YÖNTEM

Çalışmada talep edilen gen panelinde bulunan genlerin kodlayıcı bölgeleri (ekzonlar) ve ekzon-intron bağlantıları NGS yöntemi kullanılarak incelenmektedir. Çalışmada tespit edilen genetik değişimlerin sınıflandırmasında ACMG kılavuzu esas alınmaktadır ancak güvenilir veritabanlarının sınıflandırma yapmış olduğu durumlarda ve merkezimizin deneyimi ışığında ACMG sınıflandırmasından bağımsız sınıflandırma yapılabilir.

ACMG SINIFLANDIRMASI

ACMG topluluğu, *Germline* varyantların patojenik sınıflandırmasında kullanılmak üzere 2015 yılında bir kılavuz yayınlamıştır (PMID: 25741868). Nükleotid dizisindeki kalıcı değişimler için kullanılan mutant ve polimorfizm terimlerinin kullanılmaması onun yerine "varyant" teriminin kullanılması önerilmiştir. Varyantların sınıflandırılması için benin ve patojenik kriterlere göre skorlama sistemi oluşturulmuştur. Skorlama sonucunda tespit edilen varyant 5 sınıftan birine sokularak raporlanmaktadır:

Patojenik (P): Pathogenic (P, Class 5). Hastalık yapıcı.

Muhtemel Patojenik (MP): Likely Pathogenic (LP, Class 4).

Klinik Önemi Bilinmeyen (KÖB): Variant of Uncertain Significance (VUS, Class 3).

Muhtemel Benin (MB): Likely Benign (LB, Class 2).

Benin (B): Benign (Class 1). Hastalık yapmayan, selim.

Skorlamada kullanılan kriterler: Pathogenic criterion is weighted as very strong (PVS1), strong (PS1–4); moderate (PM1–6), or supporting (PP1–5) and each benign criterion is weighted as stand-alone (BA1), strong (BS1–4) or supporting (BP1–6).

Hakkında hiçbir olgu bildiriminin olmadığı varyantların, klinikteki etkilerini ön görmek için tahmin yazılımlarının (*In Silico* Predictive Programs) tek başına bir varyantı benin veya patojenik sınıfa sokamayacağı özellikle vurgulanmıştır.

Merkezimizde ticari yazılımlar, ACMG kılavuzu, uluslararası veritabanları (ClinVar, Franklin, Varsome, hastalık spesifik veritabanları) ve merkez içi veritabanımız esas alınarak varyant sınıflandırması yapılmaktadır.

Daha önce sınıflandırılmış bir varyant, güncellenen bilgiler ışığında yeniden değerlendirildiğinde başka bir sınıfta yer alabilir. Bu nedenle test sonuçlarının güncel bilgiler ışığında belli aralıklarla tekrar değerlendirilmesi önerilir. Hastada tespit edilen bir varyant için, hastanın klinik bulguları ve bazen de ailedeki diğer bireylerin de incelenmesi (segregasyon analizi) ile daha doğru sonuçlar elde edilebilir. Hastanın test sonucuna yönelik genetik danışma alması önerilir.

RAPORLAMA

Raporda tespit edilen varyantlar 3 ana başlık altında sunulmaktadır. **Sonuç** bölümünde patojenik olduğu düşünülen değişimler bildirilmektedir: P, MP. Bu değişimler hastanın başvuru kliniği ile doğrudan ilişkili olup, hasta yönetimini etkileyecek değişimlerdir. **Klinik önemi bilinmeyen** (KÖB; VUS) değişimlerin ise test sonrasında 1 yıl arayla güncel veritabanlarından sınıflandırılmasında değişim olup olmadığı kontrol edilmelidir. **İkincil (sekonder , insidental)** varyantlar, araştırma sırasında, başvuru bulguları ile doğrudan

ilişkili olmayan ancak klinik önemi olabilecek patojenik varyantları ifade eder. Sekonder varyantların raporlanması için imzalı hasta onamına ihtiyaç vardır; aksi durumda, tıbbi genetik uzmanının uygun gördüğü özel durumlar hariç, ikincil bulgular raporlanmaz. Toplumda %5'in üzerinde sıklıkla görülen varyantların benin olduğu kabul edilir ancak toplumda sık görülmesine rağmen klinik önemi olabilecek istisnai varyantların olduğu literatürde bildirlmiştir (Table 1).

Table 1.

Gene	Variant	Classification	ACMG/AMP Criteria applied (not including BA1 or BS1)	ClinVar ID	ClinGen Allele Registry ID	Chr	Position	Ref	Alt	ExAC Source Pop	ExAC Source Pop MAF	ClinVar disease entry
ACAD9	NM_014049.4: c.-44_-41dupTAAG	VUS	PS3_Supporting; BS2	1018	CA114709	3	128,598,490	C	CTAAG	AFR	0.1261	Deficiency of Acyl-CoA dehydrogenase family, member 9
GJB2	NM_004004.5: c.109G>A (p.Val37Ile)	Pathogenic	PS4; PP1_Strong; PM3_VeryStrong; PS3_Moderate	17023	CA172210	13	20,763,612	C	T	EAS	0.07242	Deafness, autosomal recessive
HFE	NM_000410.3: c.187C>G (p.His63Asp)	Pathogenic*	PS4	10	CA113797	6	26,091,179	C	G	NFE	0.1368	Hereditary hemochromatosis
HFE	NM_000410.3: c.845G>A (p.Cys282Tyr)	Pathogenic*	PS4; PP3	9	CA113795	6	26,093,141	G	A	NFE	0.05135	Hereditary hemochromatosis
MEFV	NM_000243.2: c.1105C>T (p.Pro369Ser)	VUS	PM3; PM5	2551	CA280114	16	3,299,586	G	A	EAS	0.07156	Familial Mediterranean fever
MEFV	NM_000243.2: c.1223G>A (p.Arg408Gln)	VUS	PM3; PM5	2552	CA280116	16	3,299,468	C	T	EAS	0.05407	Familial Mediterranean fever
PIBF1	NM_006346.2: c.1214G>A (p.Arg405Gln)	VUS	PM3; BS2	217689	CA210261	13	73,409,497	G	A	AMR	0.09858	Joubert syndrome
ACADS	NM_000017.3: c.511C>T (p.Arg171Trp)	VUS	PS3_Moderate; PM3; PP3	3830	CA312214	12	121,175,678	C	T	FIN #	0.06589	Deficiency of butyryl-CoA dehydrogenase
BTD	NM_000060.4: c.1330G>C (p.Asp444His)	Pathogenic	PS3; PM3_Strong; PP3; PP4	1900	CA090886	3	15,686,693	G	C	FIN #	0.05398	Biotidinase deficiency

