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(54) Title: BIOMARKERS FOR DIAGNOSIS AND TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA

(57) Abstract: A molecular classification procedure based on activity levels of modules in protein networks, wherein the proteins are biomarkers for chronic lymphocytic leukemia (CLL), and method for use of the subnetworks to distinguish between patients at low or high risk of progression of their disease.

BIOMARKERS FOR DIAGNOSIS AND TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The invention relates to the use of protein biomarkers for the differential diagnosis, determination of prognosis, and monitoring of the progression of treatment of chronic lymphocytic leukemia.

BACKGROUND INFORMATION

[0002] Cancers are the second most prevalent cause of death in the United States, causing 450,000 deaths per year. One in three Americans will develop cancer, and one in five will die of cancer. While substantial progress has been made in identifying some of the likely environmental and hereditary causes of cancer, there is a need for substantial improvement in the diagnosis and therapy for cancer and related diseases and disorders.

[0003] The course of chronic lymphocytic leukemia (CLL) is variable. Some patients have aggressive disease and require therapy within a relatively short time after diagnosis, whereas others have indolent, asymptomatic disease, and need no therapy for many years. CLL treatment depends upon both the stage and symptoms of the individual patient.

[0004] A large group of CLL patients have low-grade, or indolent, disease, which does not benefit from treatment. Individuals with CLL-related complications or more advanced disease often benefit from treatment. To this end, several molecules have been investigated in the pursuit of a biomarker to use for diagnosis of CLL. However, as yet, there is no definitive biomarker that can universally detect and distinguish the aggressive and indolent forms of CLL (see, e.g., J. Binet et al, Perspectives on the use of new diagnostic tools in the treatment of chronic lymphocytic leukemia, Blood 2006 107: 859-861; and, L. Rassenti et al, ZAP-70 compared with immunoglobulin heavy-chain gene mutation status as a predictor of disease progression in chronic lymphocytic leukemia, N Engl J Med. 2004 Aug 26;351(9):856-7). A need, therefore, exists for a method of using biomarkers for in connection with the differential diagnosis and treatment of CLL.

SUMMARY OF THE INVENTION

[0005] The present invention is based on the seminal discovery that a panel of biomarkers is differentially expressed in patients with CLL at distinct stages of the disease. More specifically, the invention relates to a molecular classification procedure based on activity levels of modules in protein networks.

[0006] Accordingly, the present invention provides a molecular differential diagnosis (prognosis) tool that assigns patients to "aggressive" (high-risk) or "indolent" (low-risk) groups based on their gene expression correlated to the treatment-free survival from the date of sample collection.

[0007] Accordingly, the invention provides a method for predicting the prognostic risk posed by chronic lymphocytic leukemia (CLL) to a patient diagnosed with the disease. The method includes obtaining a sample from the patient; and comparing expression of a first plurality of genes from said sample to expression of a second plurality of genes comprising a biomarker subnetwork, wherein the genes of the subnetwork encode proteins known to exhibit protein-protein interactions, and wherein further said proteins are associated with relatively high or low risk for progression of the disease, whereby similarity between expression of said pluralities of genes indicates the relative level of such risk for the patient. In various aspects, the subnetwork of genes encode proteins that comprise one or more protein biomarkers listed in Tables 1 through 4. In related aspects, the subnetwork includes one or more subnetworks listed in Table 5. Additionally, the subnetwork may include one or more of the subnetworks of Figures 8 through 37.

[0008] In another embodiment, the invention provides a method of diagnosing CLL in a subject. The method includes diagnosing a subject as having or being at risk of having chronic lymphocytic leukemia (CLL), by obtaining a sample from the subject; and comparing the expression or activation of one or more biomarkers listed in Tables 1 through 5 or Figures 8 through 37, in a first sample from the subject suspected of having CLL with a control sample of normal B cells, wherein differential expression of one or more of said biomarkers in the subject's sample as compared to the control sample is diagnostic of CLL in the subject. In one aspect the biomarker includes one or more biomarkers listed in Tables 1 or 3 and expression of the one or more biomarkers is increased as compared to expression of the

biomarker in the control sample. In a related aspect, the biomarker includes one or more biomarkers listed in Tables 2 or 4 and expression of the one or more biomarkers is decreased as compared to expression of the biomarker in the control sample.

[0009] In another embodiment, the invention provides a method for distinguish aggressive CLL from indolent CLL in a subject. For example a method is provided for differentially diagnosing aggressive chronic lymphocytic leukemia (CLL) versus indolent CLL in a subject. The method includes obtaining a sample from a subject; and comparing the level of expression of one or more biomarkers listed in Table 1 and/or Table 2 in a sample from the subject suspected of having aggressive CLL with a control indolent CLL sample, wherein greater expression of one or more of said biomarkers listed in Table 1 in the subject sample versus the control indolent CLL sample is diagnostic of aggressive CLL in the subject, or wherein lesser expression of one or more of said biomarkers listed in Table 2 in the subject sample versus the control indolent CLL sample is diagnostic of indolent CLL in the subject.

[0010] According to another embodiment, a method is provided for monitoring a therapeutic regime or progression of CLL in a subject. The method includes identifying when a pattern of biomarker expression indicative of CLL in the indolent state changes to a pattern indicative of CLL in the aggressive state. Detection of such a shift can provide a basis upon which to alter therapy at the early stages of aggressive CLL, thereby potentially improving the clinical outcome for the patient. Additionally, a method is provided in entailing monitoring a therapeutic regimen for treating a subject having or at risk of having CLL, including determining a change in activity or expression of one or more biomarkers listed in any of Tables 1 through 4, subnetwork listed in Table 5 or Figures 8 through 37, thereby monitoring the therapeutic regimen in the subject.

[0011] In yet another aspect, the invention provides a method for diagnosing CLL in a subject, comprising the steps of a) providing a gene expression profile of a sample from the subject suspected of having CLL, wherein the sample simultaneously expresses a plurality of genes at the protein level that are markers (biomarkers) for CLL; and b) comparing the subject's gene expression profile to a reference gene expression profile obtained from a corresponding control sample of B cells, wherein the reference gene expression profile comprises an expression value of one or more target genes for biomarkers indicative of CLL; and/or c) comparing the gene expression profile to a database of CLL protein biomarker

subnetworks, to provide a differential diagnosis between indolent and aggressive CLL and/or provide a prognosis for the patient.

[0012] In another embodiment, the invention provides a computer microchip programmed with one or more datasets concerning CLL subnetwork markers that can be used in clinical routines for predicting whether a particular patient's expression profile is likely to be in a short need of treatment. A microarray-like approach can be implemented. Accordingly, the invention provides a diagnostic chip comprising nucleotides with at least 80%, 85%, 90%, 95%, or greater percent homology to the sequences of two or more genes listed in Tables 1 through 4, and the subnetworks listed in Table 5 and those of Figures 8 through 37.

[0013] In another embodiment, the invention provides a software program with algorithms for comparing one or more datasets concerning CLL subnetwork markers that can be used in clinical routines for predicting whether a particular patient's expression profile is likely to be in a short need of treatment. Accordingly, a computer-readable media including algorithms for execution of comparisons included in the methods described herein is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1. Potential biomarkers for distinguish aggressive and indolent CLL. ZAP70 is over-expressed in aggressive CLL.

[0015] Figure 2. Schematic overview of subnetwork identification. Protein-protein interaction networks are used to assign sets of genes to discrete subnetworks. Gene expression profiles of tissue samples drawn from each type of cancer (i.e., metastatic or nonmetastatic) are transformed into a "subnetwork activity matrix". For a given subnetwork Mk in the interaction network, the activity is a combined z-score derived from the expression of its individual genes. After overlaying the expression vector of each gene on its corresponding protein in the interaction network, subnetworks with discriminative activities are found via a greedy search. Significant subnetworks are selected based on null distributions estimated from permuted subnetworks. Subnetworks are then used to identify disease genes, and the subnetwork activity matrix is also used to train a classifier.

[0016] Figure 3. Prognostic subnetworks shown as identifying new putative cancer markers and provide an array of "small-scale" models charting the molecular mechanisms

correlated with CLL progression, e.g. subnetworks detailing interactions between proteins participating in Wnt signaling, Smoothend signaling, or cell death.

[0017] Figure 4. Prognostic indicators evaluated in untreated CLL patients using the invention, with respect to subnetwork signature (Figure 4a) versus gene expression profiles (Figure 4b), IgVH mutational status (Figure 4c) or ZAP-70 protein expression (Figure 4d).

[0018] Figure 5. Comparison of subnetwork signature determined using the 131 CLL patient cohort (left panel) to gene expression profile of independent testing set of 17 CLL patients (right panel). The subnetwork signature was predictive of the prognosis of the subsequent independent testing set.

[0019] Figure 6. An illustration grouping the CLL subnetworks of Figures 6 through 52 to indicate the spectrum of CLL biomarker expression for disease progression from low to high risk (indolent to aggressive).

[0020] Figure 7. A schematic for application of the method of the invention to CLL risk classification.

[0021] Figures 8 through 37. Subnetwork matrices of protein markers for CLL.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Methods are provided for the diagnosis and monitoring of treatment of CLL based on detection of certain biomarkers in samples from patients who have, or are suspected of having, CLL. Further, expression of one or more such biomarkers can be used to distinguish aggressive CLL from indolent CLL. In addition, certain cellular pathways have been identified as biomarkers of CLL whose activation or inactivation is diagnostic for CLL.

[0023] Before the present compositions and methods are described, it is to be understood that this invention is not limited to particular compositions, methods, and experimental conditions described, as such compositions, methods, and conditions may vary. It is also to be understood that the terminology used herein is for purposes of describing particular embodiments only, and is not intended to be limiting, since the scope of the present invention will be limited only in the appended claims.

[0024] As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural references unless the context clearly dictates otherwise. Thus, for example, references to "the method" includes one or more methods, and/or steps of the type described herein which will become apparent to those persons skilled in the art upon reading this disclosure and so forth.

[0025] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods and materials are now described.

[0026] In various aspects, the invention provides biomarkers relating to CLL diagnosis, prognosis, treatment, and pathology. A biomarker is a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention. Biomarkers vary widely in nature, ease of measurement, and correlation with physiological states of interest. As in the present invention, biomarkers may include up- or down-regulation of gene expression or subnetworks of a plurality of genes. For example, increased or decreased expression of a gene encoding a protein during pathogenesis of a disease, such as CLL, implicates the protein as a protein biomarker. Similarly, increased or decreased expression of a plurality of genes, or subnetwork, during pathogenesis of a disease, such as CLL, implicates the subnetwork as a biomarker subnetwork. For example, the subnetwork, may include a plurality of genes whose expression products (proteins) are known to interact in cellular processes to define biological pathways and processes.

[0027] Biomarker subnetworks and/or protein biomarkers whose up-regulation or downregulation is indicative of an increase or decrease in the relative "activeness" of the disease. In particular, marker gene expression define a repertoire of transcriptional activity contributing to or resulting from the dynamic evolution of CLL cells. Network-based gene expression analysis reveals subnetworks of proteins that are coordinately irregulated under the disease progression. With knowledge of such subnetworks, CLL progression can be monitored by analyzing subnetwork activities inferred from gene expression profiles.

[0028] As used herein, the terms "patient" or "individual" are used interchangeably herein, and is meant a mammalian subject to be treated, with human patients being preferred. In some cases, the methods of the invention find use in experimental animals, in veterinary application, and in the development of animal models for disease, including, but not limited to, rodents including mice, rats, and hamsters, and primates.

[0029] Gene expression profiling has been used to define a repertoire of transcriptional activity contributing to or resulting from the dynamic evolution of CLL cells. To evaluate for this, samples obtained from CLL patients may be profiled for expression, using for example, microarray technology, such as mRNA expression microarrays. However, one of skill in the art would understand that expression profiling may be performed by any method known in the art, including methods, such as serial analysis of gene expression (SAGE) or SuperSAGE technology.

[0030] As discussed herein, the methods of the present invention may be used, for example, to evaluate CLL patients and those at risk for CLL. In any of the methods of diagnosis, prognosis, disease progression and therapeutic efficacy described herein, either the presence or the absence of one or more biomarkers of CLL, may be used to generate such clinical measures.

[0031] In one embodiment, the invention provides a molecular prognosis tool that assigns patients to "aggressive" (high-risk) or "indolent" (low-risk) groups based on their gene expression correlated to the treatment-free survival from the date of sample collection. To achieve better prediction performance based upon biological-defensive models, the network-based classification scheme developed for predicting metastasis potential of breast cancers (Chuang et al., *Mol Syst Biol.*, 2008) was adapted to CLL analysis. The network-based approach identifies prognostic markers not as individual genes but as subnetworks extracted from molecular interaction databases (Figure 2).

[0032] Approximately 30 prognostic subnetworks have been identified which provide new putative cancer markers and an array of "small-scale" models charting the molecular mechanisms correlated with CLL progression, e.g. subnetworks detailing interactions between proteins participating in Wnt signaling, Smoothend signaling, or cell death (Figure 3).

[0033] The network-based classification of the invention achieves higher accuracy in predicting duration of treatment-free survival in newly diagnosed patients than commonly-used prognostic factors or conventional gene-expression array analyses (compare Figure 4a to Figures 4b through 4d). Thus, the network-based approach integrating protein interactions with CLL expression profiles leads to increased classification accuracy along a scale of disease "activeness" (Figure 6) and, simultaneously, provides a view of the biological processes underlying CLL progression.

[0034] To perform the methods of the invention, the sample of cells examined according to the present method can be obtained from the subject to be treated; e.g., from a blood sample. As used herein, the term "sample" refers to any sample suitable for the methods provided by the present invention. The sample may be any sample that includes cells or cellular components suitable for detection. In one aspect, the sample is a blood sample, including, for example, whole blood or any fraction or component thereof. A blood sample, suitable for use with the present invention may be extracted from any source known that includes blood cells or components thereof, such as veinous, arterial, peripheral, tissue, cord, and the like. For example, a sample may be obtained and processed using well known and routine clinical methods (*e.g.*, procedures for drawing and processing whole blood). In one aspect, an exemplary sample may be peripheral blood drawn from a subject with cancer.

[0035] Once disease is established and a treatment protocol is initiated, the methods of the invention may be repeated on a regular basis to monitor the expression level of genes associated with CLL in the subject and correlate them to the subnetwork data. The gene expression level data allows one to distinguish between aggressive and indolent CLL, while comparison of the expression data to subnetwork matrices for CLL aids in classification of each patient into high or low risk categories (Figure 7). The results obtained from successive assays may be used to show the efficacy of treatment over a period ranging from several days to months.

[0036] A panel of protein biomarkers that can be used collectively or individually to diagnose CLL are described in Tables 1 through 4 herein below. Analysis of the panel has also revealed that up- or downregulation of certain cellular pathways can be used as indicators of CLL, as described in Table 5 below. Likewise Figures 8 through 37 include biomarker clusters of genes implicated in CLL diagnosis and progression.

[0037] Most of the individual members of the panel, and the identified cellular pathways, have not previously been recognized as CLL biomarkers or drug targets. The panel of biomarkers can be quantitated using mass spectrometry, antibodies, or other assays well known in the art that identify and measure relative or absolute quantities of gene expression or the resulting proteins, such as expression profiling using microarray or SAGE technology.

[0038] Furthermore, the biomarkers can be used to discover drugs by developing assays that report agonist or antagonist interactions of drug candidates with the panel of biomarkers, both individually and collectively, and that report both direct and indirect effects on the biomarkers.

[0039] In all of the embodiments of the invention described herein, analysis, such as comparison of the data generated relating to gene expression, is generally performed using software algorithms generally known in the art. Thus generation, comparison and analysis of data is performed on computer-readable media including such software. The results are typically outputted to a user via a visual display.

[0040] The invention further provides a microarray device, such as a microarray including nucleotide sequences of the biomarkers disclosed herein. The microarrays are provided for obtaining clinically relevant data regarding CLL diagnosis and the like as described.

[0041] Microarrays or arrays of the present invention may include any one, two or three dimensional arrangement of addressable regions bearing a particular chemical moiety or moieties (for example, polynucleotide sequences) associated with that region. Preferably the chemical moieties include oligonucleotides (i.e., probes) An array is addressable in that it has multiple regions of different moieties (i.e., different oligonucleotide sequences) such that a region (i.e., a feature or spot of the array) is at a particular predetermined location (i.e., an address) on the array. An array layout refers to one or more characteristics of the array, such as feature positioning, feature size, and some indication of a moiety at a given location. An array includes a support substrate that may be of any suitable type known in the art, such as glass, to which one or more chemical moiety or moieties are linked or bound using methods well known in the art.

[0042] As used herein, the terms "polynucleotide" and "oligonucleotide" refer to nucleic acid molecules. A polynucleotide or oligonucleotide includes single or multiple stranded

configurations, where one or more of the strands may or may not be completely aligned with another. The terms "polynucleotide" and "oligonucleotide" are intended to be generic to polydeoxyribonucleotides (containing 2-deoxy-D-ribose), polyribonucleotides (containing D-ribose), or any other type of polynucleotide which is an N-glycoside of a purine or pyrimidine base. Additionally, the terms are intended to include polymers in which the conventional backbone has been replaced with a non-naturally occurring or synthetic backbone or in which one or more of the conventional bases has been replaced with a non-naturally occurring or synthetic base. As such a polynucleotide or oligonucleotide may include naturally occurring nucleotides and phosphodiester bonds that are chemically synthesized.

[0043] While the terms “oligonucleotide” and “polynucleotide” are intended to be synonymous, an "oligonucleotide" may generally refer to a nucleotide multimer of about 2 to 100 nucleotides in length, such as a probe, while a "polynucleotide" includes a nucleotide multimer having any number of nucleotides, such as the entire genome of an organism or a portion thereof.

[0044] The probes for use with the microarray may be oligodeoxyribonucleotides or oligoribonucleotides, or any modified forms of these polymers that are capable of hybridizing with a target nucleic sequence by complementary base-pairing. Complementary base pairing means sequence-specific base pairing which includes, for example, Watson-Crick base pairing as well as other forms of base pairing such as Hoogsteen base pairing. Modified forms include 2'-O-methyl oligoribonucleotides and so-called PNAs, in which oligodeoxyribonucleotides are linked via peptide bonds rather than phosphodiester bonds. The probes can be attached by any linkage to a support substrate (i.e., 3', 5' or via the base).

[0045] A variety of methods are well known in the art for manufacturing microarrays, including methods for binding or affixing probes in a variety of configurations to a solid support, such as glass, plastic or silicon wafer. Such methods include fabrication using a variety of technologies, such as printing with fine-pointed pins onto glass slides, photolithography using pre-made masks, photolithography using dynamic micromirror devices, ink-jet printing, or electrochemistry on microelectrode arrays.

[0046] In various aspects, the number of probes affixed to the array support can be quite large. For example, the array may include up to about 6 million probes. Further, the probe

sequences may be about 80, 85, 90, 95% or more, homologous to one or more nucleotide sequences of the biomarkers identified herein. For example, the probe sequences may be about 95% homologous or greater to the biomarkers indentified in Figures 8-37.

[0047] The following examples are provided to further illustrate the embodiments of the present invention, but are not intended to limit the scope of the invention. While they are typical of those that might be used, other procedures, methodologies, or techniques known to those skilled in the art may alternatively be used.

EXAMPLE I

Differential Expression of Biomarkers in Aggressive and Indolent CLL

[0048] Purified B cell samples from aggressive and indolent CLL patients were lysed and proteins were digested by trypsin. O16/O18 labeling was used for relative quantitation by spectra count, while iTRAQ labeling was used to obtain more accurate quantitation. An automated 2D nanoflow LC system was coupled to an LTQ mass spectrometer to identify and quantify the peptides. Mass spectra were searched against the IPI™ database using Agilent Spectrum Mill™ software. Search results for individual spectra were automatically validated using filtering criteria from an in-situ False Discovery Rate (FDR) calculation. IDs for identified proteins were converted to gene symbols and Unigene IDs using the IPI gene cross reference table. Protein function analysis was done using the NCI DAVID™ website.

[0049] 5 pairs of aggressive and indolent CLL samples were analyzed using O16/O18 labeling. A total of 15,442 IPI protein sequences were identified at a protein FDR of 3.5%, which corresponds to 6,348 unigenes. Relative protein spectra count ratio was used for quantitation. Spectra count ratio was digitized into either up (+1), down (-1), or undetected (0) categories. 16 replicate runs were performed to obtain good quantitative statistics. A protein relative abundance heat map was generated using this method (Figure 1). The difference (N) of the "up" (N_{up}) and "down" (N_{down}) frequencies was used to calculate the quantitation FDR ($N=|N_{up}-N_{down}|$):

$$FDR = \frac{1}{2^{N-1}}$$

[0050] Proteins that consistently shown up or down trends were selected as potential biomarkers (Figure 1). Using a cutoff of N=10, 230 up-regulated and 71 down-regulated proteins in aggressive CLL were found. Among them, ZAP70 is a known marker for distinguishing aggressive CLL from indolent CLL.

[0051] Table 1 lists the panel of protein biomarkers that are up-regulated in aggressive CLL compared to indolent CLL B-cells.

Table 1: Proteins that are up-regulated in aggressive CLL compared to indolent CLL B-cells.

Gene Symbol	Unigene	Accession	Protein
SERPINB6	Hs.519523;	IPI00413451	SERPINB6 Hypothetical protein DKFZp686I04222
FKBP5	Hs.407190;	IPI00218775	FKBP5 FK506-binding protein 5
PSMD13	Hs.134688;	IPI00552191	PSMD13 Hypothetical protein DKFZp686H16220
FHOD1	Hs.95231;	IPI00001730	FHOD1 FH1/FH2 domain-containing protein 1
ZAP70	Hs.234569;	IPI00783674	**ZAP70 Tyrosine-protein kinase ZAP-70**
IPI00784519	IPI00784519	IPI00784519	Hypothetical protein
LOC642956	IPI00737213	IPI00737213	LOC642956 similar to Fatty acid-binding protein, epidermal
MX1	Hs.517307;	IPI00167949	MX1 Interferon-induced GTP-binding protein Mx1
ITGAX	Hs.248472;	IPI00302270	ITGAX Integrin alpha-X precursor
BLVRB	Hs.515785;	IPI00219910	BLVRB 23 kDa protein
RNASE3	Hs.73839;	IPI00025427	RNASE3 Eosinophil cationic protein precursor
RAB32	Hs.287714;	IPI00014377	RAB32 Ras-related protein Rab-32
ARFGAP1	Hs.25584;	IPI00217354	ARFGAP1 Isoform 2 of ADP-ribosylation factor GTPase-activating protein 1
NAIP1B	IPI00398857	IPI00398857	NAIP1B similar to Baculoviral IAP repeat-containing protein 1
LOC654029	IPI00787407	IPI00787407	LOC654029 similar to 40S ribosomal protein S10
CRIP2	Hs.534309;	IPI00006034	CRIP2 Cysteine-rich protein 2
ARIH2	Hs.649132;	IPI00792023	ARIH2 Ariadne homolog 2 variant
USP28	Hs.503891;	IPI00103951	USP28 Isoform 2 of Ubiquitin carboxyl-terminal hydrolase 28
HIP1R	Hs.654842; Hs.524815;	IPI00792558	HIP1R 69 kDa protein
RCN1	Hs.97887;	IPI00015842	RCN1 Reticulocalbin-1 precursor
IPI00021711	IPI00021711	IPI00021711	HLA-DPA1 HLA class II histocompatibility antigen, DP alpha chain precursor
MRPL19	Hs.44024;	IPI00027096	MRPL19 39S ribosomal protein L19, mitochondrial precursor
PFKM	Hs.75160;	IPI00743142	PFKM Isoform 1 of 6-phosphofructokinase, muscle type
KIAA0196	Hs.270043;	IPI00748472	KIAA0196 Protein KIAA0196 variant
MARCKSL1	Hs.75061;	IPI00641181	MARCKSL1 MARCKS-related protein
NDUFA11	Hs.406062;	IPI00329301	NDUFA11 NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 11
DHTKD1	Hs.612022; Hs.104980;	IPI00063408	DHTKD1 dehydrogenase E1 and transketolase domain containing protein 1
PEX11B	Hs.504284;	IPI00021978	PEX11B Peroxisomal membrane protein 11B
MRPL1	Hs.532019;	IPI00549381	MRPL1 mitochondrial ribosomal protein L1 precursor
UBE3A	Hs.654383;	IPI00219197	UBE3A Isoform I of Ubiquitin-protein ligase E3A
MYCBP2	Hs.591221;	IPI00607852	MYCBP2 Isoform 2 of Probable E3 ubiquitin-protein ligase MYCBP2
HTRA2	Hs.469045;	IPI00001663	HTRA2 Isoform 1 of Serine protease HTRA2, mitochondrial precursor
GTF2B	Hs.481852;	IPI00643469	GTF2B General transcription factor IIB
APOL2	Hs.474740;	IPI00220007	APOL2 Apolipoprotein-L2
PBXIP1	Hs.505806;	IPI00645060	PBXIP1 Pre-B-cell leukemia transcription factor interacting protein 1
PTPN11	Hs.506852; Hs.646231;	IPI00298347	PTPN11 Isoform 2 of Tyrosine-protein phosphatase non-receptor type 11
ARL2	Hs.502836;	IPI00003326	ARL2,SNX15 ADP-ribosylation factor-like protein 2
DTX3L	Hs.518201;	IPI00152503	DTX3L Protein deltex 3-like protein
EIF4B	Hs.648394; Hs.655133;	IPI00439415	EIF4B eukaryotic translation initiation factor 4B
PITPNA	Hs.429819;	IPI00216048	PITPNA Phosphatidylinositol transfer protein alpha isoform
CSNK2A1	Hs.644056;	IPI00744507	CSNK2A1 Casein kinase II subunit alpha

HK2	Hs.591588; Hs.406266;	IPI00102864	HK2 Hexokinase-2
NDRG1	Hs.372914;	IPI00183085	NDRG1 CDNA FLJ38330 fis, clone FCBBF3025280, highly similar to NDRG1 PROTEIN
TSTA3	Hs.404119;	IPI00014361	TSTA3 GDP-L-fucose synthetase
BCL7C	Hs.658547;	IPI00449172	BCL7C Hypothetical protein
CREB1	Hs.584750;	IPI00218334	CREB1 Isoform CREB-B of cAMP response element-binding protein
TBXAS1	Hs.520757;	IPI00788599	TBXAS1 thromboxane A synthase 1 (platelet, cytochrome P450, family 5, subfamily A) isoform TXS-I
MMRN1	Hs.268107;	IPI00012269	MMRN1 Multimerin-1 precursor
PAICS	Hs.518774; Hs.655926;	IPI00815732	PAICS phosphoribosylaminoimidazole carboxylase, phosphoribosylaminoimidazole succinocarboxamide synthetase isoform 1
LDHB	Hs.446149;	IPI00219217	LDHB L-lactate dehydrogenase B chain
TMEM70	Hs.106650;	IPI00106966	TMEM70 Isoform 1 of Transmembrane protein 70
IPI00171438	IPI00171438	IPI00171438	MUTED,TXNDC5 Thioredoxin domain-containing protein 5 precursor
NP	Hs.75514;	IPI00017672	NP CDNA FLJ25678 fis, clone TST04067, highly similar to PURINE NUCLEOSIDE PHOSPHORYLASE
FKBP3	Hs.509226;	IPI00024157	FKBP3 FK506-binding protein 3

[0052] Table 2 lists the panel of protein biomarkers that are down-regulated in aggressive CLL compared to indolent CLL B-cells.

Table 2: Proteins that are down-regulated in aggressive CLL compared to indolent CLL B-cells.

Gene Symbol	Unigene	Accession	Protein
SWAP70	Hs.153026;	IPI00307200	SWAP70 Switch-associated protein 70
GPD2	Hs.512382;	IPI00017895	GPD2 Isoform 1 of Glycerol-3-phosphate dehydrogenase, mitochondrial precursor
HIST1H1C	Hs.7644;	IPI00217465	HIST1H1C Histone H1.2
CAPG	Hs.516155;	IPI00027341	CAPG Macrophage-capping protein
NSL1	Hs.497692;	IPI00306330	NSL1 Kinetochore-associated protein NSL1 homolog
FAM82C	Hs.511067;	IPI00410079	FAM82C Isoform 1 of Protein FAM82C
CCBL1	Hs.495250;	IPI00002523	CCBL1 Isoform 1 of Kynurenine--oxoglutarate transaminase 1
DDEF1	Hs.655552;	IPI00410303	DDEF1 Isoform 2 of 130 kDa phosphatidylinositol 4,5-biphosphate-dependent ARF1 GTPase- activating protein
OSGEP	Hs.525196;	IPI00015809	OSGEP Probable O-sialoglycoprotein endopeptidase
AKAP8	Hs.631640;	IPI00014474	AKAP8 A-kinase anchor protein 8
BACH2	Hs.269764;	IPI00029178	BACH2 Transcription regulator protein BACH2
SIRT2	Hs.466693;	IPI00382551	SIRT2 Isoform 2 of NAD-dependent deacetylase sirtuin-2
RFC5	Hs.506989;	IPI00373883	RFC5 RFC5 protein
KIAA1598	Hs.501140;	IPI00448751	KIAA1598 Protein KIAA1598
IPI00827623	IPI00827623	IPI00827623	CDNA FLJ44136 fis, clone THYMU2009157, moderately similar to Mus musculus MRPS18b mitochondrial ribosomal protein S18b
RAB3GAP2	IPI00554590	IPI00554590	RAB3GAP2 Isoform 1 of Rab3 GTPase-activating protein non-catalytic subunit
NDUFB6	Hs.493668;	IPI00219385	NDUFB6 NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 6
AP1B1	Hs.368794;	IPI00413947	AP1B1 Isoform B of AP-1 complex subunit beta-1
DYSF	Hs.252180;	IPI00020210	DYSF Dysferlin_v1
NDNL2	Hs.656412;	IPI00217104	NDNL2 Melanoma-associated antigen G1
AYTL2	Hs.368853;	IPI00171626	AYTL2 1-acylglycerophosphocholine O-acyltransferase 1
F11R	Hs.517293;	IPI00001754	F11R Junctional adhesion molecule A precursor
EIF2A	Hs.655782;	IPI00012462	EIF2A Eukaryotic translation initiation factor 2A
TAF6	Hs.489309;	IPI00028579	TAF6 Transcription initiation factor TFIID subunit 6
REXO2	Hs.7527; Hs.677190;	IPI00032830	REXO2 Isoform 1 of Oligoribonuclease, mitochondrial precursor (Fragment)
RP6-213H19.1	Hs.444247;	IPI00182383	RP6-213H19.1 serine/threonine protein kinase MST4 isoform 3
LOC652614	IPI00739274	IPI00739274	LOC652614 similar to HLA class I histocompatibility antigen, A-11 alpha chain precursor
ANXA6	Hs.412117;	IPI00002459	ANXA6 annexin VI isoform 2

LOC730410	IPI00797359	IPI00797359	MICA,HLA-A,HLA-A29.1,LOC730410,HLA-B,HLA-C Major histocompatibility complex, class I, C
H2AFX	Hs.477879;	IPI00219037	H2AFX Histone H2A.x
FAM63A	Hs.3346;	IPI00413164	FAM63A hypothetical protein LOC55793 isoform 1
AK1	Hs.175473;	IPI00018342	AK1 Adenylate kinase isoenzyme 1
SMC5	Hs.534189;	IPI00843768	SMC5 Structural maintenance of chromosomes protein 5
PRKAR2B	Hs.433068;	IPI00554752	PRKAR2B cAMP-dependent protein kinase type II-beta regulatory subunit
GNAO1	Hs.654647;	IPI00398700	GNAO1 Guanine nucleotide-binding protein G(o) subunit alpha 2
HLA-DQB1	Hs.534322; Hs.653339; Hs.409934;	IPI00472502	HLA-DQB1 HLA class II histocompatibility antigen, DQ(W3) beta chain precursor
NCK2	Hs.657909;	IPI00306531	NCK2 Cytoplasmic protein NCK2
IGHG1	IPI00448925	IPI00448925	IGHG1 IGHG1 protein
IPI00641330	IPI00641330	IPI00641330	RING1 Isoform 1 of E3 ubiquitin-protein ligase RING1
WHSC1L1	Hs.608111;	IPI00743157	WHSC1L1 Isoform 1 of Histone-lysine N-methyltransferase NSD3
DYNLL2	Hs.591176;	IPI00062037	DYNLL2 Dynein light chain 2, cytoplasmic
RAB6B	IPI00016891	IPI00016891	RAB6B Ras-related protein Rab-6B
PTDSS1	Hs.292579;	IPI00010746	PTDSS1 Phosphatidylserine synthase 1
NUP160	Hs.643526;	IPI00748807	NUP160 Isoform 1 of Nuclear pore complex protein Nup160
HIST1H1A	Hs.150206;	IPI00217469	HIST1H1A Histone H1.1
FLJ12949	Hs.693832;	IPI00186139	FLJ12949 CDNA FLJ36560 fis, clone TRACH2009340

[0053] Table 3 lists the panel of protein biomarkers that are up-regulated in CLL compared to normal B-cells.

Table 3: Proteins that are up-regulated in CLL compared to normal B-cells.

Gene Symbol	Unigene	Accession	Protein
HIST2H2AB	Hs.664173;	IPI00216730	HIST2H2AB Histone H2A type 2-B
HIST1H1C	Hs.7644;	IPI00217465	HIST1H1C Histone H1.2
RAB15	Hs.512492;	IPI00383449	RAB15 Isoform 2 of Ras-related protein Rab-15
RAB33B	Hs.591679;	IPI00021475	RAB33B Ras-related protein Rab-33B
TMPRSS13	Hs.266308;	IPI00012505	TMPRSS13 Isoform 3 of Transmembrane protease, serine 13
SNRPE	Hs.334612; Hs.654418;	IPI00029266	SNRPE Small nuclear ribonucleoprotein E
IPI00455457	IPI00455457	IPI00455457	Histone 2, H3, pseudogene 2
RPSA	IPI00553164	IPI00553164	RPSA 40S ribosomal protein SA
IPI00787692	IPI00787692	IPI00787692	8 kDa protein
HNRPD	Hs.480073;	IPI00220684	HNRPD Isoform 3 of Heterogeneous nuclear ribonucleoprotein D0
HNRPA3	Hs.516539;	IPI00419373	HNRPA3 Isoform 1 of Heterogeneous nuclear ribonucleoprotein A3
FAU	Hs.387208;	IPI00397098	FAU 40S ribosomal protein S30
METTL7A	Hs.675538; Hs.655369;	IPI00022300	METTL7A Methyltransferase-like protein 7A precursor
PARP1	Hs.177766;	IPI00449049	PARP1 Poly [ADP-ribose] polymerase 1
FUS	Hs.513522;	IPI00785172	FUS Fusion (Involved in t(12,16) in malignant liposarcoma) isoform a variant (Fragment)
DEK	Hs.484813;	IPI00020021	DEK Protein DEK
HP1BP3	Hs.142442;	IPI00642238	HP1BP3 Hypothetical protein DKFZp434I0612
ALDH5A1	Hs.371723;	IPI00336008	ALDH5A1 aldehyde dehydrogenase 5A1 precursor, isoform 1
THOC4	Hs.534385;	IPI00328840	THOC4 THO complex subunit 4
FBL	Hs.299002;	IPI00025039	FBL rRNA 2'-O-methyltransferase fibrillarin
SRP14	Hs.533732;	IPI00293434	SRP14 Signal recognition particle 14 kDa protein
LOC653884	IPI00736887	IPI00736887	LOC653884 similar to FUS interacting protein (serine-arginine rich) 1
NOL5A	Hs.376064;	IPI00411937	NOL5A Nucleolar protein 5A
NOLA2	Hs.27222;	IPI00041325	NOLA2 H/ACA ribonucleoprotein complex subunit 2
HIST1H1E	Hs.248133;	IPI00217467	HIST1H1E Histone H1.4
NOP5/NOP58	Hs.471104;	IPI00006379	NOP5/NOP58 Nucleolar protein 5
HNRPH3	Hs.643472;	IPI00216492	HNRPH3 Isoform 2 of Heterogeneous nuclear ribonucleoprotein H3
CUGBP2	Hs.309288;	IPI00845479	CUGBP2 CUG triplet repeat, RNA binding protein 2 isoform 2
IPI00011654	IPI00011654	IPI00011654	TUBB Tubulin beta chain

MCCC1	Hs.47649;	IPI00024580	MCCC1 Methylcrotonoyl-CoA carboxylase subunit alpha, mitochondrial precursor
NHP2L1	Hs.182255;	IPI00026167	NHP2L1 NHP2-like protein 1
BUB3	Hs.418533;	IPI00013468	BUB3 Mitotic checkpoint protein BUB3
HNRPU	Hs.166463;	IPI00644079	HNRPU heterogeneous nuclear ribonucleoprotein U isoform a
IPI00013174	IPI00013174	IPI00013174	TMEM137,RBM14 Isoform 1 of RNA-binding protein 14
VDAC2	Hs.355927;	IPI00216027	VDAC2 Isoform 4 of Voltage-dependent anion-selective channel protein 2
NPM1	Hs.557550;	IPI00549248	NPM1 Isoform 1 of Nucleophosmin
APEX1	Hs.73722;	IPI00215911	APEX1 DNA-(apurinic or apyrimidinic site) lyase
HNRPA2B1	Hs.487774;	IPI00396378	HNRPA2B1 Isoform B1 of Heterogeneous nuclear ribonucleoproteins A2/B1
NCL	Hs.79110;	IPI00827674	NCL Isoform 2 of Nucleolin
COX5A	Hs.401903;	IPI00025086	COX5A Cytochrome c oxidase subunit 5A, mitochondrial precursor
DPM1	Hs.654951;	IPI00790317	DPM1 Dolichyl-phosphate mannosyltransferase polypeptide 1, catalytic subunit
ZNF22	Hs.655124; Hs.462693;	IPI00215890	ZNF22 Zinc finger protein 22
RPA1	Hs.461925; Hs.595562;	IPI00020127	RPA1 Replication protein A 70 kDa DNA-binding subunit
HNRPUL2	IPI00456887	IPI00456887	HNRPUL2 Heterogeneous nuclear ribonucleoprotein U-like protein 2
GOT2	Hs.599470;	IPI00018206	GOT2 Aspartate aminotransferase, mitochondrial precursor
SHMT2	Hs.75069;	IPI00002520	SHMT2 Serine hydroxymethyltransferase, mitochondrial precursor
SMCHD1	Hs.8118;	IPI00847644	SMCHD1 structural maintenance of chromosomes flexible hinge domain containing 1
PCK2	Hs.75812;	IPI00797038	PCK2 mitochondrial phosphoenolpyruvate carboxykinase 2 isoform 1 precursor
ILF2	Hs.75117;	IPI00005198	ILF2 Interleukin enhancer-binding factor 2
U2AF1	Hs.365116;	IPI00005613	U2AF1 Splicing factor U2AF 35 kDa subunit
ELAVL1	Hs.660070; Hs.184492;	IPI00301936	ELAVL1 ELAV-like protein 1
VDAC1	Hs.519320;	IPI00216308	VDAC1 Voltage-dependent anion-selective channel protein 1
HSPE1	Hs.1197;	IPI00220362	HSPE1 10 kDa heat shock protein, mitochondrial
FIP1L1	Hs.518760;	IPI00395337	FIP1L1 Isoform 1 of Pre-mRNA 3'-end-processing factor FIP1
SFRS1	Hs.68714;	IPI00215884	SFRS1 Isoform ASF-1 of Splicing factor, arginine/serine-rich 1
SFRS3	Hs.405144;	IPI00010204	SFRS3 Splicing factor, arginine/serine-rich 3
NDUFV2	Hs.464572;	IPI00646556	NDUFV2 28 kDa protein
DCI	Hs.403436;	IPI00300567	DCI Isoform 1 of 3,2-trans-enoyl-CoA isomerase, mitochondrial precursor
HLA-DRA	Hs.520048;	IPI00005171	HLA-DRA HLA class II histocompatibility antigen, DR alpha chain precursor
MTCH2	Hs.269944;	IPI00003833	MTCH2 Mitochondrial carrier homolog 2
MATR3	Hs.268939;	IPI00789551	MATR3 100 kDa protein
DHX9	Hs.191518;	IPI00844578	DHX9 ATP-dependent RNA helicase A
LOC138046	Hs.121663;	IPI00790685	LOC138046 34 kDa protein
CD72	Hs.116481;	IPI00010851	CD72 B-cell differentiation antigen CD72
ECH1	Hs.196176;	IPI00011416	ECH1 Delta(3,5)-Delta(2,4)-dienoyl-CoA isomerase, mitochondrial precursor
STRBP	Hs.287659;	IPI00169430	STRBP Isoform 1 of Spermatid perinuclear RNA-binding protein
HNRPA0	Hs.96996;	IPI00011913	HNRPA0 Heterogeneous nuclear ribonucleoprotein A0
FLJ12949	Hs.693832;	IPI00186139	FLJ12949 CDNA FLJ36560 fis, clone TRACH2009340
NIPSNAP1	Hs.173878;	IPI00304435	NIPSNAP1 Protein NipSnap1
MT-CO1	IPI00464968	IPI00464968	MT-CO1 Cytochrome c oxidase polypeptide I
SET	Hs.436687;	IPI00072377	SET Isoform 1 of Protein SET
SFRS7	Hs.309090;	IPI00332419	SFRS7 Isoform 3 of Splicing factor, arginine/serine-rich 7
IPI00023972	IPI00023972	IPI00023972	APOLD1,DDX47 Probable ATP-dependent RNA helicase DDX47
UFM1	Hs.694848; Hs.643655;	IPI00010207	UFM1 Ubiquitin-fold modifier 1 precursor
HMGA1	Hs.679425; Hs.518805;	IPI00179700	HMGA1 Isoform HMG-I of High mobility group protein HMG-I/HMG-Y
RPS24	Hs.356794;	IPI00219486	RPS24 40S ribosomal protein S24. Isoform 2
NUP43	Hs.510375;	IPI00742943	NUP43 Nucleoporin Nup43
ARS2	Hs.111801;	IPI00220038	ARS2 Isoform B of Arsenite-resistance protein 2
CUTC	Hs.16606;	IPI00300408	CUTC Copper homeostasis protein cutC homolog
PSIP1	Hs.658434;	IPI00028122	PSIP1 Isoform 1 of PC4 and SFRS1-interacting protein
IPI00219038	IPI00219038	IPI00219038	H3F3B,H3F3A Histone H3.3
LOC345630	IPI00736552	IPI00736552	LOC345630 similar to fibrillarin

