37
HPV31	E6	11	37
HPV31	E6	10	36
HPV31	E6	8	16
HPV31	E6	9	73
HPV31	E6	9	132
HPV31	E6	9	70
HPV31	E6	10	70
HPV31	E7	10	48
HPV31	E7	8	4
HPV31	E7	10	78
HPV31	E7	11	77
HPV31	E7	9	49
HPV31	L1	9	348
HPV31	L1	8	398
HPV31	L1	8	285
HPV31	L1	9	285
HPV31	L1	9	224
HPV31	L1	11	459
HPV31	L1	8	129
HPV31	L1	9	203
HPV31	L1	9	353
HPV31	L1	8	270
HPV31	L1	8	449
HPV31	L1	8	456
HPV31	L1	9	323
HPV31	L1	11	117
HPV31	L1	9	413
HPV31	L1	11	298
HPV31	L1	11	282
HPV31	L1	11	393
HPV31	L1	10	118
HPV31	L1	10	382
HPV31	L1	11	61
HPV31	L1	11	381
HPV31	L1	8	357
HPV31	L1	10	65
HPV31	L1	8	20
HPV31	L1	8	42
HPV31	L1	9	42
HPV31	L1	8	384
HPV31	L1	8	43
HPV31	L1	11	238
HPV31	L1	11	201
HPV31	L1	9	300
HPV31	L1	11	351
HPV31	L1	9	227
HPV31	L1	11	222
HPV31	L1	9	411
HPV31	L1	11	411
HPV31	L1	11	17
HPV31	L1	8	306
HPV31	L1	8	255
HPV31	L1	9	41
HPV31	L1	10	41
HPV31	L1	8	77
HPV31	L1	10	77
HPV31	L1	10	75
HPV31	L1	8	228
HPV31	L1	8	414
HPV31	L1	11	2
HPV31	L1	10	394
HPV31	L1	10	299
HPV31	L1	10	283
HPV31	L1	11	283
HPV31	L1	8	286
HPV31	L1	9	383
HPV31	L1	11	302
HPV31	L1	8	354
HPV31	L1	11	354
HPV31	L1	11	267
HPV31	L1	9	66
HPV31	L1	10	18
HPV31	L1	8	28
HPV31	L1	8	301
HPV31	L1	10	62
HPV31	L1	9	235
HPV31	L1	8	364
HPV31	L1	8	250
HPV31	L1	8	27
HPV31	L1	9	27
HPV31	L2	11	286
HPV31	L2	9	311
HPV31	L2	10	311
HPV31	L2	11	311
HPV31	L2	11	376
HPV31	L2	8	354
HPV31	L2	10	253
HPV31	L2	11	253
HPV31	L2	11	237
HPV31	L2	8	433
HPV31	L2	11	351
HPV31	L2	10	63
HPV31	L2	8	65

Table VII
HLA-A1 Supermotif Peptides

HPV31	L2	11	213
HPV31	L2	11	38
HPV31	L2	10	45
HPV31	L2	11	45
HPV31	L2	8	245
HPV31	L2	9	244
HPV31	L2	10	238
HPV31	L2	11	178
HPV31	L2	10	395
HPV31	L2	10	287
HPV31	L2	11	447
HPV31	L2	8	269
HPV31	L2	10	390
HPV31	L2	10	410
HPV31	L2	11	122
HPV31	L2	11	394
HPV31	L2	9	425
HPV31	L2	11	44
HPV31	L2	10	243
HPV31	L2	9	378
HPV31	L2	9	229
HPV31	L2	11	429
HPV31	L2	11	9
HPV31	L2	9	431
HPV31	L2	10	431
HPV31	L2	8	181
HPV31	L2	9	180
HPV31	L2	10	179
HPV31	L2	9	396
HPV31	L2	8	151
HPV31	L2	8	346
HPV31	L2	11	346
HPV31	L2	8	379
HPV31	L2	10	149
HPV31	L2	9	40
HPV31	L2	8	312
HPV31	L2	9	312
HPV31	L2	10	312
HPV31	L2	10	347
HPV31	L2	11	266
HPV31	L2	9	288
HPV31	L2	9	345
HPV31	L2	11	148
HPV31	L2	10	39
HPV31	L2	8	426
HPV31	L2	10	344
HPV31	L2	11	343
HPV31	L2	9	391
HPV31	L2	9	254
HPV31	L2	10	254
HPV31	L2	8	392
HPV31	L2	10	430
HPV31	L2	11	430
HPV31	L2	9	150
HPV33	E1	10	596
HPV33	E1	11	596
HPV33	E1	9	81
HPV33	E1	9	226
HPV33	E1	8	494
HPV33	E1	9	494
HPV33	E1	8	349
HPV33	E1	10	349
HPV33	E1	8	365
HPV33	E1	9	42
HPV33	E1	9	377
HPV33	E1	9	62
HPV33	E1	9	324
HPV33	E1	9	516
HPV33	E1	10	361
HPV33	E1	11	361
HPV33	E1	8	449
HPV33	E1	8	212
HPV33	E1	8	446
HPV33	E1	11	446
HPV33	E1	10	265
HPV33	E1	11	209
HPV33	E1	8	11
HPV33	E1	11	512
HPV33	E1	8	564
HPV33	E1	8	341
HPV33	E1	9	573
HPV33	E1	11	192
HPV33	E1	9	266
HPV33	E1	8	267
HPV33	E1	9	200
HPV33	E1	10	492
HPV33	E1	11	492
HPV33	E1	11	322
HPV33	E1	10	210
HPV33	E1	9	520
HPV33	E1	10	124
HPV33	E1	10	304
HPV33	E1	11	304
HPV33	E1	10	220
HPV33	E1	8	603
HPV33	E1	11	476
HPV33	E1	8	425
HPV33	E1	10	245
HPV33	E1	8	247
HPV33	E1	9	438
HPV33	E1	9	350
HPV33	E1	9	362
HPV33	E1	10	362
HPV33	E1	11	362
HPV33	E1	10	576
HPV33	E1	8	336
HPV33	E1	10	513
HPV33	E1	11	443
HPV33	E1	11	346
HPV33	E1	10	199
HPV33	E1	8	195
HPV33	E1	10	195
HPV33	E1	10	560
HPV33	E1	10	519
HPV33	E1	8	434
HPV33	E1	10	593
HPV33	E1	10	437
HPV33	E1	8	308
HPV33	E1	11	575
HPV33	E1	9	335

Table VII
HLA-A1 Supermotif Peptides

HPV33	E1	8	306	HPV33	E2	8	131
HPV33	E1	9	306	HPV33	E5	11	56
HPV33	E1	10	306	HPV33	E5	10	3
HPV33	E1	10	111	HPV33	E5	9	42
HPV33	E1	10	193	HPV33	E5	10	42
HPV33	E1	11	224	HPV33	E5	8	5
HPV33	E1	11	110	HPV33	E5	8	44
HPV33	E1	9	577	HPV33	E5	10	44
HPV33	E1	11	577	HPV33	E5	9	23
HPV33	E1	11	491	HPV33	E5	9	48
HPV33	E1	9	246	HPV33	E5	11	48
HPV33	E1	11	338	HPV33	E5	8	22
HPV33	E1	8	517	HPV33	E5	10	22
HPV33	E1	9	571	HPV33	E5	9	32
HPV33	E1	11	571	HPV33	E5	11	32
HPV33	E2	10	78	HPV33	E5	8	24
HPV33	E2	11	41	HPV33	E5	8	35
HPV33	E2	10	10	HPV33	E5	8	33
HPV33	E2	9	288	HPV33	E5	10	33
HPV33	E2	10	145	HPV33	E5	9	1
HPV33	E2	9	25	HPV33	E5	9	21
HPV33	E2	10	235	HPV33	E5	11	21
HPV33	E2	10	298	HPV33	E5	8	46
HPV33	E2	10	282	HPV33	E5	11	46
HPV33	E2	8	80	HPV33	E5	9	34
HPV33	E2	11	100	HPV33	E5	10	31
HPV33	E2	10	325	HPV33	E5	11	40
HPV33	E2	11	34	HPV33	E5	9	58
HPV33	E2	9	84	HPV33	E6	11	66
HPV33	E2	11	23	HPV33	E6	8	69
HPV33	E2	8	151	HPV33	E6	11	69
HPV33	E2	9	151	HPV33	E6	9	61
HPV33	E2	10	35	HPV33	E6	8	118
HPV33	E2	9	62	HPV33	E6	9	73
HPV33	E2	10	42	HPV33	E6	8	72
HPV33	E2	11	82	HPV33	E6	10	72
HPV33	E2	8	147	HPV33	E6	10	70
HPV33	E2	11	315	HPV33	E6	11	50
HPV33	E2	8	284	HPV33	E6	8	36
HPV33	E2	8	127	HPV33	E6	10	36
HPV33	E2	11	60	HPV33	E6	9	39
HPV33	E2	9	342	HPV33	E6	10	51
HPV33	E2	9	292	HPV33	E6	9	52
HPV33	E2	8	37	HPV33	E7	10	14
HPV33	E2	10	61	HPV33	E7	11	6
HPV33	E2	8	302	HPV33	E7	10	7
HPV33	E2	9	301	HPV33	L1	10	392
HPV33	E2	10	93	HPV33	L1	8	284
HPV33	E2	11	128	HPV33	L1	9	284
HPV33	E2	9	146	HPV33	L1	9	411
HPV33	E2	8	343	HPV33	L1	10	345
HPV33	E2	9	326	HPV33	L1	9	223
HPV33	E2	11	148	HPV33	L1	8	396
HPV33	E2	9	102	HPV33	L1	11	457
HPV33	E2	11	92	HPV33	L1	9	351
HPV33	E2	9	159	HPV33	L1	8	129
HPV33	E2	10	159	HPV33	L1	9	202
HPV33	E2	8	300	HPV33	L1	9	303
HPV33	E2	10	300	HPV33	L1	10	303
HPV33	E2	8	44	HPV33	L1	8	447

Table VII
HLA-A1 Supermotif Peptides

HPV33	L1	8	249
HPV33	L1	8	454
HPV33	L1	9	322
HPV33	L1	11	117
HPV33	L1	11	297
HPV33	L1	9	226
HPV33	L1	11	281
HPV33	L1	9	365
HPV33	L1	11	365
HPV33	L1	10	118
HPV33	L1	10	65
HPV33	L1	11	379
HPV33	L1	8	20
HPV33	L1	8	42
HPV33	L1	9	42
HPV33	L1	11	61
HPV33	L1	8	382
HPV33	L1	10	62
HPV33	L1	11	237
HPV33	L1	11	200
HPV33	L1	9	299
HPV33	L1	11	221
HPV33	L1	8	439
HPV33	L1	9	409
HPV33	L1	11	409
HPV33	L1	11	17
HPV33	L1	8	305
HPV33	L1	8	254
HPV33	L1	8	347
HPV33	L1	9	41
HPV33	L1	10	41
HPV33	L1	8	77
HPV33	L1	10	77
HPV33	L1	10	75
HPV33	L1	8	285
HPV33	L1	8	412
HPV33	L1	10	298
HPV33	L1	11	39
HPV33	L1	8	227
HPV33	L1	8	352
HPV33	L1	11	352
HPV33	L1	11	2
HPV33	L1	11	266
HPV33	L1	9	381
HPV33	L1	11	349
HPV33	L1	10	238
HPV33	L1	11	238
HPV33	L1	11	301
HPV33	L1	10	282
HPV33	L1	11	282
HPV33	L1	9	66
HPV33	L1	10	18
HPV33	L1	8	28
HPV33	L1	9	28
HPV33	L1	10	380
HPV33	L1	8	300
HPV33	L1	8	362
HPV33	L1	9	234
HPV33	L1	8	27
HPV33	L1	9	27
HPV33	L1	10	27
HPV33	L2	11	291
HPV33	L2	10	272
HPV33	L2	10	431
HPV33	L2	11	258
HPV33	L2	10	447
HPV33	L2	11	242
HPV33	L2	11	183
HPV33	L2	8	440
HPV33	L2	8	421
HPV33	L2	10	421
HPV33	L2	8	64
HPV33	L2	10	62
HPV33	L2	11	218
HPV33	L2	11	37
HPV33	L2	8	374
HPV33	L2	11	374
HPV33	L2	8	336
HPV33	L2	10	44
HPV33	L2	11	44
HPV33	L2	9	448
HPV33	L2	11	448
HPV33	L2	9	273
HPV33	L2	9	155
HPV33	L2	10	292
HPV33	L2	8	250
HPV33	L2	11	250
HPV33	L2	10	104
HPV33	L2	8	433
HPV33	L2	10	248
HPV33	L2	9	249
HPV33	L2	10	243
HPV33	L2	11	405
HPV33	L2	10	372
HPV33	L2	10	391
HPV33	L2	8	423
HPV33	L2	11	333
HPV33	L2	9	413
HPV33	L2	10	347
HPV33	L2	9	376
HPV33	L2	9	121
HPV33	L2	11	411
HPV33	L2	8	186
HPV33	L2	8	221
HPV33	L2	8	317
HPV33	L2	9	317
HPV33	L2	11	43
HPV33	L2	11	191
HPV33	L2	11	153
HPV33	L2	9	234
HPV33	L2	10	357
HPV33	L2	8	393
HPV33	L2	8	122
HPV33	L2	11	103
HPV33	L2	8	106
HPV33	L2	10	418
HPV33	L2	11	418
HPV33	L2	10	184
HPV33	L2	10	354
HPV33	L2	8	156

Table VII
HLA-A1 Supermotif Peptides

HPV33	L2	10	38	HPV45	E1	11	476
HPV33	L2	9	39	HPV45	E1	10	245
HPV33	L2	10	154	HPV45	E1	8	247
HPV33	L2	9	432	HPV45	E1	8	267
HPV33	L2	9	244	HPV45	E1	9	350
HPV33	L2	9	293	HPV45	E1	10	210
HPV33	L2	11	417	HPV45	E1	9	362
HPV33	L2	11	353	HPV45	E1	11	362
HPV33	L2	9	392	HPV45	E1	9	200
HPV33	L2	9	105	HPV45	E1	10	513
HPV33	L2	8	356	HPV45	E1	10	560
HPV33	L2	11	356	HPV45	E1	8	414
HPV45	E1	10	199	HPV45	E1	11	473
HPV45	E1	11	512	HPV45	E1	8	434
HPV45	E1	11	40	HPV45	E1	10	593
HPV45	E1	8	517	HPV45	E1	10	412
HPV45	E1	9	517	HPV45	E1	10	80
HPV45	E1	11	202	HPV45	E1	10	128
HPV45	E1	10	423	HPV45	E1	8	306
HPV45	E1	9	226	HPV45	E1	9	306
HPV45	E1	8	349	HPV45	E1	10	306
HPV45	E1	10	349	HPV45	E1	11	575
HPV45	E1	10	361	HPV45	E1	8	307
HPV45	E1	10	623	HPV45	E1	9	307
HPV45	E1	9	42	HPV45	E1	8	308
HPV45	E1	10	596	HPV45	E1	9	246
HPV45	E1	11	596	HPV45	E1	11	224
HPV45	E1	8	365	HPV45	E1	9	577
HPV45	E1	9	573	HPV45	E1	11	577
HPV45	E1	9	324	HPV45	E1	9	81
HPV45	E1	11	446	HPV45	E1	9	266
HPV45	E1	10	385	HPV45	E1	8	325
HPV45	E1	9	486	HPV45	E1	10	576
HPV45	E1	8	449	HPV45	E1	9	571
HPV45	E1	9	438	HPV45	E1	11	571
HPV45	E1	8	212	HPV45	E2	10	84
HPV45	E1	9	579	HPV45	E2	10	16
HPV45	E1	8	130	HPV45	E2	9	305
HPV45	E1	8	494	HPV45	E2	11	134
HPV45	E1	9	494	HPV45	E2	8	158
HPV45	E1	11	209	HPV45	E2	9	158
HPV45	E1	8	11	HPV45	E2	8	31
HPV45	E1	9	11	HPV45	E2	9	31
HPV45	E1	11	459	HPV45	E2	11	28
HPV45	E1	10	265	HPV45	E2	8	171
HPV45	E1	10	235	HPV45	E2	8	319
HPV45	E1	9	256	HPV45	E2	11	106
HPV45	E1	10	519	HPV45	E2	8	154
HPV45	E1	11	338	HPV45	E2	9	154
HPV45	E1	11	491	HPV45	E2	10	41
HPV45	E1	11	322	HPV45	E2	9	341
HPV45	E1	10	447	HPV45	E2	8	301
HPV45	E1	10	492	HPV45	E2	9	187
HPV45	E1	11	492	HPV45	E2	9	357
HPV45	E1	8	425	HPV45	E2	8	109
HPV45	E1	10	304	HPV45	E2	9	332
HPV45	E1	11	304	HPV45	E2	11	40
HPV45	E1	10	220	HPV45	E2	9	90
HPV45	E1	8	387	HPV45	E2	8	43
HPV45	E1	8	476	HPV45	E2	9	309

Table VII
HLA-A1 Supermotif Peptides

HPV45	E2	11	142
HPV45	E2	8	358
HPV45	E2	10	99
HPV45	E2	8	159
HPV45	E2	8	138
HPV45	E2	11	98
HPV45	E2	9	166
HPV45	E2	10	166
HPV45	E2	8	145
HPV45	E2	8	317
HPV45	E2	10	317
HPV45	E2	11	175
HPV45	E2	8	137
HPV45	E2	9	137
HPV45	E6	9	37
HPV45	E6	11	37
HPV45	E6	8	27
HPV45	E6	10	77
HPV45	E6	11	43
HPV45	E6	10	53
HPV45	E6	8	120
HPV45	E6	9	54
HPV45	E6	8	92
HPV45	E6	8	74
HPV45	E6	9	41
HPV45	E6	11	24
HPV45	E6	11	89
HPV45	E6	8	38
HPV45	E6	10	38
HPV45	E6	9	72
HPV45	E6	10	72
HPV45	E7	9	83
HPV45	E7	10	20
HPV45	E7	11	91
HPV45	E7	10	92
HPV45	E7	9	89
HPV45	E7	9	93
HPV45	E7	8	94
HPV45	L1	8	103
HPV45	L1	11	28
HPV45	L1	11	375
HPV45	L1	8	88
HPV45	L1	10	88
HPV45	L1	8	276
HPV45	L1	9	188
HPV45	L1	9	250
HPV45	L1	11	488
HPV45	L1	9	332
HPV45	L1	10	332
HPV45	L1	9	229
HPV45	L1	11	461
HPV45	L1	8	296
HPV45	L1	10	169
HPV45	L1	8	313
HPV45	L1	8	14
HPV45	L1	11	14
HPV45	L1	8	485
HPV45	L1	9	351
HPV45	L1	9	141
HPV45	L1	10	141
HPV45	L1	8	111
HPV45	L1	8	143
HPV45	L1	11	326
HPV45	L1	11	422
HPV45	L1	9	396
HPV45	L1	11	396
HPV45	L1	10	12
HPV45	L1	11	11
HPV45	L1	10	5
HPV45	L1	10	411
HPV45	L1	9	328
HPV45	L1	10	91
HPV45	L1	8	68
HPV45	L1	9	68
HPV45	L1	8	413
HPV45	L1	8	69
HPV45	L1	11	264
HPV45	L1	11	227
HPV45	L1	11	4
HPV45	L1	11	310
HPV45	L1	8	425
HPV45	L1	10	425
HPV45	L1	8	383
HPV45	L1	11	383
HPV45	L1	8	17
HPV45	L1	9	22
HPV45	L1	11	248
HPV45	L1	11	139
HPV45	L1	9	440
HPV45	L1	11	440
HPV45	L1	11	380
HPV45	L1	8	281
HPV45	L1	8	334
HPV45	L1	9	253
HPV45	L1	9	67
HPV45	L1	10	67
HPV45	L1	10	101
HPV45	L1	8	46
HPV45	L1	8	254
HPV45	L1	8	427
HPV45	L1	10	327
HPV45	L1	8	443
HPV45	L1	10	423
HPV45	L1	9	426
HPV45	L1	11	65
HPV45	L1	10	376
HPV45	L1	11	43
HPV45	L1	11	410
HPV45	L1	9	412
HPV45	L1	11	330
HPV45	L1	9	442
HPV45	L1	10	462
HPV45	L1	8	329
HPV45	L1	8	441
HPV45	L1	10	441
HPV45	L1	8	478
HPV45	L1	11	293
HPV45	L1	9	92
HPV45	L1	8	54
HPV45	L1	9	477

Table VII
HLA-A1 Supermotif Peptides

HPV45	L1	9	261	HPV45	L2	9	154
HPV45	L1	8	393	HPV45	L2	11	358
HPV45	L1	8	53	HPV45	L2	9	149
HPV45	L1	9	53	HPV45	L2	8	363
HPV45	L2	11	286	HPV45	L2	11	363
HPV45	L2	9	114	HPV45	L2	9	39
HPV45	L2	8	340	HPV45	L2	10	376
HPV45	L2	11	340	HPV45	L2	9	393
HPV45	L2	11	405	HPV45	L2	8	155
HPV45	L2	9	345	HPV45	L2	9	268
HPV45	L2	8	343	HPV45	L2	11	418
HPV45	L2	11	343	HPV45	L2	10	38
HPV45	L2	10	148	HPV45	L2	10	359
HPV45	L2	11	241	HPV45	L2	11	426
HPV45	L2	11	296	HPV45	L2	8	389
HPV45	L2	8	430	HPV45	L2	11	217
HPV45	L2	10	430	HPV45	L2	8	150
HPV45	L2	8	64	HPV45	L2	8	249
HPV45	L2	10	62	HPV45	L2	9	388
HPV45	L2	10	183	HPV45	L2	11	112
HPV45	L2	9	433	HPV45	L2	9	428
HPV45	L2	10	433	HPV45	L2	10	428
HPV45	L2	11	433	HPV45	L2	8	437
HPV45	L2	11	37	HPV45	L2	9	437
HPV45	L2	10	406	HPV56	E2	10	21
HPV45	L2	9	407	HPV56	E2	9	71
HPV45	L2	10	44	HPV56	E2	11	71
HPV45	L2	10	338	HPV56	E2	10	92
HPV45	L2	11	152	HPV56	E2	11	92
HPV45	L2	11	43	HPV56	E2	9	140
HPV45	L2	8	366	HPV56	E2	8	263
HPV45	L2	11	337	HPV56	E2	11	43
HPV45	L2	10	287	HPV56	E2	8	23
HPV45	L2	10	242	HPV56	E2	10	128
HPV45	L2	11	375	HPV56	E2	11	294
HPV45	L2	10	392	HPV56	E2	8	261
HPV45	L2	9	248	HPV56	E2	10	261
HPV45	L2	10	387	HPV56	E2	9	66
HPV45	L2	8	258	HPV56	E2	8	94
HPV45	L2	11	391	HPV56	E2	9	94
HPV45	L2	8	378	HPV56	E2	8	130
HPV45	L2	8	361	HPV56	E2	8	297
HPV45	L2	10	361	HPV56	E2	10	299
HPV45	L2	9	120	HPV56	E2	11	258
HPV45	L2	9	420	HPV56	E2	8	90
HPV45	L2	8	185	HPV56	E2	10	295
HPV45	L2	10	267	HPV56	E2	11	25
HPV45	L2	11	118	HPV56	E2	8	46
HPV45	L2	8	312	HPV56	E2	11	149
HPV45	L2	9	312	HPV56	E2	8	152
HPV45	L2	10	172	HPV56	E2	8	301
HPV45	L2	9	233	HPV56	E2	9	246
HPV45	L2	10	451	HPV56	E2	10	26
HPV45	L2	9	298	HPV56	E2	8	141
HPV45	L2	8	220	HPV56	E2	8	28
HPV45	L2	10	247	HPV56	E2	10	259
HPV45	L2	11	246	HPV56	E2	10	36
HPV45	L2	9	288	HPV56	E2	8	271
HPV45	L2	10	153	HPV56	E2	9	27
HPV45	L2	9	362	HPV56	E2	10	150

Table VII
HLA-A1 Supermotif Peptides

HPV56	E2	9	45
HPV56	E2	11	35
HPV56	E2	9	270
HPV56	E2	10	79
HPV56	E2	8	278
HPV56	E2	11	111
HPV56	E2	8	74
HPV56	E2	9	74
HPV56	E2	9	102
HPV56	E2	10	102
HPV56	E6	9	64
HPV56	E6	10	64
HPV56	E6	11	69
HPV56	E6	8	50
HPV56	E6	8	28
HPV56	E6	10	52
HPV56	E6	8	39
HPV56	E6	10	39
HPV56	E6	8	54
HPV56	E6	10	54
HPV56	E6	8	75
HPV56	E6	10	75
HPV56	E6	10	26
HPV56	E6	10	70
HPV56	E6	9	40
HPV56	E6	9	55
HPV56	E6	11	25
HPV56	E6	10	98
HPV56	E6	10	119
HPV56	E6	9	135
HPV56	E6	9	73
HPV56	E6	10	73
HPV56	E7	9	62
HPV56	E7	11	60
HPV56	L1	8	381
HPV56	L1	8	444
HPV56	L1	10	444
HPV56	L1	11	37
HPV56	L1	8	26
HPV56	L1	9	195
HPV56	L1	9	257
HPV56	L1	11	491
HPV56	L1	10	486
HPV56	L1	10	60
HPV56	L1	11	60
HPV56	L1	9	236
HPV56	L1	8	23
HPV56	L1	11	23
HPV56	L1	8	481
HPV56	L1	8	303
HPV56	L1	10	21
HPV56	L1	8	488
HPV56	L1	9	356
HPV56	L1	8	118
HPV56	L1	8	150
HPV56	L1	11	331
HPV56	L1	9	399
HPV56	L1	11	399
HPV56	L1	11	378
HPV56	L1	10	414
HPV56	L1	8	334
HPV56	L1	8	258
HPV56	L1	11	258
HPV56	L1	11	413
HPV56	L1	10	93
HPV56	L1	11	300
HPV56	L1	10	98
HPV56	L1	8	55
HPV56	L1	8	77
HPV56	L1	9	77
HPV56	L1	8	416
HPV56	L1	11	234
HPV56	L1	9	333
HPV56	L1	8	2
HPV56	L1	9	1
HPV56	L1	11	271
HPV56	L1	8	95
HPV56	L1	10	95
HPV56	L1	10	426
HPV56	L1	9	31
HPV56	L1	8	473
HPV56	L1	11	255
HPV56	L1	9	13
HPV56	L1	11	467
HPV56	L1	10	442
HPV56	L1	11	52
HPV56	L1	8	288
HPV56	L1	8	339
HPV56	L1	9	260
HPV56	L1	9	76
HPV56	L1	10	76
HPV56	L1	8	110
HPV56	L1	10	108
HPV56	L1	8	446
HPV56	L1	10	332
HPV56	L1	11	74
HPV56	L1	10	379
HPV56	L1	8	261
HPV56	L1	9	415
HPV56	L1	11	335
HPV56	L1	9	445
HPV56	L1	9	99
HPV56	L1	10	53
HPV56	L1	10	7
HPV56	L1	9	268
HPV56	L1	8	396
HPV56	L1	8	283
HPV56	L1	8	62
HPV56	L1	9	62
HPV56	L2	8	438
HPV56	L2	11	246
HPV56	L2	11	406
HPV56	L2	11	30
HPV56	L2	9	429
HPV56	L2	9	114
HPV56	L2	10	287
HPV56	L2	11	118
HPV56	L2	8	64
HPV56	L2	10	434
HPV56	L2	11	434

Table VII
HLA-A1 Supermotif Peptides

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HPV56	L2	8	258
HPV56	L2	10	62
HPV56	L2	10	310
HPV56	L2	11	310
HPV56	L2	8	269
HPV56	L2	11	372
HPV56	L2	11	190
HPV56	L2	8	44
HPV56	L2	10	44
HPV56	L2	11	44
HPV56	L2	9	210
HPV56	L2	11	182
HPV56	L2	9	279
HPV56	L2	10	407
HPV56	L2	9	43
HPV56	L2	11	43
HPV56	L2	10	38
HPV56	L2	8	337
HPV56	L2	11	338
HPV56	L2	9	248
HPV56	L2	10	278
HPV56	L2	10	342
HPV56	L2	10	388
HPV56	L2	8	395
HPV56	L2	9	374
HPV56	L2	10	209
HPV56	L2	10	392
HPV56	L2	11	392
HPV56	L2	9	336
HPV56	L2	10	267
HPV56	L2	9	410
HPV56	L2	8	185
HPV56	L2	8	312
HPV56	L2	9	312
HPV56	L2	10	312
HPV56	L2	11	421
HPV56	L2	9	233
HPV56	L2	8	220
HPV56	L2	9	435
HPV56	L2	10	435
HPV56	L2	11	435
HPV56	L2	10	153
HPV56	L2	8	211
HPV56	L2	9	154
HPV56	L2	10	183
HPV56	L2	11	414
HPV56	L2	10	247
HPV56	L2	9	288
HPV56	L2	11	112
HPV56	L2	9	408
HPV56	L2	11	408
HPV56	L2	8	249
HPV56	L2	11	152
HPV56	L2	9	389
HPV56	L2	10	31
HPV56	L2	10	431

Table VIIA HPV6A
HLA-A1 Supermotif Peptides

2	3	4
L2	11	286
E4	8	14
E1	11	520
E1	10	207
L1	8	81
L2	8	421
E6	8	37
E6	10	37
L2	9	288
E1	11	330
L1	9	342
E1	8	525
E6	11	10
E1	10	77
E1	10	601
E6	11	67
E2	10	35
E6	11	131
E4	9	64
E1	10	369
L1	9	219
E6	10	96
E1	8	570
E1	10	570
E2	9	313
E1	11	81
E2	9	25
E1	10	203
E1	9	42
L2	11	266
E7	9	44
L2	10	344
L1	9	198
E2	10	136
L2	10	120
L1	11	453
E1	10	604
E1	11	604
E1	9	131
E1	10	417
E2	11	100
E1	8	373
E2	8	80
E2	8	293
E2	10	293
L1	8	443
E2	10	205
E1	8	220
E6	8	126
E1	8	454
E1	11	454
L2	8	428
E5	9	68
E1	10	393
L2	10	398
E1	9	446
L1	8	245
E1	8	457
L2	11	239
L1	8	450
E1	9	587
E2	8	171
E5	9	28
L1	9	318
E1	10	243
E2	9	156
E1	11	217
E1	10	273
E1	8	11
L2	10	431
L2	11	431
L2	10	62
E1	10	431
L1	11	293
E2	10	179
L2	11	215
L2	8	64
E1	11	436
L1	9	407
L1	9	222
E1	8	316
L1	9	111
L1	11	113
L2	8	312
L2	9	312
L2	10	312
E6	8	119
E1	9	264
E4	8	59
E2	10	78
E2	10	310
E4	10	10
E2	9	338
E2	10	149
E2	11	149
E6	9	25
L1	11	387
E1	9	581
L1	9	361
L1	11	361
E1	8	502
E1	9	502
E5	8	21
E5	10	31
E6	9	97
E5	9	32
L2	10	44
L2	11	44
E5	8	17
E1	10	500
E1	11	500
E1	9	571
L1	10	376
L2	8	247
E1	11	476
L2	9	121
E5	10	34
E1	8	433
E6	8	73

Table VIIA HPV6A
HLA-A1 Supermotif Peptides

E6	10	73	E2	10	281
E1	10	312	L2	10	38
E1	11	312	E2	8	127
E1	9	254	L1	11	217
E1	8	357	L2	10	189
E1	10	357	L1	11	109
E1	10	228	E1	10	258
E1	11	484	L2	10	389
E2	9	84	L2	10	337
L1	10	56	L1	9	391
E6	11	116	L2	9	408
E6	8	52	E2	9	354
E6	10	52	L1	11	426
L1	10	61	L1	8	90
L1	8	19	L2	9	426
L1	10	71	L2	10	426
E1	8	255	E5	10	19
E5	9	16	L1	11	16
E2	8	314	L2	11	418
L2	9	246	L2	9	363
E5	8	33	L2	11	43
E5	11	33	L1	8	301
L1	8	41	E6	10	50
L1	9	41	E4	9	4
E1	10	521	L1	8	250
E1	9	208	L2	8	400
E2	11	82	E1	8	314
E5	9	59	E1	9	314
E5	10	59	E1	10	314
E5	8	51	E2	8	103
E5	8	69	E1	10	128
E5	8	60	L2	9	231
E5	9	60	L2	10	245
E5	10	72	L1	9	40
L1	8	378	L1	10	40
E1	10	218	E2	10	303
E1	9	259	L1	9	279
E1	9	605	L1	8	140
E1	10	605	E1	11	583
L2	9	390	L2	8	153
L2	10	240	L2	10	267
E1	8	132	E5	11	30
E1	9	358	E2	8	207
E5	10	49	L1	11	375
E6	9	38	E1	8	60
E6	11	38	L1	10	294
E5	8	61	E1	8	260
L2	9	338	E6	11	23
E5	9	73	E2	9	150
E5	8	47	E2	10	150
L1	9	295	E2	9	282
E2	8	151	L1	11	297
E2	9	151	L2	8	391
L1	11	196	L1	11	38
E1	9	274	L1	9	347
E1	10	568	E2	11	23
E1	11	451	E2	9	180
E4	10	57	E5	11	14
E1	9	59	L2	10	374
E1	8	395	L2	9	241

Table VIIA HPV6A
HLA-A1 Supermotif Peptides

E1	10	331
L1	8	348
L1	11	348
L1	8	392
E5	10	45
L2	11	145
L1	8	343
L2	9	39
E6	9	12
E2	8	355
L1	8	408
E5	10	15
E5	9	50
E5	11	71
E2	10	93
E6	8	26
L1	9	377
E2	11	128
L1	10	388
L2	9	147
L2	9	152
L1	10	346
L2	11	373
L1	8	280
E5	11	44
E6	8	39
E6	10	39
E1	11	232
L1	8	223
E1	9	585
E1	11	585
E6	10	11
L2	10	151
L1	11	345
L2	11	150
E1	9	332
E1	9	78
L1	9	57
L1	11	57
E1	11	346
E1	8	333
E5	9	20
E1	11	499
E6	9	53
E1	8	275
L1	8	73
E5	11	48
E5	9	46
L1	10	114
L1	9	62
E5	8	29
E2	9	206
L1	10	17
L1	8	296
L2	10	419
L2	8	364
L1	8	27
L2	10	146
E1	10	584
L1	9	72
L1	8	58
L1	10	58
E5	8	36
E5	10	58
E5	11	58
E2	8	92
E2	11	92
E4	8	12
E4	10	12
L2	8	435
E1	9	579
E1	11	579
L1	9	230
L1	8	358
E2	9	159
E2	10	159
L1	9	350
E2	11	168
E2	8	138
L1	8	26
L1	9	26
E2	8	131

Table VIIB HPV6B
HLA-A1 Supermotif Peptides

2	3	4
L2	11	286
E4	8	24
E1	11	520
E1	10	207
L1	8	81
L2	8	421
E6	8	37
E6	10	37
L2	9	288
E1	11	330
L1	9	342
E1	8	525
E6	11	10
E1	10	77
E1	10	601
E1	9	234
E6	11	67
E2	10	35
E6	11	131
E4	9	74
E1	10	369
L1	9	219
E6	10	96
E1	8	570
E1	10	570
E2	9	25
E2	9	313
E1	11	81
E1	10	203
E2	9	338
E1	9	42
L2	11	266
E7	9	44
L2	10	344
L1	9	198
E2	10	136
L2	10	120
L1	11	453
E1	10	604
E1	11	604
E1	9	131
E1	10	417
E2	11	100
E1	8	373
E2	8	80
E2	8	293
E2	10	293
L1	8	443
E2	10	205
E1	8	220
E6	8	126
E5A	9	16
E1	8	454
E1	11	454
L2	8	428
E5A	9	68
E1	10	393
L2	10	397
E1	9	446
L1	8	245
L2	11	239
E1	8	457
L1	8	450
E1	9	587
E2	8	171
E5A	9	28
L1	9	318
E1	10	243
E2	9	156
E1	11	217
E5B	8	15
E5B	10	25
E1	10	273
E1	8	11
L2	10	431
L2	11	431
L2	10	62
E1	10	431
L1	11	293
E2	10	179
L2	11	215
L2	8	64
E1	11	436
L1	9	407
L1	9	222
E1	8	316
L1	9	111
L1	11	113
L2	8	312
L2	9	312
L2	10	312
E6	8	119
E1	9	264
E2	10	78
E2	10	310
E6	10	50
E4	10	20
E2	10	149
E2	11	149
E6	9	25
L1	11	387
E1	9	581
L1	9	361
L1	11	361
E1	8	502
E1	9	502
E5A	8	21
E5A	10	31
E6	9	97
E5A	9	32
L2	10	44
L2	11	44
E5A	8	17
E1	10	500
E1	11	500
E1	9	571
L1	10	376
L2	8	247
E1	11	476
L2	9	121
E5A	10	34

Table VIIB HPV6B
HLA-A1 Supermotif Peptides

E1	8	433
E6	8	73
E6	10	73
E1	10	312
E1	11	312
E1	9	254
E1	8	357
E1	10	357
E1	10	228
E1	11	484
L1	10	56
E6	11	116
E6	8	52
E6	10	52
L1	10	61
L1	8	19
L1	10	71
E1	8	255
E2	8	314
L2	9	246
E5A	8	33
E5A	11	33
L1	8	41
L1	9	41
E1	10	521
E1	9	208
E5A	9	59
E5A	10	59
E5A	8	51
E2	11	82
E5A	8	69
E5A	8	60
E5A	9	60
E5A	10	72
L1	8	378
E1	10	218
L2	8	390
E1	9	259
E1	9	605
E1	10	605
L2	10	240
E5B	11	3
E1	8	132
E1	9	358
E5A	10	49
E6	9	38
E6	11	38
E5A	8	61
L2	9	338
E5A	9	73
E5A	8	47
L1	9	295
E5B	9	26
E2	8	151
E2	9	151
L1	11	196
E1	9	274
E1	10	568
E1	11	451
E1	9	59
E1	8	395
E4	10	67
E2	10	281
L2	10	38
E2	8	127
E1	8	607
L1	11	217
L2	10	189
E4	8	69
L1	11	109
L2	9	389
E1	10	258
L2	10	337
L1	9	391
L2	9	407
E2	9	354
L1	11	426
L1	8	90
L2	9	426
L2	10	426
E5A	10	19
L1	11	16
L2	9	363
E5A	10	7
L2	11	43
L1	8	301
E4	9	14
L1	8	250
L2	8	399
E1	8	314
E1	9	314
E1	10	314
E2	8	103
E1	10	128
L2	9	231
L2	10	245
L1	9	40
L1	10	40
E2	10	303
E2	9	84
L1	9	279
L1	8	140
E1	11	583
L2	8	153
L2	10	267
E5A	11	30
E2	8	207
L1	11	375
E1	8	60
L1	10	294
E1	8	260
E6	11	23
E2	9	150
E2	10	150
E2	9	282
L1	11	297
L1	11	38
L1	9	347
E2	11	23
E5A	11	14
E2	9	180
L2	10	374

Table VIIB HPV6B
HLA-A1 Supermotif Peptides

L2	9	241	L2	10	146
E1	10	331	E1	10	584
L1	8	348	L1	9	72
L1	11	348	L1	8	58
L1	8	392	L1	10	58
E5A	10	45	E5A	8	36
L2	11	145	E5B	10	13
L1	8	343	E5A	10	58
L2	9	39	E5A	11	58
E6	9	12	E2	8	92
E2	8	355	E2	11	92
L1	8	408	E4	8	22
E5A	9	50	E4	10	22
E5A	11	71	L2	8	435
E2	10	93	E1	9	579
E6	8	26	E1	11	579
L1	9	377	L1	9	230
E2	11	128	L1	8	358
E5B	10	59	E2	9	159
L1	10	388	E2	10	159
L2	9	147	L1	9	350
L2	9	152	E5B	9	62
L1	10	346	E4	8	9
L2	11	373	E2	11	168
L1	8	280	E2	8	138
E5A	11	44	L1	8	26
E6	8	39	L1	9	26
E6	10	39	E2	8	131
L1	8	223			
E1	11	232			
E5B	8	63			
E1	9	585			
E1	11	585			
E6	10	11			
L2	10	151			
L1	11	345			
L2	11	150			
E1	9	332			
L2	11	387			
E1	9	78			
L1	9	57			
L1	11	57			
E1	11	346			
E1	8	333			
E5A	9	20			
E1	11	499			
E6	9	53			
E1	8	275			
L1	8	73			
E5A	11	48			
E5A	9	46			
L1	10	114			
L1	9	62			
E5A	8	29			
E2	9	206			
L1	10	17			
L1	8	296			
E5B	11	58			
L2	8	364			
L2	11	418			
L1	8	27			

Table VIIC. HPV11
HLA-A1 Supermotif Peptides

2	3	4
L2	11	285
E1	11	520
L1	8	81
L2	8	417
E6	8	37
E6	10	37
E1	11	330
L1	9	343
E1	8	525
E6	11	10
E1	10	77
L1	8	349
L1	11	349
E5	10	26
E1	10	601
E6	11	67
E5	8	73
E5	9	73
E4	9	73
E1	10	369
L1	9	220
E2	9	25
E6	10	96
E1	10	203
E1	8	570
E1	10	570
E1	11	81
E1	9	42
E2	8	292
E2	10	292
L2	10	343
L1	9	199
E5	9	12
L1	8	125
E2	9	312
L1	11	454
E6	9	69
E1	10	604
E1	11	604
E1	9	131
E1	10	417
E2	11	100
E1	8	373
L2	11	265
E2	8	80
E1	10	128
L1	8	444
E2	10	205
L2	10	119
E6	8	126
E1	11	454
L2	8	424
E1	9	494
E5	9	68
E5	10	68
E1	10	393
E1	9	446
E1	8	457
L2	11	238
E5	8	16
L2	11	295
L1	8	451
E1	9	587
E1	8	220
L2	10	393
L1	9	319
E1	10	243
E2	9	156
E1	11	217
E1	10	273
L2	10	427
L2	11	427
E1	8	11
L2	8	63
L1	11	294
E2	10	179
E1	10	431
L1	9	408
L1	9	223
E1	8	316
L1	11	113
L2	8	311
L2	9	311
E6	8	119
E1	9	264
E2	10	136
E2	10	78
E2	10	309
E5	8	7
E5	10	7
E4	10	20
E1	8	349
E1	9	581
E6	9	25
L1	11	388
L2	11	36
L2	10	188
L1	9	362
L1	11	362
E5	10	34
E5	9	35
E6	9	97
L2	10	43
L2	11	43
E5	8	17
E1	9	571
E1	10	500
E1	11	500
L1	10	377
L2	10	286
E5	10	31
E6	8	73
E6	10	73
E1	10	312
E1	11	312
E1	9	254
E6	11	116
E1	8	357
E1	10	357

Table VIIC. HPV11
HLA-A1 Supermotif Peptides

E1	10	420
L1	10	347
E1	11	484
E1	10	228
E5	10	50
E2	9	84
L1	10	56
E1	8	433
L1	10	61
L1	8	19
L1	10	71
E6	8	52
E6	10	52
E1	8	255
E5	8	33
E5	11	33
E5	9	16
E5	8	36
L1	8	41
L1	9	41
E1	10	521
E4	9	18
E5	9	59
E5	10	59
E5	8	51
E5	8	69
E5	9	69
E5	8	60
E5	9	60
L1	8	379
E1	9	605
E1	10	605
E1	10	218
L2	8	386
E1	9	259
L2	10	239
E5	11	4
E1	8	132
E1	9	358
E5	8	70
E5	11	70
E5	10	49
E2	8	103
E6	9	38
E6	11	38
E5	8	61
L2	9	337
E5	8	47
L1	9	296
L2	9	245
E5	9	62
E5	11	62
E1	9	421
L1	11	197
E1	9	274
E4	9	1
E1	10	568
E6	10	50
E1	8	395
E1	9	59
E5	8	54
E2	8	127
L1	11	218
L2	8	385
L2	9	385
E1	10	258
E4	8	68
L2	10	336
L1	9	392
L2	9	403
E2	9	353
L1	11	427
L2	11	206
L1	8	90
L2	9	422
L2	10	422
L2	10	358
L1	11	16
L2	11	42
L1	8	302
E4	9	14
L1	8	251
L2	8	395
E1	8	314
E1	9	314
E1	10	314
L2	9	230
L2	9	297
L1	9	40
L1	10	40
E2	10	302
L2	10	244
L1	9	280
E1	8	205
L1	8	141
E1	11	583
E2	8	207
E2	11	23
E6	9	12
L2	10	266
E1	8	422
L1	11	376
E5	11	30
E6	11	23
L1	10	295
E1	8	260
L1	11	298
E2	9	337
L1	11	38
L2	9	208
L1	8	281
E2	9	150
E2	10	150
E2	11	260
E1	11	206
E2	9	180
L2	8	209
L2	10	370
L2	9	240
E1	10	331

Table VIIC. HPV11
HLA-A1 Supermotif Peptides

E2	8	151
E2	9	151
E1	8	60
L2	8	152
E1	11	436
L1	8	393
E5	10	45
L1	8	344
L2	11	144
L2	9	38
E2	10	261
E2	8	354
E5	10	71
E5	11	71
L1	8	409
E1	10	207
E5	10	15
E5	9	50
E2	10	93
E6	8	26
L1	9	378
L1	10	389
E6	10	11
L2	9	287
L2	10	207
E2	10	149
E2	11	149
L2	11	369
L2	9	151
E5	11	44
E6	8	39
E6	10	39
E1	11	232
E1	9	585
E1	11	585
L2	10	37
E5	11	14
L2	10	150
L2	11	149
L2	11	382
L1	8	224
E1	9	332
L2	10	383
L2	11	383
E1	9	78
L1	9	57
L1	11	57
E1	11	346
E1	8	333
E1	11	499
E5	9	27
E5	9	32
E4	10	17
E1	8	275
L1	8	73
E5	11	48
E5	9	46
E2	11	128
L1	10	114
L1	9	62
E2	9	206
L1	10	17
L1	8	297
L2	10	145
L2	11	414
E2	11	148
E1	10	584
L2	8	246
L1	9	72
E4	8	2
L1	8	58
L1	10	58
L2	9	120
E6	9	53
E5	10	14
E5	10	58
E5	11	58
E2	9	102
E2	8	92
E2	11	92
E4	8	22
L2	8	431
E1	9	579
E1	11	579
E2	8	138
L1	9	231
L1	8	246
L1	8	359
E5	10	61
E2	10	336
E2	9	159
E2	10	159
L1	9	351
L1	8	26
L1	9	26
E4	11	16
E4	8	9
E2	11	168
E1	8	502
E1	9	502
E2	8	131

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Table VIII
HLA-A2 Supermotif-Bearing Peptides

1	2	3	4
HPV16	E1	9	316
HPV16	E1	11	316
HPV16	E1	9	239
HPV16	E1	10	239
HPV16	E1	8	317
HPV16	E1	10	317
HPV16	E1	10	205
HPV16	E1	8	478
HPV16	E1	11	478
HPV16	E1	10	112
HPV16	E1	11	112
HPV16	E1	9	539
HPV16	E1	11	539
HPV16	E1	8	69
HPV16	E1	9	459
HPV16	E1	9	318
HPV16	E1	9	206
HPV16	E1	10	73
HPV16	E1	11	73
HPV16	E1	10	380
HPV16	E1	10	406
HPV16	E1	9	524
HPV16	E1	10	82
HPV16	E1	11	82
HPV16	E1	10	23
HPV16	E1	11	23
HPV16	E1	11	405
HPV16	E1	8	237
HPV16	E1	11	237
HPV16	E1	8	114
HPV16	E1	9	114
HPV16	E1	8	472
HPV16	E1	10	472
HPV16	E1	9	259
HPV16	E1	10	259
HPV16	E1	9	304
HPV16	E1	8	187
HPV16	E1	9	187
HPV16	E1	11	187
HPV16	E1	8	353
HPV16	E1	9	353
HPV16	E1	10	101
HPV16	E1	9	640
HPV16	E1	10	640
HPV16	E1	8	299
HPV16	E1	9	299
HPV16	E1	10	515
HPV16	E1	11	515
HPV16	E1	10	523
HPV16	E1	11	81
HPV16	E1	10	97
HPV16	E1	8	368
HPV16	E1	9	368
HPV16	E1	10	43
HPV16	E1	11	43
HPV16	E1	8	384
HPV16	E1	10	384
HPV16	E1	10	335
HPV16	E1	11	335
HPV16	E1	8	548
HPV16	E1	10	548
HPV16	E1	8	75
HPV16	E1	9	75
HPV16	E1	11	75
HPV16	E1	8	22
HPV16	E1	11	22
HPV16	E1	9	374
HPV16	E1	10	374
HPV16	E1	9	356
HPV16	E1	10	213
HPV16	E1	11	213
HPV16	E1	8	65
HPV16	E1	9	65
HPV16	E1	8	63
HPV16	E1	10	63
HPV16	E1	11	63
HPV16	E1	10	288
HPV16	E1	11	288
HPV16	E1	8	140
HPV16	E1	8	138
HPV16	E1	10	138
HPV16	E1	10	331
HPV16	E1	9	51
HPV16	E1	10	51
HPV16	E1	8	392
HPV16	E1	10	392
HPV16	E1	11	392
HPV16	E1	11	463
HPV16	E1	10	493
HPV16	E1	10	445
HPV16	E1	9	456
HPV16	E1	8	453
HPV16	E1	10	501
HPV16	E1	9	477
HPV16	E1	8	466
HPV16	E1	9	466
HPV16	E1	10	466
HPV16	E1	8	325
HPV16	E1	10	242
HPV16	E1	8	519
HPV16	E1	8	487
HPV16	E1	8	272
HPV16	E1	9	571
HPV16	E1	10	12
HPV16	E1	8	6
HPV16	E1	8	450
HPV16	E1	9	450
HPV16	E1	10	450
HPV16	E1	11	450
HPV16	E1	8	179
HPV16	E1	11	179
HPV16	E1	8	216
HPV16	E1	9	68
HPV16	E1	11	263
HPV16	E1	8	184
HPV16	E1	9	184
HPV16	E1	11	184
HPV16	E1	10	238
HPV16	E1	11	238