*ACMG/AMP criteria selected does not match the classification as these variants are common low-penetrant variants and the ACMG/AMP guidelines are not designed for this variant type
Detected at >5% MAF only in Finnish population (see text).
Genomic coordinates on build GRCh37
AFR: African/African American, EAS: East Asian, NFE: Non-Finnish European, AMR: Latino, FIN=Finnish

LİMİTASYONLAR

Dizi analizi (sekans) yöntemi ile yapılan çalışmalar tekrar sayısı hastalıkları, kromozom bozuklukları, metilasyon ve *imprinting* durumu, UPD, düşük oranlı mozaik değişimler, kopya sayısı değişiklikleri (CNV) için tanı değeri taşımaz. Özel durumlarda tarama amaçlı kullanılabilir.

KAYNAKLAR

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GEN LİSTESİ

A2M	COX11	HCCS	NDUFV3	SH2B3
A4GALT	COX14	HCFC1	NEB	SH2D1A
AAAS	COX15	HCN1	NEBL	SH3BP2
AAGAB	COX17	HCN3	NECAP1	SH3PXD2A
AANAT	COX18	HCN4	NEDD4	SH3PXD2B
AARS	COX19	HCP5	NEDD4L	SH3TC2
AARS2	COX20	HCRT	NEFH	SHANK2
AASS	CP	HDAC4	NEFL	SHANK3
ABAT	CPA1	HDAC6	NEGR1	SHBG
ABCA1	CPA6	HDAC8	NEK1	SHH
ABCA3	CPN1	HDC	NEK2	SHMT1
ABCA4	CPOX	HEATR2	NEK4	SHOC2
ABCA12	CPS1	HEATR9	NEK8	SHOX
ABCB1	CPSF3	HEPACAM	NEU1	SHOX2
ABCB4	CPT1A	HERC2	NEUROD1	SHROOM4
ABCB6	CPT1B	HES7	NEUROG3	SI
ABCB7	CPT2	HESX1	NEXN	SIAE
ABCB11	CR1	HEXA	NF1	SIGMAR1
ABCC2	CR2	HEXB	NF2	SIL1
ABCC6	CRADD	HFE	NFIX	SIM1
ABCC8	CRAT	HFE2	NFKB2	SIRT1
ABCC9	CRB1	HFM1	NFKBIA	SIRT3
ABCC10	CRBN	HGD	NFKBIL1	SIRT5
ABCC11	CREB1	HGF	NFU1	SIX1
ABCD1	CREBBP	HGSNAT	NGF	SIX2
ABCD3	CRELD1	HIBCH	NGLY1	SIX3
ABCD4	CRH	HIGD2A	NHEJ1	SIX5
ABCG2	CRHR1	HINT1	NHLRC1	SIX6
ABCG5	CRIPT	HIP1	NHP2	SKI

ABCG8	CRLF1	HIRA	NHS	SKIV2L
ABHD5	CRLS1	HK1	NIM1	SLC1A1
ABHD12	CRTAP	HK2	NIN	SLC1A3
ABHD14A-ACY1	CRX	HLA-A	NIPA1	SLC2A1
ABL1	CRYAA	HLA-B	NIPAL4	SLC2A2
ABO	CRYAB	HLA-C	NIPBL	SLC2A4
AC006486.9	CRYBA1	HLA-DOB	NIPSNAP1	SLC2A9
AC011530.4	CRYBA2	HLA-DQA1	NIPSNAP3A	SLC2A10
AC018816.3	CRYBA4	HLA-DQB1	NKX2-1	SLC3A1
AC024592.12	CRYBB1	HLA-DQB2	NKX2-2	SLC4A1
AC068533.7	CRYBB2	HLA-DRB1	NKX2-5	SLC4A4
AC093726.4	CRYBB3	HLA-G	NKX2-6	SLC4A5
AC093726.6	CRYGB	HLCS	NKX3-2	SLC4A10
AC129492.6	CRYGC	HMBS	NLGN3	SLC4A11
ACAA1	CRYGD	HMCN1	NLGN4X	SLC5A1
ACACA	CRYGS	HMGA1	NLRC4	SLC5A2
ACACB	CRYL1	HMGA2	NLRP1	SLC5A5
ACAD8	CRYM	HMGB3	NLRP3	SLC5A7
ACAD9	CSF1	HMGCL	NLRP7	SLC6A2
ACADL	CSF1R	HMGCS2	NLRP12	SLC6A3
ACADM	CSF2RA	HMMR	NLRP14	SLC6A4
ACADS	CSF2RB	HMOX1	NLRX1	SLC6A5
ACADSB	CSF3R	HMX1	NME1	SLC6A8
ACADVL	CSHL1	HNF1A	NME1-NME2	SLC6A14
ACAN	CSNK1D	HNF1B	NME2	SLC6A19
ACAT1	CSPP1	HNF4A	NME8	SLC6A20
ACAT2	CSRP3	HNMT	NMNAT1	SLC7A7
ACD	CST3	HNRNPA1	NNT	SLC7A9
ACE	CSTA	HNRNPA2B1	NOBOX	SLC7A14
ACHE	CSTB	HNRNPDL	NOD2	SLC8A1