NDUFS8	Hs.90443;	IPI00010845	NDUFS8 NADH dehydrogenase [ubiquinone] iron-sulfur protein 8, mitochondrial precursor
CD79B	Hs.89575;	IPI00027668	CD79B Isoform Long of B-cell antigen receptor complex-associated protein beta-chain precursor
PTBP2	Hs.591430;	IPI00514064	PTBP2 Isoform 1 of Polypyrimidine tract-binding protein 2
MRPL4	Hs.279652;	IPI00023334	MRPL4 Isoform 1 of Mitochondrial 39S ribosomal protein L4
PECI	Hs.15250;	IPI00419263	PECI Peroxisomal 3,2-trans-enoyl-CoA isomerase
DDX27	Hs.65234;	IPI00293078	DDX27 Probable ATP-dependent RNA helicase DDX27
PTDSS1	Hs.292579;	IPI00010746	PTDSS1 Phosphatidylserine synthase 1
RPL28	Hs.652114;	IPI00182533	RPL28 60S ribosomal protein L28
CD74	Hs.694723;	IPI00217775	CD74 Isoform Short of HLA class II histocompatibility antigen gamma chain
DDX19A	Hs.656037;	IPI00019918	DDX19A ATP-dependent RNA helicase DDX19A
WASF2	IPI00472164	IPI00472164	WASF2 Wiskott-Aldrich syndrome protein family member 2
NOLA3	Hs.14317;	IPI00032853	NOLA3 H/ACA ribonucleoprotein complex subunit 3
MBD2	Hs.25674;	IPI00434623	MBD2 Isoform 1 of Methyl-CpG-binding domain protein 2
HSPC152	Hs.333579;	IPI00009010	HSPC152 TRM112-like protein
SMU1	Hs.679417; Hs.655351;	IPI00305833	SMU1 Smu-1 suppressor of mec-8 and unc-52 protein homolog
hCG_2040224	IPI00412855	IPI00412855	hCG_2040224 similar to ribosomal protein L18a
SNRPA	Hs.466775;	IPI00012382	SNRPA U1 small nuclear ribonucleoprotein A
TETRAN	Hs.632581;	IPI00103940	TETRAN Tetracycline transporter-like protein
USMG5	Hs.500921;	IPI00063903	USMG5 Up-regulated during skeletal muscle growth protein 5
IPI00555878	IPI00555878	IPI00555878	APOBEC3C,APOBEC3D Probable DNA dC->dU-editing enzyme APOBEC-3C
MRPL9	Hs.694788;	IPI00307409	MRPL9 39S ribosomal protein L9, mitochondrial precursor
HSP90AB2P	Hs.590925;	IPI00455599	HSP90AB2P Heat shock protein 90Bb
VISA	Hs.646283;	IPI00020719	VISA Isoform 1 of Mitochondrial antiviral-signaling protein
PPM2C	Hs.22265;	IPI00794806	PPM2C 67 kDa protein
IPI00216457	IPI00216457	IPI00216457	HIST2H2AA3,HIST2H2AA4 Histone H2A type 2-A
GLS	Hs.116448;	IPI00215687	GLS Isoform GAC of Glutaminase kidney isoform, mitochondrial precursor
H2AFX	Hs.477879;	IPI00219037	H2AFX Histone H2A.x
MRPS17	Hs.44298;	IPI00744772	MRPS17 28S ribosomal protein S17, mitochondrial precursor
IPI00465070	IPI00465070	IPI00465070	HIST1H3I,HIST1H3A,HIST1H3F,HIST1H3C,HIST1H3D,HIST1H3J,HIST1H3H,HIST1H3G,HIST1H3B,HIST1H3E Histone H3.1
IPI00171611	IPI00171611	IPI00171611	HIST2H3A,HIST2H3C Histone H3.2
NDUFB6	Hs.493668;	IPI00219385	NDUFB6 NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 6
COPS2	Hs.369614;	IPI00743825	COPS2 Isoform 1 of COP9 signalosome complex subunit 2
ISG20	Hs.459265;	IPI00647246	ISG20 Isoform 1 of Interferon-stimulated gene 20 kDa protein
PIGR	Hs.497589;	IPI00004573	PIGR Polymeric-immunoglobulin receptor precursor
MRPL19	Hs.44024;	IPI00027096	MRPL19 39S ribosomal protein L19, mitochondrial precursor
RANBP3	Hs.531752;	IPI00026337	RANBP3 Isoform 1 of Ran-binding protein 3
SPCS1	Hs.297304; Hs.11125;	IPI00794229	SPCS1 9 kDa protein
KMO	IPI00642771	IPI00642771	KMO Isoform 1 of Kynurenine 3-monooxygenase
DNTTIP2	Hs.85769;	IPI00290410	DNTTIP2 Deoxynucleotidyltransferase terminal-interacting protein 2
CDIPT	Hs.121549;	IPI00647250	CDIPT 20 kDa protein
FCER2	Hs.465778;	IPI00217263	FCER2 Isoform B of Low affinity immunoglobulin epsilon Fc receptor
LEMD3	Hs.505905;	IPI00032491	LEMD3 Inner nuclear membrane protein Man1
YY1	Hs.388927;	IPI00014513	YY1 Transcriptional repressor protein YY1
PML	Hs.526464;	IPI00220453	PML Isoform PML-X of Probable transcription factor PML
LSM8	IPI00219871	IPI00219871	LSM8 U6 snRNA-associated Sm-like protein LSm8
UBE2J1	Hs.163776;	IPI00006937	UBE2J1 Ubiquitin-conjugating enzyme E2 J1
WDR12	Hs.73291;	IPI00304232	WDR12 WD repeat protein 12
SDCCAG10	Hs.371372;	IPI00744546	SDCCAG10 Hypothetical protein
CDC42SE2	Hs.508829;	IPI00024973	CDC42SE2 CDC42 small effector 2
C5orf24	Hs.406549;	IPI00396126	C5orf24 Uncharacterized protein C5orf24
SSR3	Hs.518346;	IPI00009235	SSR3 Translocon-associated protein subunit gamma
LBH	Hs.567598; Hs.593113;	IPI00333338	LBH Hypothetical protein LBH
NGDN	Hs.9043;	IPI00000162	NGDN Isoform 1 of Neuroguidin
YTHDC1	Hs.175955;	IPI00412832	YTHDC1 77 kDa protein
C14orf2	Hs.109052;	IPI00749237	C14orf2 6.8 kDa mitochondrial proteolipid
NCOA5	Hs.654991;	IPI00288941	NCOA5 Nuclear receptor coactivator 5
ZNF384	Hs.103315;	IPI00736968	ZNF384 nuclear matrix transcription factor 4 isoform b

GTPBP1	Hs.276925;	IPI00010463	GTPBP1 GTP-binding protein 1
CD19	Hs.652262;	IPI00442499	CD19 CDNA FLJ27147 fis, clone SPL09574, highly similar to B-lymphocyte antigen CD19
KIAA1704	Hs.507922;	IPI00477669	KIAA1704 Isoform 2 of Uncharacterized protein KIAA1704
SAP30L	Hs.483906;	IPI00002831	SAP30L SAP30-like protein
RPS4Y1	Hs.282376;	IPI00302740	RPS4Y1 40S ribosomal protein S4, Y isoform 1
RPS4Y2	Hs.367761;	IPI00219894	RPS4Y2 40S ribosomal protein S4, Y isoform 2
MBD1	Hs.405610;	IPI00438701	MBD1 Isoform 1 of Methyl-CpG-binding domain protein 1
MRPS31	Hs.154655;	IPI00294242	MRPS31 28S ribosomal protein S31, mitochondrial precursor
PYCRL	Hs.165186;	IPI00646105	PYCRL Pyrroline-5-carboxylate reductase
DGUOK	Hs.469022;	IPI00221319	DGUOK Isoform 4 of Deoxyguanosine kinase, mitochondrial precursor
SETD1A	Hs.297483;	IPI00783972	SETD1A Histone-lysine N-methyltransferase, H3 lysine-4 specific SET1
CREB1	Hs.584750;	IPI00218334	CREB1 Isoform CREB-B of cAMP response element-binding protein
POLR1E	Hs.591087;	IPI00550638	POLR1E Isoform 2 of DNA-directed RNA polymerase I subunit RPA49
ZNF800	Hs.159006;	IPI00396098	ZNF800 zinc finger protein 800
CETN2	Hs.82794;	IPI00215928	CETN2 Centrin-2
TOMM34	Hs.517066;	IPI00009946	TOMM34 Mitochondrial import receptor subunit TOM34
hCG_1640785	IPI00740757	IPI00740757	hCG_1640785 similar to 40S ribosomal protein S25
IPI00478694	IPI00478694	IPI00478694	14 kDa protein
LIMD2	Hs.591166;	IPI00549972	LIMD2 LIM domain-containing protein 2
MPI	Hs.75694;	IPI00332187	MPI Isoform 2 of Mannose-6-phosphate isomerase
GTF2A1	Hs.593630; Hs.592334;	IPI00004350	GTF2A1 Isoform 42 kDa of Transcription initiation factor IIA subunit 1
COL4A3BP	Hs.270437;	IPI00182914	COL4A3BP Isoform 2 of Goodpasture antigen-binding protein
CXXC5	Hs.189119;	IPI00152156	CXXC5 Putative MAPK activating protein
MRPL37	Hs.584908;	IPI00335130	MRPL37 Mitochondrial ribosomal protein L37
LOC642019	IPI00738039	IPI00738039	LOC651388,LOC642019 similar to nucleolar protein 5A
PIAS2	Hs.658013;	IPI00477352	PIAS2 Isoform 3 of E3 SUMO-protein ligase PIAS2
CAPG	Hs.516155;	IPI00848090	CAPG gelsolin-like capping protein
CD22	Hs.652118;	IPI00295133	CD22 Isoform CD22-beta of B-cell receptor CD22 precursor
FLJ11184	Hs.267446;	IPI00019962	FLJ11184 Hypothetical protein FLJ11184
UTP15	Hs.406703;	IPI00152708	UTP15 U3 small nucleolar RNA-associated protein 15 homolog
TNFRSF13C	Hs.344088;	IPI00218927	TNFRSF13C Isoform 2 of Tumor necrosis factor receptor superfamily member 13C
DBT	Hs.633217;	IPI00003944	DBT Lipoamide acyltransferase component of branched-chain alpha-keto acid dehydrogenase complex, mitochondrial precursor
ISCA2	Hs.291079;	IPI00783970	ISCA2 16 kDa protein
RBM42	Hs.5086;	IPI00550442	RBM42 MGC10433 protein
RASSF2	Hs.631504;	IPI00217958	RASSF2 Ras association (RalGDS/AF-6) domain family 2 protein isoform 2B
RALGPS2	Hs.644008;	IPI00334126	RALGPS2 Ral GEF with PH domain and SH3-binding motif 2
EXOSC3	Hs.591076;	IPI00434985	EXOSC3 exosome component 3 isoform 2
C19orf29	Hs.128425; Hs.665775;	IPI00736681	C19orf29 chromosome 19 open reading frame 29
TMEM106B	Hs.396358;	IPI00395903	TMEM106B Transmembrane protein 106B
DDB2	Hs.655280;	IPI00021518	DDB2 Isoform 1 of DNA damage-binding protein 2
hCG_1644323	IPI00376817	IPI00376817	hCG_1644323 similar to 60S ribosomal protein L32
MEN1	Hs.423348;	IPI00182106	MEN1 Isoform 2 of Menin
FCGR2B	Hs.654395;	IPI00013969	FCGR2B Isoform IIB1 of Low affinity immunoglobulin gamma Fc region receptor II-b precursor
IPI00828062	IPI00828062	IPI00828062	Anti-(ED-B) scFV (Fragment)
RPUSD2	Hs.173311;	IPI00150963	RPUSD2 RNA pseudouridylate synthase domain containing 2
YAF2	Hs.649195;	IPI00795130	YAF2 YY1-associated factor 2
MRPL55	Hs.63236;	IPI00472663	MRPL55 mitochondrial ribosomal protein L55 isoform b
ATF7	Hs.12286;	IPI00218344	ATF7 Isoform 2 of Cyclic AMP-dependent transcription factor ATF-7
MT-CO3	IPI00017533	IPI00017533	MT-CO3 Cytochrome c oxidase subunit 3
STIM2	Hs.135763;	IPI00658128	STIM2 Similar to Stromal interaction molecule 2
RUNX2	Hs.535845;	IPI00604427	RUNX2 Isoform 2 of Runt-related transcription factor 2
CDK9	Hs.557646;	IPI00301923	CDK9 Isoform 1 of Cell division protein kinase 9
RBPJ	Hs.479396;	IPI00218578	RBPJ Isoform APCR-3 of Recombining binding protein suppressor of hairless
PDE4DIP	Hs.657490; Hs.584841; Hs.654651; Hs.613082;	IPI00642902	PDE4DIP Phosphodiesterase 4D-interacting protein
CLINT1	Hs.644000;	IPI00397519	CLINT1 Isoform 2 of Clathrin interactor 1
PAPD1	Hs.173946;	IPI00641482	PAPD1 Novel protein

IPI00385252	IPI00385252	IPI00385252	Ig kappa chain V-III region GOL
INPP5F	Hs.369755;	IPI00007250	INPP5F Inositol polyphosphate-5-phosphatase F
RNASEH2B	Hs.306291;	IPI00245135	RNASEH2B RNASEH2B protein
HLA-DQB1	Hs.534322; Hs.653339; Hs.409934;	IPI00788813	HLA-DQB1 HLA DR-beta-I (Fragment)
THEM2	Hs.9676;	IPI00020530	THEM2 Thioesterase superfamily member 2
RFC2	Hs.647062;	IPI00017412	RFC2 Isoform 1 of Replication factor C subunit 2
SIRT5	Hs.567431;	IPI00010331	SIRT5 Isoform 2 of NAD-dependent deacetylase sirtuin-5
ZHX2	Hs.377090; Hs.658443;	IPI00007256	ZHX2 Zinc fingers and homeoboxes protein 2
HEATR5B	Hs.591564;	IPI00479069	HEATR5B HEAT repeat containing 5B
KRT14	Hs.654380;	IPI00384444	KRT14 Keratin, type I cytoskeletal 14
ZMYM2	Hs.644041;	IPI00294603	ZMYM2 MYM-type zinc finger protein 2
UTP14A	Hs.458598;	IPI00107113	UTP14A Isoform 1 of U3 small nucleolar RNA-associated protein 14 homolog A
COQ6	Hs.632335;	IPI00032633	COQ6 Ubiquinone biosynthesis monooxygenase COQ6
C1orf80	Hs.156625; Hs.676507; Hs.534965;	IPI00303602	C1orf80 hypothetical protein LOC64853
GSTZ1	Hs.655292;	IPI00013809	GSTZ1 Maleylacetoacetate isomerase
PPP5C	Hs.654604;	IPI00019812	PPP5C Serine/threonine-protein phosphatase 5
SFRS12	Hs.519347;	IPI00375462	SFRS12 Isoform 2 of Splicing factor, arginine/serine-rich 12
CSNK2A2	Hs.82201;	IPI00020602	CSNK2A2 Casein kinase II subunit alpha'
MOBKL2A	IPI00163727	IPI00163727	MOBKL2A Mps one binder kinase activator-like 2A
ENDOGL1	Hs.517897;	IPI00021106	ENDOGL1 Endonuclease G-like 1
GIT2	Hs.434996;	IPI00749446	GIT2 81 kDa protein
C2orf49	Hs.549577;	IPI00031698	C2orf49 Ashwin
PHF14	Hs.655688;	IPI00454969	PHF14 PHD finger protein 14
SP140	Hs.632549;	IPI00012793	SP140 Isoform LYSp100-B of Nuclear body protein SP140
BLOC1S3	Hs.695194; Hs.690005;	IPI00397721	BLOC1S3 Biogenesis of lysosome-related organelles complex-1 subunit 3
ZBTB4	Hs.694779;	IPI00001835	ZBTB4 Zinc finger and BTB domain-containing protein 4
SENP7	Hs.529551;	IPI00218776	SENP7 Isoform 2 of Sentrin-specific protease 7
IPI00643418	IPI00643418	IPI00643418	68 kDa protein
ZNF346	Hs.484259;	IPI00442165	ZNF346 Isoform 2 of Zinc finger protein 346
NOSIP	Hs.7236;	IPI00006408	NOSIP Nitric oxide synthase-interacting protein
NIF3L1	Hs.145284;	IPI00604624	NIF3L1 Hypothetical protein NIF3L1
YEATS4	Hs.4029;	IPI00008536	YEATS4 YEATS domain-containing protein 4
TP53I11	Hs.554791;	IPI00478302	TP53I11 p53-induced protein
CIRBP	Hs.634522;	IPI00641579	CIRBP 32 kDa protein
POLR2G	Hs.14839;	IPI00218895	POLR2G DNA-directed RNA polymerase II subunit RPB7
CD81	Hs.54457;	IPI00000190	CD81 CD81 antigen
ST14	Hs.504315;	IPI00001922	ST14 Suppressor of tumorigenicity protein 14
TMPO	Hs.11355;	IPI00181409	TMPO Isoform Gamma of Lamina-associated polypeptide 2, isoforms beta/gamma
RSBN1	Hs.486285;	IPI00019999	RSBN1 round spermatid basic protein 1
CXorf26	Hs.370100;	IPI00107104	CXorf26 UPF0368 protein Cxorf26
RNMT	Hs.592347;	IPI00747403	RNMT Isoform 1 of mRNA cap guanine-N7 methyltransferase
ARID1B	Hs.603283; Hs.291587;	IPI00015404	ARID1B Isoform 1 of AT-rich interactive domain-containing protein 1B
PAK1	Hs.435714;	IPI00656138	PAK1 Isoform 1 of Serine/threonine-protein kinase PAK 1
RBM26	Hs.693621;	IPI00827541	RBM26 Isoform 2 of RNA-binding protein 26
TCEB3	Hs.621226; Hs.584806;	IPI00018404	TCEB3 Transcription elongation factor B polypeptide 3
BCDIN3	Hs.178011;	IPI00021320	BCDIN3 BIN3 domain-containing protein 1
SEC24B	Hs.292472;	IPI00785208	SEC24B SEC24 (S. cerevisiae) homolog B isoform b
LOC728944	IPI00788055	IPI00788055	LOC728944 similar to THAP domain-containing protein 4
ITPR2	Hs.512235; Hs.659892;	IPI00031545	ITPR2 Isoform Long of Inositol 1,4,5-trisphosphate receptor type 2
C8orf38	Hs.435500;	IPI00852766	C8orf38 Terpenoid synthase domain containing protein
MRPL21	Hs.503047;	IPI00375677	MRPL21 39S ribosomal protein L21, mitochondrial precursor
PMVK	Hs.30954;	IPI00220648	PMVK Phosphomevalonate kinase
ORC3L	Hs.410228;	IPI00374747	ORC3L Isoform 2 of Origin recognition complex subunit 3
MGC21874	Hs.518614;	IPI00761105	MGC21874 similar to Ada2b CG9638-PA, isoform A isoform 3

APOC3	Hs.534984; Hs.73849;	IPI00657670	APOC3 13 kDa protein
SGPP1	Hs.24678;	IPI00306840	SGPP1 Sphingosine-1-phosphate phosphatase 1
SLC25A46	Hs.75639;	IPI00478497	SLC25A46 Solute carrier family 25 member 46
CXXC1	Hs.180933;	IPI00292445	CXXC1 CpG-binding protein
GNPAT	Hs.498028;	IPI00005677	GNPAT Dihydroxyacetone phosphate acyltransferase
MTCP1	Hs.6917;	IPI00446798	MTCP1 P8 MTCP-1 protein
MLL5	Hs.592262;	IPI00337726	MLL5 myeloid/lymphoid or mixed-lineage leukemia 5
STAMBPL1	Hs.16229;	IPI00290975	STAMBPL1 Isoform 1 of AMSH-like protease
SENP1	Hs.371957;	IPI00005101	SENP1 Sentrin-specific protease 1
RNUXA	Hs.693680; Hs.555731;	IPI00303402	RNUXA RNA U small nuclear RNA export adapter protein
BRE	Hs.11916;Hs .258314;	IPI00719447	BRE Isoform 3 of Protein BRE
ANKRD13A	Hs.528703;	IPI00217831	ANKRD13A Ankyrin repeat domain-containing protein 13A
RSRC2	Hs.432996;	IPI00386342	RSRC2 HSPC314
QSOX2	Hs.657864;	IPI00783371	QSOX2 Sulfhydryl oxidase 2 precursor
UTP18	IPI00000733	IPI00000733	UTP18 U3 small nucleolar RNA-associated protein 18 homolog
FAM36A	IPI00103057	IPI00103057	FAM36A Isoform 2 of Protein FAM36A
CXorf9	Hs.61469;	IPI00844580	CXorf9 42 kDa protein
LRCH3	Hs.659335; Hs.518414;	IPI00396561	LRCH3 Isoform 3 of Leucine-rich repeat and calponin homology domain-containing protein 3 precursor
HSF1	Hs.530227; Hs.571397;	IPI00218507	HSF1 Isoform Short of Heat shock factor protein 1
DDX56	Hs.654762;	IPI00302281	DDX56 Probable ATP-dependent RNA helicase DDX56
NFU1	Hs.430439;	IPI00160021	NFU1 HIRA interacting protein 5 isoform 1
SMPD4	IPI00743121	IPI00743121	SMPD4 neutral sphingomyelinase 3 isoform 1
RAB2B	Hs.22399;	IPI00102896	RAB2B Ras-related protein Rab-2B
RRP1	Hs.110757;	IPI00550766	RRP1 RRP1-like protein
FARS2	Hs.484547;	IPI00645207	FARS2 Phenylalanine-tRNA synthetase 2
IKZF3	Hs.444388;	IPI00796035	IKZF3 aiolos isoform 1
GLO1	Hs.268849;	IPI00220766	GLO1 Lactoylglutathione lyase
TRA2A	Hs.645489;	IPI00013891	TRA2A Isoform Long of Transformer-2 protein homolog
ICAM3	Hs.654563;	IPI00031620	ICAM3 Intercellular adhesion molecule 3 precursor
RBMX	Hs.661054; Hs.380118;	IPI00304692	RBMX Heterogeneous nuclear ribonucleoprotein G
TMEM70	Hs.106650;	IPI00106966	TMEM70 Isoform 1 of Transmembrane protein 70
AGPAT5	Hs.624002;	IPI00028491	AGPAT5 1-acyl-sn-glycerol-3-phosphate acyltransferase epsilon
MECP2	Hs.200716;	IPI00645192	MECP2 Isoform B of Methyl-CpG-binding protein 2
RPL18	Hs.515517;	IPI00215719	RPL18 60S ribosomal protein L18
SOD1	Hs.443914;	IPI00783680	SOD1 Superoxide dismutase
DKC1	Hs.4747;	IPI00221394	DKC1 H/ACA ribonucleoprotein complex subunit 4
CRYZ	Hs.83114;	IPI00000792	CRYZ Quinone oxidoreductase
LBR	Hs.435166;	IPI00292135	LBR Lamin-B receptor
KRT9	Hs.654569;	IPI00019359	KRT9 Keratin, type I cytoskeletal 9
IPI00853068	IPI00853068	IPI00853068	HBA2,HBA1 Alpha 2 globin variant (Fragment)
NFKB1	Hs.654408;	IPI00788987	NFKB1 Isoform 1 of Nuclear factor NF-kappa-B p105 subunit
PABPN1	Hs.117176;	IPI00414963	PABPN1 Isoform 2 of Polyadenylate-binding protein 2
ATIC	Hs.90280;	IPI00289499	ATIC Bifunctional purine biosynthesis protein PURH
RPL18A	Hs.337766;	IPI00026202	RPL18A 60S ribosomal protein L18a
PTBP1	Hs.172550;	IPI00179964	PTBP1 Isoform 1 of Polypyrimidine tract-binding protein 1
H1FX	Hs.75307;	IPI00021924	H1FX Histone H1x
KRT1	Hs.80828;	IPI00220327	KRT1 Keratin, type II cytoskeletal 1
TFAM	Hs.642966;	IPI00020928	TFAM Transcription factor A, mitochondrial precursor
HIBADH	Hs.406758;	IPI00013860	HIBADH 3-hydroxyisobutyrate dehydrogenase, mitochondrial precursor
ILF3	Hs.465885;	IPI00418313	ILF3 Isoform 4 of Interleukin enhancer-binding factor 3
SF1	Hs.502829;	IPI00386120	SF1 Isoform 6 of Splicing factor 1
SF3B3	Hs.514435;	IPI00300371	SF3B3 Isoform 1 of Splicing factor 3B subunit 3
LSM4	Hs.515255;	IPI00294955	LSM4 U6 snRNA-associated Sm-like protein LSm4
NAT10	Hs.577281;	IPI00300127	NAT10 N-acetyltransferase 10
SAE1	Hs.515500;	IPI00033130	SAE1 SUMO-activating enzyme subunit 1
DDX23	Hs.130098;	IPI00006725	DDX23 Probable ATP-dependent RNA helicase DDX23
UBB	Hs.673132; Hs.356190;	IPI00179330	RPS27A,UBC,UBB ubiquitin and ribosomal protein S27a precursor
PRKDC	Hs.491682;	IPI00296337	PRKDC Isoform 1 of DNA-dependent protein kinase catalytic subunit
HSD17B10	Hs.171280;	IPI00017726	HSD17B10 Isoform 1 of 3-hydroxyacyl-CoA dehydrogenase type-2

Sep9	Hs.440932; Hs.672188;	IPI00784614	SEPT9 Isoform 1 of Septin-9
RPS4X	Hs.446628;	IPI00217030	RPS4X 40S ribosomal protein S4, X isoform
AFG3L2	Hs.528996;	IPI00001091	AFG3L2 AFG3-like protein 2
RPL8	Hs.178551;	IPI00012772	RPL8 60S ribosomal protein L8
HSPD1	Hs.595053; Hs.632539;	IPI00784154	HSPD1 60 kDa heat shock protein, mitochondrial precursor
CROCC	Hs.309403;	IPI00843774	CROCC CROCC protein
NUMA1	Hs.325978;	IPI00006196	NUMA1 Isoform 2 of Nuclear mitotic apparatus protein 1
TUFM	Hs.12084;	IPI00027107	TUFM Tu translation elongation factor, mitochondrial
LOC197322	Hs.461727;	IPI00166395	LOC197322 LOC197322 protein
LSM2	Hs.103106;	IPI00032460	LSM2 U6 snRNA-associated Sm-like protein LSm2
MGC29506	Hs.409563;	IPI00102821	MGC29506 hypothetical protein LOC51237
C19orf53	Hs.231616;	IPI00022317	C19orf53 Leydig cell tumor 10 kDa protein homolog
NDUFA13	Hs.534453;	IPI00219685	NDUFA13 cell death-regulatory protein GRIM19
BCAS2	Hs.22960;	IPI00025178	BCAS2 Breast carcinoma amplified sequence 2
RPL31	Hs.469473;	IPI00848331	RPL31 ribosomal protein L31 isoform 2
LOC643790	Hs.447529;	IPI00456588	LOC643790 similar to Nonhistone chromosomal protein HMG-14
HNRPDL	Hs.527105;	IPI00011274	HNRPDL Isoform 1 of Heterogeneous nuclear ribonucleoprotein D-like
EIF3S5	Hs.516023;	IPI00654777	EIF3S5 Eukaryotic translation initiation factor 3 subunit 5
NOL1	Hs.534334;	IPI00654555	NOL1 Isoform 1 of Putative RNA methyltransferase NOL1
CDKN1B	Hs.238990;	IPI00006991	CDKN1B Cyclin-dependent kinase inhibitor 1B
SFRS9	Hs.369624; Hs.652394;	IPI00012340	SFRS9 Splicing factor, arginine/serine-rich 9
LEF1	Hs.555947;	IPI00007156	LEF1 Isoform 1 of Lymphoid enhancer-binding factor 1
MKI67IP	Hs.367842;	IPI00154590	MKI67IP MKI67 FHA domain-interacting nucleolar phosphoprotein
IAH1	Hs.656852;	IPI00432867	IAH1 IAH1 protein (Fragment)
RBM8A	Hs.654719;	IPI00001757	RBM8A Isoform 1 of RNA-binding protein 8A
NUCKS1	Hs.643846; Hs.632458;	IPI00022145	NUCKS1 Isoform 1 of Nuclear ubiquitous casein and cyclin-dependent kinases substrate
PIN4	Hs.655623;	IPI00006658	PIN4 protein (peptidyl-prolyl cis/trans isomerase) NIMA-interacting, 4
HIST1H1A	Hs.150206;	IPI00217469	HIST1H1A Histone H1.1
RNASE3	Hs.73839;	IPI00025427	RNASE3 Eosinophil cationic protein precursor
C20orf116	Hs.471975;	IPI00375407	C20orf116 Isoform 2 of Uncharacterized protein C20orf116 precursor
IKZF1	Hs.488251; Hs.435949;	IPI00216389	IKZF1 Isoform Ik4 of DNA-binding protein Ikaros
TRNT1	Hs.567495;	IPI00301719	TRNT1 Isoform 2 of tRNA-nucleotidyltransferase 1, mitochondrial precursor
PTPRCAP	Hs.155975;	IPI00023786	PTPRCAP Protein tyrosine phosphatase receptor type C-associated protein
HMGN4	Hs.236774;	IPI00220484	HMGN4 High mobility group nucleosome-binding domain-containing protein 4
RBM3	Hs.301404;	IPI00604407	RBM3 RNA binding motif protein 3 isoform b
FLJ20920	Hs.288959;	IPI00304071	FLJ20920 Hypothetical protein FLJ20920
C14orf43	Hs.656506;	IPI00784739	C14orf43 Uncharacterized protein C14orf43
IGHM	IPI00829729	IPI00829729	IGHM IGHM protein
HNRPAB	Hs.248746; Hs.591731;	IPI00334713	HNRPAB Isoform 3 of Heterogeneous nuclear ribonucleoprotein A/B
TERF2	Hs.63335;	IPI00024214	TERF2 Isoform 1 of Telomeric repeat-binding factor 2
CROP	Hs.130293;	IPI00107745	CROP Isoform 1 of Cisplatin resistance-associated overexpressed protein
SFXN1	Hs.369440;	IPI00009368	SFXN1 Sideroflexin-1
C11orf31	Hs.655373;	IPI00218054	C11orf31 Selenoprotein H
HSDL2	Hs.59486;	IPI00414384	HSDL2 Hydroxysteroid dehydrogenase-like protein 2
CAMK2D	Hs.144114;	IPI00172636	CAMK2D Isoform Delta 6 of Calcium/calmodulin-dependent protein kinase type II delta chain
XRCC5	Hs.388739;	IPI00220834	XRCC5 ATP-dependent DNA helicase 2 subunit 2
RAN	Hs.10842;	IPI00643041	RAN GTP-binding nuclear protein Ran
NUDT21	Hs.528834;	IPI00646917	NUDT21 Cleavage and polyadenylation specificity factor 5
DDX18	Hs.363492;	IPI00301323	DDX18 ATP-dependent RNA helicase DDX18
SWAP70	Hs.153026;	IPI00307200	SWAP70 Switch-associated protein 70
ALOX5	Hs.89499;	IPI00218916	ALOX5 Arachidonate 5-lipoxygenase
RPL23	Hs.406300;	IPI00795408	RPL23 15 kDa protein
C1QBP	Hs.555866;	IPI00014230	C1QBP Complement component 1 Q subcomponent-binding protein, mitochondrial precursor
UBTF	Hs.89781;	IPI00384556	UBTF Ribosomal RNA upstream binding transcription factor (Fragment)
DDX5	Hs.279806;	IPI00017617	DDX5 Probable ATP-dependent RNA helicase DDX5
SPTAN1	Hs.372331;	IPI00844215	SPTAN1 Isoform 1 of Spectrin alpha chain, brain

IVD	Hs.513646; Hs.449599;	IPI00789848	IVD Isovaleryl-CoA dehydrogenase, mitochondrial precursor
OGDH	Hs.488181;	IPI00098902	OGDH oxoglutarate (alpha-ketoglutarate) dehydrogenase (lipoamide) isoform 1 precursor
CPSF6	Hs.369606;	IPI00647126	CPSF6 Isoform 3 of Cleavage and polyadenylation specificity factor 6
PRPF4	Hs.374973;	IPI00150269	PRPF4 Isoform 1 of U4/U6 small nuclear ribonucleoprotein Prp4
PDCD4	Hs.232543;	IPI00240675	PDCD4 programmed cell death 4 isoform 2
TRIM28	Hs.467408;	IPI00438229	TRIM28 Isoform 1 of Transcription intermediary factor 1-beta
SNRPD1	Hs.464734;	IPI00302850	SNRPD1 Small nuclear ribonucleoprotein Sm D1
SUCLG2	Hs.655250;	IPI00096066	SUCLG2 Succinyl-CoA ligase [GDP-forming] beta-chain, mitochondrial precursor
PSPC1	Hs.213198;	IPI00103525	PSPC1 paraspeckle protein 1
RAP2C	Hs.119889;	IPI00009607	RAP2C Ras-related protein Rap-2c precursor
LANCL2	Hs.655117;	IPI00032995	LANCL2 LanC-like protein 2
WDR7	Hs.465213;	IPI00289815	WDR7 Isoform 2 of WD repeat protein 7
NOC2L	Hs.405987;	IPI00411886	NOC2L Nucleolar complex protein 2 homolog
FLJ12529	Hs.444552;	IPI00719106	FLJ12529 Isoform 2 of Cleavage and polyadenylation specificity factor 7
PPWD1	Hs.121432;	IPI00149650	PPWD1 Peptidylprolyl isomerase domain and WD repeat-containing protein 1
MAGOH	Hs.421576;	IPI00219306	MAGOH Protein mago nashi homolog
RBM13	Hs.583805;	IPI00332428	RBM13 MAK16-like protein RBM13
ELF1	Hs.135646;	IPI00167002	ELF1 ETS-related transcription factor Elf-1
ALDH18A1	Hs.500645;	IPI00008982	ALDH18A1 Isoform Long of Delta 1-pyrroline-5-carboxylate synthetase
WDR91	Hs.459858;	IPI00782984	WDR91 HSPC049 protein
SNRPG	Hs.654528; Hs.631639; Hs.465167; Hs.516076;	IPI00016572	SNRPG Small nuclear ribonucleoprotein G
HTATSF1	Hs.204475;	IPI00013788	HTATSF1 HIV Tat-specific factor 1
GYG1	Hs.477892;	IPI00794444	GYG1 Isoform GN-1S of Glycogenin-1
PCBP2	Hs.546271;	IPI00216689	PCBP2 Poly(rC)-binding protein 2
CEPT1	Hs.636850; Hs.363572;	IPI00005775	CEPT1 Choline/ethanolaminephosphotransferase 1
EP400	Hs.654919;	IPI00783050	EP400 E1A-binding protein p400
SF3B5	Hs.110695;	IPI00010404	SF3B5 Splicing factor 3B subunit 5
SFRS4	Hs.469970;	IPI00000015	SFRS4 Splicing factor, arginine/serine-rich 4
BRDG1	Hs.435579;	IPI00015876	BRDG1 Signal-transducing adaptor protein 1
MRPS21	Hs.405880;	IPI00014812	MRPS21 Mitochondrial 28S ribosomal protein S21
MAP4K1	Hs.95424;	IPI00020258	MAP4K1 Mitogen-activated protein kinase kinase kinase kinase 1
CRKRS	Hs.416108;	IPI00021175	CRKRS Cell division cycle 2-related protein kinase 7
EBP	IPI00008599	IPI00008599	EBP 3-beta-hydroxysteroid-Delta
AYTL2	Hs.368853;	IPI00171626	AYTL2 1-acylglycerophosphocholine O-acyltransferase 1
SP100	Hs.369056;	IPI00218326	SP100 Isoform Sp100-C of Nuclear autoantigen Sp-100
MRPL23	Hs.3254;	IPI00293476	MRPL23 Mitochondrial 39S ribosomal protein L23
RBM15	Hs.657503; Hs.435947;	IPI00220716	RBM15 Isoform 2 of Putative RNA-binding protein 15
PHF1	Hs.166204;	IPI00064665	PHF1 Isoform 1 of PHD finger protein 1
BCKDHB	Hs.654441;	IPI00011276	BCKDHB 2-oxoisovalerate dehydrogenase subunit beta, mitochondrial precursor
INTS1	Hs.532188;	IPI00737363	INTS1 similar to CG3173-PA isoform 7
LOC729611	Hs.558610;	IPI00052885	LOC729611 similar to 60S ribosomal protein L29
CCDC56	Hs.16059;	IPI00022277	CCDC56 Coiled-coil domain-containing protein 56
MRPL15	Hs.18349;	IPI00023086	MRPL15 39S ribosomal protein L15, mitochondrial precursor
MT-ND4	IPI00008495	IPI00008495	MT-ND4 NADH-ubiquinone oxidoreductase chain 4
NSL1	Hs.497692;	IPI00306330	NSL1 Kinetochore-associated protein NSL1 homolog
CD5	Hs.58685;	IPI00025383	CD5 T-cell surface glycoprotein CD5 precursor
NDUFA7	Hs.333427;	IPI00452731	NDUFA7 NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 7
USP24	Hs.477009;	IPI00398505	USP24 Ubiquitin carboxyl-terminal hydrolase 24
ISCU	Hs.615131;	IPI00164885	ISCU Isoform 2 of Iron-sulfur cluster assembly enzyme ISCU, mitochondrial precursor
C19orf52	Hs.662044;	IPI00157215	C19orf52 Uncharacterized protein C19orf52
DDX24	Hs.510328;	IPI00006987	DDX24 ATP-dependent RNA helicase DDX24
NSUN5	Hs.647060;	IPI00783606	NSUN5 50 kDa protein
ARID4A	Hs.161000;	IPI00218648	ARID4A Isoform III of AT-rich interactive domain-containing protein 4A
MT-ND5	IPI00008511	IPI00008511	MT-ND5 NADH-ubiquinone oxidoreductase chain 5

IMP3	Hs.513043;	IPI00019488	IMP3 U3 small nucleolar ribonucleoprotein protein IMP3
ZC3H14	Hs.325846;	IPI00451437	ZC3H14 nuclear protein UKp68 isoform 2
SUPT4H1	Hs.439481;	IPI00002895	SUPT4H1 Transcription elongation factor SPT4
HNRPC	Hs.508848; Hs.688323; Hs.449114;	IPI00216592	HNRPC Isoform C1 of Heterogeneous nuclear ribonucleoproteins C1/C2
RABEP2	Hs.555978;	IPI00412499	RABEP2 Isoform 1 of Rab GTPase-binding effector protein 2
POLR2H	Hs.432574;	IPI00003309	POLR2H DNA-directed RNA polymerases I, II, and III subunit RPABC3
NFYB	Hs.84928;	IPI00013217	NFYB Nuclear transcription factor Y subunit beta
CAPG	Hs.516155;	IPI00027341	CAPG Macrophage-capping protein
MPG	Hs.459596;	IPI00295497	MPG Isoform 1 of DNA-3-methyladenine glycosylase
RPS16	Hs.397609;	IPI00221092	RPS16 40S ribosomal protein S16
C21orf33	Hs.413482;	IPI00024913	C21orf33 Isoform Long of ES1 protein homolog, mitochondrial precursor
EFTUD2	Hs.151787;	IPI00003519	EFTUD2 116 kDa U5 small nuclear ribonucleoprotein component
RALY	Hs.136947;	IPI00847752	RALY Isoform 2 of RNA-binding protein Raly
SFPQ	Hs.355934;	IPI00010740	SFPQ Isoform Long of Splicing factor, proline- and glutamine-rich
HNRPL	Hs.654559;	IPI00027834	HNRPL heterogeneous nuclear ribonucleoprotein L isoform a
RPL37A	Hs.433701;	IPI00414860	RPL37A 60S ribosomal protein L37a
ATP5J	Hs.246310;	IPI00456008	ATP5J ATP synthase, H+ transporting, mitochondrial F0 complex, subunit F6 isoform b precursor
SLC25A19	Hs.514470;	IPI00433339	SLC25A19 Solute carrier family 25 member 19
FDPS	Hs.335918;	IPI00101405	FDPS Farnesyl diphosphate synthase
BCLAF1	Hs.486542;	IPI00006079	BCLAF1 Isoform 1 of Bcl-2-associated transcription factor 1
HVCN1	Hs.334637;	IPI00748233	HVCN1 31 kDa protein
hCG_1781062	Hs.632087;	IPI00642816	SRP9,hCG_1781062 Signal recognition particle 9 kDa protein
RBM39	Hs.282901;	IPI00215801	RBM39 Isoform 2 of RNA-binding protein 39
CTCF	Hs.368367;	IPI00027988	CTCF Transcriptional repressor CTCF
PGRMC2	Hs.507910;	IPI00005202	PGRMC2 Membrane-associated progesterone receptor component 2
PRKCB1	Hs.460355;	IPI00219628	PRKCB1 Isoform Beta-II of Protein kinase C beta type
PRPF19	Hs.502705;	IPI00004968	PRPF19 Pre-mRNA-processing factor 19
TCEA1	Hs.491745;	IPI00333215	TCEA1 Isoform 1 of Transcription elongation factor A protein 1
RCC1	Hs.469723;	IPI00787306	RCC1 regulator of chromosome condensation 1 isoform b
ACADM	Hs.445040;	IPI00005040	ACADM Medium-chain specific acyl-CoA dehydrogenase, mitochondrial precursor
ECHS1	Hs.76394;	IPI00024993	ECHS1 Enoyl-CoA hydratase, mitochondrial precursor
WDR36	Hs.533237;	IPI00169325	WDR36 WD repeat protein 36
SNRPB	Hs.83753;	IPI00844420	SNRPB SNRPB protein
PDHA1	Hs.530331;	IPI00306301	PDHA1 Mitochondrial PDHA1
NUP155	Hs.547696;	IPI00026625	NUP155 Isoform 1 of Nuclear pore complex protein Nup155
RANBP2	Hs.199561; Hs.590897;	IPI00221325	RANBP2 E3 SUMO-protein ligase RanBP2
CPSF1	Hs.493202;	IPI00026219	CPSF1 Cleavage and polyadenylation specificity factor subunit 1
DDX17	Hs.665429; Hs.528305;	IPI00023785	DDX17 DEAD box polypeptide 17 isoform 1
PDHB	Hs.161357;	IPI00003925	PDHB Isoform 1 of Pyruvate dehydrogenase E1 component subunit beta, mitochondrial precursor
RPL22	Hs.515329; Hs.554762;	IPI00219153	RPL22 60S ribosomal protein L22
CIP29	IPI00798360	IPI00798360	CIP29 18 kDa protein
SYPL1	Hs.80919;	IPI00009507	SYPL1 Isoform 1 of Synaptophysin-like protein 1
PRDX3	Hs.523302;	IPI00374151	PRDX3 peroxiredoxin 3 isoform b
RAE1	Hs.371698;	IPI00019733	RAE1 mRNA export factor
POLR2A	Hs.270017;	IPI00783837	POLR2A DNA-directed RNA polymerase II subunit RPB1

[0054] Table 4 lists the panel of protein biomarkers that are down-regulated in CLL compared to normal B-cells.