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	E1	8	247
HPV16	E1	9	247
HPV16	E1	8	375
HPV16	E1	9	375
HPV16	E1	11	375
HPV16	E1	9	473
HPV16	E1	10	194
HPV16	E1	10	264
HPV16	E1	11	264
HPV16	E1	9	564
HPV16	E1	8	369
HPV16	E1	8	401
HPV16	E1	10	442
HPV16	E1	8	52
HPV16	E1	9	52
HPV16	E1	11	52
HPV16	E1	11	204
HPV16	E1	11	111
HPV16	E1	8	517
HPV16	E1	9	517
HPV16	E1	10	517
HPV16	E1	8	400
HPV16	E1	9	400
HPV16	E1	8	296
HPV16	E1	10	296
HPV16	E1	11	296
HPV16	E1	9	292
HPV16	E1	8	311
HPV16	E1	9	311
HPV16	E1	9	77
HPV16	E1	10	77
HPV16	E1	9	418
HPV16	E1	10	117
HPV16	E1	10	323
HPV16	E1	9	252
HPV16	E1	11	252
HPV16	E1	8	199
HPV16	E1	9	199
HPV16	E1	10	199
HPV16	E1	11	199
HPV16	E1	8	267
HPV16	E1	9	267
HPV16	E1	10	267
HPV16	E1	11	267
HPV16	E1	8	513
HPV16	E1	9	513
HPV16	E1	8	382
HPV16	E1	10	382
HPV16	E1	10	208
HPV16	E1	8	563
HPV16	E1	10	563
HPV16	E1	9	297
HPV16	E1	10	297
HPV16	E1	11	297
HPV16	E1	9	562
HPV16	E1	11	562
HPV16	E1	9	254
HPV16	E1	11	254
HPV16	E1	8	293
HPV16	E1	11	293
HPV16	E1	8	474
HPV16	E1	9	490
HPV16	E1	10	490
HPV16	E1	10	464
HPV16	E1	11	464
HPV16	E1	9	494
HPV16	E1	9	346
HPV16	E1	9	510
HPV16	E1	11	510
HPV16	E1	8	255
HPV16	E1	10	255
HPV16	E1	9	145
HPV16	E1	11	145
HPV16	E1	8	457
HPV16	E1	11	457
HPV16	E1	8	191
HPV16	E1	10	191
HPV16	E1	9	243
HPV16	E1	11	243
HPV16	E1	8	59
HPV16	E1	9	59
HPV16	E1	11	59
HPV16	E1	9	554
HPV16	E1	10	554
HPV16	E1	11	554
HPV16	E1	11	222
HPV16	E1	11	544
HPV16	E1	8	91
HPV16	E1	10	306
HPV16	E1	11	306
HPV16	E1	8	207
HPV16	E1	11	207
HPV16	E1	10	144
HPV16	E1	8	305
HPV16	E1	11	305
HPV16	E1	10	360
HPV16	E1	11	360
HPV16	E1	11	569
HPV16	E1	8	202
HPV16	E1	8	538
HPV16	E1	10	538
HPV16	E1	8	193
HPV16	E1	11	193
HPV16	E1	9	328
HPV16	E1	8	105
HPV16	E1	9	105
HPV16	E1	11	105
HPV16	E1	10	535
HPV16	E1	11	535
HPV16	E1	9	136
HPV16	E1	10	136
HPV16	E1	9	480
HPV16	E1	11	480
HPV16	E1	8	196
HPV16	E1	10	196
HPV16	E1	11	196
HPV16	E1	10	4
HPV16	E1	9	512
HPV16	E1	10	512
HPV16	E1	8	561

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	E1	10	561
HPV16	E1	9	94
HPV16	E1	8	190
HPV16	E1	9	190
HPV16	E1	11	190
HPV16	E1	10	553
HPV16	E1	11	553
HPV16	E1	11	302
HPV16	E1	11	636
HPV16	E1	9	61
HPV16	E1	10	61
HPV16	E1	9	398
HPV16	E1	10	398
HPV16	E1	11	398
HPV16	E1	11	441
HPV16	E1	9	381
HPV16	E1	11	381
HPV16	E1	8	556
HPV16	E1	9	556
HPV16	E1	10	556
HPV16	E1	11	143
HPV16	E1	8	419
HPV16	E1	11	359
HPV16	E1	9	256
HPV16	E1	8	188
HPV16	E1	10	188
HPV16	E1	11	188
HPV16	E1	8	146
HPV16	E1	10	146
HPV16	E1	8	84
HPV16	E1	9	84
HPV16	E1	9	414
HPV16	E1	8	615
HPV16	E1	11	432
HPV16	E1	10	390
HPV16	E1	8	246
HPV16	E1	9	246
HPV16	E1	10	246
HPV16	E1	11	250
HPV16	E1	8	266
HPV16	E1	9	266
HPV16	E1	10	266
HPV16	E1	11	266
HPV16	E1	8	484
HPV16	E1	11	484
HPV16	E1	10	489
HPV16	E1	11	489
HPV16	E1	8	634
HPV16	E1	9	546
HPV16	E1	10	546
HPV16	E1	10	397
HPV16	E1	11	397
HPV16	E1	11	423
HPV16	E1	11	314
HPV16	E1	8	231
HPV16	E1	9	231
HPV16	E1	10	231
HPV16	E1	10	315
HPV16	E1	8	66
HPV16	E1	11	66
HPV16	E1	10	458
HPV16	E1	11	72
HPV16	E1	8	185
HPV16	E1	10	185
HPV16	E1	11	185
HPV16	E1	9	289
HPV16	E1	10	289
HPV16	E1	8	253
HPV16	E1	10	253
HPV16	E1	9	407
HPV16	E1	8	60
HPV16	E1	10	60
HPV16	E1	11	60
HPV16	E1	11	344
HPV16	E1	8	525
HPV16	E1	8	85
HPV16	E1	11	85
HPV16	E1	9	197
HPV16	E1	10	197
HPV16	E1	11	197
HPV16	E1	10	345
HPV16	E1	9	443
HPV16	E1	8	555
HPV16	E1	9	555
HPV16	E1	10	555
HPV16	E1	11	555
HPV16	E1	9	83
HPV16	E1	10	83
HPV16	E1	9	361
HPV16	E1	10	361
HPV16	E1	9	24
HPV16	E1	10	24
HPV16	E1	8	363
HPV16	E1	9	425
HPV16	E1	8	339
HPV16	E1	8	509
HPV16	E1	10	509
HPV16	E1	11	379
HPV16	E1	9	531
HPV16	E1	10	531
HPV16	E1	8	261
HPV16	E1	8	578
HPV16	E1	10	578
HPV16	E1	9	58
HPV16	E1	10	58
HPV16	E1	9	90
HPV16	E1	10	448
HPV16	E1	11	448
HPV16	E1	10	20
HPV16	E2	8	220
HPV16	E2	9	220
HPV16	E2	10	220
HPV16	E2	8	72
HPV16	E2	10	72
HPV16	E2	11	72
HPV16	E2	9	41
HPV16	E2	9	228
HPV16	E2	10	228
HPV16	E2	11	228
HPV16	E2	9	69

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16 E2	10	69	HPV16 E2	8	136
HPV16 E2	11	69	HPV16 E2	10	136
HPV16 E2	8	221	HPV16 E2	11	136
HPV16 E2	9	221	HPV16 E2	8	214
HPV16 E2	11	221	HPV16 E2	9	214
HPV16 E2	9	226	HPV16 E2	11	214
HPV16 E2	11	226	HPV16 E2	8	290
HPV16 E2	8	63	HPV16 E2	9	290
HPV16 E2	10	63	HPV16 E2	8	35
HPV16 E2	11	63	HPV16 E2	8	56
HPV16 E2	9	314	HPV16 E2	9	56
HPV16 E2	10	40	HPV16 E2	9	223
HPV16 E2	8	109	HPV16 E2	11	252
HPV16 E2	9	109	HPV16 E2	11	210
HPV16 E2	11	109	HPV16 E2	10	15
HPV16 E2	11	300	HPV16 E2	10	238
HPV16 E2	11	5	HPV16 E2	8	356
HPV16 E2	10	309	HPV16 E2	10	356
HPV16 E2	10	174	HPV16 E2	8	288
HPV16 E2	8	294	HPV16 E2	10	288
HPV16 E2	9	124	HPV16 E2	11	288
HPV16 E2	9	344	HPV16 E2	8	68
HPV16 E2	8	246	HPV16 E2	10	68
HPV16 E2	9	246	HPV16 E2	11	68
HPV16 E2	11	246	HPV16 E2	10	45
HPV16 E2	8	96	HPV16 E2	10	225
HPV16 E2	9	96	HPV16 E2	11	14
HPV16 E2	10	96	HPV16 E2	8	351
HPV16 E2	11	142	HPV16 E2	10	351
HPV16 E2	8	209	HPV16 E2	8	255
HPV16 E2	8	74	HPV16 E2	11	255
HPV16 E2	9	74	HPV16 E2	10	354
HPV16 E2	11	48	HPV16 E2	11	182
HPV16 E2	9	2	HPV16 E2	8	215
HPV16 E2	8	185	HPV16 E2	10	215
HPV16 E2	9	185	HPV16 E2	8	62
HPV16 E2	10	185	HPV16 E2	9	62
HPV16 E2	8	118	HPV16 E2	11	62
HPV16 E2	11	118	HPV16 E2	10	256
HPV16 E2	8	204	HPV16 E2	8	70
HPV16 E2	8	100	HPV16 E2	9	70
HPV16 E2	11	100	HPV16 E2	10	70
HPV16 E2	10	346	HPV16 E2	8	94
HPV16 E2	11	346	HPV16 E2	10	94
HPV16 E2	8	168	HPV16 E2	11	94
HPV16 E2	9	156	HPV16 E2	8	75
HPV16 E2	11	156	HPV16 E2	8	103
HPV16 E2	8	150	HPV16 E2	9	16
HPV16 E2	11	150	HPV16 E2	11	16
HPV16 E2	8	190	HPV16 E2	9	127
HPV16 E2	10	190	HPV16 E2	11	127
HPV16 E2	8	230	HPV16 E2	8	284
HPV16 E2	9	230	HPV16 E2	8	9
HPV16 E2	8	187	HPV16 E2	9	9
HPV16 E2	11	187	HPV16 E2	8	325
HPV16 E2	8	29	HPV16 E2	9	325
HPV16 E2	10	29	HPV16 E2	10	325
HPV16 E2	9	53	HPV16 E2	11	325
HPV16 E2	10	53	HPV16 E2	8	219
HPV16 E2	11	53	HPV16 E2	9	219

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	E2	10	219	8	227
HPV16	E2	11	219	10	227
HPV16	E2	9	287	11	227
HPV16	E2	11	287	8	192
HPV16	E2	11	106	10	119
HPV16	E2	10	60	11	119
HPV16	E2	11	60	8	145
HPV16	E2	10	196	11	147
HPV16	E2	8	71	10	341
HPV16	E2	9	71	11	321
HPV16	E2	11	71	10	134
HPV16	E2	10	151	8	92
HPV16	E2	9	191	10	92
HPV16	E2	8	349	8	138
HPV16	E2	9	349	9	138
HPV16	E2	10	349	10	138
HPV16	E2	8	57	11	138
HPV16	E2	8	278	9	102
HPV16	E2	9	278	11	312
HPV16	E2	11	278	9	131
HPV16	E2	10	37	11	115
HPV16	E2	9	7	8	159
HPV16	E2	10	7	11	159
HPV16	E2	11	7	9	53
HPV16	E2	9	212	10	53
HPV16	E2	10	212	8	26
HPV16	E2	11	212	9	26
HPV16	E2	11	165	11	26
HPV16	E2	8	98	9	24
HPV16	E2	10	98	10	24
HPV16	E2	8	348	11	24
HPV16	E2	9	348	8	20
HPV16	E2	10	348	9	20
HPV16	E2	11	348	10	20
HPV16	E2	9	85	8	5
HPV16	E2	10	85	9	5
HPV16	E2	8	23	8	60
HPV16	E2	10	317	10	60
HPV16	E2	8	261	10	72
HPV16	E2	9	261	11	72
HPV16	E2	10	261	8	15
HPV16	E2	8	198	9	15
HPV16	E2	9	144	11	15
HPV16	E2	11	269	8	66
HPV16	E2	10	313	9	66
HPV16	E2	11	237	11	66
HPV16	E2	9	355	8	75
HPV16	E2	11	355	9	75
HPV16	E2	9	61	8	64
HPV16	E2	10	61	10	64
HPV16	E2	8	3	11	64
HPV16	E2	9	93	9	43
HPV16	E2	11	93	10	43
HPV16	E2	9	310	11	43
HPV16	E2	8	128	8	44
HPV16	E2	10	128	9	44
HPV16	E2	10	253	10	44
HPV16	E2	11	285	11	44
HPV16	E2	10	116	11	51
HPV16	E2	9	357	9	61

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	E5	11	61
HPV16	E5	10	12
HPV16	E5	11	12
HPV16	E5	9	73
HPV16	E5	10	73
HPV16	E5	11	73
HPV16	E5	8	42
HPV16	E5	10	42
HPV16	E5	11	42
HPV16	E5	9	28
HPV16	E5	11	28
HPV16	E5	11	11
HPV16	E5	8	16
HPV16	E5	10	16
HPV16	E5	8	22
HPV16	E5	11	22
HPV16	E5	8	27
HPV16	E5	10	27
HPV16	E5	9	32
HPV16	E5	11	32
HPV16	E5	8	47
HPV16	E5	10	47
HPV16	E5	8	33
HPV16	E5	10	33
HPV16	E5	11	33
HPV16	E5	9	48
HPV16	E5	8	45
HPV16	E5	9	45
HPV16	E5	10	45
HPV16	E5	9	1
HPV16	E5	10	1
HPV16	E5	11	1
HPV16	E5	8	3
HPV16	E5	9	3
HPV16	E5	10	3
HPV16	E5	11	3
HPV16	E5	9	70
HPV16	E5	8	31
HPV16	E5	10	31
HPV16	E5	8	55
HPV16	E5	10	55
HPV16	E5	11	55
HPV16	E5	8	41
HPV16	E5	9	41
HPV16	E5	11	41
HPV16	E5	9	8
HPV16	E5	10	8
HPV16	E5	8	37
HPV16	E5	9	37
HPV16	E5	10	37
HPV16	E5	11	37
HPV16	E5	8	35
HPV16	E5	9	35
HPV16	E5	10	35
HPV16	E5	11	35
HPV16	E5	10	52
HPV16	E5	11	52
HPV16	E5	8	6
HPV16	E5	11	6
HPV16	E5	8	10
HPV16	E5	8	9
HPV16	E5	9	9
HPV16	E5	8	21
HPV16	E5	9	21
HPV16	E5	8	46
HPV16	E5	9	46
HPV16	E5	11	46
HPV16	E5	9	63
HPV16	E5	11	63
HPV16	E5	9	68
HPV16	E5	11	68
HPV16	E5	8	39
HPV16	E5	9	39
HPV16	E5	10	39
HPV16	E5	11	39
HPV16	E6	8	110
HPV16	E6	11	58
HPV16	E6	8	73
HPV16	E6	10	143
HPV16	E6	8	23
HPV16	E6	11	23
HPV16	E6	8	37
HPV16	E6	9	37
HPV16	E6	9	25
HPV16	E6	10	25
HPV16	E6	11	25
HPV16	E6	8	96
HPV16	E6	11	96
HPV16	E6	10	48
HPV16	E6	8	52
HPV16	E6	9	52
HPV16	E6	11	9
HPV16	E6	11	125
HPV16	E6	11	34
HPV16	E6	10	59
HPV16	E6	11	59
HPV16	E6	9	18
HPV16	E6	11	18
HPV16	E6	9	41
HPV16	E6	11	107
HPV16	E6	10	44
HPV16	E6	8	26
HPV16	E6	9	26
HPV16	E6	10	26
HPV16	E6	11	134
HPV16	E6	10	102
HPV16	E6	11	116
HPV16	E6	8	12
HPV16	E6	11	12
HPV16	E6	9	20
HPV16	E6	10	20
HPV16	E6	11	20
HPV16	E6	8	21
HPV16	E6	9	21
HPV16	E6	10	21
HPV16	E6	11	43
HPV16	E6	8	42
HPV16	E6	10	97
HPV16	E6	11	97
HPV16	E6	8	27

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	E6	9	27
HPV16	E6	8	151
HPV16	E6	10	29
HPV16	E6	10	94
HPV16	E6	8	28
HPV16	E6	11	28
HPV16	E6	11	93
HPV16	E6	8	67
HPV16	E7	9	68
HPV16	E7	11	68
HPV16	E7	8	75
HPV16	E7	9	75
HPV16	E7	10	75
HPV16	E7	9	81
HPV16	E7	10	81
HPV16	E7	9	14
HPV16	E7	8	21
HPV16	E7	9	4
HPV16	E7	10	4
HPV16	E7	9	37
HPV16	E7	11	18
HPV16	E7	8	43
HPV16	E7	9	85
HPV16	E7	10	73
HPV16	E7	11	73
HPV16	E7	11	54
HPV16	E7	8	82
HPV16	E7	9	82
HPV16	E7	8	83
HPV16	E7	11	83
HPV16	E7	8	15
HPV16	E7	8	12
HPV16	E7	9	12
HPV16	E7	11	12
HPV16	E7	10	41
HPV16	E7	8	6
HPV16	E7	10	6
HPV16	E7	11	44
HPV16	E7	8	49
HPV16	E7	9	66
HPV16	E7	11	66
HPV16	E7	8	77
HPV16	E7	10	77
HPV16	E7	11	77
HPV16	E7	8	71
HPV16	E7	9	71
HPV16	E7	10	63
HPV16	E7	9	78
HPV16	E7	10	78
HPV16	E7	8	86
HPV16	E7	9	7
HPV16	E7	9	64
HPV16	E7	11	64
HPV16	E7	10	19
HPV16	E7	8	69
HPV16	E7	10	69
HPV16	E7	11	69
HPV16	E7	10	55
HPV16	E7	11	55
HPV16	E7	9	11
HPV16	E7	10	11
HPV16	L1	8	372
HPV16	L1	9	372
HPV16	L1	8	451
HPV16	L1	11	451
HPV16	L1	8	373
HPV16	L1	9	233
HPV16	L1	8	342
HPV16	L1	10	330
HPV16	L1	8	513
HPV16	L1	10	513
HPV16	L1	11	513
HPV16	L1	8	35
HPV16	L1	10	35
HPV16	L1	10	292
HPV16	L1	9	70
HPV16	L1	10	205
HPV16	L1	9	371
HPV16	L1	10	371
HPV16	L1	9	172
HPV16	L1	11	172
HPV16	L1	9	183
HPV16	L1	8	454
HPV16	L1	11	251
HPV16	L1	11	329
HPV16	L1	8	397
HPV16	L1	11	397
HPV16	L1	10	300
HPV16	L1	11	300
HPV16	L1	9	225
HPV16	L1	10	225
HPV16	L1	10	486
HPV16	L1	11	486
HPV16	L1	9	154
HPV16	L1	10	154
HPV16	L1	10	228
HPV16	L1	11	228
HPV16	L1	8	120
HPV16	L1	10	120
HPV16	L1	9	113
HPV16	L1	8	361
HPV16	L1	10	361
HPV16	L1	10	442
HPV16	L1	11	442
HPV16	L1	9	412
HPV16	L1	11	17
HPV16	L1	9	34
HPV16	L1	11	34
HPV16	L1	8	279
HPV16	L1	8	132
HPV16	L1	10	132
HPV16	L1	10	474
HPV16	L1	8	245
HPV16	L1	10	245
HPV16	L1	8	400
HPV16	L1	9	400
HPV16	L1	10	400
HPV16	L1	11	400
HPV16	L1	8	5
HPV16	L1	9	494

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	L1	8	402	HPV16	L1	10	406
HPV16	L1	9	402	HPV16	L1	8	151
HPV16	L1	10	402	HPV16	L1	10	151
HPV16	L1	11	25	HPV16	L1	11	262
HPV16	L1	8	506	HPV16	L1	8	178
HPV16	L1	9	506	HPV16	L1	9	90
HPV16	L1	11	506	HPV16	L1	9	46
HPV16	L1	11	236	HPV16	L1	10	46
HPV16	L1	9	282	HPV16	L1	9	312
HPV16	L1	11	282	HPV16	L1	10	69
HPV16	L1	8	446	HPV16	L1	8	184
HPV16	L1	8	356	HPV16	L1	11	216
HPV16	L1	11	356	HPV16	L1	11	68
HPV16	L1	8	232	HPV16	L1	8	148
HPV16	L1	10	232	HPV16	L1	11	148
HPV16	L1	11	291	HPV16	L1	8	495
HPV16	L1	8	348	HPV16	L1	8	239
HPV16	L1	10	348	HPV16	L1	10	239
HPV16	L1	11	348	HPV16	L1	10	398
HPV16	L1	8	142	HPV16	L1	11	398
HPV16	L1	11	142	HPV16	L1	8	432
HPV16	L1	9	499	HPV16	L1	9	432
HPV16	L1	10	499	HPV16	L1	11	339
HPV16	L1	9	431	HPV16	L1	8	94
HPV16	L1	10	431	HPV16	L1	10	94
HPV16	L1	9	93	HPV16	L1	9	409
HPV16	L1	11	93	HPV16	L1	10	9
HPV16	L1	8	136	HPV16	L1	8	87
HPV16	L1	10	438	HPV16	L1	8	124
HPV16	L1	11	438	HPV16	L1	10	124
HPV16	L1	8	64	HPV16	L1	8	1
HPV16	L1	8	166	HPV16	L1	9	1
HPV16	L1	10	166	HPV16	L1	10	1
HPV16	L1	10	130	HPV16	L1	11	1
HPV16	L1	9	140	HPV16	L1	10	414
HPV16	L1	10	140	HPV16	L1	11	414
HPV16	L1	8	62	HPV16	L1	8	226
HPV16	L1	9	62	HPV16	L1	9	226
HPV16	L1	10	62	HPV16	L1	10	263
HPV16	L1	8	22	HPV16	L1	8	325
HPV16	L1	10	22	HPV16	L1	10	164
HPV16	L1	8	285	HPV16	L1	9	157
HPV16	L1	9	285	HPV16	L1	11	157
HPV16	L1	11	457	HPV16	L1	8	58
HPV16	L1	10	452	HPV16	L1	11	58
HPV16	L1	9	424	HPV16	L1	10	311
HPV16	L1	11	8	HPV16	L1	8	476
HPV16	L1	9	86	HPV16	L1	10	476
HPV16	L1	9	221	HPV16	L1	8	367
HPV16	L1	8	11	HPV16	L1	10	367
HPV16	L1	10	11	HPV16	L1	8	353
HPV16	L1	8	407	HPV16	L1	10	353
HPV16	L1	9	407	HPV16	L1	11	353
HPV16	L1	11	407	HPV16	L1	8	383
HPV16	L1	8	501	HPV16	L1	9	218
HPV16	L1	9	512	HPV16	L1	10	218
HPV16	L1	11	512	HPV16	L1	8	296
HPV16	L1	10	85	HPV16	L1	9	19
HPV16	L1	8	406	HPV16	L1	11	19
HPV16	L1	9	406	HPV16	L1	8	460

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	L1	10	77	HPV16	L1	9	365
HPV16	L1	11	77	HPV16	L1	10	365
HPV16	L1	8	247	HPV16	L1	10	375
HPV16	L1	8	213	HPV16	L1	11	521
HPV16	L1	9	213	HPV16	L1	8	410
HPV16	L1	8	489	HPV16	L1	11	410
HPV16	L1	10	489	HPV16	L1	9	523
HPV16	L1	11	138	HPV16	L1	10	423
HPV16	L1	10	466	HPV16	L1	9	439
HPV16	L1	9	147	HPV16	L1	10	439
HPV16	L1	8	319	HPV16	L1	8	507
HPV16	L1	9	319	HPV16	L1	10	507
HPV16	L1	8	515	HPV16	L1	11	507
HPV16	L1	9	515	HPV16	L1	9	238
HPV16	L1	10	515	HPV16	L1	11	238
HPV16	L1	8	41	HPV16	L1	8	408
HPV16	L1	10	41	HPV16	L1	10	408
HPV16	L1	8	43	HPV16	L1	9	121
HPV16	L1	11	497	HPV16	L1	11	121
HPV16	L1	9	450	HPV16	L1	10	522
HPV16	L1	9	240	HPV16	L1	10	237
HPV16	L1	11	240	HPV16	L1	9	362
HPV16	L1	9	331	HPV16	L1	11	362
HPV16	L1	8	403	HPV16	L1	8	516
HPV16	L1	9	403	HPV16	L1	9	516
HPV16	L1	11	403	HPV16	L1	8	219
HPV16	L1	11	181	HPV16	L1	9	219
HPV16	L1	9	354	HPV16	L1	11	219
HPV16	L1	10	354	HPV16	L1	9	358
HPV16	L1	11	280	HPV16	L1	11	358
HPV16	L1	10	26	HPV16	L1	9	36
HPV16	L1	11	26	HPV16	L1	10	54
HPV16	L1	8	2	HPV16	L1	11	204
HPV16	L1	9	2	HPV16	L1	8	220
HPV16	L1	10	2	HPV16	L1	10	220
HPV16	L1	11	2	HPV16	L1	9	10
HPV16	L1	9	289	HPV16	L1	11	10
HPV16	L1	9	341	HPV16	L1	8	413
HPV16	L1	9	123	HPV16	L1	11	413
HPV16	L1	11	123	HPV16	L1	8	3
HPV16	L1	8	56	HPV16	L1	9	3
HPV16	L1	10	56	HPV16	L1	10	3
HPV16	L1	9	482	HPV16	L1	10	357
HPV16	L1	9	159	HPV16	L1	8	359
HPV16	L1	9	253	HPV16	L1	10	359
HPV16	L1	11	253	HPV16	L1	8	47
HPV16	L1	8	369	HPV16	L1	9	47
HPV16	L1	11	369	HPV16	L1	11	47
HPV16	L1	11	271	HPV16	L1	8	126
HPV16	L1	8	28	HPV16	L1	8	30
HPV16	L1	9	28	HPV16	L1	10	30
HPV16	L1	10	28	HPV16	L1	8	416
HPV16	L1	9	174	HPV16	L1	9	416
HPV16	L1	11	174	HPV16	L1	10	416
HPV16	L1	9	324	HPV16	L1	8	302
HPV16	L1	10	449	HPV16	L1	9	302
HPV16	L1	9	49	HPV16	L1	11	302
HPV16	L1	11	49	HPV16	L1	10	38
HPV16	L1	11	422	HPV16	L1	11	38
HPV16	L1	8	365	HPV16	L1	10	389

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	L1	9	275	HPV16	L2	11	283
HPV16	L1	8	470	HPV16	L2	11	163
HPV16	L1	11	53	HPV16	L2	8	181
HPV16	L2	11	355	HPV16	L2	10	181
HPV16	L2	8	144	HPV16	L2	9	118
HPV16	L2	9	144	HPV16	L2	8	404
HPV16	L2	10	144	HPV16	L2	8	259
HPV16	L2	11	144	HPV16	L2	8	59
HPV16	L2	8	288	HPV16	L2	10	57
HPV16	L2	10	356	HPV16	L2	11	364
HPV16	L2	9	293	HPV16	L2	10	226
HPV16	L2	8	82	HPV16	L2	8	26
HPV16	L2	11	15	HPV16	L2	11	26
HPV16	L2	8	116	HPV16	L2	9	65
HPV16	L2	11	116	HPV16	L2	11	65
HPV16	L2	10	31	HPV16	L2	10	61
HPV16	L2	11	31	HPV16	L2	8	76
HPV16	L2	8	147	HPV16	L2	10	76
HPV16	L2	9	147	HPV16	L2	11	76
HPV16	L2	10	147	HPV16	L2	9	52
HPV16	L2	11	147	HPV16	L2	11	52
HPV16	L2	10	415	HPV16	L2	8	354
HPV16	L2	9	285	HPV16	L2	9	440
HPV16	L2	10	285	HPV16	L2	11	41
HPV16	L2	11	285	HPV16	L2	8	277
HPV16	L2	8	367	HPV16	L2	10	277
HPV16	L2	9	367	HPV16	L2	11	277
HPV16	L2	11	367	HPV16	L2	10	439
HPV16	L2	9	422	HPV16	L2	9	32
HPV16	L2	10	422	HPV16	L2	10	32
HPV16	L2	9	43	HPV16	L2	11	32
HPV16	L2	11	43	HPV16	L2	8	145
HPV16	L2	11	199	HPV16	L2	9	145
HPV16	L2	10	84	HPV16	L2	10	145
HPV16	L2	11	84	HPV16	L2	11	145
HPV16	L2	10	376	HPV16	L2	9	45
HPV16	L2	9	140	HPV16	L2	8	420
HPV16	L2	8	129	HPV16	L2	9	420
HPV16	L2	9	129	HPV16	L2	11	420
HPV16	L2	11	129	HPV16	L2	9	374
HPV16	L2	8	338	HPV16	L2	8	344
HPV16	L2	11	338	HPV16	L2	9	344
HPV16	L2	8	195	HPV16	L2	8	243
HPV16	L2	9	195	HPV16	L2	9	243
HPV16	L2	11	195	HPV16	L2	8	135
HPV16	L2	9	340	HPV16	L2	10	135
HPV16	L2	11	340	HPV16	L2	11	135
HPV16	L2	8	176	HPV16	L2	11	250
HPV16	L2	9	111	HPV16	L2	8	286
HPV16	L2	11	111	HPV16	L2	9	286
HPV16	L2	8	114	HPV16	L2	10	286
HPV16	L2	10	114	HPV16	L2	9	430
HPV16	L2	8	373	HPV16	L2	10	430
HPV16	L2	10	373	HPV16	L2	11	430
HPV16	L2	8	242	HPV16	L2	8	105
HPV16	L2	9	242	HPV16	L2	11	105
HPV16	L2	10	242	HPV16	L2	8	202
HPV16	L2	9	201	HPV16	L2	9	202
HPV16	L2	10	201	HPV16	L2	10	202
HPV16	L2	11	201	HPV16	L2	9	248

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	L2	10	23	HPV16	L2	9	435
HPV16	L2	11	23	HPV16	L2	8	80
HPV16	L2	8	20	HPV16	L2	10	80
HPV16	L2	8	39	HPV16	L2	8	161
HPV16	L2	8	35	HPV16	L2	9	161
HPV16	L2	11	35	HPV16	L2	11	246
HPV16	L2	10	323	HPV16	L2	11	172
HPV16	L2	11	323	HPV16	L2	8	358
HPV16	L2	8	236	HPV16	L2	11	358
HPV16	L2	9	236	HPV16	L2	11	120
HPV16	L2	10	236	HPV16	L2	11	221
HPV16	L2	8	86	HPV16	L2	9	97
HPV16	L2	9	86	HPV16	L2	10	97
HPV16	L2	10	86	HPV16	L2	8	381
HPV16	L2	8	249	HPV16	L2	10	381
HPV16	L2	9	169	HPV16	L2	8	88
HPV16	L2	8	341	HPV16	L2	11	88
HPV16	L2	10	341	HPV16	L2	9	24
HPV16	L2	11	341	HPV16	L2	10	24
HPV16	L2	8	46	HPV16	L2	8	423
HPV16	L2	8	294	HPV16	L2	9	423
HPV16	L2	8	108	HPV16	L2	8	44
HPV16	L2	10	108	HPV16	L2	10	44
HPV16	L2	9	410	HPV16	L2	9	17
HPV16	L2	11	410	HPV16	L2	11	17
HPV16	L2	9	454	HPV16	L2	9	233
HPV16	L2	9	276	HPV16	L2	11	233
HPV16	L2	11	276	HPV16	L2	9	342
HPV16	L2	10	407	HPV16	L2	10	342
HPV16	L2	9	419	HPV16	L2	11	342
HPV16	L2	10	419	HPV16	L2	11	310
HPV16	L2	9	397	HPV16	L2	8	234
HPV16	L2	9	208	HPV16	L2	10	234
HPV16	L2	8	150	HPV16	L2	11	234
HPV16	L2	9	174	HPV16	L2	10	12
HPV16	L2	10	174	HPV16	L2	8	305
HPV16	L2	8	240	HPV16	L2	10	305
HPV16	L2	10	240	HPV16	L2	8	224
HPV16	L2	11	240	HPV16	L2	9	224
HPV16	L2	9	143	HPV16	L2	9	461
HPV16	L2	10	143	HPV16	L2	11	461
HPV16	L2	11	143	HPV16	L2	9	298
HPV16	L2	8	292	HPV16	L2	9	69
HPV16	L2	10	292	HPV16	L2	8	9
HPV16	L2	11	395	HPV16	L2	10	9
HPV16	L2	8	255	HPV16	L2	8	313
HPV16	L2	11	255	HPV16	L2	10	313
HPV16	L2	8	417	HPV16	L2	8	230
HPV16	L2	11	417	HPV16	L2	9	230
HPV16	L2	8	215	HPV16	L2	9	335
HPV16	L2	9	215	HPV16	L2	10	335
HPV16	L2	11	215	HPV16	L2	11	335
HPV16	L2	10	429	HPV16	L2	8	6
HPV16	L2	11	429	HPV16	L2	10	6
HPV16	L2	8	74	HPV16	L2	11	6
HPV16	L2	9	74	HPV16	L2	8	14
HPV16	L2	10	74	HPV16	L2	11	274
HPV16	L2	8	409	HPV16	L2	9	360
HPV16	L2	10	409	HPV16	L2	11	360
HPV16	L2	9	197	HPV16	L2	11	125

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV16	L2	8	134
HPV16	L2	9	134
HPV16	L2	11	134
HPV16	L2	9	104
HPV16	L2	8	389
HPV16	L2	10	389
HPV16	L2	11	389
HPV16	L2	9	107
HPV16	L2	11	107
HPV16	L2	9	50
HPV16	L2	11	50
HPV16	L2	8	138
HPV16	L2	9	138
HPV16	L2	11	138
HPV16	L2	8	189
HPV16	L2	10	189
HPV16	L2	9	331
HPV16	L2	11	331
HPV16	L2	11	186
HPV16	L2	8	204
HPV16	L2	11	204
HPV16	L2	10	213
HPV16	L2	11	213
HPV16	L2	8	387
HPV16	L2	10	387
HPV16	L2	8	378
HPV16	L2	11	378
HPV16	L2	9	347
HPV16	L2	10	347
HPV16	L2	11	347
HPV16	L2	9	167
HPV16	L2	11	167
HPV16	L2	9	122
HPV16	L2	11	384
HPV16	L2	9	81
HPV16	L2	8	332
HPV16	L2	10	332
HPV16	L2	11	438
HPV16	L2	10	399
HPV16	L2	10	187
HPV16	L2	8	343
HPV16	L2	9	343
HPV16	L2	10	343
HPV16	L2	9	85
HPV16	L2	10	85
HPV16	L2	11	85
HPV16	L2	10	311
HPV16	L2	9	182
HPV16	L2	11	265
HPV16	L2	10	16
HPV16	L2	10	232
HPV16	L2	9	156
HPV16	L2	8	398
HPV16	L2	11	398
HPV16	L2	8	141
HPV16	L2	11	141
HPV16	L2	8	244
HPV16	L2	10	379
HPV16	L2	8	231
HPV16	L2	11	231
HPV16	L2	9	351
HPV16	L2	11	351
HPV16	L2	9	136
HPV16	L2	10	136
HPV16	L2	11	136
HPV16	L2	8	350
HPV16	L2	10	350
HPV16	L2	10	153
HPV16	L2	8	209
HPV16	L2	9	154
HPV16	L2	11	154
HPV16	L2	8	287
HPV16	L2	9	287
HPV16	L2	10	222
HPV16	L2	11	222
HPV16	L2	8	168
HPV16	L2	10	168
HPV16	L2	8	155
HPV16	L2	10	155
HPV16	L2	11	152
HPV16	L2	8	237
HPV16	L2	9	237
HPV16	L2	11	237
HPV16	L2	9	369
HPV16	L2	11	369
HPV16	L2	8	393
HPV16	L2	10	72
HPV16	L2	11	72
HPV16	L2	8	447
HPV16	L2	9	447
HPV16	L2	10	453
HPV16	L2	8	349
HPV16	L2	9	349
HPV16	L2	11	349
HPV18	E1	11	396
HPV18	E1	10	397
HPV18	E1	8	324
HPV18	E1	10	324
HPV18	E1	8	246
HPV18	E1	9	246
HPV18	E1	10	246
HPV18	E1	10	22
HPV18	E1	11	22
HPV18	E1	9	546
HPV18	E1	8	68
HPV18	E1	9	466
HPV18	E1	10	387
HPV18	E1	11	387
HPV18	E1	9	325
HPV18	E1	9	213
HPV18	E1	8	526
HPV18	E1	9	526
HPV18	E1	10	66
HPV18	E1	8	72
HPV18	E1	10	72
HPV18	E1	11	72
HPV18	E1	8	422
HPV18	E1	9	199
HPV18	E1	8	40
HPV18	E1	9	40

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E1	10	413
HPV18	E1	8	144
HPV18	E1	11	531
HPV18	E1	9	216
HPV18	E1	9	504
HPV18	E1	11	412
HPV18	E1	8	273
HPV18	E1	9	273
HPV18	E1	10	273
HPV18	E1	11	273
HPV18	E1	8	479
HPV18	E1	10	479
HPV18	E1	9	311
HPV18	E1	10	404
HPV18	E1	11	404
HPV18	E1	8	240
HPV18	E1	11	240
HPV18	E1	9	196
HPV18	E1	10	196
HPV18	E1	11	635
HPV18	E1	8	78
HPV18	E1	8	530
HPV18	E1	9	628
HPV18	E1	11	628
HPV18	E1	11	203
HPV18	E1	9	363
HPV18	E1	11	228
HPV18	E1	8	381
HPV18	E1	9	381
HPV18	E1	10	381
HPV18	E1	8	46
HPV18	E1	11	46
HPV18	E1	9	637
HPV18	E1	8	106
HPV18	E1	11	106
HPV18	E1	10	42
HPV18	E1	10	522
HPV18	E1	11	522
HPV18	E1	9	342
HPV18	E1	10	342
HPV18	E1	11	342
HPV18	E1	10	52
HPV18	E1	8	220
HPV18	E1	10	220
HPV18	E1	11	220
HPV18	E1	8	540
HPV18	E1	11	30
HPV18	E1	8	166
HPV18	E1	8	143
HPV18	E1	9	143
HPV18	E1	11	115
HPV18	E1	8	62
HPV18	E1	11	62
HPV18	E1	9	108
HPV18	E1	11	108
HPV18	E1	8	375
HPV18	E1	9	375
HPV18	E1	11	366
HPV18	E1	8	59
HPV18	E1	10	59
HPV18	E1	11	59
HPV18	E1	9	64
HPV18	E1	11	309
HPV18	E1	10	104
HPV18	E1	9	141
HPV18	E1	10	141
HPV18	E1	11	141
HPV18	E1	8	74
HPV18	E1	9	74
HPV18	E1	11	74
HPV18	E1	10	338
HPV18	E1	11	89
HPV18	E1	8	497
HPV18	E1	9	497
HPV18	E1	10	497
HPV18	E1	10	265
HPV18	E1	10	500
HPV18	E1	8	460
HPV18	E1	9	463
HPV18	E1	11	470
HPV18	E1	8	399
HPV18	E1	11	399
HPV18	E1	10	452
HPV18	E1	11	452
HPV18	E1	10	508
HPV18	E1	10	465
HPV18	E1	10	212
HPV18	E1	10	503
HPV18	E1	9	356
HPV18	E1	8	332
HPV18	E1	9	332
HPV18	E1	8	223
HPV18	E1	8	300
HPV18	E1	11	300
HPV18	E1	8	494
HPV18	E1	11	494
HPV18	E1	9	121
HPV18	E1	11	121
HPV18	E1	9	172
HPV18	E1	9	55
HPV18	E1	11	55
HPV18	E1	10	11
HPV18	E1	8	473
HPV18	E1	9	473
HPV18	E1	8	182
HPV18	E1	11	182
HPV18	E1	8	279
HPV18	E1	9	71
HPV18	E1	11	71
HPV18	E1	11	270
HPV18	E1	8	83
HPV18	E1	8	306
HPV18	E1	9	306
HPV18	E1	8	254
HPV18	E1	9	254
HPV18	E1	8	198
HPV18	E1	10	198
HPV18	E1	10	569
HPV18	E1	9	266
HPV18	E1	10	271

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E1	11	271	HPV18	E1	9	520
HPV18	E1	9	501	HPV18	E1	8	350
HPV18	E1	8	562	HPV18	E1	8	571
HPV18	E1	9	562	HPV18	E1	9	295
HPV18	E1	10	562	HPV18	E1	10	295
HPV18	E1	11	562	HPV18	E1	11	295
HPV18	E1	8	262	HPV18	E1	9	480
HPV18	E1	10	262	HPV18	E1	10	229
HPV18	E1	10	314	HPV18	E1	11	229
HPV18	E1	11	314	HPV18	E1	8	382
HPV18	E1	11	347	HPV18	E1	9	382
HPV18	E1	11	461	HPV18	E1	8	214
HPV18	E1	9	590	HPV18	E1	11	214
HPV18	E1	9	23	HPV18	E1	8	527
HPV18	E1	10	23	HPV18	E1	11	527
HPV18	E1	10	449	HPV18	E1	8	312
HPV18	E1	8	124	HPV18	E1	10	47
HPV18	E1	9	124	HPV18	E1	10	367
HPV18	E1	11	439	HPV18	E1	11	367
HPV18	E1	11	647	HPV18	E1	8	545
HPV18	E1	8	318	HPV18	E1	10	545
HPV18	E1	9	318	HPV18	E1	9	39
HPV18	E1	8	210	HPV18	E1	10	39
HPV18	E1	8	259	HPV18	E1	10	188
HPV18	E1	9	259	HPV18	E1	11	188
HPV18	E1	11	259	HPV18	E1	9	335
HPV18	E1	8	237	HPV18	E1	9	487
HPV18	E1	9	237	HPV18	E1	8	158
HPV18	E1	10	237	HPV18	E1	10	158
HPV18	E1	11	237	HPV18	E1	11	158
HPV18	E1	8	524	HPV18	E1	8	191
HPV18	E1	9	524	HPV18	E1	9	191
HPV18	E1	10	524	HPV18	E1	11	191
HPV18	E1	11	524	HPV18	E1	10	577
HPV18	E1	8	206	HPV18	E1	11	485
HPV18	E1	9	206	HPV18	E1	8	568
HPV18	E1	10	206	HPV18	E1	11	568
HPV18	E1	11	206	HPV18	E1	11	551
HPV18	E1	8	389	HPV18	E1	11	448
HPV18	E1	9	389	HPV18	E1	8	98
HPV18	E1	10	389	HPV18	E1	10	98
HPV18	E1	10	215	HPV18	E1	10	560
HPV18	E1	9	561	HPV18	E1	11	560
HPV18	E1	10	561	HPV18	E1	8	519
HPV18	E1	11	561	HPV18	E1	9	519
HPV18	E1	9	261	HPV18	E1	10	519
HPV18	E1	11	261	HPV18	E1	8	194
HPV18	E1	11	313	HPV18	E1	11	194
HPV18	E1	9	388	HPV18	E1	9	252
HPV18	E1	10	388	HPV18	E1	10	252
HPV18	E1	11	388	HPV18	E1	11	252
HPV18	E1	9	304	HPV18	E1	9	60
HPV18	E1	10	304	HPV18	E1	10	60
HPV18	E1	11	304	HPV18	E1	8	21
HPV18	E1	10	204	HPV18	E1	11	21
HPV18	E1	11	204	HPV18	E1	9	405
HPV18	E1	11	285	HPV18	E1	10	405
HPV18	E1	9	570	HPV18	E1	11	405
HPV18	E1	8	376	HPV18	E1	9	67
HPV18	E1	8	520	HPV18	E1	8	457

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E1	10	457
HPV18	E1	11	457
HPV18	E1	8	563
HPV18	E1	9	563
HPV18	E1	10	563
HPV18	E1	11	563
HPV18	E1	8	200
HPV18	E1	8	426
HPV18	E1	9	456
HPV18	E1	11	456
HPV18	E1	11	80
HPV18	E1	9	649
HPV18	E1	9	421
HPV18	E1	10	589
HPV18	E1	11	626
HPV18	E1	8	102
HPV18	E1	9	349
HPV18	E1	8	294
HPV18	E1	10	294
HPV18	E1	11	294
HPV18	E1	9	425
HPV18	E1	10	330
HPV18	E1	11	330
HPV18	E1	8	622
HPV18	E1	9	553
HPV18	E1	10	553
HPV18	E1	9	117
HPV18	E1	11	430
HPV18	E1	10	164
HPV18	E1	11	93
HPV18	E1	9	302
HPV18	E1	11	302
HPV18	E1	10	511
HPV18	E1	11	511
HPV18	E1	10	322
HPV18	E1	11	179
HPV18	E1	9	245
HPV18	E1	10	245
HPV18	E1	11	245
HPV18	E1	8	65
HPV18	E1	11	65
HPV18	E1	8	253
HPV18	E1	9	253
HPV18	E1	10	253
HPV18	E1	8	197
HPV18	E1	9	197
HPV18	E1	11	197
HPV18	E1	8	260
HPV18	E1	10	260
HPV18	E1	8	303
HPV18	E1	10	303
HPV18	E1	11	303
HPV18	E1	9	414
HPV18	E1	9	53
HPV18	E1	11	53
HPV18	E1	8	238
HPV18	E1	9	238
HPV18	E1	10	238
HPV18	E1	9	533
HPV18	E1	11	533
HPV18	E1	10	150
HPV18	E1	10	532
HPV18	E1	8	296
HPV18	E1	9	296
HPV18	E1	10	296
HPV18	E1	8	591
HPV18	E1	9	323
HPV18	E1	11	323
HPV18	E1	8	297
HPV18	E1	9	297
HPV18	E1	11	297
HPV18	E1	8	525
HPV18	E1	9	525
HPV18	E1	10	525
HPV18	E1	10	31
HPV18	E1	11	31
HPV18	E1	8	505
HPV18	E1	10	81
HPV18	E1	11	84
HPV18	E1	9	339
HPV18	E1	9	20
HPV18	E1	9	450
HPV18	E1	9	368
HPV18	E1	10	368
HPV18	E1	10	244
HPV18	E1	11	244
HPV18	E1	11	149
HPV18	E1	8	370
HPV18	E1	8	346
HPV18	E1	9	432
HPV18	E1	8	516
HPV18	E1	10	516
HPV18	E1	11	516
HPV18	E1	8	536
HPV18	E1	11	536
HPV18	E1	8	243
HPV18	E1	11	243
HPV18	E1	11	386
HPV18	E1	8	585
HPV18	E1	8	408
HPV18	E1	11	542
HPV18	E1	8	455
HPV18	E1	10	455
HPV18	E1	10	19
HPV18	E2	9	49
HPV18	E2	10	49
HPV18	E2	10	245
HPV18	E2	11	245
HPV18	E2	8	76
HPV18	E2	11	76
HPV18	E2	11	45
HPV18	E2	8	351
HPV18	E2	9	351
HPV18	E2	10	351
HPV18	E2	11	87
HPV18	E2	9	154
HPV18	E2	8	214
HPV18	E2	11	214
HPV18	E2	9	246
HPV18	E2	10	246

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E2	10	132
HPV18	E2	10	156
HPV18	E2	8	146
HPV18	E2	9	146
HPV18	E2	10	146
HPV18	E2	11	29
HPV18	E2	9	315
HPV18	E2	11	315
HPV18	E2	9	100
HPV18	E2	8	210
HPV18	E2	9	210
HPV18	E2	9	78
HPV18	E2	10	78
HPV18	E2	8	104
HPV18	E2	10	6
HPV18	E2	8	340
HPV18	E2	10	340
HPV18	E2	11	340
HPV18	E2	8	190
HPV18	E2	9	190
HPV18	E2	8	48
HPV18	E2	10	48
HPV18	E2	11	48
HPV18	E2	11	346
HPV18	E2	9	324
HPV18	E2	10	324
HPV18	E2	11	324
HPV18	E2	11	331
HPV18	E2	9	54
HPV18	E2	10	54
HPV18	E2	11	253
HPV18	E2	9	85
HPV18	E2	11	161
HPV18	E2	9	235
HPV18	E2	11	235
HPV18	E2	8	148
HPV18	E2	10	148
HPV18	E2	11	187
HPV18	E2	9	291
HPV18	E2	9	60
HPV18	E2	9	223
HPV18	E2	10	223
HPV18	E2	11	289
HPV18	E2	10	332
HPV18	E2	8	358
HPV18	E2	8	55
HPV18	E2	9	55
HPV18	E2	11	55
HPV18	E2	8	72
HPV18	E2	10	72
HPV18	E2	11	72
HPV18	E2	8	75
HPV18	E2	9	75
HPV18	E2	8	280
HPV18	E2	10	280
HPV18	E2	11	280
HPV18	E2	10	257
HPV18	E2	11	257
HPV18	E2	11	152
HPV18	E2	10	92
HPV18	E2	8	329
HPV18	E2	8	238
HPV18	E2	9	238
HPV18	E2	10	238
HPV18	E2	10	254
HPV18	E2	8	86
HPV18	E2	8	39
HPV18	E2	11	39
HPV18	E2	8	266
HPV18	E2	8	98
HPV18	E2	11	98
HPV18	E2	11	83
HPV18	E2	11	221
HPV18	E2	8	79
HPV18	E2	9	79
HPV18	E2	9	333
HPV18	E2	8	217
HPV18	E2	8	1
HPV18	E2	10	144
HPV18	E2	11	144
HPV18	E2	9	133
HPV18	E2	10	67
HPV18	E2	11	67
HPV18	E2	8	285
HPV18	E2	9	348
HPV18	E2	11	348
HPV18	E2	9	196
HPV18	E2	10	64
HPV18	E2	9	265
HPV18	E2	10	272
HPV18	E2	11	110
HPV18	E2	8	262
HPV18	E2	9	262
HPV18	E2	10	262
HPV18	E2	8	357
HPV18	E2	9	357
HPV18	E2	8	33
HPV18	E2	8	38
HPV18	E2	9	38
HPV18	E2	9	216
HPV18	E2	8	80
HPV18	E2	8	56
HPV18	E2	10	56
HPV18	E2	11	2
HPV18	E2	8	61
HPV18	E2	9	11
HPV18	E2	10	11
HPV18	E2	8	343
HPV18	E2	9	343
HPV18	E2	10	343
HPV18	E2	11	244
HPV18	E2	9	213
HPV18	E2	9	298
HPV18	E2	9	203
HPV18	E2	10	203
HPV18	E2	8	32
HPV18	E2	9	32
HPV18	E2	9	206
HPV18	E2	10	206
HPV18	E2	8	230

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E2	10	230
HPV18	E2	8	318
HPV18	E2	11	233
HPV18	E2	9	355
HPV18	E2	10	355
HPV18	E2	11	355
HPV18	E2	8	140
HPV18	E2	10	140
HPV18	E2	8	236
HPV18	E2	10	236
HPV18	E2	11	236
HPV18	E2	10	153
HPV18	E2	9	57
HPV18	E2	9	97
HPV18	E2	9	7
HPV18	E2	10	215
HPV18	E2	9	341
HPV18	E2	10	341
HPV18	E2	11	341
HPV18	E2	8	349
HPV18	E2	10	349
HPV18	E2	11	349
HPV18	E2	8	211
HPV18	E2	11	211
HPV18	E2	9	231
HPV18	E2	8	334
HPV18	E2	11	334
HPV18	E2	9	350
HPV18	E2	10	350
HPV18	E2	11	350
HPV18	E2	9	136
HPV18	E2	10	136
HPV18	E2	8	197
HPV18	E2	11	197
HPV18	E2	8	356
HPV18	E2	9	356
HPV18	E2	10	356
HPV18	E2	10	335
HPV18	E2	9	37
HPV18	E2	10	37
HPV18	E2	9	322
HPV18	E2	11	322
HPV18	E2	10	96
HPV18	E2	11	143
HPV18	E2	10	135
HPV18	E2	11	135
HPV18	E2	8	164
HPV18	E2	11	164
HPV18	E5	8	47
HPV18	E5	8	29
HPV18	E5	10	29
HPV18	E5	8	27
HPV18	E5	9	27
HPV18	E5	10	27
HPV18	E5	8	13
HPV18	E5	10	13
HPV18	E5	11	13
HPV18	E5	10	11
HPV18	E5	9	6
HPV18	E5	11	6
HPV18	E5	8	57
HPV18	E5	10	57
HPV18	E5	9	50
HPV18	E5	10	50
HPV18	E5	8	37
HPV18	E5	11	37
HPV18	E5	8	65
HPV18	E5	8	19
HPV18	E5	10	19
HPV18	E5	9	43
HPV18	E5	10	43
HPV18	E5	8	40
HPV18	E5	9	40
HPV18	E5	10	40
HPV18	E5	9	4
HPV18	E5	11	4
HPV18	E5	8	63
HPV18	E5	10	63
HPV18	E5	8	62
HPV18	E5	9	62
HPV18	E5	11	62
HPV18	E5	9	58
HPV18	E5	11	58
HPV18	E5	9	22
HPV18	E5	11	22
HPV18	E5	8	35
HPV18	E5	9	35
HPV18	E5	10	35
HPV18	E5	8	61
HPV18	E5	9	61
HPV18	E5	10	61
HPV18	E5	9	46
HPV18	E5	8	21
HPV18	E5	10	21
HPV18	E5	9	60
HPV18	E5	10	60
HPV18	E5	11	60
HPV18	E5	10	3
HPV18	E5	8	25
HPV18	E5	10	25
HPV18	E5	11	25
HPV18	E5	11	48
HPV18	E5	8	51
HPV18	E5	9	51
HPV18	E5	11	51
HPV18	E5	8	42
HPV18	E5	10	42
HPV18	E5	11	42
HPV18	E5	8	34
HPV18	E5	9	34
HPV18	E5	10	34
HPV18	E5	11	34
HPV18	E5	8	41
HPV18	E5	9	41
HPV18	E5	11	41
HPV18	E5	8	33
HPV18	E5	9	33
HPV18	E5	10	33
HPV18	E5	11	33
HPV18	E5	8	31