ACKR1	CTA-211A9.5	HNRNPU	NODAL	SLC9A3R1
ACLY	CTA-373H7.7	HNRNPUL1	NOG	SLC9A6
ACO2	CTBS	HOGA1	NOL3	SLC9A9
ACOX1	CTB-102L5.4	HOXA1	NOL11	SLC9B1
ACP2	CTC1	HOXA2	NOP10	SLC10A2
ACP5	CTCF	HOXA3	NOP56	SLC11A1
ACSF3	CTC-260F20.3	HOXA11	NOS1AP	SLC11A2
ACSL4	CTC-360G5.8	HOXA13	NOS2	SLC12A1
ACSL5	CTC-435M10.3	HOXB1	NOS3	SLC12A2
ACSM3	CTDP1	HOXB13	NOTCH1	SLC12A3
ACTA1	CTD-2192J16.24	HOXC13	NOTCH2	SLC12A5
ACTA2	CTD-2521M24.10	HOXD10	NOTCH3	SLC12A6
ACTB	CTD-2545M3.6	HOXD13	NPAP1	SLC12A7
ACTC1	CTD-3074O7.11	HP	NPAT	SLC13A5
ACTG1	CTF1	HPD	NPC1	SLC14A1
ACTL6A	CTH	HPGD	NPC2	SLC16A1
ACTL6B	CTHRC1	HPRT1	NPHP1	SLC16A2
ACTN1	CTLA4	HPS1	NPHP3	SLC16A12
ACTN2	CTNNA1	HPS3	NPHP3-ACAD11	SLC17A3
ACTN4	CTNNA2	HPS4	NPHP4	SLC17A5
ACVR1	CTNNA3	HPS5	NPHS1	SLC17A8
ACVR2B	CTNNB1	HPS6	NPHS2	SLC17A9
ACVRL1	CTNND2	HPSE2	NPL	SLC19A1
ACY1	CTNS	HR	NPM1	SLC19A2
ADA	CTPS1	HRAS	NPPA	SLC19A3
ADAM9	CTRC	HRG	NPR1	SLC20A2
ADAM10	CTSA	HS6ST1	NPR2	SLC22A4
ADAM17	CTSC	HSD3B1	NPSR1	SLC22A5
ADAMTS2	CTSD	HSD3B2	NQO2	SLC22A12

ADAMTS10	CTSF	HSD3B7	NR0B1	SLC22A18
ADAMTS13	CTSK	HSD11B1	NR0B2	SLC24A1
ADAMTS17	CUBN	HSD11B2	NR1D1	SLC24A4
ADAMTS18	CUL3	HSD17B3	NR1H4	SLC24A5
ADAMTSL2	CUL4B	HSD17B4	NR1I3	SLC25A1
ADAMTSL4	CUL7	HSD17B10	NR2E1	SLC25A3
ADAR	CUX2	HSF4	NR2E3	SLC25A4
ADAT3	CWF19L1	HSFY1	NR2F1	SLC25A12
ADCK3	CX3CR1	HSPA9	NR2F2	SLC25A13
ADCK4	CXADR	HSPB1	NR3C1	SLC25A15
ADCY1	CXCL12	HSPB3	NR3C2	SLC25A16
ADCY5	CXCR1	HSPB7	NR4A2	SLC25A19
ADCY10	CXCR4	HSPB8	NR4A3	SLC25A20
ADD1	CYB5A	HSPD1	NR5A1	SLC25A22
ADH1B	CYB5R3	HSPG2	NR5A2	SLC25A35
ADH1C	CYBA	HTR1A	NRAS	SLC25A38
ADIPOQ	CYBB	HTR1B	NRG1	SLC25A39
ADK	CYC1	HTR2A	NRL	SLC26A2
ADNP	CYCS	HTR2B	NRTN	SLC26A3
ADRB1	CYLD	HTR2C	NRXN1	SLC26A4
ADRB2	CYP1A2	HTR3A	NRXN2	SLC26A5
ADRB3	CYP1B1	HTR3B	NSD1	SLC26A6
ADSL	CYP2A6	HTR3C	NSDHL	SLC26A8
AF011889.5	CYP2A7	HTR3E	NSMF	SLC27A4
AF196779.12	CYP2B6	HTR5A	NSUN2	SLC27A5
AFF2	CYP2C9	HTR5AOS	NT5C2	SLC29A3
AFG3L2	CYP2C19	HTR6	NT5C3A	SLC30A2
AFP	CYP2D6	HTR7	NT5E	SLC30A8
AGA	CYP2R1	HTRA1	NTF4	SLC30A10
AGBL1	CYP2U1	HTRA2	NTHL1	SLC33A1

AGGF1	CYP3A4	HTT	NTNG1	SLC34A1
AGK	CYP3A5	HUWE1	NTRK1	SLC34A2
AGL	CYP4F2	HYAL1	NTRK2	SLC34A3
AGPAT2	CYP4F22	HYDIN	NUB1	SLC35A1
AGPS	CYP4V2	HYLS1	NUBPL	SLC35A2
AGRN	CYP7A1	IARS2	NUMA1	SLC35A3
AGRP	CYP7B1	IBA57	NUP62	SLC35C1
AGT	CYP11A1	ICAM1	NUP155	SLC35D1
AGTR1	CYP11B1	ICAM4	NXF5	SLC36A2
AGTR2	CYP11B2	ICK	NXNL1	SLC37A4
AGXT	CYP17A1	ICOS	NXPE3	SLC38A8
AGXT2	CYP19A1	IDE	NYX	SLC39A4
AHCY	CYP21A2	IDH1	OAS1	SLC39A5
AHCYL1	CYP24A1	IDH2	OAT	SLC39A13
AHDC1	CYP26B1	IDH3B	OBSCN	SLC40A1
AHI1	CYP26C1	IDH3G	OBSL1	SLC45A2
AICDA	CYP27A1	IDS	Oca.02	SLC46A1
AIFM1	CYP27B1	IDUA	OCLN	SLC48A1
AIFM2	D2HGDH	IER3IP1	OCRL	SLC51A
AIM2	DACH1	IFI16	OFD1	SLC52A1
AIMP1	DAG1	IFIH1	OGDH	SLC52A2
AIP	DAO	IFITM3	OGG1	SLC52A3
AIPL1	DAOA	IFITM5	OGT	SLCO1B1
AIRE	DARC	IFNAR2	OLR1	SLCO1B3
AK1	DARS	IFNG	OPA1	SLCO1B7
AK2	DARS2	IFNGR1	OPA3	SLCO2A1
AKAP9	DAZ1	IFNGR2	OPCML	SLITRK1
AKAP10	DAZ2	IFNL3	OPHN1	SLITRK6
AKR1C2	DAZ3	IFRD1	OPLAH	SLMAP
AKR1C4	DBH	IFT27	OPN1LW	SLURP1