Table 4: Proteins that are down-regulated in CLL compared to normal B-cells.

Gene Symbol	Unigene	Accession	Protein
FGG	Hs.546255;	IPI00219713	FGG Isoform Gamma-A of Fibrinogen gamma chain precursor
FGA	Hs.351593;	IPI00029717	FGA Isoform 2 of Fibrinogen alpha chain precursor
GP1BB	Hs.283743;	IPI00464990	GP1BB Glycoprotein Ib beta
ITGA2B	Hs.411312;	IPI00295976	ITGA2B Isoform 1 of Integrin alpha-IIb precursor
STOM	Hs.253903;	IPI00219682	STOM Erythrocyte band 7 integral membrane protein
MMRN1	Hs.268107;	IPI00012269	MMRN1 Multimerin-1 precursor
ITGB3	Hs.218040;	IPI00303283	ITGB3 Isoform Beta-3A of Integrin beta-3 precursor
ACTN1	Hs.509765;	IPI00759776	ACTN1 Actinin alpha 1 isoform b
FGB	Hs.300774;	IPI00298497	FGB Fibrinogen beta chain precursor
GP9	Hs.1144;	IPI00027502	GP9 Platelet glycoprotein IX precursor
PF4	Hs.81564;	IPI00022446	PF4 Platelet factor 4 precursor
LIMS1	Hs.655316; Hs.597715;	IPI00555886	LIMS1 44 kDa protein
ILK	Hs.655002;	IPI00013219	ILK Integrin-linked protein kinase
F13A1	Hs.335513;	IPI00297550	F13A1 Coagulation factor XIII A chain precursor
SDPR	Hs.26530;	IPI00005809	SDPR Serum deprivation-response protein
ANPEP	Hs.1239;	IPI00221224	ANPEP Aminopeptidase N
THBS1	Hs.164226;	IPI00296099	THBS1 Thrombospondin-1 precursor
TBXAS1	Hs.520757;	IPI00788599	TBXAS1 thromboxane A synthase 1 (platelet, cytochrome P450, family 5, subfamily A) isoform TXS-I
SELP	Hs.73800;	IPI00295339	SELP P-selectin precursor
VWF	Hs.440848;	IPI00788786	VWF 309 kDa protein
LYZ	Hs.524579;	IPI00019038	LYZ Lysozyme C precursor
STX11	Hs.118958;	IPI00026128	STX11 Syntaxin-11
IGHG4	IPI00829814	IPI00829814	IGHG4 Ig gamma-4 chain C region
VCL	Hs.643896;	IPI00291175	VCL Isoform 1 of Vinculin
FBP1	Hs.494496;	IPI00073772	FBP1 Fructose-1,6-bisphosphatase 1
CES1	Hs.558865;	IPI00607801	CES1 Isoform 2 of Liver carboxylesterase 1 precursor
GLRX	Hs.28988;	IPI00219025	GLRX Glutaredoxin-1
KALRN	Hs.8004;	IPI00410727	KALRN Isoform 2 of Serine/threonine-protein kinase Duet
TUBB1	Hs.592143;	IPI00006510	TUBB1 Tubulin beta-1 chain
ANXA1	Hs.494173;	IPI00218918	ANXA1 Annexin A1
FHL1	Hs.435369;	IPI00014398	FHL1 Four and a half LIM domains 1 variant
CTSG	Hs.421724;	IPI00028064	CTSG Cathepsin G precursor
LTF	Hs.529517;	IPI00848342	LTF Lactotransferrin precursor
KCTD12	Hs.693617;	IPI00060715	KCTD12 BTB/POZ domain-containing protein KCTD12
ADAM10	Hs.578508;	IPI00794448	ADAM10 63 kDa protein
TLN1	Hs.471014;	IPI00784273	TLN1 Talin-1
URP2	Hs.180535;	IPI00216699	URP2 Isoform 2 of Unc-112-related protein 2
PYGL	Hs.282417;	IPI00470525	PYGL Glycogen phosphorylase, liver form
MPO	Hs.458272;	IPI00007244	MPO Isoform H17 of Myeloperoxidase precursor
TPM4	Hs.631618;	IPI00010779	TPM4 Isoform 1 of Tropomyosin alpha-4 chain
EMILIN1	Hs.63348;	IPI00013079	EMILIN1 EMILIN-1 precursor
FLNA	Hs.195464;	IPI00302592	FLNA filamin A, alpha
ALDH2	Hs.632733;	IPI00006663	ALDH2 Aldehyde dehydrogenase, mitochondrial precursor
ELA2	Hs.99863;	IPI00027769	ELA2 Leukocyte elastase precursor
APOB48R	Hs.200333;	IPI00399183	APOB48R apolipoprotein B48 receptor
ITGB2	Hs.375957;	IPI00291792	ITGB2 Integrin beta-2 precursor
BPI	Hs.529019;	IPI00827847	BPI Bactericidal permeability-increasing protein precursor
LCN2	Hs.204238;	IPI00299547	LCN2 Neutrophil gelatinase-associated lipocalin precursor
ITGAM	Hs.172631;	IPI00645887	ITGAM Integrin, alpha M
GSN	Hs.522373;	IPI00026314	GSN Isoform 1 of Gelsolin precursor
NUCB2	Hs.654599;	IPI00746961	NUCB2 Nucb2 splice variant
CTSA	Hs.652282;	IPI00021794	CTSA Lysosomal protective protein precursor
SERPINB10	Hs.158339;	IPI00010304	SERPINB10 Serpin B10
IQGAP2	Hs.291030;	IPI00299048	IQGAP2 Isoform 1 of Ras GTPase-activating-like protein IQGAP2
CYBB	Hs.292356;	IPI00218646	CYBB Cytochrome b-245 heavy chain
MMP9	Hs.297413;	IPI00027509	MMP9 Matrix metalloproteinase-9 precursor
LTBP1	Hs.654497;	IPI00784258	LTBP1 latent transforming growth factor beta binding protein 1 isoform LTBP-1L
F5	Hs.30054;	IPI00022937	F5 Coagulation factor V
S100A4	Hs.654444;	IPI00032313	S100A4 Protein S100-A4

FLJ22662	Hs.131933;	IPI00016255	FLJ22662 hypothetical protein LOC79887
LGALS1	Hs.445351;	IPI00219219	LGALS1 Galectin-1
RTN4	Hs.645283;	IPI00021766	RTN4 Isoform 1 of Reticulon-4
GCA	Hs.377894;	IPI00004524	GCA Grancalcin
PECAM1	Hs.514412;	IPI00470719	PECAM1 Isoform Delta12 of Platelet endothelial cell adhesion molecule precursor
ITGB1	Hs.643813;	IPI00645194	ITGB1 integrin beta 1 isoform 1A precursor
HK3	Hs.411695;	IPI00005118	HK3 Hexokinase-3
GIMAP4	Hs.647101;	IPI00019563	GIMAP4 GTPase IMAP family member 4
CSRP1	Hs.108080;	IPI00442073	CSRP1 Cysteine and glycine-rich protein 1
MNDA	Hs.153837;	IPI00013163	MNDA Myeloid cell nuclear differentiation antigen
CTSD	Hs.654447; Hs.121575;	IPI00011229	CTSD Cathepsin D precursor
BIN2	Hs.14770;	IPI00550792	BIN2 Isoform 1 of Bridging integrator 2
ECGF1	Hs.592212;	IPI00853163	ECGF1 46 kDa protein
SAMHD1	Hs.580681;	IPI00294739	SAMHD1 SAM domain and HD domain-containing protein 1
RAP1B	Hs.369920;	IPI00015148	RAP1B Ras-related protein Rap-1b precursor
MYH9	Hs.474751;	IPI00019502	MYH9 Myosin-9
MYL6	Hs.632717;	IPI00789605	MYL6 Isoform Smooth muscle of Myosin light polypeptide 6
PLEK	Hs.468840;	IPI00306311	PLEK Pleckstrin
PGD	Hs.464071;	IPI00219525	PGD 6-phosphogluconate dehydrogenase, decarboxylating
DIAPH1	Hs.529451;	IPI00030876	DIAPH1 Diaphanous 1
VASP	Hs.515469;	IPI00301058	VASP Vasodilator-stimulated phosphoprotein
ITGB2	Hs.375957;	IPI00746851	ITGB2 Integrin beta chain, beta 2 variant (Fragment)
TKT	Hs.89643;	IPI00643920	TKT Transketolase
NAGA	Hs.75372;	IPI00414909	NAGA Alpha-N-acetylgalactosaminidase precursor
PYGB	Hs.368157;	IPI00004358	PYGB Glycogen phosphorylase, brain form
EFHD2	Hs.465374;	IPI00060181	EFHD2 EF-hand domain-containing protein 2
CAPN2	Hs.350899;	IPI00289758	CAPN2 Calpain-2 catalytic subunit precursor
IPI00377005	IPI00377005	IPI00377005	RcTPM3 (Fragment)
MYH14	Hs.467142;	IPI00337335	MYH14 myosin, heavy chain 14 isoform 1
GNS	Hs.334534;	IPI00012102	GNS N-acetylglucosamine-6-sulfatase precursor
P4HB	Hs.464336;	IPI00010796	P4HB Protein disulfide-isomerase precursor
ARHGAP1	Hs.138860;	IPI00020567	ARHGAP1 Rho GTPase-activating protein 1
YARS	Hs.213264;	IPI00007074	YARS Tyrosyl-tRNA synthetase, cytoplasmic
LRRFIP1	Hs.471779;	IPI00006207	LRRFIP1 Isoform 2 of Leucine-rich repeat flightless-interacting protein 1
CASP1	Hs.2490;	IPI00219307	CASP1 Isoform Beta of Caspase-1 precursor
PRKAR1A	Hs.280342; Hs.659124;	IPI00021831	PRKAR1A cAMP-dependent protein kinase type I-alpha regulatory subunit
PDXK	Hs.284491;	IPI00418202	PDXK Isoform 3 of Pyridoxal kinase
ATP6V1B2	Hs.295917;	IPI00007812	ATP6V1B2 Vacuolar ATP synthase subunit B, brain isoform
STMN1	Hs.209983;	IPI00479997	STMN1 Stathmin
TMOD3	Hs.4998;	IPI00005087	TMOD3 Tropomodulin-3
CAT	Hs.502302;	IPI00465436	CAT Catalase
TAGLN2	Hs.517168;	IPI00550363	TAGLN2 Transgelin-2
PTPN12	Hs.61812;	IPI00289082	PTPN12 Tyrosine-protein phosphatase non-receptor type 12
FKBP1A	Hs.471933;	IPI00647507	FKBP1A Peptidyl-prolyl cis-trans isomerase
ENO1	Hs.517145;	IPI00465248	ENO1 Isoform alpha-enolase of Alpha-enolase
FKBP15	Hs.522351;	IPI00853400	FKBP15 FK506 binding protein 15, 133kDa
SNAP23	Hs.511149;	IPI00010438	SNAP23 Isoform SNAP-23a of Synaptosomal-associated protein 23
MRCL3	Hs.190086;	IPI00604523	MRCL3 Myosin regulatory light chain MRCL3 variant
RAB18	Hs.406799;	IPI00479988	RAB18 RAB18, member RAS oncogene family
ANXA2	Hs.511605;	IPI00418169	ANXA2 annexin A2 isoform 1
ACTN4	Hs.270291;	IPI00013808	ACTN4 Alpha-actinin-4
RAB35	Hs.524788;	IPI00300096	RAB35 Ras-related protein Rab-35
WDR44	Hs.98510;	IPI00747740	WDR44 102 kDa protein
S100A10	Hs.143873;	IPI00183695	S100A10 Protein S100-A10
BLMH	Hs.371914;	IPI00219575	BLMH Bleomycin hydrolase
FLII	Hs.513984;	IPI00555570	FLII Flightless I homolog variant
HYOU1	Hs.277704;	IPI00000877	HYOU1 Hypoxia up-regulated protein 1 precursor
RAB11FIP1	Hs.191179;	IPI00419433	RAB11FIP1 Isoform 1 of Rab11 family-interacting protein 1
MAPRE1	Hs.472437;	IPI00017596	MAPRE1 Microtubule-associated protein RP/EB family member 1
ACADVL	Hs.437178;	IPI00028031	ACADVL Isoform 1 of Very-long-chain specific acyl-CoA dehydrogenase, mitochondrial precursor
SACM1L	Hs.156509;	IPI00022275	SACM1L SAC1 suppressor of actin mutations 1-like

ARHGDIA	Hs.159161;	IPI00003815	ARHGDIA Rho GDP-dissociation inhibitor 1
HPRT1	Hs.412707;	IPI00218493	HPRT1 Hypoxanthine-guanine phosphoribosyltransferase
GPX1	Hs.76686;	IPI00293975	GPX1 glutathione peroxidase 1 isoform 1
ARPC5	Hs.518609;	IPI00550234	ARPC5 Isoform 1 of Actin-related protein 2/3 complex subunit 5
NANS	Hs.665191; Hs.522310;	IPI00147874	NANS Sialic acid synthase
LAMP1	Hs.494419;	IPI00004503	LAMP1 lysosomal-associated membrane protein 1
CAPZB	Hs.432760;	IPI00642256	CAPZB Capping protein (Actin filament) muscle Z-line, beta
RAB11B	Hs.626404;	IPI00020436	RAB11B Ras-related protein Rab-11B
PRDX4	Hs.83383;	IPI00011937	PRDX4 Peroxiredoxin-4
STIM1	Hs.501735;	IPI00299063	STIM1 Stromal interaction molecule 1 precursor
SH3KBP1	Hs.444770;	IPI00294962	SH3KBP1 Isoform 1 of SH3 domain-containing kinase-binding protein 1
UGP2	Hs.516217;	IPI00329331	UGP2 Isoform 1 of UTP--glucose-1-phosphate uridylyltransferase
CANX	Hs.567968;	IPI00020984	CANX Calnexin precursor
EIF2S2	Hs.429180;	IPI00816442	EIF2S2 Eukaryotic translation initiation factor 2 subunit 2
HMGB2	Hs.434953;	IPI00219097	HMGB2 High mobility group protein B2
SLC3A2	Hs.502769;	IPI00554722	SLC3A2,LOC442497 solute carrier family 3 (activators of dibasic and neutral amino acid transport), member 2 isoform e
IGLV7-43	IPI00022890	IPI00022890	IGLV7-43 Ig lambda chain V region 4A precursor
PARVB	Hs.475074;	IPI00043083	PARVB Beta-parvin
TUBA8	Hs.137400;	IPI00792478	TUBA8 43 kDa protein
RSU1	Hs.524161;	IPI00377066	RSU1 ras suppressor protein 1 isoform 2
CA2	Hs.155097;	IPI00218414	CA2 Carbonic anhydrase 2
HSPC159	Hs.372208;	IPI00023549	HSPC159 Galectin-related protein
CD36	Hs.120949; Hs.633085;	IPI00418495	CD36 Platelet glycoprotein 4
CD9	Hs.114286;	IPI00795937	CD9 15 kDa protein
FLNA	Hs.195464;	IPI00553169	FLNA 28 kDa protein
PADI4	Hs.522969;	IPI00008307	PADI4 Protein-arginine deiminase type-4
ITGA6	Hs.133397;	IPI00216224	ITGA6 Isoform Alpha-6X2B of Integrin alpha-6 precursor
CAMP	Hs.51120;	IPI00292532	CAMP Antibacterial protein FALL-39 precursor
CALD1	Hs.490203;	IPI00218696	CALD1 Isoform 4 of Caldesmon
PDLIM7	Hs.533040;	IPI00023560	PDLIM7 Isoform 2 of PDZ and LIM domain protein 7
CLU	Hs.436657;	IPI00795633	CLU CLU
GIMAP7	Hs.647074;	IPI00169340	GIMAP7 GTPase IMAP family member 7
BST1	Hs.169998;	IPI00026240	BST1 ADP-ribosyl cyclase 2 precursor
EPX	Hs.279259;	IPI00006690	EPX Eosinophil peroxidase precursor
CD14	Hs.163867;	IPI00029260	CD14 Monocyte differentiation antigen CD14 precursor
ZYX	Hs.490415;	IPI00020513	ZYX Zyxin
ITGAL	Hs.174103;	IPI00219896	ITGAL Isoform 2 of Integrin alpha-L precursor
RAB3A	Hs.27744;	IPI00023504	RAB3A Ras-related protein Rab-3A
RAB3B	Hs.123072;	IPI00300562	RAB3B Ras-related protein Rab-3B
MYL9	Hs.504687;	IPI00220278	MYL9 Myosin regulatory light chain 2, smooth muscle isoform
CTSB	Hs.520898;	IPI00295741	CTSB Cathepsin B precursor
RAB3D	Hs.655274;	IPI00032808	RAB3D Ras-related protein Rab-3D
NCF2	Hs.587558;	IPI00815773	NCF2 Neutrophil cytosol factor 2 variant (Fragment)
EHD3	Hs.368808;	IPI00021458	EHD3 EH domain-containing protein 3
BLVRA	Hs.488143;	IPI00294158	BLVRA Biliverdin reductase A precursor
MYL1	Hs.187338;	IPI00216070	MYL1 Myosin light chain 1, skeletal muscle isoform
CYBA	Hs.513803;	IPI00218433	CYBA Cytochrome b-245 light chain
LGALS3	Hs.531081;	IPI00465431	LGALS3 Galectin-3
MGST1	Hs.389700;	IPI00021805	MGST1 Microsomal glutathione S-transferase 1
DUSP3	Hs.181046;	IPI00018671	DUSP3 Dual specificity protein phosphatase 3
LAMP2	Hs.496684;	IPI00009030	LAMP2 Isoform LAMP-2A of Lysosome-associated membrane glycoprotein 2 precursor
CTTN	Hs.632133;	IPI00029601	CTTN Src substrate cortactin
PIP5K2A	Hs.57079;	IPI00009688	PIP5K2A Phosphatidylinositol-4-phosphate 5-kinase type-2 alpha
S100A11	Hs.417004;	IPI00013895	S100A11 Protein S100-A11
Sep11	Hs.128199;	IPI00019376	SEPT11 Septin-11
RP2	Hs.44766;	IPI00026627	RP2 Protein XRP2
LCP2	Hs.304475;	IPI00297169	LCP2 Lymphocyte cytosolic protein 2
TST	Hs.474783;	IPI00216293	TST Thiosulfate sulfurtransferase
CASP3	Hs.141125;	IPI00292140	CASP3 Caspase-3 precursor
PPM1A	Hs.592298;	IPI00020950	PPM1A Isoform Alpha-1 of Protein phosphatase 1A
EHBP1L1	Hs.502867;	IPI00296421	EHBP1L1 EH domain-binding protein 1-like protein 1

EHD4	Hs.143703;	IPI00005578	EHD4 EH domain-containing protein 4
MAPRE2	Hs.532824;	IPI00003420	MAPRE2 Isoform 1 of Microtubule-associated protein RP/EB family member 2
ATP6V1E1	Hs.517338;	IPI00003856	ATP6V1E1 Vacuolar ATP synthase subunit E 1
CECR1	Hs.170310;	IPI00303071	CECR1 Cat eye syndrome critical region protein 1 precursor
BRUNOL6	Hs.348342;	IPI00829779	BRUNOL6 61 kDa protein
ACOX1	Hs.464137;	IPI00296907	ACOX1 Isoform 1 of Acyl-coenzyme A oxidase 1, peroxisomal
ARMET	Hs.436446;	IPI00328748	ARMET Protein ARMET precursor
LOC151579	Hs.529231;	IPI00787155	LOC151579,BZW1 similar to basic leucine zipper and W2 domains 1
PYCARD	Hs.499094;	IPI00001699	PYCARD Isoform 1 of Apoptosis-associated speck-like protein containing a CARD
ERO1L	Hs.592304;	IPI00386755	ERO1L ERO1-like protein alpha precursor
STRAP	Hs.504895;	IPI00294536	STRAP Serine-threonine kinase receptor-associated protein
CD55	Hs.527653;	IPI00647119	CD55 CD55 molecule, decay accelerating factor for complement
TUBA4A	Hs.75318;	IPI00007750	TUBA4A Tubulin alpha-4A chain
RDX	Hs.592679; Hs.263671;	IPI00017367	RDX Radixin
KIF5B	Hs.644646;	IPI00012837	KIF5B Kinesin heavy chain
AP2B1	Hs.514819;	IPI00784156	AP2B1 Isoform 1 of AP-2 complex subunit beta-1
CALR	Hs.515162;	IPI00794237	CALR Protein
GMFG	Hs.5210;	IPI00028414	GMFG Glia maturation factor gamma
ROCK1	Hs.306307;	IPI00022542	ROCK1 Rho-associated protein kinase 1
CCL5	Hs.514821;	IPI00009309	CCL5 Small inducible cytokine A5 precursor
TPM1	Hs.133892;	IPI00216134	TPM1 tropomyosin 1 alpha chain isoform 7
IPI00784519	IPI00784519	IPI00784519	Hypothetical protein
FHOD1	Hs.95231;	IPI00001730	FHOD1 FH1/FH2 domain-containing protein 1
ESAM	Hs.173840;	IPI00303161	ESAM Endothelial cell-selective adhesion molecule precursor
SKAP2	Hs.644804; Hs.200770;	IPI00022508	SKAP2 Src kinase-associated phosphoprotein 2
RAB6B	IPI00016891	IPI00016891	RAB6B Ras-related protein Rab-6B
HEXB	Hs.69293;	IPI00012585	HEXB Beta-hexosaminidase beta chain precursor
SLC2A3	Hs.655169; Hs.419240;	IPI00003909	SLC2A3 Solute carrier family 2, facilitated glucose transporter member 3
MAOB	Hs.654473;	IPI00328156	MAOB Amine oxidase [flavin-containing] B
AIF1	Hs.76364;	IPI00795705	AIF1 Allograft inflammatory factor 1
IGHV4-31	IPI00784822	IPI00784822	IGHV4-31 IGHV4-31 protein
S100P	Hs.2962;	IPI00017526	S100P Protein S100-P
GP1BA	Hs.1472;	IPI00748955	GP1BA platelet glycoprotein Ib alpha polypeptide precursor
FER1L3	Hs.655278;	IPI00216269	FER1L3 Isoform 3 of Myoferlin
PF4V1	Hs.72933;	IPI00022295	PF4V1 Platelet factor 4 variant precursor
ALOX12	Hs.654431;	IPI00218915	ALOX12 Arachidonate 12-lipoxygenase, 12S-type
C9orf19	Hs.493819;	IPI00007067	C9orf19 Golgi-associated plant pathogenesis-related protein 1
RAB32	Hs.287714;	IPI00014377	RAB32 Ras-related protein Rab-32
VTN	Hs.2257;	IPI00298971	VTN Vitronectin precursor
CPVL	Hs.233389; Hs.449281;	IPI00301395	CPVL Probable serine carboxypeptidase CPVL precursor
ORM1	Hs.567311;	IPI00022429	ORM1 Alpha-1-acid glycoprotein 1 precursor
PSTPIP2	Hs.567384;	IPI00743499	PSTPIP2 33 kDa protein
SIRPA	Hs.581021; Hs.679042;	IPI00332887	SIRPA signal-regulatory protein alpha precursor
HSP90AB1	Hs.509736;	IPI00515119	HSP90AB1 Heat shock protein 90kDa alpha (Cytosolic), class B member 1
ITGAX	Hs.248472;	IPI00302270	ITGAX Integrin alpha-X precursor
SCPEP1	Hs.514950;	IPI00012426	SCPEP1 Isoform 1 of Retinoid-inducible serine carboxypeptidase precursor
PPM1F	Hs.112728;	IPI00291412	PPM1F Protein phosphatase 1F
BLVRB	Hs.515785;	IPI00219910	BLVRB 23 kDa protein
GNB2	Hs.185172;	IPI00790896	GNB2 26 kDa protein
BID	Hs.591054;	IPI00420084	BID Isoform 2 of BH3-interacting domain death agonist
PXN	Hs.661210; Hs.446336;	IPI00335634	PXN Isoform Beta of Paxillin
TMEM30A	Hs.108530;	IPI00019381	TMEM30A Isoform 1 of Cell cycle control protein 50A
C1orf38	Hs.10649;	IPI00514477	C1orf38 Isoform 1 of Induced by contact to basement membrane 1 protein
ARF4	Hs.652183;	IPI00792330	ARF4 14 kDa protein
ROCK2	Hs.591600;	IPI00307155	ROCK2 Rho-associated protein kinase 2

FYB	Hs.370503;	IPI00446986	FYB FYN-binding protein
DPYD	Hs.335034;	IPI00029772	DPYD Dihydropyrimidine dehydrogenase [NADP+] precursor
OGFR	Hs.67896;	IPI00021537	OGFR Isoform 1 of Opioid growth factor receptor
VAMP3	Hs.66708;	IPI00549343	VAMP3 Vesicle-associated membrane protein 3
ITGB5	Hs.536663;	IPI00790921	ITGB5 21 kDa protein
SHMT1	Hs.695559; Hs.513987; Hs.636044;	IPI00793862	SHMT1 49 kDa protein
PRCP	Hs.523936;	IPI00001593	PRCP Lysosomal Pro-X carboxypeptidase precursor
STMN2	Hs.521651;	IPI00795953	STMN2 20 kDa protein
HMGB3	Hs.693708;	IPI00217477	HMGB3 High mobility group protein B3
WAS	Hs.2157;	IPI00001545	WAS Wiskott-Aldrich syndrome protein
VAMP8	Hs.534373;	IPI00030911	VAMP8 Vesicle-associated membrane protein 8
FLJ25715	IPI00025285	IPI00025285	ATP6V1G1,FLJ25715 Vacuolar ATP synthase subunit G 1
COMMD1	Hs.468702;	IPI00171117	COMMD1 COMM domain-containing protein 1
GZMK	Hs.277937;	IPI00028602	GZMK Granzyme K precursor (Fragment)
USP15	Hs.434951;	IPI00219505	USP15 Isoform 3 of Ubiquitin carboxyl-terminal hydrolase 15
TRIM21	Hs.532357;	IPI00018971	TRIM21 52 kDa Ro protein
TCEB2	Hs.172772;	IPI00026670	TCEB2 Transcription elongation factor B polypeptide 2
TMOD2	Hs.659839;	IPI00794581	TMOD2 34 kDa protein
IPO7	Hs.652248;	IPI00784008	IPO7 Importin-7
PTGS1	Hs.201978;	IPI00514766	PTGS1 prostaglandin-endoperoxide synthase 1 isoform 2 precursor
ARRB1	Hs.503284; Hs.625320;	IPI00293857	ARRB1 Isoform 1A of Beta-arrestin-1
S100A12	Hs.19413;	IPI00218131	S100A12 Protein S100-A12
CLC	Hs.889;	IPI00216071	CLC Eosinophil lysophospholipase
NAIP1B	IPI00398857	IPI00398857	NAIP1B similar to Baculoviral IAP repeat-containing protein 1
TGFB1I1	Hs.513530;	IPI00761017	TGFB1I1 Isoform 1 of Transforming growth factor beta-1-induced transcript 1 protein
FCER1G	Hs.433300;	IPI00025804	FCER1G High affinity immunoglobulin epsilon receptor subunit gamma precursor
EPB49	Hs.106124;	IPI00797253	EPB49 46 kDa protein
NEXN	Hs.632387;	IPI00180404	NEXN nexilin
VAPA	Hs.165195;	IPI00640416	VAPA 19 kDa protein
TGFB1	Hs.645227;	IPI00000075	TGFB1 Transforming growth factor beta-1 precursor
PADI2	Hs.33455;	IPI00294187	PADI2 Protein-arginine deiminase type-2
CD97	Hs.466039;	IPI00397230	CD97 Isoform 3 of CD97 antigen precursor
LOC654029	IPI00787407	IPI00787407	LOC654029 similar to 40S ribosomal protein S10
ARFGAP1	Hs.25584;	IPI00217354	ARFGAP1 Isoform 2 of ADP-ribosylation factor GTPase-activating protein 1
MAPKAPK3	Hs.234521;	IPI00005777	MAPKAPK3 MAP kinase-activated protein kinase 3
C6orf25	Hs.247879;	IPI00216583	C6orf25 Isoform A of Protein G6b precursor
DSTN	Hs.304192; Hs.667348;	IPI00643237	DSTN 15 kDa protein
IPI00555957	IPI00555957	IPI00555957	Heat shock protein 90Ad
RAB27B	Hs.25318;	IPI00010491	RAB27B Ras-related protein Rab-27B
ANXA3	Hs.480042;	IPI00745868	ANXA3 36 kDa protein
KIAA1598	Hs.501140;	IPI00448751	KIAA1598 Protein KIAA1598
HK2	Hs.591588; Hs.406266;	IPI00102864	HK2 Hexokinase-2
RENBP	Hs.158331;	IPI00796170	RENBP 49 kDa protein
DYSF	Hs.252180;	IPI00020210	DYSF Dysferlin_v1
RASA3	Hs.655219;	IPI00784114	RASA3 96 kDa protein
PRAM1	Hs.465812;	IPI00335147	PRAM1 Isoform 2 of PML-RARA-regulated adapter molecule 1
TPM4	Hs.631618;	IPI00216975	TPM4 Isoform 2 of Tropomyosin alpha-4 chain
RARRES2	Hs.647064;	IPI00019176	RARRES2 Retinoic acid receptor responder protein 2 precursor
SYTL4	Hs.592224;	IPI00060201	SYTL4 Isoform 1 of Synaptotagmin-like protein 4
MARCKS	Hs.519909; Hs.694902;	IPI00219301	MARCKS Myristoylated alanine-rich C-kinase substrate
DBN1	Hs.130316;	IPI00295624	DBN1 drebrin 1 isoform b
ATP6V1C1	Hs.86905;	IPI00514430	ATP6V1C1 ATPase, H+ transporting, lysosomal 42kDa, V1 subunit C1 isoform B
SORT1	Hs.609479; Hs.485195;	IPI00843957	SORT1 83 kDa protein
ATP6V0A1	Hs.463074;	IPI00465178	ATP6V0A1 Isoform 1 of Vacuolar proton translocating ATPase 116 kDa subunit a isoform 1

MPP1	Hs.496984;	IPI00215610	MPP1 55 kDa erythrocyte membrane protein
PDIA5	Hs.477352;	IPI00031479	PDIA5 Protein disulfide-isomerase A5 precursor
MPST	Hs.248267;	IPI00165360	MPST 3-mercaptopyruvate sulfurtransferase
CD180	Hs.87205;	IPI00023722	CD180 CD180 antigen precursor
TREML1	Hs.117331;	IPI00410333	TREML1 Isoform 1 of Trem-like transcript 1 protein precursor
P2RX4	Hs.321709;	IPI00293327	P2RX4 P2X purinoceptor 4
SAR1A	Hs.499960;	IPI00015954	SAR1A GTP-binding protein SAR1a
CASP4	Hs.138378;	IPI00027725	CASP4 Caspase-4 precursor
RCN1	Hs.97887;	IPI00015842	RCN1 Reticulocalbin-1 precursor
SLC44A1	Hs.573495;	IPI00005068	SLC44A1 Isoform 2 of Choline transporter-like protein 1
CARD9	Hs.694071;	IPI00745573	CARD9 Isoform 2 of Caspase recruitment domain-containing protein 9
VPS37B	Hs.507162;	IPI00002926	VPS37B Vacuolar protein sorting-associated protein 37B
DOK3	Hs.153343;	IPI00156649	DOK3 Isoform 1 of Docking protein 3
RAB1A	Hs.310645;	IPI00005719	RAB1A Isoform 1 of Ras-related protein Rab-1A
ARRB2	Hs.435811;	IPI00786904	ARRB2 Isoform 2 of Beta-arrestin-2
HOOK3	Hs.162852;	IPI00031768	HOOK3 Hook homolog 3
ATP6V0D1	Hs.106876;	IPI00034159	ATP6V0D1 Vacuolar ATP synthase subunit d 1
VPS36	Hs.109520;	IPI00646971	VPS36 Isoform 2 of Vacuolar protein sorting-associated protein 36
SPTLC2	Hs.435661;	IPI00005751	SPTLC2 Serine palmitoyltransferase 2
NDRG1	Hs.372914;	IPI00183085	NDRG1 CDNA FLJ38330 fis, clone FCBBF3025280, highly similar to NDRG1 PROTEIN
CHP	Hs.675412; Hs.406234;	IPI00218924	CHP Calcium-binding protein p22
IPI00735653	IPI00735653	IPI00735653	KIAA1949
RNASE2	Hs.728;	IPI00019449	RNASE2 Nonsecretory ribonuclease precursor
PSMB6	Hs.77060;	IPI00796198	PSMB6 12 kDa protein
ZZEF1	Hs.277624;	IPI00847913	ZZEF1 Isoform 3 of Zinc finger ZZ-type and EF-hand domain-containing protein 1
ANKFY1	Hs.513875;	IPI00159899	ANKFY1 ankyrin repeat and FYVE domain containing 1 isoform 1
SNX27	Hs.192326;	IPI00640980	SNX27 sorting nexin family member 27
PPP1R12C	IPI00014340	IPI00014340	PPP1R12C Protein phosphatase 1 regulatory subunit 12C
STX12	Hs.523855;	IPI00329332	STX12 Syntaxin-12
CUL2	Hs.82919;	IPI00014311	CUL2 Cullin-2
NRD1	Hs.584782;	IPI00243221	NRD1 Nardilysin
PDXDC1	Hs.370781;	IPI00645809	PDXDC1 similar to CG1486-PA, isoform A
DOCK5	Hs.195403;	IPI00792788	DOCK5 Isoform 1 of Dedicator of cytokinesis protein 5
CNTROB	Hs.348012;	IPI00295638	CNTROB Isoform 1 of Centrobin
HTATIP2	Hs.90753;	IPI00383665	HTATIP2 Isoform 2 of Oxidoreductase HTATIP2
C14orf173	Hs.24956; Hs.317821;	IPI00008339	C14orf173 hypothetical protein LOC64423 isoform 1
PDE6D	Hs.516808;	IPI00015161	PDE6D Retinal rod rhodopsin-sensitive cGMP 3',5'-cyclic phosphodiesterase subunit delta
ACO1	Hs.651276;	IPI00008485	ACO1 Iron-responsive element-binding protein 1
DPP7	Hs.37916;	IPI00788159	DPP7 similar to Dipeptidyl-peptidase 2 precursor
GYS1	Hs.386225;	IPI00157144	GYS1 GYS1 protein
NEDD8	Hs.531064; Hs.657248;	IPI00020008	NEDD8 NEDD8 precursor
RPS6KA2	Hs.655277;	IPI00748195	RPS6KA2 91 kDa protein
CD99	IPI00253036	IPI00253036	CD99 Isoform I of CD99 antigen precursor
GOLGA2	Hs.155827;	IPI00413895	GOLGA2 Golgin subfamily A member 2
FCGRT	Hs.111903;	IPI00026646	FCGRT IgG receptor FcRn large subunit p51 precursor (Fragment)
DUSP23	Hs.425801;	IPI00306353	DUSP23 Dual specificity protein phosphatase 23
CYB5R1	Hs.334832;	IPI00643530	CYB5R1 Protein
TPT1	Hs.374596;	IPI00550900	TPT1 Translationally-controlled tumor protein
ARFIP1	Hs.416089;	IPI00021258	ARFIP1 Isoform B of Arfaptin-1
RAB9A	Hs.495704;	IPI00016372	RAB9A Ras-related protein Rab-9
ICAM2	Hs.431460;	IPI00793902	ICAM2 Intercellular adhesion molecule 2
CCDC88B	Hs.98564;	IPI00398837	CCDC88B coiled-coil domain containing 88
EHBP1	Hs.271667;	IPI00178187	EHBP1 Isoform 1 of EH domain-binding protein 1
PREB	Hs.279784;	IPI00033349	PREB Prolactin regulatory element-binding protein
AP3D1	Hs.512815;	IPI00289608	AP3D1 Isoform 2 of AP-3 complex subunit delta-1
COBLL1	Hs.470457;	IPI00007133	COBLL1 Isoform 3 of Cordon-bleu protein-like 1
TMEM40	Hs.475502;	IPI00168036	TMEM40 Isoform 1 of Transmembrane protein 40
CD33	Hs.83731;	IPI00642882	CD33 31 kDa protein
JAM3	Hs.150718;	IPI00152850	JAM3 junctional adhesion molecule 3 precursor
AGTRAP	Hs.464438;	IPI00513986	AGTRAP Isoform 2 of Type-1 angiotensin II receptor-associated protein