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E5	10	31	HPV18	E6	9	95
HPV18	E5	11	31	HPV18	E6	9	22
HPV18	E5	9	39	HPV18	E6	10	22
HPV18	E5	10	39	HPV18	E6	8	114
HPV18	E5	11	39	HPV18	E6	8	111
HPV18	E5	8	15	HPV18	E6	11	111
HPV18	E5	9	15	HPV18	E6	8	7
HPV18	E5	9	53	HPV18	E6	11	7
HPV18	E5	10	53	HPV18	E6	8	149
HPV18	E5	11	53	HPV18	E6	10	149
HPV18	E6	8	68	HPV18	E6	11	146
HPV18	E6	11	68	HPV18	E6	11	59
HPV18	E6	8	105	HPV18	E6	8	24
HPV18	E6	11	105	HPV18	E6	10	24
HPV18	E6	8	108	HPV18	E6	10	84
HPV18	E6	11	108	HPV18	E6	11	84
HPV18	E6	8	18	HPV18	E6	8	89
HPV18	E6	11	18	HPV18	E6	10	89
HPV18	E6	8	32	HPV18	E6	8	37
HPV18	E6	10	32	HPV18	E6	11	38
HPV18	E6	11	32	HPV18	E6	10	54
HPV18	E6	11	27	HPV18	E6	11	54
HPV18	E6	8	16	HPV18	E7	8	6
HPV18	E6	10	16	HPV18	E7	10	6
HPV18	E6	10	51	HPV18	E7	8	63
HPV18	E6	9	88	HPV18	E7	10	63
HPV18	E6	11	88	HPV18	E7	8	24
HPV18	E6	9	29	HPV18	E7	8	82
HPV18	E6	10	29	HPV18	E7	10	82
HPV18	E6	11	29	HPV18	E7	8	69
HPV18	E6	9	20	HPV18	E7	10	40
HPV18	E6	11	20	HPV18	E7	8	90
HPV18	E6	9	77	HPV18	E7	8	86
HPV18	E6	9	40	HPV18	E7	9	86
HPV18	E6	10	43	HPV18	E7	9	43
HPV18	E6	8	47	HPV18	E7	8	14
HPV18	E6	9	47	HPV18	E7	10	14
HPV18	E6	8	53	HPV18	E7	9	46
HPV18	E6	11	53	HPV18	E7	11	11
HPV18	E6	10	97	HPV18	E7	8	5
HPV18	E6	10	136	HPV18	E7	9	5
HPV18	E6	8	62	HPV18	E7	11	5
HPV18	E6	11	120	HPV18	E7	8	73
HPV18	E6	8	30	HPV18	E7	11	73
HPV18	E6	9	30	HPV18	E7	8	8
HPV18	E6	10	30	HPV18	E7	10	74
HPV18	E6	9	13	HPV18	E7	10	61
HPV18	E6	11	13	HPV18	E7	11	92
HPV18	E6	10	92	HPV18	E7	11	50
HPV18	E6	11	92	HPV18	E7	9	17
HPV18	E6	9	36	HPV18	E7	10	17
HPV18	E6	11	102	HPV18	E7	9	56
HPV18	E6	9	25	HPV18	E7	10	22
HPV18	E6	9	150	HPV18	E7	10	88
HPV18	E6	8	41	HPV18	E7	8	87
HPV18	E6	9	93	HPV18	E7	11	87
HPV18	E6	10	93	HPV18	E7	8	53
HPV18	E6	11	93	HPV18	E7	9	53
HPV18	E6	8	1	HPV18	E7	10	53
HPV18	E6	8	95	HPV18	E7	8	84

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	E7	10	84	HPV18	L1	8	167
HPV18	E7	11	84	HPV18	L1	10	167
HPV18	E7	10	71	HPV18	L1	8	155
HPV18	E7	11	79	HPV18	L1	10	155
HPV18	E7	9	7	HPV18	L1	10	280
HPV18	E7	10	93	HPV18	L1	9	317
HPV18	E7	11	60	HPV18	L1	11	317
HPV18	E7	10	12	HPV18	L1	8	436
HPV18	E7	9	75	HPV18	L1	9	436
HPV18	E7	11	75	HPV18	L1	10	436
HPV18	L1	10	195	HPV18	L1	11	436
HPV18	L1	10	225	HPV18	L1	10	49
HPV18	L1	11	225	HPV18	L1	8	438
HPV18	L1	8	487	HPV18	L1	9	438
HPV18	L1	9	487	HPV18	L1	10	438
HPV18	L1	11	487	HPV18	L1	8	482
HPV18	L1	9	63	HPV18	L1	8	391
HPV18	L1	10	63	HPV18	L1	11	391
HPV18	L1	10	268	HPV18	L1	8	267
HPV18	L1	8	377	HPV18	L1	11	267
HPV18	L1	11	419	HPV18	L1	8	535
HPV18	L1	9	196	HPV18	L1	11	177
HPV18	L1	8	552	HPV18	L1	10	342
HPV18	L1	11	552	HPV18	L1	8	171
HPV18	L1	10	222	HPV18	L1	9	233
HPV18	L1	8	406	HPV18	L1	11	326
HPV18	L1	8	218	HPV18	L1	8	383
HPV18	L1	9	218	HPV18	L1	10	383
HPV18	L1	9	310	HPV18	L1	11	383
HPV18	L1	8	2	HPV18	L1	10	165
HPV18	L1	9	2	HPV18	L1	8	467
HPV18	L1	8	490	HPV18	L1	10	467
HPV18	L1	11	286	HPV18	L1	11	467
HPV18	L1	9	441	HPV18	L1	11	194
HPV18	L1	10	441	HPV18	L1	8	97
HPV18	L1	11	350	HPV18	L1	9	97
HPV18	L1	8	512	HPV18	L1	10	97
HPV18	L1	10	512	HPV18	L1	9	38
HPV18	L1	8	433	HPV18	L1	10	38
HPV18	L1	10	433	HPV18	L1	11	38
HPV18	L1	11	433	HPV18	L1	9	13
HPV18	L1	9	260	HPV18	L1	10	428
HPV18	L1	10	260	HPV18	L1	8	40
HPV18	L1	10	522	HPV18	L1	9	40
HPV18	L1	11	522	HPV18	L1	11	40
HPV18	L1	8	189	HPV18	L1	8	39
HPV18	L1	9	189	HPV18	L1	9	39
HPV18	L1	11	263	HPV18	L1	10	39
HPV18	L1	8	276	HPV18	L1	8	46
HPV18	L1	10	276	HPV18	L1	10	46
HPV18	L1	9	148	HPV18	L1	9	460
HPV18	L1	8	396	HPV18	L1	9	47
HPV18	L1	9	396	HPV18	L1	8	219
HPV18	L1	10	396	HPV18	L1	9	9
HPV18	L1	9	330	HPV18	L1	8	32
HPV18	L1	9	478	HPV18	L1	9	32
HPV18	L1	10	478	HPV18	L1	10	32
HPV18	L1	11	478	HPV18	L1	8	488
HPV18	L1	9	448	HPV18	L1	10	488
HPV18	L1	8	203	HPV18	L1	8	443

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	L1	11	443
HPV18	L1	8	360
HPV18	L1	9	376
HPV18	L1	10	186
HPV18	L1	11	186
HPV18	L1	9	505
HPV18	L1	9	120
HPV18	L1	8	213
HPV18	L1	11	213
HPV18	L1	9	125
HPV18	L1	8	8
HPV18	L1	10	8
HPV18	L1	8	14
HPV18	L1	11	103
HPV18	L1	8	274
HPV18	L1	10	274
HPV18	L1	9	434
HPV18	L1	10	434
HPV18	L1	11	434
HPV18	L1	9	445
HPV18	L1	11	403
HPV18	L1	10	104
HPV18	L1	8	476
HPV18	L1	11	476
HPV18	L1	11	531
HPV18	L1	8	159
HPV18	L1	10	159
HPV18	L1	8	33
HPV18	L1	9	33
HPV18	L1	10	62
HPV18	L1	11	62
HPV18	L1	8	261
HPV18	L1	9	261
HPV18	L1	11	36
HPV18	L1	8	402
HPV18	L1	8	388
HPV18	L1	10	388
HPV18	L1	11	388
HPV18	L1	9	84
HPV18	L1	11	84
HPV18	L1	9	253
HPV18	L1	10	253
HPV18	L1	10	70
HPV18	L1	11	70
HPV18	L1	10	510
HPV18	L1	9	54
HPV18	L1	10	54
HPV18	L1	11	54
HPV18	L1	9	52
HPV18	L1	11	52
HPV18	L1	10	199
HPV18	L1	9	207
HPV18	L1	11	207
HPV18	L1	11	496
HPV18	L1	10	114
HPV18	L1	8	224
HPV18	L1	11	224
HPV18	L1	9	558
HPV18	L1	8	344
HPV18	L1	8	57
HPV18	L1	8	282
HPV18	L1	8	248
HPV18	L1	9	248
HPV18	L1	8	525
HPV18	L1	10	525
HPV18	L1	9	28
HPV18	L1	10	28
HPV18	L1	8	26
HPV18	L1	9	26
HPV18	L1	11	26
HPV18	L1	10	240
HPV18	L1	8	20
HPV18	L1	10	20
HPV18	L1	9	333
HPV18	L1	11	333
HPV18	L1	10	540
HPV18	L1	8	91
HPV18	L1	8	472
HPV18	L1	8	412
HPV18	L1	9	412
HPV18	L1	9	533
HPV18	L1	10	533
HPV18	L1	8	216
HPV18	L1	10	216
HPV18	L1	11	216
HPV18	L1	8	439
HPV18	L1	9	439
HPV18	L1	11	439
HPV18	L1	11	315
HPV18	L1	9	366
HPV18	L1	9	389
HPV18	L1	10	389
HPV18	L1	10	137
HPV18	L1	11	61
HPV18	L1	11	297
HPV18	L1	10	214
HPV18	L1	8	324
HPV18	L1	9	324
HPV18	L1	9	158
HPV18	L1	11	158
HPV18	L1	9	6
HPV18	L1	10	6
HPV18	L1	9	81
HPV18	L1	10	81
HPV18	L1	9	299
HPV18	L1	9	551
HPV18	L1	10	127
HPV18	L1	9	288
HPV18	L1	11	288
HPV18	L1	11	93
HPV18	L1	10	459
HPV18	L1	9	31
HPV18	L1	10	31
HPV18	L1	11	31
HPV18	L1	9	359
HPV18	L1	10	150
HPV18	L1	11	150
HPV18	L1	9	518
HPV18	L1	9	475
HPV18	L1	9	335

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	L1	11	335
HPV18	L1	11	306
HPV18	L1	8	242
HPV18	L1	10	242
HPV18	L1	10	365
HPV18	L1	10	272
HPV18	L1	8	400
HPV18	L1	10	400
HPV18	L1	10	485
HPV18	L1	11	485
HPV18	L1	8	78
HPV18	L1	9	209
HPV18	L1	11	209
HPV18	L1	8	234
HPV18	L1	8	446
HPV18	L1	11	446
HPV18	L1	10	404
HPV18	L1	9	541
HPV18	L1	8	442
HPV18	L1	9	442
HPV18	L1	9	273
HPV18	L1	11	273
HPV18	L1	10	444
HPV18	L1	10	327
HPV18	L1	9	215
HPV18	L1	11	215
HPV18	L1	9	156
HPV18	L1	11	156
HPV18	L1	11	409
HPV18	L1	8	397
HPV18	L1	9	397
HPV18	L1	11	397
HPV18	L1	11	473
HPV18	L1	10	553
HPV18	L1	9	105
HPV18	L1	11	105
HPV18	L1	8	254
HPV18	L1	9	254
HPV18	L1	11	254
HPV18	L1	8	331
HPV18	L1	11	331
HPV18	L1	9	393
HPV18	L1	11	393
HPV18	L1	9	71
HPV18	L1	10	71
HPV18	L1	9	486
HPV18	L1	10	486
HPV18	L1	11	79
HPV18	L1	8	255
HPV18	L1	10	255
HPV18	L1	8	7
HPV18	L1	9	7
HPV18	L1	11	7
HPV18	L1	8	449
HPV18	L1	10	532
HPV18	L1	11	532
HPV18	L1	11	136
HPV18	L1	10	89
HPV18	L1	10	392
HPV18	L1	8	394
HPV18	L1	10	394
HPV18	L1	11	394
HPV18	L1	8	82
HPV18	L1	9	82
HPV18	L1	11	82
HPV18	L1	8	161
HPV18	L1	9	452
HPV18	L1	10	452
HPV18	L1	9	45
HPV18	L1	11	45
HPV18	L1	9	337
HPV18	L1	8	73
HPV18	L1	10	73
HPV18	L1	11	73
HPV18	L1	8	129
HPV18	L1	10	129
HPV18	L1	11	4
HPV18	L1	11	88
HPV18	L2	9	6
HPV18	L2	10	6
HPV18	L2	8	286
HPV18	L2	9	286
HPV18	L2	10	341
HPV18	L2	9	303
HPV18	L2	11	303
HPV18	L2	10	139
HPV18	L2	9	358
HPV18	L2	10	358
HPV18	L2	9	278
HPV18	L2	10	278
HPV18	L2	11	278
HPV18	L2	8	404
HPV18	L2	10	404
HPV18	L2	9	142
HPV18	L2	11	142
HPV18	L2	8	129
HPV18	L2	9	129
HPV18	L2	11	129
HPV18	L2	10	349
HPV18	L2	11	349
HPV18	L2	10	346
HPV18	L2	11	16
HPV18	L2	8	354
HPV18	L2	9	83
HPV18	L2	10	83
HPV18	L2	11	83
HPV18	L2	8	270
HPV18	L2	10	270
HPV18	L2	11	270
HPV18	L2	10	396
HPV18	L2	11	396
HPV18	L2	9	30
HPV18	L2	10	30
HPV18	L2	11	30
HPV18	L2	8	194
HPV18	L2	8	334
HPV18	L2	9	334
HPV18	L2	8	175
HPV18	L2	10	175
HPV18	L2	8	169

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	L2	9	169
HPV18	L2	8	455
HPV18	L2	9	369
HPV18	L2	10	369
HPV18	L2	11	200
HPV18	L2	9	443
HPV18	L2	9	53
HPV18	L2	8	241
HPV18	L2	9	241
HPV18	L2	10	241
HPV18	L2	11	276
HPV18	L2	9	122
HPV18	L2	10	122
HPV18	L2	11	157
HPV18	L2	8	306
HPV18	L2	10	306
HPV18	L2	9	181
HPV18	L2	8	116
HPV18	L2	10	116
HPV18	L2	10	314
HPV18	L2	9	51
HPV18	L2	11	51
HPV18	L2	8	58
HPV18	L2	9	429
HPV18	L2	10	56
HPV18	L2	8	300
HPV18	L2	8	25
HPV18	L2	11	25
HPV18	L2	10	204
HPV18	L2	9	64
HPV18	L2	11	64
HPV18	L2	10	60
HPV18	L2	8	188
HPV18	L2	10	188
HPV18	L2	9	432
HPV18	L2	8	310
HPV18	L2	8	124
HPV18	L2	10	124
HPV18	L2	8	37
HPV18	L2	9	37
HPV18	L2	8	134
HPV18	L2	10	134
HPV18	L2	11	134
HPV18	L2	8	292
HPV18	L2	8	326
HPV18	L2	10	326
HPV18	L2	10	167
HPV18	L2	11	167
HPV18	L2	8	279
HPV18	L2	9	279
HPV18	L2	10	279
HPV18	L2	9	44
HPV18	L2	11	44
HPV18	L2	9	405
HPV18	L2	8	143
HPV18	L2	10	143
HPV18	L2	8	130
HPV18	L2	10	130
HPV18	L2	11	130
HPV18	L2	11	249
HPV18	L2	8	416
HPV18	L2	10	416
HPV18	L2	10	103
HPV18	L2	11	103
HPV18	L2	8	43
HPV18	L2	10	43
HPV18	L2	10	22
HPV18	L2	11	22
HPV18	L2	8	19
HPV18	L2	8	34
HPV18	L2	11	34
HPV18	L2	11	40
HPV18	L2	8	106
HPV18	L2	9	106
HPV18	L2	8	248
HPV18	L2	8	335
HPV18	L2	9	197
HPV18	L2	8	45
HPV18	L2	10	45
HPV18	L2	9	263
HPV18	L2	8	242
HPV18	L2	9	242
HPV18	L2	8	287
HPV18	L2	9	391
HPV18	L2	11	391
HPV18	L2	10	338
HPV18	L2	9	79
HPV18	L2	8	179
HPV18	L2	11	179
HPV18	L2	8	254
HPV18	L2	9	254
HPV18	L2	10	254
HPV18	L2	11	254
HPV18	L2	8	160
HPV18	L2	9	160
HPV18	L2	11	160
HPV18	L2	9	285
HPV18	L2	10	285
HPV18	L2	9	422
HPV18	L2	11	138
HPV18	L2	10	357
HPV18	L2	11	357
HPV18	L2	9	325
HPV18	L2	11	325
HPV18	L2	9	209
HPV18	L2	10	209
HPV18	L2	9	415
HPV18	L2	11	415
HPV18	L2	8	73
HPV18	L2	9	73
HPV18	L2	10	73
HPV18	L2	8	214
HPV18	L2	9	214
HPV18	L2	10	196
HPV18	L2	8	390
HPV18	L2	10	390
HPV18	L2	11	337
HPV18	L2	10	171
HPV18	L2	10	419
HPV18	L2	8	98

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	L2	9	98
HPV18	L2	10	98
HPV18	L2	11	120
HPV18	L2	8	86
HPV18	L2	11	86
HPV18	L2	11	185
HPV18	L2	11	216
HPV18	L2	9	95
HPV18	L2	10	95
HPV18	L2	11	95
HPV18	L2	8	360
HPV18	L2	11	360
HPV18	L2	10	90
HPV18	L2	8	398
HPV18	L2	9	398
HPV18	L2	10	398
HPV18	L2	11	232
HPV18	L2	8	198
HPV18	L2	9	172
HPV18	L2	11	172
HPV18	L2	10	233
HPV18	L2	11	233
HPV18	L2	8	5
HPV18	L2	10	5
HPV18	L2	11	5
HPV18	L2	10	11
HPV18	L2	10	302
HPV18	L2	8	229
HPV18	L2	9	229
HPV18	L2	8	298
HPV18	L2	10	298
HPV18	L2	8	281
HPV18	L2	10	225
HPV18	L2	11	220
HPV18	L2	8	316
HPV18	L2	11	316
HPV18	L2	11	450
HPV18	L2	8	132
HPV18	L2	9	132
HPV18	L2	10	132
HPV18	L2	8	380
HPV18	L2	9	380
HPV18	L2	10	380
HPV18	L2	8	340
HPV18	L2	11	340
HPV18	L2	8	166
HPV18	L2	11	166
HPV18	L2	8	151
HPV18	L2	11	151
HPV18	L2	11	102
HPV18	L2	9	49
HPV18	L2	11	49
HPV18	L2	9	247
HPV18	L2	10	212
HPV18	L2	11	212
HPV18	L2	10	424
HPV18	L2	8	147
HPV18	L2	9	147
HPV18	L2	9	153
HPV18	L2	8	409
HPV18	L2	9	409
HPV18	L2	8	235
HPV18	L2	9	235
HPV18	L2	10	149
HPV18	L2	8	13
HPV18	L2	11	111
HPV18	L2	9	412
HPV18	L2	10	412
HPV18	L2	9	420
HPV18	L2	11	420
HPV18	L2	11	377
HPV18	L2	8	105
HPV18	L2	9	105
HPV18	L2	10	105
HPV18	L2	8	406
HPV18	L2	11	406
HPV18	L2	10	262
HPV18	L2	8	304
HPV18	L2	10	304
HPV18	L2	9	425
HPV18	L2	8	38
HPV18	L2	11	261
HPV18	L2	8	154
HPV18	L2	8	136
HPV18	L2	9	136
HPV18	L2	8	410
HPV18	L2	11	410
HPV18	L2	9	135
HPV18	L2	10	135
HPV18	L2	10	388
HPV18	L2	11	293
HPV18	L2	10	217
HPV18	L2	8	80
HPV18	L2	9	176
HPV18	L2	11	176
HPV18	L2	10	221
HPV18	L2	8	236
HPV18	L2	8	92
HPV18	L2	9	140
HPV18	L2	11	140
HPV18	L2	9	104
HPV18	L2	10	104
HPV18	L2	11	104
HPV18	L2	9	113
HPV18	L2	11	113
HPV18	L2	11	387
HPV18	L2	11	81
HPV18	L2	9	91
HPV18	L2	8	31
HPV18	L2	9	31
HPV18	L2	10	31
HPV18	L2	11	31
HPV18	L2	10	112
HPV18	L2	8	351
HPV18	L2	9	351
HPV18	L2	11	351
HPV18	L2	8	332
HPV18	L2	10	332
HPV18	L2	11	332
HPV18	L2	11	427

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV18	L2	10	71	HPV31	E1	8	528
HPV18	L2	11	71	HPV31	E1	10	528
HPV18	L2	9	436	HPV31	E1	8	348
HPV18	L2	8	400	HPV31	E1	9	348
HPV18	L2	11	400	HPV31	E1	10	311
HPV31	E1	9	296	HPV31	E1	8	74
HPV31	E1	11	296	HPV31	E1	9	74
HPV31	E1	8	219	HPV31	E1	11	74
HPV31	E1	9	219	HPV31	E1	8	62
HPV31	E1	10	219	HPV31	E1	11	62
HPV31	E1	8	297	HPV31	E1	8	21
HPV31	E1	10	297	HPV31	E1	11	80
HPV31	E1	10	185	HPV31	E1	9	354
HPV31	E1	10	111	HPV31	E1	10	354
HPV31	E1	11	111	HPV31	E1	10	127
HPV31	E1	9	519	HPV31	E1	8	193
HPV31	E1	11	519	HPV31	E1	10	193
HPV31	E1	8	68	HPV31	E1	11	193
HPV31	E1	9	439	HPV31	E1	9	64
HPV31	E1	10	533	HPV31	E1	10	315
HPV31	E1	11	533	HPV31	E1	11	315
HPV31	E1	9	298	HPV31	E1	8	168
HPV31	E1	9	186	HPV31	E1	10	168
HPV31	E1	10	66	HPV31	E1	11	168
HPV31	E1	8	72	HPV31	E1	8	139
HPV31	E1	10	72	HPV31	E1	8	137
HPV31	E1	11	72	HPV31	E1	10	137
HPV31	E1	10	360	HPV31	E1	11	443
HPV31	E1	9	504	HPV31	E1	8	372
HPV31	E1	11	22	HPV31	E1	10	372
HPV31	E1	10	81	HPV31	E1	11	372
HPV31	E1	10	370	HPV31	E1	10	473
HPV31	E1	8	263	HPV31	E1	10	425
HPV31	E1	11	263	HPV31	E1	9	436
HPV31	E1	8	113	HPV31	E1	9	206
HPV31	E1	9	113	HPV31	E1	8	433
HPV31	E1	10	452	HPV31	E1	10	433
HPV31	E1	8	279	HPV31	E1	8	499
HPV31	E1	9	279	HPV31	E1	8	467
HPV31	E1	9	239	HPV31	E1	8	305
HPV31	E1	10	239	HPV31	E1	8	252
HPV31	E1	9	284	HPV31	E1	11	403
HPV31	E1	8	213	HPV31	E1	10	11
HPV31	E1	11	213	HPV31	E1	10	160
HPV31	E1	8	217	HPV31	E1	10	386
HPV31	E1	10	217	HPV31	E1	9	225
HPV31	E1	11	217	HPV31	E1	10	225
HPV31	E1	10	100	HPV31	E1	11	225
HPV31	E1	9	620	HPV31	E1	8	446
HPV31	E1	10	620	HPV31	E1	9	446
HPV31	E1	10	495	HPV31	E1	10	446
HPV31	E1	11	495	HPV31	E1	8	196
HPV31	E1	10	503	HPV31	E1	8	78
HPV31	E1	10	96	HPV31	E1	9	71
HPV31	E1	11	421	HPV31	E1	11	71
HPV31	E1	9	336	HPV31	E1	11	243
HPV31	E1	11	46	HPV31	E1	8	355
HPV31	E1	10	42	HPV31	E1	9	355
HPV31	E1	9	332	HPV31	E1	9	453
HPV31	E1	10	332	HPV31	E1	9	287

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31 E1	10	287	HPV31 E1	11	175
HPV31 E1	11	287	HPV31 E1	11	258
HPV31 E1	10	268	HPV31 E1	8	187
HPV31 E1	11	268	HPV31 E1	11	187
HPV31 E1	8	381	HPV31 E1	8	285
HPV31 E1	10	422	HPV31 E1	11	285
HPV31 E1	11	184	HPV31 E1	10	255
HPV31 E1	11	110	HPV31 E1	8	257
HPV31 E1	11	532	HPV31 E1	8	535
HPV31 E1	8	497	HPV31 E1	9	535
HPV31 E1	9	497	HPV31 E1	10	535
HPV31 E1	10	497	HPV31 E1	11	535
HPV31 E1	8	380	HPV31 E1	10	47
HPV31 E1	9	380	HPV31 E1	9	143
HPV31 E1	10	276	HPV31 E1	10	143
HPV31 E1	11	276	HPV31 E1	11	143
HPV31 E1	9	272	HPV31 E1	10	340
HPV31 E1	11	272	HPV31 E1	11	340
HPV31 E1	8	291	HPV31 E1	11	549
HPV31 E1	9	291	HPV31 E1	8	518
HPV31 E1	10	119	HPV31 E1	10	518
HPV31 E1	9	232	HPV31 E1	8	173
HPV31 E1	8	179	HPV31 E1	9	308
HPV31 E1	9	179	HPV31 E1	8	104
HPV31 E1	10	179	HPV31 E1	9	104
HPV31 E1	11	412	HPV31 E1	11	104
HPV31 E1	8	247	HPV31 E1	8	59
HPV31 E1	9	247	HPV31 E1	10	59
HPV31 E1	10	247	HPV31 E1	11	59
HPV31 E1	11	247	HPV31 E1	9	135
HPV31 E1	8	493	HPV31 E1	10	135
HPV31 E1	9	493	HPV31 E1	9	460
HPV31 E1	8	362	HPV31 E1	11	460
HPV31 E1	10	362	HPV31 E1	9	55
HPV31 E1	8	454	HPV31 E1	11	55
HPV31 E1	10	286	HPV31 E1	9	4
HPV31 E1	11	286	HPV31 E1	9	492
HPV31 E1	11	202	HPV31 E1	10	492
HPV31 E1	9	470	HPV31 E1	8	541
HPV31 E1	10	470	HPV31 E1	10	541
HPV31 E1	8	543	HPV31 E1	9	93
HPV31 E1	9	277	HPV31 E1	8	170
HPV31 E1	10	277	HPV31 E1	9	170
HPV31 E1	11	277	HPV31 E1	11	170
HPV31 E1	8	273	HPV31 E1	10	524
HPV31 E1	10	273	HPV31 E1	11	524
HPV31 E1	9	542	HPV31 E1	9	60
HPV31 E1	11	234	HPV31 E1	10	60
HPV31 E1	9	256	HPV31 E1	10	378
HPV31 E1	9	534	HPV31 E1	11	378
HPV31 E1	10	534	HPV31 E1	9	67
HPV31 E1	11	534	HPV31 E1	8	430
HPV31 E1	9	474	HPV31 E1	10	430
HPV31 E1	8	326	HPV31 E1	11	430
HPV31 E1	9	326	HPV31 E1	9	361
HPV31 E1	9	490	HPV31 E1	11	361
HPV31 E1	11	490	HPV31 E1	8	536
HPV31 E1	10	235	HPV31 E1	9	536
HPV31 E1	10	244	HPV31 E1	10	536
HPV31 E1	11	244	HPV31 E1	8	399

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	E1	10	142
HPV31	E1	11	142
HPV31	E1	11	339
HPV31	E1	9	429
HPV31	E1	11	429
HPV31	E1	11	141
HPV31	E1	11	323
HPV31	E1	8	145
HPV31	E1	9	145
HPV31	E1	8	83
HPV31	E1	10	176
HPV31	E1	11	176
HPV31	E1	9	394
HPV31	E1	8	267
HPV31	E1	11	267
HPV31	E1	9	398
HPV31	E1	10	303
HPV31	E1	8	595
HPV31	E1	10	438
HPV31	E1	8	526
HPV31	E1	9	526
HPV31	E1	10	526
HPV31	E1	8	246
HPV31	E1	9	246
HPV31	E1	10	246
HPV31	E1	11	246
HPV31	E1	10	469
HPV31	E1	11	469
HPV31	E1	11	377
HPV31	E1	11	294
HPV31	E1	8	211
HPV31	E1	9	211
HPV31	E1	10	211
HPV31	E1	11	616
HPV31	E1	10	295
HPV31	E1	9	120
HPV31	E1	8	65
HPV31	E1	11	65
HPV31	E1	9	269
HPV31	E1	10	269
HPV31	E1	8	233
HPV31	E1	10	152
HPV31	E1	9	387
HPV31	E1	8	333
HPV31	E1	9	333
HPV31	E1	11	151
HPV31	E1	8	505
HPV31	E1	8	226
HPV31	E1	9	226
HPV31	E1	10	226
HPV31	E1	10	324
HPV31	E1	11	324
HPV31	E1	9	218
HPV31	E1	10	218
HPV31	E1	11	218
HPV31	E1	8	227
HPV31	E1	9	227
HPV31	E1	10	23
HPV31	E1	11	84
HPV31	E1	9	177
HPV31	E1	10	177
HPV31	E1	11	177
HPV31	E1	9	325
HPV31	E1	10	325
HPV31	E1	8	349
HPV31	E1	11	254
HPV3i	E1	8	144
HPV31	E1	9	144
HPV31	E1	10	144
HPV31	E1	9	82
HPV31	E1	9	341
HPV31	E1	10	341
HPV31	E1	11	223
HPV31	E1	8	343
HPV31	E1	8	319
HPV31	E1	9	405
HPV31	E1	8	489
HPV31	E1	10	489
HPV31	E1	10	481
HPV31	E1	11	359
HPV31	E1	9	511
HPV31	E1	10	511
HPV31	E1	8	558
HPV31	E1	10	558
HPV31	E1	11	515
HPV31	E1	10	428
HPV31	E1	10	19
HPV31	E1	9	89
HPV31	E2	8	277
HPV31	E2	10	277
HPV31	E2	11	277
HPV31	E2	9	278
HPV31	E2	10	278
HPV31	E2	8	72
HPV31	E2	10	72
HPV31	E2	11	72
HPV31	E2	8	338
HPV31	E2	10	338
HPV31	E2	8	229
HPV31	E2	11	229
HPV31	E2	9	69
HPV31	E2	10	69
HPV31	E2	11	69
HPV31	E2	9	61
HPV31	E2	10	61
HPV31	E2	8	291
HPV31	E2	10	239
HPV31	E2	8	286
HPV31	E2	10	286
HPV31	E2	11	286
HPV31	E2	9	228
HPV31	E2	8	140
HPV31	E2	9	140
HPV31	E2	8	109
HPV31	E2	9	109
HPV31	E2	11	109
HPV31	E2	9	330
HPV31	E2	10	330
HPV31	E2	11	330
HPV31	E2	8	280

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31 E2	8	145	HPV31 E2	11	210
HPV31 E2	10	40	HPV31 E2	9	339
HPV31 E2	8	301	HPV31 E2	8	66
HPV31 E2	9	124	HPV31 E2	10	66
HPV31 E2	8	204	HPV31 E2	8	68
HPV31 E2	9	204	HPV31 E2	10	68
HPV31 E2	11	204	HPV31 E2	11	68
HPV31 E2	8	74	HPV31 E2	10	45
HPV31 E2	9	74	HPV31 E2	8	358
HPV31 E2	8	100	HPV31 E2	10	358
HPV31 E2	11	100	HPV31 E2	8	260
HPV31 E2	11	48	HPV31 E2	11	260
HPV31 E2	10	320	HPV31 E2	8	213
HPV31 E2	9	2	HPV31 E2	9	213
HPV31 E2	8	185	HPV31 E2	10	213
HPV31 E2	9	185	HPV31 E2	10	316
HPV31 E2	10	185	HPV31 E2	11	226
HPV31 E2	8	118	HPV31 E2	10	261
HPV31 E2	11	118	HPV31 E2	8	42
HPV31 E2	8	207	HPV31 E2	10	42
HPV31 E2	10	207	HPV31 E2	8	70
HPV31 E2	11	207	HPV31 E2	9	70
HPV31 E2	11	136	HPV31 E2	10	70
HPV31 E2	10	353	HPV31 E2	8	75
HPV31 E2	11	353	HPV31 E2	11	75
HPV31 E2	10	171	HPV31 E2	8	103
HPV31 E2	8	168	HPV31 E2	8	78
HPV31 E2	9	50	HPV31 E2	9	77
HPV31 E2	10	50	HPV31 E2	8	94
HPV31 E2	8	209	HPV31 E2	10	94
HPV31 E2	9	209	HPV31 E2	11	94
HPV31 E2	10	156	HPV31 E2	9	337
HPV31 E2	11	156	HPV31 E2	11	337
HPV31 E2	10	143	HPV31 E2	10	303
HPV31 E2	10	190	HPV31 E2	10	282
HPV31 E2	8	150	HPV31 E2	11	282
HPV31 E2	11	150	HPV31 E2	10	84
HPV31 E2	8	179	HPV31 E2	11	84
HPV31 E2	10	179	HPV31 E2	8	254
HPV31 E2	9	231	HPV31 E2	9	254
HPV31 E2	10	231	HPV31 E2	11	127
HPV31 E2	11	231	HPV31 E2	9	219
HPV31 E2	9	273	HPV31 E2	11	219
HPV31 E2	9	235	HPV31 E2	8	355
HPV31 E2	8	187	HPV31 E2	9	355
HPV31 E2	8	29	HPV31 E2	11	355
HPV31 E2	10	29	HPV31 E2	10	361
HPV31 E2	8	35	HPV31 E2	11	361
HPV31 E2	9	35	HPV31 E2	8	9
HPV31 E2	9	164	HPV31 E2	8	60
HPV31 E2	8	297	HPV31 E2	10	60
HPV31 E2	9	297	HPV31 E2	11	60
HPV31 E2	9	56	HPV31 E2	9	290
HPV31 E2	8	295	HPV31 E2	9	294
HPV31 E2	10	295	HPV31 E2	11	294
HPV31 E2	11	295	HPV31 E2	8	215
HPV31 E2	9	304	HPV31 E2	11	106
HPV31 E2	8	165	HPV31 E2	8	71
HPV31 E2	11	165	HPV31 E2	9	71
HPV31 E2	8	210	HPV31 E2	11	71

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	E2	9	317	HPV31 E2	11 220
HPV31	E2	10	76	HPV31 E2	10 116
HPV31	E2	9	95	HPV31 E2	8 356
HPV31	E2	10	95	HPV31 E2	10 356
HPV31	E2	11	95	HPV31 E2	9 362
HPV31	E2	9	283	HPV31 E2	10 362
HPV31	E2	10	283	HPV31 E2	11 362
HPV31	E2	11	283	HPV31 E2	8 274
HPV31	E2	8	96	HPV31 E2	11 274
HPV31	E2	9	96	HPV31 E2	8 192
HPV31	E2	10	96	HPV31 E2	9 41
HPV31	E2	9	191	HPV31 E2	11 41
HPV31	E2	10	151	HPV31 E2	10 119
HPV31	E2	9	321	HPV31 E2	11 119
HPV31	E2	11	321	HPV31 E2	10 211
HPV31	E2	8	57	HPV31 E2	11 211
HPV31	E2	11	57	HPV31 E2	8 340
HPV31	E2	11	238	HPV31 E2	11 147
HPV31	E2	8	285	HPV31 E2	10 58
HPV31	E2	9	285	HPV31 E2	11 328
HPV31	E2	11	285	HPV31 E2	8 92
HPV31	E2	10	37	HPV31 E2	10 92
HPV31	E2	9	7	HPV31 E2	11 344
HPV31	E2	10	7	HPV31 E2	9 138
HPV31	E2	8	311	HPV31 E2	10 138
HPV31	E2	9	247	HPV31 E2	11 138
HPV31	E2	9	276	HPV31 E2	9 102
HPV31	E2	11	276	HPV31 E2	9 131
HPV31	E2	9	53	HPV31 E2	11 131
HPV31	E2	10	53	HPV31 E2	11 115
HPV31	E2	8	98	HPV31 E2	8 159
HPV31	E2	10	98	HPV31 E2	11 159
HPV31	E2	9	348	HPV31 E5	8 40
HPV31	E2	10	348	HPV31 E5	9 40
HPV31	E2	11	5	HPV31 E5	10 40
HPV31	E2	9	346	HPV31 E5	10 53
HPV31	E2	11	346	HPV31 E5	9 61
HPV31	E2	8	324	HPV31 E5	11 61
HPV31	E2	9	266	HPV31 E5	8 26
HPV31	E2	10	266	HPV31 E5	9 26
HPV31	E2	8	198	HPV31 E5	11 26
HPV31	E2	11	198	HPV31 E5	8 20
HPV31	E2	9	269	HPV31 E5	9 20
HPV31	E2	10	269	HPV31 E5	10 20
HPV31	E2	11	269	HPV31 E5	9 3
HPV31	E2	8	63	HPV31 E5	10 3
HPV31	E2	10	63	HPV31 E5	11 3
HPV31	E2	11	63	HPV31 E5	8 66
HPV31	E2	8	364	HPV31 E5	9 66
HPV31	E2	9	364	HPV31 E5	11 66
HPV31	E2	8	3	HPV31 E5	8 15
HPV31	E2	10	128	HPV31 E5	9 15
HPV31	E2	9	93	HPV31 E5	11 15
HPV31	E2	11	93	HPV31 E5	9 24
HPV31	E2	11	292	HPV31 E5	10 24
HPV31	E2	9	221	HPV31 E5	11 24
HPV31	E2	10	221	HPV31 E5	10 72
HPV31	E2	9	240	HPV31 E5	11 52
HPV31	E2	8	220	HPV31 E5	10 48
HPV31	E2	10	220	HPV31 E5	8 46

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31 E5	9	46	
HPV31 E5	11	11	
HPV31 E5	8	45	
HPV31 E5	9	45	
HPV31 E5	10	45	
HPV31 E5	8	16	
HPV31 E5	10	16	
HPV31 E5	8	22	
HPV31 E5	11	22	
HPV31 E5	8	44	
HPV31 E5	9	44	
HPV31 E5	10	44	
HPV31 E5	11	44	
HPV31 E5	9	43	
HPV31 E5	10	43	
HPV31 E5	11	43	
HPV31 E5	8	42	
HPV31 E5	10	42	
HPV31 E5	11	42	
HPV31 E5	8	27	
HPV31 E5	10	27	
HPV31 E5	9	32	
HPV31 E5	10	32	
HPV31 E5	11	32	
HPV31 E5	8	1	
HPV31 E5	9	1	
HPV31 E5	11	1	
HPV31 E5	8	5	
HPV31 E5	9	5	
HPV31 E5	9	70	
HPV31 E5	9	56	
HPV31 E5	10	56	
HPV31 E5	8	31	
HPV31 E5	10	31	
HPV31 E5	11	31	
HPV31 E5	8	10	
HPV31 E5	10	7	
HPV31 E5	11	7	
HPV31 E5	8	35	
HPV31 E5	9	35	
HPV31 E5	10	35	
HPV31 E5	11	35	
HPV31 E5	8	37	
HPV31 E5	9	37	
HPV31 E5	10	37	
HPV31 E5	11	37	
HPV31 E5	8	41	
HPV31 E5	9	41	
HPV31 E5	11	41	
HPV31 E5	9	8	
HPV31 E5	10	8	
HPV31 E5	9	73	
HPV31 E5	8	47	
HPV31 E5	11	47	
HPV31 E5	9	28	
HPV31 E5	11	28	
HPV31 E5	10	12	
HPV31 E5	11	12	
HPV31 E5	8	21	
HPV31 E5	9	21	
HPV31 E5	8	33	
HPV31 E5	9	33	
HPV31 E5	10	33	
HPV31 E5	11	33	
HPV31 E5	8	64	
HPV31 E5	10	64	
HPV31 E5	11	64	
HPV31 E5	8	50	
HPV31 E5	8	39	
HPV31 E5	9	39	
HPV31 E5	10	39	
HPV31 E5	11	39	
HPV31 E5	9	68	
HPV31 E5	11	68	
HPV31 E5	9	63	
HPV31 E5	11	63	
HPV31 E6	9	18	
HPV31 E6	11	18	
HPV31 E6	10	136	
HPV31 E6	8	103	
HPV31 E6	8	66	
HPV31 E6	11	63	
HPV31 E6	8	30	
HPV31 E6	9	30	
HPV31 E6	11	30	
HPV31 E6	8	98	
HPV31 E6	10	49	
HPV31 E6	8	57	
HPV31 E6	11	57	
HPV31 E6	9	20	
HPV31 E6	8	14	
HPV31 E6	8	39	
HPV31 E6	10	39	
HPV31 E6	8	41	
HPV31 E6	10	41	
HPV31 E6	11	41	
HPV31 E6	8	45	
HPV31 E6	9	45	
HPV31 E6	10	95	
HPV31 E6	11	95	
HPV31 E6	8	35	
HPV31 E6	9	35	
HPV31 E6	8	85	
HPV31 E6	11	118	
HPV31 E6	9	137	
HPV31 E6	11	137	
HPV31 E6	11	52	
HPV31 E6	8	11	
HPV31 E6	9	11	
HPV31 E6	11	11	
HPV31 E6	10	90	
HPV31 E6	11	90	
HPV31 E6	11	100	
HPV31 E6	10	37	
HPV31 E6	9	50	
HPV31 E6	9	91	
HPV31 E6	10	91	
HPV31 E6	11	91	
HPV31 E6	11	127	
HPV31 E6	8	5	

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	E6	11	5	HPV31	E7	11	72
HPV31	E6	11	109	HPV31	E7	9	37
HPV31	E6	8	36	HPV31	E7	8	12
HPV31	E6	11	36	HPV31	E7	9	12
HPV31	E6	11	27	HPV31	E7	11	12
HPV31	E6	10	17	HPV31	E7	8	69
HPV31	E6	10	82	HPV31	E7	10	69
HPV31	E6	11	82	HPV31	E7	11	69
HPV31	E6	8	51	HPV31	E7	10	55
HPV31	E6	10	87	HPV31	E7	11	55
HPV31	E6	11	86	HPV31	E7	9	11
HPV31	E6	9	42	HPV31	E7	10	11
HPV31	E6	10	42	HPV31	L1	8	347
HPV31	E6	11	42	HPV31	L1	9	347
HPV31	E7	10	19	HPV31	L1	8	348
HPV31	E7	9	59	HPV31	L1	10	398
HPV31	E7	11	59	HPV31	L1	11	398
HPV31	E7	9	68	HPV31	L1	8	426
HPV31	E7	11	68	HPV31	L1	10	180
HPV31	E7	8	75	HPV31	L1	9	213
HPV31	E7	9	75	HPV31	L1	11	213
HPV31	E7	10	75	HPV31	L1	10	208
HPV31	E7	8	21	HPV31	L1	8	317
HPV31	E7	9	14	HPV31	L1	10	305
HPV31	E7	8	48	HPV31	L1	11	285
HPV31	E7	9	48	HPV31	L1	8	9
HPV31	E7	10	36	HPV31	L1	10	9
HPV31	E7	11	18	HPV31	L1	9	346
HPV31	E7	9	81	HPV31	L1	10	346
HPV31	E7	10	81	HPV31	L1	9	147
HPV31	E7	9	4	HPV31	L1	11	147
HPV31	E7	10	4	HPV31	L1	9	158
HPV31	E7	9	88	HPV31	L1	11	304
HPV31	E7	11	88	HPV31	L1	9	387
HPV31	E7	8	89	HPV31	L1	8	372
HPV31	E7	10	89	HPV31	L1	11	372
HPV31	E7	11	54	HPV31	L1	10	275
HPV31	E7	8	82	HPV31	L1	11	275
HPV31	E7	9	82	HPV31	L1	9	200
HPV31	E7	8	83	HPV31	L1	10	200
HPV31	E7	8	8	HPV31	L1	10	461
HPV31	E7	11	79	HPV31	L1	11	461
HPV31	E7	8	15	HPV31	L1	9	129
HPV31	E7	9	41	HPV31	L1	10	203
HPV31	E7	8	6	HPV31	L1	11	203
HPV31	E7	10	6	HPV31	L1	8	216
HPV31	E7	11	44	HPV31	L1	10	216
HPV31	E7	11	27	HPV31	L1	9	88
HPV31	E7	10	73	HPV31	L1	8	336
HPV31	E7	11	73	HPV31	L1	10	336
HPV31	E7	8	77	HPV31	L1	10	417
HPV31	E7	9	66	HPV31	L1	11	417
HPV31	E7	11	66	HPV31	L1	9	8
HPV31	E7	10	63	HPV31	L1	11	8
HPV31	E7	8	71	HPV31	L1	8	95
HPV31	E7	9	71	HPV31	L1	10	95
HPV31	E7	9	7	HPV31	L1	8	107
HPV31	E7	9	64	HPV31	L1	10	107
HPV31	E7	11	64	HPV31	L1	10	449
HPV31	E7	8	72	HPV31	L1	8	375

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	L1	9	375	HPV31	L1	10	373
HPV31	L1	10	375	HPV31	L1	11	373
HPV31	L1	9	469	HPV31	L1	8	69
HPV31	L1	8	377	HPV31	L1	10	69
HPV31	L1	10	377	HPV31	L1	9	407
HPV31	L1	11	211	HPV31	L1	10	43
HPV31	L1	11	257	HPV31	L1	8	99
HPV31	L1	8	421	HPV31	L1	10	99
HPV31	L1	8	331	HPV31	L1	11	314
HPV31	L1	11	331	HPV31	L1	10	389
HPV31	L1	8	207	HPV31	L1	11	389
HPV31	L1	11	207	HPV31	L1	9	238
HPV31	L1	8	323	HPV31	L1	10	238
HPV31	L1	10	323	HPV31	L1	8	201
HPV31	L1	11	323	HPV31	L1	9	201
HPV31	L1	8	117	HPV31	L1	8	300
HPV31	L1	10	105	HPV31	L1	11	179
HPV31	L1	9	68	HPV31	L1	9	32
HPV31	L1	11	68	HPV31	L1	11	32
HPV31	L1	10	406	HPV31	L1	8	451
HPV31	L1	8	111	HPV31	L1	10	451
HPV31	L1	8	141	HPV31	L1	8	342
HPV31	L1	10	141	HPV31	L1	9	342
HPV31	L1	9	266	HPV31	L1	8	328
HPV31	L1	11	266	HPV31	L1	10	328
HPV31	L1	9	115	HPV31	L1	11	328
HPV31	L1	10	115	HPV31	L1	10	220
HPV31	L1	8	36	HPV31	L1	11	397
HPV31	L1	9	36	HPV31	L1	8	222
HPV31	L1	10	36	HPV31	L1	8	188
HPV31	L1	9	399	HPV31	L1	9	188
HPV31	L1	10	399	HPV31	L1	8	464
HPV31	L1	11	399	HPV31	L1	10	464
HPV31	L1	8	388	HPV31	L1	11	113
HPV31	L1	11	388	HPV31	L1	9	122
HPV31	L1	9	196	HPV31	L1	8	294
HPV31	L1	8	382	HPV31	L1	9	294
HPV31	L1	9	382	HPV31	L1	8	15
HPV31	L1	11	382	HPV31	L1	10	15
HPV31	L1	9	181	HPV31	L1	8	17
HPV31	L1	11	181	HPV31	L1	8	425
HPV31	L1	9	61	HPV31	L1	9	425
HPV31	L1	10	482	HPV31	L1	9	306
HPV31	L1	8	381	HPV31	L1	9	378
HPV31	L1	9	381	HPV31	L1	11	378
HPV31	L1	10	381	HPV31	L1	11	156
HPV31	L1	10	60	HPV31	L1	9	329
HPV31	L1	10	237	HPV31	L1	10	329
HPV31	L1	11	237	HPV31	L1	9	316
HPV31	L1	8	153	HPV31	L1	8	476
HPV31	L1	9	65	HPV31	L1	9	98
HPV31	L1	9	20	HPV31	L1	11	98
HPV31	L1	10	20	HPV31	L1	8	30
HPV31	L1	9	287	HPV31	L1	11	30
HPV31	L1	8	159	HPV31	L1	8	385
HPV31	L1	8	123	HPV31	L1	11	385
HPV31	L1	8	470	HPV31	L1	9	457
HPV31	L1	11	42	HPV31	L1	8	487
HPV31	L1	8	214	HPV31	L1	9	487
HPV31	L1	10	214	HPV31	L1	11	487