AKR1D1	DBT	IFT43	OPN1MW	SLX4
AKR7A2	DCAF8	IFT80	OPN1SW	SMAD3
AKT1	DCAF17	IFT88	OPRM1	SMAD4
AKT2	DCBLD1	IFT122	OPTN	SMAD6
AKT3	DCC	IFT140	OR2J3	SMAD7
AL021546.6	DCHS1	IFT172	ORAI1	SMAD9
ALAD	DCK	IGBP1	ORC1	SMARCA2
ALAS2	DCLRE1C	IGF1	ORC4	SMARCA4
ALB	DCN	IGF1R	ORC6	SMARCAD1
ALDH1A3	DCSTAMP	IGF2	OSMR	SMARCAL1
ALDH2	DCTN1	IGF2BP2	OSTM1	SMARCB1
ALDH3A2	DCX	IGF2R	OTC	SMARCC1
ALDH4A1	DCXR	IGFALS	OTOA	SMARCC2
ALDH5A1	DDAH1	IGFBP7	OTOF	SMARCD1
ALDH6A1	DDB2	IGHD3-10	OTOG	SMARCD2
ALDH7A1	DDC	IGHG1	OTOGL	SMARCD3
ALDH18A1	DDHD1	IGHJ5	OTUD4	SMARCE1
ALDOA	DDHD2	IGHM	OTX2	SMC1A
ALDOB	DDIT3	IGHMBP2	OXA1L	SMC3
ALG1	DDOST	IGHV3-11	OXCT1	SMCHD1
ALG2	DDR2	IGHV3-21	OXSR1	SMG6
ALG3	DDX3Y	IGHV6-1	P2RX2	SMIM1
ALG6	DDX11	IGKC	P2RY12	SMN1
ALG8	DDX25	IGKJ3	PABPN1	SMN2
ALG9	DDX59	IGKJ4	PACRG	SMNDC1
ALG10	DEAF1	IGKV1-8	PACS1	SMO
ALG11	DEC1	IGKV1-9	PADI4	SMOC1
ALG12	DECR1	IGKV1-12	PAFAH1B1	SMOC2
ALG13	DEK	IGKV3-11	PAH	SMPD1
ALG14	DEPDC5	IGKV3-15	PAK3	SMPX

ALK	DES	IGLL1	PAK7	SMS
ALMS1	DFNA5	IGSF1	PALB2	SNAI2
ALOX5	DFNB31	IHH	PALLD	SNAP29
ALOX5AP	DFNB59	IK	PANK2	SNCA
ALOX12B	DGAT1	IKBKAP	PAPSS2	SNCAIP
ALOXE3	DGCR2	IKBKB	PARK2	SNCB
ALPL	DGCR6	IKBKG	PARK7	SNIP1
ALS2	DGCR8	IKZF1	PARL	SNORD107
ALX1	DGCR14	IL1B	PARN	SNRNP200
ALX3	DGKE	IL1RAPL1	PARP1	SNRPE
ALX4	DGUOK	IL1RN	PARS2	SNRPN
AMACR	DHCR7	IL2RA	PAX1	SNTA1
AMELX	DHCR24	IL2RG	PAX2	SNX5
AMER1	DHDDS	IL4R	PAX3	SNX10
AMH	DHFR	IL6	PAX4	SOAT1
AMHR2	DHH	IL6R	PAX5	SOBP
AMN	DHODH	IL7R	PAX6	SOD1
AMPD1	DHTKD1	IL10	PAX7	SOD2
AMPD2	DHX8	IL10RA	PAX8	SOHLH1
AMPD3	DIABLO	IL10RB	PAX9	SORL1
AMT	DIAPH1	IL11RA	PAXIP1	SORT1
ANG	DIAPH2	IL12B	PAXIP1OS	SOS1
ANGPTL3	DIAPH3	IL12RB1	PBRM1	SOST
ANGPTL4	DICER1	IL13	PC	SOX1
ANK1	DIP2B	IL17F	PCBD1	SOX2
ANK2	DIRAS3	IL17RA	PCCA	SOX3
ANK3	DIRC2	IL17RD	PCCB	SOX5
ANKH	DIS3L2	IL18	PCDH9	SOX9
ANKRD1	DISC1	IL18RAP	PCDH15	SOX10
ANKRD11	DISC2	IL21	PCDH19	SOX11