PTPN18	Hs.591549;	IPI00152019	PTPN18 PTPN18 protein
LOC389101	Hs.525984;	IPI00787625	LOC389101 similar to 60S ribosomal protein L23a
TSPAN32	Hs.271954;	IPI00220777	TSPAN32 Isoform 2 of Tetraspanin-32
GNLY	Hs.105806;	IPI00396242	GNLY Isoform Short of Granulysin precursor
CAMK1	Hs.434875;	IPI00028296	CAMK1 Calcium/calmodulin-dependent protein kinase type 1
CRISP3	Hs.404466;	IPI00004798	CRISP3 Cysteine-rich secretory protein 3 precursor
HIST1H4G	Hs.553507;	IPI00020618	HIST1H4G H4 histone family, member L
EPB41L3	Hs.213394;	IPI00215717	EPB41L3 Isoform C of Band 4.1-like protein 3
BRF1	Hs.424484;	IPI00607889	BRF1 Isoform 5 of Transcription factor IIIB 90 kDa subunit
C10orf54	Hs.47382;	IPI00303333	C10orf54 Platelet receptor Gi24 precursor
CD300LF	Hs.567706;	IPI00783431	CD300LF Isoform 6 of CMRF35-like-molecule 1 precursor
TMEM126B	Hs.525063;	IPI00477843	TMEM126B Isoform 5 of Transmembrane protein 126B
GNAQ	Hs.269782;	IPI00288947	GNAQ Guanine nucleotide binding protein (G protein), q polypeptide
SERPINB10	Hs.158339;	IPI00791734	SERPINB10 Protein
ALDH3B1	Hs.523841;	IPI00166751	ALDH3B1 Isoform 2 of Aldehyde dehydrogenase 3B1
VNN2	Hs.293130;	IPI00030872	VNN2 Vascular non-inflammatory molecule 2 precursor
C10orf47	Hs.435775;	IPI00329115	C10orf47 Isoform 1 of Uncharacterized protein C10orf47
IGF2BP2	Hs.35354;	IPI00743914	IGF2BP2 Insulin-like growth factor 2 mRNA binding protein 2
PRKG1	Hs.654556;	IPI00552517	PRKG1 Protein kinase, cGMP-dependent, type I
FAM101B	Hs.591203; Hs.345588; Hs.615223; Hs.596411;	IPI00166945	FAM101B Protein FAM101B
PABPC1	Hs.387804;	IPI00796139	PABPC1 8 kDa protein
GMPR	Hs.484741;	IPI00304803	GMPR GMP reductase 1
AYTL1	Hs.460857;	IPI00016418	AYTL1 Isoform 1 of Acyltransferase-like 1
MYH2	IPI00007856	IPI00007856	MYH2 Myosin-2
IPI00414883	IPI00414883	IPI00414883	30 kDa protein
C20orf27	Hs.274422;	IPI00101095	C20orf27 Uncharacterized protein C20orf27
ITGA2B	Hs.411312;	IPI00556609	ITGA2B Integrin alpha-IIb variant (Fragment)
SNCA	Hs.271771;	IPI00024107	SNCA Isoform 1 of Alpha-synuclein
CHI3L1	Hs.382202;	IPI00002147	CHI3L1 Chitinase-3-like protein 1 precursor
NBEAL2	Hs.437043;	IPI00297242	NBEAL2 similar to CG1332-PA
NADK	Hs.654792;	IPI00301034	NADK NAD kinase
NID1	Hs.356624;	IPI00026944	NID1 Isoform 1 of Nidogen-1 precursor
TMSB4X	Hs.522584;	IPI00220828	TMSB4X Thymosin beta-4
CR1	Hs.334019;	IPI00640083	CR1 Complement component (3b/4b) receptor 1
GTPBP2	Hs.485449;	IPI00785134	GTPBP2 Isoform 2 of GTP-binding protein 2
SLC16A3	Hs.500761;	IPI00006666	SLC16A3 Monocarboxylate transporter 4
GNAZ	Hs.584760;	IPI00328128	GNAZ Guanine nucleotide-binding protein G
GIMAP5	Hs.647079;	IPI00304937	GIMAP5 Isoform 1 of GTPase IMAP family member 5
MRPL40	Hs.431307;	IPI00099871	MRPL40 39S ribosomal protein L40, mitochondrial precursor
TOE1	Hs.525091;	IPI00549516	TOE1 Target of EGR1 protein 1
ITGA2	Hs.482077;	IPI00013744	ITGA2 Integrin alpha-2 precursor
MAP4	Hs.517949;	IPI00396171	MAP4 Isoform 1 of Microtubule-associated protein 4
MGC11102	Hs.425178;	IPI00298618	MGC11102 CDNA FLJ36810 fis, clone ASTRO2001249
SNTB1	Hs.655236;	IPI00026059	SNTB1 Isoform 1 of Beta-1-syntrophin
LOC643287	Hs.671023;	IPI00737372	LOC643287 similar to prothymosin, alpha (gene sequence 28) isoform 1
PLCB3	Hs.591953;	IPI00181283	PLCB3 Similar to phospholipase C, beta 3 (Fragment)
CLIP2	Hs.647018;	IPI00246616	CLIP2 Isoform 2 of CAP-Gly domain-containing linker protein 2
PRKACB	Hs.487325;	IPI00376119	PRKACB Isoform 2 of cAMP-dependent protein kinase, beta-catalytic subunit
SRGN	Hs.1908;	IPI00019372	SRGN Serglycin precursor
TMBIM1	Hs.591605;	IPI00290452	TMBIM1 Transmembrane BAX inhibitor motif-containing protein 1
PTPN18	Hs.591549;	IPI00219132	PTPN18 protein tyrosine phosphatase, non-receptor type 18
LGMN	Hs.18069;	IPI00293303	LGMN Legumain precursor
HNRPK	Hs.522257;	IPI00640296	HNRPK Heterogeneous nuclear ribonucleoprotein K
DENND3	Hs.656299;	IPI00448616	DENND3 DENN/MADD domain containing 3
HEBP1	Hs.642618;	IPI00148063	HEBP1 Heme-binding protein 1
PLAUR	Hs.466871;	IPI00010676	PLAUR Isoform 1 of Urokinase plasminogen activator surface receptor precursor
PSCD4	Hs.170944;	IPI00395879	PSCD4 Cytohesin-4
VTA1	Hs.431367;	IPI00643263	VTA1 Chromosome 6 open reading frame 55
ADAM15	Hs.312098;	IPI00013302	ADAM15 ADAM 15 precursor
MGST2	Hs.81874;	IPI00017767	MGST2 Microsomal glutathione S-transferase 2

FRYL	Hs.660485; Hs.631525; Hs.646327;	IPI00739940	FRYL Isoform 1 of Protein furry homolog-like
SRC	Hs.195659;	IPI00328867	SRC Isoform 2 of Proto-oncogene tyrosine-protein kinase Src
ACTA2	Hs.500483;	IPI00816229	ACTA2 ACTA2 protein (Fragment)
UTRN	Hs.133135;	IPI00009329	UTRN Utrophin
ZNF185	Hs.16622;	IPI00647837	ZNF185 zinc finger protein 185
EPB41L2	Hs.486470;	IPI00022133	EPB41L2 4.1G protein (Fragment)
CAST	Hs.440961;	IPI00760715	CAST calpastatin isoform e
PLCB2	Hs.355888;	IPI00301480	PLCB2 134 kDa protein
TF	Hs.518267;	IPI00798430	TF Transferrin variant (Fragment)
CST3	Hs.304682;	IPI00032293	CST3 Cystatin-C precursor
AKT1	Hs.525622;	IPI00012866	AKT1 RAC-alpha serine/threonine-protein kinase
UBQLN2	Hs.179309;	IPI00409659	UBQLN2 Ubiquilin-2
KLF12	Hs.592500; Hs.373857;	IPI00239722	KLF12 Isoform 2 of Krueppel-like factor 12
YES1	Hs.194148;	IPI00013981	YES1 Proto-oncogene tyrosine-protein kinase Yes
OS9	Hs.527861;	IPI00784446	OS9 amplified in osteosarcoma isoform 2 precursor
PROS1	Hs.64016;	IPI00294004	PROS1 Vitamin K-dependent protein S precursor
KIAA0828	Hs.600789;	IPI00101645	KIAA0828 Putative adenosylhomocysteinase 3
APPL2	Hs.506603;	IPI00172513	APPL2 DCC-interacting protein 13-beta
CLASP1	Hs.469840;	IPI00396279	CLASP1 Isoform 1 of CLIP-associating protein 1
MTA1	Hs.525629;	IPI00012773	MTA1 Isoform Long of Metastasis-associated protein MTA1
SGTB	Hs.482301;	IPI00061623	SGTB Small glutamine-rich tetratricopeptide repeat-containing protein B
CLIC5	Hs.485489;	IPI00294443	CLIC5 Isoform 1 of Chloride intracellular channel protein 5
RAB5A	Hs.475663;	IPI00023510	RAB5A Ras-related protein Rab-5A
SMAD2	Hs.12253; Hs.598146;	IPI00019548	SMAD2 Isoform Long of Mothers against decapentaplegic homolog 2
JMJD1B	Hs.483486;	IPI00298935	JMJD1B Isoform 1 of JmjC domain-containing histone demethylation protein 2B
ARF5	Hs.653202;	IPI00215919	ARF5 ADP-ribosylation factor 5
MGC40499	Hs.632293;	IPI00102962	MGC40499 PRotein Associated with Tlr4
SLK	Hs.591922;	IPI00247439	SLK Isoform 2 of STE20-like serine/threonine-protein kinase
USP4	Hs.631919;	IPI00796905	USP4 Ubiquitin specific protease, proto-oncogene isoform b variant (Fragment)
CAST	Hs.440961;	IPI00302047	CAST calpastatin isoform c
AHCYL1	Hs.485365;	IPI00182938	AHCYL1 Isoform 1 of Putative adenosylhomocysteinase 2
TESC	Hs.525709;	IPI00149680	TESC Tescalcin
TBC1D2	Hs.371016;	IPI00647041	TBC1D2 TBC1 domain family, member 2
VPS25	Hs.500165;	IPI00031655	VPS25 Vacuolar protein sorting-associated protein 25
CUTL1	Hs.654389;	IPI00741668	CUTL1 Isoform 7 of Homeobox protein cut-like 1
RAB4A	Hs.296169;	IPI00549945	RAB4A,SPHAR RAB4A, member RAS oncogene family variant
SIGIRR	Hs.501624;	IPI00029155	SIGIRR Isoform 1 of Single Ig IL-1-related receptor
AVEN	Hs.555966;	IPI00006904	AVEN Cell death regulator Aven
IDE	Hs.500546;	IPI00220373	IDE Insulin-degrading enzyme
TMSB10	Hs.446574;	IPI00220827	TMSB10 Thymosin beta-10
ATP8A1	Hs.435052;	IPI00032402	ATP8A1 Isoform Long of Probable phospholipid-transporting ATPase IA
STAT5A	Hs.437058;	IPI00030783	STAT5A Signal transducer and activator of transcription 5A
CIC	Hs.388236;	IPI00045360	CIC Protein capicua homolog
PPFIA1	Hs.530749;	IPI00219754	PPFIA1 Isoform 2 of Liprin-alpha-1
ZRF1	Hs.558476;	IPI00830108	ZRF1 Isoform 1 of DnaJ homolog subfamily C member 2
GLT25D1	Hs.418795;	IPI00168262	GLT25D1 Glycosyltransferase 25 domain-containing protein 1
KDELC2	Hs.83286;	IPI00783221	KDELC2 Isoform 2 of KDEL motif-containing protein 2 precursor
BICD2	Hs.436939;	IPI00337667	BICD2 Isoform 2 of Protein bicaudal D homolog 2
POLG	Hs.694818;	IPI00004317	POLG DNA polymerase subunit gamma 1
C14orf133	Hs.16157;	IPI00004958	C14orf133 Isoform 1 of Uncharacterized protein C14orf133
CCDC93	Hs.107845;	IPI00154668	CCDC93 Coiled-coil domain-containing protein 93
MAX	Hs.285354;	IPI00219929	MAX Isoform 2 of Protein max
ADA	Hs.654536;	IPI00296441	ADA Adenosine deaminase
GSDMDC1	Hs.118983;	IPI00658006	GSDMDC1 CDNA FLJ46051 fis, clone SYNOV4000598
CEP170	Hs.533635; Hs.408293;	IPI00186194	CEP170 Isoform 1 of Centrosomal protein of 170 kDa
PLOD3	Hs.153357;	IPI00030255	PLOD3 Procollagen-lysine,2-oxoglutarate 5-dioxygenase 3 precursor
ACTN2	Hs.498178;	IPI00019884	ACTN2 Alpha-actinin-2
IGF2R	Hs.487062;	IPI00289819	IGF2R Cation-independent mannose-6-phosphate receptor precursor

ATG3	Hs.477126;	IPI00022254	ATG3 Isoform 1 of Autophagy-related protein 3
IFI35	Hs.632258;	IPI00008613	IFI35 Isoform 1 of Interferon-induced 35 kDa protein
FN1	Hs.203717;	IPI00642991	FN1 fibronectin 1 isoform 6 preproprotein
NCF1	Hs.655201; Hs.647047;	IPI00472396	NCF1 neutrophil cytosolic factor 1
COMMD10	Hs.483136;	IPI00412811	COMMD10 COMM domain-containing protein 10
TACC1	Hs.279245;	IPI00550248	TACC1 Isoform 7 of Transforming acidic coiled-coil-containing protein 1
CD3EAP	Hs.664501;	IPI00012788	CD3EAP Isoform 2 of DNA-directed RNA polymerase I subunit RPA34
VPS13A	Hs.459790; Hs.662256;	IPI00604660	VPS13A Isoform 4 of Vacuolar protein sorting-associated protein 13A
RNASEL	Hs.518545;	IPI00015864	RNASEL 2-5A-dependent ribonuclease
TOR1A	Hs.534312;	IPI00477657	TOR1A 38 kDa protein
MACF1	Hs.580782;	IPI00550385	MACF1 Isoform 1 of Microtubule-actin cross-linking factor 1, isoforms 1/2/3/5
RELA	Hs.502875;	IPI00719633	RELA RELA protein
CHMP2A	Hs.12107;	IPI00004416	CHMP2A Charged multivesicular body protein 2a
RYBP	Hs.694786;	IPI00296594	RYBP RING1 and YY1-binding protein
LRCH1	Hs.656722;	IPI00376144	LRCH1 Isoform 2 of Leucine-rich repeat and calponin homology domain-containing protein 1
C10orf119	Hs.124246;	IPI00414458	C10orf119 Isoform 1 of Uncharacterized protein C10orf119
RNPEP	Hs.497391;	IPI00647400	RNPEP 68 kDa protein
KIAA0157	Hs.280695;	IPI00299517	KIAA0157 Uncharacterized protein KIAA0157
GMPPB	Hs.567488;	IPI00030920	GMPPB,AMIGO3 GDP-mannose pyrophosphorylase B isoform 2
SEC23B	Hs.369373; Hs.460238;	IPI00017376	SEC23B Protein transport protein Sec23B
AARSD1	Hs.317403;	IPI00748490	AARSD1 Alanyl-tRNA synthetase, class IIc family protein
ARHGAP6	Hs.435291;	IPI00221123	ARHGAP6 Isoform 4 of Rho GTPase-activating protein 6
NCSTN	Hs.517249;	IPI00375688	NCSTN Isoform 2 of Nicastrin precursor
SPAG9	Hs.593620; Hs.463439;	IPI00218097	SPAG9 Isoform 2 of C-jun-amino-terminal kinase-interacting protein 4
EXOC1	Hs.269665;	IPI00215762	EXOC1 Isoform 2 of Exocyst complex component 1
NRAS	Hs.486502;	IPI00844005	NRAS 89 kDa protein
RSU1	Hs.524161;	IPI00643346	RSU1 RSU1 protein (Fragment)
MAPKAPK2	Hs.643566;	IPI00026054	MAPKAPK2 Isoform 1 of MAP kinase-activated protein kinase 2
RCN2	Hs.79088;	IPI00029628	RCN2 Reticulocalbin-2 precursor
LUZP1	Hs.257900;	IPI00296830	LUZP1 Isoform 1 of Leucine zipper protein 1
FYN	Hs.390567;	IPI00219012	FYN Isoform 1 of Proto-oncogene tyrosine-protein kinase Fyn
LOC645312	IPI00412440	IPI00412440	LOC645312 similar to Glycolipid transfer protein
PFDN2	Hs.492516;	IPI00006052	PFDN2 Prefoldin subunit 2
EIF2C2	Hs.449415;	IPI00220349	EIF2C2 eukaryotic translation initiation factor 2C, 2
PRPS2	Hs.654581;	IPI00219617	PRPS2 Ribose-phosphate pyrophosphokinase II
RAB24	Hs.16258;	IPI00792833	RAB24 20 kDa protein
CLN6	Hs.584921;	IPI00798061	CLN6 29 kDa protein
GGA2	Hs.460336;	IPI00642330	GGA2 31 kDa protein
SCAMP4	Hs.144980;	IPI00472242	SCAMP4 Isoform 2 of Secretory carrier-associated membrane protein 4
GSTM4	Hs.348387;	IPI00008770	GSTM4,GSTM2 Isoform 1 of Glutathione S-transferase Mu 4
CRTC2	Hs.406392;	IPI00639850	CRTC2 Transducer of regulated cAMP response element-binding protein (CREB) 2
EXOC4	Hs.321273;	IPI00655649	EXOC4 EXOC4 protein
EXOC3	Hs.646923;	IPI00157734	EXOC3 Isoform 1 of Exocyst complex component 3
GTF2E1	Hs.445272;	IPI00019977	GTF2E1 Transcription initiation factor IIE subunit alpha
MTMR3	Hs.474536;	IPI00185018	MTMR3 Isoform B of Myotubularin-related protein 3
CEP250	Hs.443976;	IPI00160622	CEP250 Isoform 1 of Centrosome-associated protein CEP250
WDR55	Hs.286261;	IPI00302990	WDR55 WD repeat protein 55
ATP2B4	Hs.343522;	IPI00217170	ATP2B4 Isoform ZB of Plasma membrane calcium-transporting ATPase 4
TBC1D13	Hs.3376;	IPI00647082	TBC1D13 TBC1 domain family, member 13
LUC7L	Hs.16803;	IPI00410026	LUC7L Isoform 2 of Putative RNA-binding protein Luc7-like 1
S100A9	Hs.112405;	IPI00027462	S100A9 Protein S100-A9
S100A8	Hs.416073;	IPI00007047	S100A8 Protein S100-A8
CSTA	Hs.518198;	IPI00032325	CSTA Cystatin-A
UNC13D	Hs.41045;	IPI00456635	UNC13D Isoform 1 of Unc-13 homolog D
PPBP	Hs.2164;	IPI00022445	PPBP Platelet basic protein precursor
TMEM173	Hs.379754;	IPI00257059	TMEM173 Transmembrane protein 173
MYLK	Hs.556600;	IPI00221255	MYLK Isoform 2 of Myosin light chain kinase, smooth muscle
EIF4A1	Hs.129673;	IPI00025491	EIF4A1 Eukaryotic initiation factor 4A-I

STS-1	Hs.444075;	IPI00154910	STS-1 Suppressor of T-cell receptor signaling 1
PTPRJ	Hs.318547; Hs.595299;	IPI00290328	PTPRJ Receptor-type tyrosine-protein phosphatase eta precursor
SNAP29	Hs.108002;	IPI00032831	SNAP29 Synaptosomal-associated protein 29
PLEKHQ1	Hs.207157;	IPI00791133	PLEKHQ1 PLEKHQ1 protein
ALDH4A1	Hs.77448;	IPI00217871	ALDH4A1 Delta-1-pyrroline-5-carboxylate dehydrogenase, mitochondrial precursor
CHMP6	Hs.514560;	IPI00305423	CHMP6 Charged multivesicular body protein 6
SLC9A3R1	Hs.655595; Hs.396783;	IPI00003527	SLC9A3R1 Ezrin-radixin-moesin-binding phosphoprotein 50
DNAJB11	Hs.317192;	IPI00008454	DNAJB11 DnaJ homolog subfamily B member 11 precursor
PDLIM1	Hs.368525;	IPI00010414	PDLIM1 PDZ and LIM domain protein 1
IQGAP1	Hs.430551;	IPI00009342	IQGAP1 Ras GTPase-activating-like protein IQGAP1
MOBK1B	Hs.196437;	IPI00301518	MOBK1B Isoform 1 of Mps one binder kinase activator-like 1B
RAB8A	Hs.642874;	IPI00028481	RAB8A Ras-related protein Rab-8A
EVI2B	Hs.5509;	IPI00301248	EVI2B EVI2B protein precursor
RAB14	Hs.371563; Hs.655183;	IPI00291928	RAB14 Ras-related protein Rab-14
SCYE1	Hs.591680;	IPI00006252	SCYE1 Multisynthetase complex auxiliary component p43
IPI00075248	IPI00075248	IPI00075248	CALM1,CALM3,CALM2 Calmodulin
MVP	Hs.632177;	IPI00000105	MVP Major vault protein
RAB8B	Hs.389733;	IPI00024282	RAB8B Ras-related protein Rab-8B
ARHGEF1	Hs.631550;	IPI00395605	ARHGEF1 Rho guanine nucleotide exchange factor 1 isoform 1
HSPA5	Hs.605502;	IPI00003362	HSPA5 HSPA5 protein
CD47	Hs.446414;	IPI00216514	CD47 Isoform OA3-293 of Leukocyte surface antigen CD47 precursor
TXNL1	Hs.114412;	IPI00305692	TXNL1 Thioredoxin-like protein 1
ENDOD1	Hs.167115;	IPI00001952	ENDOD1 Endonuclease domain-containing 1 protein precursor
LILRB1	Hs.667388; Hs.655593;	IPI00658078	LILRB1 leukocyte immunoglobulin-like receptor, subfamily B, member 1 isoform 4
LRRFIP2	Hs.475319;	IPI00789379	LRRFIP2 48 kDa protein
FASN	Hs.83190;	IPI00847250	FASN Fatty acid synthase
PACSIN2	Hs.162877;	IPI00027009	PACSIN2 Isoform 1 of Protein kinase C and casein kinase substrate in neurons protein 2
NAPRT1	Hs.493164;	IPI00465085	NAPRT1 Nicotinate phosphoribosyltransferase domain-containing protein 1
IKBKG	Hs.43505;	IPI00641117	IKBKG Inhibitor of kappaB kinase gamma
RNASET2	Hs.529989;	IPI00414896	RNASET2 Isoform 1 of Ribonuclease T2 precursor
SH3GL1	Hs.97616;	IPI00019169	SH3GL1 SH3-containing GRB2-like protein 1
SNX3	Hs.12102;	IPI00552276	SNX3 Isoform 4 of Sorting nexin-3
TPP2	Hs.432424;	IPI00020416	TPP2 Tripeptidyl-peptidase 2
MAPK14	Hs.588289;	IPI00002857	MAPK14 Isoform CSBP2 of Mitogen-activated protein kinase 14
TSPO	Hs.202;	IPI00847172	TSPO translocator protein (18kDa) isoform PBR
GSPT1	Hs.528780;	IPI00218829	GSPT1 G1 to S phase transition protein 1 homolog
NIPSNAP3A	Hs.591897;	IPI00745420	NIPSNAP3A 23 kDa protein
FLJ11151	Hs.560445; Hs.460002;	IPI00305010	FLJ11151 Hypothetical protein FLJ11151
PSTPIP1	Hs.129758;	IPI00022606	PSTPIP1 Isoform 1 of Proline-serine-threonine phosphatase-interacting protein 1
BASP1	Hs.201641;	IPI00299024	BASP1 Brain acid soluble protein 1
IPI00436520	IPI00436520	IPI00436520	Cytochrome c oxidase VIIc
AP1S2	Hs.656471;	IPI00009244	AP1S2 AP-1 complex subunit sigma-2
DPYSL2	Hs.173381;	IPI00257508	DPYSL2 Dihydropyrimidinase-related protein 2
UROD	Hs.78601;	IPI00301489	UROD Uroporphyrinogen decarboxylase
IRF2BP2	Hs.350268;	IPI00376199	IRF2BP2 interferon regulatory factor 2 binding protein 2 isoform A
ACSL4	Hs.268785;	IPI00219897	ACSL4 Isoform Short of Long-chain-fatty-acid--CoA ligase 4
CENTD2	Hs.503165;	IPI00220421	CENTD2 Isoform 2 of Centaurin-delta 2
ATP6V1H	Hs.491737;	IPI00414079	ATP6V1H Isoform 2 of Vacuolar ATP synthase subunit H
RDH11	IPI00782958	IPI00782958	RDH11 35 kDa protein
CAPNS1	Hs.515371;	IPI00794720	CAPNS1 34 kDa protein
H1F0	Hs.694881;	IPI00550239	H1F0 Histone H1.0
TMED4	Hs.510745; Hs.598832; Hs.632641;	IPI00296259	TMED4 Transmembrane emp24 domain-containing protein 4 precursor
RAB1B	Hs.300816;	IPI00008964	RAB1B Ras-related protein Rab-1B
PGRMC1	Hs.90061;	IPI00220739	PGRMC1 Membrane-associated progesterone receptor component 1
TOM1	Hs.474705;	IPI00023191	TOM1 Target of myb1

CORO1B	Hs.6191;	IPI00007058	CORO1B,PTPRCAP Coronin-1B
EPS15L1	Hs.654639;	IPI00646339	EPS15L1 EPS15L1 protein
BLOC1S2	Hs.576605;	IPI00411983	BLOC1S2 Isoform 1 of Biogenesis of lysosome-related organelles complex-1 subunit 2
STXBP2	Hs.515104;	IPI00019971	STXBP2 Syntaxin-binding protein 2
IDH1	Hs.593422; Hs.694738;	IPI00027223	IDH1 Isocitrate dehydrogenase [NADP] cytoplasmic
DNM1L	Hs.556296;	IPI00235412	DNM1L Isoform 3 of Dynamin-1-like protein
TSC22D4	Hs.469798;	IPI00852894	TSC22D4 17 kDa protein
NP	Hs.75514;	IPI00017672	NP CDNA FLJ25678 fis, clone TST04067, highly similar to PURINE NUCLEOSIDE PHOSPHORYLASE
CPT1A	Hs.503043;	IPI00479108	CPT1A Isoform 2 of Carnitine O-palmitoyltransferase I, liver isoform
OSTF1	Hs.494192;	IPI00414836	OSTF1 Osteoclast-stimulating factor 1
RAB10	Hs.643072; Hs.467960;	IPI00016513	RAB10 Ras-related protein Rab-10
LCP1	Hs.381099;	IPI00010471	LCP1 Plastin-2
GDI1	Hs.74576;	IPI00010154	GDI1 Rab GDP dissociation inhibitor alpha
ATP6V1A	Hs.477155;	IPI00007682	ATP6V1A Vacuolar ATP synthase catalytic subunit A
G6PD	Hs.461047; Hs.684904;	IPI00853547	G6PD glucose-6-phosphate dehydrogenase isoform a
CAP1	Hs.370581;	IPI00008274	CAP1 Adenylyl cyclase-associated protein 1
TXN	Hs.435136;	IPI00216298	TXN Thioredoxin
TIAF1	Hs.462590; Hs.655992; Hs.664319;	IPI00402167	TIAF1 232 kDa protein
VDP	Hs.292689;	IPI00743314	VDP General vesicular transport factor p115
ARPC2	Hs.529303;	IPI00005161	ARPC2 Actin-related protein 2/3 complex subunit 2
FAM49B	Hs.126941;	IPI00303318	FAM49B Protein FAM49B
GTPBP9	Hs.157351;	IPI00290416	GTPBP9 Isoform 1 of Putative GTP-binding protein 9
STAT3	Hs.463059;	IPI00306436	STAT3 Isoform Del-701 of Signal transducer and activator of transcription 3
MSN	Hs.87752;	IPI00219365	MSN Moesin
GSS	Hs.82327;	IPI00010706	GSS Glutathione synthetase
SCP2	Hs.476365;	IPI00479934	SCP2 sterol carrier protein 2 isoform 2 precursor
ARHGAP4	Hs.3109;	IPI00398854	ARHGAP4 Rho GTPase-activating protein 4
OLFM4	Hs.559736;	IPI00022255	OLFM4 olfactomedin 4 precursor
CDA	Hs.466910;	IPI00027983	CDA Cytidine deaminase
GZMA	Hs.90708;	IPI00024657	GZMA Granzyme A precursor (Fragment)
CYFIP1	Hs.26704;	IPI00644231	CYFIP1 Isoform 1 of Cytoplasmic FMR1-interacting protein 1
MYO1F	Hs.465818;	IPI00414576	MYO1F 125 kDa protein
HSPB1	Hs.520973;	IPI00025512	HSPB1 Heat shock protein beta-1
GAA	Hs.1437;	IPI00293088	GAA 106 kDa protein
TAOK3	Hs.644420;	IPI00796238	TAOK3 53 kDa protein
PSMD13	Hs.134688;	IPI00552191	PSMD13 Hypothetical protein DKFZp686H16220
FLNC	Hs.58414;	IPI00783128	FLNC Gamma filamin variant
CHCHD2	Hs.547257; Hs.389996;	IPI00007673	CHCHD2 Coiled-coil-helix-coiled-coil-helix domain-containing protein 2
WIPF1	Hs.654521;	IPI00418328	WIPF1 Isoform 1 of WAS/WASL-interacting protein family member 1
ADSS	Hs.498313;	IPI00026833	ADSS Adenylosuccinate synthetase isozyme 2
WNK1	Hs.356604;	IPI00397591	WNK1 Isoform 3 of Serine/threonine-protein kinase WNK1
LMAN1	Hs.465295;	IPI00026530	LMAN1 ERGIC-53 protein precursor
GMIP	Hs.49427;	IPI00292376	GMIP GEM-interacting protein
HPCA	Hs.632391;	IPI00219103	HPCA Neuron-specific calcium-binding protein hippocalcin
FKBP2	Hs.227729;	IPI00002535	FKBP2 FK506-binding protein 2 precursor
SH3BGRL2	Hs.302772;	IPI00412272	SH3BGRL2 SH3 domain-binding glutamic acid-rich-like protein 2
CHMP5	Hs.635313;	IPI00100796	CHMP5 Charged multivesicular body protein 5
MMP8	Hs.161839;	IPI00027846	MMP8 Neutrophil collagenase precursor
PRKAR2B	Hs.433068;	IPI00554752	PRKAR2B cAMP-dependent protein kinase type II-beta regulatory subunit
FAM63A	Hs.3346;	IPI00413164	FAM63A hypothetical protein LOC55793 isoform 1
MLL	Hs.258855; Hs.664477;	IPI00009286	MLL Isoform 1 of Zinc finger protein HRX
PLG	Hs.143436;	IPI00019580	PLG Plasminogen precursor
DNMT1	Hs.202672;	IPI00220918	DNMT1 Isoform 2 of DNA (cytosine-5)-methyltransferase 1
COASY	Hs.296422;	IPI00184821	COASY Bifunctional coenzyme A synthase
ERLIN1	Hs.150087;	IPI00007940	ERLIN1 Erlin-1 precursor

RAB27A	Hs.654978;	IPI00016381	RAB27A Isoform Long of Ras-related protein Rab-27A
ANXA6	Hs.412117;	IPI00002459	ANXA6 annexin VI isoform 2
ICAM1	Hs.643447;	IPI00008494	ICAM1 Intercellular adhesion molecule 1 precursor
RP6-213H19.1	Hs.444247;	IPI00182383	RP6-213H19.1 serine/threonine protein kinase MST4 isoform 3
TSG101	Hs.523512;	IPI00018434	TSG101 Isoform 1 of Tumor susceptibility gene 101 protein
EIF2A	Hs.655782;	IPI00012462	EIF2A Eukaryotic translation initiation factor 2A
EIF2B2	Hs.409137;	IPI00028083	EIF2B2 Translation initiation factor eIF-2B subunit beta
SNF8	Hs.127249;	IPI00795683	SNF8 12 kDa protein
SAPS3	Hs.503022;	IPI00019540	SAPS3 Isoform 4 of SAPS domain family member 3
ACAD9	Hs.567482;	IPI00152981	ACAD9 Acyl-CoA dehydrogenase family member 9, mitochondrial precursor
MKKS	Hs.472119;	IPI00020827	MKKS PNAS-117
EXOC7	Hs.533985;	IPI00394717	EXOC7 Isoform 4 of Exocyst complex component 7
PKN1	Hs.466044;	IPI00412672	PKN1 protein kinase N1 isoform 1
LACTB2	Hs.118554;	IPI00006952	LACTB2 Lactamase beta-2
TRIM56	Hs.521092;	IPI00514832	TRIM56 Tripartite motif-containing protein 56
MAPBPIP	Hs.632483;	IPI00477441	MAPBPIP Mitogen-activated protein-binding protein-interacting protein
CCNY	Hs.14745;	IPI00465457	CCNY Isoform 1 of Cyclin-Y
CALU	Hs.7753;	IPI00789155	CALU Calumenin precursor
METAP1	Hs.480364;	IPI00022239	METAP1 Methionine aminopeptidase 1
SKIV2L	Hs.89864;	IPI00414819	SKIV2L Helicase SKI2W
CLASP2	Hs.108614;	IPI00789331	CLASP2 49 kDa protein
TXNDC12	Hs.476033;	IPI00026328	TXNDC12 Thioredoxin domain-containing protein 12 precursor
IKBKB	Hs.656458;	IPI00024709	IKBKB Inhibitor of nuclear factor kappa-B kinase subunit beta
TBRG4	Hs.231411;	IPI00477123	TBRG4 Isoform 2 of Protein TBRG4
AP2A2	Hs.19121;	IPI00016621	AP2A2 AP-2 complex subunit alpha-2
PEX19	Hs.517232;	IPI00642757	PEX19 Peroxisomal biogenesis factor 19
HP	Hs.655196; Hs.513711;	IPI00641737	HP Haptoglobin precursor
LDHA	Hs.2795;	IPI00217966	LDHA Isoform 1 of L-lactate dehydrogenase A chain
PRDX6	Hs.573688;	IPI00220301	PRDX6 Peroxiredoxin-6
NCF4	Hs.474781;	IPI00014338	NCF4 Isoform 1 of Neutrophil cytosol factor 4
ARHGDIB	Hs.504877;	IPI00003817	ARHGDIB Rho GDP-dissociation inhibitor 2
DNAJC13	Hs.12707;	IPI00847695	DNAJC13 DnaJ (Hsp40) homolog, subfamily C, member 13
CNN2	Hs.651923;	IPI00015262	CNN2 Calponin-2
CLIC1	Hs.414565;	IPI00010896	CLIC1 Chloride intracellular channel protein 1
YWHAH	Hs.226755;	IPI00216319	YWHAH 14-3-3 protein eta
HMHA1	Hs.465521;	IPI00022471	HMHA1 minor histocompatibility antigen HA-1
PSME2	Hs.512410; Hs.434081;	IPI00746205	PSME2 proteasome activator subunit 2
ALDOA	Hs.513490;	IPI00465439	ALDOA Fructose-bisphosphate aldolase A
RNH1	Hs.530687;	IPI00550069	RNH1 Ribonuclease inhibitor
PPP1CA	Hs.183994;	IPI00550451	PPP1CA Serine/threonine-protein phosphatase PP1-alpha catalytic subunit
DCTN1	Hs.516111;	IPI00029485	DCTN1 Isoform p150 of Dynactin subunit 1
SEC31A	Hs.370024;	IPI00305152	SEC31A Isoform 3 of Protein transport protein Sec31A
EHD1	Hs.523774;	IPI00017184	EHD1 EH domain-containing protein 1
HSP90AA1	Hs.525600;	IPI00784295	HSP90AA1 Isoform 1 of Heat shock protein HSP 90-alpha
SND1	Hs.122523;	IPI00140420	SND1 Staphylococcal nuclease domain-containing protein 1

[0055] Regulation of known subnetworks of cellular pathways to identify biomarker subnetworks relating to measures of CLL prognosis, diagnosis and/or pathology were also identified by determining up- and down-regulation of genes within the subnetworks. Cellular pathways of molecular interaction and reaction networks are provided in various curated databases, such as Biocarta™ and Kegg™. Table 5 lists known Biocarta™ (biocarta.com/genes/index.asp) and Kegg™ (genome.jp/kegg/pathway.html) subnetworks of

cellular pathways that are up- or down- regulated in CLL B cells compared to normal B cells and thus determined to be biomarker subetworks.

Table 5: Pathways that are up- or down-regulated in CLL B cells compared to normal B cells:

Biocarta™ Pathways	**Gene #**	**P-Value**	**Benjamini**
Spliceosomal Assembly	6	1.30E-02	9.80E-01
Adhesion and Diapedesis of Granulocytes	6	2.20E-02	9.70E-01
TSP-1 Induced Apoptosis in Microvascular Endothelial Cell	4	2.60E-02	9.40E-01
uCalpain and friends in Cell spread	5	3.40E-02	9.40E-01
SARS Coronavirus Protease	4	3.90E-02	9.20E-01
Rab GTPases Mark Targets In The Endocytotic Machinery	5	4.50E-02	9.10E-01
Erk and PI-3 Kinase Are Necessary for Collagen Binding in Corneal Epithelia	6	6.30E-02	9.50E-01
Monocyte and its Surface Molecules	5	6.90E-02	9.40E-01
Cell to Cell Adhesion Signaling	4	7.10E-02	9.30E-01
Eph Kinases and ephrins support platelet aggregation	4	9.10E-02	9.50E-01
Kegg ™ Pathways	**Gene #**	**P-Value**	**Benjamini**
Regulation of actin cytoskeleton	35	5.30E-06	1.10E-03
Hematopoietic cell lineage	18	7.70E-05	7.70E-03
Focal adhesion	30	1.40E-04	9.20E-03
Leukocyte transendothelial migration	21	1.80E-04	9.20E-03
Epithelial cell signaling in Helicobacter pylori infection	14	8.50E-04	3.30E-02
Tight junction	20	2.30E-03	7.50E-02
Methane metabolism	5	3.80E-03	1.00E-01
Fatty acid metabolism	9	1.30E-02	2.80E-01
Adherens junction	12	1.50E-02	2.80E-01
Glutathione metabolism	8	1.90E-02	3.20E-01
Complement and coagulation cascades	11	2.30E-02	3.50E-01
Pentose phosphate pathway	6	2.90E-02	3.90E-01
Long-term potentiation	10	4.00E-02	4.70E-01
Aminosugars metabolism	6	4.50E-02	4.90E-01
ECM-receptor interaction	12	4.70E-02	4.80E-01
Antigen processing and presentation	11	5.70E-02	5.20E-01
Lysine degradation	8	5.70E-02	5.00E-01
Glycolysis / Gluconeogenesis	9	6.10E-02	5.10E-01
Cholera - Infection	7	6.90E-02	5.30E-01
Pathogenic Escherichia coli infection - EPEC	8	8.10E-02	5.50E-01
Pathogenic Escherichia coli infection - EHEC	8	8.10E-02	5.50E-01
Caprolactam degradation	4	8.70E-02	5.60E-01
Acute myeloid leukemia	8	9.40E-02	5.80E-01

EXAMPLE II

Prognostic Classification of CLL Patients Using Subnetwork Data

[0056] The clinical course of patients with chronic lymphocytic leukemia (CLL) is heterogeneous. For unknown reasons, some patients become fatal within few years while some others may stay symptom free for more than a decade. Several prognostic factors have been identified that can stratify patients into groups that differ in their relative tendency for

disease progression and/or survival. Microarray studies have highlighted differences in mRNA levels found between such CLL subgroups.

[0057] To evaluate gene expression profiling to define a repertoires of transcriptional activity contributing to or resulting from the dynamic evolution of CLL cells. 131 CLL patients (of >90% CD19+CD5+ peripheral blood mononuclear cells in each sample) were profiled on mRNA expression microarrays using Affymetrix HG-U133 plus 2 GeneChips™. Patterns of gene activity correlated with the time intervals to treatment of CLL patients from the date of sample collection (treatment-free survival). An expression-based prognosis that assigns patients to "aggressive" (high-risk) or "indolent" (low-risk) groups based upon biological-defendable models by incorporating knowledge of molecular pathways was next develeped.

[0058] To identify progression-associated pathway markers, a network-based marker identification was adopted. The network-based approach identified prognostic markers not as individual genes but as subnetworks extracted from molecular interaction databases (Figure 2). Gene expression profiles from CLL patients were mapped to a large human molecular interaction network, consisting of 45,526 interactions (including protein-protein and protein-DNA interactions) among 9,800 genes/proteins, compiled from high-throughput screenings and curation of previous measurements reported in the literature. A search over this network was performed to identify prognostic subnetworks that could be used to predict treatment-free survival.

[0059] Specifically, each subnetwork was scored by a vector of activities across all patients, where the activity for a given patient is a function of the expression levels of its member genes. A subnetwork's prognostic power was scored by the Cox metric, which measures the correlation between the activity vector and the patients' treatment-free survival. The resulting 30 prognostic biomarker subnetworks identify new putative cancer markers and provide an array of "small-scale" models charting the molecular mechanisms correlated with CLL disease progression, e.g. subnetworks detailing interactions between proteins participating in cell cycle and death, Myc regulation, proteasome or Wnt signaling (Figure 3).

[0060] To examine the utility of the 30 subnetwork markers in CLL risk assessment, a 5-fold cross validation was performed where 80% of the 131 patients were designated as a

training set and the rest as a test set. The patients in a training set were first separated into two groups based on the similarity between their activity patterns of the 30 prognostic subnetworks; one set was assigned as "aggressive" and the other as "indolent" according to the median survival time of each patient set. Patients in a test set were segregated into either the "aggressive" or "indolent" group based on their activity similarity to that of the training samples. The survival difference between the two predicted groups of patients in a test set was then used as a metric to evaluate the prognostic power of the given markers.

[0061] Combining the results from the 5 test trials, the two risk groups defined by the subnetwork markers displayed significantly different behaviors with respect to treatment-free survival (Figure 4); however, neither of conventional gene-expression array analyses or the two commonly-used prognostic factors, IgVH gene mutational status or leukemia-cell expression of ZAP-70 protein, could segregate the test samples to the same degree of statistical significance. Moreover, the subnetwork signature learned from the patient cohort was also predictive of the prognosis of a subsequent independent testing set of 17 patients from Europe (Figure 5). The identified subnetwork signature provides a powerful tool for identification of CLL patients at high risk of immediate care. In all, the network-based approach integrating protein interactions with CLL expression profiles leads to increased classification accuracy and, simultaneously, provides a view of the biological processes underlying cancer progression.

[0062] Although the invention has been described with reference to the above example, which is incorporated herein by reference, it will be understood that modifications and variations are encompassed within the spirit and scope of the invention. Accordingly, the invention is limited only by the following claims.

CLAIMS

1. A method for predicting the prognostic risk posed by chronic lymphocytic leukemia (CLL) to a patient diagnosed with the disease comprising:

a) obtaining a sample from the patient; and

b) comparing expression of a first plurality of genes from said sample to expression of a second plurality of genes comprising a biomarker subnetwork, wherein the genes of the subnetwork encode proteins known to exhibit protein-protein interactions, and wherein further said proteins are associated with relatively high or low risk for progression of the disease, whereby similarity between expression of said pluralities of genes indicates the relative level of such risk for the patient.

2. The method of claim 1, wherein the subnetwork of genes encode proteins that comprise one or more protein biomarkers listed in Tables 1 through 4.

3. The method of claim 1, wherein the subnetwork of genes encode proteins that comprise one or more protein biomarkers listed in any of Tables 1 and 2.

4. The method of claim 1, wherein the subnetwork comprises one or more subnetworks listed in Table 5.

5. The method of claim 1, wherein the subnetwork of genes comprises one or more of the subnetworks of Figures 8 through 37.