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	L1	8	490
HPV31	L1	9	228
HPV31	L1	11	228
HPV31	L1	11	51
HPV31	L1	9	414
HPV31	L1	10	414
HPV31	L1	8	2
HPV31	L1	9	2
HPV31	L1	10	2
HPV31	L1	9	149
HPV31	L1	11	149
HPV31	L1	9	299
HPV31	L1	9	424
HPV31	L1	10	424
HPV31	L1	9	283
HPV31	L1	9	23
HPV31	L1	11	23
HPV31	L1	8	340
HPV31	L1	9	340
HPV31	L1	10	340
HPV31	L1	11	340
HPV31	L1	11	492
HPV31	L1	11	290
HPV31	L1	11	344
HPV31	L1	8	194
HPV31	L1	9	194
HPV31	L1	11	194
HPV31	L1	8	271
HPV31	L1	10	212
HPV31	L1	8	284
HPV31	L1	10	286
HPV31	L1	11	246
HPV31	L1	8	383
HPV31	L1	10	383
HPV31	L1	9	96
HPV31	L1	11	96
HPV31	L1	9	494
HPV31	L1	8	408
HPV31	L1	11	408
HPV31	L1	9	337
HPV31	L1	11	337
HPV31	L1	10	493
HPV31	L1	8	267
HPV31	L1	10	267
HPV31	L1	9	44
HPV31	L1	9	333
HPV31	L1	11	333
HPV31	L1	9	10
HPV31	L1	8	239
HPV31	L1	9	239
HPV31	L1	8	195
HPV31	L1	10	195
HPV31	L1	10	28
HPV31	L1	11	422
HPV31	L1	10	332
HPV31	L1	8	334
HPV31	L1	10	334
HPV31	L1	8	62
HPV31	L1	8	21
HPV31	L1	9	21
HPV31	L1	11	21
HPV31	L1	8	101
HPV31	L1	8	391
HPV31	L1	9	391
HPV31	L1	10	391
HPV31	L1	8	277
HPV31	L1	9	277
HPV31	L1	10	277
HPV31	L1	11	277
HPV31	L1	10	12
HPV31	L1	11	12
HPV31	L1	10	364
HPV31	L1	9	250
HPV31	L1	8	445
HPV31	L1	11	27
HPV31	L2	9	24
HPV31	L2	10	24
HPV31	L2	8	143
HPV31	L2	10	143
HPV31	L2	8	281
HPV31	L2	8	286
HPV31	L2	9	286
HPV31	L2	9	367
HPV31	L2	10	367
HPV31	L2	11	367
HPV31	L2	10	15
HPV31	L2	11	15
HPV31	L2	8	226
HPV31	L2	11	226
HPV31	L2	9	135
HPV31	L2	10	135
HPV31	L2	11	135
HPV31	L2	11	342
HPV31	L2	8	376
HPV31	L2	10	376
HPV31	L2	8	382
HPV31	L2	10	382
HPV31	L2	11	382
HPV31	L2	8	133
HPV31	L2	9	133
HPV31	L2	11	133
HPV31	L2	9	278
HPV31	L2	10	278
HPV31	L2	11	278
HPV31	L2	10	400
HPV31	L2	8	322
HPV31	L2	9	354
HPV31	L2	10	354
HPV31	L2	9	43
HPV31	L2	11	43
HPV31	L2	8	358
HPV31	L2	10	358
HPV31	L2	11	358
HPV31	L2	8	364
HPV31	L2	9	139
HPV31	L2	10	139
HPV31	L2	8	116
HPV31	L2	9	31
HPV31	L2	10	31
HPV31	L2	11	31

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	L2	9	408
HPV31	L2	11	408
HPV31	L2	10	84
HPV31	L2	8	190
HPV31	L2	9	190
HPV31	L2	11	190
HPV31	L2	9	334
HPV31	L2	10	334
HPV31	L2	11	334
HPV31	L2	8	171
HPV31	L2	9	253
HPV31	L2	10	196
HPV31	L2	11	196
HPV31	L2	11	276
HPV31	L2	8	237
HPV31	L2	9	237
HPV31	L2	10	237
HPV31	L2	11	158
HPV31	L2	8	459
HPV31	L2	8	361
HPV31	L2	11	361
HPV31	L2	9	433
HPV31	L2	11	118
HPV31	L2	10	314
HPV31	L2	9	339
HPV31	L2	10	339
HPV31	L2	8	310
HPV31	L2	8	59
HPV31	L2	9	113
HPV31	L2	11	113
HPV31	L2	10	57
HPV31	L2	9	351
HPV31	L2	10	221
HPV31	L2	8	26
HPV31	L2	11	26
HPV31	L2	9	65
HPV31	L2	11	65
HPV31	L2	9	52
HPV31	L2	8	213
HPV31	L2	10	213
HPV31	L2	11	413
HPV31	L2	9	175
HPV31	L2	11	175
HPV31	L2	8	38
HPV31	L2	9	38
HPV31	L2	11	41
HPV31	L2	8	280
HPV31	L2	9	280
HPV31	L2	8	270
HPV31	L2	10	270
HPV31	L2	11	270
HPV31	L2	8	134
HPV31	L2	10	134
HPV31	L2	11	134
HPV31	L2	8	279
HPV31	L2	9	279
HPV31	L2	10	279
HPV31	L2	9	144
HPV31	L2	9	45
HPV31	L2	10	205
HPV31	L2	10	245
HPV31	L2	11	245
HPV31	L2	8	114
HPV31	L2	10	114
HPV31	L2	10	105
HPV31	L2	11	105
HPV31	L2	9	197
HPV31	L2	10	197
HPV31	L2	10	23
HPV31	L2	11	23
HPV31	L2	8	225
HPV31	L2	9	225
HPV31	L2	8	35
HPV31	L2	11	35
HPV31	L2	10	242
HPV31	L2	10	302
HPV31	L2	11	302
HPV31	L2	8	231
HPV31	L2	10	231
HPV31	L2	8	423
HPV31	L2	10	423
HPV31	L2	8	244
HPV31	L2	11	244
HPV31	L2	8	176
HPV31	L2	10	176
HPV31	L2	9	177
HPV31	L2	9	164
HPV31	L2	8	287
HPV31	L2	8	108
HPV31	L2	10	108
HPV31	L2	9	447
HPV31	L2	8	335
HPV31	L2	9	335
HPV31	L2	10	335
HPV31	L2	11	335
HPV31	L2	11	256
HPV31	L2	9	269
HPV31	L2	11	269
HPV31	L2	8	204
HPV31	L2	11	204
HPV31	L2	8	390
HPV31	L2	8	292
HPV31	L2	8	370
HPV31	L2	11	370
HPV31	L2	8	169
HPV31	L2	9	169
HPV31	L2	10	169
HPV31	L2	8	328
HPV31	L2	11	328
HPV31	L2	9	142
HPV31	L2	11	142
HPV31	L2	9	285
HPV31	L2	10	285
HPV31	L2	9	120
HPV31	L2	10	120
HPV31	L2	10	217
HPV31	L2	11	217
HPV31	L2	10	366
HPV31	L2	11	366
HPV31	L2	8	250

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	L2	9	410
HPV31	L2	8	402
HPV31	L2	10	402
HPV31	L2	9	210
HPV31	L2	11	210
HPV31	L2	8	122
HPV31	L2	8	88
HPV31	L2	11	88
HPV31	L2	9	422
HPV31	L2	11	422
HPV31	L2	9	100
HPV31	L2	10	100
HPV31	L2	8	337
HPV31	L2	9	337
HPV31	L2	11	337
HPV31	L2	8	394
HPV31	L2	10	394
HPV31	L2	8	74
HPV31	L2	9	74
HPV31	L2	9	192
HPV31	L2	10	235
HPV31	L2	11	235
HPV31	L2	8	156
HPV31	L2	9	156
HPV31	L2	8	388
HPV31	L2	10	388
HPV31	L2	10	167
HPV31	L2	11	167
HPV31	L2	9	415
HPV31	L2	10	415
HPV31	L2	8	425
HPV31	L2	10	425
HPV31	L2	8	127
HPV31	L2	9	127
HPV31	L2	10	127
HPV31	L2	11	127
HPV31	L2	9	97
HPV31	L2	10	97
HPV31	L2	10	92
HPV31	L2	8	44
HPV31	L2	10	44
HPV31	L2	9	243
HPV31	L2	8	17
HPV31	L2	9	17
HPV31	L2	11	17
HPV31	L2	9	228
HPV31	L2	11	228
HPV31	L2	8	20
HPV31	L2	9	303
HPV31	L2	10	303
HPV31	L2	11	303
HPV31	L2	8	417
HPV31	L2	10	417
HPV31	L2	11	417
HPV31	L2	8	229
HPV31	L2	10	229
HPV31	L2	10	12
HPV31	L2	8	219
HPV31	L2	9	219
HPV31	L2	8	298
HPV31	L2	10	298
HPV31	L2	9	69
HPV31	L2	8	9
HPV31	L2	10	9
HPV31	L2	8	306
HPV31	L2	10	306
HPV31	L2	8	316
HPV31	L2	11	316
HPV31	L2	9	454
HPV31	L2	11	454
HPV31	L2	8	239
HPV31	L2	8	14
HPV31	L2	11	14
HPV31	L2	8	341
HPV31	L2	9	381
HPV31	L2	11	381
HPV31	L2	8	384
HPV31	L2	9	384
HPV31	L2	10	384
HPV31	L2	8	94
HPV31	L2	9	332
HPV31	L2	11	332
HPV31	L2	11	431
HPV31	L2	9	325
HPV31	L2	11	325
HPV31	L2	8	86
HPV31	L2	10	86
HPV31	L2	10	182
HPV31	L2	11	104
HPV31	L2	8	107
HPV31	L2	9	107
HPV31	L2	11	107
HPV31	L2	11	260
HPV31	L2	9	50
HPV31	L2	11	50
HPV31	L2	9	374
HPV31	L2	10	374
HPV31	L2	8	396
HPV31	L2	9	151
HPV31	L2	8	184
HPV31	L2	10	184
HPV31	L2	8	6
HPV31	L2	10	6
HPV31	L2	11	6
HPV31	L2	10	346
HPV31	L2	8	199
HPV31	L2	11	199
HPV31	L2	11	208
HPV31	L2	10	76
HPV31	L2	9	379
HPV31	L2	11	379
HPV31	L2	8	80
HPV31	L2	10	80
HPV31	L2	9	162
HPV31	L2	11	162
HPV31	L2	9	149
HPV31	L2	11	149
HPV31	L2	8	137
HPV31	L2	9	137
HPV31	L2	11	137

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV31	L2	8	375	HPV33	E1	8	65
HPV31	L2	9	375	HPV33	E1	9	532
HPV31	L2	11	375	HPV33	E1	11	532
HPV31	L2	9	347	HPV33	E1	8	84
HPV31	L2	11	347	HPV33	E1	10	546
HPV31	L2	8	304	HPV33	E1	11	546
HPV31	L2	9	304	HPV33	E1	8	311
HPV31	L2	10	304	HPV33	E1	9	311
HPV31	L2	9	16	HPV33	E1	8	318
HPV31	L2	10	16	HPV33	E1	11	318
HPV31	L2	10	227	HPV33	E1	10	373
HPV31	L2	8	416	HPV33	E1	11	373
HPV31	L2	9	416	HPV33	E1	10	81
HPV31	L2	11	416	HPV33	E1	11	81
HPV31	L2	8	136	HPV33	E1	11	22
HPV31	L2	9	136	HPV33	E1	8	83
HPV31	L2	10	136	HPV33	E1	9	83
HPV31	L2	8	39	HPV33	E1	8	310
HPV31	L2	8	140	HPV33	E1	9	310
HPV31	L2	9	140	HPV33	E1	10	310
HPV31	L2	11	140	HPV33	E1	11	230
HPV31	L2	9	426	HPV33	E1	8	259
HPV31	L2	8	128	HPV33	E1	9	259
HPV31	L2	9	128	HPV33	E1	10	259
HPV31	L2	10	128	HPV33	E1	11	259
HPV31	L2	11	128	HPV33	E1	8	465
HPV31	L2	9	344	HPV33	E1	10	465
HPV31	L2	10	343	HPV33	E1	9	297
HPV31	L2	11	391	HPV33	E1	11	226
HPV31	L2	10	362	HPV33	E1	9	14
HPV31	L2	8	254	HPV33	E1	10	14
HPV31	L2	10	392	HPV33	E1	11	14
HPV31	L2	9	81	HPV33	E1	8	118
HPV31	L2	9	232	HPV33	E1	11	118
HPV31	L2	8	32	HPV33	E1	10	494
HPV31	L2	9	32	HPV33	E1	10	508
HPV31	L2	10	32	HPV33	E1	11	508
HPV31	L2	11	32	HPV33	E1	9	367
HPV31	L2	8	163	HPV33	E1	10	367
HPV31	L2	10	163	HPV33	E1	10	46
HPV31	L2	9	377	HPV33	E1	8	78
HPV31	L2	11	377	HPV33	E1	9	349
HPV31	L2	11	147	HPV33	E1	8	62
HPV31	L2	8	356	HPV33	E1	11	62
HPV31	L2	10	356	HPV33	E1	8	541
HPV31	L2	8	440	HPV33	E1	10	541
HPV31	L2	9	440	HPV33	E1	10	324
HPV31	L2	10	446	HPV33	E1	8	516
HPV31	L2	9	19	HPV33	E1	10	516
HPV31	L2	10	72	HPV33	E1	9	64
HPV31	L2	11	72	HPV33	E1	8	21
HPV31	L2	8	386	HPV33	E1	8	206
HPV31	L2	10	386	HPV33	E1	10	206
HPV33	E1	11	382	HPV33	E1	11	206
HPV33	E1	8	90	HPV33	E1	10	537
HPV33	E1	11	90	HPV33	E1	11	537
HPV33	E1	9	96	HPV33	E1	11	186
HPV33	E1	10	96	HPV33	E1	10	127
HPV33	E1	10	383	HPV33	E1	8	361
HPV33	E1	9	104	HPV33	E1	9	361

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E1	11	214	HPV33	E1	11	197
HPV33	E1	11	352	HPV33	E1	8	510
HPV33	E1	8	38	HPV33	E1	9	510
HPV33	E1	10	38	HPV33	E1	11	510
HPV33	E1	11	38	HPV33	E1	8	393
HPV33	E1	11	295	HPV33	E1	9	393
HPV33	E1	10	173	HPV33	E1	9	285
HPV33	E1	11	173	HPV33	E1	8	304
HPV33	E1	9	139	HPV33	E1	9	304
HPV33	E1	10	19	HPV33	E1	8	412
HPV33	E1	8	137	HPV33	E1	9	249
HPV33	E1	11	137	HPV33	E1	11	425
HPV33	E1	8	169	HPV33	E1	9	223
HPV33	E1	8	89	HPV33	E1	10	223
HPV33	E1	9	89	HPV33	E1	9	245
HPV33	E1	10	50	HPV33	E1	11	245
HPV33	E1	9	449	HPV33	E1	8	375
HPV33	E1	10	486	HPV33	E1	9	375
HPV33	E1	11	456	HPV33	E1	10	375
HPV33	E1	8	385	HPV33	E1	8	467
HPV33	E1	10	385	HPV33	E1	9	247
HPV33	E1	11	385	HPV33	E1	11	247
HPV33	E1	10	451	HPV33	E1	9	483
HPV33	E1	8	265	HPV33	E1	10	483
HPV33	E1	10	399	HPV33	E1	11	271
HPV33	E1	8	459	HPV33	E1	9	47
HPV33	E1	9	459	HPV33	E1	9	555
HPV33	E1	10	459	HPV33	E1	11	555
HPV33	E1	8	209	HPV33	E1	10	438
HPV33	E1	10	235	HPV33	E1	11	438
HPV33	E1	10	11	HPV33	E1	9	290
HPV33	E1	9	512	HPV33	E1	10	290
HPV33	E1	8	480	HPV33	E1	11	290
HPV33	E1	11	416	HPV33	E1	8	556
HPV33	E1	8	44	HPV33	E1	10	556
HPV33	E1	9	564	HPV33	E1	8	286
HPV33	E1	10	6	HPV33	E1	11	286
HPV33	E1	10	327	HPV33	E1	10	257
HPV33	E1	11	327	HPV33	E1	11	257
HPV33	E1	8	163	HPV33	E1	8	184
HPV33	E1	11	256	HPV33	E1	9	339
HPV33	E1	8	368	HPV33	E1	9	503
HPV33	E1	9	368	HPV33	E1	11	503
HPV33	E1	8	200	HPV33	E1	8	260
HPV33	E1	11	200	HPV33	E1	9	260
HPV33	E1	9	400	HPV33	E1	10	260
HPV33	E1	8	59	HPV33	E1	11	260
HPV33	E1	10	59	HPV33	E1	8	362
HPV33	E1	11	59	HPV33	E1	9	557
HPV33	E1	8	72	HPV33	E1	10	281
HPV33	E1	10	72	HPV33	E1	11	281
HPV33	E1	11	72	HPV33	E1	9	547
HPV33	E1	8	484	HPV33	E1	10	547
HPV33	E1	9	484	HPV33	E1	11	547
HPV33	E1	8	419	HPV33	E1	10	215
HPV33	E1	10	231	HPV33	E1	10	1
HPV33	E1	11	231	HPV33	E1	8	513
HPV33	E1	8	394	HPV33	E1	11	513
HPV33	E1	10	435	HPV33	E1	9	466
HPV33	E1	9	407	HPV33	E1	8	298

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E1	10	353	HPV33	E1	8	280
HPV33	E1	11	353	HPV33	E1	11	280
HPV33	E1	11	562	HPV33	E1	10	316
HPV33	E1	8	531	HPV33	E1	11	109
HPV33	E1	10	531	HPV33	E1	8	608
HPV33	E1	11	80	HPV33	E1	9	608
HPV33	E1	8	443	HPV33	E1	10	95
HPV33	E1	10	443	HPV33	E1	11	95
HPV33	E1	8	346	HPV33	E1	9	634
HPV33	E1	9	346	HPV33	E1	8	539
HPV33	E1	9	199	HPV33	E1	9	539
HPV33	E1	9	71	HPV33	E1	10	539
HPV33	E1	11	71	HPV33	E1	9	111
HPV33	E1	8	321	HPV33	E1	8	292
HPV33	E1	9	321	HPV33	E1	9	292
HPV33	E1	9	31	HPV33	E1	8	58
HPV33	E1	10	31	HPV33	E1	9	58
HPV33	E1	9	627	HPV33	E1	11	58
HPV33	E1	8	289	HPV33	E1	10	482
HPV33	E1	10	289	HPV33	E1	11	482
HPV33	E1	11	289	HPV33	E1	11	243
HPV33	E1	10	155	HPV33	E1	9	252
HPV33	E1	9	135	HPV33	E1	10	252
HPV33	E1	10	135	HPV33	E1	8	54
HPV33	E1	9	473	HPV33	E1	10	54
HPV33	E1	11	473	HPV33	E1	11	390
HPV33	E1	8	175	HPV33	E1	8	149
HPV33	E1	9	175	HPV33	E1	11	149
HPV33	E1	10	175	HPV33	E1	8	93
HPV33	E1	8	189	HPV33	E1	9	93
HPV33	E1	10	189	HPV33	E1	11	307
HPV33	E1	10	181	HPV33	E1	11	629
HPV33	E1	11	181	HPV33	E1	8	239
HPV33	E1	11	471	HPV33	E1	9	239
HPV33	E1	11	519	HPV33	E1	10	239
HPV33	E1	11	434	HPV33	E1	9	39
HPV33	E1	8	554	HPV33	E1	10	39
HPV33	E1	10	554	HPV33	E1	11	447
HPV33	E1	9	505	HPV33	E1	9	317
HPV33	E1	10	505	HPV33	E1	8	183
HPV33	E1	9	60	HPV33	E1	9	183
HPV33	E1	10	60	HPV33	E1	8	140
HPV33	E1	10	391	HPV33	E1	9	328
HPV33	E1	11	391	HPV33	E1	10	328
HPV33	E1	9	374	HPV33	E1	11	328
HPV33	E1	10	374	HPV33	E1	9	282
HPV33	E1	11	374	HPV33	E1	10	282
HPV33	E1	8	549	HPV33	E1	11	337
HPV33	E1	9	549	HPV33	E1	8	240
HPV33	E1	10	549	HPV33	E1	9	240
HPV33	E1	8	437	HPV33	E1	8	283
HPV33	E1	11	437	HPV33	E1	9	283
HPV33	E1	10	145	HPV33	E1	11	283
HPV33	E1	10	308	HPV33	E1	11	299
HPV33	E1	11	308	HPV33	E1	10	23
HPV33	E1	9	146	HPV33	E1	9	190
HPV33	E1	11	146	HPV33	E1	11	190
HPV33	E1	8	103	HPV33	E1	8	246
HPV33	E1	10	103	HPV33	E1	10	246
HPV33	E1	11	545	HPV33	E1	10	338

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E1	9	325	HPV33	E2	9	136
HPV33	E1	8	548	HPV33	E2	11	136
HPV33	E1	9	548	HPV33	E2	8	74
HPV33	E1	10	548	HPV33	E2	9	74
HPV33	E1	11	548	HPV33	E2	9	298
HPV33	E1	9	436	HPV33	E2	8	328
HPV33	E1	11	144	HPV33	E2	10	328
HPV33	E1	9	354	HPV33	E2	11	328
HPV33	E1	10	354	HPV33	E2	10	80
HPV33	E1	9	182	HPV33	E2	8	185
HPV33	E1	10	182	HPV33	E2	9	185
HPV33	E1	9	517	HPV33	E2	10	185
HPV33	E1	11	100	HPV33	E2	10	334
HPV33	E1	8	356	HPV33	E2	11	334
HPV33	E1	8	332	HPV33	E2	8	70
HPV33	E1	9	418	HPV33	E2	9	70
HPV33	E1	8	502	HPV33	E2	10	70
HPV33	E1	10	502	HPV33	E2	9	325
HPV33	E1	8	522	HPV33	E2	11	325
HPV33	E1	11	522	HPV33	E2	8	319
HPV33	E1	11	372	HPV33	E2	9	319
HPV33	E1	9	524	HPV33	E2	11	156
HPV33	E1	10	524	HPV33	E2	8	190
HPV33	E1	8	571	HPV33	E2	10	190
HPV33	E1	11	528	HPV33	E2	8	336
HPV33	E1	8	441	HPV33	E2	9	336
HPV33	E1	10	441	HPV33	E2	11	336
HPV33	E1	8	254	HPV33	E2	10	53
HPV33	E2	9	223	HPV33	E2	11	53
HPV33	E2	11	223	HPV33	E2	9	278
HPV33	E2	8	224	HPV33	E2	8	56
HPV33	E2	10	224	HPV33	E2	9	56
HPV33	E2	11	224	HPV33	E2	8	187
HPV33	E2	9	175	HPV33	E2	11	187
HPV33	E2	9	249	HPV33	E2	8	139
HPV33	E2	10	249	HPV33	E2	9	139
HPV33	E2	11	249	HPV33	E2	10	139
HPV33	E2	9	41	HPV33	E2	11	139
HPV33	E2	10	237	HPV33	E2	10	15
HPV33	E2	10	258	HPV33	E2	11	276
HPV33	E2	11	258	HPV33	E2	8	320
HPV33	E2	9	10	HPV33	E2	8	68
HPV33	E2	10	245	HPV33	E2	10	68
HPV33	E2	11	245	HPV33	E2	11	68
HPV33	E2	10	40	HPV33	E2	8	14
HPV33	E2	8	145	HPV33	E2	11	14
HPV33	E2	11	145	HPV33	E2	8	339
HPV33	E2	8	261	HPV33	E2	10	339
HPV33	E2	8	174	HPV33	E2	8	242
HPV33	E2	10	174	HPV33	E2	9	242
HPV33	E2	11	25	HPV33	E2	8	34
HPV33	E2	8	17	HPV33	E2	9	34
HPV33	E2	10	17	HPV33	E2	10	34
HPV33	E2	9	235	HPV33	E2	8	112
HPV33	E2	10	143	HPV33	E2	8	47
HPV33	E2	9	232	HPV33	E2	10	264
HPV33	E2	10	232	HPV33	E2	11	264
HPV33	E2	11	20	HPV33	E2	8	23
HPV33	E2	8	3	HPV33	E2	8	66
HPV33	E2	9	3	HPV33	E2	10	66

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E2	9	180	HPV33	E2	9	191
HPV33	E2	10	151	HPV33	E2	8	57
HPV33	E2	11	165	HPV33	E2	11	57
HPV33	E2	10	63	HPV33	E2	8	292
HPV33	E2	11	63	HPV33	E2	9	7
HPV33	E2	8	35	HPV33	E2	10	7
HPV33	E2	9	35	HPV33	E2	9	37
HPV33	E2	11	35	HPV33	E2	10	37
HPV33	E2	8	62	HPV33	E2	10	253
HPV33	E2	11	62	HPV33	E2	8	266
HPV33	E2	8	42	HPV33	E2	9	266
HPV33	E2	8	75	HPV33	E2	11	266
HPV33	E2	8	94	HPV33	E2	11	5
HPV33	E2	10	94	HPV33	E2	9	198
HPV33	E2	10	240	HPV33	E2	10	198
HPV33	E2	11	240	HPV33	E2	9	285
HPV33	E2	9	147	HPV33	E2	9	61
HPV33	E2	11	147	HPV33	E2	9	302
HPV33	E2	8	9	HPV33	E2	8	28
HPV33	E2	10	9	HPV33	E2	9	28
HPV33	E2	8	202	HPV33	E2	11	28
HPV33	E2	9	202	HPV33	E2	8	90
HPV33	E2	11	202	HPV33	E2	10	90
HPV33	E2	11	127	HPV33	E2	9	85
HPV33	E2	8	272	HPV33	E2	10	85
HPV33	E2	8	230	HPV33	E2	10	88
HPV33	E2	11	230	HPV33	E2	8	205
HPV33	E2	8	248	HPV33	E2	10	205
HPV33	E2	10	248	HPV33	E2	10	45
HPV33	E2	11	248	HPV33	E2	8	236
HPV33	E2	8	239	HPV33	E2	11	236
HPV33	E2	11	239	HPV33	E2	9	254
HPV33	E2	11	221	HPV33	E2	11	257
HPV33	E2	9	196	HPV33	E2	9	93
HPV33	E2	11	196	HPV33	E2	11	93
HPV33	E2	10	342	HPV33	E2	9	81
HPV33	E2	11	342	HPV33	E2	10	128
HPV33	E2	10	222	HPV33	E2	10	146
HPV33	E2	8	29	HPV33	E2	8	181
HPV33	E2	10	29	HPV33	E2	8	233
HPV33	E2	8	345	HPV33	E2	9	233
HPV33	E2	9	345	HPV33	E2	11	233
HPV33	E2	8	203	HPV33	E2	9	206
HPV33	E2	10	203	HPV33	E2	8	267
HPV33	E2	9	332	HPV33	E2	10	267
HPV33	E2	11	48	HPV33	E2	11	267
HPV33	E2	11	182	HPV33	E2	8	337
HPV33	E2	8	331	HPV33	E2	10	337
HPV33	E2	10	331	HPV33	E2	9	343
HPV33	E2	8	330	HPV33	E2	10	343
HPV33	E2	9	330	HPV33	E2	11	343
HPV33	E2	11	330	HPV33	E2	11	118
HPV33	E2	9	329	HPV33	E2	8	72
HPV33	E2	10	329	HPV33	E2	10	72
HPV33	E2	9	95	HPV33	E2	11	72
HPV33	E2	11	213	HPV33	E2	8	192
HPV33	E2	8	96	HPV33	E2	8	11
HPV33	E2	8	71	HPV33	E2	11	11
HPV33	E2	9	71	HPV33	E2	8	344
HPV33	E2	11	71	HPV33	E2	9	344

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E2	10	344	HPV33	E5	11	1
HPV33	E2	10	119	HPV33	E5	8	61
HPV33	E2	11	119	HPV33	E5	11	61
HPV33	E2	8	326	HPV33	E5	8	21
HPV33	E2	10	326	HPV33	E5	10	21
HPV33	E2	11	323	HPV33	E5	9	46
HPV33	E2	8	148	HPV33	E5	10	46
HPV33	E2	10	148	HPV33	E5	9	60
HPV33	E2	10	58	HPV33	E5	8	25
HPV33	E2	8	92	HPV33	E5	9	25
HPV33	E2	10	92	HPV33	E5	10	25
HPV33	E2	8	159	HPV33	E5	11	25
HPV33	E2	9	138	HPV33	E5	8	16
HPV33	E2	10	138	HPV33	E5	9	16
HPV33	E2	11	138	HPV33	E5	11	16
HPV33	E2	11	44	HPV33	E5	8	27
HPV33	E2	9	131	HPV33	E5	9	27
HPV33	E2	10	131	HPV33	E5	10	27
HPV33	E5	9	63	HPV33	E5	11	27
HPV33	E5	10	63	HPV33	E5	8	6
HPV33	E5	9	14	HPV33	E5	10	6
HPV33	E5	10	14	HPV33	E5	8	36
HPV33	E5	11	14	HPV33	E5	8	34
HPV33	E5	9	9	HPV33	E5	10	34
HPV33	E5	10	9	HPV33	E5	8	31
HPV33	E5	11	9	HPV33	E5	9	31
HPV33	E5	8	12	HPV33	E5	11	31
HPV33	E5	11	12	HPV33	E5	8	40
HPV33	E5	9	56	HPV33	E5	10	40
HPV33	E5	8	3	HPV33	E5	8	29
HPV33	E5	9	3	HPV33	E5	9	29
HPV33	E5	11	3	HPV33	E5	10	29
HPV33	E5	8	42	HPV33	E5	11	29
HPV33	E5	9	5	HPV33	E5	9	53
HPV33	E5	11	5	HPV33	E5	10	53
HPV33	E5	8	10	HPV33	E5	11	58
HPV33	E5	9	10	HPV33	E6	11	137
HPV33	E5	10	10	HPV33	E6	9	18
HPV33	E5	8	23	HPV33	E6	11	18
HPV33	E5	10	23	HPV33	E6	8	103
HPV33	E5	11	23	HPV33	E6	8	66
HPV33	E5	8	48	HPV33	E6	8	16
HPV33	E5	10	48	HPV33	E6	11	16
HPV33	E5	9	22	HPV33	E6	8	30
HPV33	E5	11	22	HPV33	E6	8	14
HPV33	E5	8	54	HPV33	E6	9	14
HPV33	E5	9	54	HPV33	E6	10	14
HPV33	E5	11	54	HPV33	E6	9	120
HPV33	E5	8	17	HPV33	E6	8	4
HPV33	E5	10	17	HPV33	E6	9	4
HPV33	E5	11	37	HPV33	E6	8	98
HPV33	E5	9	18	HPV33	E6	11	27
HPV33	E5	11	18	HPV33	E6	8	89
HPV33	E5	8	32	HPV33	E6	11	89
HPV33	E5	10	32	HPV33	E6	9	20
HPV33	E5	10	38	HPV33	E6	8	41
HPV33	E5	9	35	HPV33	E6	10	41
HPV33	E5	9	33	HPV33	E6	11	41
HPV33	E5	11	33	HPV33	E6	8	45
HPV33	E5	10	1	HPV33	E6	9	45

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	E6	10	2	HPV33	E7	8	88
HPV33	E6	11	2	HPV33	E7	8	62
HPV33	E6	10	61	HPV33	E7	11	62
HPV33	E6	11	118	HPV33	E7	8	47
HPV33	E6	10	64	HPV33	E7	9	47
HPV33	E6	11	100	HPV33	E7	10	47
HPV33	E6	10	28	HPV33	E7	10	19
HPV33	E6	10	37	HPV33	E7	8	6
HPV33	E6	11	127	HPV33	E7	10	6
HPV33	E6	11	86	HPV33	E7	11	44
HPV33	E6	11	109	HPV33	E7	9	81
HPV33	E6	10	95	HPV33	E7	10	81
HPV33	E6	11	95	HPV33	E7	8	80
HPV33	E6	11	36	HPV33	E7	10	80
HPV33	E6	8	112	HPV33	E7	11	80
HPV33	E6	10	112	HPV33	E7	8	66
HPV33	E6	10	17	HPV33	E7	11	66
HPV33	E6	10	90	HPV33	E7	8	77
HPV33	E6	11	90	HPV33	E7	10	77
HPV33	E6	9	10	HPV33	E7	11	77
HPV33	E6	10	10	HPV33	E7	8	71
HPV33	E6	10	82	HPV33	E7	9	71
HPV33	E6	11	82	HPV33	E7	8	49
HPV33	E6	10	22	HPV33	E7	8	72
HPV33	E6	10	87	HPV33	E7	11	72
HPV33	E6	8	11	HPV33	E7	9	78
HPV33	E6	9	11	HPV33	E7	10	78
HPV33	E6	11	11	HPV33	E7	9	7
HPV33	E6	8	21	HPV33	E7	10	63
HPV33	E6	11	21	HPV33	E7	11	63
HPV33	E6	9	91	HPV33	E7	8	86
HPV33	E6	10	91	HPV33	E7	10	86
HPV33	E6	11	91	HPV33	E7	9	64
HPV33	E6	11	52	HPV33	E7	10	64
HPV33	E7	10	45	HPV33	E7	9	12
HPV33	E7	11	45	HPV33	E7	11	12
HPV33	E7	8	48	HPV33	E7	9	55
HPV33	E7	9	48	HPV33	E7	10	55
HPV33	E7	9	68	HPV33	E7	11	55
HPV33	E7	11	68	HPV33	E7	8	53
HPV33	E7	8	75	HPV33	E7	11	53
HPV33	E7	9	75	HPV33	E7	10	11
HPV33	E7	10	75	HPV33	L1	10	179
HPV33	E7	8	21	HPV33	L1	8	482
HPV33	E7	9	14	HPV33	L1	11	482
HPV33	E7	9	37	HPV33	L1	8	424
HPV33	E7	8	43	HPV33	L1	8	316
HPV33	E7	9	85	HPV33	L1	8	9
HPV33	E7	11	85	HPV33	L1	10	9
HPV33	E7	9	59	HPV33	L1	9	44
HPV33	E7	11	59	HPV33	L1	8	270
HPV33	E7	8	79	HPV33	L1	9	158
HPV33	E7	9	79	HPV33	L1	9	147
HPV33	E7	11	79	HPV33	L1	11	147
HPV33	E7	10	54	HPV33	L1	9	207
HPV33	E7	11	54	HPV33	L1	9	345
HPV33	E7	8	82	HPV33	L1	10	396
HPV33	E7	9	82	HPV33	L1	11	396
HPV33	E7	8	83	HPV33	L1	8	449
HPV33	E7	11	83	HPV33	L1	10	449

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	L1	8	370	HPV33	L1	10	115
HPV33	L1	11	370	HPV33	L1	8	391
HPV33	L1	9	274	HPV33	L1	10	365
HPV33	L1	10	274	HPV33	L1	8	194
HPV33	L1	11	274	HPV33	L1	10	194
HPV33	L1	10	199	HPV33	L1	9	397
HPV33	L1	10	459	HPV33	L1	10	397
HPV33	L1	11	459	HPV33	L1	9	286
HPV33	L1	11	202	HPV33	L1	9	474
HPV33	L1	8	95	HPV33	L1	10	474
HPV33	L1	10	95	HPV33	L1	8	478
HPV33	L1	9	88	HPV33	L1	10	478
HPV33	L1	8	335	HPV33	L1	10	60
HPV33	L1	9	335	HPV33	L1	11	236
HPV33	L1	10	335	HPV33	L1	8	153
HPV33	L1	10	415	HPV33	L1	10	211
HPV33	L1	11	415	HPV33	L1	9	65
HPV33	L1	10	219	HPV33	L1	8	379
HPV33	L1	9	8	HPV33	L1	9	379
HPV33	L1	11	8	HPV33	L1	10	379
HPV33	L1	9	269	HPV33	L1	9	20
HPV33	L1	8	107	HPV33	L1	10	43
HPV33	L1	10	107	HPV33	L1	11	190
HPV33	L1	10	447	HPV33	L1	11	42
HPV33	L1	8	385	HPV33	L1	8	159
HPV33	L1	9	385	HPV33	L1	8	123
HPV33	L1	9	467	HPV33	L1	10	123
HPV33	L1	9	249	HPV33	L1	8	468
HPV33	L1	8	375	HPV33	L1	9	61
HPV33	L1	9	375	HPV33	L1	11	469
HPV33	L1	10	375	HPV33	L1	8	213
HPV33	L1	8	373	HPV33	L1	10	213
HPV33	L1	9	373	HPV33	L1	8	413
HPV33	L1	10	373	HPV33	L1	9	413
HPV33	L1	11	373	HPV33	L1	10	371
HPV33	L1	9	256	HPV33	L1	11	371
HPV33	L1	11	256	HPV33	L1	11	313
HPV33	L1	8	419	HPV33	L1	8	69
HPV33	L1	8	330	HPV33	L1	10	69
HPV33	L1	11	330	HPV33	L1	9	382
HPV33	L1	8	141	HPV33	L1	11	382
HPV33	L1	10	141	HPV33	L1	9	405
HPV33	L1	8	322	HPV33	L1	8	62
HPV33	L1	10	322	HPV33	L1	8	99
HPV33	L1	11	322	HPV33	L1	10	99
HPV33	L1	8	117	HPV33	L1	8	342
HPV33	L1	10	105	HPV33	L1	10	237
HPV33	L1	8	472	HPV33	L1	11	387
HPV33	L1	11	472	HPV33	L1	9	200
HPV33	L1	9	68	HPV33	L1	8	299
HPV33	L1	11	68	HPV33	L1	11	178
HPV33	L1	8	404	HPV33	L1	10	57
HPV33	L1	10	404	HPV33	L1	8	341
HPV33	L1	11	138	HPV33	L1	9	341
HPV33	L1	8	111	HPV33	L1	8	327
HPV33	L1	11	265	HPV33	L1	10	327
HPV33	L1	10	281	HPV33	L1	11	327
HPV33	L1	8	173	HPV33	L1	9	192
HPV33	L1	10	173	HPV33	L1	10	192
HPV33	L1	9	115	HPV33	L1	8	181

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	L1	10	181	HPV33	L1	9	23
HPV33	L1	11	181	HPV33	L1	11	23
HPV33	L1	8	221	HPV33	L1	8	339
HPV33	L1	8	187	HPV33	L1	10	339
HPV33	L1	9	187	HPV33	L1	11	339
HPV33	L1	10	439	HPV33	L1	8	2
HPV33	L1	8	462	HPV33	L1	9	2
HPV33	L1	10	462	HPV33	L1	10	2
HPV33	L1	11	113	HPV33	L1	8	383
HPV33	L1	9	122	HPV33	L1	10	383
HPV33	L1	11	122	HPV33	L1	11	383
HPV33	L1	10	165	HPV33	L1	8	283
HPV33	L1	11	165	HPV33	L1	8	193
HPV33	L1	8	55	HPV33	L1	9	193
HPV33	L1	9	55	HPV33	L1	11	193
HPV33	L1	8	293	HPV33	L1	11	343
HPV33	L1	9	293	HPV33	L1	10	266
HPV33	L1	9	484	HPV33	L1	9	212
HPV33	L1	8	15	HPV33	L1	11	212
HPV33	L1	10	15	HPV33	L1	8	381
HPV33	L1	8	17	HPV33	L1	10	381
HPV33	L1	10	470	HPV33	L1	9	96
HPV33	L1	8	423	HPV33	L1	11	96
HPV33	L1	9	423	HPV33	L1	8	346
HPV33	L1	9	214	HPV33	L1	9	282
HPV33	L1	11	214	HPV33	L1	8	336
HPV33	L1	8	376	HPV33	L1	9	336
HPV33	L1	9	376	HPV33	L1	11	336
HPV33	L1	11	376	HPV33	L1	11	430
HPV33	L1	11	156	HPV33	L1	9	332
HPV33	L1	9	305	HPV33	L1	11	332
HPV33	L1	11	254	HPV33	L1	9	10
HPV33	L1	9	328	HPV33	L1	9	174
HPV33	L1	10	328	HPV33	L1	8	386
HPV33	L1	9	481	HPV33	L1	8	380
HPV33	L1	8	263	HPV33	L1	9	380
HPV33	L1	9	263	HPV33	L1	11	380
HPV33	L1	9	315	HPV33	L1	11	420
HPV33	L1	9	98	HPV33	L1	10	331
HPV33	L1	11	98	HPV33	L1	8	333
HPV33	L1	8	30	HPV33	L1	10	333
HPV33	L1	10	488	HPV33	L1	11	333
HPV33	L1	9	455	HPV33	L1	8	21
HPV33	L1	11	289	HPV33	L1	11	21
HPV33	L1	11	410	HPV33	L1	8	101
HPV33	L1	8	51	HPV33	L1	11	401
HPV33	L1	11	51	HPV33	L1	8	36
HPV33	L1	10	285	HPV33	L1	9	36
HPV33	L1	11	32	HPV33	L1	10	36
HPV33	L1	11	245	HPV33	L1	9	389
HPV33	L1	9	412	HPV33	L1	10	389
HPV33	L1	10	412	HPV33	L1	8	276
HPV33	L1	9	149	HPV33	L1	9	276
HPV33	L1	11	149	HPV33	L1	11	276
HPV33	L1	9	298	HPV33	L1	10	362
HPV33	L1	9	422	HPV33	L1	10	12
HPV33	L1	10	422	HPV33	L1	11	12
HPV33	L1	10	304	HPV33	L1	8	443
HPV33	L1	9	227	HPV33	L1	11	27
HPV33	L1	11	227	HPV33	L2	8	81

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	L2	8	140	HPV33	L2	11	201
HPV33	L2	11	82	HPV33	L2	9	117
HPV33	L2	8	291	HPV33	L2	10	319
HPV33	L2	9	291	HPV33	L2	10	361
HPV33	L2	8	286	HPV33	L2	10	226
HPV33	L2	9	23	HPV33	L2	8	305
HPV33	L2	10	23	HPV33	L2	8	25
HPV33	L2	11	308	HPV33	L2	11	25
HPV33	L2	10	14	HPV33	L2	8	75
HPV33	L2	11	14	HPV33	L2	9	75
HPV33	L2	8	385	HPV33	L2	11	75
HPV33	L2	10	385	HPV33	L2	10	60
HPV33	L2	9	283	HPV33	L2	9	51
HPV33	L2	10	283	HPV33	L2	11	51
HPV33	L2	11	283	HPV33	L2	11	158
HPV33	L2	9	409	HPV33	L2	10	374
HPV33	L2	11	272	HPV33	L2	10	336
HPV33	L2	8	327	HPV33	L2	8	297
HPV33	L2	11	327	HPV33	L2	11	40
HPV33	L2	9	42	HPV33	L2	8	285
HPV33	L2	11	42	HPV33	L2	9	285
HPV33	L2	8	431	HPV33	L2	8	284
HPV33	L2	11	431	HPV33	L2	9	284
HPV33	L2	10	264	HPV33	L2	10	284
HPV33	L2	10	401	HPV33	L2	9	44
HPV33	L2	9	350	HPV33	L2	8	152
HPV33	L2	9	136	HPV33	L2	11	152
HPV33	L2	10	95	HPV33	L2	8	292
HPV33	L2	11	95	HPV33	L2	8	331
HPV33	L2	9	369	HPV33	L2	8	104
HPV33	L2	10	30	HPV33	L2	11	104
HPV33	L2	11	30	HPV33	L2	9	433
HPV33	L2	8	130	HPV33	L2	10	433
HPV33	L2	9	130	HPV33	L2	10	22
HPV33	L2	11	130	HPV33	L2	11	22
HPV33	L2	10	364	HPV33	L2	9	248
HPV33	L2	9	115	HPV33	L2	8	311
HPV33	L2	11	115	HPV33	L2	10	311
HPV33	L2	8	344	HPV33	L2	8	34
HPV33	L2	10	344	HPV33	L2	11	34
HPV33	L2	8	341	HPV33	L2	8	236
HPV33	L2	11	341	HPV33	L2	9	236
HPV33	L2	9	110	HPV33	L2	8	107
HPV33	L2	11	110	HPV33	L2	10	107
HPV33	L2	9	384	HPV33	L2	8	249
HPV33	L2	11	384	HPV33	L2	8	266
HPV33	L2	8	113	HPV33	L2	11	266
HPV33	L2	11	113	HPV33	L2	8	85
HPV33	L2	8	181	HPV33	L2	9	85
HPV33	L2	10	181	HPV33	L2	10	85
HPV33	L2	11	281	HPV33	L2	9	345
HPV33	L2	8	242	HPV33	L2	8	243
HPV33	L2	9	242	HPV33	L2	9	243
HPV33	L2	10	242	HPV33	L2	9	377
HPV33	L2	9	268	HPV33	L2	10	377
HPV33	L2	8	460	HPV33	L2	11	377
HPV33	L2	11	163	HPV33	L2	8	195
HPV33	L2	9	440	HPV33	L2	9	195
HPV33	L2	10	440	HPV33	L2	11	195
HPV33	L2	10	201	HPV33	L2	8	397

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	L2	9	397	HPV33	L2	11	233
HPV33	L2	8	231	HPV33	L2	8	19
HPV33	L2	11	231	HPV33	L2	10	153
HPV33	L2	8	391	HPV33	L2	8	234
HPV33	L2	10	143	HPV33	L2	10	234
HPV33	L2	8	209	HPV33	L2	11	234
HPV33	L2	9	174	HPV33	L2	10	11
HPV33	L2	11	255	HPV33	L2	8	321
HPV33	L2	10	240	HPV33	L2	11	321
HPV33	L2	11	240	HPV33	L2	9	224
HPV33	L2	9	139	HPV33	L2	9	68
HPV33	L2	9	290	HPV33	L2	9	388
HPV33	L2	10	290	HPV33	L2	11	388
HPV33	L2	11	172	HPV33	L2	8	303
HPV33	L2	8	275	HPV33	L2	10	303
HPV33	L2	10	275	HPV33	L2	8	134
HPV33	L2	11	275	HPV33	L2	9	134
HPV33	L2	8	73	HPV33	L2	11	134
HPV33	L2	9	73	HPV33	L2	8	13
HPV33	L2	10	73	HPV33	L2	11	13
HPV33	L2	11	73	HPV33	L2	9	357
HPV33	L2	8	215	HPV33	L2	11	357
HPV33	L2	9	215	HPV33	L2	10	393
HPV33	L2	11	215	HPV33	L2	10	122
HPV33	L2	8	87	HPV33	L2	11	122
HPV33	L2	10	87	HPV33	L2	9	151
HPV33	L2	11	87	HPV33	L2	9	103
HPV33	L2	10	423	HPV33	L2	9	49
HPV33	L2	11	423	HPV33	L2	11	49
HPV33	L2	8	330	HPV33	L2	9	106
HPV33	L2	9	330	HPV33	L2	11	106
HPV33	L2	9	99	HPV33	L2	8	204
HPV33	L2	10	99	HPV33	L2	11	204
HPV33	L2	10	413	HPV33	L2	8	382
HPV33	L2	8	395	HPV33	L2	11	382
HPV33	L2	10	395	HPV33	L2	9	156
HPV33	L2	11	395	HPV33	L2	8	38
HPV33	L2	9	84	HPV33	L2	10	213
HPV33	L2	10	84	HPV33	L2	11	213
HPV33	L2	11	84	HPV33	L2	8	189
HPV33	L2	9	197	HPV33	L2	10	189
HPV33	L2	8	376	HPV33	L2	9	6
HPV33	L2	10	376	HPV33	L2	10	6
HPV33	L2	11	376	HPV33	L2	11	352
HPV33	L2	10	79	HPV33	L2	9	146
HPV33	L2	8	161	HPV33	L2	10	146
HPV33	L2	9	161	HPV33	L2	9	167
HPV33	L2	8	124	HPV33	L2	11	167
HPV33	L2	9	124	HPV33	L2	9	80
HPV33	L2	10	124	HPV33	L2	9	154
HPV33	L2	9	416	HPV33	L2	11	154
HPV33	L2	11	186	HPV33	L2	10	432
HPV33	L2	8	403	HPV33	L2	11	432
HPV33	L2	10	91	HPV33	L2	10	309
HPV33	L2	8	43	HPV33	L2	9	265
HPV33	L2	10	43	HPV33	L2	9	15
HPV33	L2	8	16	HPV33	L2	10	15
HPV33	L2	9	16	HPV33	L2	10	232
HPV33	L2	11	16	HPV33	L2	9	190
HPV33	L2	9	233	HPV33	L2	11	190

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV33	L2	8	137
HPV33	L2	11	137
HPV33	L2	9	386
HPV33	L2	11	386
HPV33	L2	9	132
HPV33	L2	10	132
HPV33	L2	11	132
HPV33	L2	8	93
HPV33	L2	9	96
HPV33	L2	10	96
HPV33	L2	9	337
HPV33	L2	11	298
HPV33	L2	10	187
HPV33	L2	11	222
HPV33	L2	9	31
HPV33	L2	10	31
HPV33	L2	11	31
HPV33	L2	8	168
HPV33	L2	10	168
HPV33	L2	8	441
HPV33	L2	9	441
HPV33	L2	11	404
HPV33	L2	8	131
HPV33	L2	10	131
HPV33	L2	11	131
HPV33	L2	9	92
HPV33	L2	8	434
HPV33	L2	9	434
HPV33	L2	8	237
HPV33	L2	9	202
HPV33	L2	10	202
HPV33	L2	8	366
HPV33	L2	10	366
HPV33	L2	8	325
HPV33	L2	10	325
HPV33	L2	9	18
HPV33	L2	10	71
HPV33	L2	11	71
HPV45	E1	11	382
HPV45	E1	8	144
HPV45	E1	10	144
HPV45	E1	10	383
HPV45	E1	8	310
HPV45	E1	10	310
HPV45	E1	10	198
HPV45	E1	8	232
HPV45	E1	9	232
HPV45	E1	10	232
HPV45	E1	9	532
HPV45	E1	8	68
HPV45	E1	9	452
HPV45	E1	9	311
HPV45	E1	9	199
HPV45	E1	9	512
HPV45	E1	10	66
HPV45	E1	8	72
HPV45	E1	10	72
HPV45	E1	11	72
HPV45	E1	8	408
HPV45	E1	10	373
HPV45	E1	11	373
HPV45	E1	8	40
HPV45	E1	9	40
HPV45	E1	10	251
HPV45	E1	9	202
HPV45	E1	10	399
HPV45	E1	11	398
HPV45	E1	8	465
HPV45	E1	10	465
HPV45	E1	8	259
HPV45	E1	9	259
HPV45	E1	10	259
HPV45	E1	11	259
HPV45	E1	9	297
HPV45	E1	10	390
HPV45	E1	11	390
HPV45	E1	8	226
HPV45	E1	11	226
HPV45	E1	10	634
HPV45	E1	11	621
HPV45	E1	8	78
HPV45	E1	8	516
HPV45	E1	8	206
HPV45	E1	10	206
HPV45	E1	11	206
HPV45	E1	9	614
HPV45	E1	11	614
HPV45	E1	9	349
HPV45	E1	9	108
HPV45	E1	11	108
HPV45	E1	8	361
HPV45	E1	9	361
HPV45	E1	11	214
HPV45	E1	9	367
HPV45	E1	10	367
HPV45	E1	8	46
HPV45	E1	10	46
HPV45	E1	11	352
HPV45	E1	8	106
HPV45	E1	11	106
HPV45	E1	9	623
HPV45	E1	10	42
HPV45	E1	10	508
HPV45	E1	11	508
HPV45	E1	9	328
HPV45	E1	10	328
HPV45	E1	11	328
HPV45	E1	10	52
HPV45	E1	10	30
HPV45	E1	11	30
HPV45	E1	8	143
HPV45	E1	9	143
HPV45	E1	11	143
HPV45	E1	11	115
HPV45	E1	8	186
HPV45	E1	10	189
HPV45	E1	11	189
HPV45	E1	8	59
HPV45	E1	10	59
HPV45	E1	11	59