ANKRD26	DISP1	IL21R	PCK1	SOX17
ANKS6	DKC1	IL23R	PCK2	SOX18
ANLN	DLAT	IL31RA	PCM1	SP7
ANO3	DLD	IL36RN	PCNA	SP110
ANO5	DLEC1	ILDR1	PCNT	SPAG1
ANO6	DLG3	ILF3	PCOLCE2	SPAG8
ANO10	DLG4	ILK	PCSK1	SPAST
ANTXR1	DLGAP2	IMMP2L	PCSK9	SPATA7
ANTXR2	DLL1	IMMT	PCYT1A	SPATA16
ANXA5	DLL3	IMPAD1	PDCD10	SPECC1L
AOC1	DLST	IMPDH1	PDE4D	SPEG
AOC2	DLX3	IMPG2	PDE6A	SPG7
AP1S1	DLX5	INF2	PDE6B	SPG11
AP1S2	DMD	ING1	PDE6C	SPG20
AP2S1	DMGDH	INPP5E	PDE6D	SPG21
AP3B1	DMP1	INPPL1	PDE6G	SPINK1
AP3B2	DMPK	INS	PDE6H	SPINK5
AP4B1	DMRT1	INSL3	PDE8B	SPINT2
AP4E1	DMRT2	INSR	PDE10A	SPR
AP4M1	DMXL2	INSRR	PDE11A	SPRED1
AP4S1	DNA2	INS-IGF2	PDGFB	SPRY4
AP5Z1	DNAAF1	INVS	PDGFRA	SPTA1
AP000275.65	DNAAF2	IPCEF1	PDGFRB	SPTAN1
AP000295.9	DNAAF3	IPW	PDGFRL	SPTB
AP000304.12	DNAH5	IQCB1	PDHA1	SPTBN2
AP000350.4	DNAH9	IQSEC2	PDHB	SPTLC1
AP000350.10	DNAH10	IRAK3	PDHX	SPTLC2
AP000721.4	DNAH11	IRAK4	PDK1	SQSTM1
AP003419.11	DNAI1	IRF1	PDK2	SRC
APBB2	DNAI2	IRF4	PDK3	SRCAP

APC	DNAJB2	IRF5	PDLIM3	SRD5A2
APCDD1	DNAJB6	IRF6	PDLIM4	SRD5A3
APEX2	DNAJC5	IRF8	PDP1	SRGAP2
APLN	DNAJC6	IRGM	PDSS1	SRP72
APOA1	DNAJC19	IRS1	PDSS2	SRPX2
APOA2	DNAJC25-GNG10	IRS2	PDX1	SRY
APOA4	DNAL1	IRX5	PDYN	SS18L1
APOA5	DNAL4	ISCA2	PDZD7	SSR4
APOB	DNASE1	ISCU	PEAR1	SSTR5
APOC2	DNASE1L1	ISG15	PEPD	SSX1
APOC3	DNASE1L3	ISPD	PER2	SSX2
APOC4-APOC2	DNM1L	ITCH	PET100	SSX7
APOE	DNM2	ITGA2	PEX1	ST3GAL3
APOL1	DNMT1	ITGA2B	PEX2	ST3GAL4
APOL2	DNMT3A	ITGA3	PEX3	ST3GAL5
APOL4	DNMT3B	ITGA6	PEX5	ST7
APOPT1	DOCK4	ITGA7	PEX6	ST14
APP	DOCK6	ITGA8	PEX7	ST20-MTHFS
APRT	DOCK7	ITGAM	PEX10	STAC3
APTX	DOCK8	ITGB2	PEX11A	STAG1
AQP1	DOK7	ITGB3	PEX11B	STAG3
AQP2	DOLK	ITGB4	PEX11G	STAMBP
AQP3	DPAGT1	ITIH4	PEX12	STAR
AQP7	DPM1	ITK	PEX13	STAT1
AR	DPM2	ITM2B	PEX14	STAT2
ARFGEF2	DPM3	ITPA	PEX16	STAT3
ARG1	DPP6	ITPKC	PEX19	STAT4
ARHGAP24	DPP10	ITPR1	PEX26	STAT5B
ARHGAP26	DPY19L2	ITPR3	PFKM	STEAP3
ARHGAP29	DPYD	ITPRIP	PFN1	STIL

ARHGAP31	DPYS	IVD	PGAM2	STIM1
ARHGDIA	DRC1	IYD	PGAP1	STK3
ARHGEF6	DRD2	JAG1	PGAP2	STK4
ARHGEF9	DRD3	JAGN1	PGAP3	STK11
ARHGEF10	DRD4	JAK2	PGK1	STK39
ARHGEF15	DRD5	JAK3	PGM1	STOM
ARID1A	DSC2	JAM3	PGM3	STOX1
ARID1B	DSC3	JPH2	PGR	STRA6
ARID2	DSE	JPH3	PHB	STRADA
ARL2BP	DSG1	JRK	PHC1	STRC
ARL6	DSG2	JUP	PHEX	STS
ARL6IP1	DSG4	KAL1	PHF3	STT3A
ARL13B	DSP	KALRN	PHF6	STT3B
ARMC4	DSPP	KANK1	PHF8	STUB1
ARMC5	DST	KANK2	PHF11	STX11
ARMS2	DSTYK	KANSL1	PHGDH	STX16
ARNT2	DTD1	KARS	PHIP	STXBP1
ARSA	DTNA	KAT6B	PHKA1	STXBP2
ARSB	DTNBP1	KATNAL2	PHKA2	SUCLA2
ARSE	DUOX2	KBTBD13	PHKB	SUCLG1
ART4	DUOXA1	KCNA1	PHKG2	SUCLG2
ARX	DUOXA2	KCNA4	PHOX2A	SUFU
AS3MT	DUSP6	KCNA5	PHOX2B	SUGCT
ASAH1	DYM	KCNAB1	PHYH	SULF1
ASB10	DYNC1H1	KCNB1	PHYKPL	SULT2A1
ASCC1	DYNC2H1	KCNC3	PICALM	SULT2B1
ASCL1	DYRK1A	KCND3	PIEZO1	SUMF1
ASIP	DYRK1B	KCNE1	PIEZO2	SUMO1
ASL	DYSF	KCNE1L	PIGA	SUMO4
ASNS	DYX1C1	KCNE2	PIGL	SUOX