6. The method of claim 1, wherein the sample is a blood sample.

7. A method of diagnosing a subject as having or being at risk of having chronic lymphocytic leukemia (CLL), comprising:

a) obtaining a sample from the subject; and

b) comparing the expression or activation of one or more biomarkers listed in Tables 1 through 5 or Figures 8 through 37, in a first sample from the subject suspected of having CLL with a control sample of normal B cells, wherein differential expression

of one or more of said biomarkers in the subject's sample as compared to the control sample is diagnostic of CLL in the subject.

8. The method of claim 7, wherein the biomarker comprises one or more biomarkers listed in Tables 1 or 3 and expression of the one or more biomarkers is increased as compared to expression of the biomarker in the control sample.

9. The method of claim 7, wherein the biomarker comprises one or more biomarkers listed in Tables 2 or 4 and expression of the one or more biomarkers is decreased as compared to expression of the biomarker in the control sample.

10. The method of claim 7, wherein the biomarker comprises one or more subnetworks listed in Table 5.

11. The method of claim 1, wherein the subnetwork comprises one or more of the subnetworks of Figures 8 through 37.

12. A method of differentially diagnosing aggressive chronic lymphocytic leukemia (CLL) versus indolent CLL in a subject, comprising:

a) obtaining a sample from a subject; and

b) comparing the level of expression of one or more biomarkers listed in Table 1 in a sample from the subject suspected of having aggressive CLL with a control indolent CLL sample, wherein greater expression of one or more of said biomarkers listed in Table 1 in the subject sample versus the control indolent CLL sample is diagnostic of aggressive CLL in the subject.

13. A method of differentially diagnosing aggressive chronic lymphocytic leukemia (CLL) versus indolent CLL in a subject, comprising:

a) obtaining a sample from a subject; and

b) comparing the level of expression of one or more biomarkers listed in Table 2 in a sample from the subject suspected of having aggressive CLL with a control indolent CLL sample, wherein lesser expression of one or more of said biomarkers listed in

Table 2 in the subject sample versus the control indolent CLL sample is diagnostic of indolent CLL in the subject.

14. A method for diagnosing CLL in a subject, comprising:

a) providing a gene expression profile of a sample suspected of being CLL from the subject, wherein the sample simultaneously expresses a plurality of genes at the protein level that are markers for CLL; and

b) comparing the subject's gene expression profile to a reference gene expression profile obtained from a corresponding control sample, wherein the reference gene expression profile comprises an expression value of one or more target biomarkers selected from the genes listed in Table 1 and Table 2.

15. A method for distinguishing aggressive chronic lymphocytic leukemia (CLL) from indolent CLL in a subject, comprising:

a) providing a gene expression profile of a sample suspected of being aggressive CLL from the subject, wherein the sample simultaneously expresses a plurality of genes at the protein level that are markers for aggressive CLL; and

b) comparing the subject's gene expression profile to a reference gene expression profile obtained from a corresponding indolent CLL control sample, wherein the reference gene expression profile comprises an expression value of one or more target genes selected from the biomarkers listed in Table 3 and Table 4.

16. A computer-readable media comprising an algorithm for execution of (b) of the method of claims 1-16.

17. A method of monitoring a therapeutic regimen for treating a subject having or at risk of having CLL, comprising determining a change in activity or expression of one or more biomarkers listed in any of Tables 1 through 4, subnetwork listed in Table 5 or Figures 8 through 37, thereby monitoring the therapeutic regimen in the subject.

18. A diagnostic chip comprising nucleotides with at least 95% homology to the sequences of two or more genes shown in a subnetwork of Figures 8 through 37.

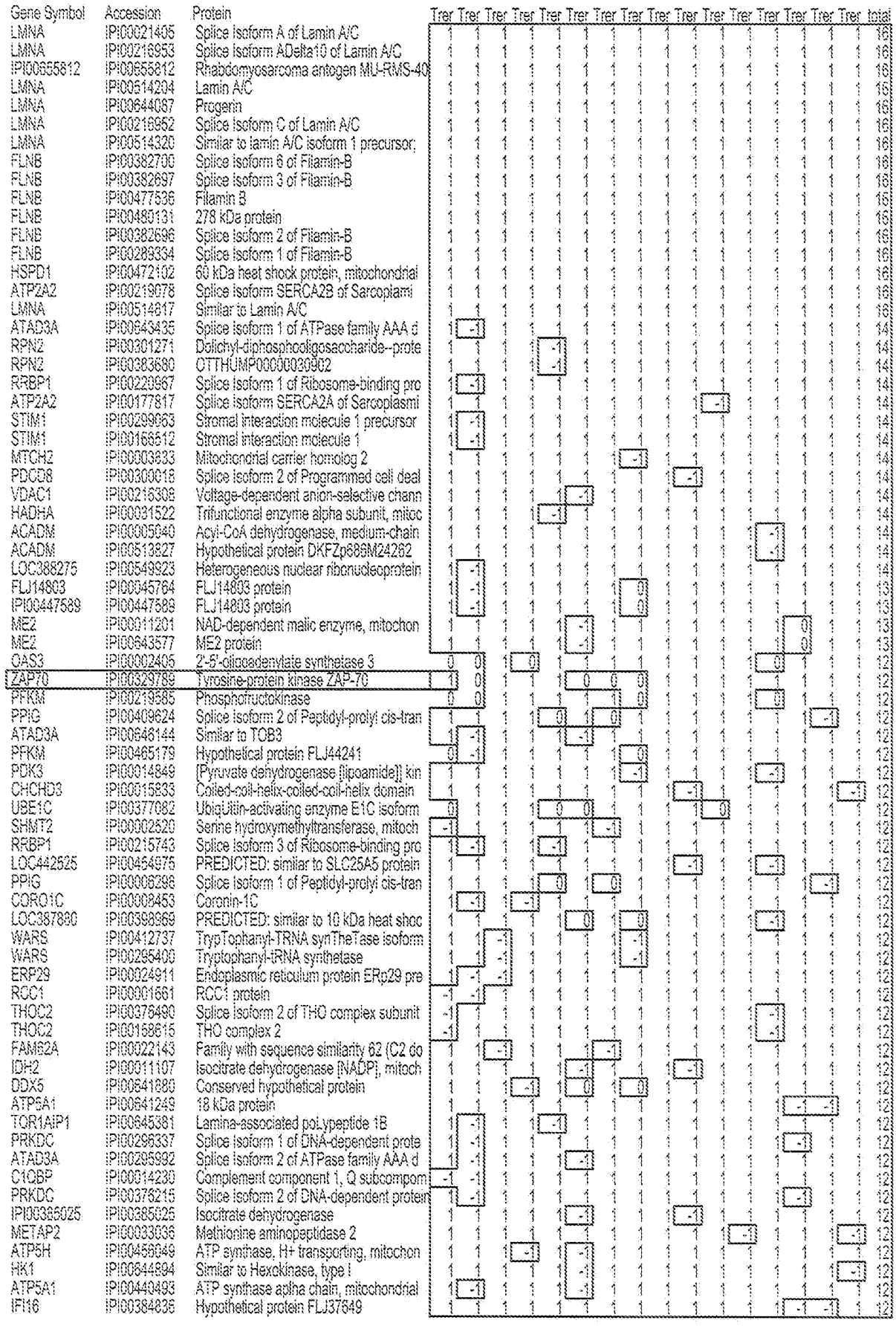
Gene Symbol
Accession
Protein
Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Initial
LMNA IPI00021405 Splice isoform A of Lamin A/C
LMNA IPI00216953 Splice isoform ADelta10 of Lamin A/C
IPI00655812 IPI00655812 Rhabdomyosarcoma antogen MU-RMS-40
LMNA IPI00514204 Lamin A/C
LMNA IPI00644087 Progerin
LMNA IPI00216952 Splice isoform C of Lamin A/C
LMNA IPI00514320 Similar to lamin A/C isoform 1 precursor;
FLNB IPI00382700 Splice isoform 6 of Filamin-B
FLNB IPI00382697 Splice isoform 3 of Filamin-B
FLNB IPI00477536 Filamin B
FLNB IPI00480131 278 kDa protein
FLNB IPI00382696 Splice isoform 2 of Filamin-B
FLNB IPI00289334 Splice isoform 1 of Filamin-B
HSPD1 IPI00472102 60 kDa heat shock protein, mitochondrial
ATP2A2 IPI00219078 Splice isoform SERCA2B of Sarcoplasmi
LMNA IPI00514817 Similar to Lamin A/C
ATAD3A IPI00643435 Splice isoform 1 of ATPase family AAA d
RPN2 IPI00301271 Dolichyl-diphosphooligosaccharide--prote
RPN2 IPI00383690 OTTHUMP00000030902
RRBP1 IPI00220667 Splice isoform 1 of Ribosome-binding pro
ATP2A2 IPI00177817 Splice isoform SERCA2A of Sarcoplasmi
STIM1 IPI00299063 Stromal interaction molecule 1 precursor
STIM1 IPI00166512 Stromal interaction molecule 1
MTCH2 IPI00003833 Mitochondrial carrier homolog 2
PDCD8 IPI00300018 Splice isoform 2 of Programmed cell deal
VDAC1 IPI00216308 Voltage-dependent anion-selective chann
HADHA IPI00031522 Trifunctional enzyme alpha subunit, mitoc
ACADM IPI00005040 Acyl-CoA dehydrogenase, medium-chain
ACADM IPI00513827 Hypothetical protein DKFZp686M24262
LOC388275 IPI00549923 Heterogeneous nuclear ribonucleoprotein
FLJ14803 IPI00045764 FLJ14803 protein
IPI00447589 IPI00447589 FLJ14803 protein
ME2 IPI00011201 NAD-dependent malic enzyme, mitochon
ME2 IPI00643577 ME2 protein
OAS3 IPI00002405 2'-5'-oligoadenylate synthetase 3
ZAP70 IPI00329789 Tyrosine-protein kinase ZAP-70
PFKM IPI00219585 Phosphofructokinase
PPIG IPI00409624 Splice isoform 2 of Peptidyl-prolyl cis-tran
ATAD3A IPI00646144 Similar to TOB3
PFKM IPI00465179 Hypothetical protein FLJ44241
PDK3 IPI00014849 [Pyruvate dehydrogenase [lipoamide]] kin
CHCHD3 IPI00015833 Coiled-coil-helix-coiled-coil-helix domain
UBE1C IPI00377082 Ubiquitin-activating enzyme E1C isoform
SHMT2 IPI00002520 Serine hydroxymethyltransferase, mitoch
RRBP1 IPI00215743 Splice isoform 3 of Ribosome-binding pro
LOC442525 IPI00454875 PREDICTED: similar to SLC25A5 protein
PPIG IPI00006296 Splice isoform 1 of Peptidyl-prolyl cis-tran
CORO1C IPI00008453 Coronin-1C
LOC387890 IPI00398969 PREDICTED: similar to 10 kDa heat shoc
WARS IPI00412737 TrypTophanyl-TRNA synTheTase isoform
WARS IPI00295400 Tryptophanyl-tRNA synthetase
ERP29 IPI00024911 Endoplasmic reticulum protein ERp29 pre
RCC1 IPI00001661 RCC1 protein
THOC2 IPI00376490 Splice isoform 2 of THO complex subunit
THOC2 IPI00158815 THO complex 2
FAM62A IPI00022143 Family with sequence similarity 62 (C2 do
IDH2 IPI00011107 Isocitrate dehydrogenase [NADP], mitoch
DDX5 IPI00641880 Conserved hypothetical protein
ATP5A1 IPI00641249 18 kDa protein
TOR1AIP1 IPI00645381 Lamina-associated poLypeptide 1B
PRKDC IPI00296337 Splice isoform 1 of DNA-dependent prote
ATAD3A IPI00295992 Splice isoform 2 of ATPase family AAA d
C1QBP IPI00014230 Complement component 1, Q subcompon
PRKDC IPI00376215 Splice isoform 2 of DNA-dependent protein
IPI00385025 IPI00385025 Isocitrate dehydrogenase
METAP2 IPI00033036 Methionine aminopeptidase 2
ATP5H IPI00456049 ATP synthase, H+ transporting, mitochon
HK1 IPI00644894 Similar to Hexokinase, type I
ATP5A1 IPI00440493 ATP synthase alpha chain, mitochondrial
IFI16 IPI00384836 Hypothetical protein FLJ37849

FIG. 1-1

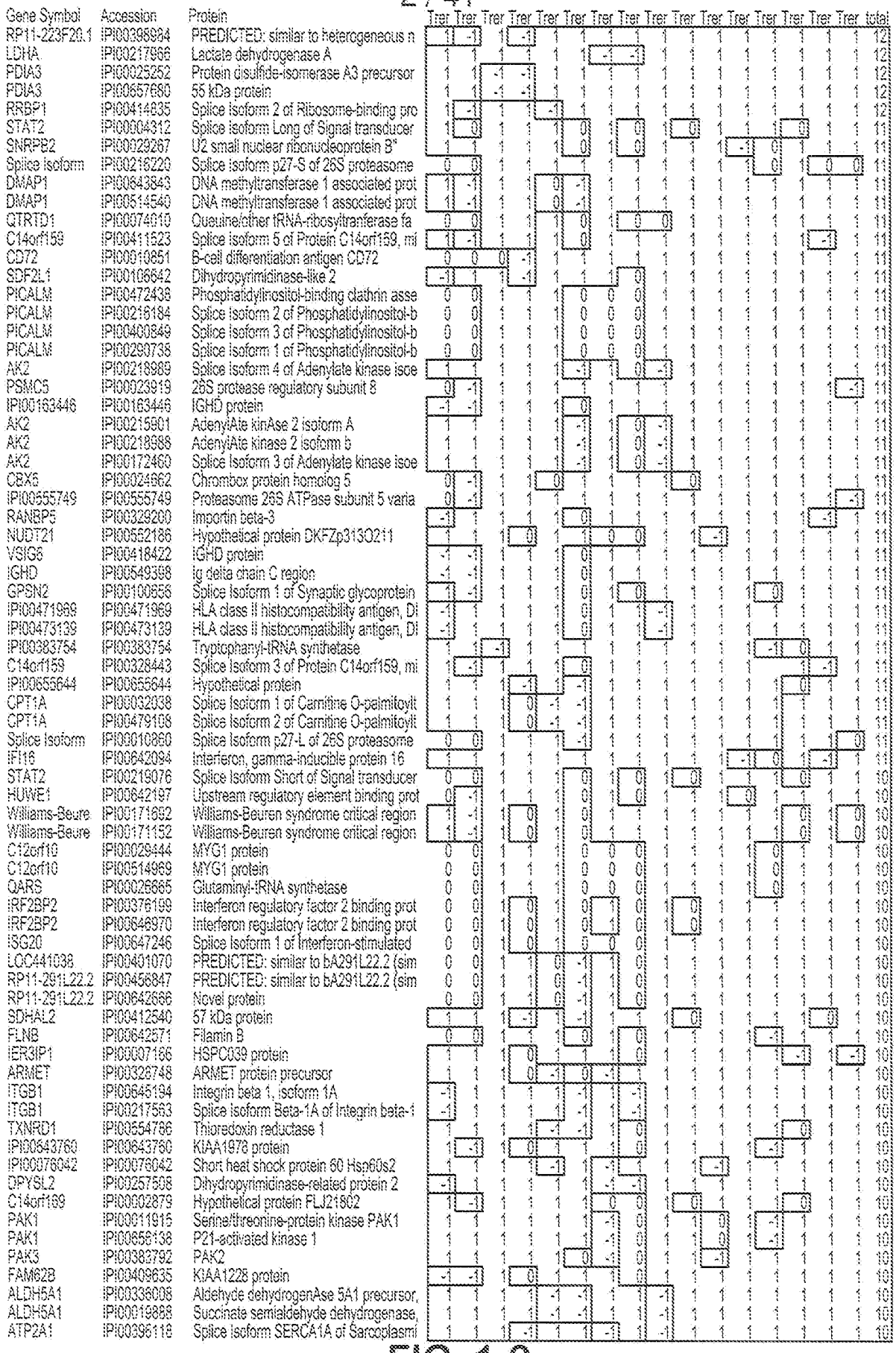
Gene Symbol
Accession
Protein
Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer total
RP11-223F20.1 IPI00398984 PREDICTED: similar to heterogeneous n 12
LDHA IPI00217966 Lactate dehydrogenase A 12
PDIA3 IPI00025252 Protein disulfide-isomerase A3 precursor 12
PDIA3 IPI00657680 55 kDa protein 12
RRBP1 IPI00414835 Splice isoform 2 of Ribosome-binding pro 12
STAT2 IPI00004312 Splice isoform Long of Signal transducer 11
SNRPB2 IPI00029267 U2 small nuclear ribonucleoprotein B" 11
Splice isoform IPI00216220 Splice isoform p27-S of 26S proteasome 11
DMAP1 IPI00843843 DNA methyltransferase 1 associated prot 11
DMAP1 IPI00514540 DNA methyltransferase 1 associated prot 11
QTRTD1 IPI00074010 Queuine/other tRNA-ribosyltranferase fa 11
C14orf159 IPI00411523 Splice isoform 5 of Protein C14orf159, mi 11
CD72 IPI00019851 B-cell differentiation antigen CD72 11
SDF2L1 IPI00106642 Dihydropyrimidinase-like 2 11
PICALM IPI00472438 Phosphatidylinositol-binding clathrin asse 11
PICALM IPI00216184 Splice isoform 2 of Phosphatidylinositol-b 11
PICALM IPI00400849 Splice isoform 3 of Phosphatidylinositol-b 11
PICALM IPI00290735 Splice isoform 1 of Phosphatidylinositol-b 11
AK2 IPI00218989 Splice isoform 4 of Adenylate kinase isoe 11
PSMC5 IPI00023919 26S protease regulatory subunit 8 11
IPI00163446 IPI00163446 IGHD protein 11
AK2 IPI00215901 AdenylAte kinAse 2 isoform A 11
AK2 IPI00218988 AdenylAte kinase 2 isoform b 11
AK2 IPI00172460 Splice isoform 3 of Adenylate kinase isoe 11
CBX5 IPI00024962 Chromobox protein homolog 5 11
IPI00555749 IPI00555749 Proteasome 26S ATPase subunit 5 varia 11
RANBP5 IPI00329200 Importin beta-3 11
NUDT21 IPI00552186 Hypothetical protein DKFZp313O211 11
VSIG6 IPI00418422 IGHD protein 11
IGHD IPI00549388 Ig delta chain C region 11
GPSN2 IPI00100656 Splice isoform 1 of Synaptic glycoprotein 11
IPI00471969 IPI00471969 HLA class II histocompatibility antigen, DI 11
IPI00473139 IPI00473139 HLA class II histocompatibility antigen, DI 11
IPI00383754 IPI00383754 Tryptophanyl-tRNA synthetase 11
C14orf159 IPI00328443 Splice isoform 3 of Protein C14orf159, mi 11
IPI00655644 IPI00655644 Hypothetical protein 11
CPT1A IPI00032038 Splice isoform 1 of Carnitine O-palmitoylt 11
CPT1A IPI00479108 Splice isoform 2 of Carnitine O-palmitoylt 11
Splice isoform IPI00010860 Splice isoform p27-L of 26S proteasome 11
IFI16 IPI00642094 Interferon, gamma-inducible protein 16 10
STAT2 IPI00219076 Splice isoform Short of Signal transducer 10
HUWE1 IPI00642197 Upstream regulatory element binding prot 10
Williams-Beure IPI00171692 Williams-Beuren syndrome critical region 10
Williams-Beure IPI00171152 Williams-Beuren syndrome critical region 10
C12orf10 IPI00029444 MYG1 protein 10
C12orf10 IPI00514969 MYG1 protein 10
QARS IPI00026665 Glutaminyl-tRNA synthetase 10
IRF2BP2 IPI00376199 Interferon regulatory factor 2 binding prot 10
IRF2BP2 IPI00646970 Interferon regulatory factor 2 binding prot 10
ISG20 IPI00647246 Splice isoform 1 of Interferon-stimulated 10
LOC441036 IPI00401070 PREDICTED: similar to bA291L22.2 (sim 10
RP11-291L22.2 IPI00456847 PREDICTED: similar to bA291L22.2 (sim 10
RP11-291L22.2 IPI00642686 Novel protein 10
SDHAL2 IPI00412540 57 kDa protein 10
FLNB IPI00642571 Filamin B 10
IER3IP1 IPI00007186 HSPC039 protein 10
ARMET IPI00328748 ARMET protein precursor 10
ITGB1 IPI00645194 Integrin beta 1, isoform 1A 10
ITGB1 IPI00217563 Splice isoform Beta-1A of Integrin beta-1 10
TXNRD1 IPI00554786 Thioredoxin reductase 1 10
IPI00643760 IPI00643760 KIAA1978 protein 10
IPI00076042 IPI00076042 Short heat shock protein 60 Hsp60s2 10
DPYSL2 IPI00257508 Dihydropyrimidinase-related protein 2 10
C14orf159 IPI00002879 Hypothetical protein FLJ21802 10
PAK1 IPI00011915 Serine/threonine-protein kinase PAK1 10
PAK1 IPI00656138 P21-activated kinase 1 10
PAK3 IPI00383792 PAK2 10
FAM62B IPI00409635 KIAA1228 protein 10
ALDH5A1 IPI00336008 Aldehyde dehydrogenAse 5A1 precursor, 10
ALDH5A1 IPI00019869 Succinate semialdehyde dehydrogenase, 10
ATP2A1 IPI00396118 Splice isoform SERCA1A of Sarcoplasmi 10

FIG. 1-2

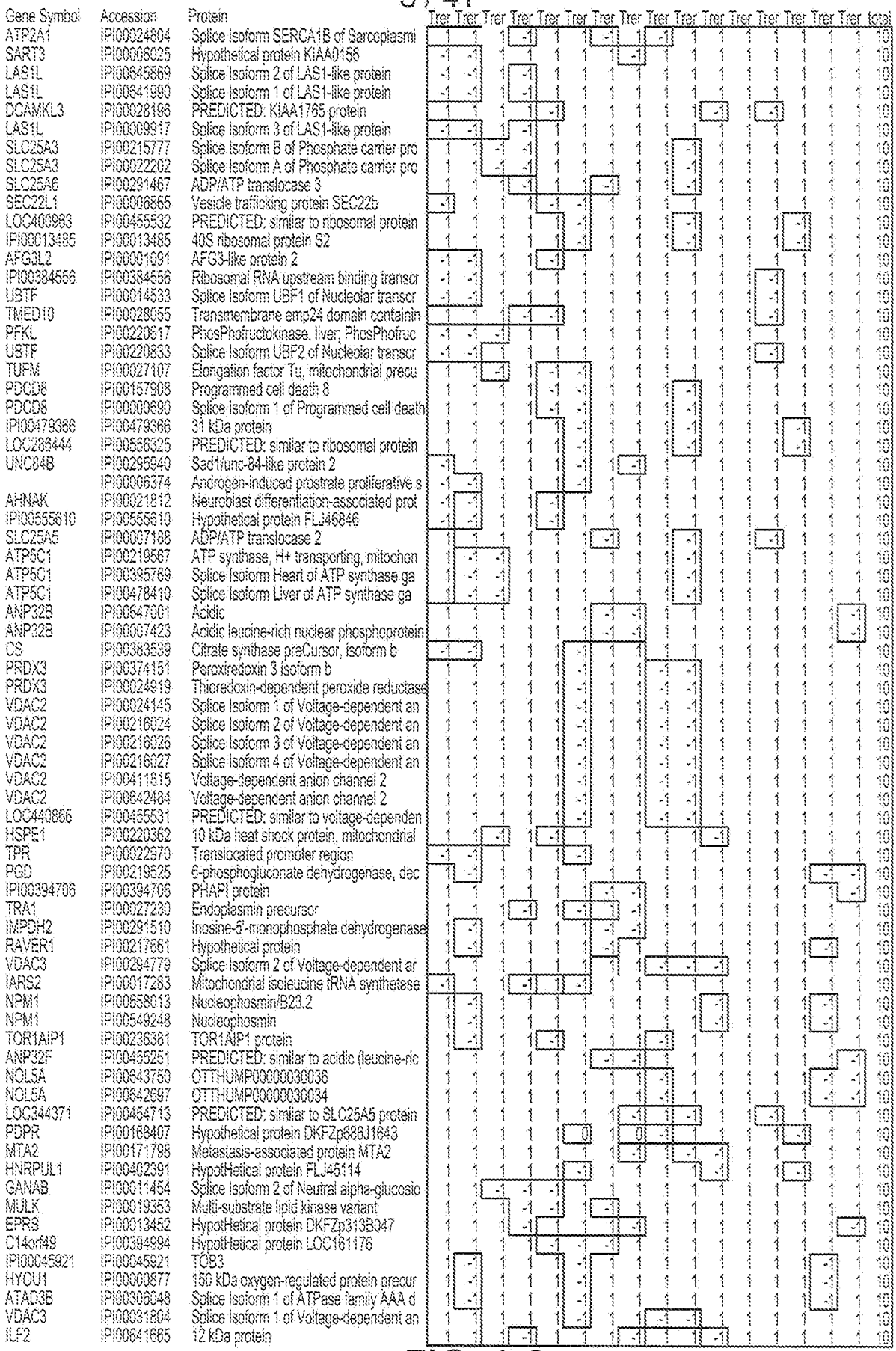
Gene Symbol
Accession
Protein
Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer total
ATP2A1 IPI00024804 Splice isoform SERCA1B of Sarcoplasmi
SART3 IPI00006025 Hypothetical protein KIAA0156
LAS1L IPI00645869 Splice isoform 2 of LAS1-like protein
LAS1L IPI00641990 Splice isoform 1 of LAS1-like protein
DCAMKL3 IPI00028186 PREDICTED: KIAA1765 protein
LAS1L IPI00009917 Splice isoform 3 of LAS1-like protein
SLC25A3 IPI00215777 Splice isoform B of Phosphate carrier pro
SLC25A3 IPI00022202 Splice isoform A of Phosphate carrier pro
SLC25A6 IPI00291467 ADP/ATP translocase 3
SEC22L1 IPI00006865 Vesicle trafficking protein SEC22b
LOC400963 IPI00455532 PREDICTED: similar to ribosomal protein
IPI00013485 IPI00013485 40S ribosomal protein S2
AFG3L2 IPI00001091 AFG3-like protein 2
IPI00384556 IPI00384556 Ribosomal RNA upstream binding transcr
UBTF IPI00014533 Splice isoform UBF1 of Nucleolar transcr
TMED10 IPI00028055 Transmembrane emp24 domain containin
PFKL IPI00220617 PhosPhofructokinase, liver; PhosPhofruc
UBTF IPI00220833 Splice isoform UBF2 of Nucleolar transcr
TUFM IPI00027107 Elongation factor Tu, mitochondrial precu
PDCD8 IPI00157908 Programmed cell death 8
PDCD8 IPI00000690 Splice isoform 1 of Programmed cell death
IPI00479366 IPI00479366 31 kDa protein
LOC286444 IPI00556325 PREDICTED: similar to ribosomal protein
UNC84B IPI00295940 Sad1/unc-84-like protein 2
IPI00006374 Androgen-induced prostrate proliferative s
AHNAK IPI00021812 Neuroblast differentiation-associated prot
IPI00555610 IPI00555610 Hypothetical protein FLJ46846
SLC25A5 IPI00007188 ADP/ATP translocase 2
ATP5C1 IPI00219567 ATP synthase, H+ transporting, mitochon
ATP5C1 IPI00395769 Splice isoform Heart of ATP synthase ga
ATP5C1 IPI00478410 Splice isoform Liver of ATP synthase ga
ANP32B IPI00647001 Acidic
ANP32B IPI00007423 Acidic leucine-rich nuclear phosphoprotein
CS IPI00383539 Citrate synthase preCursor, isoform b
PRDX3 IPI00374151 Peroxiredoxin 3 isoform b
PRDX3 IPI00024919 Thioredoxin-dependent peroxide reductase
VDAC2 IPI00024145 Splice isoform 1 of Voltage-dependent an
VDAC2 IPI00216024 Splice isoform 2 of Voltage-dependent an
VDAC2 IPI00216026 Splice isoform 3 of Voltage-dependent an
VDAC2 IPI00216027 Splice isoform 4 of Voltage-dependent an
VDAC2 IPI00411615 Voltage-dependent anion channel 2
VDAC2 IPI00642484 Voltage-dependent anion channel 2
LOC440866 IPI00455531 PREDICTED: similar to voltage-dependen
HSPE1 IPI00220362 10 kDa heat shock protein, mitochondrial
TPR IPI00022970 Translocated promoter region
PGD IPI00219525 6-phosphogluconate dehydrogenase, dec
IPI00394706 IPI00394706 PHAPI protein
TRA1 IPI00027230 Endoplasmin precursor
IMPDH2 IPI00291510 inosine-5'-monophosphate dehydrogenase
RAVER1 IPI00217661 Hypothetical protein
VDAC3 IPI00294779 Splice isoform 2 of Voltage-dependent ar
IARS2 IPI00017283 Mitochondrial isoleucine tRNA synthetase
NPM1 IPI00658013 Nucleophosmin/B23.2
NPM1 IPI00549248 Nucleophosmin
TOR1AIP1 IPI00236381 TOR1AIP1 protein
ANP32F IPI00455251 PREDICTED: similar to acidic (leucine-ric
NOL5A IPI00643750 OTTHUMP00000030036
NOL5A IPI00642697 OTTHUMP00000030034
LOC344371 IPI00454713 PREDICTED: similar to SLC25A5 protein
PDPR IPI00168407 Hypothetical protein DKFZp686J1643
MTA2 IPI00171798 Metastasis-associated protein MTA2
HNRPUL1 IPI00402391 HypotHetical protein FLJ45114
GANAB IPI00011454 Splice isoform 2 of Neutral alpha-glucosio
MULK IPI00019353 Multi-substrate lipid kinase variant
EPRS IPI00013452 HypotHetical protein DKFZp313B047
C14orf49 IPI00394994 HypotHetical protein LOC161176
IPI00045921 IPI00045921 TOB3
HYOU1 IPI00000877 150 kDa oxygen-regulated protein precur
ATAD3B IPI00306048 Splice isoform 1 of ATPase family AAA d
VDAC3 IPI00031804 Splice isoform 1 of Voltage-dependent an
ILF2 IPI00641665 12 kDa protein

FIG. 1-3

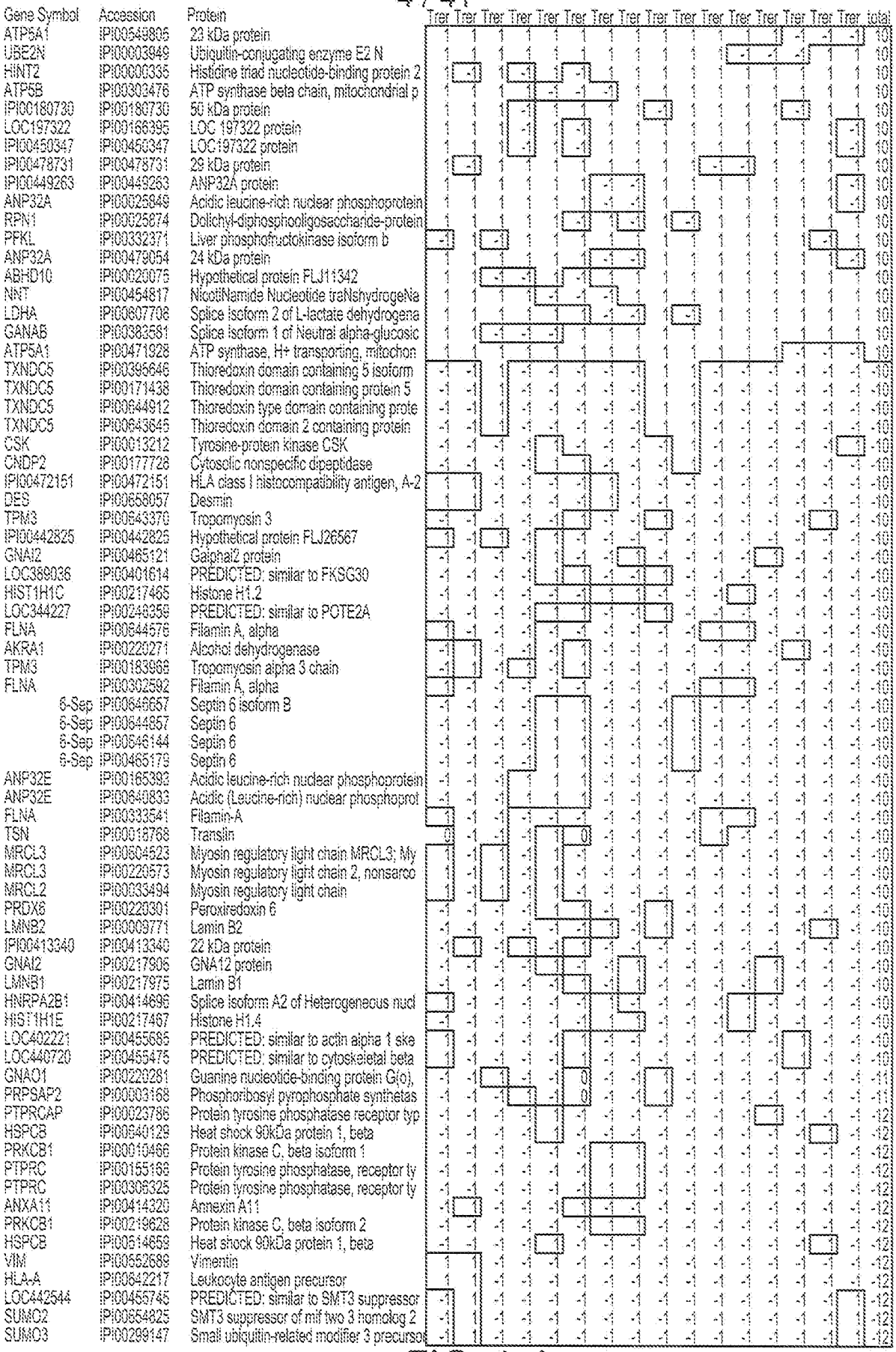
Gene Symbol
Accession
Protein
Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer Trer total
ATP5A1 IPI00549805 23 kDa protein
UBE2N IPI00003949 Ubiquitin-conjugating enzyme E2 N
HINT2 IPI00000335 Histidine triad nucleotide-binding protein 2
ATP5B IPI00303476 ATP synthase beta chain, mitochondrial p
IPI00180730 IPI00180730 50 kDa protein
LOC197322 IPI00166395 LOC 197322 protein
IPI00450347 IPI00450347 LOC197322 protein
IPI00478731 IPI00478731 29 kDa protein
IPI00449263 IPI00449263 ANP32A protein
ANP32A IPI00025849 Acidic leucine-rich nuclear phosphoprotein
RPN1 IPI00025874 Dolichyl-diphosphooligosaccharide-protein
PFKL IPI00332371 Liver phosphofructokinase isoform b
ANP32A IPI00479054 24 kDa protein
ABHD10 IPI00020075 Hypothetical protein FLJ11342
NNT IPI00454817 NicotiNamide Nucleotide traNshydrogeNa
LDHA IPI00607708 Splice isoform 2 of L-lactate dehydrogena
GANAB IPI00383581 Splice isoform 1 of Neutral alpha-glucosic
ATP5A1 IPI00471928 ATP synthase, H+ transporting, mitochon
TXNDC5 IPI00395646 Thioredoxin domain containing 5 isoform
TXNDC5 IPI00171438 Thioredoxin domain containing protein 5
TXNDC5 IPI00644912 Thioredoxin type domain containing prote
TXNDC5 IPI00643645 Thioredoxin domain 2 containing protein
CSK IPI00013212 Tyrosine-protein kinase CSK
CNDP2 IPI00177728 Cytosolic nonspecific dipeptidase
IPI00472151 IPI00472151 HLA class I histocompatibility antigen, A-2
DES IPI00658057 Desmin
TPM3 IPI00643370 Tropomyosin 3
IPI00442825 IPI00442825 Hypothetical protein FLJ26567
GNAI2 IPI00465121 Gaiphai2 protein
LOC389036 IPI00401614 PREDICTED: similar to FKSG30
HIST1H1C IPI00217465 Histone H1.2
LOC344227 IPI00248359 PREDICTED: similar to POTE2A
FLNA IPI00644576 Filamin A, alpha
AKRA1 IPI00220271 Alcohol dehydrogenase
TPM3 IPI00183968 Tropomyosin alpha 3 chain
FLNA IPI00302592 Filamin A, alpha
6-Sep IPI00646657 Septin 6 isoform B
6-Sep IPI00644857 Septin 6
6-Sep IPI00646144 Septin 6
6-Sep IPI00465179 Septin 6
ANP32E IPI00165393 Acidic leucine-rich nuclear phosphoprotein
ANP32E IPI00640833 Acidic (Leucine-rich) nuclear phosphoprot
FLNA IPI00333541 Filamin-A
TSN IPI00018768 Translin
MRCL3 IPI00604523 Myosin regulatory light chain MRCL3; My
MRCL3 IPI00220573 Myosin regulatory light chain 2, nonsarco
MRCL2 IPI00033494 Myosin regulatory light chain
PRDX6 IPI00220301 Peroxiredoxin 6
LMNB2 IPI00009771 Lamin B2
IPI00413340 IPI00413340 22 kDa protein
GNAI2 IPI00217906 GNA12 protein
LMNB1 IPI00217975 Lamin B1
HNRPA2B1 IPI00414696 Splice isoform A2 of Heterogeneous nucl
HIST1H1E IPI00217467 Histone H1.4
LOC402221 IPI00455685 PREDICTED: similar to actin alpha 1 ske
LOC440720 IPI00455475 PREDICTED: similar to cytoskeletal beta
GNAO1 IPI00220281 Guanine nucleotide-binding protein G(o),
PRPSAP2 IPI00003168 Phosphoribosyl pyrophosphate synthetas
PTPRCAP IPI00023786 Protein tyrosine phosphatase receptor typ
HSPCB IPI00640129 Heat shock 90kDa protein 1, beta
PRKCB1 IPI00010466 Protein kinase C, beta isoform 1
PTPRC IPI00155166 Protein tyrosine phosphatase, receptor ty
PTPRC IPI00306325 Protein tyrosine phosphatase, receptor ty
ANXA11 IPI00414320 Annexin A11
PRKCB1 IPI00219628 Protein kinase C, beta isoform 2
HSPCB IPI00614659 Heat shock 90kDa protein 1, beta
VIM IPI00552689 Vimentin
HLA-A IPI00642217 Leukocyte antigen precursor
LOC442544 IPI00455745 PREDICTED: similar to SMT3 suppressor
SUMO2 IPI00554825 SMT3 suppressor of mif two 3 homolog 2
SUMO3 IPI00299147 Small ubiquitin-related modifier 3 precurso

FIG. 1-4

Gene Symbol	Accession	Protein	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	Trer	total
SUMO2	IPI00550406	Ubiquitin-like protein SMT3B	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-12
SUMO2	IPI00478345	Small ubiquitin-like modifier 2 isoform b p	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-12
LOC441512	IPI00140827	PREDICTED: similar to SMT3 suppressor	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-12
SUMO2	IPI00299149	Small ubiquitin-related modifier 2 precurso	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-12
HNRPA2B1	IPI00477522	Heterogeneous nuclear ribonucleoprotein	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-12
HNRPA2B1	IPI00396378	Splice Isoform B1 of Heterogeneous nucl	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-12
IPI00411463	IPI00411463	Protein	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-12
ARHGDIA	IPI00003815	Rho GDP-dissociation inhibitor 1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-12
IPI00412473	IPI00412473	Protein	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-12
IPI00414489	IPI00414489	Protein	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-12
GNAO1	IPI00398709	Guanine nucleotide-binding protein G(o),	-1	-1	-1	-1	1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-13
SUMO4	IPI00434968	Small ubiquitin-related modifier 4 precurso	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-13
IPI00654744	IPI00654744	SYNGR2 protein	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
SYNGR2	IPI00013946	Synaptogyrin-2	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
MYH10	IPI00397526	Myosin-10	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-14
ANXA6	IPI00002459	Annexin VI isoform 2	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
MYH11	IPI00020501	Myosin-11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-16
MYH11	IPI00024870	Smooth muscle myosin heavy chain 11, is	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-18