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	E1	8	62	HPV45	E1	11	257
HPV45	E1	11	62	HPV45	E1	11	333
HPV45	E1	9	101	HPV45	E1	8	184
HPV45	E1	9	64	HPV45	E1	10	184
HPV45	E1	10	38	HPV45	E1	9	23
HPV45	E1	11	38	HPV45	E1	10	23
HPV45	E1	11	295	HPV45	E1	10	435
HPV45	E1	8	21	HPV45	E1	11	197
HPV45	E1	11	21	HPV45	E1	8	124
HPV45	E1	8	146	HPV45	E1	9	124
HPV45	E1	10	146	HPV45	E1	11	425
HPV45	E1	9	141	HPV45	E1	8	304
HPV45	E1	10	141	HPV45	E1	9	304
HPV45	E1	11	141	HPV45	E1	8	245
HPV45	E1	8	74	HPV45	E1	9	245
HPV45	E1	9	74	HPV45	E1	11	245
HPV45	E1	11	74	HPV45	E1	8	223
HPV45	E1	10	324	HPV45	E1	9	223
HPV45	E1	11	89	HPV45	E1	10	223
HPV45	E1	8	50	HPV45	E1	11	223
HPV45	E1	8	483	HPV45	E1	8	510
HPV45	E1	9	483	HPV45	E1	9	510
HPV45	E1	10	483	HPV45	E1	11	510
HPV45	E1	8	446	HPV45	E1	8	375
HPV45	E1	11	456	HPV45	E1	9	375
HPV45	E1	8	385	HPV45	E1	10	375
HPV45	E1	11	385	HPV45	E1	8	506
HPV45	E1	10	486	HPV45	E1	9	506
HPV45	E1	9	449	HPV45	E1	10	201
HPV45	E1	10	438	HPV45	E1	11	299
HPV45	E1	10	19	HPV45	E1	9	247
HPV45	E1	10	494	HPV45	E1	11	247
HPV45	E1	9	342	HPV45	E1	9	290
HPV45	E1	10	626	HPV45	E1	10	290
HPV45	E1	11	626	HPV45	E1	11	290
HPV45	E1	8	318	HPV45	E1	9	190
HPV45	E1	8	209	HPV45	E1	10	190
HPV45	E1	8	286	HPV45	E1	11	190
HPV45	E1	11	286	HPV45	E1	9	547
HPV45	E1	8	480	HPV45	E1	10	547
HPV45	E1	11	480	HPV45	E1	11	547
HPV45	E1	11	630	HPV45	E1	11	271
HPV45	E1	10	11	HPV45	E1	9	556
HPV45	E1	8	459	HPV45	E1	8	467
HPV45	E1	9	459	HPV45	E1	8	191
HPV45	E1	10	459	HPV45	E1	9	191
HPV45	E1	8	443	HPV45	E1	10	191
HPV45	E1	10	443	HPV45	E1	11	191
HPV45	E1	11	443	HPV45	E1	9	487
HPV45	E1	8	265	HPV45	E1	8	548
HPV45	E1	9	71	HPV45	E1	9	548
HPV45	E1	11	71	HPV45	E1	10	548
HPV45	E1	11	256	HPV45	E1	11	548
HPV45	E1	8	83	HPV45	E1	8	362
HPV45	E1	11	519	HPV45	E1	8	336
HPV45	E1	8	292	HPV45	E1	8	557
HPV45	E1	9	292	HPV45	E1	9	281
HPV45	E1	10	555	HPV45	E1	10	281
HPV45	E1	9	466	HPV45	E1	11	281
HPV45	E1	10	257	HPV45	E1	10	215

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	E1	11	215	HPV45	E1	8	54
HPV45	E1	8	368	HPV45	E1	8	102
HPV45	E1	9	368	HPV45	E1	8	412
HPV45	E1	9	231	HPV45	E1	11	80
HPV45	E1	10	231	HPV45	E1	8	148
HPV45	E1	11	231	HPV45	E1	10	451
HPV45	E1	8	200	HPV45	E1	9	407
HPV45	E1	11	200	HPV45	E1	11	612
HPV45	E1	8	513	HPV45	E1	9	335
HPV45	E1	11	513	HPV45	E1	8	280
HPV45	E1	8	298	HPV45	E1	10	280
HPV45	E1	9	47	HPV45	E1	11	280
HPV45	E1	11	47	HPV45	E1	9	411
HPV45	E1	10	353	HPV45	E1	10	316
HPV45	E1	11	353	HPV45	E1	8	608
HPV45	E1	8	154	HPV45	E1	10	575
HPV45	E1	11	154	HPV45	E1	10	56
HPV45	E1	11	174	HPV45	E1	11	56
HPV45	E1	8	531	HPV45	E1	9	539
HPV45	E1	10	531	HPV45	E1	10	539
HPV45	E1	9	321	HPV45	E1	8	183
HPV45	E1	9	473	HPV45	E1	9	183
HPV45	E1	10	152	HPV45	E1	11	183
HPV45	E1	8	177	HPV45	E1	9	117
HPV45	E1	9	177	HPV45	E1	11	416
HPV45	E1	11	177	HPV45	E1	9	288
HPV45	E1	10	563	HPV45	E1	11	288
HPV45	E1	11	471	HPV45	E1	10	308
HPV45	E1	8	250	HPV45	E1	10	104
HPV45	E1	11	250	HPV45	E1	8	65
HPV45	E1	8	554	HPV45	E1	11	65
HPV45	E1	11	554	HPV45	E1	9	39
HPV45	E1	11	537	HPV45	E1	10	39
HPV45	E1	11	434	HPV45	E1	10	22
HPV45	E1	8	505	HPV45	E1	11	22
HPV45	E1	9	505	HPV45	E1	8	246
HPV45	E1	10	505	HPV45	E1	10	246
HPV45	E1	8	98	HPV45	E1	8	289
HPV45	E1	10	98	HPV45	E1	10	289
HPV45	E1	10	546	HPV45	E1	11	289
HPV45	E1	11	546	HPV45	E1	9	252
HPV45	E1	9	238	HPV45	E1	9	53
HPV45	E1	10	238	HPV45	E1	9	147
HPV45	E1	11	238	HPV45	E1	8	224
HPV45	E1	9	60	HPV45	E1	9	224
HPV45	E1	10	60	HPV45	E1	10	224
HPV45	E1	9	391	HPV45	E1	8	239
HPV45	E1	10	391	HPV45	E1	9	239
HPV45	E1	11	391	HPV45	E1	10	239
HPV45	E1	9	67	HPV45	E1	8	282
HPV45	E1	8	192	HPV45	E1	9	282
HPV45	E1	9	192	HPV45	E1	10	282
HPV45	E1	10	192	HPV45	E1	8	577
HPV45	E1	11	192	HPV45	E1	9	309
HPV45	E1	9	374	HPV45	E1	11	309
HPV45	E1	10	374	HPV45	E1	8	240
HPV45	E1	11	374	HPV45	E1	9	240
HPV45	E1	8	549	HPV45	E1	8	283
HPV45	E1	9	549	HPV45	E1	9	283
HPV45	E1	10	549	HPV45	E1	11	283

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	E1	8	511	HPV45	E2	10	343
HPV45	E1	10	511	HPV45	E2	11	343
HPV45	E1	9	31	HPV45	E2	8	192
HPV45	E1	10	31	HPV45	E2	9	192
HPV45	E1	11	31	HPV45	E2	11	349
HPV45	E1	10	81	HPV45	E2	8	50
HPV45	E1	10	230	HPV45	E2	9	50
HPV45	E1	11	230	HPV45	E2	11	50
HPV45	E1	9	400	HPV45	E2	11	334
HPV45	E1	9	436	HPV45	E2	9	56
HPV45	E1	8	75	HPV45	E2	10	56
HPV45	E1	10	75	HPV45	E2	8	150
HPV45	E1	11	75	HPV45	E2	10	150
HPV45	E1	9	354	HPV45	E2	10	255
HPV45	E1	10	354	HPV45	E2	9	237
HPV45	E1	9	635	HPV45	E2	11	237
HPV45	E1	9	576	HPV45	E2	10	163
HPV45	E1	8	356	HPV45	E2	11	163
HPV45	E1	9	418	HPV45	E2	9	225
HPV45	E1	8	332	HPV45	E2	10	225
HPV45	E1	8	502	HPV45	E2	9	295
HPV45	E1	10	502	HPV45	E2	9	62
HPV45	E1	11	502	HPV45	E2	11	267
HPV45	E1	8	522	HPV45	E2	11	293
HPV45	E1	11	522	HPV45	E2	10	48
HPV45	E1	8	229	HPV45	E2	11	48
HPV45	E1	11	229	HPV45	E2	10	335
HPV45	E1	11	372	HPV45	E2	10	146
HPV45	E1	8	571	HPV45	E2	11	146
HPV45	E1	10	571	HPV45	E2	8	57
HPV45	E1	8	394	HPV45	E2	9	57
HPV45	E1	11	528	HPV45	E2	8	219
HPV45	E1	10	441	HPV45	E2	10	219
HPV45	E2	9	156	HPV45	E2	8	74
HPV45	E2	8	78	HPV45	E2	10	74
HPV45	E2	11	78	HPV45	E2	11	74
HPV45	E2	11	47	HPV45	E2	8	77
HPV45	E2	11	89	HPV45	E2	9	77
HPV45	E2	10	247	HPV45	E2	10	59
HPV45	E2	11	247	HPV45	E2	9	2
HPV45	E2	8	216	HPV45	E2	11	154
HPV45	E2	11	216	HPV45	E2	8	284
HPV45	E2	10	305	HPV45	E2	10	284
HPV45	E2	10	134	HPV45	E2	11	284
HPV45	E2	10	158	HPV45	E2	8	41
HPV45	E2	11	31	HPV45	E2	9	41
HPV45	E2	9	102	HPV45	E2	11	41
HPV45	E2	8	212	HPV45	E2	8	100
HPV45	E2	9	212	HPV45	E2	11	100
HPV45	E2	9	351	HPV45	E2	8	223
HPV45	E2	11	351	HPV45	E2	11	223
HPV45	E2	9	319	HPV45	E2	8	81
HPV45	E2	9	80	HPV45	E2	9	81
HPV45	E2	10	80	HPV45	E2	9	256
HPV45	E2	9	258	HPV45	E2	11	256
HPV45	E2	11	258	HPV45	E2	9	336
HPV45	E2	8	148	HPV45	E2	8	3
HPV45	E2	9	148	HPV45	E2	10	69
HPV45	E2	10	148	HPV45	E2	11	69
HPV45	E2	8	343	HPV45	E2	8	347

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	E2	9	347
HPV45	E2	8	332
HPV45	E2	8	265
HPV45	E2	9	265
HPV45	E2	8	289
HPV45	E2	11	189
HPV45	E2	9	198
HPV45	E2	11	246
HPV45	E2	9	67
HPV45	E2	8	360
HPV45	E2	9	360
HPV45	E2	8	35
HPV45	E2	10	35
HPV45	E2	9	218
HPV45	E2	11	218
HPV45	E2	8	40
HPV45	E2	9	40
HPV45	E2	10	40
HPV45	E2	9	222
HPV45	E2	8	82
HPV45	E2	11	4
HPV45	E2	8	63
HPV45	E2	9	43
HPV45	E2	10	43
HPV45	E2	9	13
HPV45	E2	10	13
HPV45	E2	8	221
HPV45	E2	10	221
HPV45	E2	10	263
HPV45	E2	11	263
HPV45	E2	8	15
HPV45	E2	9	215
HPV45	E2	8	142
HPV45	E2	10	142
HPV45	E2	9	302
HPV45	E2	8	9
HPV45	E2	9	9
HPV45	E2	9	205
HPV45	E2	10	205
HPV45	E2	10	113
HPV45	E2	11	113
HPV45	E2	8	34
HPV45	E2	9	34
HPV45	E2	11	34
HPV45	E2	8	229
HPV45	E2	10	229
HPV45	E2	9	208
HPV45	E2	10	208
HPV45	E2	10	276
HPV45	E2	8	227
HPV45	E2	10	227
HPV45	E2	9	235
HPV45	E2	11	235
HPV45	E2	9	358
HPV45	E2	10	358
HPV45	E2	11	358
HPV45	E2	10	155
HPV45	E2	8	51
HPV45	E2	10	51
HPV45	E2	11	233
HPV45	E2	8	354
HPV45	E2	10	354
HPV45	E2	9	99
HPV45	E2	10	217
HPV45	E2	8	213
HPV45	E2	11	213
HPV45	E2	8	337
HPV45	E2	8	199
HPV45	E2	11	199
HPV45	E2	8	359
HPV45	E2	9	359
HPV45	E2	10	359
HPV45	E2	9	344
HPV45	E2	10	344
HPV45	E2	11	344
HPV45	E2	8	193
HPV45	E2	9	353
HPV45	E2	11	353
HPV45	E2	11	338
HPV45	E2	8	352
HPV45	E2	10	352
HPV45	E2	9	138
HPV45	E2	10	138
HPV45	E2	9	39
HPV45	E2	10	39
HPV45	E2	11	39
HPV45	E2	8	326
HPV45	E2	10	326
HPV45	E2	11	326
HPV45	E2	10	98
HPV45	E2	8	313
HPV45	E2	11	313
HPV45	E2	8	166
HPV45	E2	11	166
HPV45	E2	11	145
HPV45	E2	10	137
HPV45	E2	11	137
HPV45	E6	8	37
HPV45	E6	11	59
HPV45	E6	8	68
HPV45	E6	11	68
HPV45	E6	8	105
HPV45	E6	11	105
HPV45	E6	8	108
HPV45	E6	8	18
HPV45	E6	11	18
HPV45	E6	8	32
HPV45	E6	11	32
HPV45	E6	8	16
HPV45	E6	10	16
HPV45	E6	10	51
HPV45	E6	11	51
HPV45	E6	8	143
HPV45	E6	11	27
HPV45	E6	9	20
HPV45	E6	11	20
HPV45	E6	9	77
HPV45	E6	10	97
HPV45	E6	9	88
HPV45	E6	11	88

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	E6	10	43
HPV45	E6	8	47
HPV45	E6	9	47
HPV45	E6	8	53
HPV45	E6	9	53
HPV45	E6	11	53
HPV45	E6	10	136
HPV45	E6	9	132
HPV45	E6	11	120
HPV45	E6	8	30
HPV45	E6	9	30
HPV45	E6	10	30
HPV45	E6	11	130
HPV45	E6	10	60
HPV45	E6	9	93
HPV45	E6	10	93
HPV45	E6	11	93
HPV45	E6	8	54
HPV45	E6	10	54
HPV45	E6	11	54
HPV45	E6	9	36
HPV45	E6	10	92
HPV45	E6	11	92
HPV45	E6	9	13
HPV45	E6	11	13
HPV45	E6	11	102
HPV45	E6	9	25
HPV45	E6	8	1
HPV45	E6	8	95
HPV45	E6	9	95
HPV45	E6	9	22
HPV45	E6	10	22
HPV45	E6	8	114
HPV45	E6	11	111
HPV45	E6	8	7
HPV45	E6	11	7
HPV45	E6	8	149
HPV45	E6	10	149
HPV45	E6	11	146
HPV45	E6	8	41
HPV45	E6	9	29
HPV45	E6	10	29
HPV45	E6	11	29
HPV45	E6	8	24
HPV45	E6	10	24
HPV45	E6	10	84
HPV45	E6	11	84
HPV45	E6	8	89
HPV45	E6	10	89
HPV45	E6	11	38
HPV45	E6	10	8
HPV45	E6	8	62
HPV45	E6	8	45
HPV45	E6	10	45
HPV45	E6	11	45
HPV45	E7	8	48
HPV45	E7	8	6
HPV45	E7	10	6
HPV45	E7	10	64
HPV45	E7	8	25
HPV45	E7	8	83
HPV45	E7	10	83
HPV45	E7	8	41
HPV45	E7	10	41
HPV45	E7	8	20
HPV45	E7	8	74
HPV45	E7	11	74
HPV45	E7	8	91
HPV45	E7	8	97
HPV45	E7	9	44
HPV45	E7	9	47
HPV45	E7	8	14
HPV45	E7	11	14
HPV45	E7	11	11
HPV45	E7	8	8
HPV45	E7	8	87
HPV45	E7	9	87
HPV45	E7	10	75
HPV45	E7	8	17
HPV45	E7	10	17
HPV45	E7	11	17
HPV45	E7	9	57
HPV45	E7	10	23
HPV45	E7	10	89
HPV45	E7	8	88
HPV45	E7	11	88
HPV45	E7	9	54
HPV45	E7	10	54
HPV45	E7	8	5
HPV45	E7	9	5
HPV45	E7	11	5
HPV45	E7	10	72
HPV45	E7	8	85
HPV45	E7	10	85
HPV45	E7	11	85
HPV45	E7	8	80
HPV45	E7	11	80
HPV45	E7	11	93
HPV45	E7	9	7
HPV45	E7	9	86
HPV45	E7	10	86
HPV45	E7	10	94
HPV45	E7	11	94
HPV45	E7	9	76
HPV45	E7	11	76
HPV45	E7	10	12
HPV45	L1	11	517
HPV45	L1	10	161
HPV45	L1	10	191
HPV45	L1	11	191
HPV45	L1	10	103
HPV45	L1	9	28
HPV45	L1	10	28
HPV45	L1	10	234
HPV45	L1	8	345
HPV45	L1	11	205
HPV45	L1	9	162
HPV45	L1	11	164
HPV45	L1	8	455
HPV45	L1	9	455

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	L1	8	374	HPV45	L1	11	351
HPV45	L1	11	374	HPV45	L1	9	10
HPV45	L1	8	184	HPV45	L1	11	10
HPV45	L1	9	184	HPV45	L1	8	503
HPV45	L1	9	276	HPV45	L1	11	143
HPV45	L1	11	252	HPV45	L1	10	131
HPV45	L1	9	409	HPV45	L1	8	137
HPV45	L1	10	409	HPV45	L1	9	199
HPV45	L1	10	188	HPV45	L1	9	306
HPV45	L1	11	318	HPV45	L1	9	292
HPV45	L1	10	480	HPV45	L1	11	292
HPV45	L1	8	401	HPV45	L1	8	435
HPV45	L1	10	401	HPV45	L1	10	435
HPV45	L1	11	401	HPV45	L1	11	435
HPV45	L1	9	301	HPV45	L1	8	160
HPV45	L1	11	301	HPV45	L1	11	160
HPV45	L1	9	226	HPV45	L1	8	62
HPV45	L1	10	226	HPV45	L1	9	62
HPV45	L1	10	490	HPV45	L1	10	62
HPV45	L1	11	490	HPV45	L1	10	396
HPV45	L1	8	155	HPV45	L1	8	221
HPV45	L1	9	155	HPV45	L1	10	221
HPV45	L1	10	155	HPV45	L1	9	12
HPV45	L1	11	155	HPV45	L1	8	11
HPV45	L1	11	229	HPV45	L1	10	11
HPV45	L1	8	242	HPV45	L1	8	5
HPV45	L1	10	242	HPV45	L1	9	5
HPV45	L1	8	364	HPV45	L1	11	5
HPV45	L1	9	364	HPV45	L1	9	428
HPV45	L1	10	364	HPV45	L1	8	185
HPV45	L1	9	296	HPV45	L1	8	411
HPV45	L1	9	446	HPV45	L1	11	411
HPV45	L1	10	446	HPV45	L1	9	166
HPV45	L1	11	446	HPV45	L1	11	166
HPV45	L1	8	169	HPV45	L1	8	328
HPV45	L1	8	133	HPV45	L1	9	344
HPV45	L1	10	133	HPV45	L1	8	152
HPV45	L1	8	121	HPV45	L1	10	152
HPV45	L1	10	121	HPV45	L1	11	152
HPV45	L1	9	416	HPV45	L1	9	473
HPV45	L1	10	246	HPV45	L1	9	86
HPV45	L1	9	283	HPV45	L1	8	467
HPV45	L1	11	283	HPV45	L1	8	179
HPV45	L1	8	404	HPV45	L1	11	179
HPV45	L1	9	404	HPV45	L1	9	91
HPV45	L1	10	404	HPV45	L1	11	68
HPV45	L1	11	404	HPV45	L1	8	240
HPV45	L1	10	14	HPV45	L1	10	240
HPV45	L1	8	406	HPV45	L1	9	402
HPV45	L1	9	406	HPV45	L1	10	402
HPV45	L1	10	406	HPV45	L1	11	402
HPV45	L1	8	450	HPV45	L1	9	207
HPV45	L1	8	359	HPV45	L1	11	207
HPV45	L1	11	359	HPV45	L1	9	413
HPV45	L1	8	82	HPV45	L1	11	371
HPV45	L1	11	82	HPV45	L1	10	69
HPV45	L1	8	233	HPV45	L1	11	69
HPV45	L1	11	233	HPV45	L1	8	444
HPV45	L1	8	351	HPV45	L1	11	444
HPV45	L1	10	351	HPV45	L1	11	499

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	L1	8	125	HPV45	L1	9	290
HPV45	L1	10	125	HPV45	L1	11	290
HPV45	L1	11	1	HPV45	L1	9	124
HPV45	L1	10	27	HPV45	L1	11	124
HPV45	L1	11	27	HPV45	L1	8	56
HPV45	L1	8	227	HPV45	L1	9	46
HPV45	L1	9	227	HPV45	L1	9	265
HPV45	L1	8	4	HPV45	L1	8	158
HPV45	L1	9	4	HPV45	L1	9	158
HPV45	L1	10	4	HPV45	L1	10	158
HPV45	L1	8	370	HPV45	L1	10	93
HPV45	L1	10	310	HPV45	L1	11	93
HPV45	L1	8	356	HPV45	L1	9	254
HPV45	L1	10	356	HPV45	L1	11	254
HPV45	L1	11	356	HPV45	L1	11	58
HPV45	L1	9	49	HPV45	L1	10	427
HPV45	L1	11	49	HPV45	L1	9	327
HPV45	L1	9	219	HPV45	L1	9	443
HPV45	L1	10	219	HPV45	L1	11	272
HPV45	L1	9	19	HPV45	L1	10	333
HPV45	L1	10	19	HPV45	L1	10	521
HPV45	L1	11	19	HPV45	L1	8	115
HPV45	L1	9	17	HPV45	L1	11	115
HPV45	L1	11	17	HPV45	L1	10	238
HPV45	L1	9	173	HPV45	L1	8	368
HPV45	L1	11	173	HPV45	L1	10	368
HPV45	L1	8	516	HPV45	L1	9	376
HPV45	L1	8	190	HPV45	L1	9	519
HPV45	L1	11	190	HPV45	L1	10	35
HPV45	L1	8	22	HPV45	L1	11	35
HPV45	L1	8	248	HPV45	L1	8	43
HPV45	L1	8	214	HPV45	L1	10	453
HPV45	L1	9	214	HPV45	L1	11	453
HPV45	L1	8	493	HPV45	L1	9	175
HPV45	L1	10	493	HPV45	L1	11	175
HPV45	L1	9	299	HPV45	L1	8	414
HPV45	L1	11	299	HPV45	L1	11	414
HPV45	L1	10	508	HPV45	L1	9	522
HPV45	L1	11	508	HPV45	L1	11	522
HPV45	L1	11	387	HPV45	L1	8	163
HPV45	L1	8	440	HPV45	L1	9	509
HPV45	L1	9	380	HPV45	L1	10	509
HPV45	L1	9	501	HPV45	L1	8	220
HPV45	L1	10	501	HPV45	L1	9	220
HPV45	L1	8	87	HPV45	L1	11	220
HPV45	L1	8	182	HPV45	L1	8	410
HPV45	L1	10	182	HPV45	L1	9	410
HPV45	L1	11	182	HPV45	L1	10	116
HPV45	L1	8	407	HPV45	L1	11	116
HPV45	L1	9	407	HPV45	L1	10	372
HPV45	L1	11	407	HPV45	L1	8	200
HPV45	L1	11	281	HPV45	L1	9	239
HPV45	L1	9	334	HPV45	L1	11	239
HPV45	L1	9	357	HPV45	L1	10	412
HPV45	L1	10	357	HPV45	L1	8	167
HPV45	L1	10	206	HPV45	L1	10	167
HPV45	L1	11	26	HPV45	L1	9	181
HPV45	L1	11	263	HPV45	L1	11	181
HPV45	L1	10	180	HPV45	L1	8	377
HPV45	L1	8	290	HPV45	L1	9	122

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	L1	11	122	HPV45	L2	9	278
HPV45	L1	8	365	HPV45	L2	10	278
HPV45	L1	9	365	HPV45	L2	8	322
HPV45	L1	11	365	HPV45	L2	11	322
HPV45	L1	11	441	HPV45	L2	9	142
HPV45	L1	9	70	HPV45	L2	11	142
HPV45	L1	10	70	HPV45	L2	11	16
HPV45	L1	8	297	HPV45	L2	9	260
HPV45	L1	11	297	HPV45	L2	9	83
HPV45	L1	9	361	HPV45	L2	10	83
HPV45	L1	11	361	HPV45	L2	11	83
HPV45	L1	9	36	HPV45	L2	9	30
HPV45	L1	10	36	HPV45	L2	10	30
HPV45	L1	11	102	HPV45	L2	11	30
HPV45	L1	11	44	HPV45	L2	10	397
HPV45	L1	9	454	HPV45	L2	11	397
HPV45	L1	10	454	HPV45	L2	10	348
HPV45	L1	10	165	HPV45	L2	8	331
HPV45	L1	8	293	HPV45	L2	10	331
HPV45	L1	10	293	HPV45	L2	11	331
HPV45	L1	8	417	HPV45	L2	8	194
HPV45	L1	10	500	HPV45	L2	8	129
HPV45	L1	11	500	HPV45	L2	9	129
HPV45	L1	8	456	HPV45	L2	11	129
HPV45	L1	10	360	HPV45	L2	8	333
HPV45	L1	8	362	HPV45	L2	9	333
HPV45	L1	10	362	HPV45	L2	8	169
HPV45	L1	11	362	HPV45	L2	8	175
HPV45	L1	8	47	HPV45	L2	10	175
HPV45	L1	11	47	HPV45	L2	8	456
HPV45	L1	11	78	HPV45	L2	8	200
HPV45	L1	8	127	HPV45	L2	11	200
HPV45	L1	10	196	HPV45	L2	9	53
HPV45	L1	9	420	HPV45	L2	8	241
HPV45	L1	10	420	HPV45	L2	9	241
HPV45	L1	9	303	HPV45	L2	10	241
HPV45	L1	8	38	HPV45	L2	11	276
HPV45	L1	10	38	HPV45	L2	9	122
HPV45	L1	11	38	HPV45	L2	10	122
HPV45	L1	8	95	HPV45	L2	11	157
HPV45	L1	9	95	HPV45	L2	8	306
HPV45	L1	10	95	HPV45	L2	8	368
HPV45	L1	11	53	HPV45	L2	9	368
HPV45	L2	9	6	HPV45	L2	10	368
HPV45	L2	10	6	HPV45	L2	8	116
HPV45	L2	8	381	HPV45	L2	10	116
HPV45	L2	9	381	HPV45	L2	9	51
HPV45	L2	10	381	HPV45	L2	11	51
HPV45	L2	8	327	HPV45	L2	9	430
HPV45	L2	11	327	HPV45	L2	8	300
HPV45	L2	8	286	HPV45	L2	8	25
HPV45	L2	9	286	HPV45	L2	11	25
HPV45	L2	10	328	HPV45	L2	8	206
HPV45	L2	11	328	HPV45	L2	10	206
HPV45	L2	11	303	HPV45	L2	10	60
HPV45	L2	10	340	HPV45	L2	8	124
HPV45	L2	8	139	HPV45	L2	8	37
HPV45	L2	9	139	HPV45	L2	9	37
HPV45	L2	8	405	HPV45	L2	8	134
HPV45	L2	10	405	HPV45	L2	10	134

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	L2	11	134	8	325
HPV45	L2	8	292	10	325
HPV45	L2	8	411	9	209
HPV45	L2	11	411	10	209
HPV45	L2	9	326	8	399
HPV45	L2	10	167	9	399
HPV45	L2	9	406	10	399
HPV45	L2	8	279	11	258
HPV45	L2	9	279	8	73
HPV45	L2	8	407	9	73
HPV45	L2	9	44	10	73
HPV45	L2	11	44	11	336
HPV45	L2	8	143	8	214
HPV45	L2	10	143	8	391
HPV45	L2	8	130	10	391
HPV45	L2	10	130	9	413
HPV45	L2	11	130	11	413
HPV45	L2	10	103	10	171
HPV45	L2	11	103	8	98
HPV45	L2	8	43	9	98
HPV45	L2	10	43	10	98
HPV45	L2	10	22	11	120
HPV45	L2	11	22	8	420
HPV45	L2	8	34	10	420
HPV45	L2	11	34	8	86
HPV45	L2	11	40	11	86
HPV45	L2	10	337	11	185
HPV45	L2	8	334	11	267
HPV45	L2	11	197	8	145
HPV45	L2	8	45	11	145
HPV45	L2	10	45	11	216
HPV45	L2	8	242	9	95
HPV45	L2	9	242	10	95
HPV45	L2	8	375	11	95
HPV45	L2	9	392	8	118
HPV45	L2	11	392	10	90
HPV45	L2	8	106	11	232
HPV45	L2	9	106	10	198
HPV45	L2	8	248	9	172
HPV45	L2	8	422	11	172
HPV45	L2	10	422	10	233
HPV45	L2	8	179	11	233
HPV45	L2	8	231	8	5
HPV45	L2	9	79	10	5
HPV45	L2	8	270	11	5
HPV45	L2	10	270	8	229
HPV45	L2	11	270	10	229
HPV45	L2	9	387	10	11
HPV45	L2	8	160	11	451
HPV45	L2	9	160	8	298
HPV45	L2	11	160	10	298
HPV45	L2	9	285	10	225
HPV45	L2	10	285	8	19
HPV45	L2	8	356	8	316
HPV45	L2	9	356	11	316
HPV45	L2	9	138	11	220
HPV45	L2	10	138	8	235
HPV45	L2	8	254	9	235
HPV45	L2	9	254	8	13
HPV45	L2	10	254	8	339

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV45	L2	11	339	HPV45	L2	11	249
HPV45	L2	9	394	HPV45	L2	9	104
HPV45	L2	8	166	HPV45	L2	10	104
HPV45	L2	11	166	HPV45	L2	11	104
HPV45	L2	8	151	HPV45	L2	8	388
HPV45	L2	11	151	HPV45	L2	11	388
HPV45	L2	11	102	HPV45	L2	8	112
HPV45	L2	9	49	HPV45	L2	10	112
HPV45	L2	11	49	HPV45	L2	11	81
HPV45	L2	8	374	HPV45	L2	9	91
HPV45	L2	9	374	HPV45	L2	8	350
HPV45	L2	9	247	HPV45	L2	10	350
HPV45	L2	10	239	HPV45	L2	11	350
HPV45	L2	11	239	HPV45	L2	11	428
HPV45	L2	10	379	HPV45	L2	8	401
HPV45	L2	11	379	HPV45	L2	10	71
HPV45	L2	8	362	HPV45	L2	11	71
HPV45	L2	10	212	HPV56	E2	8	15
HPV45	L2	8	154	HPV56	E2	11	15
HPV45	L2	9	417	HPV56	E2	8	21
HPV45	L2	10	417	HPV56	E2	9	21
HPV45	L2	11	417	HPV56	E2	9	4
HPV45	L2	8	424	HPV56	E2	10	71
HPV45	L2	11	424	HPV56	E2	8	204
HPV45	L2	10	149	HPV56	E2	11	204
HPV45	L2	9	111	HPV56	E2	8	39
HPV45	L2	11	111	HPV56	E2	9	39
HPV45	L2	9	380	HPV56	E2	9	263
HPV45	L2	10	380	HPV56	E2	11	263
HPV45	L2	11	380	HPV56	E2	10	117
HPV45	L2	10	262	HPV56	E2	8	288
HPV45	L2	8	105	HPV56	E2	11	288
HPV45	L2	9	105	HPV56	E2	8	154
HPV45	L2	10	105	HPV56	E2	11	154
HPV45	L2	10	304	HPV56	E2	9	128
HPV45	L2	8	38	HPV56	E2	9	17
HPV45	L2	8	261	HPV56	E2	11	17
HPV45	L2	11	261	HPV56	E2	9	294
HPV45	L2	8	136	HPV56	E2	10	294
HPV45	L2	9	136	HPV56	E2	9	254
HPV45	L2	11	136	HPV56	E2	11	254
HPV45	L2	11	359	HPV56	E2	11	261
HPV45	L2	9	135	HPV56	E2	11	99
HPV45	L2	10	135	HPV56	E2	10	94
HPV45	L2	10	425	HPV56	E2	9	201
HPV45	L2	9	426	HPV56	E2	11	201
HPV45	L2	10	146	HPV56	E2	8	210
HPV45	L2	10	389	HPV56	E2	9	239
HPV45	L2	11	293	HPV56	E2	10	208
HPV45	L2	10	217	HPV56	E2	10	297
HPV45	L2	8	80	HPV56	E2	11	297
HPV45	L2	9	113	HPV56	E2	8	20
HPV45	L2	11	113	HPV56	E2	9	20
HPV45	L2	8	92	HPV56	E2	10	20
HPV45	L2	8	31	HPV56	E2	10	280
HPV45	L2	9	31	HPV56	E2	9	281
HPV45	L2	10	31	HPV56	E2	8	11
HPV45	L2	11	31	HPV56	E2	10	11
HPV45	L2	8	140	HPV56	E2	11	11
HPV45	L2	11	140	HPV56	E2	8	9

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56 E2	10	9	HPV56 E2	8	264
HPV56 E2	8	299	HPV56 E2	10	264
HPV56 E2	9	299	HPV56 E2	10	205
HPV56 E2	8	258	HPV56 E2	11	237
HPV56 E2	10	258	HPV56 E2	8	88
HPV56 E2	8	233	HPV56 E2	10	35
HPV56 E2	8	163	HPV56 E2	11	270
HPV56 E2	10	163	HPV56 E2	8	111
HPV56 E2	11	108	HPV56 E2	8	102
HPV56 E2	11	90	HPV56 E2	11	102
HPV56 E2	8	5	HPV56 E6	11	89
HPV56 E2	11	5	HPV56 E6	8	64
HPV56 E2	9	72	HPV56 E6	8	139
HPV56 E2	10	1	HPV56 E6	8	69
HPV56 E2	9	216	HPV56 E6	8	33
HPV56 E2	8	160	HPV56 E6	9	33
HPV56 E2	9	160	HPV56 E6	11	33
HPV56 E2	11	160	HPV56 E6	9	23
HPV56 E2	8	149	HPV56 E6	11	39
HPV56 E2	10	152	HPV56 E6	8	20
HPV56 E2	9	19	HPV56 E6	10	20
HPV56 E2	10	19	HPV56 E6	8	44
HPV56 E2	11	19	HPV56 E6	10	44
HPV56 E2	10	6	HPV56 E6	8	48
HPV56 E2	11	6	HPV56 E6	9	48
HPV56 E2	8	14	HPV56 E6	8	88
HPV56 E2	9	14	HPV56 E6	8	129
HPV56 E2	11	279	HPV56 E6	8	17
HPV56 E2	8	135	HPV56 E6	10	17
HPV56 E2	11	135	HPV56 E6	11	17
HPV56 E2	10	144	HPV56 E6	10	131
HPV56 E2	9	272	HPV56 E6	9	94
HPV56 E2	10	272	HPV56 E6	10	94
HPV56 E2	11	272	HPV56 E6	11	94
HPV56 E2	9	169	HPV56 E6	11	54
HPV56 E2	10	169	HPV56 E6	8	97
HPV56 E2	11	169	HPV56 E6	11	130
HPV56 E2	11	26	HPV56 E6	9	26
HPV56 E2	8	266	HPV56 E6	11	103
HPV56 E2	8	171	HPV56 E6	8	113
HPV56 E2	9	171	HPV56 E6	10	40
HPV56 E2	10	141	HPV56 E6	10	55
HPV56 E2	8	282	HPV56 E6	11	55
HPV56 E2	9	28	HPV56 E6	10	25
HPV56 E2	10	28	HPV56 E6	9	112
HPV56 E2	9	259	HPV56 E6	8	8
HPV56 E2	9	36	HPV56 E6	11	8
HPV56 E2	11	36	HPV56 E6	10	145
HPV56 E2	10	289	HPV56 E6	11	145
HPV56 E2	9	206	HPV56 E6	8	42
HPV56 E2	10	27	HPV56 E6	10	42
HPV56 E2	11	27	HPV56 E6	11	30
HPV56 E2	11	167	HPV56 E6	11	144
HPV56 E2	8	165	HPV56 E6	10	67
HPV56 E2	9	164	HPV56 E6	10	93
HPV56 E2	10	155	HPV56 E6	11	93
HPV56 E2	11	155	HPV56 E6	8	14
HPV56 E2	8	18	HPV56 E6	9	14
HPV56 E2	10	18	HPV56 E6	11	14
HPV56 E2	11	18	HPV56 E6	10	85

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	E6	11	85	HPV56	E7	11	51
HPV56	E6	10	90	HPV56	E7	8	84
HPV56	E6	9	21	HPV56	E7	10	84
HPV56	E6	11	21	HPV56	E7	11	84
HPV56	E6	8	63	HPV56	E7	8	78
HPV56	E6	9	63	HPV56	E7	9	78
HPV56	E7	8	93	HPV56	E7	9	7
HPV56	E7	10	93	HPV56	E7	10	7
HPV56	E7	9	75	HPV56	E7	8	95
HPV56	E7	11	75	HPV56	E7	8	12
HPV56	E7	8	22	HPV56	E7	10	12
HPV56	E7	8	82	HPV56	E7	8	72
HPV56	E7	9	82	HPV56	E7	8	86
HPV56	E7	10	82	HPV56	E7	9	86
HPV56	E7	10	10	HPV56	E7	10	86
HPV56	E7	10	20	HPV56	E7	11	86
HPV56	E7	8	14	HPV56	E7	9	11
HPV56	E7	10	14	HPV56	E7	11	11
HPV56	E7	10	70	HPV56	E7	9	71
HPV56	E7	9	92	HPV56	E7	9	85
HPV56	E7	11	92	HPV56	E7	10	85
HPV56	E7	9	42	HPV56	E7	11	85
HPV56	E7	8	56	HPV56	L1	11	458
HPV56	E7	10	62	HPV56	L1	10	198
HPV56	E7	11	62	HPV56	L1	11	198
HPV56	E7	8	76	HPV56	L1	8	350
HPV56	E7	10	76	HPV56	L1	10	338
HPV56	E7	11	76	HPV56	L1	9	58
HPV56	E7	8	54	HPV56	L1	11	58
HPV56	E7	10	54	HPV56	L1	10	381
HPV56	E7	8	4	HPV56	L1	8	327
HPV56	E7	9	4	HPV56	L1	9	327
HPV56	E7	10	4	HPV56	L1	8	514
HPV56	E7	8	89	HPV56	L1	10	514
HPV56	E7	9	89	HPV56	L1	11	444
HPV56	E7	8	90	HPV56	L1	10	37
HPV56	E7	11	90	HPV56	L1	10	512
HPV56	E7	8	8	HPV56	L1	8	207
HPV56	E7	9	8	HPV56	L1	9	207
HPV56	E7	8	43	HPV56	L1	10	207
HPV56	E7	11	43	HPV56	L1	9	79
HPV56	E7	9	15	HPV56	L1	10	79
HPV56	E7	9	94	HPV56	L1	9	26
HPV56	E7	11	47	HPV56	L1	11	26
HPV56	E7	8	6	HPV56	L1	8	19
HPV56	E7	10	6	HPV56	L1	9	19
HPV56	E7	11	6	HPV56	L1	11	19
HPV56	E7	9	52	HPV56	L1	8	191
HPV56	E7	10	52	HPV56	L1	9	191
HPV56	E7	9	49	HPV56	L1	8	461
HPV56	E7	11	73	HPV56	L1	10	195
HPV56	E7	8	88	HPV56	L1	9	389
HPV56	E7	9	88	HPV56	L1	11	274
HPV56	E7	10	88	HPV56	L1	9	233
HPV56	E7	10	48	HPV56	L1	10	233
HPV56	E7	8	87	HPV56	L1	8	128
HPV56	E7	9	87	HPV56	L1	10	128
HPV56	E7	10	87	HPV56	L1	10	493
HPV56	E7	11	87	HPV56	L1	11	493
HPV56	E7	10	51	HPV56	L1	8	162

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	L1	11	236
HPV56	L1	8	369
HPV56	L1	9	369
HPV56	L1	10	369
HPV56	L1	10	23
HPV56	L1	10	481
HPV56	L1	11	337
HPV56	L1	8	404
HPV56	L1	11	404
HPV56	L1	8	383
HPV56	L1	11	464
HPV56	L1	9	303
HPV56	L1	8	140
HPV56	L1	10	140
HPV56	L1	9	419
HPV56	L1	11	419
HPV56	L1	10	253
HPV56	L1	9	290
HPV56	L1	9	21
HPV56	L1	8	409
HPV56	L1	10	409
HPV56	L1	8	407
HPV56	L1	9	407
HPV56	L1	10	407
HPV56	L1	8	364
HPV56	L1	11	364
HPV56	L1	9	148
HPV56	L1	8	240
HPV56	L1	9	206
HPV56	L1	10	206
HPV56	L1	11	206
HPV56	L1	8	25
HPV56	L1	10	25
HPV56	L1	8	356
HPV56	L1	10	356
HPV56	L1	11	356
HPV56	L1	8	17
HPV56	L1	10	17
HPV56	L1	11	17
HPV56	L1	10	138
HPV56	L1	11	150
HPV56	L1	8	438
HPV56	L1	10	438
HPV56	L1	8	144
HPV56	L1	8	506
HPV56	L1	9	506
HPV56	L1	10	506
HPV56	L1	8	71
HPV56	L1	9	71
HPV56	L1	10	71
HPV56	L1	10	399
HPV56	L1	10	459
HPV56	L1	8	414
HPV56	L1	9	414
HPV56	L1	11	414
HPV56	L1	8	192
HPV56	L1	8	251
HPV56	L1	9	251
HPV56	L1	9	392
HPV56	L1	8	413
HPV56	L1	9	413
HPV56	L1	10	413
HPV56	L1	11	270
HPV56	L1	8	186
HPV56	L1	11	186
HPV56	L1	9	93
HPV56	L1	8	300
HPV56	L1	10	300
HPV56	L1	8	245
HPV56	L1	10	245
HPV56	L1	9	98
HPV56	L1	9	55
HPV56	L1	9	45
HPV56	L1	9	474
HPV56	L1	11	474
HPV56	L1	8	222
HPV56	L1	10	78
HPV56	L1	11	78
HPV56	L1	11	224
HPV56	L1	11	77
HPV56	L1	9	431
HPV56	L1	11	502
HPV56	L1	9	484
HPV56	L1	8	247
HPV56	L1	10	247
HPV56	L1	10	405
HPV56	L1	11	405
HPV56	L1	11	347
HPV56	L1	8	132
HPV56	L1	10	132
HPV56	L1	11	36
HPV56	L1	9	421
HPV56	L1	11	421
HPV56	L1	8	234
HPV56	L1	9	234
HPV56	L1	8	333
HPV56	L1	8	1
HPV56	L1	10	5
HPV56	L1	10	503
HPV56	L1	11	503
HPV56	L1	10	376
HPV56	L1	10	428
HPV56	L1	8	436
HPV56	L1	9	436
HPV56	L1	10	436
HPV56	L1	9	180
HPV56	L1	11	180
HPV56	L1	10	123
HPV56	L1	11	123
HPV56	L1	8	167
HPV56	L1	8	430
HPV56	L1	10	430
HPV56	L1	8	483
HPV56	L1	10	483
HPV56	L1	8	375
HPV56	L1	11	375
HPV56	L1	8	361
HPV56	L1	10	361
HPV56	L1	11	361

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	L1	9	91	HPV56	L1	8	520
HPV56	L1	11	91	HPV56	L1	10	520
HPV56	L1	9	226	HPV56	L1	10	100
HPV56	L1	10	226	HPV56	L1	11	67
HPV56	L1	9	28	HPV56	L1	9	446
HPV56	L1	10	28	HPV56	L1	9	332
HPV56	L1	11	28	HPV56	L1	11	279
HPV56	L1	10	172	HPV56	L1	9	261
HPV56	L1	8	197	HPV56	L1	11	261
HPV56	L1	11	197	HPV56	L1	9	489
HPV56	L1	11	511	HPV56	L1	8	373
HPV56	L1	8	228	HPV56	L1	9	373
HPV56	L1	10	228	HPV56	L1	10	373
HPV56	L1	8	31	HPV56	L1	9	182
HPV56	L1	10	473	HPV56	L1	11	182
HPV56	L1	9	221	HPV56	L1	9	86
HPV56	L1	8	255	HPV56	L1	11	86
HPV56	L1	9	155	HPV56	L1	11	323
HPV56	L1	11	146	HPV56	L1	11	380
HPV56	L1	8	496	HPV56	L1	8	304
HPV56	L1	10	496	HPV56	L1	9	377
HPV56	L1	8	13	HPV56	L1	8	415
HPV56	L1	10	13	HPV56	L1	10	415
HPV56	L1	11	4	HPV56	L1	9	188
HPV56	L1	8	467	HPV56	L1	11	188
HPV56	L1	9	467	HPV56	L1	11	212
HPV56	L1	8	50	HPV56	L1	8	215
HPV56	L1	9	50	HPV56	L1	9	215
HPV56	L1	10	50	HPV56	L1	10	215
HPV56	L1	8	522	HPV56	L1	11	215
HPV56	L1	8	52	HPV56	L1	8	370
HPV56	L1	8	189	HPV56	L1	9	370
HPV56	L1	10	189	HPV56	L1	11	370
HPV56	L1	11	189	HPV56	L1	9	366
HPV56	L1	9	410	HPV56	L1	11	366
HPV56	L1	11	410	HPV56	L1	10	57
HPV56	L1	11	288	HPV56	L1	8	326
HPV56	L1	9	339	HPV56	L1	9	326
HPV56	L1	9	362	HPV56	L1	10	326
HPV56	L1	10	362	HPV56	L1	9	513
HPV56	L1	9	504	HPV56	L1	11	513
HPV56	L1	10	504	HPV56	L1	9	173
HPV56	L1	11	504	HPV56	L1	11	173
HPV56	L1	10	384	HPV56	L1	9	246
HPV56	L1	10	187	HPV56	L1	11	246
HPV56	L1	10	213	HPV56	L1	8	420
HPV56	L1	11	213	HPV56	L1	10	420
HPV56	L1	8	297	HPV56	L1	11	259
HPV56	L1	9	297	HPV56	L1	8	87
HPV56	L1	11	297	HPV56	L1	10	87
HPV56	L1	9	349	HPV56	L1	9	214
HPV56	L1	10	159	HPV56	L1	10	214
HPV56	L1	11	159	HPV56	L1	11	214
HPV56	L1	10	110	HPV56	L1	10	365
HPV56	L1	9	131	HPV56	L1	8	56
HPV56	L1	11	131	HPV56	L1	11	56
HPV56	L1	8	65	HPV56	L1	8	367
HPV56	L1	9	272	HPV56	L1	10	367
HPV56	L1	8	417	HPV56	L1	11	367
HPV56	L1	11	417	HPV56	L1	8	134

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	L1	10	203	HPV56	L2	11	398
HPV56	L1	8	7	HPV56	L2	8	175
HPV56	L1	9	423	HPV56	L2	10	175
HPV56	L1	10	423	HPV56	L2	8	457
HPV56	L1	8	268	HPV56	L2	8	382
HPV56	L1	10	47	HPV56	L2	9	382
HPV56	L1	11	47	HPV56	L2	10	382
HPV56	L1	10	396	HPV56	L2	8	200
HPV56	L1	9	283	HPV56	L2	11	200
HPV56	L1	8	102	HPV56	L2	9	162
HPV56	L1	10	102	HPV56	L2	8	241
HPV56	L1	9	325	HPV56	L2	9	241
HPV56	L1	10	325	HPV56	L2	11	241
HPV56	L1	11	325	HPV56	L2	11	276
HPV56	L1	11	62	HPV56	L2	10	231
HPV56	L1	8	453	HPV56	L2	9	122
HPV56	L2	9	222	HPV56	L2	10	122
HPV56	L2	8	281	HPV56	L2	8	287
HPV56	L2	9	281	HPV56	L2	9	51
HPV56	L2	8	327	HPV56	L2	11	51
HPV56	L2	11	327	HPV56	L2	9	418
HPV56	L2	9	303	HPV56	L2	10	418
HPV56	L2	11	303	HPV56	L2	8	116
HPV56	L2	10	246	HPV56	L2	10	314
HPV56	L2	9	367	HPV56	L2	8	188
HPV56	L2	10	14	HPV56	L2	10	188
HPV56	L2	9	6	HPV56	L2	8	56
HPV56	L2	10	6	HPV56	L2	8	360
HPV56	L2	10	201	HPV56	L2	9	360
HPV56	L2	8	139	HPV56	L2	9	346
HPV56	L2	11	139	HPV56	L2	8	25
HPV56	L2	8	322	HPV56	L2	11	25
HPV56	L2	11	322	HPV56	L2	8	206
HPV56	L2	8	142	HPV56	L2	10	206
HPV56	L2	9	142	HPV56	L2	8	62
HPV56	L2	11	142	HPV56	L2	11	62
HPV56	L2	10	406	HPV56	L2	10	60
HPV56	L2	10	349	HPV56	L2	8	310
HPV56	L2	11	260	HPV56	L2	9	269
HPV56	L2	8	425	HPV56	L2	11	269
HPV56	L2	9	83	HPV56	L2	11	293
HPV56	L2	10	83	HPV56	L2	8	156
HPV56	L2	11	83	HPV56	L2	8	372
HPV56	L2	10	30	HPV56	L2	9	372
HPV56	L2	10	429	HPV56	L2	8	151
HPV56	L2	11	429	HPV56	L2	11	151
HPV56	L2	10	357	HPV56	L2	10	221
HPV56	L2	11	357	HPV56	L2	9	326
HPV56	L2	8	169	HPV56	L2	10	180
HPV56	L2	8	331	HPV56	L2	9	44
HPV56	L2	10	331	HPV56	L2	8	432
HPV56	L2	8	194	HPV56	L2	11	432
HPV56	L2	9	194	HPV56	L2	9	305
HPV56	L2	8	129	HPV56	L2	11	305
HPV56	L2	9	129	HPV56	L2	11	157
HPV56	L2	11	129	HPV56	L2	8	143
HPV56	L2	8	333	HPV56	L2	10	143
HPV56	L2	9	36	HPV56	L2	8	130
HPV56	L2	10	36	HPV56	L2	10	130
HPV56	L2	10	398	HPV56	L2	11	130