ASPA	E2F3	KCNE3	PIGM	SURF1
ASPH	EARS2	KCNE4	PIGN	SURF2
ASPM	EBP	KCNH2	PIGO	SYCP3
ASPN	ECE1	KCNH5	PIGT	SYN1
ASPSCR1	ECEL1	KCNJ1	PIGV	SYN2
ASS1	ECI1	KCNJ2	PIGW	SYNE1
ASTE1	ECM1	KCNJ3	PIK3CA	SYNE2
ASXL1	ECSIT	KCNJ5	PIK3CD	SYNE4
ASXL3	EDA	KCNJ8	PIK3R1	SYNGAP1
ATCAY	EDAR	KCNJ10	PIK3R2	SYNJ1
ATG16L1	EDARADD	KCNJ11	PIK3R5	SYP
ATIC	EDN1	KCNJ12	PIKFYVE	SYT2
ATL1	EDN3	KCNJ13	PINK1	SYT14
ATL3	EDNRA	KCNJ18	PIP5K1B	SZT2
ATM	EDNRB	KCNK3	PIP5K1C	T
ATN1	EEF1A2	KCNK9	PITPNM3	TAB2
ATOH7	EEF2	KCNK18	PITX1	TAC3
ATP1A2	EFEMP1	KCNMA1	PITX2	TACC3
ATP1A3	EFEMP2	KCNMB1	PITX3	TACO1
ATP1B1	EFHC1	KCNQ1	PKD1	TACR3
ATP2A1	EFHC2	KCNQ2	PKD2	TACSTD2
ATP2A2	EFNB1	KCNQ3	PKHD1	TAF1
ATP2B2	EFNB2	KCNQ4	PKLR	TAF2
ATP2B3	EFTUD2	KCNT1	PKP1	TAF4B
ATP2C1	EGF	KCNV2	PKP2	TAF6
ATP5A1	EGFR	KCTD1	PKP4	TAF13
ATP5B	EGLN1	KCTD7	PLA2G2A	TAF15
ATP5C1	EGR2	KCTD13	PLA2G5	TAGLN2
ATP5D	EHBP1	KCTD14	PLA2G6	TALDO1
ATP5E	EHHADH	KDM5C	PLA2G7	TAP1

ATP5F1	EHMT1	KDM5D	PLA2R1	TAP2
ATP5G1	EIF2AK3	KDM6A	PLAG1	TAPBP
ATP5G2	EIF2AK4	KDR	PLAGL1	TARDBP
ATP5G3	EIF2B1	KEL	PLAT	TARP
ATP5I	EIF2B2	KERA	PLAU	TARS2
ATP5J	EIF2B3	KHDC3L	PLCB1	TAS2R16
ATP5O	EIF2B4	KHK	PLCB4	TAS2R38
ATP5SL	EIF2B5	KIAA0196	PLCD1	TAT
ATP6AP2	EIF2S3	KIAA0226	PLCE1	TAZ
ATP6V0A2	EIF4A3	KIAA0319	PLCG2	TBC1D4
ATP6V0A4	EIF4E	KIAA0895	PLD3	TBC1D7
ATP6V1B1	EIF4G1	KIAA1279	PLEC	TBC1D20
ATP6V1G2	ELAC2	KIAA2022	PLEKHA1	TBC1D24
ATP7A	ELANE	KIF1A	PLEKHG4	TBCB
ATP7B	ELK1	KIF1B	PLEKHG5	TBCE
ATP8A2	ELMOD2	KIF1C	PLEKHM1	TBK1
ATP8B1	ELMOD3	KIF2A	PLG	TBL1X
ATP10D	ELN	KIF4A	PLIN1	TBP
ATP13A2	ELOVL4	KIF5A	PLK1S1	TBX1
ATPAF1	ELOVL5	KIF5C	PLN	TBX3
ATPAF2	ELP4	KIF7	PLOD1	TBX4
ATPIF1	EMD	KIF11	PLOD2	TBX5
ATR	EMG1	KIF14	PLOD3	TBX6
ATRIP	EMP2	KIF20B	PLP1	TBX15
ATRX	EMX2	KIF21A	PLS3	TBX19
ATXN1	EN2	KIF22	PML	TBX20
ATXN2	ENAM	KIF23	PMM2	TBX21
ATXN3	ENG	KIR2DL3	PMP22	TBX22
ATXN7	ENO1	KIR3DL1	PMPCA	TBXA2R
ATXN10	ENO3	KIR3DL2	PMS1	TBXAS1

AUH	ENPP1	KIR3DL3	PMS2	TCAP
AURKA	ENTPD1	KIRREL3	PNKD	TCF4
AURKC	ENTPD5	KISS1	PNKP	TCF7L2
AUTS2	EOGT	KISS1R	PNLIP	TCF12
AVIL	EOMES	KIT	PNMT	TCF21
AVP	EP300	KITLG	PNN	TCIRG1
AVPR1A	EPAS1	KIZ	PNP	TCN1
AVPR2	EPB41	KL	PNPLA1	TCN2
AXDND1	EPB41L1	KLC1	PNPLA2	TCOF1
AXIN1	EPB42	KLF1	PNPLA3	TCTN1
AXIN2	EPCAM	KLF6	PNPLA4	TCTN2
B2M	EPG5	KLF8	PNPLA6	TCTN3
B3GALNT1	EPHA2	KLF10	PNPO	TDGF1
B3GALNT2	EPHB2	KLF11	PNPT1	TDP1
B3GALT6	EPHX1	KLHDC8B	POC1A	TDRD7
B3GALTL	EPHX2	KLHL3	POC1B	TEAD1
B3GAT3	EPM2A	KLHL7	POC1B-GALNT4	TECPR2
B3GNT1	EPO	KLHL10	POF1B	TECR
B4GALNT1	EPOR	KLHL40	POFUT1	TECTA
B4GALT1	EPS8	KLHL41	POGLUT1	TEK
B4GALT7	EPT1	KLK1	POLA1	TEKT2
B9D1	EPX	KLK4	POLD1	TENM1
B9D2	ERAP2	KLKB1	POLE	TENM3
BAAT	ERBB2	KLLN	POLG	TERC
BAG3	ERBB3	KMT2A	POLG2	TERT
BANF1	ERBB4	KMT2D	POLH	TET2
BANK1	ERCC1	KNG1	POLR1C	TF
BAP1	ERCC2	KPTN	POLR1D	TFAM
BARD1	ERCC3	KRAS	POLR3A	TFAP2A
BAX	ERCC4	KRIT1	POLR3B	TFAP2B