FIG. 1-5

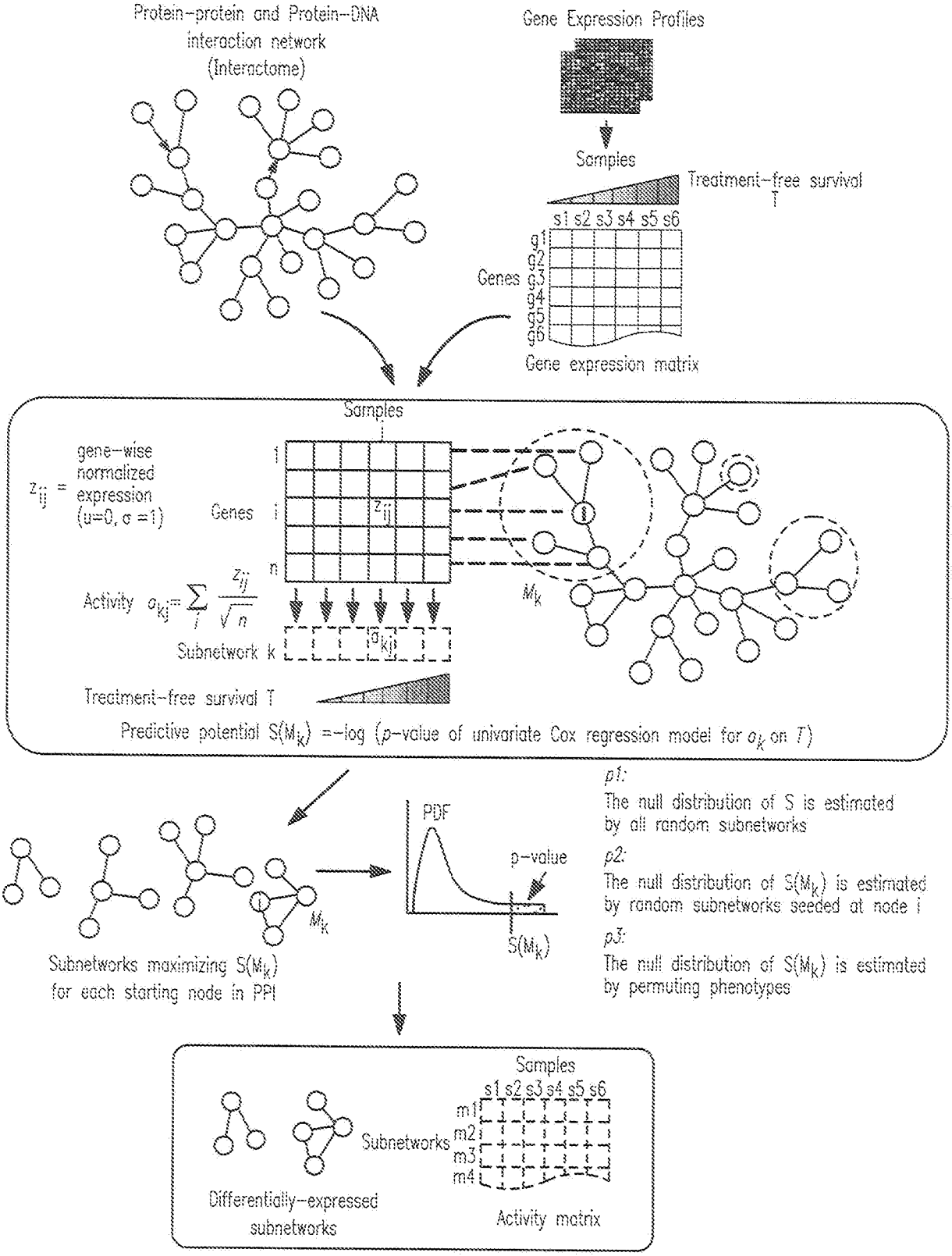
Protein-protein and Protein-DNA interaction network (Interactome)
Gene Expression Profiles
Samples
Treatment-free survival T
s1 s2 s3 s4 s5 s6
g1 g2 g3 g4 g5 g6
Genes
Gene expression matrix
Samples
gene-wise normalized expression (u=0, σ =1)
Genes
Activity
Subnetwork k
Treatment-free survival T
Predictive potential S(Mk) =-log (p-value of univariate Cox regression model for ok on T)
PDF
p-value
S(Mk)
Subnetworks maximizing S(Mk) for each starting node in PPI
p1:
The null distribution of S is estimated by all random subnetworks
p2:
The null distribution of S(Mk) is estimated by random subnetworks seeded at node i
p3:
The null distribution of S(Mk) is estimated by permuting phenotypes
Samples
s1 s2 s3 s4 s5 s6
m1 m2 m3 m4
Subnetworks
Differentially-expressed subnetworks
Activity matrix

FIG. 2

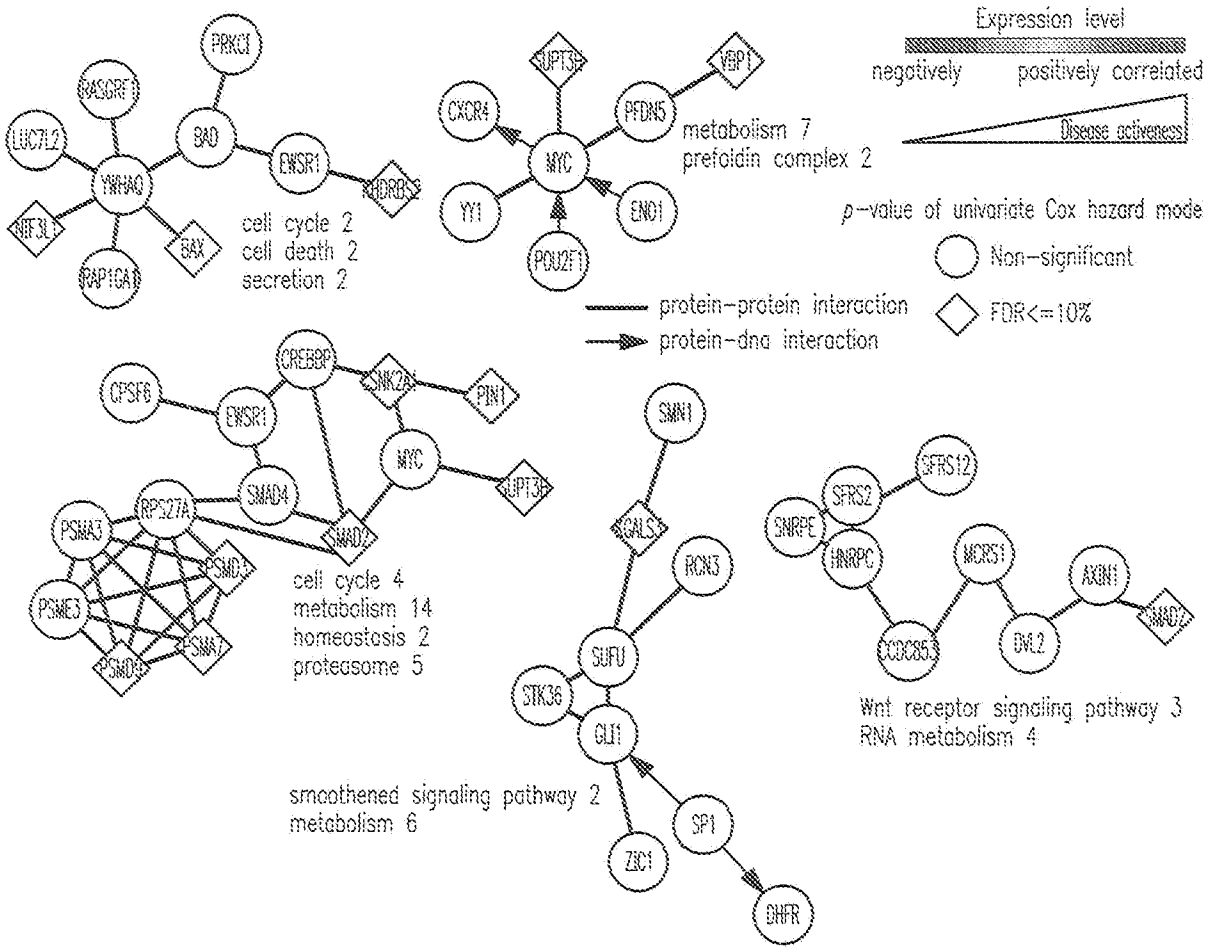
Expression level
negatively
positively correlated
Disease activeness
p-value of univariate Cox hazard mode
Non-significant
FDR<=10%
protein-protein interaction
protein-dna interaction
PRKCI
BASCRF1
LUC7L2
BAD
YWHAQ
BNSR1
HNRNPC
MTF3L
BAX
RAP1GA1
cell cycle 2
cell death 2
secretion 2
SUPT3H
VBP1
CXCR4
PFDN5
MYC
metabolism 7
prefoldin complex 2
YY1
ENO1
POU2F1
CREBBP
SNK2N
CPSF6
BNSR1
PIN1
MYC
SMAD4
SUPT3H
RPS27A
PSMA3
SMAD2
PSMC3
PSMC2
PSMA7
PSMD9
cell cycle 4
metabolism 14
homeostasis 2
proteasome 5
SMN1
XGALS3
RCN3
SUFU
STK36
GLI1
SP1
ZIC1
DHFR
smoothened signaling pathway 2
metabolism 6
SFRS12
SFRS2
SNRPE
HNRPC
MCRS1
AXIN1
CCDC85B
DVL2
SMAD2
Wnt receptor signaling pathway 3
RNA metabolism 4

FIG. 3

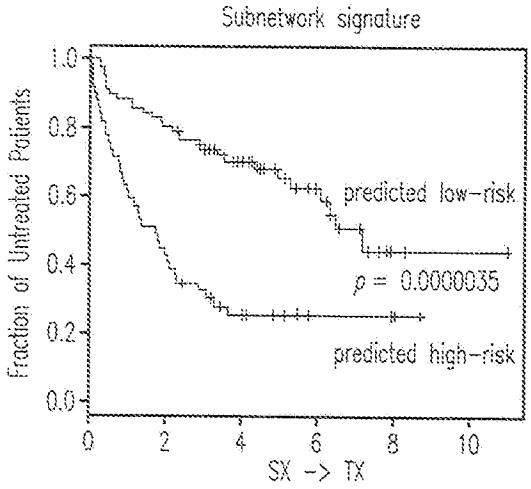

FIG. 4a

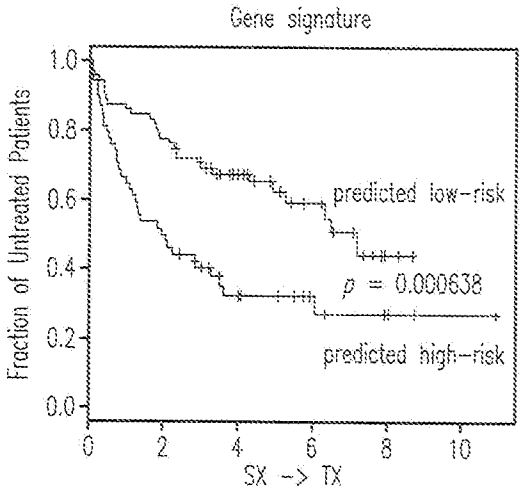

FIG. 4b

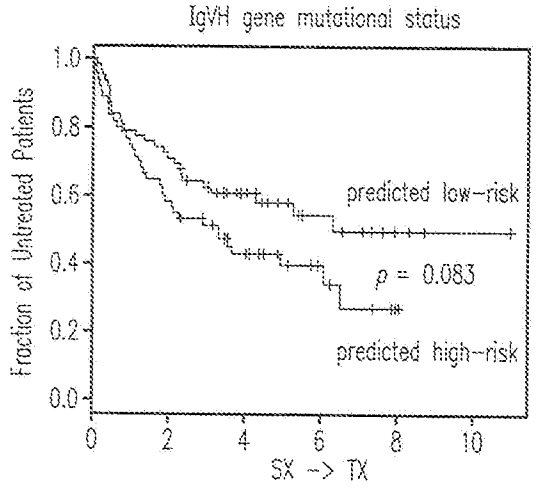

FIG. 4c

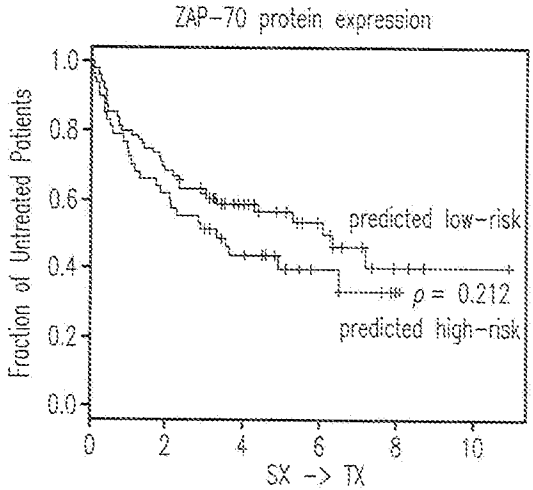

FIG. 4d

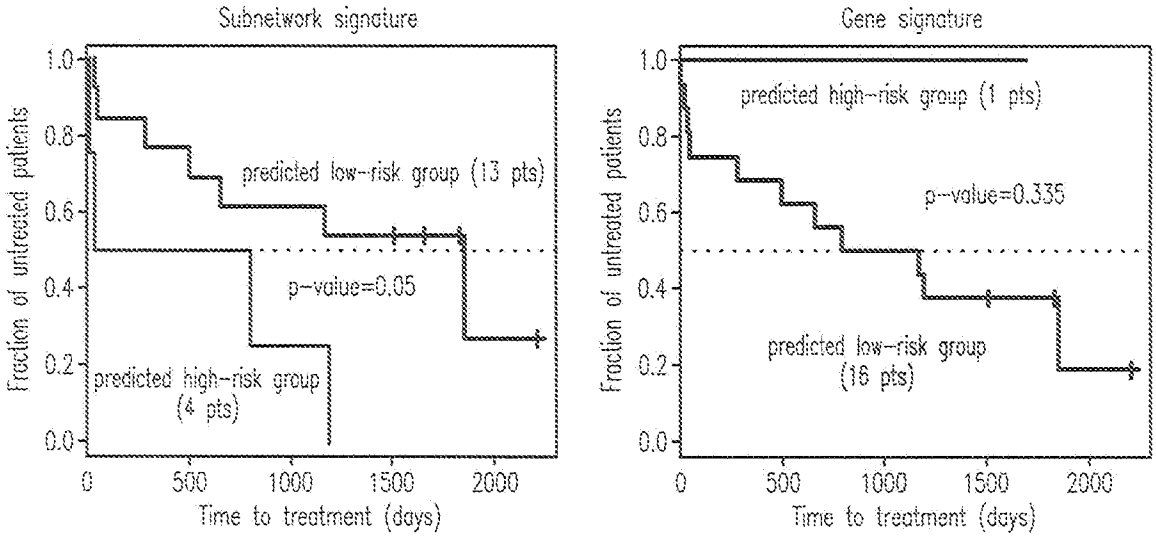
Subnetwork signature
Fraction of untreated patients
1.0
0.8
0.6
0.4
0.2
0.0
predicted low-risk group (13 pts)
p-value=0.05
predicted high-risk group
(4 pts)
0
500
1000
1500
2000
Time to treatment (days)
Gene signature
Fraction of untreated patients
predicted high-risk group (1 pts)
p-value=0.335
predicted low-risk group
(16 pts)
Time to treatment (days)

FIG. 5

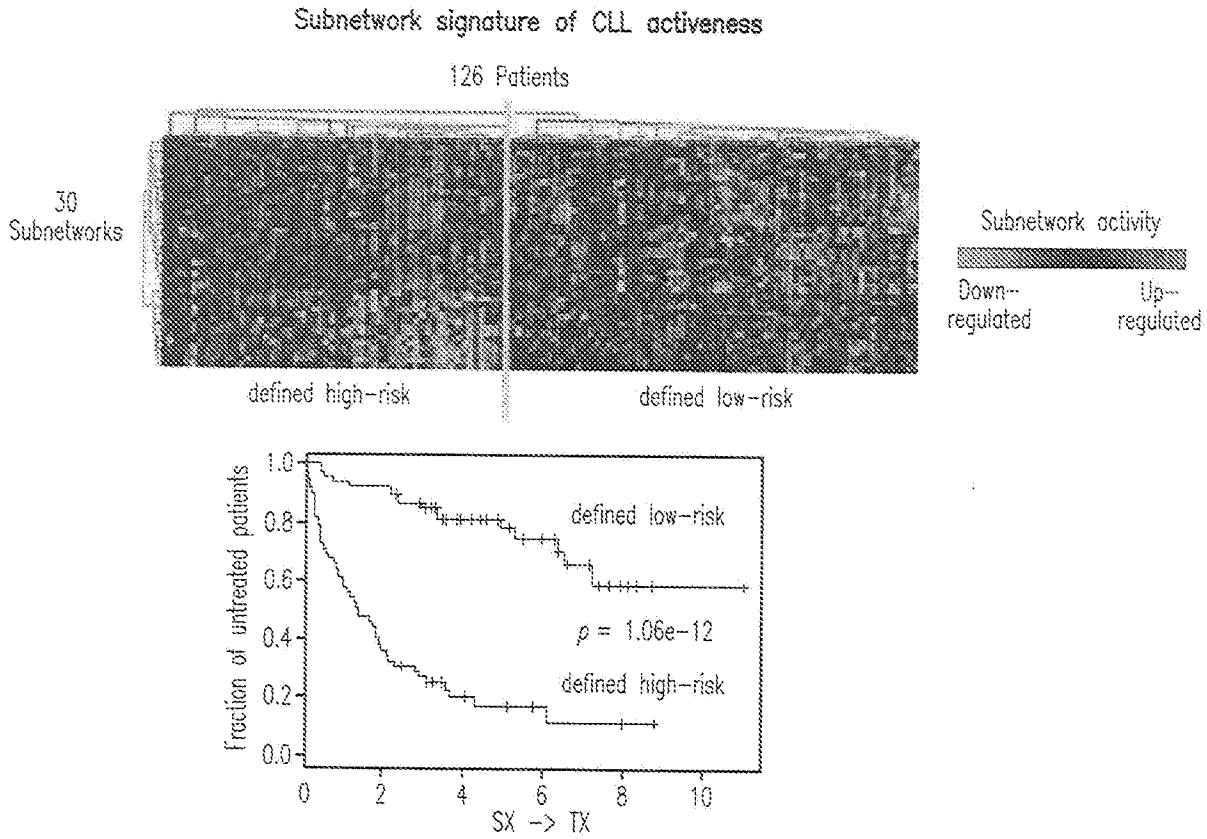
Subnetwork signature of CLL activeness
126 Patients
30
Subnetworks
Subnetwork activity
Down-
regulated
Up-
regulated
defined high-risk
defined low-risk
Fraction of untreated patients
1.0
0.8
0.6
0.4
0.2
0.0
defined low-risk
p = 1.06e-12
defined high-risk
0
2
4
6
8
10
SX -> TX

FIG. 6

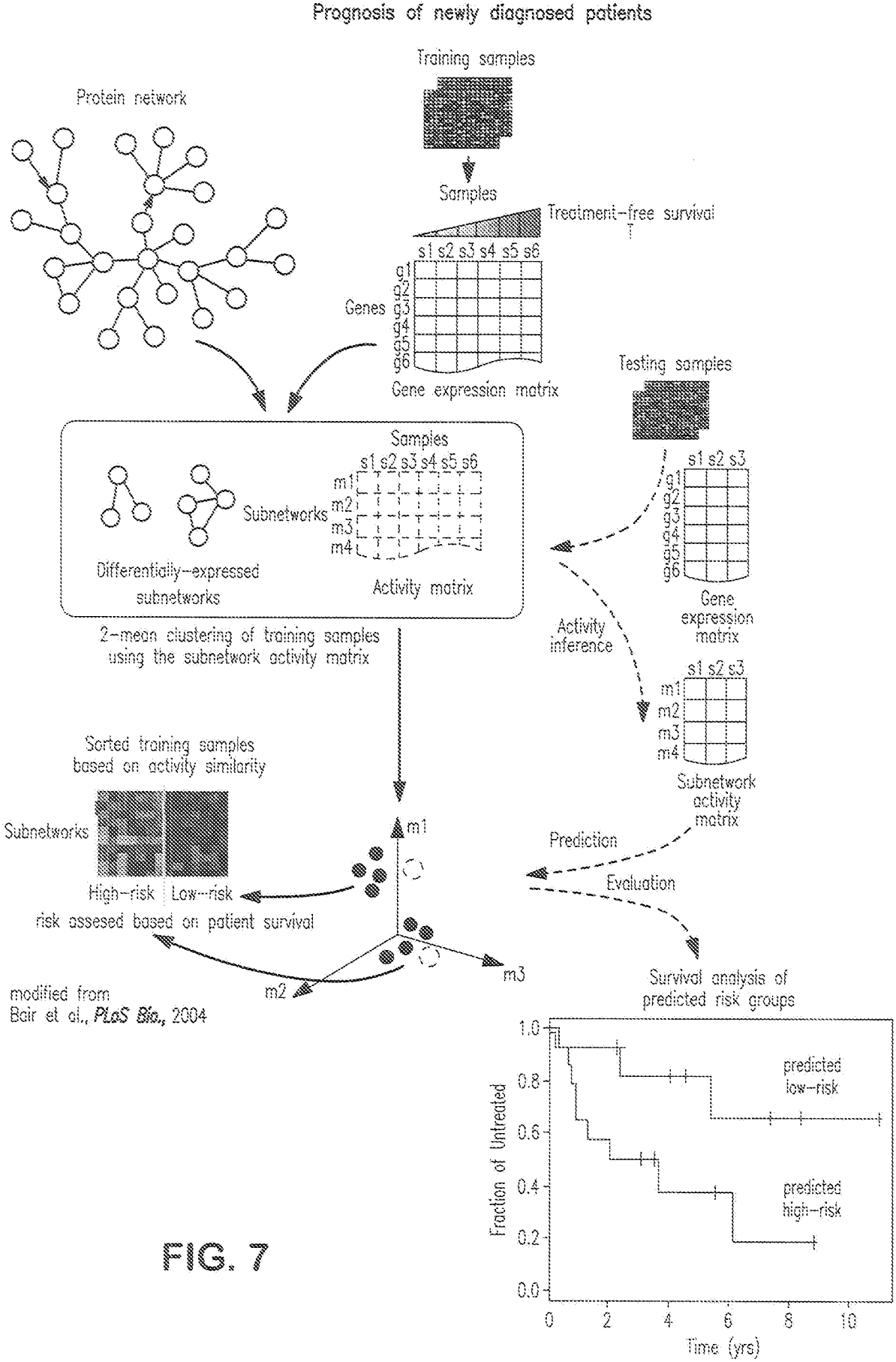
Prognosis of newly diagnosed patients
Training samples
Protein network
Samples
Treatment-free survival
s1 s2 s3 s4 s5 s6
Genes
g1 g2 g3 g4 g5 g6
Gene expression matrix
Testing samples
Samples
s1 s2 s3 s4 s5 s6
Subnetworks
m1 m2 m3 m4
Differentially-expressed subnetworks
Activity matrix
s1 s2 s3
Gene expression matrix
2-mean clustering of training samples using the subnetwork activity matrix
Activity inference
s1 s2 s3
Subnetwork activity matrix
Sorted training samples based on activity similarity
Subnetworks
Prediction
Evaluation
High-risk
Low-risk
risk assesed based on patient survival
m1
m2
m3
modified from Bair et al., PLoS Bio., 2004
Survival analysis of predicted risk groups
Fraction of Untreated
1.0
0.8
0.6
0.4
0.2
0.0
predicted low-risk
predicted high-risk
0
2
4
6
8
10
Time (yrs)

FIG. 7

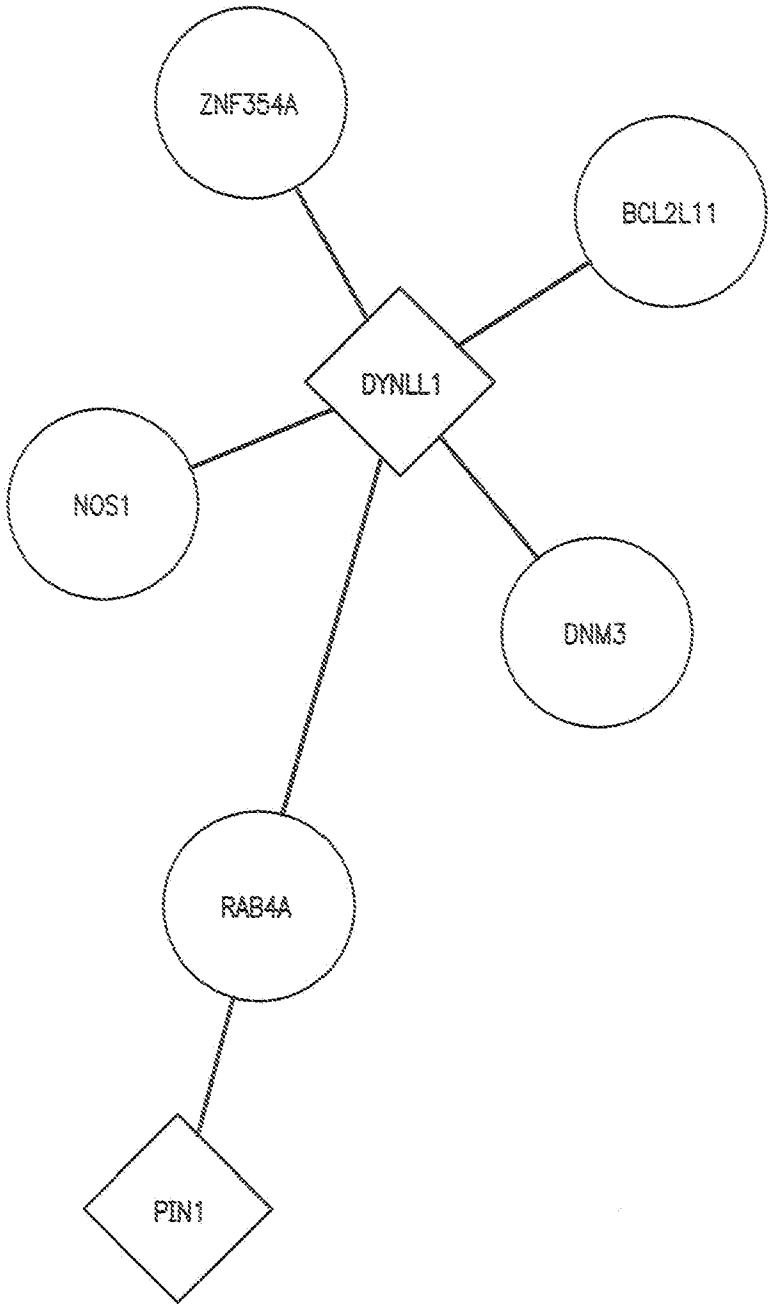

FIG. 8

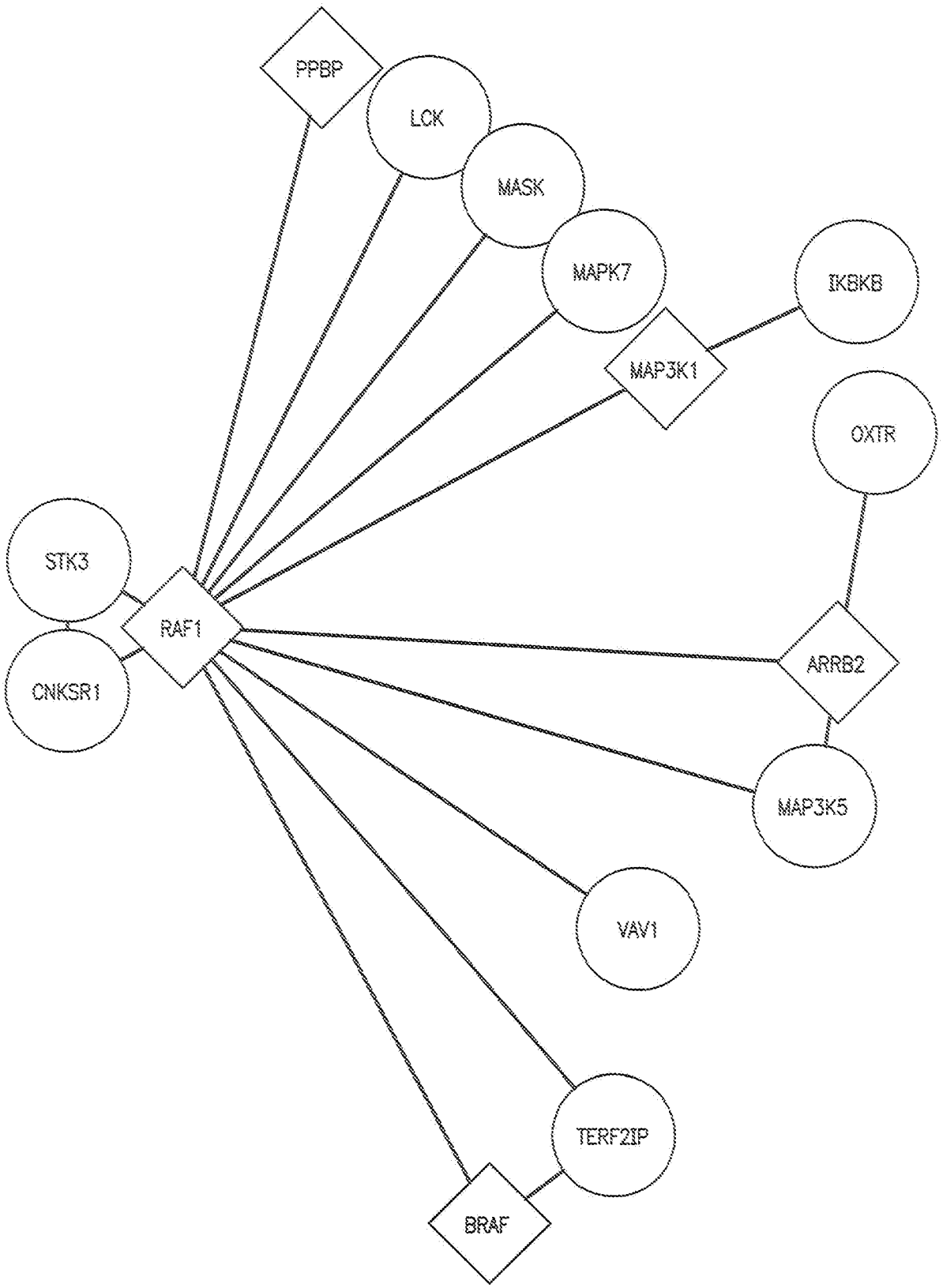
PPBP
LCK
MASK
MAPK7
IKBKB
MAP3K1
OXTR
STK3
RAF1
CNKSR1
ARRB2
MAP3K5
VAV1
TERF2IP
BRAF