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	L2	8	279	HPV56	L2	10	73
HPV56	L2	10	279	HPV56	L2	8	420
HPV56	L2	11	279	HPV56	L2	11	420
HPV56	L2	11	81	HPV56	L2	10	171
HPV56	L2	9	407	HPV56	L2	11	171
HPV56	L2	10	103	HPV56	L2	8	98
HPV56	L2	11	103	HPV56	L2	9	98
HPV56	L2	9	91	HPV56	L2	10	98
HPV56	L2	8	229	HPV56	L2	10	410
HPV56	L2	9	229	HPV56	L2	11	185
HPV56	L2	10	302	HPV56	L2	8	145
HPV56	L2	8	34	HPV56	L2	11	145
HPV56	L2	11	34	HPV56	L2	8	166
HPV56	L2	8	43	HPV56	L2	11	166
HPV56	L2	10	43	HPV56	L2	10	328
HPV56	L2	10	22	HPV56	L2	11	328
HPV56	L2	11	22	HPV56	L2	8	16
HPV56	L2	8	19	HPV56	L2	11	16
HPV56	L2	8	38	HPV56	L2	9	232
HPV56	L2	8	235	HPV56	L2	11	232
HPV56	L2	8	263	HPV56	L2	10	198
HPV56	L2	9	263	HPV56	L2	9	172
HPV56	L2	9	181	HPV56	L2	10	172
HPV56	L2	11	337	HPV56	L2	11	172
HPV56	L2	8	45	HPV56	L2	8	306
HPV56	L2	8	106	HPV56	L2	10	306
HPV56	L2	8	248	HPV56	L2	8	233
HPV56	L2	11	197	HPV56	L2	10	233
HPV56	L2	9	353	HPV56	L2	10	11
HPV56	L2	8	179	HPV56	L2	8	5
HPV56	L2	11	179	HPV56	L2	10	5
HPV56	L2	9	278	HPV56	L2	11	5
HPV56	L2	11	278	HPV56	L2	11	220
HPV56	L2	9	385	HPV56	L2	11	452
HPV56	L2	9	388	HPV56	L2	8	298
HPV56	L2	8	239	HPV56	L2	10	298
HPV56	L2	9	239	HPV56	L2	10	225
HPV56	L2	10	239	HPV56	L2	8	316
HPV56	L2	11	239	HPV56	L2	11	316
HPV56	L2	10	285	HPV56	L2	10	250
HPV56	L2	8	86	HPV56	L2	10	370
HPV56	L2	11	86	HPV56	L2	11	370
HPV56	L2	11	245	HPV56	L2	9	339
HPV56	L2	9	138	HPV56	L2	8	13
HPV56	L2	8	325	HPV56	L2	11	13
HPV56	L2	10	325	HPV56	L2	11	102
HPV56	L2	10	374	HPV56	L2	9	262
HPV56	L2	8	214	HPV56	L2	10	262
HPV56	L2	9	214	HPV56	L2	9	49
HPV56	L2	10	214	HPV56	L2	11	49
HPV56	L2	10	90	HPV56	L2	9	363
HPV56	L2	8	254	HPV56	L2	11	363
HPV56	L2	10	254	HPV56	L2	8	154
HPV56	L2	11	254	HPV56	L2	10	154
HPV56	L2	8	160	HPV56	L2	9	79
HPV56	L2	9	160	HPV56	L2	9	378
HPV56	L2	11	160	HPV56	L2	10	378
HPV56	L2	8	392	HPV56	L2	10	212
HPV56	L2	8	73	HPV56	L2	11	212
HPV56	L2	9	73	HPV56	L2	8	134

Table VIII
HLA-A2 Supermotif-Bearing Peptides

HPV56	L2	10	134
HPV56	L2	11	134
HPV56	L2	8	148
HPV56	L2	10	148
HPV56	L2	11	148
HPV56	L2	9	365
HPV56	L2	11	365
HPV56	L2	9	95
HPV56	L2	10	95
HPV56	L2	11	95
HPV56	L2	9	111
HPV56	L2	10	390
HPV56	L2	8	304
HPV56	L2	10	304
HPV56	L2	8	80
HPV56	L2	8	379
HPV56	L2	9	379
HPV56	L2	11	379
HPV56	L2	8	105
HPV56	L2	9	105
HPV56	L2	9	247
HPV56	L2	9	15
HPV56	L2	8	386
HPV56	L2	11	386
HPV56	L2	8	136
HPV56	L2	9	136
HPV56	L2	11	136
HPV56	L2	9	135
HPV56	L2	10	135
HPV56	L2	9	149
HPV56	L2	10	149
HPV56	L2	11	2
HPV56	L2	9	280
HPV56	L2	10	280
HPV56	L2	8	270
HPV56	L2	10	270
HPV56	L2	11	270
HPV56	L2	8	366
HPV56	L2	10	366
HPV56	L2	10	167
HPV56	L2	8	112
HPV56	L2	10	140
HPV56	L2	11	140
HPV56	L2	8	408
HPV56	L2	8	389
HPV56	L2	11	389
HPV56	L2	11	236
HPV56	L2	9	104
HPV56	L2	10	104
HPV56	L2	8	84
HPV56	L2	9	84
HPV56	L2	10	84
HPV56	L2	8	92
HPV56	L2	9	31
HPV56	L2	11	31
HPV56	L2	11	40
HPV56	L2	8	351
HPV56	L2	11	351
HPV56	L2	8	431
HPV56	L2	9	431
HPV56	L2	10	71
HPV56	L2	11	71

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

2	3	4
L1	9	234
L2	10	329
L2	11	329
E5	8	9
E5	9	9
E5	10	9
E1	8	318
E1	10	318
L1	8	489
L1	10	489
L2	9	340
L2	11	340
E4	8	2
E4	10	2
E2	8	3
L2	8	286
L2	9	286
E2	8	72
E2	11	72
L2	10	112
L2	11	112
E1	11	112
L2	8	140
L2	11	140
L1	8	420
E1	8	475
E1	9	22
E1	11	22
E2	10	250
E1	8	65
E1	10	65
E4	9	14
E4	11	14
L2	8	228
L2	11	228
L1	11	81
L2	9	421
L2	10	421
E1	10	554
E1	11	554
E6	11	37
E5	8	79
E5	9	79
E5	11	79
E1	9	319
L1	9	203
L2	9	327
E1	10	63
L2	8	341
L2	10	341
L1	8	312
L1	10	300
E4	9	3
E4	11	3
E1	10	381
E2	11	217
L1	9	22
L1	11	22
E1	11	296
E1	10	407
E4	8	61
E4	9	61
L2	10	14
L2	11	14
E1	9	525
E1	11	525
E6	10	10
E6	8	86
E1	11	77
E1	10	101
L1	9	43
E2	10	231
L1	8	483
E1	8	601
E6	11	64
E1	11	234
E2	9	124
E2	10	124
L1	9	341
L1	11	341
E1	11	406
E1	10	473
E6	8	67
E6	9	137
E2	9	296
E2	8	35
E2	9	35
E1	8	488
E1	11	488
L1	9	153
E2	8	11
E7	9	71
E1	9	14
E1	10	14
E1	11	14
L1	8	171
E6	8	131
E2	8	252
E6	8	31
E6	9	31
E6	10	31
E6	11	31
E1	9	640
E1	10	640
E4	10	64
E4	11	64
E2	8	9
E2	10	9
E2	8	153
E1	10	516
E1	11	516
E1	8	524
E1	10	524
E2	11	230
L1	9	24
E1	8	369
E1	9	369
E1	8	170
E1	10	170

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L2	9	278	E1	8	71
L2	10	278	E1	9	71
L2	11	278	E1	9	178
E6	11	96	E2	8	174
L2	9	356	L2	9	274
L2	10	356	E1	10	250
E7	8	75	E1	8	143
E7	9	75	E2	9	2
E7	10	75	E1	8	21
L2	8	322	E1	10	21
L2	9	322	E2	8	66
L2	9	404	E2	10	66
L2	11	404	L2	8	173
E1	11	570	L2	10	173
E7	8	88	E1	10	336
E7	11	88	E1	11	336
L2	11	347	E1	11	180
L2	10	396	E1	11	62
L2	11	396	L1	11	299
E1	11	222	E1	11	100
E2	10	313	L2	8	332
L1	8	366	L2	9	332
L1	11	366	L2	10	332
E7	8	14	L2	8	192
E7	10	14	L2	9	192
L1	9	208	E1	8	105
L1	11	208	E1	9	105
E1	11	46	E1	11	105
L1	9	195	L2	11	120
L1	10	195	E6	10	42
L2	9	42	E1	8	197
L2	11	42	E1	10	197
E6	9	14	E1	11	197
E6	11	14	E2	8	17
L1	10	455	E2	10	17
L1	11	455	L2	8	334
E2	8	141	E2	9	74
E2	11	141	E2	10	74
L1	10	198	E1	11	417
E1	9	481	E1	11	360
E1	11	481	E7	11	27
E1	10	73	E2	9	341
L1	8	331	E2	10	341
L1	9	331	E7	10	73
L1	10	331	E7	11	73
L2	10	369	E6	9	92
L2	11	369	E6	10	92
E1	8	534	E6	11	92
L1	10	411	E2	9	96
L1	11	411	L2	8	135
L2	10	30	L2	10	135
L2	11	30	E4	8	75
E6	8	99	E4	9	75
L1	9	215	E4	10	75
L1	10	215	E4	11	75
L2	11	258	E2	8	185
L2	8	143	E2	9	185
L2	9	143	E7	10	39
L2	10	143	E1	8	141
E2	11	136	E1	10	141

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E1	9	39
E1	10	39
E6	8	113
E6	9	113
E6	10	113
L1	9	262
L1	10	262
L1	11	262
L1	8	103
L1	10	103
E2	8	118
E2	11	118
L1	8	381
L1	9	381
E7	9	78
E7	10	78
E2	8	205
E2	9	205
E2	11	205
E5	8	2
E5	9	2
E5	11	2
L1	11	206
L1	8	80
L1	9	252
L2	9	442
L2	11	442
E1	8	50
L1	8	369
L1	9	369
L1	10	369
E1	10	454
L2	9	428
E5	8	40
E5	9	40
E5	10	40
E5	11	40
E1	10	494
L1	8	119
E1	8	393
E1	11	393
E2	10	346
E2	11	346
L2	8	398
L2	9	398
E1	10	446
L1	9	245
E1	9	457
L2	8	239
L2	9	239
L2	10	239
L2	11	276
E1	11	18
E2	8	290
E1	8	252
E1	10	252
L1	8	371
L1	10	371
L2	8	129
L2	9	129
L2	10	129
L2	11	198
E2	11	171
E5	8	28
E5	10	28
L1	8	326
L1	11	326
E5	8	24
E5	9	24
E5	10	24
E5	11	24
L1	8	202
L1	10	202
L2	9	117
L2	10	314
L1	8	318
L1	10	318
L1	11	318
L2	8	58
E1	9	243
E1	11	194
E1	8	326
E1	9	326
E2	11	156
E1	9	350
E1	10	350
L1	10	101
L2	10	56
E7	8	22
E7	9	22
E1	8	217
E2	9	50
E2	10	50
L1	9	400
L1	10	400
L2	8	292
L2	10	223
L1	9	144
L1	11	144
E2	8	55
E2	10	55
E1	8	273
L1	8	136
L1	10	136
E1	10	162
E2	8	162
E2	11	162
L1	8	107
L2	8	300
E1	8	191
E1	9	191
L2	8	215
L2	10	215
L2	8	25
L2	11	25
E1	10	6
L2	9	64
L2	11	64
E1	8	436
E1	9	436

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L2	10	60	L2	11	149
E1	11	145	L1	10	361
E7	9	85	E2	8	29
E7	11	85	E1	10	502
L1	10	407	E7	8	5
L2	8	413	E7	9	5
L2	9	413	E7	11	5
L2	10	413	E5	8	8
E1	8	467	E5	9	8
E1	9	467	E5	10	8
E1	10	467	E5	11	8
E1	11	467	L2	11	40
E1	9	147	E1	9	98
L2	8	75	E5	8	22
L2	9	75	E5	10	22
L1	10	222	E5	11	22
E5	8	11	E1	9	474
E5	10	11	L2	8	326
E5	11	11	L2	10	326
E4	8	90	L2	8	287
E4	10	90	E5	9	21
E1	10	316	E5	11	21
L2	9	51	L1	9	272
L2	11	51	L1	11	272
L1	10	111	E5	11	31
L1	10	478	L2	9	113
E2	9	242	L2	10	113
E2	10	242	L2	8	279
L1	8	113	L2	9	279
E1	9	415	L2	10	279
E1	8	189	E6	10	97
E1	10	189	L2	10	141
E1	11	189	L2	11	141
L1	8	35	E1	10	195
L1	9	35	L2	8	178
L1	10	35	L2	9	178
E2	10	53	E5	10	32
L2	8	177	E5	11	32
L2	9	177	L2	9	44
L2	10	177	E5	9	17
E6	9	119	E5	10	17
E6	11	119	E6	8	120
E1	8	264	E6	10	120
E1	11	264	L1	9	191
E4	10	59	E1	8	313
E4	11	59	E1	10	265
E2	8	78	E1	11	265
E2	9	310	L2	8	405
E1	10	449	L2	10	405
E2	11	274	L2	8	429
L2	9	230	L2	11	429
L2	11	230	E1	8	56
E1	8	176	E1	10	56
E1	11	176	E1	11	56
E6	8	25	E1	10	571
L1	8	387	L1	8	376
E4	10	26	L1	9	376
L2	8	306	L1	11	376
L2	10	306	E1	11	341
E1	8	581	L2	11	82

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L2	9	185	L1	11	148
L2	11	185	E2	10	182
L2	8	131	E2	11	182
L2	10	131	E1	11	424
L2	11	131	E2	10	84
L1	10	187	E2	11	84
L1	11	187	E6	9	18
E4	9	83	E6	10	18
E4	10	83	E4	8	42
E4	11	83	E1	8	231
E7	10	89	E1	9	231
E7	11	11	E1	10	231
L2	10	121	E2	11	115
L2	11	121	E2	8	165
E1	10	443	E2	11	165
E2	11	287	E1	8	518
E1	8	23	E1	9	518
E1	10	23	L2	8	34
L2	9	104	L2	11	34
L2	10	104	E2	8	147
L2	11	104	E2	11	147
E5	8	34	E6	9	116
E5	9	34	E1	9	121
E5	11	34	E6	11	52
E5	8	41	E1	8	283
E5	9	41	E1	9	283
E5	10	41	E1	10	283
E5	11	41	E2	10	63
E2	10	45	E2	11	63
E1	11	553	L1	9	61
E2	8	325	L1	9	19
E2	9	325	L1	10	19
E2	10	325	L1	11	71
E2	11	325	E1	8	351
L1	9	311	E1	9	351
E6	10	123	E1	11	351
L1	11	486	E4	10	13
E1	11	433	E4	9	60
E6	11	73	E4	10	60
E2	10	351	L1	10	42
E1	8	312	L2	8	107
E1	9	312	L2	10	107
E2	9	359	E1	9	255
E2	10	359	E1	11	255
E1	8	254	E1	11	307
E1	10	254	L1	10	271
E6	11	128	E1	8	557
E1	9	357	E1	9	557
L2	10	22	E1	10	557
L2	11	22	E5	8	16
E1	9	114	E5	10	16
E1	8	420	E5	11	16
L1	8	169	E6	11	101
L1	10	169	E1	10	223
E6	8	94	E1	11	223
E6	9	94	L2	8	179
E7	8	49	E1	8	491
E2	8	47	E1	9	491
E2	10	47	E1	10	491
L1	8	148	E2	9	314

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L1	11	186	L1	11	465
L2	8	246	L1	8	209
E5	9	33	L1	10	209
E5	10	33	E1	11	132
L1	11	41	E1	8	358
E1	11	521	L2	9	23
E1	9	540	L2	10	23
E2	10	15	E4	11	81
E1	11	208	E6	9	121
E7	8	83	E1	9	555
E7	11	83	E1	10	555
E4	8	8	E1	11	555
E1	9	198	E5	8	49
E1	10	198	E5	9	49
E1	11	198	E5	11	49
E2	8	82	E5	10	70
E7	8	82	E5	11	70
E7	9	82	E1	8	268
E5	11	59	E1	9	268
E5	8	55	E1	10	268
E5	9	55	E1	11	268
E5	11	55	E1	8	115
E5	9	51	L2	8	372
E5	10	51	L2	9	372
E5	11	51	E6	10	38
E1	9	298	E5	9	61
E1	10	298	E5	10	61
E1	11	298	E5	11	61
E5	11	69	L2	8	338
E5	10	60	L2	11	338
E5	11	60	E5	8	73
E5	8	72	E5	10	73
E5	9	72	E1	8	514
E5	11	72	E1	9	514
E1	9	276	E7	9	29
E1	9	563	E5	9	47
E1	10	563	E5	10	47
E5	8	56	E5	11	47
E5	10	56	E1	8	277
E2	8	42	L1	8	295
E2	10	42	E1	8	564
E5	8	52	E1	9	564
E5	9	52	E7	8	67
E5	10	52	E7	10	67
E5	11	52	L1	8	95
E2	8	94	L1	10	95
E2	11	94	L1	10	233
E5	8	65	E4	8	1
E5	9	65	E4	9	1
E5	10	65	E4	11	1
L1	10	367	L2	8	87
L1	11	367	L2	11	87
E6	11	27	L1	11	383
L1	11	309	E1	8	306
E1	9	511	E1	10	398
E1	10	511	E1	11	398
E1	11	511	E2	8	75
E7	9	15	E2	9	75
L2	8	399	E2	11	75
L2	11	399	E2	9	56

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L1	8	338	L1	9	142
L1	9	338	L1	11	142
E2	10	151	E7	9	64
E1	10	47	E7	11	64
E1	11	47	E2	8	348
L1	8	196	E2	9	348
L1	9	196	L2	10	237
E1	10	19	L2	11	237
L1	8	154	L2	8	124
E1	11	274	L2	9	124
E1	10	361	L2	9	285
L2	8	115	L2	10	285
L2	11	115	L2	8	139
E2	9	71	L2	9	139
E2	8	249	E5	9	78
E2	11	249	E5	10	78
E6	8	36	E2	8	216
E1	11	607	E2	8	196
L2	8	270	E2	11	196
L2	10	270	L1	8	482
L2	11	270	L1	9	482
E1	10	389	L2	9	325
E6	8	5	L2	11	325
E6	9	5	L1	8	217
E1	9	329	L2	9	189
E1	9	600	L2	11	189
E1	8	270	E1	8	94
E1	9	270	E1	9	94
E1	10	270	E1	11	442
E1	11	270	E6	8	110
E1	8	451	E6	11	110
L1	11	31	E4	10	34
E1	8	300	L1	8	183
E1	9	300	L1	9	183
L2	8	366	L2	8	451
L2	10	366	L2	9	451
E1	9	55	L1	8	458
E1	11	55	L2	10	73
L1	10	445	L2	11	73
E1	8	539	E7	8	47
E1	10	539	E7	9	47
L1	9	438	E7	10	47
E6	9	21	E1	8	562
E1	11	397	E1	10	562
L1	8	337	E1	11	562
L1	9	337	E5	8	64
L1	10	337	E5	9	64
L1	8	323	E5	10	64
L1	10	323	E5	11	64
L1	11	323	E1	8	258
E1	10	304	E1	11	258
E6	9	75	L2	9	389
L2	8	38	L2	11	389
E1	11	96	L2	9	337
E2	9	127	E1	8	513
E2	11	127	E1	9	513
L1	8	289	E1	10	513
L2	9	385	L2	8	86
L2	10	377	L2	9	86
L2	11	377	L2	9	411

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

L2	10	411	L1	9	419
L2	11	411	E1	9	399
E1	10	545	E1	10	399
E1	11	545	E1	11	399
L2	11	168	E1	9	64
L2	11	243	E1	11	64
L2	8	423	E5	9	7
E2	10	354	E5	10	7
L2	8	183	E5	11	7
L2	11	183	L2	8	43
E4	8	67	L2	10	43
E4	10	67	E6	10	28
E4	11	67	E6	11	28
E1	9	182	E1	10	31
E1	11	182	E6	8	15
L2	9	359	E6	10	15
L2	10	207	L1	8	151
L2	11	207	L1	11	151
L1	9	90	L1	9	372
L1	11	90	L1	11	372
L2	9	96	L1	9	301
L2	10	96	L1	9	324
E2	9	258	L1	10	324
E2	10	258	E2	11	14
E2	11	258	E7	9	81
L2	8	171	E7	10	81
L2	9	171	E7	10	28
L2	10	171	L2	8	16
L2	11	426	L2	9	16
L2	8	158	L2	11	16
L2	9	158	E4	8	4
E7	10	20	E4	10	4
E7	11	20	E4	11	4
E5	8	19	L1	11	232
E5	11	19	L1	11	250
L1	8	266	E2	9	48
L2	11	212	E2	11	48
L1	10	175	E2	8	76
E5	8	5	E2	10	76
E5	9	5	E1	9	305
E5	11	5	E2	9	344
L1	8	16	E7	8	80
L1	10	16	E7	10	80
E2	10	222	E7	11	80
E2	11	222	E2	8	244
L2	10	418	E2	10	244
L2	8	363	E2	11	244
L2	10	363	L2	8	19
L2	11	363	L1	9	210
L2	8	91	L1	11	210
L2	8	252	E2	8	233
L2	10	252	E2	11	233
L2	8	328	L1	10	149
L2	11	328	E2	10	218
E1	9	636	E1	8	344
E1	10	636	E1	9	344
E1	11	636	L2	8	231
L1	8	177	L2	10	231
L1	10	177	L2	8	233
L1	11	177	L2	10	233

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E2	8	57
E2	11	57
E1	8	391
E1	10	391
L1	9	259
L2	8	227
L2	9	227
L1	10	53
L2	8	5
L2	10	5
L2	11	5
L2	10	11
L2	8	298
L2	10	298
L2	8	316
L2	11	316
L2	9	449
L2	10	449
L2	11	449
E2	9	7
E2	10	7
E1	8	109
L1	11	241
E1	8	125
E1	9	125
L2	8	281
L2	9	245
E2	9	303
E1	8	616
E7	9	66
E7	11	66
L1	9	94
L1	11	94
E1	9	69
E1	10	69
E1	11	69
E1	10	117
E2	8	343
E2	10	343
E1	9	343
E1	10	343
E1	9	324
E1	10	324
E1	11	324
L1	8	476
L1	9	476
L2	9	68
L2	11	68
E1	9	293
L1	8	29
L1	8	279
L1	10	279
L2	8	221
L2	9	221
L1	11	140
L1	9	488
L1	11	488
L1	8	379
L1	10	379
L1	11	379
L2	8	111
L2	11	111
L2	11	77
E6	8	3
E6	9	3
E6	10	3
E6	11	3
L2	10	181
L2	8	13
L2	11	13
E6	8	9
E6	11	9
E1	8	547
E1	9	547
E1	10	547
E1	11	547
L2	9	153
L2	9	267
L2	11	267
E5	8	30
L1	8	50
L1	9	50
L1	10	50
E2	9	207
E2	11	207
L2	8	392
L1	10	474
L1	11	474
E1	9	247
E1	10	247
L1	8	375
L1	9	375
L1	10	375
L2	8	81
L2	10	103
L2	11	103
L1	11	285
L1	10	86
L1	11	86
L2	9	49
L2	11	49
L2	8	106
L2	9	106
L2	11	106
E1	9	490
E1	10	490
E1	11	490
E2	9	81
E4	8	80
L1	9	294
E1	9	260
E1	10	260
E2	10	88
E6	10	23
L2	10	304
E2	8	150
E2	11	150
E1	10	635
E1	11	635
L1	10	418

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E1	8	354	E1	10	97
E1	9	354	E6	8	12
E7	10	45	E6	11	12
E7	11	45	E2	9	355
E2	8	23	E2	11	355
E2	9	23	L2	10	184
E4	8	86	L2	8	130
E4	9	86	L2	9	130
E4	10	86	L2	11	130
E5	8	14	E4	10	82
E5	9	14	E4	11	82
E5	10	14	E1	8	294
L1	8	335	L1	8	339
L1	10	335	L1	11	339
L1	11	335	E7	8	86
L2	8	241	E7	10	86
L2	8	210	E4	9	68
E2	8	220	E4	10	68
E2	9	226	E4	11	68
E6	10	7	L1	9	408
E2	8	201	L1	11	270
E2	9	211	E1	8	556
E2	11	211	E1	9	556
E1	8	289	E1	10	556
E1	9	289	E1	11	556
E1	10	289	E5	8	15
E1	11	289	E5	9	15
E2	8	190	E5	11	15
E2	10	190	E7	9	7
E1	11	331	E5	8	50
L1	11	7	E5	10	50
E2	10	317	E5	11	50
L1	8	281	E1	10	297
L1	10	281	E1	11	297
L1	8	189	E5	9	71
L1	9	189	E5	10	71
L1	11	189	E2	9	93
L1	10	392	L1	8	377
E2	10	40	L1	10	377
E5	8	45	E1	9	408
E5	9	45	E1	11	408
E5	11	45	E2	8	128
L2	9	260	E2	10	128
E1	8	185	E2	8	227
E1	9	185	E2	10	203
E1	11	185	E2	11	203
E2	9	198	L2	8	360
E2	11	198	L2	11	360
L2	9	164	E1	11	30
L2	11	164	L1	9	150
L2	8	145	L2	9	15
L2	10	145	L2	10	15
L1	9	343	E1	8	526
E6	8	40	E1	10	526
E1	8	192	L2	9	166
L2	8	420	L2	8	380
L2	10	420	L2	9	380
L2	11	420	L2	11	380
L2	11	409	L1	9	92
L2	9	216	L1	11	92

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E1	8	148	L2	10	378
E6	9	39	L2	11	378
E1	8	232	E4	8	92
E1	9	232	L1	9	328
L1	9	223	L1	11	328
L1	11	223	L1	10	8
E6	8	142	E1	9	317
E6	9	11	E1	11	317
L2	8	137	L2	10	339
L2	10	137	E1	10	239
L2	11	137	E1	8	519
E5	8	62	L2	8	97
E5	9	62	L2	9	97
E5	10	62	L2	11	97
E5	11	62	E1	8	291
E2	11	202	E1	9	291
L1	8	91	E1	11	291
L1	10	91	L1	8	21
L1	8	332	L1	10	21
L1	9	332	E2	8	192
L1	11	332	E2	11	192
L2	9	151	E1	9	333
L2	11	151	E1	10	333
E4	8	77	E5	10	20
E4	9	77	L2	9	31
E4	11	77	L2	10	31
E4	8	84	L2	11	31
E4	9	84	L1	8	190
E4	10	84	L1	10	190
E4	11	84	L2	10	199
E5	9	12	E7	10	12
E5	10	12	L1	9	393
E5	11	12	E6	10	53
L2	9	136	E6	11	53
L2	11	136	E4	8	7
L2	10	150	E4	9	7
E4	8	76	E1	10	275
E4	9	76	E2	9	41
E4	10	76	E2	11	41
E6	11	87	L1	9	73
L2	8	386	L1	10	73
E4	9	91	E5	8	48
E2	8	212	E5	9	48
E2	10	212	E5	10	48
E1	8	290	E5	8	46
E1	9	290	E5	10	46
E1	10	290	E5	11	46
E6	10	88	L1	8	382
E6	11	88	L1	9	176
E4	9	73	L1	11	176
E4	10	73	E7	8	69
E4	11	73	E7	11	69
E2	10	116	E1	9	79
E2	9	191	E2	8	139
E1	8	345	E2	10	139
E1	10	332	E1	9	444
E1	11	332	E2	10	288
L2	11	387	L2	8	261
E1	10	78	L2	11	261
L2	9	378	E1	9	24

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E5	8	6	E1	11	464
E5	10	6	E5	8	58
E5	11	6	E1	8	510
E7	8	79	E1	10	510
E7	9	79	E1	11	510
E7	11	79	E1	8	267
E2	8	243	E1	9	267
E2	9	243	E1	10	267
E2	11	243	E1	11	267
E2	9	232	E2	9	134
L2	9	232	E2	10	92
L2	11	232	E6	8	141
E1	9	362	E6	9	141
L2	9	419	E4	10	72
L2	11	419	E4	11	72
E7	11	55	E2	8	145
L2	9	234	E2	10	145
E7	8	6	E1	8	237
E7	10	6	E6	8	61
L2	9	364	L2	9	349
L2	10	364	E6	8	82
L2	8	165	E1	8	262
L2	10	165	E1	10	262
L2	8	379	E1	11	380
L2	9	379	E6	9	85
L2	10	379	E6	8	46
L1	10	27	E6	9	46
L2	9	146	E5	9	81
E1	8	565	L1	9	385
L1	8	344	L1	10	385
L1	10	327	E4	11	12
E1	11	238	E6	10	105
L1	8	20	E1	10	86
L1	9	20	L2	9	435
L1	11	20	E1	8	579
E5	8	25	E1	10	579
E5	9	25	E5	8	54
E5	10	25	E5	9	54
E5	11	25	E5	10	54
L1	8	329	L2	8	371
L1	10	329	L2	9	371
L1	11	329	L2	10	371
E2	8	349	E1	9	532
L1	10	72	E1	10	532
L1	11	72	L1	10	358
E2	10	58	E1	11	536
E5	8	3	L2	9	18
E5	10	3	L1	8	65
E5	11	3	L1	9	65
E7	9	68	L1	10	65
E2	8	132	E2	8	159
E2	11	132	E2	11	159
L1	8	97	L1	10	350
E2	11	321	E2	8	214
E1	9	426	E2	10	214
E5	9	36	E5	8	43
E5	11	36	E5	9	43
E1	8	340	E5	10	43
E1	8	530	E5	11	43
E1	11	530	E1	8	402

Table VIIIA HPV 6A
HLA-A2 Supermotif Peptides

E4	8	6
E4	9	6
E4	10	6
E2	8	168
L1	9	287
L1	10	287
L2	8	71
L1	8	10
L1	11	10
E2	9	138
E2	11	138
L1	8	415
E1	8	91
E1	9	91
E1	11	91
L1	11	26
E2	9	131

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

2	3	4
L1	9	234
L2	10	329
L2	11	329
E5A	9	9
E5A	10	9
E1	8	318
E1	10	318
L1	8	489
L1	10	489
L2	9	340
L2	11	340
E4	8	12
E4	10	12
E2	8	3
L2	8	286
L2	9	286
E2	8	72
E2	11	72
L2	10	112
L2	11	112
E1	11	112
L2	8	140
L2	11	140
L1	8	420
E1	8	475
E1	9	22
E1	11	22
E2	10	250
E1	8	65
E1	10	65
E4	9	24
E4	11	24
L2	8	228
L2	11	228
L1	11	81
L2	9	421
L2	10	421
E1	10	554
E1	11	554
E6	11	37
E5A	8	79
E5A	9	79
E5A	10	79
E5A	11	79
E1	9	319
L1	9	203
L2	9	327
E1	10	63
L2	8	341
L2	10	341
L1	8	312
L1	10	300
E4	9	13
E4	11	13
E1	10	381
E2	11	217
L1	9	22
L1	11	22
E1	11	296
E1	10	407
E4	8	71
E4	9	71
L2	10	14
L2	11	14
E1	9	525
E1	11	525
E6	10	10
E6	8	86
E1	11	77
E1	10	101
L1	9	43
E5B	8	36
E2	10	231
L1	8	483
E1	8	601
E6	11	64
E5B	8	20
E5B	10	20
E5B	11	20
E2	9	124
E2	10	124
L1	9	341
L1	11	341
E1	11	406
E1	10	473
E1	11	234
E6	8	67
E6	9	137
E2	9	296
E2	8	35
E1	8	488
E1	11	488
L1	9	153
E2	8	11
E5B	8	5
E5B	10	5
E7	9	71
E1	9	14
E1	10	14
E1	11	14
L1	8	171
E6	8	131
E2	8	252
E6	8	31
E6	9	31
E6	10	31
E6	11	31
E1	9	640
E1	10	640
E4	10	74
E4	11	74
E2	8	9
E2	10	9
E2	8	153
E1	10	516
E1	11	516
E1	8	524
E1	10	524
E2	11	230
L1	9	24

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E1	8	369	L2	10	143
E1	9	369	E2	8	348
E1	8	170	E2	9	348
E1	10	170	E2	9	136
L2	9	278	E2	11	136
L2	10	278	E1	8	71
L2	11	278	E1	9	71
E6	11	96	E1	9	178
E7	8	75	E2	8	174
E7	9	75	L2	9	274
E7	10	75	E1	10	250
L2	8	322	E1	8	143
L2	9	322	E2	9	2
L2	9	403	E1	8	21
L2	11	403	E1	10	21
E1	11	570	E2	8	66
L2	11	347	E2	10	66
L2	10	395	L2	8	173
L2	11	395	L2	10	173
E1	11	222	E1	10	336
E2	10	313	E1	11	336
L1	8	366	E1	11	180
L1	11	366	E1	11	62
E7	8	14	L1	11	299
E7	10	14	E1	11	100
L1	9	208	L2	8	332
L1	11	208	L2	9	332
E1	11	46	L2	10	332
L1	9	195	L2	8	192
L1	10	195	L2	9	192
L2	9	42	E1	8	105
L2	11	42	E1	9	105
E6	9	14	E1	11	105
E6	11	14	L2	11	120
L1	10	455	E6	10	42
L1	11	455	E1	8	197
L1	10	198	E1	10	197
E1	9	481	E1	11	197
E1	11	481	E2	8	17
E1	10	73	E2	10	17
L1	8	331	L2	8	334
L1	9	331	E2	9	74
L1	10	331	E2	10	74
E5B	8	11	E1	11	417
E5B	9	11	E1	11	360
E5B	11	11	E7	11	27
E2	9	143	E2	9	341
E2	10	143	E2	10	341
L2	10	369	E7	10	73
L2	11	369	E7	11	73
E1	8	534	E6	9	92
L1	10	411	E6	10	92
L1	11	411	E6	11	92
L2	10	30	E2	9	96
L2	11	30	L2	8	135
E6	8	99	L2	10	135
L1	9	215	E4	8	85
L1	10	215	E4	9	85
L2	11	258	E4	10	85
L2	8	143	E4	11	85
L2	9	143	E2	8	185

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E2	9	185	E1	9	457
E7	10	39	L2	11	276
E1	8	141	E1	11	18
E1	10	141	E2	8	290
E1	9	39	E1	8	252
E1	10	39	E1	10	252
E6	8	113	L1	8	371
E6	9	113	L1	10	371
E6	10	113	L2	8	129
L1	9	262	L2	9	129
L1	10	262	L2	10	129
L1	11	262	E2	11	171
L1	8	103	E5A	8	28
L1	10	103	E5A	10	28
E2	8	118	L1	8	326
E2	11	118	L1	11	326
L1	8	381	E5A	8	24
L1	9	381	E5A	9	24
E7	9	78	E5A	10	24
E7	10	78	E5A	11	24
E2	8	205	L2	11	198
E2	9	205	L1	8	202
E2	11	205	L1	10	202
E5A	8	2	L2	9	117
E5A	9	2	E4	9	2
E5A	11	2	E4	10	2
L1	11	206	E4	11	2
L1	8	80	L2	10	314
L1	9	252	L1	8	318
L2	9	442	L1	10	318
L2	11	442	L1	11	318
E1	8	50	L2	8	58
L1	8	369	E1	9	243
L1	9	369	E1	11	194
L1	10	369	L2	9	356
E5A	8	16	L2	10	356
E5A	10	16	E1	8	326
E5A	11	16	E1	9	326
E1	10	454	E2	11	156
L2	9	428	E1	9	350
E5B	8	22	E1	10	350
E5B	9	22	L1	10	101
E5B	10	22	L2	10	56
E5B	11	22	E7	8	22
E5A	8	40	E7	9	22
E5A	9	40	E5B	9	28
E5A	10	40	E5B	10	28
E5A	11	40	E1	8	217
E2	10	346	E2	9	50
E2	11	346	E2	10	50
E1	10	494	L1	9	400
L1	8	119	L1	10	400
E1	8	393	L2	8	292
E1	11	393	E5B	9	15
L2	8	397	E5B	10	15
L2	9	397	L2	10	223
E1	10	446	L1	9	144
L1	9	245	L1	11	144
L2	8	239	E5B	8	25
L2	9	239	E2	8	55
L2	10	239	E2	10	55

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E1	8	273	E2	8	78
L1	8	136	E2	9	310
L1	10	136	E1	10	449
E1	10	162	E1	11	449
E2	8	162	E2	11	274
E2	11	162	L2	9	230
L1	8	107	L2	11	230
L2	8	300	E1	8	176
E1	8	191	E1	11	176
E1	9	191	E6	8	25
L2	8	215	L1	8	387
L2	10	215	E4	10	36
L2	8	25	L2	8	306
L2	11	25	L2	10	306
E1	10	6	E1	8	581
L2	9	64	L2	11	149
L2	11	64	L1	10	361
E1	8	436	E2	8	29
E1	9	436	E1	10	502
L2	10	60	E7	8	5
E1	11	145	E7	9	5
L1	10	407	E7	11	5
E7	9	85	E5A	8	8
E7	11	85	E5A	10	8
L2	8	412	E5A	11	8
L2	10	412	L2	11	40
L2	11	412	E1	9	98
E1	8	467	E5A	8	22
E1	9	467	E5A	10	22
E1	10	467	E5A	11	22
E1	11	467	E1	9	474
E1	9	147	L2	8	326
L1	10	222	L2	10	326
E5A	8	11	L2	8	287
E5A	10	11	E5A	9	21
E5A	11	11	E5A	11	21
E4	8	100	L1	9	272
E4	10	100	L1	11	272
E1	10	316	E5A	11	31
L2	9	51	L2	9	113
L2	11	51	L2	10	113
L1	10	111	L2	8	279
L1	10	478	L2	9	279
E2	9	242	L2	10	279
E2	10	242	E6	10	97
L1	8	113	L2	10	141
E1	9	415	L2	11	141
E1	8	189	E1	10	195
E1	10	189	L2	8	178
E1	11	189	L2	9	178
L1	8	35	E5A	10	32
L1	9	35	E5A	11	32
L1	10	35	L2	9	44
E2	10	53	E5A	9	17
L2	8	177	E5A	10	17
L2	9	177	E6	8	120
L2	10	177	E6	10	120
E6	9	119	L1	9	191
E6	11	119	E1	8	313
E1	8	264	E1	10	265
E1	11	264	E1	11	265

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

L2	8	404	E1	9	357
L2	10	404	L2	10	22
L2	8	429	L2	11	22
L2	11	429	E1	9	114
E1	8	56	E1	8	420
E1	10	56	L1	8	169
E1	11	56	L1	10	169
E1	10	571	E6	8	94
L1	8	376	E6	9	94
L1	9	376	E7	8	49
L1	11	376	E2	8	47
E1	11	341	E2	10	47
L2	11	82	L1	8	148
L2	8	131	L1	11	148
L2	10	131	E1	11	424
L2	11	131	E6	9	18
L1	10	187	E6	10	18
L1	11	187	E4	8	52
E4	9	93	E1	8	231
E4	10	93	E1	9	231
E4	11	93	E1	10	231
E7	10	89	E2	11	115
E5B	8	23	E2	8	165
E5B	9	23	E2	11	165
E5B	10	23	E1	8	518
E7	11	11	E1	9	518
L2	10	121	L2	8	34
L2	11	121	L2	11	34
E1	10	443	E2	8	147
E2	11	287	E2	11	147
E1	8	23	E6	9	116
E1	10	23	E1	9	121
L2	9	104	E6	11	52
L2	10	104	E1	8	283
L2	11	104	E1	9	283
E5A	8	34	E1	10	283
E5A	9	34	E2	10	63
E5A	11	34	E2	11	63
E5A	8	41	L1	9	61
E5A	9	41	L1	9	19
E5A	10	41	L1	10	19
E5A	11	41	L1	11	71
E2	10	45	E1	8	351
E1	11	553	E1	9	351
E2	8	325	E1	11	351
E2	9	325	E4	10	23
E2	10	325	E4	9	70
E2	11	325	E4	10	70
L1	9	311	L1	10	42
E6	10	123	L2	8	107
L1	11	486	L2	10	107
E1	11	433	E1	9	255
E6	11	73	E1	11	255
E2	10	351	E1	11	307
E1	8	312	L1	10	271
E1	9	312	E1	8	557
E2	9	359	E1	9	557
E2	10	359	E1	10	557
E1	8	254	E6	11	101
E1	10	254	E1	10	223
E6	11	128	E1	11	223

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

L2	8	179	L1	11	367
E1	8	491	E6	11	27
E1	9	491	L1	11	309
E1	10	491	E1	9	511
E2	9	314	E1	10	511
L1	11	186	E1	11	511
L2	8	246	E7	9	15
E5A	9	33	L2	8	398
E5A	10	33	L2	11	398
L1	11	41	L1	11	465
E5B	9	18	L1	8	209
E5B	10	18	L1	10	209
E1	11	521	L2	9	74
E1	9	540	L2	10	74
E2	10	15	E5B	10	3
E1	11	208	E1	11	132
E7	8	83	E1	8	358
E7	11	83	L2	9	23
E4	8	18	L2	10	23
E1	9	198	E4	11	91
E1	10	198	E6	9	121
E1	11	198	E1	8	458
E7	8	82	E1	11	458
E7	9	82	E1	9	555
E5B	8	29	E1	10	555
E5B	9	29	E1	11	555
E5A	11	59	E5A	8	49
E5A	8	55	E5A	9	49
E5A	9	55	E5A	11	49
E5A	11	55	E5A	10	70
E5A	9	51	E5A	11	70
E5A	10	51	E1	8	268
E5A	11	51	E1	9	268
E5B	8	30	E1	10	268
E1	9	298	E1	11	268
E1	10	298	E1	8	115
E1	11	298	L2	8	372
E2	8	82	L2	9	372
E5A	11	69	E6	10	38
E5A	10	60	E5A	9	61
E5A	11	60	E5A	10	61
E5A	8	72	E5A	11	61
E5A	9	72	L2	8	338
E5A	11	72	L2	11	338
E1	9	276	E5A	8	73
E1	9	563	E5A	10	73
E1	10	563	E1	8	514
E5A	8	56	E1	9	514
E5A	10	56	E7	9	29
E2	8	42	E1	8	277
E2	10	42	E5A	9	47
E5A	8	52	E5A	10	47
E5A	9	52	E5A	11	47
E5A	10	52	L1	8	295
E5A	11	52	E2	10	222
E2	8	94	E2	11	222
E2	11	94	E1	8	564
E5A	8	65	E1	9	564
E5A	9	65	E7	8	67
E5A	10	65	E7	10	67
L1	10	367	L1	8	95

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

L1	10	95	E1	8	539
L1	10	233	E1	10	539
E4	8	11	L1	9	438
E4	9	11	E6	9	21
E4	11	11	E1	11	397
L2	8	87	L1	8	337
L2	11	87	L1	9	337
L1	11	383	L1	10	337
E5B	11	26	L1	8	323
E1	8	306	L1	10	323
E5B	11	2	L1	11	323
E1	10	398	E1	10	304
E1	11	398	E6	9	75
E2	8	75	L2	8	38
E2	9	75	E1	11	96
E2	11	75	E2	9	127
E2	9	56	E2	11	127
L1	8	338	E1	11	607
L1	9	338	L1	8	289
E2	10	151	L2	8	385
E1	10	47	L2	10	377
E1	11	47	L2	11	377
L1	8	196	L1	9	142
L1	9	196	L1	11	142
E1	10	19	E7	9	64
L1	8	154	E7	11	64
E1	11	274	L2	10	237
E1	10	361	L2	11	237
L2	8	115	L2	8	124
L2	11	115	L2	9	124
E2	9	71	L2	9	285
E2	8	249	L2	10	285
E2	11	249	L2	8	139
E6	8	36	L2	9	139
L2	8	270	L2	8	420
L2	10	270	L2	10	420
L2	11	270	L2	11	420
E1	10	389	E5A	9	78
E6	8	5	E5A	10	78
E6	9	5	E5A	11	78
E1	9	329	E2	8	216
E1	9	600	E2	8	196
E1	8	270	E2	11	196
E1	9	270	L1	8	482
E1	10	270	L1	9	482
E1	11	270	L2	9	325
E1	8	451	L2	11	325
E1	9	451	L1	8	217
L1	11	31	L2	9	189
E4	8	5	L2	11	189
E4	9	5	E1	8	94
E4	11	5	E1	9	94
E1	8	300	E1	11	442
E1	9	300	E4	10	69
L2	8	366	E4	11	69
L2	10	366	E6	8	110
E1	9	55	E6	11	110
E1	11	55	E4	10	44
E7	8	88	L1	8	183
E7	11	88	L1	9	183
L1	10	445	L2	8	451

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

L2	9	451	L1	10	175
L1	8	458	E5A	8	5
E7	8	47	E5A	9	5
E7	9	47	E5A	11	5
E7	10	47	L1	8	16
E1	8	562	L1	10	16
E1	10	562	L2	8	363
E1	11	562	L2	10	363
E5A	8	64	L2	11	363
E5A	9	64	L2	8	417
E5A	10	64	L2	11	417
E5A	11	64	L2	8	91
L2	10	73	L2	8	252
L2	11	73	L2	10	252
L2	8	389	L2	8	328
L2	10	389	L2	11	328
E1	8	258	E1	9	636
E1	11	258	E1	10	636
L2	9	337	E1	11	636
E1	8	513	L1	8	177
E1	9	513	L1	10	177
E1	10	513	L1	11	177
L2	8	86	L1	9	419
L2	9	86	E1	9	399
L2	9	410	E1	10	399
L2	10	410	E1	11	399
E1	10	545	E1	9	64
E1	11	545	E1	11	64
L2	11	168	E5A	9	7
L2	11	243	E5A	11	7
L2	8	423	L2	8	43
E2	10	354	L2	10	43
E4	8	77	E6	10	28
E4	10	77	E6	11	28
E4	11	77	E1	10	31
E1	9	182	E6	8	15
E1	11	182	E6	10	15
L2	9	359	L1	8	151
L2	10	207	L1	11	151
L2	11	207	L1	9	372
L1	9	90	L1	11	372
L1	11	90	L1	9	301
L2	8	183	L1	9	324
L2	11	183	L1	10	324
L2	9	96	E2	11	14
L2	10	96	E7	9	81
E2	9	258	E7	10	81
E2	10	258	E7	10	28
E2	11	258	L2	8	16
L2	8	171	L2	9	16
L2	9	171	L2	11	16
L2	10	171	E4	8	14
L2	11	426	E4	10	14
L2	8	158	E4	11	14
L2	9	158	L1	11	232
E7	10	20	L1	11	250
E7	11	20	E2	9	48
E5A	8	19	E2	11	48
E5A	11	19	E2	8	76
L1	8	266	E2	10	76
L2	11	212	E1	9	305

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E2	9	344	E2	10	343
E7	8	80	E1	9	343
E7	10	80	E1	10	343
E7	11	80	E2	10	84
E2	8	244	E2	11	84
E2	10	244	E1	9	324
E2	11	244	E1	10	324
L2	8	19	E1	11	324
L1	9	210	L1	8	476
L1	11	210	L1	9	476
E2	8	233	L2	9	68
E2	11	233	L2	11	68
L1	10	149	E1	9	293
L2	8	75	L1	8	29
L2	9	75	L1	8	279
E2	10	218	L1	10	279
E1	8	344	L2	8	221
E1	9	344	L2	9	221
L2	8	231	L1	11	140
L2	10	231	L1	9	488
L2	8	233	L1	11	488
L2	10	233	L1	8	379
E2	8	57	L1	10	379
E2	11	57	L1	11	379
E1	8	391	L2	8	111
E1	10	391	L2	11	111
L1	9	259	L2	11	77
L2	8	227	E6	8	3
L2	9	227	E6	9	3
L1	10	53	E6	10	3
L2	8	5	E6	11	3
L2	10	5	L2	10	181
L2	11	5	L2	8	13
L2	10	11	L2	11	13
E5B	9	35	E6	8	9
L2	8	298	E6	11	9
L2	10	298	E1	8	547
L2	8	316	E1	9	547
L2	11	316	E1	10	547
L2	9	449	E1	11	547
L2	10	449	L2	9	153
L2	11	449	L2	9	267
E2	9	7	L2	11	267
E2	10	7	E5A	8	30
E1	8	109	L1	8	50
L1	11	241	L1	9	50
E1	8	125	L1	10	50
E1	9	125	E2	9	207
L2	8	281	E2	11	207
L2	9	245	L1	10	474
E2	9	303	L1	11	474
E1	8	616	E1	9	247
E7	9	66	E1	10	247
E7	11	66	L1	8	375
L1	9	94	L1	9	375
L1	11	94	L1	10	375
E1	9	69	L2	8	81
E1	10	69	L2	10	103
E1	11	69	L2	11	103
E1	10	117	L1	11	285
E2	8	343	L1	10	86

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

L1	11	86	E2	10	40
L2	9	49	E5A	8	45
L2	11	49	E5A	9	45
L2	8	106	E5A	11	45
L2	9	106	L2	9	260
L2	11	106	E1	8	185
E1	9	490	E1	9	185
E1	10	490	E1	11	185
E1	11	490	E2	9	198
E2	9	81	E2	11	198
L2	8	391	L2	9	164
E4	8	90	L2	11	164
L1	9	294	L2	8	145
E1	9	260	L2	10	145
E1	10	260	L1	9	343
E2	10	88	E6	8	40
E6	10	23	E1	8	192
L2	10	304	L2	11	408
E2	8	150	L2	9	216
E2	11	150	E1	10	97
E1	10	635	E6	8	12
E1	11	635	E6	11	12
L1	10	418	E2	9	355
E1	8	354	E2	11	355
E1	9	354	L2	8	130
E7	10	45	L2	9	130
E7	11	45	L2	11	130
E2	8	23	E4	10	92
E2	9	23	E4	11	92
E5A	8	14	E1	8	294
E5A	9	14	L1	8	339
E5A	10	14	L1	11	339
E4	8	96	E4	9	78
E4	9	96	E4	10	78
E4	10	96	E4	11	78
E2	9	226	L1	9	408
E2	8	220	L1	11	270
L1	8	335	E1	8	556
L1	10	335	E1	9	556
L1	11	335	E1	10	556
L2	8	241	E1	11	556
L2	8	210	E7	9	7
E6	10	7	E5A	8	50
E2	8	201	E5A	10	50
E2	9	211	E5A	11	50
E2	11	211	E1	10	297
E1	8	289	E1	11	297
E1	9	289	E5A	9	71
E1	10	289	E5A	10	71
E1	11	289	E7	8	86
E2	8	190	E7	10	86
E2	10	190	E2	9	93
E1	11	331	L1	8	377
L1	11	7	L1	10	377
E2	10	317	E2	11	221
L1	8	281	E1	9	408
L1	10	281	E1	11	408
L1	8	189	E2	8	128
L1	9	189	E2	10	128
L1	11	189	E5B	11	59
L1	10	392	E2	10	203

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E2	11	203	E1	8	290
L2	8	360	E1	9	290
L2	11	360	E1	10	290
E1	11	30	E6	10	88
L1	9	150	E6	11	88
L2	9	15	E4	9	83
L2	10	15	E4	10	83
E1	8	526	E4	11	83
E1	10	526	E2	10	116
L2	9	166	E2	9	191
L2	8	380	E1	8	345
L2	9	380	E1	10	332
L2	11	380	E1	11	332
L1	9	92	L2	10	387
L1	11	92	E1	10	78
E1	8	148	L2	9	378
E6	9	39	L2	10	378
L1	9	223	L2	11	378
L1	11	223	L2	10	184
E1	8	232	E4	8	102
E1	9	232	L1	9	328
E6	8	142	L1	11	328
E5B	9	63	L1	10	8
E6	9	11	E1	9	317
L2	8	137	E1	11	317
L2	10	137	L2	10	339
L2	11	137	E1	10	239
E5A	8	62	E1	8	519
E5A	9	62	L2	8	97
E5A	10	62	L2	9	97
E5A	11	62	L2	11	97
E2	11	202	E1	8	291
L1	8	91	E1	9	291
L1	10	91	E1	11	291
L1	8	332	L1	8	21
L1	9	332	L1	10	21
L1	11	332	E2	8	192
L2	9	151	E2	11	192
L2	11	151	E1	9	333
E4	8	87	E1	10	333
E4	9	87	E5A	10	20
E4	11	87	L2	9	31
E5A	9	12	L2	10	31
E5A	10	12	L2	11	31
E5A	11	12	L1	8	190
E4	8	94	L1	10	190
E4	9	94	E7	10	12
E4	10	94	L1	9	393
E4	11	94	E6	10	53
L2	9	136	E6	11	53
L2	11	136	E4	8	17
L2	10	150	E4	9	17
E4	8	86	E1	10	275
E4	9	86	E2	9	41
E4	10	86	E2	11	41
E6	11	87	L1	9	73
L2	11	386	L1	10	73
E4	9	101	E5A	8	48
E2	8	212	E5A	9	48
E2	10	212	E5A	10	48
E2	11	212	E5A	8	46