BBIP1	ERCC5	KRT1	POLRMT	TFB1M
BBS1	ERCC6	KRT2	POMC	TFE3
BBS2	ERCC6L2	KRT3	POMGNT1	TFG
BBS4	ERCC6-PGBD3	KRT4	POMGNT2	TFR2
BBS5	ERCC8	KRT5	POMK	TG
BBS7	ERF	KRT6A	POMP	TGFB1
BBS9	ERI2	KRT6B	POMT1	TGFB2
BBS10	ERLIN2	KRT6C	POMT2	TGFB3
BBS12	ERMAP	KRT9	PON1	TGFBI
BCAM	ERMARD	KRT10	PON3	TGFBR1
BCAP31	ESCO2	KRT12	POR	TGFBR2
BCAT1	ESPN	KRT13	PORCN	TGFBR3
BCAT2	ESR1	KRT14	POT1	TGIF1
BCHE	ESR2	KRT16	POU1F1	TGM1
BCKDHA	ESRRB	KRT17	POU3F4	TGM5
BCKDHB	ETFA	KRT71	POU4F3	TGM6
BCKDK	ETFB	KRT74	POU6F2	TH
BCL2	ETFDH	KRT75	PPARG	THAP1
BCL2L2-PABPN1	ETHE1	KRT81	PPARGC1A	THBD
BCL10	ETV4	KRT83	PPARGC1B	THBS2
BCO1	ETV5	KRT85	PPIB	THOC2
BCOR	EVC	KRT86	PPM1B	THOC6
BCR	EVC2	KYNU	PPM1D	THPO
BCS1L	EVI5	L1CAM	PPM1K	THRA
BDNF	EWSR1	L2HGDH	PPOX	THRB
BEAN1	EXO1	LAD1	PPP1R3A	TIA1
BEST1	EXOC8	LAMA1	PPP1R17	TICAM1
BFSP1	EXOSC3	LAMA2	PPP2R1B	TICRR
BFSP2	EXOSC4	LAMA3	PPP2R2B	TIMM8A
BHLHE41	EXOSC8	LAMA4	PPT1	TIMM44

BICC1	EXPH5	LAMB1	PPT2	TIMP3
BICD2	EXT1	LAMB2	PQBP1	TINF2
BIN1	EXT2	LAMB3	PRCC	TIRAP
BIRC5	EYA1	LAMC2	PRCD	TJP2
BIVM-ERCC5	EYA4	LAMC3	PRDM5	TK2
BLK	EYS	LAMP2	PRDM9	TLL1
BLM	EZH2	LAMTOR2	PRDM16	TLR1
BLMH	F2	LARGE	PREPL	TLR2
BLNK	F5	LARP7	PRF1	TLR3
BLOC1S1	F7	LARS	PRG4	TLR4
BLOC1S3	F8	LARS2	PRICKLE1	TLR5
BLOC1S6	F9	LAS1L	PRICKLE2	TM4SF2
BLVRA	F10	LBR	PRIMPOL	TM4SF20
BMP1	F11	LCA5	PRKACA	TMC1
BMP2	F12	LCAT	PRKAG2	TMC6
BMP4	F13A1	LCK	PRKAR1A	TMC8
BMP15	F13B	LCT	PRKCD	TMCO1
BMPER	FA2H	LDB3	PRKCG	TMED1
BMPR1A	FAAH	LDHA	PRKCH	TMEM5
BMPR1B	FAAH2	LDHB	PRKCSH	TMEM38B
BMPR2	FABP5	LDLR	PRKDC	TMEM43
BMS1	FADD	LDLRAP1	PRKG1	TMEM67
BOLA3	FAH	LEFTY2	PRKRA	TMEM70
BPGM	FAM20A	LEMD3	PRLR	TMEM98
BPY2	FAM20C	LEP	PRM1	TMEM126A
BRAF	FAM58A	LEPR	PRM2	TMEM127
BRAT1	FAM72A	LEPRE1	PRM3	TMEM138
BRCA1	FAM83H	LEPREL1	PRNP	TMEM151B
BRCA2	FAM111A	LETM1	PROC	TMEM165
BRD2	FAM111B	LFNG	PROCR	TMEM167B

BRIP1	FAM126A	LGALS1	PRODH	TMEM173
BRWD3	FAM134B	LGALS2	PROK2	TMEM216
BSCL2	FAM161A	LGI1	PROKR2	TMEM231
BSG	FAM161B	LGR4	PROM1	TMEM237
BSND	FAM175A	LHB	PROP1	TMEM240
BTD	FAM187A	LHCGR	PROS1	TMIE
BTK	FAM188B	LHFPL5	PROZ	TMLHE
BTNL2	FAN1	LHX3	PRPF3	TMPO
BUB1B	FANCA	LHX4	PRPF4	TMPRSS3
C1GALT1C1	FANCB	LIAS	PRPF6	TMPRSS5
C1QA	FANCC	LIFR	PRPF8	TMPRSS6
C1QB	FANCD2	LIG4	PRPF31	TMPRSS15
C1QC	FANCE	LIM2	PRPH	TNC
C1QTNF5	FANCF	LIMK1	PRPH2	TNF
C1R	FANCG	LIMS2	PRPS1	TNFRSF1A
C1S	FANCI	LINC01016	PRRT2	TNFRSF4
C1orf106	FANCL	LINS	PRRX1	TNFRSF10B
C1orf145	FANCM	LIPA	PRSS1	TNFRSF11A
C2	FAR1	LIPC	PRSS2	TNFRSF11B
C2CD3	FARS2	LIPE	PRSS12	TNFRSF13B
C2orf71	FAS	LIPH	PRSS23	TNFRSF13C
C3	FASLG	LIPI	PRSS56	TNFSF4
C4A	FASN	LIPN	PRX	TNFSF11
C4B	FASTKD2	LIPT1	PRY	TNFSF12
C4orf26	FAT4	LITAF	PRY2	TNFSF12-TNFSF13
C5	FBLN1	LMAN1	PSAP	TNNC1
C5orf42	FBLN5	LMBR1	PSAT1	TNNI2
C6	FBN1	LMBRD1	PSEN1	TNNI3
C7	FBN2	LMF1	PSEN2	TNNI3K