FIG. 9

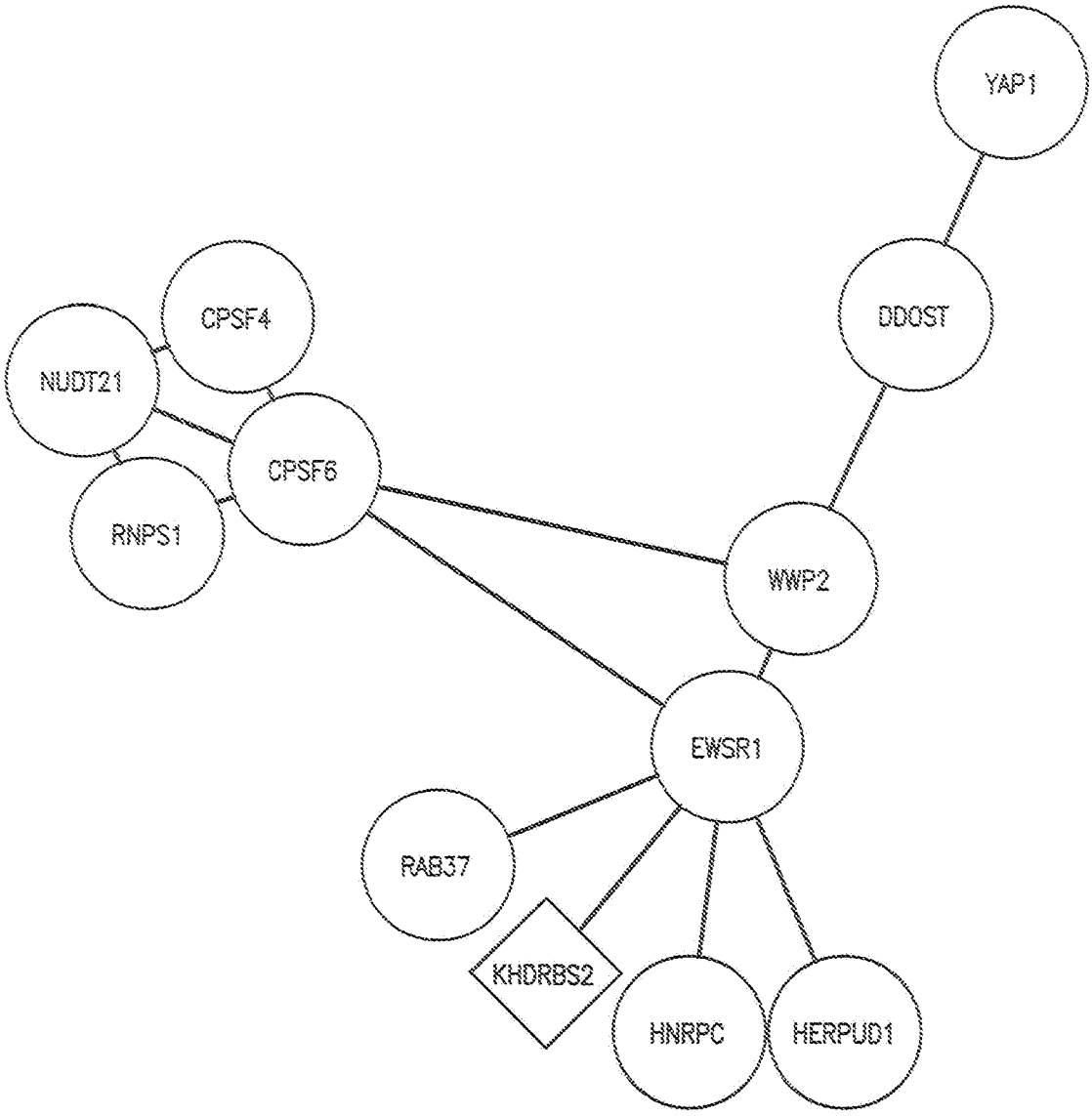
YAP1
DDOST
CPSF4
NUDT21
CPSF6
RNPS1
WWP2
EWSR1
RAB37
KHDRBS2
HNRPC
HERPUD1

FIG. 10

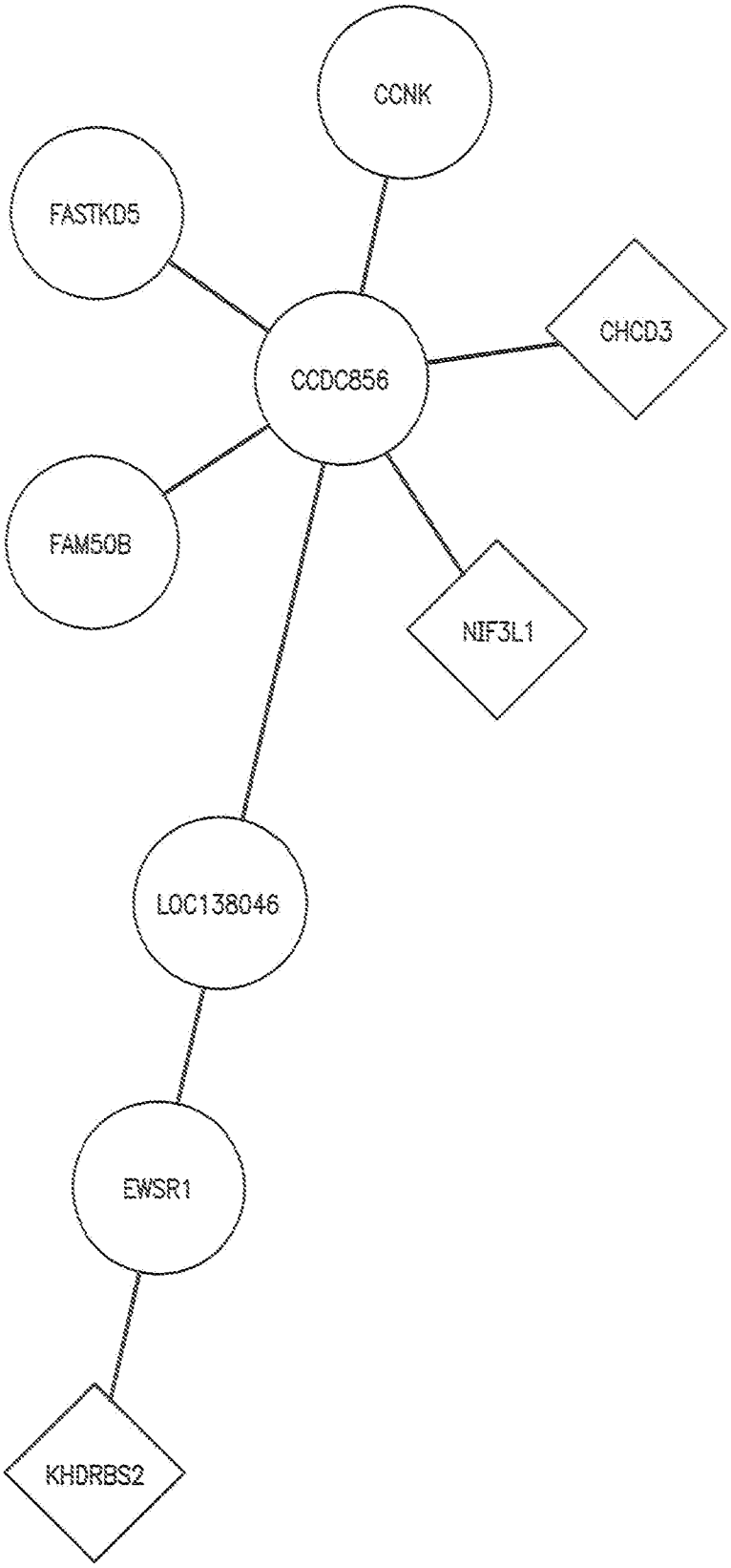
CCNK
FASTKD5
CHCD3
CCDC856
FAM50B
NIF3L1
LOC138046
EWSR1
KHDRBS2

FIG. 11

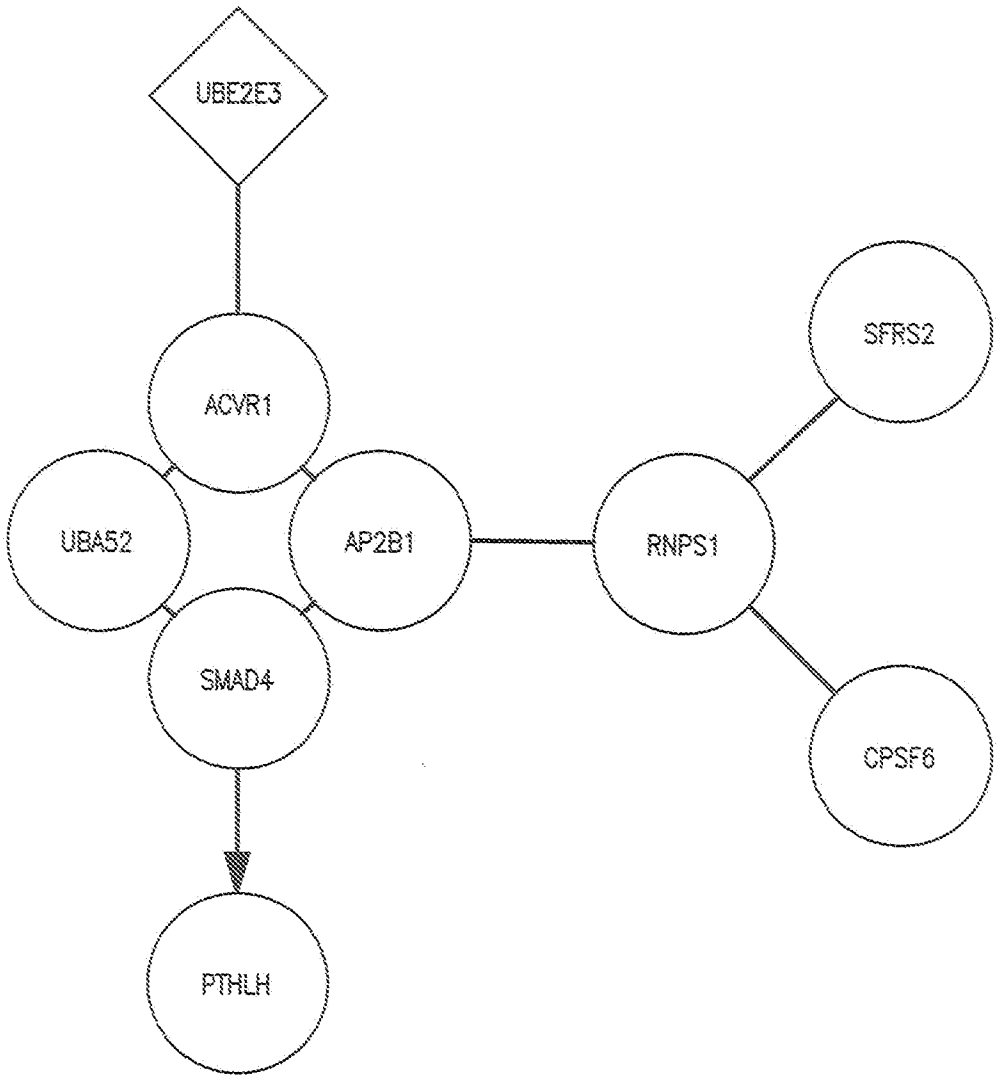

FIG. 12

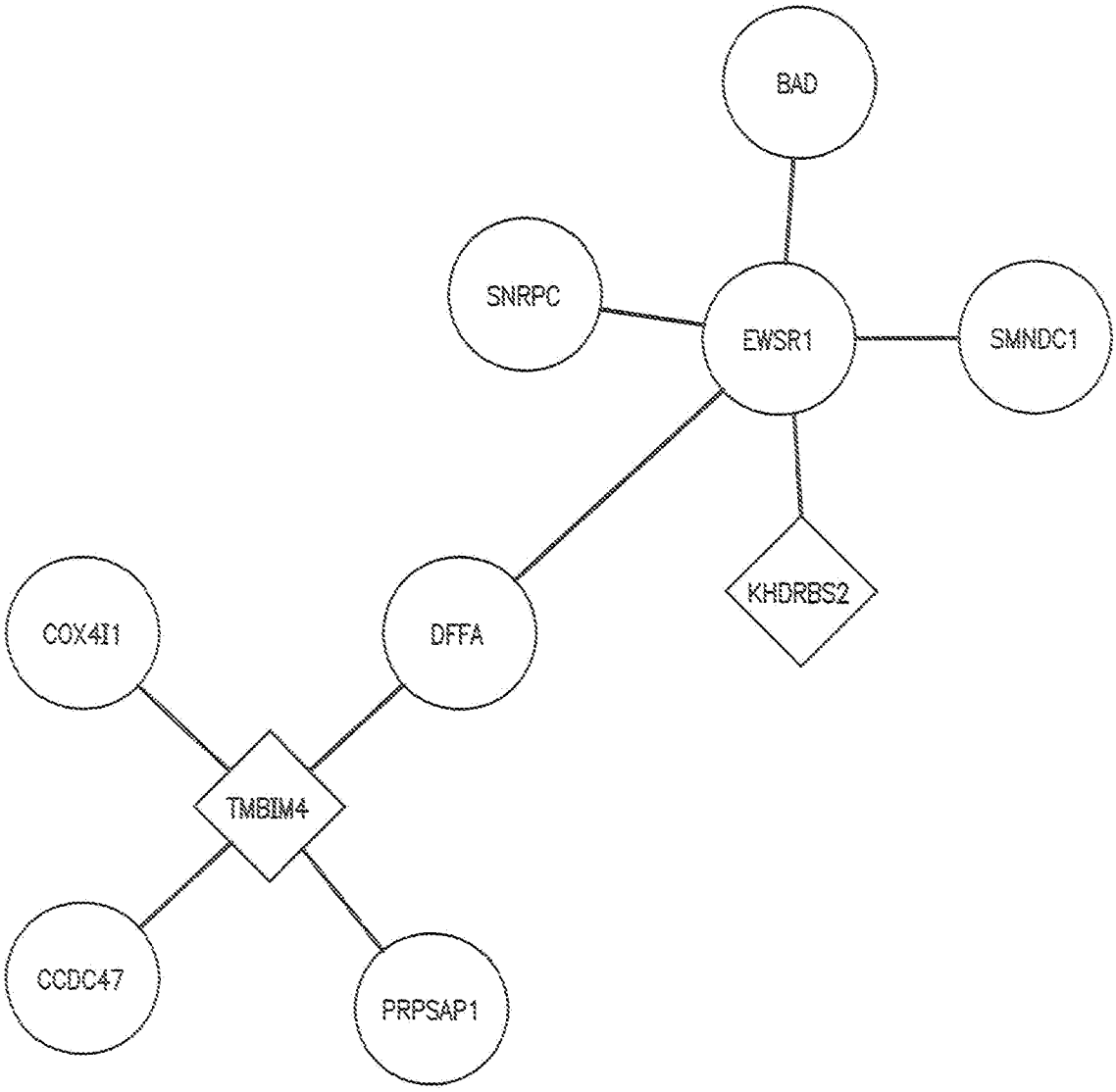
BAD
SNRPC
EWSR1
SMNDC1
KHDRBS2
DFFA
COX4I1
TMBIM4
CCDC47
PRPSAP1

FIG. 13

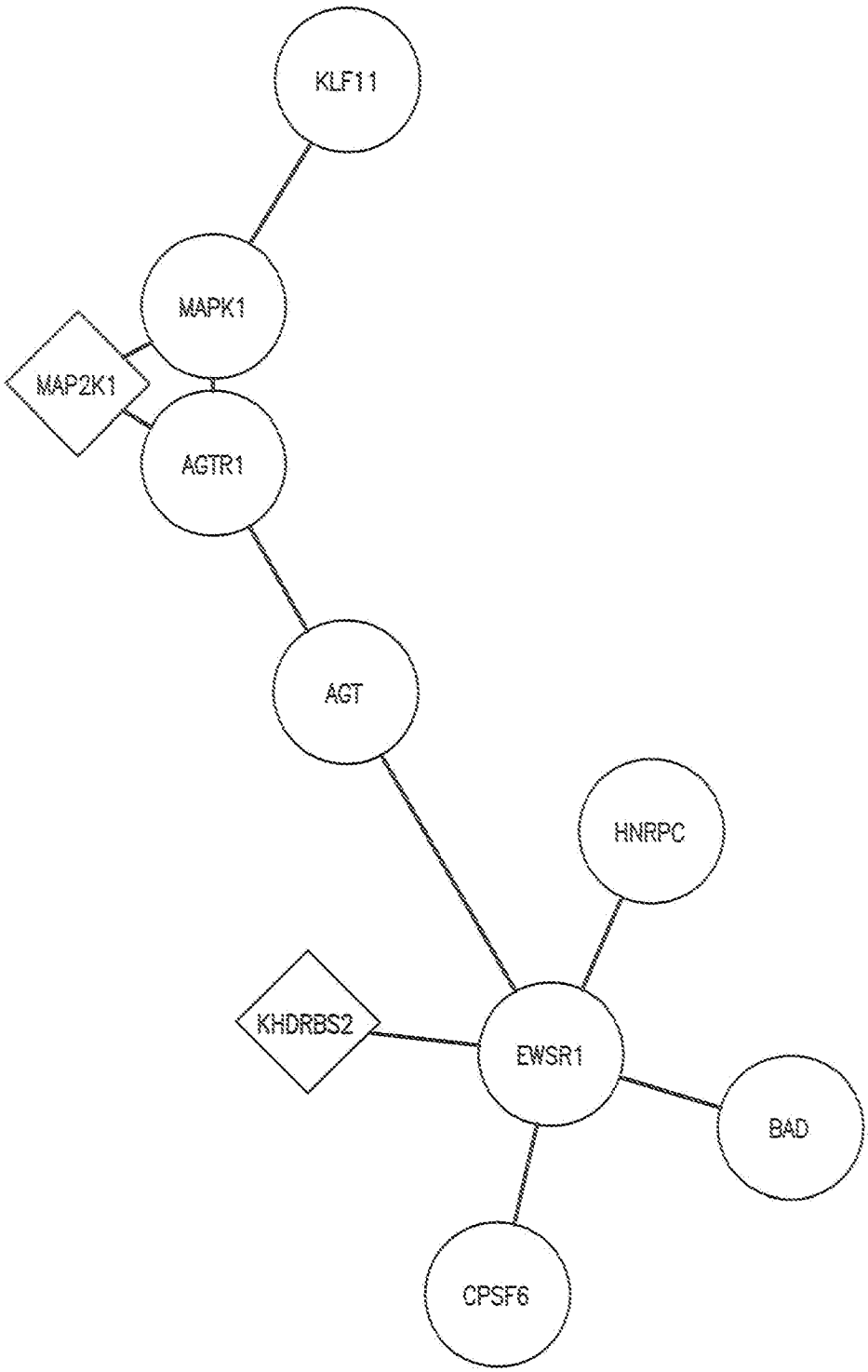

FIG. 14

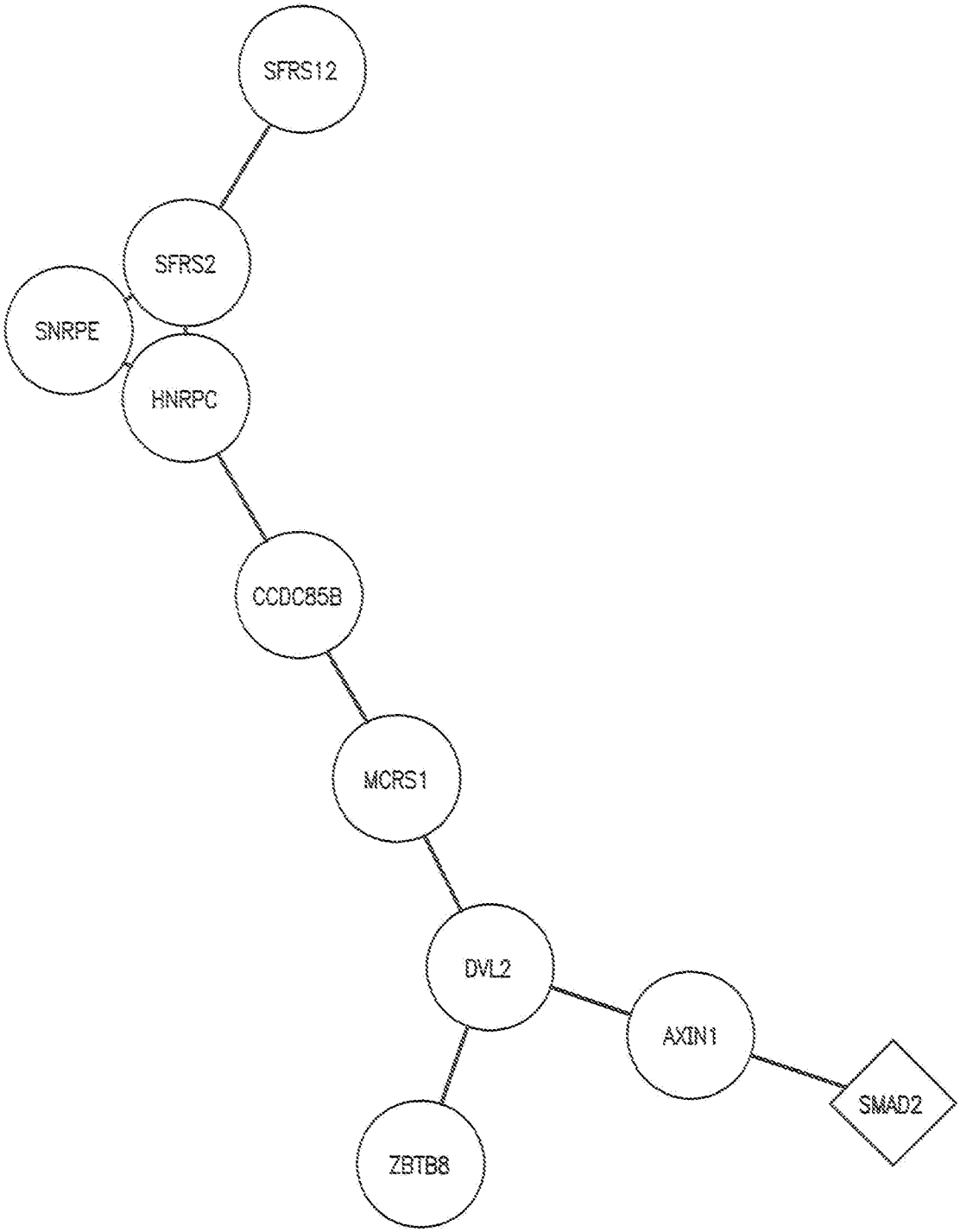
SFRS12
SFRS2
SNRPE
HNRPC
CCDC85B
MCRS1
DVL2
AXIN1
SMAD2
ZBTB8

FIG. 15

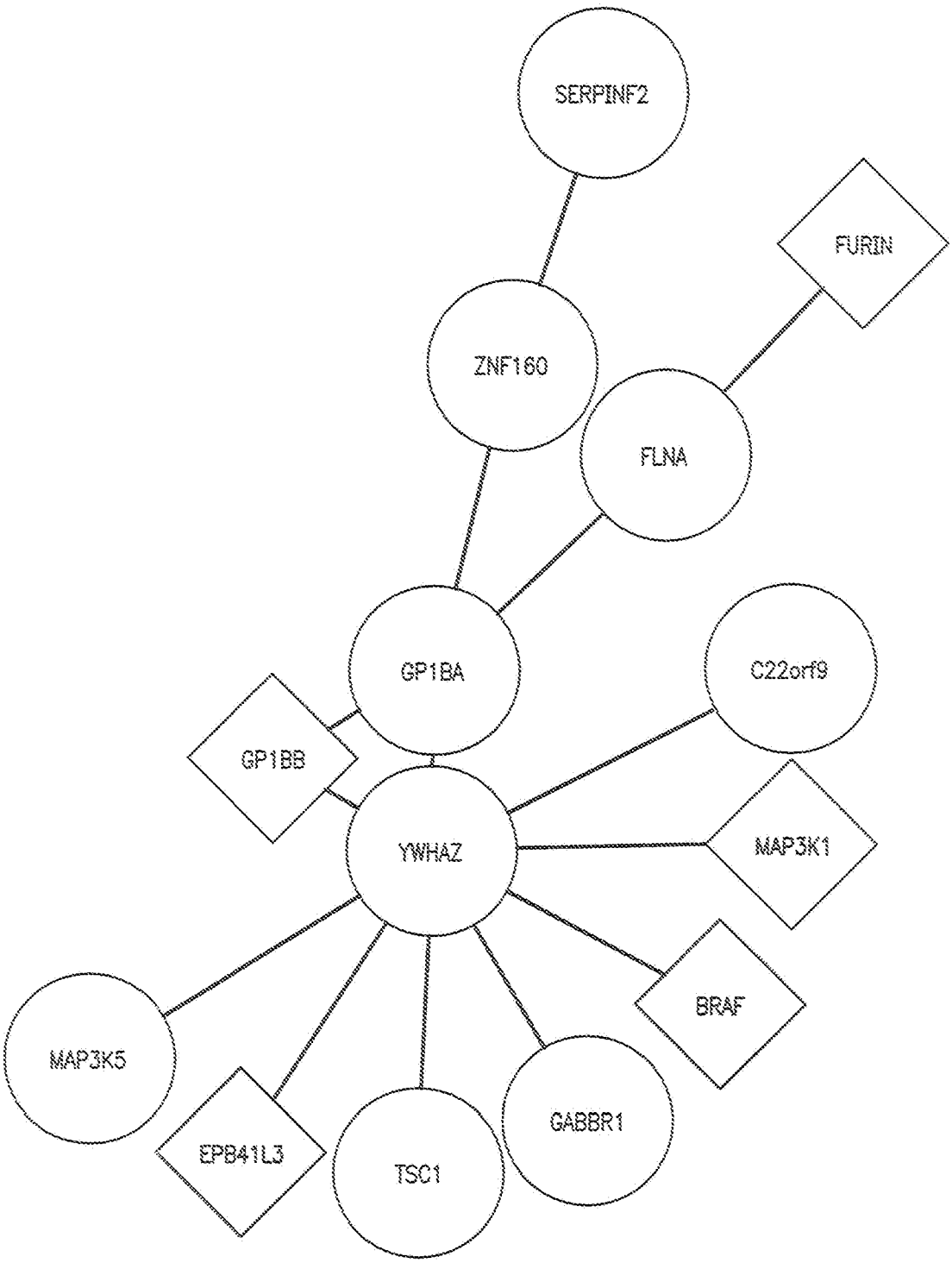
SERPINF2
FURIN
ZNF160
FLNA
GP1BA
C22orf9
GP1BB
YWHAZ
MAP3K1
BRAF
MAP3K5
EPB41L3
TSC1
GABBR1

FIG. 16

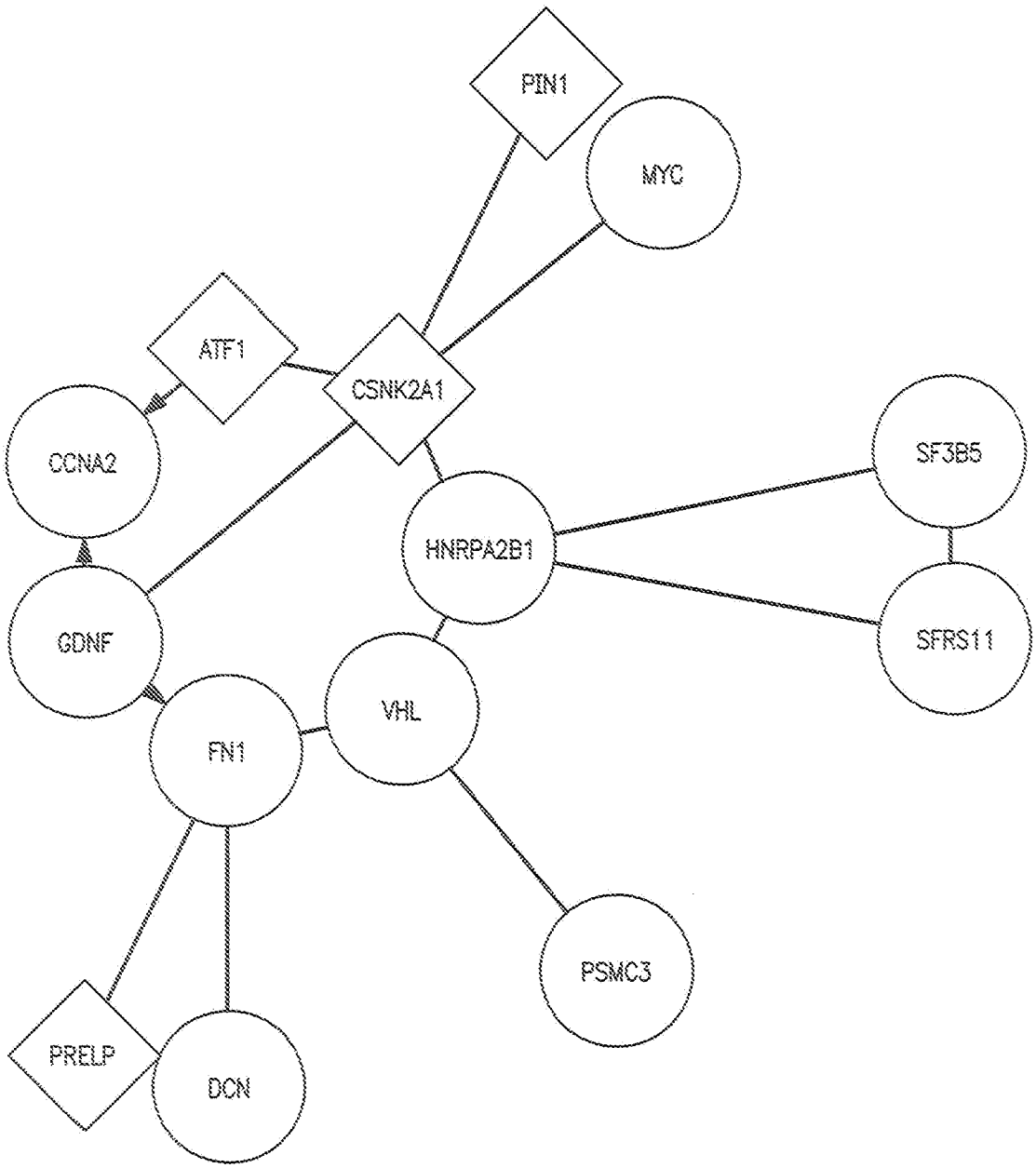
PIN1
MYC
ATF1
CSNK2A1
CCNA2
SF3B5
HNRPA2B1
GDNF
SFRS11
VHL
FN1
PSMC3
PRELP
DCN

FIG. 17

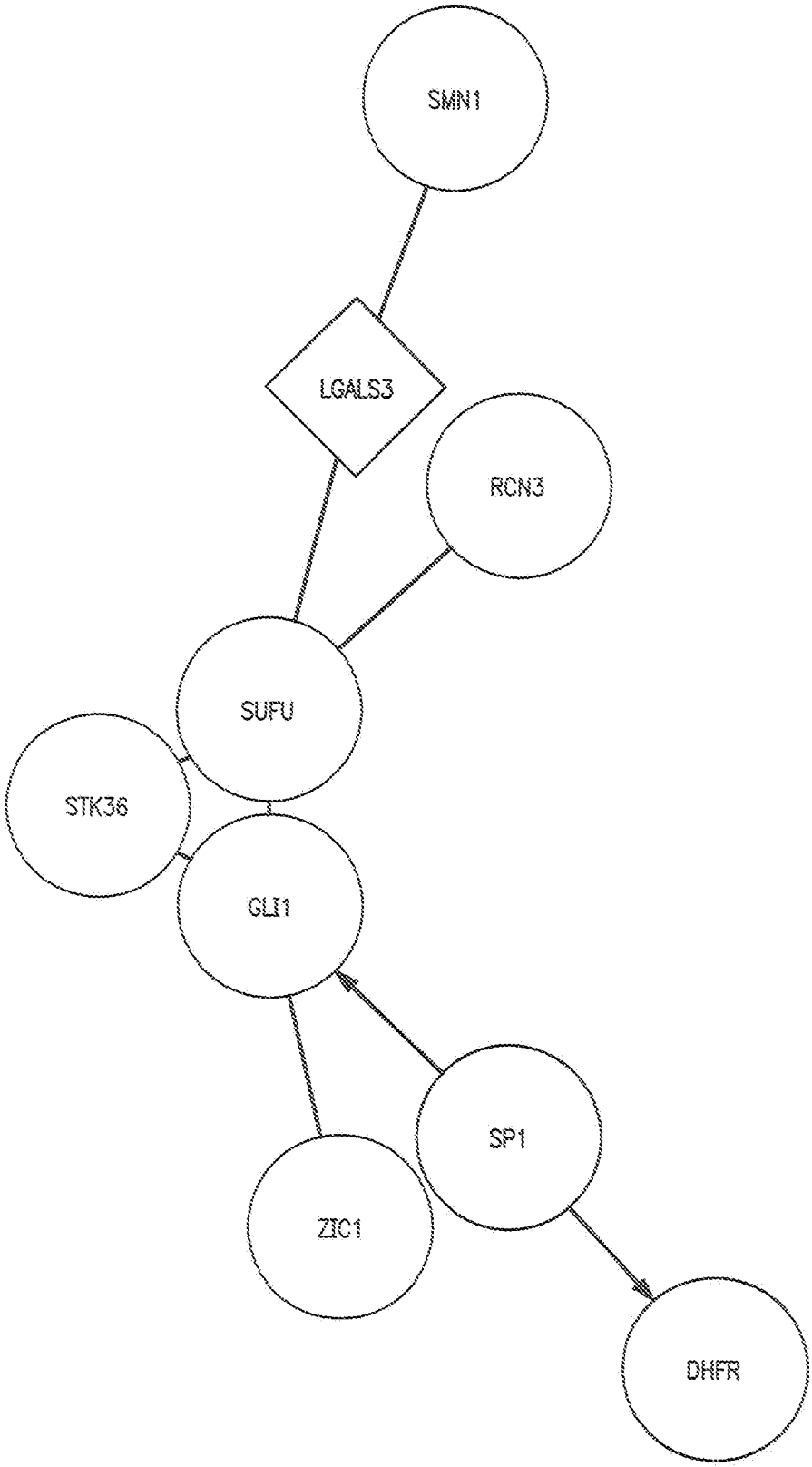

FIG. 18

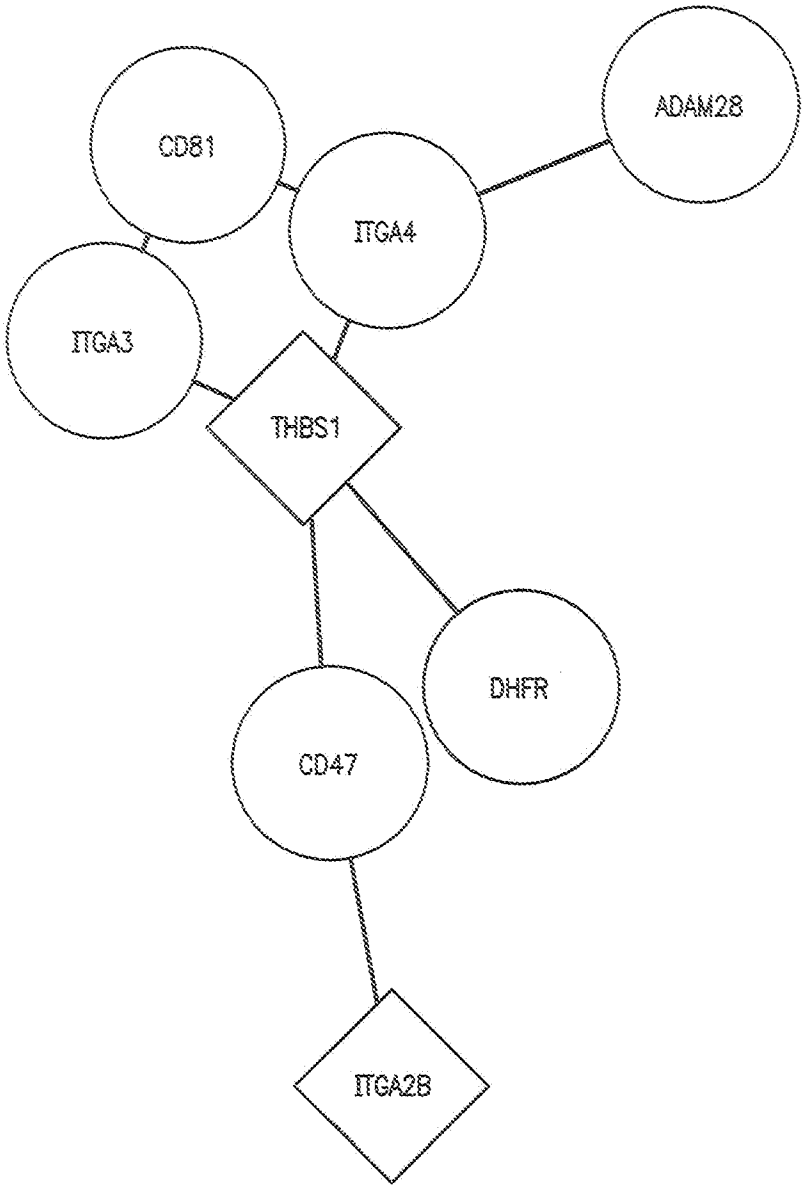

FIG. 19

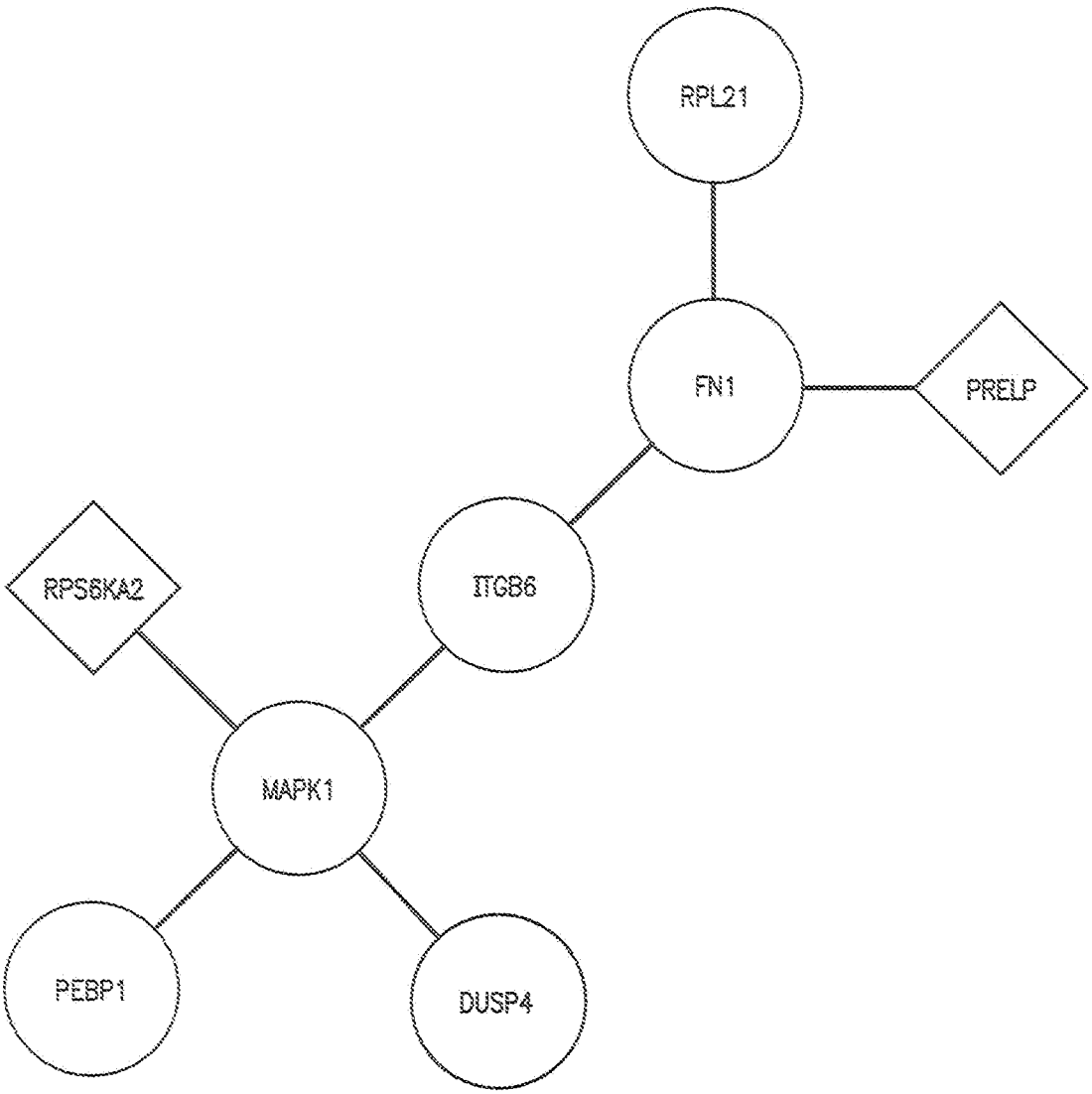

FIG. 20

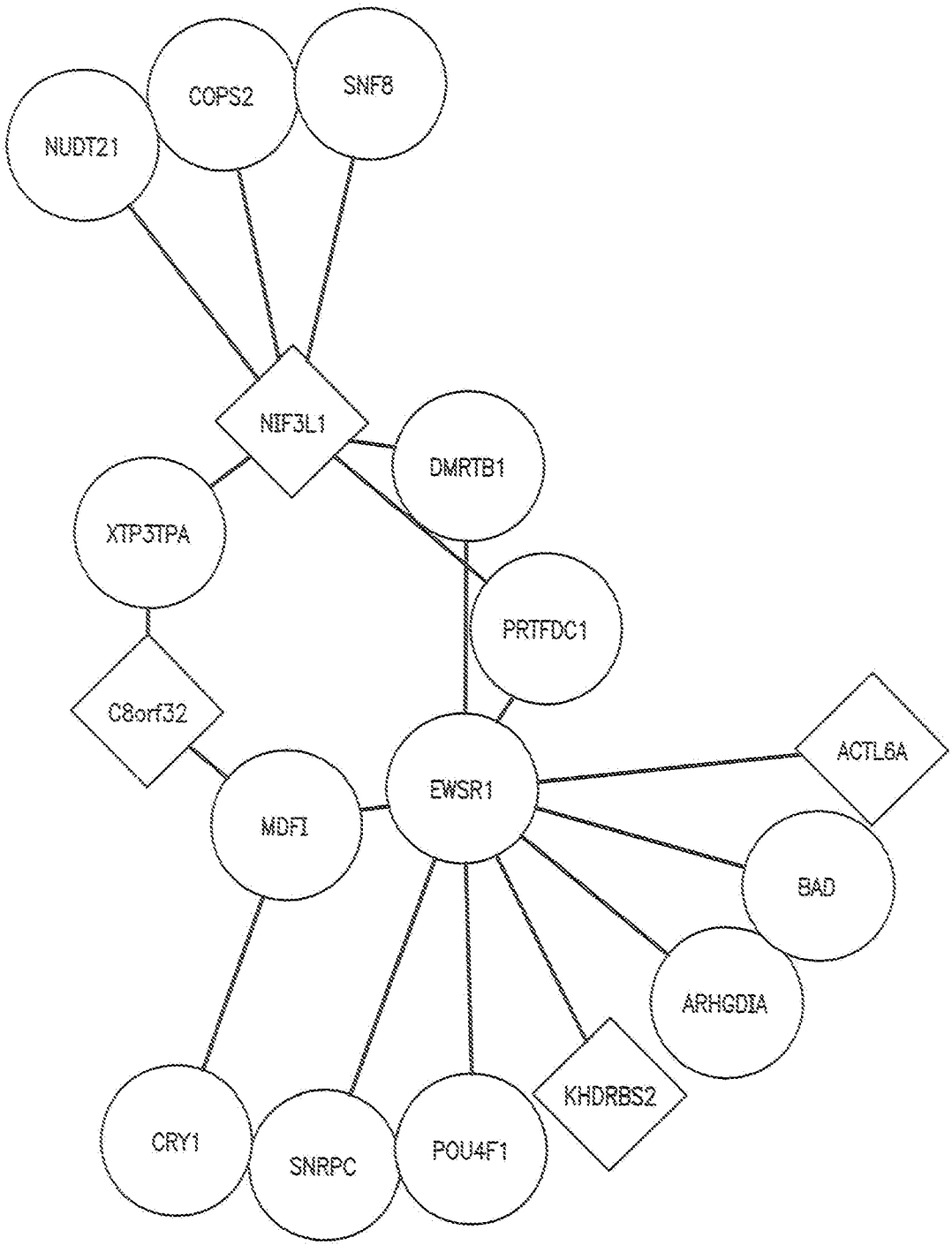
NUDT21
COPS2
SNF8
NIF3L1
DMRTB1
XTP3TPA
PRTFDC1
C8orf32
EWSR1
ACTL6A
MDFI
BAD
ARHGDIA
KHDRBS2
CRY1
SNRPC
POU4F1