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E5A	10	46
E5A	11	46
E4	8	10
E4	9	10
E4	10	10
L1	8	382
L1	9	176
L1	11	176
E7	8	69
E7	11	69
E1	9	79
E2	8	139
E2	10	139
E1	9	444
E2	10	288
L2	8	261
L2	11	261
E1	9	24
E5A	8	6
E5A	10	6
E7	8	79
E7	9	79
E7	11	79
E2	8	243
E2	9	243
E2	11	243
E2	9	232
L2	9	232
L2	11	232
E1	9	362
E7	11	55
L2	9	234
E7	8	6
E7	10	6
L2	9	364
L2	10	364
L2	10	418
L2	8	165
L2	10	165
L2	8	379
L2	9	379
L2	10	379
L1	10	27
L2	9	185
L2	11	185
L2	9	146
E1	8	565
L1	8	344
L1	10	327
E1	11	238
L1	8	20
L1	9	20
L1	11	20
E5A	8	25
E5A	9	25
E5A	10	25
E5A	11	25
L1	8	329
L1	10	329
L1	11	329
E2	8	349
L1	10	72
L1	11	72
E2	10	58
E5A	8	3
E5A	10	3
E5A	11	3
E7	9	68
L2	10	199
E2	8	132
L1	8	97
E2	11	321
E1	9	426
E5A	9	36
E5A	11	36
E1	8	340
E1	8	530
E1	11	530
E5B	9	13
E5B	11	13
E1	11	464
E5B	8	17
E5B	10	17
E5B	11	17
E5A	8	58
E1	8	510
E1	10	510
E1	11	510
E1	8	267
E1	9	267
E1	10	267
E1	11	267
E2	11	134
E2	10	92
E6	8	141
E6	9	141
E4	10	82
E4	11	82
E2	8	145
E2	10	145
E1	8	237
E6	8	61
L2	9	349
E6	8	82
E1	8	262
E1	10	262
E1	11	380
E6	9	85
E6	8	46
E6	9	46
L1	9	385
L1	10	385
E5A	8	81
E5A	9	81
E4	11	22
E6	10	105
E1	10	86
L2	9	435
E1	8	579
E1	10	579
E5A	8	54
E5A	9	54

Table VIIIB HPV 6B
HLA-A2 Supermotif Peptides

E5A	10	54
L2	8	371
L2	9	371
L2	10	371
E1	9	532
E1	10	532
L1	10	358
E1	11	536
L2	9	18
L1	8	65
L1	9	65
L1	10	65
E2	8	159
E2	11	159
L1	10	350
E2	8	214
E2	9	214
E2	10	214
E5A	8	43
E5A	9	43
E5A	10	43
E5A	11	43
E5B	8	62
E5B	10	62
E1	8	402
E4	8	16
E4	9	16
E4	10	16
E4	9	9
E4	10	9
E4	11	9
E2	8	168
L1	9	287
L1	10	287
L2	8	71
L1	8	10
L1	11	10
E2	9	138
E2	11	138
L1	8	415
E1	8	91
E1	9	91
E1	11	91
E5B	8	57
L1	11	26
E2	9	131

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

2	3	4
E5	8	9
E5	9	9
E5	10	9
E6	9	62
L1	9	235
L2	10	328
L2	11	328
L2	9	339
L2	11	339
E4	8	12
E4	10	12
L2	8	86
L2	11	86
E2	8	282
E5	8	10
E5	9	10
E5	11	10
E6	11	83
E2	8	3
E2	8	72
E2	11	72
L2	10	111
L2	11	111
E1	11	112
L2	8	139
L2	11	139
E1	10	407
L1	8	421
L2	8	80
L2	8	285
L2	9	285
E1	9	22
E1	11	22
E1	8	475
E1	8	65
E1	10	65
L1	11	81
L2	9	417
L2	10	417
L2	8	227
L2	11	227
E1	10	554
E1	11	554
E6	9	37
E6	11	37
E4	8	24
E4	9	24
E4	11	24
E1	9	319
L1	9	204
E1	10	63
L1	8	313
L1	10	301
E4	9	13
E4	11	13
E7	10	45
E7	11	45
E1	10	381
E2	8	217
E2	10	217
L1	9	22
L1	11	22
L2	9	22
L2	10	22
L2	10	13
L2	11	13
E1	9	525
E1	11	525
E6	10	10
E5	8	11
E5	10	11
E5	11	11
E1	11	77
E5	8	25
E5	9	25
E5	10	25
E5	11	25
E1	10	181
E1	10	101
L1	9	43
E5	8	37
E5	11	37
E5	8	26
L1	8	484
E1	8	601
E6	11	64
E1	11	234
E1	11	406
E5	10	46
E5	11	46
L1	8	342
L1	9	342
L1	11	342
E1	10	473
E5	8	27
E5	9	27
E5	10	27
E5	11	27
E2	8	35
E2	9	35
E6	8	67
E6	9	137
E2	9	295
E1	8	488
E1	11	488
L1	9	154
E2	8	11
E7	9	71
E1	9	14
E1	10	14
E1	11	14
E2	9	227
E1	9	289
E1	10	289
E1	11	289
E2	8	251
E2	11	251
E5	10	73
E6	8	31

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E6	9	31	E1	8	191
E6	10	31	E1	9	191
E6	11	31	E2	8	96
E1	9	640	E2	9	96
E1	10	640	L1	8	332
E4	10	73	L1	9	332
E4	11	73	L1	10	332
E2	8	9	E5	8	12
E2	10	9	E5	10	12
E1	10	250	E5	11	12
E1	10	73	E1	8	534
E2	8	153	L1	10	412
E1	10	516	L1	11	412
E1	11	516	L2	9	29
E1	11	607	L2	10	29
E7	11	44	L2	11	29
E6	9	5	L1	9	216
E1	8	524	L1	10	216
E1	10	524	L2	11	257
L1	9	24	L2	8	142
E1	8	369	L2	9	142
E1	9	369	L2	10	142
L2	9	277	E1	8	71
L2	10	277	E1	9	71
L2	11	277	E1	9	178
E6	11	96	L2	9	273
L2	8	191	E2	9	2
L2	9	191	E1	8	21
E7	8	75	E1	10	21
E7	9	75	E1	10	336
E7	10	75	E1	11	336
E1	11	570	E2	8	324
L2	8	321	E2	9	324
L2	9	321	E2	10	324
L2	9	399	E2	11	324
L2	11	399	E1	11	62
L2	10	346	E2	8	174
E1	11	222	L1	11	300
E7	9	81	L2	8	172
E7	10	81	L2	10	172
L1	8	367	E1	11	180
L1	11	367	E6	8	113
E7	8	14	E6	9	113
E7	10	14	L2	8	331
L1	9	209	L2	9	331
L1	11	209	L2	10	331
L1	9	439	E1	8	105
E1	11	46	E1	9	105
L1	9	196	E1	11	105
L1	10	196	E6	10	42
L1	10	456	E2	10	312
L1	11	456	L2	8	333
L2	9	41	E1	8	197
L2	11	41	E1	11	197
E6	9	14	E2	8	17
E6	11	14	E2	10	17
L1	10	199	E1	11	417
E1	9	481	E2	9	74
E1	11	481	E2	10	74
E1	11	164	E1	11	360

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E7	11	27
E2	10	340
E2	8	66
E2	10	66
E6	9	92
E6	10	92
E6	11	92
E2	8	185
E2	9	185
E7	10	36
E1	8	141
E1	9	39
E1	10	39
L1	8	103
L1	10	103
E2	11	118
L1	8	382
L1	9	382
E2	8	205
E2	9	205
E2	11	205
L2	11	119
E5	8	2
E5	9	2
E5	10	2
E5	11	2
E6	8	61
E6	10	61
L1	11	207
L1	8	80
L1	9	253
L1	11	253
L2	9	438
L2	11	438
E5	8	24
E5	9	24
E5	10	24
E5	11	24
E1	8	50
L1	8	370
L1	9	370
L1	10	370
E1	8	454
E1	10	454
L2	9	424
E1	10	494
L1	11	464
E1	8	393
E1	11	393
E2	10	345
E2	11	345
E1	10	446
E1	9	457
L2	8	238
L2	9	238
L2	10	238
E5	9	16
E5	10	16
E5	11	16
L2	11	275
E1	10	18
E1	11	18
L2	8	319
L2	10	319
L2	11	319
E1	8	252
E1	10	252
L1	8	372
L1	10	372
L2	11	154
E5	8	20
E5	9	20
E5	11	20
L2	9	262
L2	9	128
L2	10	128
L2	8	393
L2	9	393
L1	8	327
L1	11	327
E5	8	23
E5	9	23
E5	10	23
E5	11	23
L2	11	197
E5	8	40
E5	9	40
E5	10	40
E5	11	40
L2	8	61
L2	11	61
L1	8	203
L1	10	203
L2	9	116
L2	10	313
L1	8	319
L1	10	319
L1	11	319
E1	9	243
E1	11	194
E1	8	326
E1	9	326
E2	11	156
L1	10	101
L2	8	55
E7	8	22
E5	9	29
E5	10	29
E2	8	55
E2	9	55
E2	10	55
E1	8	217
E2	9	50
E2	10	50
L1	9	401
L1	10	401
L2	8	291
L2	10	222
L1	9	145
L1	11	145

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E1	8	273	E2	8	78
L1	8	137	E2	9	309
L1	10	137	L1	9	325
E1	10	160	L1	10	325
E2	8	162	E5	9	7
L2	8	309	E5	11	7
L1	8	107	E1	9	305
L2	8	299	E1	10	449
L2	8	24	E2	10	273
L2	11	24	E2	11	273
E5	8	40	E6	8	25
E1	10	6	L1	8	388
L2	10	59	E4	10	36
L1	10	408	L1	8	290
E1	11	296	L2	8	36
E7	9	85	L2	9	36
E7	11	85	L2	11	148
L2	8	408	E4	8	64
L2	10	408	E4	11	64
L2	11	408	L2	9	188
E1	8	467	L2	11	188
E1	9	467	L1	10	362
E1	10	467	E5	8	8
E1	11	467	E5	9	8
L1	9	169	E5	10	8
E4	8	99	E5	11	8
E4	10	99	E1	8	248
L1	10	223	E1	9	248
L1	11	262	L2	11	39
E1	9	173	E2	8	208
E1	10	173	E2	10	208
E2	10	88	E5	8	22
L2	9	50	E5	10	22
L2	11	50	E5	11	22
L1	9	111	E1	9	474
L1	10	111	E4	8	5
E1	10	316	E4	9	5
E2	10	232	E4	11	5
L1	8	113	E5	8	34
E1	8	189	E5	9	34
E1	10	189	E5	11	34
E1	11	189	L2	9	112
E1	9	415	L2	10	112
L1	8	35	L2	8	278
L1	9	35	L2	9	278
L1	10	35	L2	10	278
E2	10	53	L2	10	140
E2	11	53	L2	11	140
E6	9	119	E1	10	195
E6	11	119	E6	8	120
L2	8	176	E6	10	120
L2	9	176	L2	8	177
L2	10	176	L2	9	177
E2	8	29	E5	8	35
E2	10	29	E5	10	35
E1	8	264	E6	10	97
E1	11	264	L2	9	43
E1	9	55	E5	9	17
E1	11	55	E5	10	17
E2	11	136	E5	8	28

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E5	9	28
E5	10	28
E1	9	408
E1	11	408
E2	9	30
E6	9	29
E6	10	29
E6	11	29
L1	9	192
L2	9	165
E1	8	313
E1	10	265
E1	11	265
L2	8	400
L2	10	400
L2	11	81
L2	8	425
L2	11	425
L1	8	377
L1	9	377
L1	11	377
E1	8	56
E1	10	56
E1	11	56
E1	11	341
L2	9	184
L2	11	184
L2	8	286
L2	8	130
L2	10	130
L2	11	130
L1	10	188
L1	11	188
E4	9	92
E4	10	92
E4	11	92
E1	8	23
E1	10	23
E7	11	11
E5	11	31
E1	10	443
E2	11	286
L2	9	103
L2	10	103
L2	11	103
E2	10	45
L1	9	312
L2	10	21
L2	11	21
E6	11	73
E2	10	350
E1	8	312
E1	9	312
E1	8	254
E1	10	254
E6	9	116
E1	9	460
E6	11	128
E1	9	357
E1	9	114
E1	8	420
E7	8	42
L1	8	433
E2	8	112
E2	8	47
E2	10	47
L1	8	149
L1	11	149
E1	9	424
E1	11	424
E4	8	53
E6	9	18
E6	10	18
E2	10	84
E2	11	84
E2	11	165
E1	8	518
E1	9	518
E7	10	39
E7	11	39
E1	11	433
L2	8	33
L2	11	33
E2	9	358
E2	10	358
E1	9	121
E6	8	99
E1	8	283
E1	9	283
E1	10	283
L1	10	53
L1	9	61
E2	8	147
E2	11	147
L1	9	19
L1	11	71
E6	11	52
E1	8	351
E1	9	351
E1	11	351
E2	8	82
E4	9	23
E4	10	23
E2	9	313
L1	10	42
L2	8	106
L2	10	106
E1	9	255
E1	11	255
E1	11	307
E5	9	33
E5	10	33
E1	8	557
E1	9	557
E1	10	557
E1	8	491
E1	9	491
E1	10	491
E5	8	16
E5	10	16

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E5	11	16	E5	8	65
E6	11	101	E5	10	65
E1	10	223	L1	10	368
E1	11	223	L1	11	368
L2	8	178	L2	8	260
E5	9	36	L2	11	260
E5	11	36	E2	8	289
L1	11	187	E6	11	27
L1	11	41	L1	11	310
E1	11	521	E1	9	511
E1	9	540	E1	10	511
E2	10	15	E1	11	511
E7	8	83	E7	9	15
E7	11	83	L2	10	228
E2	8	42	L1	9	466
E2	10	42	L1	11	466
E4	8	18	L1	8	210
E5	10	32	L1	10	210
E1	10	198	E2	8	56
E1	11	198	E2	9	56
E7	8	82	E7	11	55
E7	9	82	E5	10	4
E5	8	31	E1	8	514
E5	11	31	E1	9	514
E5	8	30	E1	11	132
E5	9	30	E1	8	358
E5	11	59	E4	11	90
E5	8	55	E5	10	70
E5	9	55	E1	9	555
E5	11	55	E1	10	555
E5	9	51	E1	11	555
E5	10	51	E5	8	49
E5	11	51	E5	9	49
E1	9	298	E5	11	49
E1	10	298	E1	8	268
E1	11	298	E1	9	268
L1	8	119	E1	10	268
L1	10	465	E1	11	268
E5	11	69	E7	8	48
E5	10	60	E7	9	48
E5	11	60	L2	8	368
E1	9	276	E6	8	38
E1	9	563	E6	10	38
E5	8	56	E4	9	69
E5	10	56	E5	9	61
E5	8	52	E5	10	61
E5	9	52	E5	11	61
E5	10	52	E1	8	115
E5	11	52	E2	11	62
E4	10	45	L2	8	337
E4	11	45	L2	11	337
E7	8	79	L1	11	273
E7	9	79	E1	8	277
E7	11	79	E5	9	47
E2	8	139	E5	10	47
E2	10	139	E5	11	47
E2	11	139	L1	8	296
E2	8	94	E7	8	5
E2	10	94	E7	9	5
E2	11	94	E7	11	5

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E1	8	564
L2	8	245
E7	10	67
L1	8	95
L1	10	95
L1	10	234
E4	8	11
E4	9	11
E4	11	11
L1	11	384
E1	8	306
E5	11	3
E1	10	398
E1	11	398
E2	8	75
E2	9	75
E2	11	75
L1	11	339
E1	10	47
E1	11	47
L1	8	197
L1	9	197
E1	9	19
E1	10	19
L1	8	155
E1	11	274
E5	8	1
E1	10	361
E4	10	1
E4	11	1
L2	8	114
L2	11	114
E2	9	71
E6	8	36
E6	10	36
L2	8	269
L2	10	269
L2	11	269
E1	10	389
E1	9	329
E1	11	100
E1	9	600
E1	8	270
E1	9	270
E1	10	270
E1	11	270
E1	8	451
E1	11	451
L1	11	31
E1	8	300
E1	9	300
E2	8	254
E2	9	254
E7	8	88
L1	10	446
E1	8	539
E1	10	539
E6	9	21
E1	11	397
L1	8	338
E6	8	131
E6	9	75
E6	10	75
E2	8	248
E2	11	248
L2	10	373
L2	11	373
E5	9	54
L2	8	381
E1	10	97
L1	9	143
L1	11	143
E2	9	127
E2	11	127
E7	9	64
L2	8	85
L2	9	85
L2	10	236
L2	11	236
E5	9	78
E5	10	78
L2	8	138
L2	9	138
L2	8	79
L2	9	79
L2	9	284
L2	10	284
L2	8	416
L2	10	416
L2	11	416
E2	8	216
E2	9	216
E2	11	216
E2	8	196
E2	11	196
L1	8	483
L1	9	483
E4	8	4
E4	9	4
E4	10	4
L2	10	354
L2	11	354
E1	8	94
E1	9	94
E1	11	442
E6	8	110
E6	11	110
L1	8	218
L1	8	184
L1	9	184
L2	8	447
L2	9	447
L2	8	157
L2	9	157
L1	10	161
L1	8	459
L2	9	72
L2	10	72
L2	11	72
L1	11	109

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

L1	9	118
E4	8	30
E1	8	562
E1	10	562
L2	11	211
E4	11	44
E5	8	64
E5	9	64
E5	11	64
L2	10	385
E1	8	258
E1	11	258
E1	8	513
E1	9	513
E1	10	513
E7	8	47
E7	9	47
E7	10	47
E4	10	68
L2	9	336
E1	10	545
E1	11	545
L2	11	167
L2	11	242
L2	8	419
E2	10	353
L2	8	182
L2	11	182
L2	8	123
L2	9	123
E4	8	76
E4	11	76
L2	10	206
L1	9	90
L1	11	90
E2	9	211
E2	10	211
E2	11	211
E6	11	87
E2	8	222
L2	9	95
L2	10	95
L2	8	170
L2	9	170
L2	10	170
L2	11	422
E7	10	20
L2	8	90
L1	8	267
L2	11	358
E5	8	5
E5	9	5
E5	10	5
E5	11	5
L1	8	16
L1	10	16
L2	8	413
L2	11	413
L2	9	324
L2	11	324
E5	8	19
E5	10	19
E5	11	19
L2	8	251
L2	10	251
L2	8	327
L2	11	327
E1	10	636
E1	11	636
L1	9	420
E1	9	399
E1	10	399
E1	11	399
E1	9	64
E1	11	64
E5	8	7
E5	9	7
E5	10	7
E5	11	7
L2	8	42
L2	10	42
E6	10	28
E6	11	28
E1	10	31
E6	8	15
E6	10	15
L1	8	152
L1	11	152
L1	9	373
L1	11	373
E7	10	28
L1	9	302
E2	11	14
E7	9	78
E7	10	78
E2	9	288
L2	8	15
L2	9	15
L2	11	15
E4	8	14
E4	10	14
E4	11	14
L1	11	233
L1	11	251
E2	9	48
E2	11	48
E2	8	76
E2	10	76
E2	9	343
L2	9	229
L2	11	229
L2	8	18
L1	9	211
L1	11	211
L1	10	150
E2	9	218
E2	11	218
E1	8	344
E1	9	344
L2	8	230

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

L2	10	230
L2	8	232
L2	10	232
E2	8	57
E2	11	57
E1	8	391
E1	10	391
L2	8	214
L2	10	214
L1	9	260
L2	8	226
L2	9	226
E1	11	553
E1	8	318
E1	10	318
E2	10	240
E2	11	240
L2	8	4
L2	10	4
L2	11	4
L2	10	10
E5	9	36
L2	8	297
L2	10	297
L2	8	315
L2	11	315
L2	9	445
L2	10	445
L2	11	445
E2	9	7
E2	10	7
E1	8	109
E1	9	109
E2	10	37
E1	8	125
E1	9	125
L1	11	242
E4	11	59
L2	8	280
E2	9	302
E1	8	616
E7	8	4
E7	9	4
E7	10	4
L2	9	244
E7	11	66
L1	9	94
L1	11	94
E1	9	69
E1	10	69
E1	11	69
E7	8	77
E7	10	77
E7	11	77
E2	8	342
E2	10	342
E1	9	343
E1	10	343
L1	8	477
L1	9	477
E1	9	324
E1	10	324
E1	11	324
E1	9	293
L1	8	29
L1	8	473
E1	8	231
E1	9	231
E1	10	231
L2	8	220
L2	9	220
L1	11	141
E2	9	281
E2	9	225
E2	11	225
L1	8	380
L1	10	380
L1	11	380
L2	8	110
L2	11	110
E2	8	234
L2	10	180
L1	10	475
L1	11	475
L2	8	12
L2	11	12
E6	8	9
E6	11	9
E1	9	247
E1	10	247
E2	9	207
E2	11	207
E2	8	23
E2	9	23
E6	8	12
E6	11	12
E1	8	547
E1	9	547
E1	10	547
E1	11	547
L2	9	266
L2	11	266
L1	8	50
L1	9	50
L1	10	50
E1	11	422
L2	8	387
L1	8	376
L1	9	376
L1	10	376
E5	8	30
L2	10	102
L2	11	102
L1	11	286
E1	9	350
E1	10	350
E2	9	81
L1	10	86
L1	11	86
L2	9	48

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

L2	11	48
E6	10	23
L2	8	105
L2	9	105
L2	11	105
E1	9	490
E1	10	490
E1	11	490
L2	9	259
E4	8	89
L1	9	295
E1	9	260
E1	10	260
L2	9	406
L2	10	406
L2	10	303
E1	11	635
L1	10	419
E1	8	354
E1	9	354
L2	9	186
L2	11	186
L2	8	376
L2	9	376
L2	11	376
L1	9	489
L1	11	489
E2	8	260
E4	8	95
E4	9	95
E4	10	95
L1	8	336
L1	10	336
E2	8	245
E2	9	245
E2	11	245
L2	8	240
E1	8	185
E1	11	185
E6	10	7
L2	9	135
L2	11	135
E4	8	85
E4	9	85
E4	10	85
E2	8	190
E2	10	190
E1	11	331
E2	8	201
E2	9	201
L1	11	7
E2	10	316
L1	8	282
L1	10	282
E2	10	151
E2	9	257
E2	10	257
E2	11	257
L2	9	152
E1	8	436
E1	9	436
L1	8	190
L1	9	190
L1	11	190
L2	9	163
L2	11	163
E2	8	348
L1	10	393
E2	10	40
E5	8	45
E5	9	45
E5	11	45
L1	10	176
L1	9	344
E2	9	198
E2	11	198
L2	8	144
L2	10	144
L2	8	362
L2	10	362
E6	8	40
E5	8	21
E5	10	21
E5	11	21
L1	8	490
L1	10	490
E2	9	220
E2	10	220
L2	11	404
E2	9	354
E2	11	354
L2	10	183
L2	8	129
L2	9	129
L2	11	129
E4	10	91
E4	11	91
L1	10	340
L1	11	340
E2	10	249
E5	9	71
L1	9	409
E1	8	294
E1	8	556
E1	9	556
E1	10	556
E1	11	556
E5	8	15
E5	9	15
E5	11	15
E7	9	7
E5	8	50
E5	10	50
E5	11	50
E1	10	297
E1	11	297
E7	8	86
E7	10	86
E2	9	93
E2	11	93

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

L1	8	378	E5	9	13
L1	10	378	E5	10	13
L2	9	374	E5	11	13
L2	10	374	L2	10	149
L2	11	374	E5	9	12
L2	9	326	E5	10	12
L1	8	170	E5	11	12
L2	8	124	E5	8	55
E7	8	49	E4	9	100
E1	11	30	E2	8	212
L1	9	151	E2	9	212
L2	9	14	E2	10	212
L2	10	14	E1	8	290
E1	9	57	E1	9	290
E1	10	57	E1	10	290
E1	8	526	L1	9	224
E1	10	526	L1	11	224
E1	10	117	E6	10	88
L1	9	92	E6	11	88
L1	11	92	L1	10	263
L2	8	364	L1	11	263
L2	11	364	E2	9	191
E2	9	85	E1	8	345
E2	10	85	E1	10	332
E6	9	39	E1	11	332
E2	8	219	E1	10	78
E2	10	219	E4	9	82
E2	11	219	E4	10	82
E1	8	232	E4	11	82
E1	9	232	E2	8	202
E6	8	142	E2	11	202
E2	8	228	E2	11	223
L2	8	37	E2	10	63
E5	8	14	E2	11	63
E5	9	14	E4	8	101
E5	10	14	L1	9	329
L2	8	136	L1	11	329
L2	10	136	L1	10	8
L2	11	136	L2	10	338
E4	8	70	E1	10	239
E5	8	62	E1	11	239
E5	9	62	E1	8	519
E5	10	62	E1	9	98
E5	11	62	E2	10	252
E1	11	116	E2	11	252
L1	8	91	L2	8	96
L1	10	91	L2	9	96
L1	8	333	L2	11	96
L1	9	333	E1	8	291
L1	11	333	E1	9	291
E4	8	86	E1	11	291
E4	9	86	L1	9	283
E4	11	86	L1	10	21
E4	8	93	E5	8	25
E4	9	93	E5	9	25
E4	10	93	E5	8	21
E4	11	93	E5	9	21
L2	9	150	E5	11	21
L2	11	150	E2	8	192
E5	8	13	E2	11	192

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E1	9	333
E1	10	333
L2	8	30
L2	9	30
L2	10	30
L2	11	30
L1	8	191
L1	10	191
L2	8	164
L2	10	164
E7	10	12
L1	9	394
E5	11	27
E5	10	32
E5	11	32
E2	9	41
E2	11	41
E4	8	17
E4	9	17
E1	10	275
L1	9	73
L1	10	73
E5	8	48
E5	9	48
E5	10	48
E5	8	46
E5	10	46
E5	11	46
E4	8	10
E4	9	10
E4	10	10
L1	8	383
E2	8	128
E2	10	128
E1	9	79
E1	9	444
L2	10	359
L2	11	359
E5	8	6
E5	9	6
E5	10	6
E5	11	6
E2	10	287
L1	9	177
L1	11	177
L2	8	394
L2	11	394
E4	8	83
E4	9	83
E4	10	83
E4	11	83
L2	9	231
L2	11	231
E1	9	362
L2	9	233
E7	8	6
E7	10	6
L2	9	145
L2	10	414
L2	8	325
L2	10	325
L2	9	363
E2	10	148
L1	10	328
E1	11	238
L1	8	20
L1	11	20
E5	8	24
E5	9	24
E5	10	24
L1	8	330
L1	10	330
L1	11	330
E7	9	68
E5	9	20
E5	10	20
L1	10	72
L1	11	72
E4	9	2
E4	10	2
E4	11	2
E2	10	58
L2	10	120
L2	11	120
E5	8	3
E5	9	3
E5	10	3
E5	11	3
L2	10	198
E6	10	53
E6	11	53
E2	8	132
E5	8	41
E5	9	41
E5	10	41
E5	11	41
L1	8	97
E2	11	320
E1	9	426
E1	8	340
E5	8	14
E5	9	14
E5	11	14
E5	8	18
E5	9	18
E5	10	18
E5	11	18
E1	11	464
E5	8	58
E1	8	510
E1	10	510
E1	11	510
E1	8	267
E1	9	267
E1	10	267
E1	11	267
E2	10	92
E6	8	141
E6	9	141
E4	10	81

Table VIIIC HPV11
HLA-A2 Supermotif Peptides

E4	11	81
E1	8	530
E1	11	530
E2	8	145
E2	10	145
E1	8	237
E6	8	82
L2	8	348
E1	8	262
E1	10	262
E6	9	85
E1	11	380
E6	8	44
E6	10	44
E6	11	44
E6	8	46
E6	9	46
E5	9	81
L1	9	386
L1	10	386
L2	11	70
E4	10	22
E4	11	22
E6	10	105
E1	10	86
L2	9	431
E1	8	579
E1	10	579
E5	8	54
E5	9	54
E5	10	54
E2	9	138
E2	11	138
L1	9	246
L2	8	367
L2	9	367
E1	9	532
E1	10	532
L1	10	359
E1	11	536
E5	11	61
L2	9	17
L1	8	65
L1	9	65
L1	10	65
E2	8	159
E2	11	159
L1	10	351
E2	8	214
E2	10	214
E2	11	214
L2	8	305
L2	10	305
E5	8	43
E5	9	43
E5	10	43
E5	11	43
L1	9	288
L1	10	288
E1	8	402
L1	11	26
E4	8	16
E4	9	16
E4	10	16
E4	9	9
E4	10	9
E4	11	9
E2	8	168
E1	10	502
L1	8	10
L1	11	10
L1	8	416
E1	8	91
E1	9	91
E1	11	91
E2	9	131

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Table IX
HLA-A3 Supermotif Peptides

1	2	3	4
HPV16	E1	8	316
HPV16	E1	8	205
HPV16	E1	9	112
HPV16	E1	9	69
HPV16	E1	11	459
HPV16	E1	8	406
HPV16	E1	9	406
HPV16	E1	8	82
HPV16	E1	9	405
HPV16	E1	10	405
HPV16	E1	10	114
HPV16	E1	11	114
HPV16	E1	8	304
HPV16	E1	10	304
HPV16	E1	9	101
HPV16	E1	11	101
HPV16	E1	8	81
HPV16	E1	9	81
HPV16	E1	11	368
HPV16	E1	10	573
HPV16	E1	11	384
HPV16	E1	8	335
HPV16	E1	11	548
HPV16	E1	8	603
HPV16	E1	10	221
HPV16	E1	9	288
HPV16	E1	11	140
HPV16	E1	9	392
HPV16	E1	8	463
HPV16	E1	9	453
HPV16	E1	10	453
HPV16	E1	9	219
HPV16	E1	10	71
HPV16	E1	11	242
HPV16	E1	9	272
HPV16	E1	11	272
HPV16	E1	10	174
HPV16	E1	10	496
HPV16	E1	9	216
HPV16	E1	10	68
HPV16	E1	11	473
HPV16	E1	11	194
HPV16	E1	10	369
HPV16	E1	10	401
HPV16	E1	9	204
HPV16	E1	10	111
HPV16	E1	11	400
HPV16	E1	10	610
HPV16	E1	10	483
HPV16	E1	10	394
HPV16	E1	10	276
HPV16	E1	9	277
HPV16	E1	11	277
HPV16	E1	10	474
HPV16	E1	9	620
HPV16	E1	9	191
HPV16	E1	10	243
HPV16	E1	9	222
HPV16	E1	8	278
HPV16	E1	10	278
HPV16	E1	9	544
HPV16	E1	8	306
HPV16	E1	9	305
HPV16	E1	8	454
HPV16	E1	9	454
HPV16	E1	8	420
HPV16	E1	10	420
HPV16	E1	8	422
HPV16	E1	11	422
HPV16	E1	8	273
HPV16	E1	10	273
HPV16	E1	9	202
HPV16	E1	11	202
HPV16	E1	9	567
HPV16	E1	8	543
HPV16	E1	10	543
HPV16	E1	9	386
HPV16	E1	8	396
HPV16	E1	9	196
HPV16	E1	10	190
HPV16	E1	10	302
HPV16	E1	8	245
HPV16	E1	8	600
HPV16	E1	11	600
HPV16	E1	8	143
HPV16	E1	9	419
HPV16	E1	11	419
HPV16	E1	8	118
HPV16	E1	9	109
HPV16	E1	10	619
HPV16	E1	11	313
HPV16	E1	9	432
HPV16	E1	11	390
HPV16	E1	9	484
HPV16	E1	8	621
HPV16	E1	9	421
HPV16	E1	10	314
HPV16	E1	9	497
HPV16	E1	9	315
HPV16	E1	9	72
HPV16	E1	8	289
HPV16	E1	8	407
HPV16	E1	11	407
HPV16	E1	11	200
HPV16	E1	11	565
HPV16	E1	8	498
HPV16	E1	8	197
HPV16	E1	8	275
HPV16	E1	11	275
HPV16	E1	8	217
HPV16	E1	11	217
HPV16	E1	8	545
HPV16	E1	9	274
HPV16	E1	8	425
HPV16	E1	9	509
HPV16	E1	8	20
HPV16	E1	9	20
HPV16	E2	8	40
HPV16	E2	8	300

Table IX
HLA-A3 Supermotif Peptides

HPV16	E2	9	174
HPV16	E2	9	294
HPV16	E2	11	294
HPV16	E2	10	25
HPV16	E2	10	246
HPV16	E2	8	233
HPV16	E2	10	233
HPV16	E2	9	204
HPV16	E2	9	346
HPV16	E2	10	168
HPV16	E2	10	163
HPV16	E2	10	156
HPV16	E2	11	230
HPV16	E2	9	29
HPV16	E2	10	290
HPV16	E2	11	35
HPV16	E2	8	252
HPV16	E2	10	267
HPV16	E2	8	45
HPV16	E2	11	215
HPV16	E2	8	347
HPV16	E2	9	268
HPV16	E2	11	268
HPV16	E2	9	103
HPV16	E2	10	103
HPV16	E2	9	335
HPV16	E2	11	282
HPV16	E2	8	84
HPV16	E2	9	296
HPV16	E2	11	296
HPV16	E2	9	284
HPV16	E2	11	266
HPV16	E2	9	60
HPV16	E2	8	235
HPV16	E2	10	57
HPV16	E2	9	37
HPV16	E2	11	37
HPV16	E2	8	7
HPV16	E2	8	165
HPV16	E2	11	317
HPV16	E2	8	269
HPV16	E2	10	269
HPV16	E2	8	104
HPV16	E2	9	104
HPV16	E2	11	81
HPV16	E2	8	61
HPV16	E2	8	297
HPV16	E2	10	297
HPV16	E2	11	297
HPV16	E2	10	334
HPV16	E2	8	285
HPV16	E2	8	205
HPV16	E2	11	333
HPV16	E2	9	58
HPV16	E2	11	58
HPV16	E2	9	321
HPV16	E2	10	102
HPV16	E2	11	102
HPV16	E5	11	20
HPV16	E5	8	72
HPV16	E5	8	51
HPV16	E5	9	22
HPV16	E5	11	48
HPV16	E5	10	70
HPV16	E5	10	21
HPV16	E5	9	50
HPV16	E6	9	7
HPV16	E6	11	7
HPV16	E6	8	68
HPV16	E6	9	143
HPV16	E6	11	143
HPV16	E6	10	37
HPV16	E6	11	37
HPV16	E6	10	32
HPV16	E6	11	105
HPV16	E6	8	48
HPV16	E6	11	52
HPV16	E6	10	92
HPV16	E6	9	33
HPV16	E6	8	34
HPV16	E6	9	107
HPV16	E6	10	106
HPV16	E6	8	144
HPV16	E6	10	144
HPV16	E6	11	144
HPV16	E6	9	134
HPV16	E6	8	102
HPV16	E6	9	116
HPV16	E6	11	5
HPV16	E6	10	6
HPV16	E6	8	94
HPV16	E6	9	93
HPV16	E6	10	139
HPV16	E6	9	67
HPV16	E6	8	77
HPV16	E7	10	68
HPV16	E7	10	88
HPV16	E7	9	89
HPV16	E7	8	53
HPV16	E7	9	41
HPV16	E7	8	70
HPV16	L1	11	372
HPV16	L1	9	162
HPV16	L1	10	373
HPV16	L1	11	233
HPV16	L1	10	70
HPV16	L1	11	70
HPV16	L1	8	128
HPV16	L1	8	249
HPV16	L1	9	484
HPV16	L1	10	484
HPV16	L1	10	397
HPV16	L1	8	270
HPV16	L1	9	270
HPV16	L1	11	113
HPV16	L1	10	378
HPV16	L1	8	494
HPV16	L1	10	494
HPV16	L1	8	236
HPV16	L1	8	282

Table IX
HLA-A3 Supermotif Peptides

HPV16	L1	11	446	HPV16	L1	11	520
HPV16	L1	9	356	HPV16	L1	8	522
HPV16	L1	10	142	HPV16	L1	9	522
HPV16	L1	8	93	HPV16	L1	10	516
HPV16	L1	8	438	HPV16	L1	11	516
HPV16	L1	9	143	HPV16	L1	9	379
HPV16	L1	9	374	HPV16	L1	11	36
HPV16	L1	10	501	HPV16	L1	10	91
HPV16	L1	11	501	HPV16	L1	9	48
HPV16	L1	8	90	HPV16	L1	10	326
HPV16	L1	11	90	HPV16	L1	10	447
HPV16	L1	11	46	HPV16	L1	8	357
HPV16	L1	11	69	HPV16	L1	10	47
HPV16	L1	9	495	HPV16	L1	10	126
HPV16	L1	11	495	HPV16	L1	10	161
HPV16	L1	11	87	HPV16	L1	9	38
HPV16	L1	11	325	HPV16	L1	10	275
HPV16	L1	10	58	HPV16	L1	9	470
HPV16	L1	9	383	HPV16	L1	11	470
HPV16	L1	9	296	HPV16	L2	10	288
HPV16	L1	9	460	HPV16	L2	11	288
HPV16	L1	10	460	HPV16	L2	10	293
HPV16	L1	8	190	HPV16	L2	8	13
HPV16	L1	9	77	HPV16	L2	11	13
HPV16	L1	10	247	HPV16	L2	9	82
HPV16	L1	11	515	HPV16	L2	9	15
HPV16	L1	9	497	HPV16	L2	9	31
HPV16	L1	11	331	HPV16	L2	9	283
HPV16	L1	8	181	HPV16	L2	11	59
HPV16	L1	11	354	HPV16	L2	10	300
HPV16	L1	10	280	HPV16	L2	11	226
HPV16	L1	10	179	HPV16	L2	10	26
HPV16	L1	9	100	HPV16	L2	9	61
HPV16	L1	11	482	HPV16	L2	8	32
HPV16	L1	10	253	HPV16	L2	9	294
HPV16	L1	8	271	HPV16	L2	8	454
HPV16	L1	8	518	HPV16	L2	9	240
HPV16	L1	9	518	HPV16	L2	11	292
HPV16	L1	10	518	HPV16	L2	10	215
HPV16	L1	11	518	HPV16	L2	8	450
HPV16	L1	8	49	HPV16	L2	9	450
HPV16	L1	8	375	HPV16	L2	10	450
HPV16	L1	8	519	HPV16	L2	11	450
HPV16	L1	9	519	HPV16	L2	11	80
HPV16	L1	10	519	HPV16	L2	10	221
HPV16	L1	11	519	HPV16	L2	9	310
HPV16	L1	8	521	HPV16	L2	9	12
HPV16	L1	9	521	HPV16	L2	9	305
HPV16	L1	10	521	HPV16	L2	11	305
HPV16	L1	8	523	HPV16	L2	8	5
HPV16	L1	9	327	HPV16	L2	9	315
HPV16	L1	10	114	HPV16	L2	8	298
HPV16	L1	11	252	HPV16	L2	10	69
HPV16	L1	9	448	HPV16	L2	11	313
HPV16	L1	9	517	HPV16	L2	10	14
HPV16	L1	10	517	HPV16	L2	9	212
HPV16	L1	11	517	HPV16	L2	8	213
HPV16	L1	8	520	HPV16	L2	10	81
HPV16	L1	9	520	HPV16	L2	8	311
HPV16	L1	10	520	HPV16	L2	8	295

Table IX
HLA-A3 Supermotif Peptides

HPV16	L2	11	295
HPV16	L2	10	211
HPV16	L2	11	287
HPV16	L2	9	222
HPV16	L2	11	210
HPV16	L2	10	447
HPV16	L2	11	447
HPV16	L2	8	453
HPV16	L2	9	453
HPV16	L2	11	303
HPV16	L2	9	228
HPV18	E1	11	397
HPV18	E1	11	546
HPV18	E1	11	466
HPV18	E1	9	284
HPV18	E1	11	284
HPV18	E1	8	413
HPV18	E1	9	413
HPV18	E1	9	412
HPV18	E1	10	412
HPV18	E1	8	311
HPV18	E1	10	311
HPV18	E1	11	437
HPV18	E1	11	196
HPV18	E1	9	78
HPV18	E1	10	78
HPV18	E1	11	78
HPV18	E1	8	203
HPV18	E1	10	228
HPV18	E1	11	391
HPV18	E1	11	637
HPV18	E1	8	342
HPV18	E1	8	610
HPV18	E1	9	115
HPV18	E1	10	115
HPV18	E1	10	309
HPV18	E1	9	104
HPV18	E1	9	460
HPV18	E1	10	463
HPV18	E1	8	470
HPV18	E1	9	399
HPV18	E1	9	226
HPV18	E1	8	465
HPV18	E1	8	212
HPV18	E1	9	223
HPV18	E1	11	92
HPV18	E1	9	279
HPV18	E1	11	279
HPV18	E1	11	249
HPV18	E1	8	270
HPV18	E1	9	198
HPV18	E1	8	282
HPV18	E1	11	282
HPV18	E1	11	569
HPV18	E1	8	552
HPV18	E1	8	116
HPV18	E1	9	116
HPV18	E1	11	116
HPV18	E1	8	461
HPV18	E1	9	439
HPV18	E1	9	647
HPV18	E1	9	468
HPV18	E1	10	468
HPV18	E1	10	401
HPV18	E1	8	292
HPV18	E1	10	283
HPV18	E1	9	281
HPV18	E1	8	313
HPV18	E1	8	285
HPV18	E1	10	285
HPV18	E1	10	570
HPV18	E1	8	224
HPV18	E1	11	224
HPV18	E1	9	571
HPV18	E1	11	480
HPV18	E1	9	229
HPV18	E1	9	312
HPV18	E1	8	429
HPV18	E1	11	429
HPV18	E1	9	574
HPV18	E1	9	428
HPV18	E1	8	119
HPV18	E1	9	119
HPV18	E1	10	119
HPV18	E1	9	393
HPV18	E1	9	551
HPV18	E1	8	252
HPV18	E1	8	607
HPV18	E1	11	607
HPV18	E1	11	200
HPV18	E1	9	426
HPV18	E1	11	426
HPV18	E1	8	80
HPV18	E1	9	80
HPV18	E1	11	102
HPV18	E1	11	320
HPV18	E1	8	117
HPV18	E1	10	117
HPV18	E1	11	117
HPV18	E1	10	321
HPV18	E1	10	93
HPV18	E1	9	322
HPV18	E1	10	197
HPV18	E1	8	414
HPV18	E1	11	414
HPV18	E1	8	572
HPV18	E1	11	572
HPV18	E1	8	323
HPV18	E1	8	81
HPV18	E1	8	280
HPV18	E1	10	280
HPV18	E1	11	339
HPV18	E1	8	432
HPV18	E1	9	516
HPV18	E1	9	536
HPV18	E1	10	268
HPV18	E1	10	408
HPV18	E1	8	19
HPV18	E1	9	19
HPV18	E2	9	269

Table IX
HLA-A3 Supermotif Peptides

HPV18	E2	10	269
HPV18	E2	11	269
HPV18	E2	9	82
HPV18	E2	11	82
HPV18	E2	8	270
HPV18	E2	9	270
HPV18	E2	10	270
HPV18	E2	11	270
HPV18	E2	8	301
HPV18	E2	11	156
HPV18	E2	11	31
HPV18	E2	10	210
HPV18	E2	10	268
HPV18	E2	11	268
HPV18	E2	8	85
HPV18	E2	10	291
HPV18	E2	8	338
HPV18	E2	10	19
HPV18	E2	8	289
HPV18	E2	8	68
HPV18	E2	11	18
HPV18	E2	9	152
HPV18	E2	11	238
HPV18	E2	11	8
HPV18	E2	11	333
HPV18	E2	10	81
HPV18	E2	9	144
HPV18	E2	8	44
HPV18	E2	9	67
HPV18	E2	9	297
HPV18	E2	11	297
HPV18	E2	9	107
HPV18	E2	10	107
HPV18	E2	8	170
HPV18	E2	9	285
HPV18	E2	9	64
HPV18	E2	9	288
HPV18	E2	8	272
HPV18	E2	9	272
HPV18	E2	9	33
HPV18	E2	11	80
HPV18	E2	10	2
HPV18	E2	11	119
HPV18	E2	10	61
HPV18	E2	8	122
HPV18	E2	10	305
HPV18	E2	8	11
HPV18	E2	8	298
HPV18	E2	10	298
HPV18	E2	11	298
HPV18	E2	10	229
HPV18	E2	9	230
HPV18	E2	8	153
HPV18	E2	8	286
HPV18	E2	11	286
HPV18	E2	10	120
HPV18	E2	9	211
HPV18	E2	8	231
HPV18	E2	10	334
HPV18	E2	8	212
HPV18	E2	10	157
HPV18	E2	9	335
HPV18	E2	11	335
HPV18	E2	9	62
HPV18	E2	11	62
HPV18	E2	8	322
HPV18	E2	10	173
HPV18	E2	10	143
HPV18	E2	11	228
HPV18	E6	9	68
HPV18	E6	10	27
HPV18	E6	10	58
HPV18	E6	10	83
HPV18	E6	8	29
HPV18	E6	11	40
HPV18	E6	8	43
HPV18	E6	11	47
HPV18	E6	8	97
HPV18	E6	11	97
HPV18	E6	8	139
HPV18	E6	11	139
HPV18	E6	8	117
HPV18	E6	9	117
HPV18	E6	10	117
HPV18	E6	9	102
HPV18	E6	10	101
HPV18	E6	10	41
HPV18	E6	9	1
HPV18	E6	10	1
HPV18	E6	8	100
HPV18	E6	11	100
HPV18	E6	10	95
HPV18	E6	11	114
HPV18	E6	9	111
HPV18	E6	9	144
HPV18	E6	10	144
HPV18	E6	11	144
HPV18	E6	9	59
HPV18	E6	9	84
HPV18	E6	8	72
HPV18	E7	9	63
HPV18	E7	11	63
HPV18	E7	8	77
HPV18	E7	10	43
HPV18	E7	11	43
HPV18	E7	11	48
HPV18	E7	9	59
HPV18	E7	11	74
HPV18	E7	11	61
HPV18	E7	9	50
HPV18	E7	8	60
HPV18	E7	10	75
HPV18	L1	11	195
HPV18	L1	8	225
HPV18	L1	11	268
HPV18	L1	9	419
HPV18	L1	10	196
HPV18	L1	9	552
HPV18	L1	10	552
HPV18	L1	8	163

Table IX
HLA-A3 Supermotif Peptides

HPV18	L1	11	222
HPV18	L1	10	310
HPV18	L1	8	493
HPV18	L1	10	418
HPV18	L1	8	284
HPV18	L1	11	122
HPV18	L1	9	520
HPV18	L1	10	520
HPV18	L1	8	305
HPV18	L1	9	305
HPV18	L1	11	148
HPV18	L1	10	330
HPV18	L1	11	203
HPV18	L1	8	317
HPV18	L1	8	59
HPV18	L1	8	530
HPV18	L1	9	530
HPV18	L1	10	530
HPV18	L1	8	271
HPV18	L1	11	482
HPV18	L1	11	535
HPV18	L1	10	177
HPV18	L1	11	360
HPV18	L1	10	505
HPV18	L1	8	125
HPV18	L1	11	125
HPV18	L1	10	103
HPV18	L1	9	178
HPV18	L1	9	104
HPV18	L1	8	531
HPV18	L1	9	531
HPV18	L1	10	496
HPV18	L1	9	224
HPV18	L1	8	558
HPV18	L1	10	558
HPV18	L1	11	558
HPV18	L1	10	57
HPV18	L1	10	282
HPV18	L1	10	16
HPV18	L1	8	550
HPV18	L1	11	550
HPV18	L1	8	540
HPV18	L1	10	472
HPV18	L1	10	412
HPV18	L1	10	315
HPV18	L1	11	366
HPV18	L1	9	484
HPV18	L1	11	102
HPV18	L1	11	547
HPV18	L1	9	112
HPV18	L1	9	135
HPV18	L1	8	561
HPV18	L1	10	548
HPV18	L1	10	551
HPV18	L1	11	551
HPV18	L1	9	127
HPV18	L1	10	93
HPV18	L1	9	150
HPV18	L1	11	518
HPV18	L1	8	306
HPV18	L1	9	555
HPV18	L1	11	555
HPV18	L1	8	485
HPV18	L1	9	362
HPV18	L1	11	92
HPV18	L1	10	149
HPV18	L1	8	474
HPV18	L1	9	197
HPV18	L1	8	554
HPV18	L1	10	554
HPV18	L1	9	473
HPV18	L1	8	553
HPV18	L1	9	553
HPV18	L1	11	553
HPV18	L1	8	105
HPV18	L1	9	331
HPV18	L1	11	71
HPV18	L1	10	126
HPV18	L1	10	361
HPV18	L1	10	161
HPV18	L1	8	230
HPV18	L1	10	230
HPV18	L1	9	73
HPV18	L2	10	286
HPV18	L2	8	12
HPV18	L2	11	12
HPV18	L2	11	354
HPV18	L2	9	273
HPV18	L2	11	109
HPV18	L2	9	260
HPV18	L2	8	443
HPV18	L2	9	276
HPV18	L2	11	306
HPV18	L2	11	58
HPV18	L2	10	25
HPV18	L2	9	60
HPV18	L2	11	292
HPV18	L2	10	210
HPV18	L2	11	210
HPV18	L2	10	34
HPV18	L2	9	287
HPV18	L2	8	1
HPV18	L2	9	1
HPV18	L2	10	1
HPV18	L2	11	1
HPV18	L2	10	79
HPV18	L2	11	285
HPV18	L2	8	357
HPV18	L2	11	209
HPV18	L2	8	439
HPV18	L2	9	439
HPV18	L2	10	439
HPV18	L2	11	439
HPV18	L2	10	216
HPV18	L2	11	258
HPV18	L2	9	11
HPV18	L2	11	298
HPV18	L2	10	281
HPV18	L2	11	281
HPV18	L2	9	308

Table IX
HLA-A3 Supermotif Peptides

HPV18	L2	10	364
HPV18	L2	10	68
HPV18	L2	10	220
HPV18	L2	9	211
HPV18	L2	10	211
HPV18	L2	10	110
HPV18	L2	8	212
HPV18	L2	9	212
HPV18	L2	9	365
HPV18	L2	10	235
HPV18	L2	10	13
HPV18	L2	9	111
HPV18	L2	8	288
HPV18	L2	11	288
HPV18	L2	8	261
HPV18	L2	8	366
HPV18	L2	10	293
HPV18	L2	9	217
HPV18	L2	9	80
HPV18	L2	9	221
HPV18	L2	9	236
HPV18	L2	8	2
HPV18	L2	9	2
HPV18	L2	10	2
HPV18	L2	11	234
HPV18	L2	9	14
HPV18	L2	8	81
HPV18	L2	8	112
HPV18	L2	11	436
HPV31	E1	8	296
HPV31	E1	8	185
HPV31	E1	9	111
HPV31	E1	11	439
HPV31	E1	8	81
HPV31	E1	11	370
HPV31	E1	10	263
HPV31	E1	10	113
HPV31	E1	11	113
HPV31	E1	9	477
HPV31	E1	8	284
HPV31	E1	10	284
HPV31	E1	9	100
HPV31	E1	11	100
HPV31	E1	8	620
HPV31	E1	11	364
HPV31	E1	9	366
HPV31	E1	11	528
HPV31	E1	11	348
HPV31	E1	8	80
HPV31	E1	9	80
HPV31	E1	10	201
HPV31	E1	8	583
HPV31	E1	8	315
HPV31	E1	8	443
HPV31	E1	9	372
HPV31	E1	10	436
HPV31	E1	11	566
HPV31	E1	9	433
HPV31	E1	9	252
HPV31	E1	11	252
HPV31	E1	9	157
HPV31	E1	8	386
HPV31	E1	9	386
HPV31	E1	8	225
HPV31	E1	9	196
HPV31	E1	11	222
HPV31	E1	9	78
HPV31	E1	10	78
HPV31	E1	11	78
HPV31	E1	11	162
HPV31	E1	8	478
HPV31	E1	11	453
HPV31	E1	11	174
HPV31	E1	9	268
HPV31	E1	9	544
HPV31	E1	10	381
HPV31	E1	9	184
HPV31	E1	10	110
HPV31	E1	11	380
HPV31	E1	9	441
HPV31	E1	10	441
HPV31	E1	10	590
HPV31	E1	10	374
HPV31	E1	9	412
HPV31	E1	10	454
HPV31	E1	8	286
HPV31	E1	9	202
HPV31	E1	10	543
HPV31	E1	11	542
HPV31	E1	10	256
HPV31	E1	9	437
HPV31	E1	8	258
HPV31	E1	10	258
HPV31	E1	9	285
HPV31	E1	8	255
HPV31	E1	11	255
HPV31	E1	9	257
HPV31	E1	11	257
HPV31	E1	8	400
HPV31	E1	10	400
HPV31	E1	8	253
HPV31	E1	10	253
HPV31	E1	9	547
HPV31	E1	8	601
HPV31	E1	8	117
HPV31	E1	8	376
HPV31	E1	10	170
HPV31	E1	9	524
HPV31	E1	8	580
HPV31	E1	11	580
HPV31	E1	9	399
HPV31	E1	11	399
HPV31	E1	9	176
HPV31	E1	10	267
HPV31	E1	10	599
HPV31	E1	11	293
HPV31	E1	8	438
HPV31	E1	9	401
HPV31	E1	11	98
HPV31	E1	10	294

Table IX
HLA-A3 Supermotif Peptides

HPV31	E1	11	281
HPV31	E1	9	295
HPV31	E1	8	269
HPV31	E1	8	387
HPV31	E1	11	387
HPV31	E1	11	180
HPV31	E1	8	545
HPV31	E1	11	545
HPV31	E1	8	177
HPV31	E1	10	349
HPV31	E1	9	254
HPV31	E1	8	413
HPV31	E1	8	434
HPV31	E1	8	197
HPV31	E1	8	525
HPV31	E1	10	223
HPV31	E1	8	405
HPV31	E1	9	489
HPV31	E1	8	19
HPV31	E2	9	277
HPV31	E2	8	278
HPV31	E2	9	229
HPV31	E2	10	229
HPV31	E2	8	61
HPV31	E2	9	291
HPV31	E2	9	239
HPV31	E2	10	228
HPV31	E2	11	228
HPV31	E2	8	307
HPV31	E2	10	307
HPV31	E2	11	145
HPV31	E2	8	40
HPV31	E2	9	301
HPV31	E2	11	301
HPV31	E2	9	174
HPV31	E2	10	174
HPV31	E2	10	204
HPV31	E2	9	80
HPV31	E2	9	168
HPV31	E2	10	168
HPV31	E2	8	231
HPV31	E2	10	235
HPV31	E2	11	235
HPV31	E2	9	29
HPV31	E2	11	35
HPV31	E2	10	297
HPV31	E2	10	15
HPV31	E2	11	15
HPV31	E2	8	304
HPV31	E2	11	304
HPV31	E2	11	275
HPV31	E2	9	205
HPV31	E2	11	14
HPV31	E2	11	4
HPV31	E2	9	103
HPV31	E2	10	103
HPV31	E2	9	342
HPV31	E2	11	78
HPV31	E2	9	303
HPV31	E2	10	254
HPV31	E2	9	127
HPV31	E2	8	219
HPV31	E2	9	60
HPV31	E2	10	290
HPV31	E2	10	57
HPV31	E2	8	238
HPV31	E2	10	238
HPV31	E2	10	25
HPV31	E2	9	37
HPV31	E2	11	37
HPV31	E2	8	7
HPV31	E2	10	276
HPV31	E2	11	324
HPV31	E2	11	216
HPV31	E2	8	104
HPV31	E2	9	104
HPV31	E2	8	81
HPV31	E2	10	341
HPV31	E2	8	128
HPV31	E2	8	292
HPV31	E2	8	240
HPV31	E2	10	146
HPV31	E2	11	340
HPV31	E2	9	147
HPV31	E2	9	58
HPV31	E2	11	58
HPV31	E2	9	328
HPV31	E2	10	102
HPV31	E2	11	102
HPV31	E5	11	20
HPV31	E5	11	48
HPV31	E5	9	22
HPV31	E5	8	51
HPV31	E5	10	21
HPV31	E5	9	50
HPV31	E6	10	18
HPV31	E6	9	136
HPV31	E6	10	63
HPV31	E6	11	98
HPV31	E6	9	57
HPV31	E6	8	20
HPV31	E6	10	25
HPV31	E6	11	45
HPV31	E6	9	47
HPV31	E6	8	95
HPV31	E6	10	85
HPV31	E6	8	61
HPV31	E6	8	137
HPV31	E6	9	72
HPV31	E6	9	100
HPV31	E6	10	99
HPV31	E6	9	127
HPV31	E6	9	109
HPV31	E6	8	27
HPV31	E6	11	17
HPV31	E6	9	82
HPV31	E6	8	87
HPV31	E6	9	86
HPV31	E6	8	73
HPV31	E6	10	132

Table IX
HLA-A3 Supermotif Peptides

HPV31	E6	11	132
HPV31	E6	8	70
HPV31	E6	11	70
HPV31	E6	10	81
HPV31	E7	10	68
HPV31	E7	10	88
HPV31	E7	9	89
HPV31	E7	9	54
HPV31	E7	10	53
HPV31	E7	8	70
HPV31	E7	8	55
HPV31	L1	11	347
HPV31	L1	10	348
HPV31	L1	11	426
HPV31	L1	11	208
HPV31	L1	8	491
HPV31	L1	9	491
HPV31	L1	10	491
HPV31	L1	11	491
HPV31	L1	8	103
HPV31	L1	8	224
HPV31	L1	9	459
HPV31	L1	10	459
HPV31	L1	10	372
HPV31	L1	8	245
HPV31	L1	9	245
HPV31	L1	11	88
HPV31	L1	10	353
HPV31	L1	10	270
HPV31	L1	8	469
HPV31	L1	10	469
HPV31	L1	8	211
HPV31	L1	8	257
HPV31	L1	11	421
HPV31	L1	9	331
HPV31	L1	10	117
HPV31	L1	8	68
HPV31	L1	10	68
HPV31	L1	8	413
HPV31	L1	9	349
HPV31	L1	9	118
HPV31	L1	10	427
HPV31	L1	10	357
HPV31	L1	8	431
HPV31	L1	8	65
HPV31	L1	11	65
HPV31	L1	11	20
HPV31	L1	9	470
HPV31	L1	11	470
HPV31	L1	11	300
HPV31	L1	10	32
HPV31	L1	11	227
HPV31	L1	8	496
HPV31	L1	9	496
HPV31	L1	8	165
HPV31	L1	10	222
HPV31	L1	10	489
HPV31	L1	11	489
HPV31	L1	10	411
HPV31	L1	9	472
HPV31	L1	11	472
HPV31	L1	11	306
HPV31	L1	8	156
HPV31	L1	11	329
HPV31	L1	10	255
HPV31	L1	10	154
HPV31	L1	10	476
HPV31	L1	11	476
HPV31	L1	9	75
HPV31	L1	11	457
HPV31	L1	9	490
HPV31	L1	10	490
HPV31	L1	11	490
HPV31	L1	10	228
HPV31	L1	9	51
HPV31	L1	10	51
HPV31	L1	9	358
HPV31	L1	8	23
HPV31	L1	8	492
HPV31	L1	9	492
HPV31	L1	10	492
HPV31	L1	9	271
HPV31	L1	8	246
HPV31	L1	9	302
HPV31	L1	10	89
HPV31	L1	9	423
HPV31	L1	9	354
HPV31	L1	8	494
HPV31	L1	10	494
HPV31	L1	11	494
HPV31	L1	8	493
HPV31	L1	9	493
HPV31	L1	11	493
HPV31	L1	11	44
HPV31	L1	11	10
HPV31	L1	10	66
HPV31	L1	9	22
HPV31	L1	10	301
HPV31	L1	10	422
HPV31	L1	8	332
HPV31	L1	11	62
HPV31	L1	10	21
HPV31	L1	10	101
HPV31	L1	10	136
HPV31	L1	9	12
HPV31	L1	10	250
HPV31	L1	10	50
HPV31	L1	11	50
HPV31	L1	9	445
HPV31	L1	11	445
HPV31	L2	10	281
HPV31	L2	11	281
HPV31	L2	10	286
HPV31	L2	11	13
HPV31	L2	9	15
HPV31	L2	9	276
HPV31	L2	11	59
HPV31	L2	11	221
HPV31	L2	9	61
HPV31	L2	10	26

Table IX
HLA-A3 Supermotif Peptides

HPV31	L2	10	38
HPV31	L2	11	280
HPV31	L2	11	205
HPV31	L2	9	287
HPV31	L2	8	447
HPV31	L2	11	292
HPV31	L2	11	285
HPV31	L2	9	217
HPV31	L2	10	210
HPV31	L2	8	443
HPV31	L2	9	443
HPV31	L2	10	443
HPV31	L2	11	443
HPV31	L2	8	235
HPV31	L2	9	298
HPV31	L2	11	298
HPV31	L2	9	308
HPV31	L2	8	2
HPV31	L2	10	2
HPV31	L2	11	2
HPV31	L2	8	5
HPV31	L2	10	69
HPV31	L2	11	306
HPV31	L2	10	14
HPV31	L2	9	207
HPV31	L2	10	207
HPV31	L2	8	208
HPV31	L2	9	208
HPV31	L2	11	80
HPV31	L2	8	40
HPV31	L2	8	288
HPV31	L2	11	288
HPV31	L2	10	206
HPV31	L2	11	206
HPV31	L2	9	39
HPV31	L2	10	293
HPV31	L2	10	81
HPV31	L2	11	232
HPV31	L2	9	82
HPV31	L2	10	440
HPV31	L2	11	440
HPV31	L2	8	446
HPV31	L2	9	446
HPV31	L2	9	223
HPV31	L2	11	296
HPV33	E1	8	96
HPV33	E1	11	383
HPV33	E1	11	104
HPV33	E1	8	596
HPV33	E1	8	81
HPV33	E1	8	297
HPV33	E1	10	297
HPV33	E1	8	633
HPV33	E1	11	633
HPV33	E1	10	276
HPV33	E1	9	490
HPV33	E1	8	614
HPV33	E1	9	78
HPV33	E1	10	78
HPV33	E1	11	78
HPV33	E1	11	377
HPV33	E1	10	566
HPV33	E1	11	541
HPV33	E1	11	99
HPV33	E1	9	537
HPV33	E1	10	214
HPV33	E1	8	242
HPV33	E1	10	295
HPV33	E1	8	19
HPV33	E1	9	19
HPV33	E1	10	449
HPV33	E1	8	456
HPV33	E1	9	385
HPV33	E1	9	212
HPV33	E1	9	446
HPV33	E1	10	446
HPV33	E1	8	451
HPV33	E1	9	265
HPV33	E1	11	265
HPV33	E1	8	399
HPV33	E1	9	399
HPV33	E1	9	209
HPV33	E1	11	235
HPV33	E1	9	480
HPV33	E1	9	327
HPV33	E1	9	256
HPV33	E1	10	573
HPV33	E1	8	266
HPV33	E1	10	266
HPV33	E1	9	267
HPV33	E1	8	268
HPV33	E1	11	268
HPV33	E1	8	400
HPV33	E1	11	400
HPV33	E1	8	210
HPV33	E1	11	210
HPV33	E1	8	538
HPV33	E1	11	187
HPV33	E1	10	236
HPV33	E1	11	520
HPV33	E1	10	394
HPV33	E1	9	197
HPV33	E1	11	393
HPV33	E1	10	612
HPV33	E1	11	412
HPV33	E1	10	603
HPV33	E1	10	387
HPV33	E1	9	425
HPV33	E1	10	467
HPV33	E1	8	271
HPV33	E1	10	271
HPV33	E1	9	270
HPV33	E1	11	270
HPV33	E1	10	269
HPV33	E1	9	215
HPV33	E1	11	466
HPV33	E1	10	413
HPV33	E1	8	481
HPV33	E1	9	298
HPV33	E1	8	80

Table IX
HLA-A3 Supermotif Peptides

HPV33	E1	9	80
HPV33	E1	11	57
HPV33	E1	9	379
HPV33	E1	8	389
HPV33	E1	9	195
HPV33	E1	11	195
HPV33	E1	9	560
HPV33	E1	9	189
HPV33	E1	8	238
HPV33	E1	11	593
HPV33	E1	8	60
HPV33	E1	10	94
HPV33	E1	9	308
HPV33	E1	8	575
HPV33	E1	11	306
HPV33	E1	8	109
HPV33	E1	9	95
HPV33	E1	10	634
HPV33	E1	9	414
HPV33	E1	11	111
HPV33	E1	10	58
HPV33	E1	11	193
HPV33	E1	11	239
HPV33	E1	8	447
HPV33	E1	9	447
HPV33	E1	11	558
HPV33	E1	8	328
HPV33	E1	10	240
HPV33	E1	8	299
HPV33	E1	8	491
HPV33	E1	8	190
HPV33	E1	10	100
HPV33	E1	8	418
HPV33	E1	9	502
HPV33	E1	9	522
HPV33	E1	9	595
HPV33	E1	11	254
HPV33	E2	8	249
HPV33	E2	9	258
HPV33	E2	9	245
HPV33	E2	8	40
HPV33	E2	10	288
HPV33	E2	9	211
HPV33	E2	10	25
HPV33	E2	8	235
HPV33	E2	9	143
HPV33	E2	11	232
HPV33	E2	11	74
HPV33	E2	9	282
HPV33	E2	11	282
HPV33	E2	11	115
HPV33	E2	9	100
HPV33	E2	10	156
HPV33	E2	10	278
HPV33	E2	9	15
HPV33	E2	11	4
HPV33	E2	10	14
HPV33	E2	8	165
HPV33	E2	8	77
HPV33	E2	9	284
HPV33	E2	11	284
HPV33	E2	9	272
HPV33	E2	9	248
HPV33	E2	9	60
HPV33	E2	8	27
HPV33	E2	11	27
HPV33	E2	8	222
HPV33	E2	9	29
HPV33	E2	9	76
HPV33	E2	8	332
HPV33	E2	10	57
HPV33	E2	8	7
HPV33	E2	11	37
HPV33	E2	9	256
HPV33	E2	11	256
HPV33	E2	10	5
HPV33	E2	11	98
HPV33	E2	8	285
HPV33	E2	10	285
HPV33	E2	8	61
HPV33	E2	11	270
HPV33	E2	11	304
HPV33	E2	10	305
HPV33	E2	11	209
HPV33	E2	11	254
HPV33	E2	8	257
HPV33	E2	10	257
HPV33	E2	8	310
HPV33	E2	10	233
HPV33	E2	8	118
HPV33	E2	9	118
HPV33	E2	10	116
HPV33	E2	11	116
HPV33	E2	8	273
HPV33	E2	9	117
HPV33	E2	10	117
HPV33	E2	9	58
HPV33	E2	11	58
HPV33	E2	10	102
HPV33	E2	11	102
HPV33	E2	9	309
HPV33	E2	11	159
HPV33	E5	9	12
HPV33	E5	11	10
HPV33	E5	11	38
HPV33	E5	9	40
HPV33	E6	8	137
HPV33	E6	9	137
HPV33	E6	8	136
HPV33	E6	9	136
HPV33	E6	10	136
HPV33	E6	10	30
HPV33	E6	11	98
HPV33	E6	8	27
HPV33	E6	9	27
HPV33	E6	9	47
HPV33	E6	11	45
HPV33	E6	9	69
HPV33	E6	8	61
HPV33	E6	10	99

Table IX
HLA-A3 Supermotif Peptides

HPV33	E6	8	128
HPV33	E6	9	64
HPV33	E6	9	100
HPV33	E6	8	70
HPV33	E6	10	25
HPV33	E6	11	25
HPV33	E6	9	127
HPV33	E6	8	86
HPV33	E6	9	86
HPV33	E6	8	109
HPV33	E6	9	109
HPV33	E6	8	95
HPV33	E6	8	87
HPV33	E6	10	132
HPV33	E7	10	68
HPV33	E7	11	30
HPV33	E7	8	59
HPV33	E7	8	70
HPV33	E7	10	31
HPV33	L1	11	424
HPV33	L1	8	411
HPV33	L1	10	44
HPV33	L1	9	270
HPV33	L1	11	207
HPV33	L1	11	345
HPV33	L1	8	103
HPV33	L1	8	223
HPV33	L1	9	457
HPV33	L1	10	457
HPV33	L1	10	370
HPV33	L1	8	244
HPV33	L1	9	244
HPV33	L1	10	351
HPV33	L1	10	202
HPV33	L1	11	88
HPV33	L1	10	269
HPV33	L1	8	467
HPV33	L1	10	467
HPV33	L1	10	249
HPV33	L1	10	50
HPV33	L1	11	50
HPV33	L1	8	256
HPV33	L1	11	419
HPV33	L1	9	330
HPV33	L1	10	117
HPV33	L1	9	472
HPV33	L1	10	472
HPV33	L1	8	68
HPV33	L1	10	68
HPV33	L1	11	226
HPV33	L1	9	118
HPV33	L1	10	425
HPV33	L1	8	474
HPV33	L1	11	478
HPV33	L1	8	429
HPV33	L1	8	65
HPV33	L1	11	65
HPV33	L1	11	20
HPV33	L1	11	43
HPV33	L1	9	468
HPV33	L1	11	468
HPV33	L1	11	62
HPV33	L1	11	299
HPV33	L1	9	57
HPV33	L1	10	221
HPV33	L1	10	409
HPV33	L1	8	165
HPV33	L1	11	55
HPV33	L1	10	484
HPV33	L1	11	484
HPV33	L1	9	470
HPV33	L1	11	470
HPV33	L1	8	156
HPV33	L1	11	305
HPV33	L1	10	254
HPV33	L1	10	154
HPV33	L1	11	328
HPV33	L1	9	347
HPV33	L1	8	481
HPV33	L1	8	488
HPV33	L1	9	488
HPV33	L1	11	488
HPV33	L1	9	75
HPV33	L1	11	455
HPV33	L1	8	491
HPV33	L1	9	491
HPV33	L1	9	410
HPV33	L1	9	51
HPV33	L1	10	51
HPV33	L1	10	32
HPV33	L1	8	245
HPV33	L1	9	490
HPV33	L1	10	490
HPV33	L1	10	227
HPV33	L1	8	23
HPV33	L1	8	486
HPV33	L1	9	486
HPV33	L1	10	486
HPV33	L1	11	486
HPV33	L1	9	352
HPV33	L1	9	301
HPV33	L1	10	89
HPV33	L1	11	31
HPV33	L1	9	421
HPV33	L1	8	489
HPV33	L1	10	489
HPV33	L1	11	489
HPV33	L1	9	485
HPV33	L1	10	485
HPV33	L1	11	485
HPV33	L1	11	10
HPV33	L1	10	66
HPV33	L1	9	22
HPV33	L1	8	348
HPV33	L1	10	300
HPV33	L1	10	420
HPV33	L1	8	331
HPV33	L1	10	21
HPV33	L1	10	101
HPV33	L1	9	12

Table IX
HLA-A3 Supermotif Peptides

HPV33	L1	9	443	HPV45	E1	9	270
HPV33	L1	11	443	HPV45	E1	11	270
HPV33	L2	9	81	HPV45	E1	8	399
HPV33	L2	8	82	HPV45	E1	9	399
HPV33	L2	10	291	HPV45	E1	9	398
HPV33	L2	10	286	HPV45	E1	10	398
HPV33	L2	11	286	HPV45	E1	8	297
HPV33	L2	11	12	HPV45	E1	10	297
HPV33	L2	9	308	HPV45	E1	11	423
HPV33	L2	9	14	HPV45	E1	8	634
HPV33	L2	8	447	HPV45	E1	9	78
HPV33	L2	9	447	HPV45	E1	10	78
HPV33	L2	9	281	HPV45	E1	11	78
HPV33	L2	11	301	HPV45	E1	10	214
HPV33	L2	11	440	HPV45	E1	11	623
HPV33	L2	11	58	HPV45	E1	8	328
HPV33	L2	11	226	HPV45	E1	8	596
HPV33	L2	10	37	HPV45	E1	9	115
HPV33	L2	10	25	HPV45	E1	10	115
HPV33	L2	9	60	HPV45	E1	11	186
HPV33	L2	10	379	HPV45	E1	8	189
HPV33	L2	11	297	HPV45	E1	9	189
HPV33	L2	11	285	HPV45	E1	10	295
HPV33	L2	8	448	HPV45	E1	9	446
HPV33	L2	9	292	HPV45	E1	8	456
HPV33	L2	10	307	HPV45	E1	9	385
HPV33	L2	11	311	HPV45	E1	10	449
HPV33	L2	9	240	HPV45	E1	9	212
HPV33	L2	11	290	HPV45	E1	11	579
HPV33	L2	10	215	HPV45	E1	8	19
HPV33	L2	8	444	HPV45	E1	9	19
HPV33	L2	9	444	HPV45	E1	8	626
HPV33	L2	10	444	HPV45	E1	9	209
HPV33	L2	11	444	HPV45	E1	9	443
HPV33	L2	11	79	HPV45	E1	9	265
HPV33	L2	10	221	HPV45	E1	11	265
HPV33	L2	9	313	HPV45	E1	11	235
HPV33	L2	9	303	HPV45	E1	8	256
HPV33	L2	11	303	HPV45	E1	8	268
HPV33	L2	10	13	HPV45	E1	11	268
HPV33	L2	9	212	HPV45	E1	11	555
HPV33	L2	9	38	HPV45	E1	11	466
HPV33	L2	8	213	HPV45	E1	8	447
HPV33	L2	10	80	HPV45	E1	8	538
HPV33	L2	8	39	HPV45	E1	8	116
HPV33	L2	8	309	HPV45	E1	9	116
HPV33	L2	8	293	HPV45	E1	11	116
HPV33	L2	11	293	HPV45	E1	9	197
HPV33	L2	10	211	HPV45	E1	9	425
HPV33	L2	10	298	HPV45	E1	10	387
HPV33	L2	9	222	HPV45	E1	10	269
HPV33	L2	10	441	HPV45	E1	8	299
HPV33	L2	11	441	HPV45	E1	9	267
HPV33	L2	11	210	HPV45	E1	11	84
HPV33	L2	9	228	HPV45	E1	8	190
HPV33	L2	8	381	HPV45	E1	8	271
HPV45	E1	11	383	HPV45	E1	10	271
HPV45	E1	8	198	HPV45	E1	10	556
HPV45	E1	11	532	HPV45	E1	10	467
HPV45	E1	11	452	HPV45	E1	8	210

Table IX
HLA-A3 Supermotif Peptides

HPV45	E1	11	210	HPV45	E2	9	242
HPV45	E1	10	103	HPV45	E2	11	242
HPV45	E1	9	557	HPV45	E2	10	295
HPV45	E1	9	215	HPV45	E2	8	124
HPV45	E1	9	298	HPV45	E2	8	293
HPV45	E1	8	415	HPV45	E2	10	21
HPV45	E1	11	415	HPV45	E2	8	70
HPV45	E1	9	560	HPV45	E2	8	36
HPV45	E1	9	414	HPV45	E2	9	146
HPV45	E1	8	119	HPV45	E2	10	77
HPV45	E1	9	119	HPV45	E2	11	20
HPV45	E1	10	119	HPV45	E2	9	232
HPV45	E1	9	379	HPV45	E2	11	121
HPV45	E1	9	537	HPV45	E2	10	272
HPV45	E1	8	238	HPV45	E2	11	272
HPV45	E1	8	593	HPV45	E2	11	10
HPV45	E1	11	593	HPV45	E2	8	256
HPV45	E1	11	102	HPV45	E2	11	336
HPV45	E1	9	412	HPV45	E2	10	83
HPV45	E1	11	412	HPV45	E2	8	46
HPV45	E1	8	80	HPV45	E2	9	69
HPV45	E1	9	80	HPV45	E2	9	301
HPV45	E1	8	451	HPV45	E2	11	301
HPV45	E1	11	306	HPV45	E2	11	33
HPV45	E1	8	117	HPV45	E2	9	109
HPV45	E1	10	117	HPV45	E2	10	109
HPV45	E1	11	117	HPV45	E2	9	289
HPV45	E1	10	307	HPV45	E2	9	292
HPV45	E1	9	308	HPV45	E2	8	67
HPV45	E1	9	104	HPV45	E2	11	67
HPV45	E1	8	558	HPV45	E2	11	271
HPV45	E1	11	558	HPV45	E2	10	112
HPV45	E1	11	239	HPV45	E2	9	35
HPV45	E1	8	309	HPV45	E2	11	222
HPV45	E1	10	240	HPV45	E2	11	82
HPV45	E1	8	81	HPV45	E2	9	244
HPV45	E1	8	266	HPV45	E2	10	4
HPV45	E1	10	266	HPV45	E2	10	63
HPV45	E1	8	400	HPV45	E2	11	43
HPV45	E1	11	400	HPV45	E2	8	13
HPV45	E1	11	325	HPV45	E2	8	302
HPV45	E1	8	418	HPV45	E2	10	302
HPV45	E1	9	502	HPV45	E2	11	302
HPV45	E1	9	522	HPV45	E2	8	275
HPV45	E1	10	254	HPV45	E2	9	275
HPV45	E1	10	394	HPV45	E2	10	275
HPV45	E2	9	78	HPV45	E2	11	321
HPV45	E2	9	84	HPV45	E2	8	276
HPV45	E2	8	305	HPV45	E2	9	276
HPV45	E2	8	274	HPV45	E2	10	322
HPV45	E2	9	274	HPV45	E2	9	51
HPV45	E2	10	274	HPV45	E2	8	233
HPV45	E2	11	274	HPV45	E2	8	277
HPV45	E2	11	158	HPV45	E2	8	290
HPV45	E2	9	171	HPV45	E2	11	290
HPV45	E2	10	212	HPV45	E2	8	172
HPV45	E2	10	50	HPV45	E2	10	122
HPV45	E2	9	255	HPV45	E2	9	213
HPV45	E2	8	225	HPV45	E2	10	337
HPV45	E2	8	242	HPV45	E2	8	214

Table IX
HLA-A3 Supermotif Peptides

HPV45	E2	10	159
HPV45	E2	9	338
HPV45	E2	9	64
HPV45	E2	11	64
HPV45	E2	10	145
HPV45	E2	10	175
HPV45	E6	9	59
HPV45	E6	9	68
HPV45	E6	10	32
HPV45	E6	10	27
HPV45	E6	8	97
HPV45	E6	11	97
HPV45	E6	8	43
HPV45	E6	11	47
HPV45	E6	8	128
HPV45	E6	8	60
HPV45	E6	9	102
HPV45	E6	10	101
HPV45	E6	10	1
HPV45	E6	8	100
HPV45	E6	11	100
HPV45	E6	10	83
HPV45	E6	8	139
HPV45	E6	11	139
HPV45	E6	10	95
HPV45	E6	9	114
HPV45	E6	11	114
HPV45	E6	8	111
HPV45	E6	9	111
HPV45	E6	8	144
HPV45	E6	9	144
HPV45	E6	10	144
HPV45	E6	11	144
HPV45	E6	10	41
HPV45	E6	8	29
HPV45	E6	9	84
HPV45	E6	9	28
HPV45	E6	8	72
HPV45	E7	9	64
HPV45	E7	8	78
HPV45	E7	10	44
HPV45	E7	11	44
HPV45	E7	8	47
HPV45	E7	11	62
HPV45	E7	8	61
HPV45	E7	11	75
HPV45	E7	9	51
HPV45	E7	11	51
HPV45	E7	11	49
HPV45	E7	8	54
HPV45	E7	10	76
HPV45	E7	9	45
HPV45	E7	10	45
HPV45	L1	9	517
HPV45	L1	11	161
HPV45	L1	8	191
HPV45	L1	11	234
HPV45	L1	9	523
HPV45	L1	11	523
HPV45	L1	8	518
HPV45	L1	11	518
HPV45	L1	10	162
HPV45	L1	8	164
HPV45	L1	11	88
HPV45	L1	10	276
HPV45	L1	8	129
HPV45	L1	11	188
HPV45	L1	8	250
HPV45	L1	9	488
HPV45	L1	10	488
HPV45	L1	8	271
HPV45	L1	9	271
HPV45	L1	11	114
HPV45	L1	10	296
HPV45	L1	11	169
HPV45	L1	8	283
HPV45	L1	8	24
HPV45	L1	8	498
HPV45	L1	9	498
HPV45	L1	10	498
HPV45	L1	8	237
HPV45	L1	11	450
HPV45	L1	9	359
HPV45	L1	10	82
HPV45	L1	11	503
HPV45	L1	10	143
HPV45	L1	11	328
HPV45	L1	10	473
HPV45	L1	8	91
HPV45	L1	11	91
HPV45	L1	10	68
HPV45	L1	9	144
HPV45	L1	9	69
HPV45	L1	8	499
HPV45	L1	9	499
HPV45	L1	8	49
HPV45	L1	9	383
HPV45	L1	10	516
HPV45	L1	9	190
HPV45	L1	8	526
HPV45	L1	10	526
HPV45	L1	11	526
HPV45	L1	10	22
HPV45	L1	10	248
HPV45	L1	8	508
HPV45	L1	9	387
HPV45	L1	10	440
HPV45	L1	10	380
HPV45	L1	10	281
HPV45	L1	11	334
HPV45	L1	11	357
HPV45	L1	9	452
HPV45	L1	11	67
HPV45	L1	9	101
HPV45	L1	8	529
HPV45	L1	11	46
HPV45	L1	10	77
HPV45	L1	9	93
HPV45	L1	10	58
HPV45	L1	8	272

Table IX
HLA-A3 Supermotif Peptides

HPV45	L1	11	486
HPV45	L1	8	521
HPV45	L1	9	521
HPV45	L1	11	521
HPV45	L1	10	115
HPV45	L1	10	519
HPV45	L1	11	519
HPV45	L1	8	453
HPV45	L1	8	522
HPV45	L1	10	522
HPV45	L1	9	163
HPV45	L1	9	116
HPV45	L1	9	330
HPV45	L1	11	57
HPV45	L1	8	442
HPV45	L1	9	520
HPV45	L1	10	520
HPV45	L1	10	329
HPV45	L1	9	441
HPV45	L1	8	70
HPV45	L1	9	297
HPV45	L1	11	36
HPV45	L1	8	102
HPV45	L1	10	92
HPV45	L1	8	360
HPV45	L1	10	47
HPV45	L1	9	78
HPV45	L1	10	127
HPV45	L1	8	196
HPV45	L1	8	477
HPV45	L1	10	303
HPV45	L1	9	38
HPV45	L2	10	286
HPV45	L2	8	12
HPV45	L2	11	12
HPV45	L2	10	357
HPV45	L2	9	14
HPV45	L2	9	303
HPV45	L2	9	273
HPV45	L2	9	276
HPV45	L2	11	306
HPV45	L2	11	58
HPV45	L2	10	25
HPV45	L2	9	60
HPV45	L2	11	292
HPV45	L2	10	210
HPV45	L2	11	210
HPV45	L2	10	34
HPV45	L2	9	287
HPV45	L2	8	1
HPV45	L2	9	1
HPV45	L2	10	1
HPV45	L2	11	1
HPV45	L2	10	79
HPV45	L2	11	285
HPV45	L2	11	356
HPV45	L2	11	209
HPV45	L2	9	214
HPV45	L2	10	216
HPV45	L2	9	11
HPV45	L2	10	302
HPV45	L2	11	298
HPV45	L2	10	281
HPV45	L2	11	281
HPV45	L2	11	225
HPV45	L2	9	308
HPV45	L2	10	68
HPV45	L2	10	220
HPV45	L2	10	13
HPV45	L2	8	288
HPV45	L2	11	288
HPV45	L2	9	211
HPV45	L2	10	211
HPV45	L2	11	362
HPV45	L2	8	212
HPV45	L2	9	212
HPV45	L2	11	212
HPV45	L2	9	358
HPV45	L2	10	363
HPV45	L2	8	304
HPV45	L2	8	359
HPV45	L2	10	293
HPV45	L2	9	217
HPV45	L2	9	80
HPV45	L2	8	2
HPV45	L2	9	2
HPV45	L2	10	2
HPV45	L2	8	81
HPV45	L2	11	437
HPV45	L2	9	227
HPV56	E2	9	177
HPV56	E2	10	177
HPV56	E2	8	178
HPV56	E2	9	178
HPV56	E2	11	178
HPV56	E2	8	4
HPV56	E2	8	71
HPV56	E2	10	176
HPV56	E2	11	176
HPV56	E2	9	195
HPV56	E2	8	140
HPV56	E2	8	213
HPV56	E2	10	213
HPV56	E2	8	117
HPV56	E2	8	43
HPV56	E2	9	43
HPV56	E2	8	191
HPV56	E2	10	154
HPV56	E2	8	61
HPV56	E2	10	99
HPV56	E2	10	59
HPV56	E2	11	210
HPV56	E2	8	239
HPV56	E2	10	239
HPV56	E2	9	297
HPV56	E2	9	283
HPV56	E2	10	211
HPV56	E2	11	281
HPV56	E2	9	233
HPV56	E2	9	90

Table IX
HLA-A3 Supermotif Peptides

HPV56	E2	11	295
HPV56	E2	9	46
HPV56	E2	10	46
HPV56	E2	9	1
HPV56	E2	11	1
HPV56	E2	8	292
HPV56	E2	11	236
HPV56	E2	10	301
HPV56	E2	8	246
HPV56	E2	11	246
HPV56	E2	11	188
HPV56	E2	8	279
HPV56	E2	11	223
HPV56	E2	8	196
HPV56	E2	11	266
HPV56	E2	10	282
HPV56	E2	11	28
HPV56	E2	8	234
HPV56	E2	9	155
HPV56	E2	8	179
HPV56	E2	10	179
HPV56	E2	10	237
HPV56	E2	9	302
HPV56	E2	10	45
HPV56	E2	11	45
HPV56	E2	9	278
HPV56	E2	9	111
HPV56	E2	10	111
HPV56	E6	8	89
HPV56	E6	9	89
HPV56	E6	10	139
HPV56	E6	9	69
HPV56	E6	10	69
HPV56	E6	9	50
HPV56	E6	10	33
HPV56	E6	8	101
HPV56	E6	10	28
HPV56	E6	11	28
HPV56	E6	8	23
HPV56	E6	11	20
HPV56	E6	11	44
HPV56	E6	11	48
HPV56	E6	9	88
HPV56	E6	10	88
HPV56	E6	8	137
HPV56	E6	8	70
HPV56	E6	9	70
HPV56	E6	11	70
HPV56	E6	8	31
HPV56	E6	8	98
HPV56	E6	11	98
HPV56	E6	8	119
HPV56	E6	9	119
HPV56	E6	9	110
HPV56	E6	8	30
HPV56	E6	9	30
HPV56	E6	9	67
HPV56	E6	11	67
HPV56	E6	8	90
HPV56	E6	10	21
HPV56	E6	10	135
HPV56	E6	8	73
HPV56	E7	10	75
HPV56	E7	8	39
HPV56	E7	11	70
HPV56	E7	10	42
HPV56	E7	8	62
HPV56	E7	10	60
HPV56	E7	8	73
HPV56	E7	8	77
HPV56	E7	10	71
HPV56	E7	11	59
HPV56	L1	11	241
HPV56	L1	8	198
HPV56	L1	8	58
HPV56	L1	11	381
HPV56	L1	9	444
HPV56	L1	9	37
HPV56	L1	8	512
HPV56	L1	11	79
HPV56	L1	11	195
HPV56	L1	8	136
HPV56	L1	10	389
HPV56	L1	8	257
HPV56	L1	9	491
HPV56	L1	10	491
HPV56	L1	8	278
HPV56	L1	9	278
HPV56	L1	11	176
HPV56	L1	10	236
HPV56	L1	11	121
HPV56	L1	10	404
HPV56	L1	10	308
HPV56	L1	10	303
HPV56	L1	8	290
HPV56	L1	11	290
HPV56	L1	8	501
HPV56	L1	10	501
HPV56	L1	8	33
HPV56	L1	9	364
HPV56	L1	10	150
HPV56	L1	10	378
HPV56	L1	10	334
HPV56	L1	8	98
HPV56	L1	11	98
HPV56	L1	10	55
HPV56	L1	11	55
HPV56	L1	11	45
HPV56	L1	11	168
HPV56	L1	9	502
HPV56	L1	9	151
HPV56	L1	8	385
HPV56	L1	10	36
HPV56	L1	11	333
HPV56	L1	9	2
HPV56	L1	10	1
HPV56	L1	11	95
HPV56	L1	9	123
HPV56	L1	8	91
HPV56	L1	9	197

Table IX
HLA-A3 Supermotif Peptides

HPV56	L1	8	511
HPV56	L1	9	511
HPV56	L1	10	31
HPV56	L1	10	255
HPV56	L1	10	467
HPV56	L1	9	522
HPV56	L1	10	522
HPV56	L1	11	522
HPV56	L1	9	442
HPV56	L1	11	442
HPV56	L1	10	288
HPV56	L1	11	339
HPV56	L1	11	362
HPV56	L1	8	384
HPV56	L1	9	384
HPV56	L1	11	35
HPV56	L1	11	260
HPV56	L1	10	508
HPV56	L1	11	508
HPV56	L1	9	455
HPV56	L1	9	108
HPV56	L1	11	520
HPV56	L1	9	100
HPV56	L1	11	100
HPV56	L1	10	67
HPV56	L1	10	446
HPV56	L1	8	279
HPV56	L1	8	456
HPV56	L1	9	379
HPV56	L1	10	261
HPV56	L1	11	489
HPV56	L1	8	526
HPV56	L1	9	526
HPV56	L1	8	524
HPV56	L1	9	524
HPV56	L1	10	524
HPV56	L1	11	524
HPV56	L1	8	86
HPV56	L1	8	380
HPV56	L1	9	304
HPV56	L1	11	377
HPV56	L1	9	335
HPV56	L1	11	66
HPV56	L1	8	445
HPV56	L1	11	445
HPV56	L1	8	525
HPV56	L1	9	525
HPV56	L1	10	525
HPV56	L1	8	523
HPV56	L1	9	523
HPV56	L1	10	523
HPV56	L1	11	523
HPV56	L1	8	57
HPV56	L1	9	57
HPV56	L1	8	443
HPV56	L1	10	443
HPV56	L1	10	99
HPV56	L1	8	365
HPV56	L1	9	56
HPV56	L1	10	56
HPV56	L1	10	134
HPV56	L1	8	203
HPV56	L1	8	310
HPV56	L1	9	47
HPV56	L1	10	283
HPV56	L1	9	85
HPV56	L1	11	453
HPV56	L2	8	222
HPV56	L2	10	281
HPV56	L2	11	281
HPV56	L2	9	438
HPV56	L2	10	438
HPV56	L2	11	438
HPV56	L2	8	12
HPV56	L2	11	12
HPV56	L2	10	367
HPV56	L2	9	14
HPV56	L2	9	30
HPV56	L2	10	437
HPV56	L2	11	437
HPV56	L2	9	276
HPV56	L2	9	287
HPV56	L2	11	58
HPV56	L2	10	25
HPV56	L2	9	60
HPV56	L2	9	293
HPV56	L2	10	293
HPV56	L2	8	221
HPV56	L2	9	221
HPV56	L2	10	210
HPV56	L2	11	210
HPV56	L2	8	81
HPV56	L2	8	302
HPV56	L2	10	34
HPV56	L2	10	235
HPV56	L2	8	1
HPV56	L2	9	1
HPV56	L2	10	1
HPV56	L2	11	1
HPV56	L2	11	285
HPV56	L2	11	209
HPV56	L2	8	369
HPV56	L2	11	78
HPV56	L2	8	441
HPV56	L2	9	441
HPV56	L2	10	441
HPV56	L2	11	441
HPV56	L2	11	306
HPV56	L2	10	68
HPV56	L2	9	11
HPV56	L2	9	220
HPV56	L2	10	220
HPV56	L2	11	298
HPV56	L2	11	225
HPV56	L2	10	13
HPV56	L2	9	211
HPV56	L2	10	211
HPV56	L2	10	79
HPV56	L2	8	212
HPV56	L2	9	212

Table IX
HLA-A3 Supermotif Peptides

HPV56	L2	9	80
HPV56	L2	8	288
HPV56	L2	11	288
HPV56	L2	8	2
HPV56	L2	9	2
HPV56	L2	10	2
HPV56	L2	11	280
HPV56	L2	11	366
HPV56	L2	9	236
HPV56	L2	8	31

Table IXA HPV 6A
HLA-A3 Supermotif Peptides

2	3	4
L1	8	234
E1	8	206
L1	9	489
L1	11	489
L2	10	286
E1	9	112
E1	10	112
L1	11	420
E1	10	475
L1	11	203
L1	8	487
L1	9	487
L1	11	487
L2	11	12
E2	8	322
L2	8	288
L2	11	288
L1	8	22
E1	8	407
L2	9	14
E6	9	10
E6	9	86
E1	8	77
E1	9	77
E1	9	101
L1	10	43
L1	11	43
E2	8	231
E2	9	231
E2	11	231
L1	10	483
L1	11	483
E1	11	601
E6	10	64
L1	11	157
E1	9	406
E2	8	296
E2	11	35
L1	8	99
E1	8	640
E1	10	111
E1	11	111
E2	8	230
E2	9	230
E2	10	230
L1	8	219
E6	8	96
E1	9	570
E7	10	88
E1	10	222
E2	10	25
E1	9	203
E1	11	203
L1	11	84
E1	11	73
L1	11	269
E6	11	99
E1	10	178
E2	9	174
L2	8	274
L2	11	274
E1	10	143
E1	8	336
E1	8	180
E1	8	62
E1	10	100
E1	9	375
E1	10	105
E6	8	42
E6	11	42
L1	9	453
L1	10	453
E1	9	197
E1	8	604
E2	11	74
E1	8	417
E2	8	100
E2	9	100
E1	11	373
E2	9	293
E2	11	293
E2	9	39
E7	11	39
E6	11	113
L1	8	206
L1	8	252
L2	8	442
E1	9	220
E6	9	126
E6	11	126
E1	9	454
L1	8	463
L1	10	463
E4	11	21
E1	9	393
L1	10	245
L2	9	276
L1	8	49
E1	11	587
L1	9	326
L2	11	58
E1	9	194
E2	10	156
E1	8	350
E1	9	217
L2	11	292
E2	9	55
E1	9	273
E1	11	273
L1	11	130
E1	11	431
L2	9	303
E1	8	632
E1	10	191
L2	10	25
L2	9	60
E1	8	145
L1	8	407
E4	9	90

Table IXA HPV 6A
HLA-A3 Supermotif Peptides

E1	9	316
L1	9	478
L1	10	113
E1	10	415
E2	11	53
E6	10	119
E4	8	10
E4	9	10
E1	9	246
L2	8	3
L2	9	3
E6	11	25
L2	11	306
L2	8	149
E2	9	29
E1	8	376
E1	11	474
L2	9	287
L1	8	272
E1	8	195
E1	11	195
E6	9	120
E1	9	106
E2	11	315
L1	10	421
E1	8	571
E2	10	267
E2	11	267
L2	8	82
E7	9	89
E1	9	476
L1	8	486
L1	9	486
L1	10	486
E1	9	433
E2	9	351
E6	9	128
E1	8	114
E1	10	114
E1	11	114
E1	9	462
E1	10	462
E1	9	420
E1	11	420
E1	8	286
E2	9	165
E2	9	147
E6	8	116
E6	10	116
E1	10	121
E1	11	283
L1	8	61
L1	11	61
L1	11	19
L1	9	71
L1	11	42
L1	9	271
E6	9	101
E1	9	223
E2	11	266
E1	11	540
E4	10	8
E4	11	8
E4	8	24
E1	8	198
L1	9	464
E1	8	276
E1	11	276
E1	11	563
E1	8	218
E1	11	218
L1	9	439
L1	11	439
E4	8	81
E6	8	121
E1	9	115
E1	10	115
E1	11	115
E1	10	277
E1	8	279
E1	10	279
L2	10	293
L1	11	295
E1	10	564
E7	11	67
L1	9	233
L2	8	1
L2	9	1
L2	10	1
L2	11	1
E1	8	546
E1	8	421
E1	10	421
E1	8	274
E1	10	274
E1	10	607
E1	9	568
E1	11	568
E1	10	451
L1	10	31
E4	9	23
L1	10	438
E1	8	397
L1	9	352
E1	11	59
E1	10	395
L2	9	38
E2	10	348
L2	9	237
L2	11	285
L1	11	482
L2	8	438
L2	9	438
L2	10	438
L2	11	438
L1	10	217
E6	9	110
E4	8	34
E4	9	34
L1	8	160

DEMANDES OU BREVETS VOLUMINEUX

LA PRÉSENTE PARTIE DE CETTE DEMANDE OU CE BREVETS COMPREND PLUS D'UN TOME.

CECI EST LE TOME __1___ DE __3___

NOTE: Pour les tomes additionels, veillez contacter le Bureau Canadien des Brevets.

JUMBO APPLICATIONS / PATENTS

THIS SECTION OF THE APPLICATION / PATENT CONTAINS MORE THAN ONE VOLUME.

THIS IS VOLUME __1___ OF __3___

NOTE: For additional volumes please contact the Canadian Patent Office.

THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An isolated prepared human papilloma virus (HPV) epitope consisting of a human leukocyte antigen (HLA)-A2 supermotif peptide from HPV45 as set forth in Table VIII.

2. The isolated epitope of claim 1, wherein said epitope comprises a primary anchor residue selected from the group consisting of V, A, T and Q at position 2 and a L, I, V, A or T at the C-terminal position.

3. The isolated epitope of claim 1, wherein said epitope consists of the sequence set forth in SEQ ID NO:50, from amino acid 137 to amino acid 146.

4. A composition comprising the isolated epitope of any one of claims 1 to 3, wherein the epitope is admixed or joined to a cytotoxic T lymphocyte (CTL) epitope.

5. The composition of claim 4, wherein the CTL epitope is selected from the peptides set forth in Tables VII-XVIII.

6. A composition comprising the isolated epitope of any one of claims 1 to 3, wherein the epitope is admixed or joined to a helper T lymphocyte (HTL) epitope.

7. The composition of claim 6, wherein the HTL epitope is selected from the peptides set forth in Tables XIX-XX.

8. The composition of claim 6, wherein the HTL epitope is a pan-DR binding molecule.

9. A composition comprising at least three epitopes selected from the human leukocyte antigen (HLA)-A2 supermotif peptides from human papilloma virus (HPV) as set forth in Table VIII, wherein at least one peptide is the peptide of any one of claims 1 to 3.

10. A composition comprising the isolated epitope of any one of claims 1 to 3, further comprising a liposome, wherein the epitope is on or within the liposome.

11. A composition comprising the isolated epitope of any one of claims 1 to 3, wherein the epitope is joined to a lipid.

12. A composition comprising the isolated epitope of any one of claims 1 to 3, wherein the epitope is joined to a linker.

13. A composition comprising the isolated epitope of any one of claims 1 to 3, wherein the epitope is bound to an HLA heavy chain, β-microglobulin, and strepavidin complex, whereby a tetramer is formed.

14. A composition comprising the isolated epitope of any one of claims 1 to 3, further comprising an antigen presenting cell, wherein the epitope is on or within the antigen presenting cell.

15. A composition of claim 14, wherein the epitope is bound to an HLA molecule on the antigen presenting cell, whereby when a cytotoxic T lymphocyte (CTL) restricted to the HLA molecule is present, a receptor of the CTL binds to a complex of the HLA molecule and the epitope.

16. A clonal cytotoxic T lymphocyte (CTL), wherein the CTL is cultured *in vitro* and binds to a complex comprising the epitope of any one of claims 1 to 3, bound to an HLA-A2 molecule.

17. A peptide comprising at least a first and a second epitope, wherein the first epitope is the epitope of any one of claims 1 to 3;

wherein the peptide comprises less than 50 contiguous amino acids that have 100% identity with a native HPV peptide sequence.

18. A composition comprising the peptide of claim 17 and a pharmaceutical excipient, wherein the second epitope is selected from the peptides set forth in Tables VII-XVIII.

19. A composition of claim 18, further comprising a third epitope selected from the peptides set forth in Tables VII-XX.

20. A composition comprising the peptide of claim 17, wherein the peptide is a heteropolymer.

21. A composition comprising the peptide of claim 17, wherein the peptide is a homopolymer.

22. A composition comprising the peptide of claim 17, wherein the second epitope is a cytotoxic T lymphocyte (CTL) epitope.

23. A composition comprising the peptide of claim 17, wherein the second epitope is a PanDR binding molecule.

24. A vaccine composition comprising:

a unit dose of a peptide that comprises less than 50 contiguous amino acids that have 100% identity with a native peptide sequence of human papilloma virus (HPV), the peptide comprising at least a first epitope, wherein the first epitope is the epitope of any one of claims 1 to 3 and

a pharmaceutical excipient.

25. The vaccine composition of claim 24, further comprising a second epitope.

26. The vaccine composition of claim 25, wherein the second epitope is a PanDR binding molecule.

27. The vaccine composition of claim 24, wherein the pharmaceutical excipient comprises an adjuvant.

28. An isolated nucleic acid encoding a peptide consisting of the epitope of any one of claims 1 to 3.

29. An isolated nucleic acid encoding a peptide comprising at least a first and a second epitope, wherein the first epitope is the epitope of any one of claims 1 to 3; and

wherein the peptide comprises less than 50 contiguous amino acids that have 100% identity with a native HPV peptide sequence.

30. The isolated nucleic acid of claim 29, wherein the second epitope is selected from the peptides as set forth in Tables VII-XX.

31. The isolated nucleic acid of claim 30, wherein the peptide comprises a third epitope selected from the peptides as set forth in Tables VII-XX.

32. The isolated nucleic acid of claim 29, wherein the second epitope is a CTL epitope.

33. The isolated nucleic acid of claim 29, wherein the second epitope is an HTL epitope.

34. The isolated prepared human papilloma virus HPV epitope acording to claim 1, wherein the epitope is from a protein antigen comprising the sequence as set forth SEQ ID NO:50.

35. The composition according to claim 9, wherein the at least three epitopes are from a protein antigen selected from the group consisting of HPV45 E1, HPV45 E2, HPV45 E6, HPV45 E7, HPV45 L1 and HPV45 L2.