FIG. 21

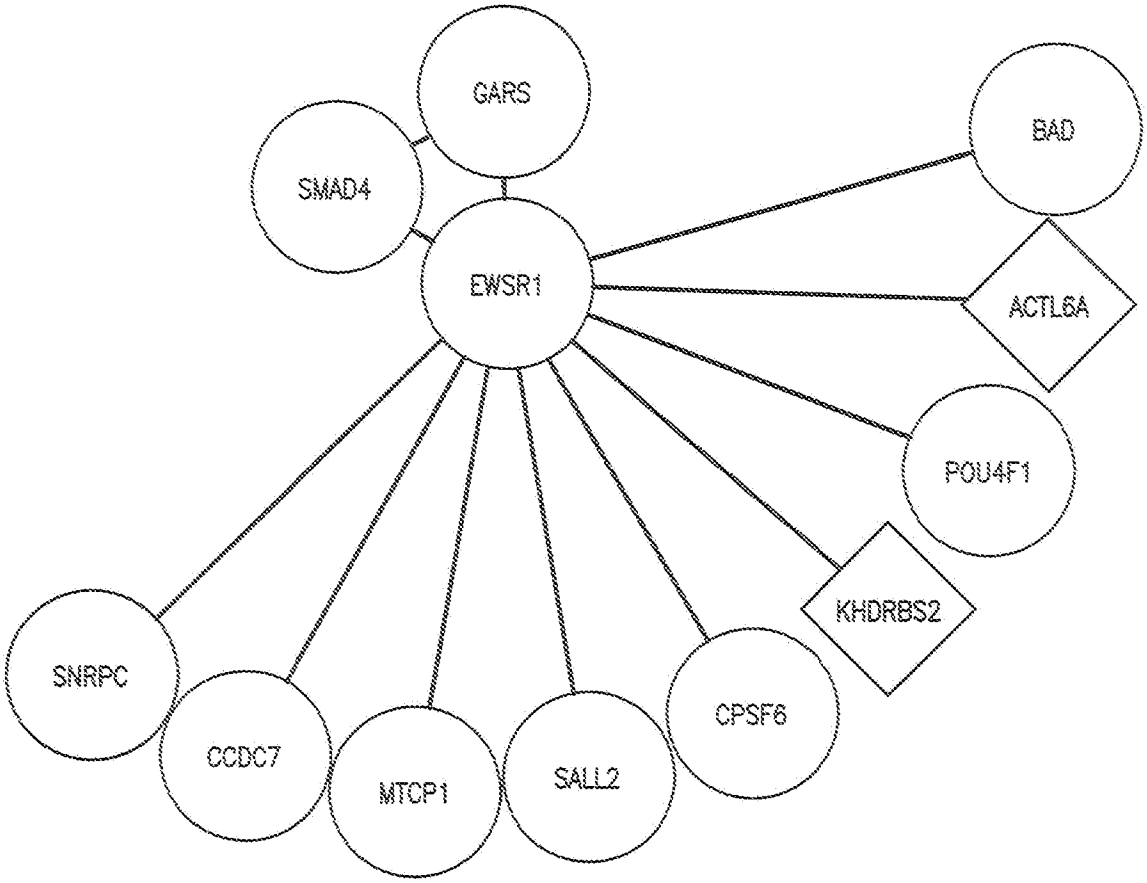
GARS
SMAD4
EWSR1
BAD
ACTL6A
POU4F1
KHDRBS2
CPSF6
SALL2
MTCP1
CCDC7
SNRPC

FIG. 22

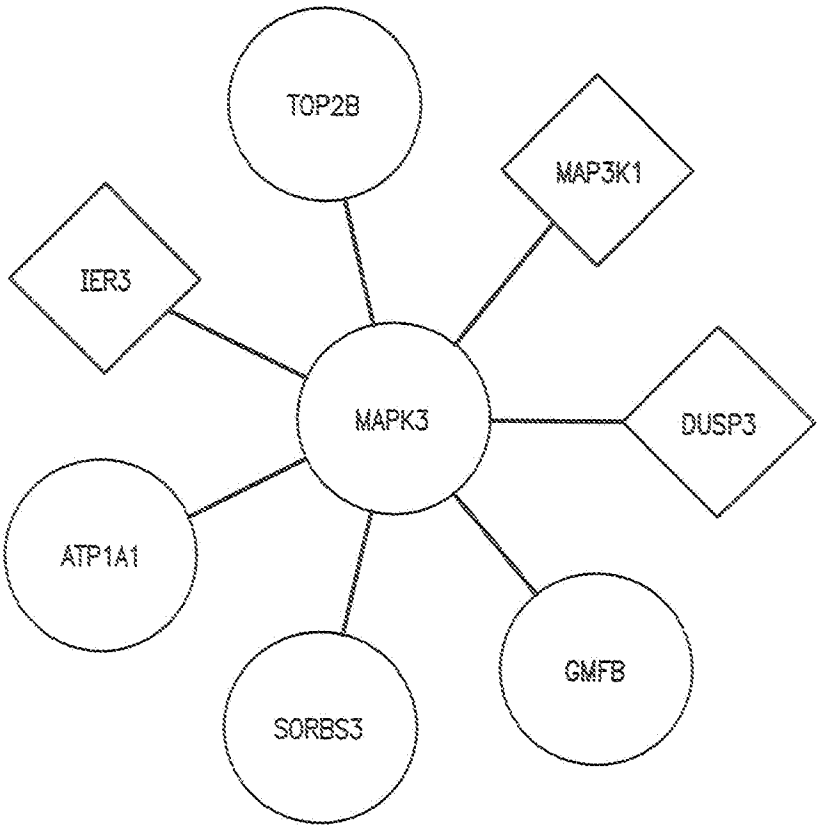

FIG. 23

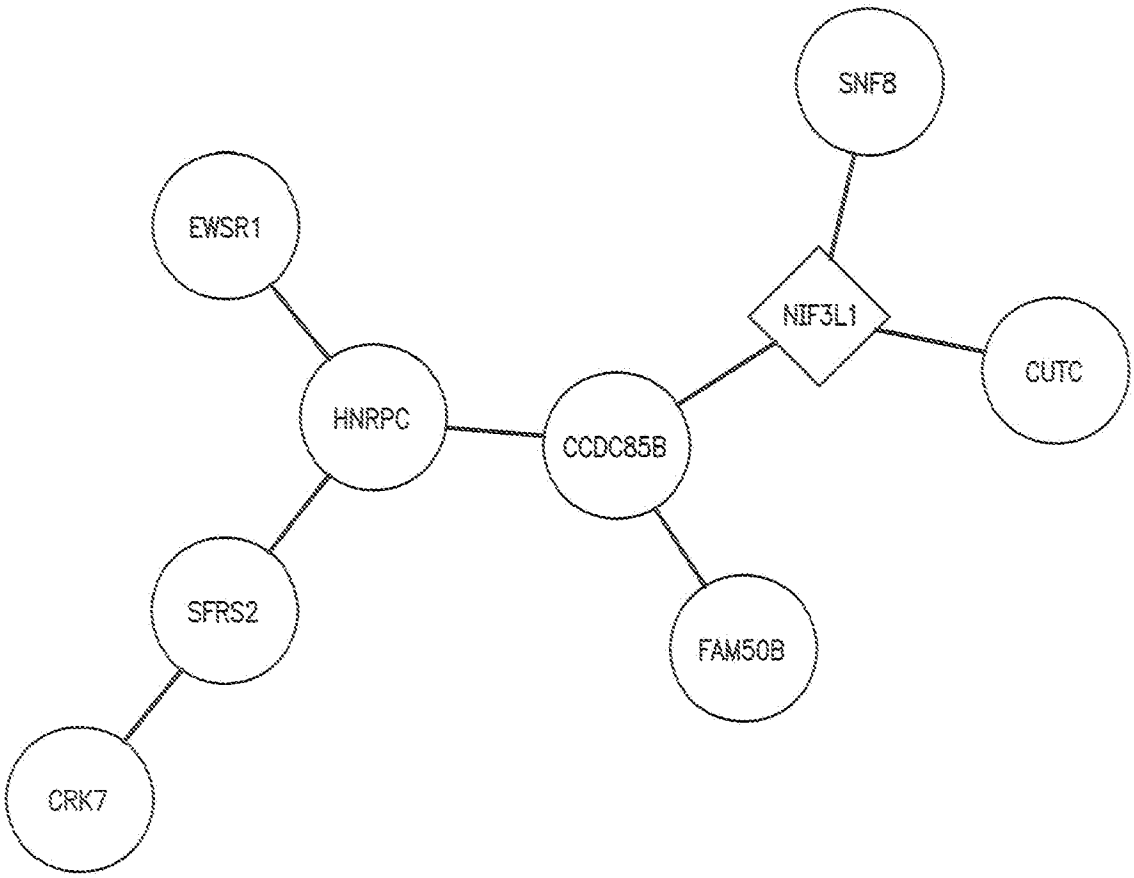

FIG. 24

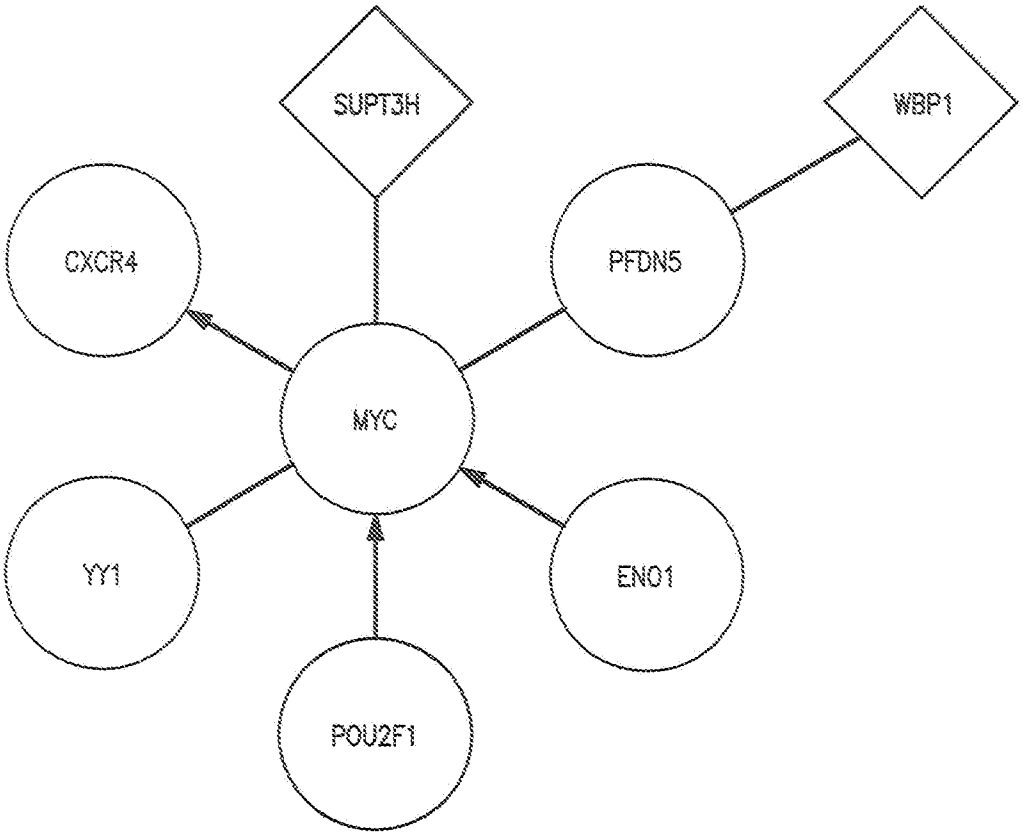

FIG. 25

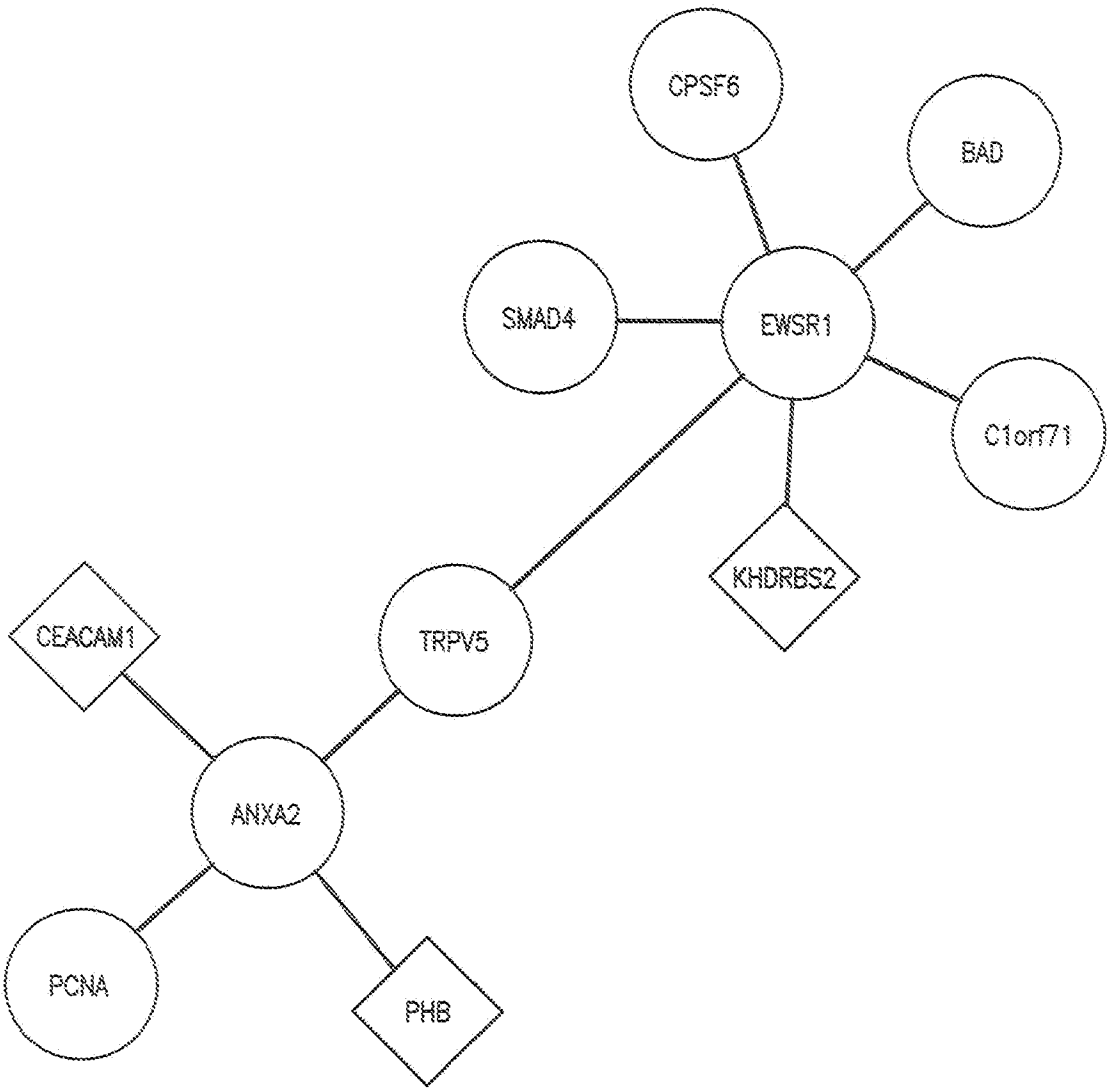
CPSF6
BAD
SMAD4
EWSR1
C1orf71
KHDRBS2
CEACAM1
TRPV5
ANXA2
PCNA
PHB

FIG. 26

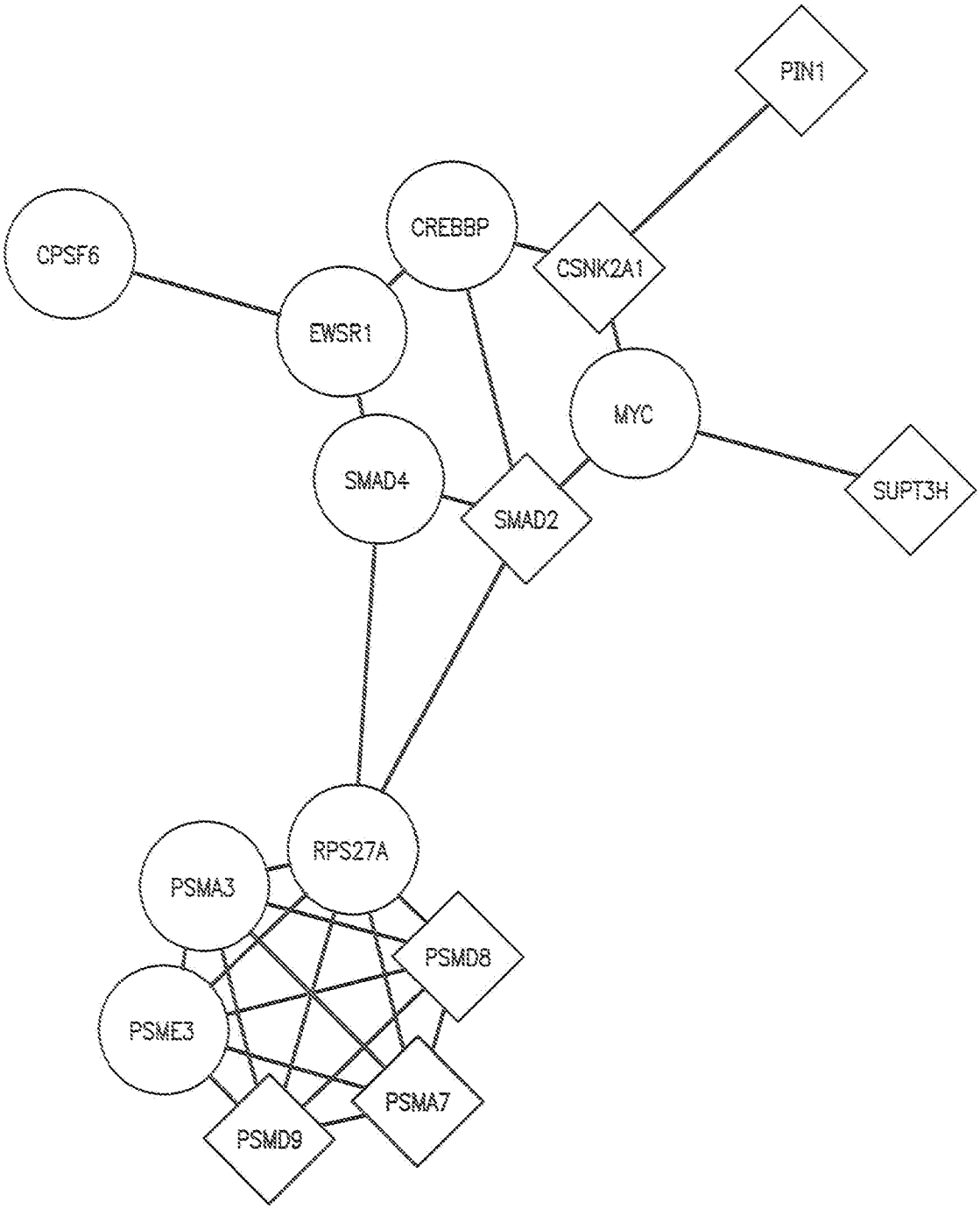
PIN1
CREBBP
CPSF6
CSNK2A1
EWSR1
MYC
SMAD4
SMAD2
SUPT3H
RPS27A
PSMA3
PSMD8
PSME3
PSMA7
PSMD9

FIG. 27

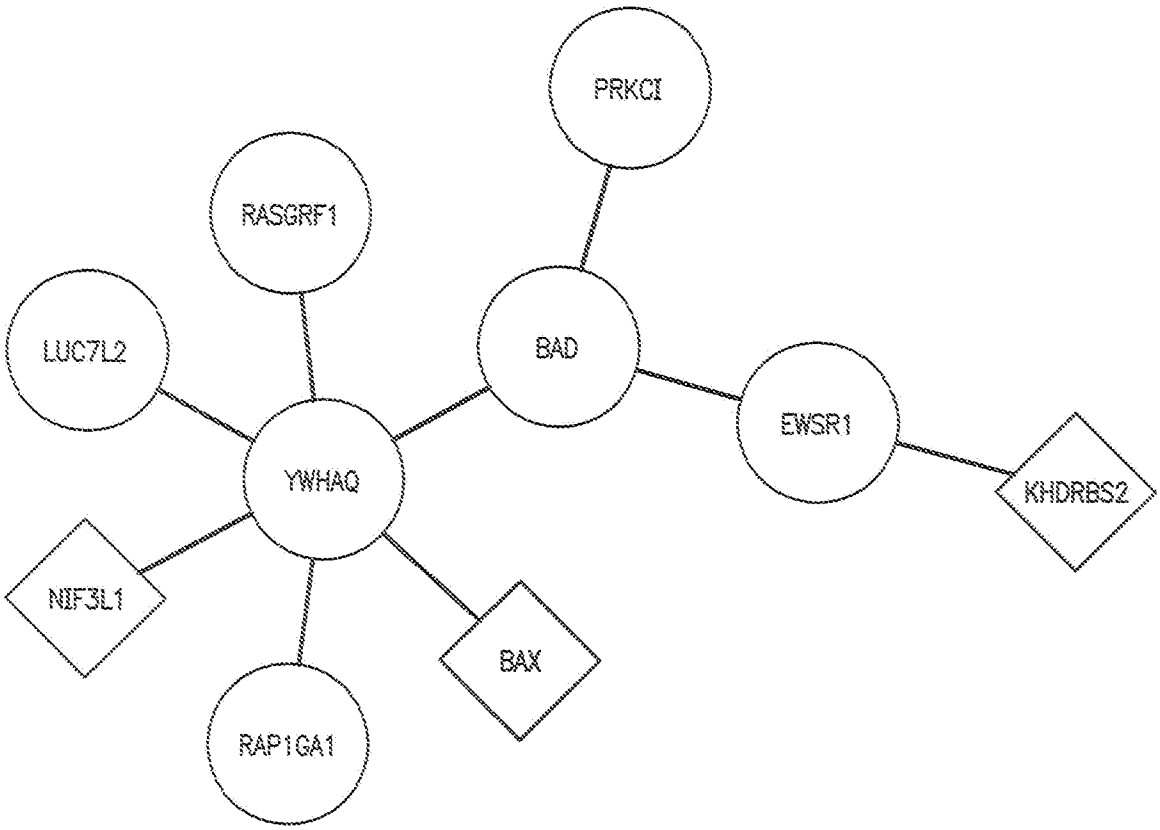
PRKCI
RASGRF1
LUC7L2
BAD
EWSR1
KHDRBS2
YWHAQ
NIF3L1
BAX
RAP1GA1

FIG. 28

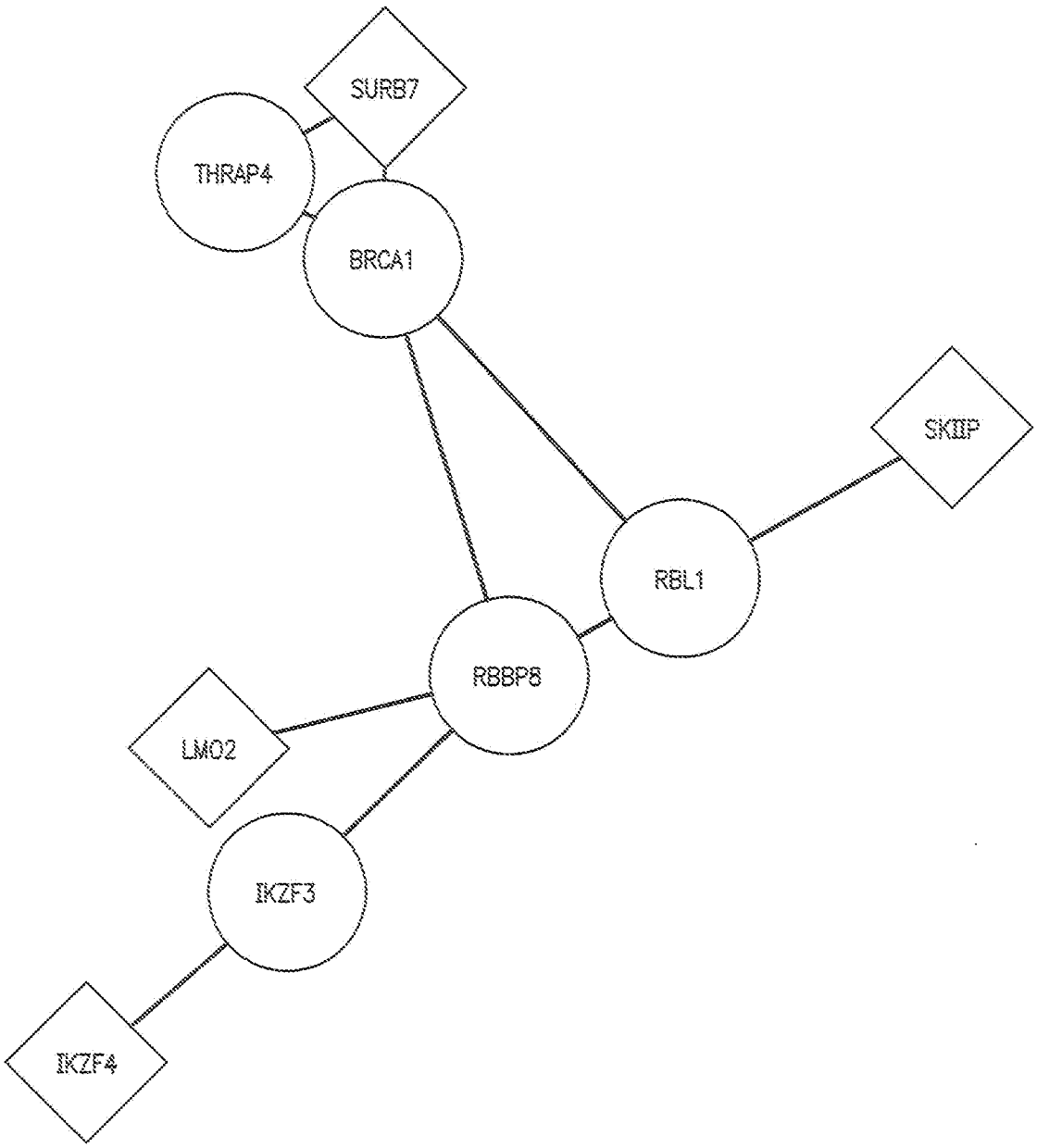

FIG. 29

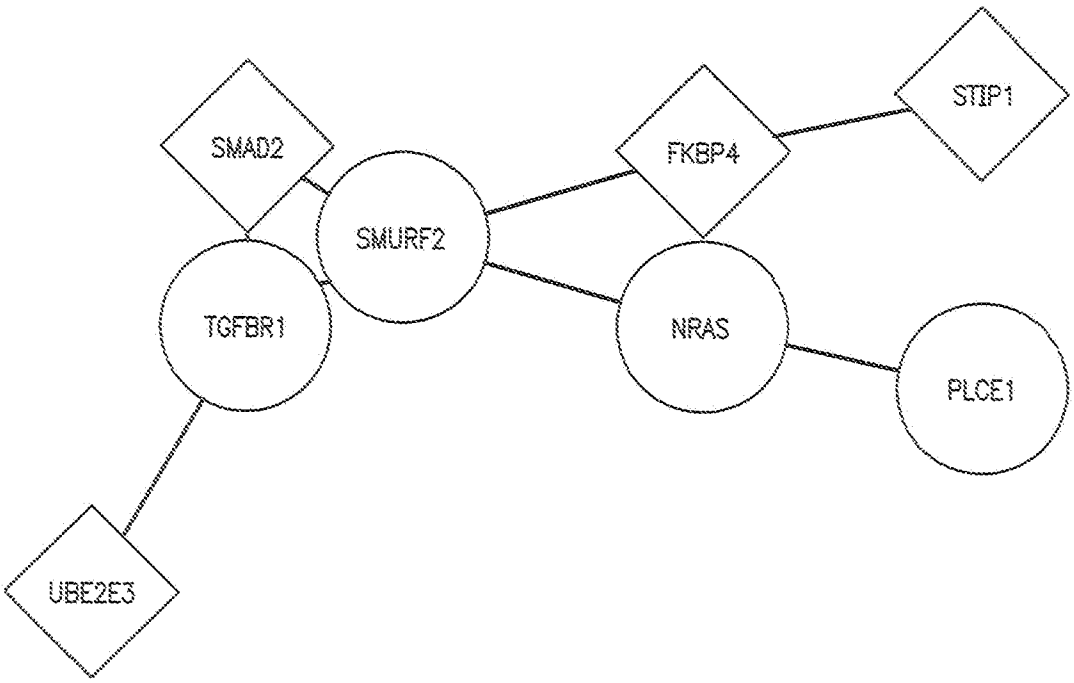

FIG. 30

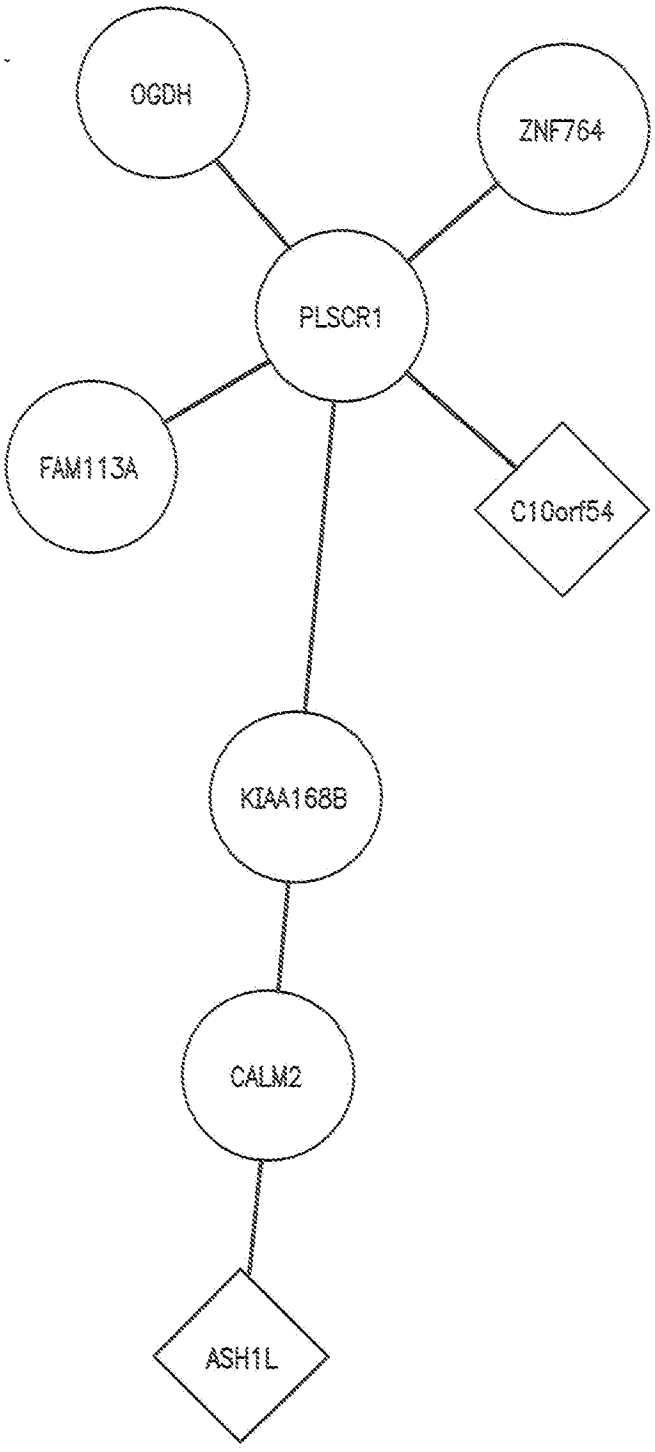

FIG. 31

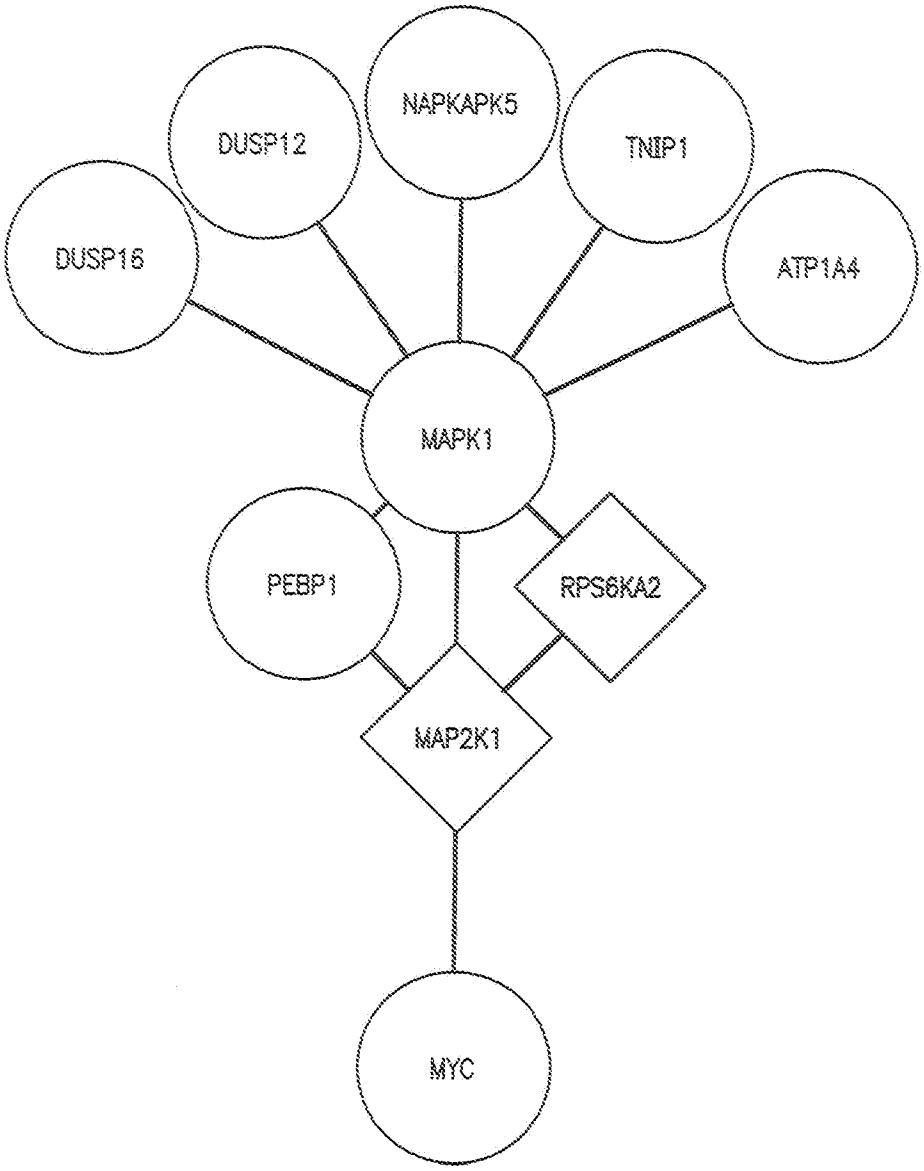
NAPKAPK5
DUSP12
TNIP1
DUSP16
ATP1A4
MAPK1
PEBP1
RPS6KA2
MAP2K1
MYC

FIG. 32

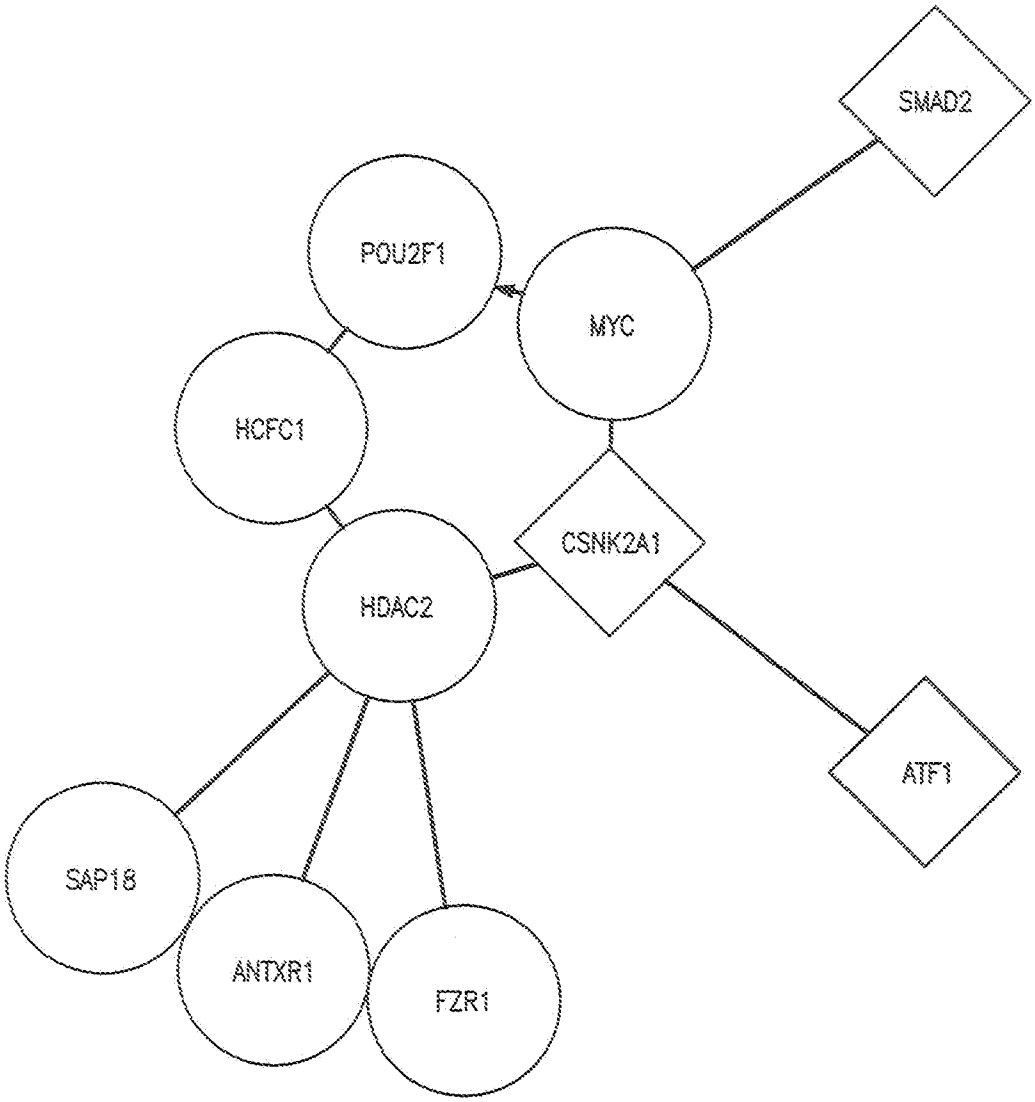
SMAD2
POU2F1
MYC
HCFC1
CSNK2A1
HDAC2
ATF1
SAP18
ANTXR1
FZR1

FIG. 33

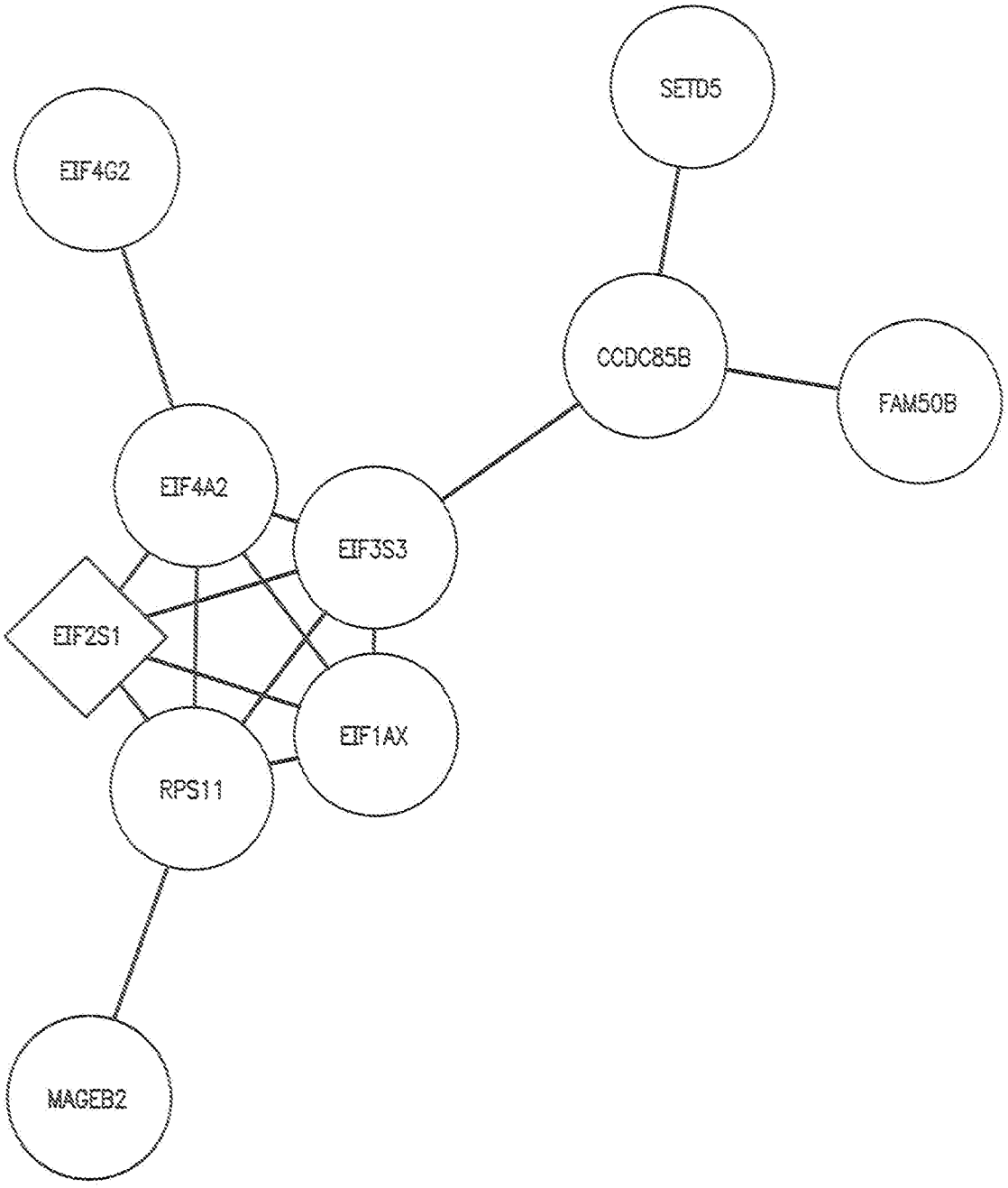
SETD5
EIF4G2
CCDC85B
FAM50B
EIF4A2
EIF3S3
EIF2S1
EIF1AX
RPS11
MAGEB2

FIG. 34

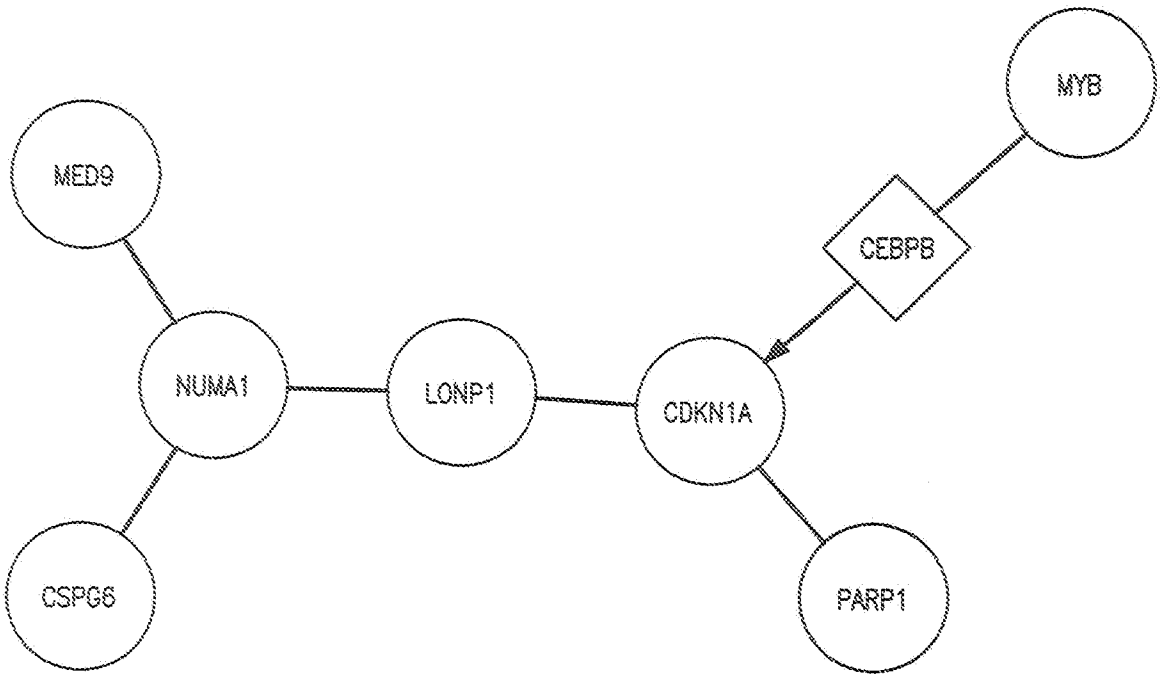

FIG. 35

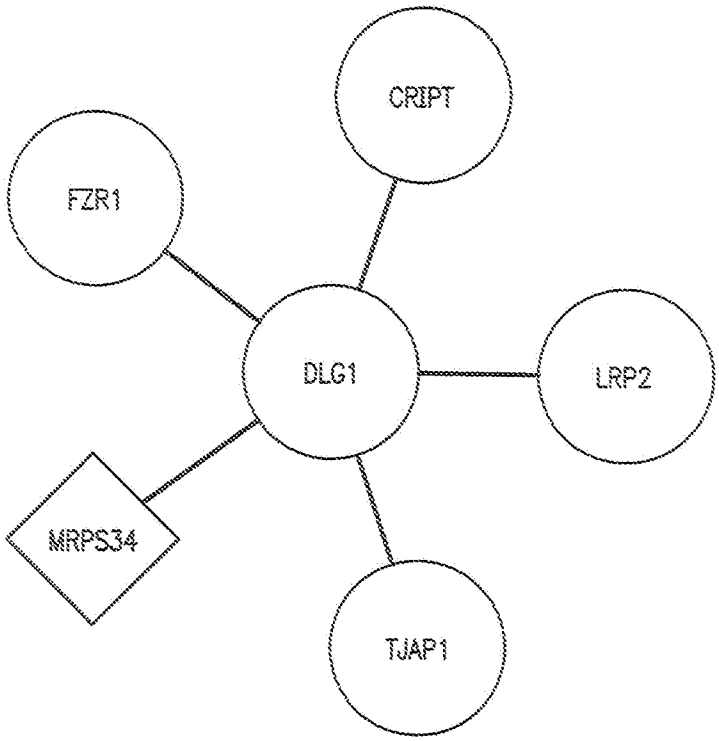

FIG. 36

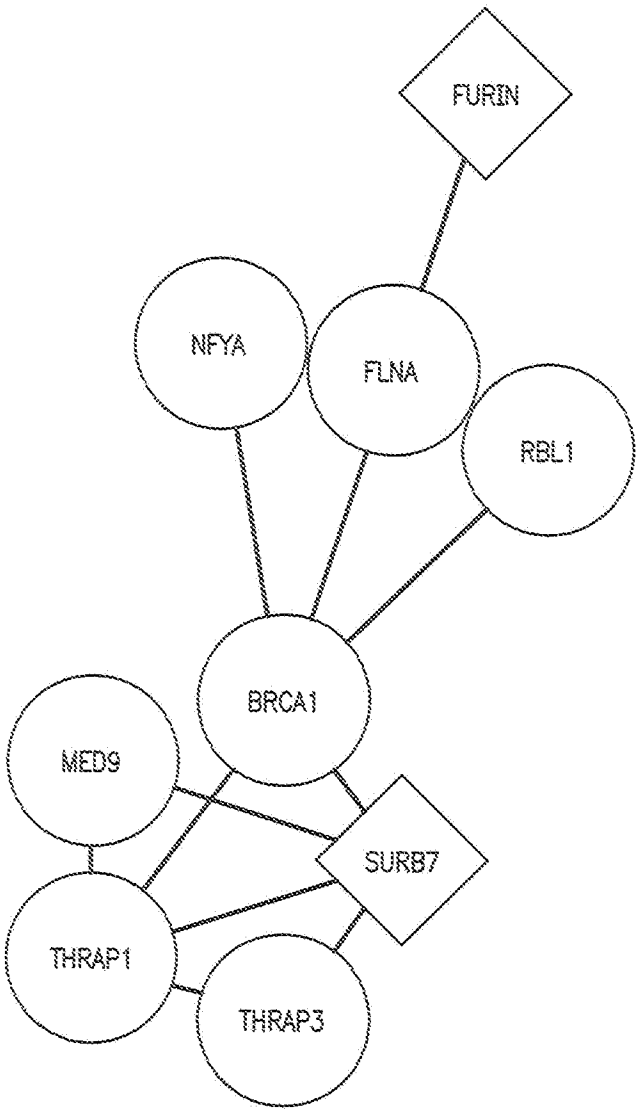

FIG. 37