C8A	FBP1	LMNA	PSENEN	TNNT1
C8B	FBXL4	LMNB1	PSMA6	TNNT2
C8orf37	FBXO7	LMNB2	PSMB8	TNNT3
C9	FBXO31	LMX1B	PSMC3IP	TNPO3
C9orf66	FBXO38	LOC101927322	PSMD4	TNXB
C9orf72	FBXW4	LOC101927403	PSPH	TOE1
C10orf2	FBXW7	LOC101928170	PSTPIP1	TOMM40
C10orf11	FBXW11	LOC101928352	PTCH1	TOP1MT
C10orf55	FCGR1A	LOC101928728	PTCH2	TOPBP1
C11orf65	FCGR2A	LOC102723566	PTCHD1	TOPORS
C11orf91	FCGR2B	LOC102724043	PTDSS1	TOR1A
C12orf57	FCGR2C	LOC102724371	PTEN	TOR1AIP1
C12orf65	FCGR3A	LOR	PTF1A	TP53
C14orf2	FCGR3B	LOXHD1	PTGDR	TP63
C15orf41	FCGRT	LOXL1	PTGER2	TPCN2
C17orf66	FCN3	LPAR6	PTGES2	TPH1
C18orf8	FDXACB1	LPIN1	PTGIS	TPH2
C18orf56	FECH	LPIN2	PTH	TPI1
C19orf12	FERMT1	LPL	PTH1R	TPK1
C21orf2	FERMT3	LRAT	PTHLH	TPM1
C21orf33	FEZF1	LRBA	PTPN1	TPM2
C21orf59	FFAR4	LRIG2	PTPN11	TPM3
CA2	FGA	LRIT3	PTPN14	TPMT
CA4	FGB	LRP2	PTPN22	TPO
CA5A	FGD1	LRP4	PTPRC	TPP1
CA8	FGD4	LRP5	PTPRF	TPRN
CA12	FGF3	LRP6	PTPRO	TRAC
CABP2	FGF5	LRP8	PTPRQ	TRAF3
CABP4	FGF8	LRPAP1	PTPRZ1	TRAF3IP2
CACNA1A	FGF9	LRPPRC	PTRF	TRAJ29

CACNA1B	FGF10	LRRC6	PTS	TRAJ32
CACNA1C	FGF14	LRRC8A	PUF60	TRAJ54
CACNA1D	FGF17	LRRC41	PUS1	TRAPPC2
CACNA1F	FGF20	LRRK2	PVRL1	TRAPPC4
CACNA1H	FGF23	LRSAM1	PVRL4	TRAPPC9
CACNA1S	FGFR1	LRTOMT	PWAR1	TRAPPC10
CACNA2D1	FGFR2	LTA	PWARSN	TRAPPC11
CACNA2D4	FGFR3	LTBP1	PWRN1	TRAV38-2DV8
CACNB2	FGFR4	LTBP2	PXDN	TRDC
CACNB4	FGG	LTBP3	PYCR1	TRDN
CACNG2	FH	LTBP4	PYGL	TRDV2
CALCR	FHL1	LTC4S	PYGM	TREH
CALM1	FHL2	LXN	PYY	TREM2
CALM2	FICD	LYRM4	QARS	TREX1
CALM3	FIG4	LYRM7	QDPR	TRGC1
CALR	FIGLA	LYST	RAB3GAP1	TRGC2
CALR3	FIP1L1	LYZ	RAB3GAP2	TRGJ1
CAMK1	FKBP5	LZTFL1	RAB7A	TRGJP
CAMTA1	FKBP10	LZTR1	RAB11FIP5	TRGV1
CANT1	FKBP14	LZTS1	RAB18	TRGV8
CAPN3	FKRP	MAB21L2	RAB23	TRGV9
CAPN5	FKTN	MAD1L1	RAB27A	TRH
CAPN10	FLCN	MAF	RAB28	TRHR
CARD9	FLG	MAFB	RAB33B	TRIM2
CARD11	FLNA	MAGEL2	RAB39B	TRIM13
CARD14	FLNB	MAGI2	RAB40AL	TRIM24
CARS2	FLNC	MAGT1	RAC2	TRIM32
CARTPT	FLRT3	MAK	RAD18	TRIM33
CASC5	FLT3	MALT1	RAD21	TRIM37
CASK	FLT4	MAMLD1	RAD50	TRIM63

CASP8	FLVCR1	MAN1B1	RAD51	TRIOBP
CASP10	FLVCR2	MAN2B1	RAD51B	TRIP11
CASQ2	FMN1	MANBA	RAD51C	TRIP13
CASR	FMO3	MAOA	RAD51D	TRMT10A
CAT	FMR1	MAOB	RAD51L3-RFFL	TRMU
CATSPER1	FN1	MAP2K1	RAD54B	TRNT1
CATSPER2	FOLH1	MAP2K2	RAD54L	TRPA1
CAV1	FOLR1	MAP3K1	RAF1	TRPC1
CAV3	FOXC1	MAP3K8	RAG1	TRPC6
CBFB	FOXC2	MAPK1	RAG2	TRPM1
CBL	FOXD3	MAPK8IP1	RAI1	TRPM2
CBR4	FOXE1	MAPK10	RAN	TRPM4
CBS	FOXE3	MAPT	RANBP2	TRPM6
CBX2	FOXF1	MARS	RANGRF	TRPM7
CBX3	FOXG1	MARS2	RAPSN	TRPS1
CC2D1A	FOXH1	MARVELD2	RARA	TRPV3
CC2D2A	FOXI1	MASP1	RARB	TRPV4
CCBE1	FOXK1	MASP2	RARS	TSC1
CCDC6	FOXL2	MASTL	RARS2	TSC2
CCDC8	FOXN1	MAT1A	RASA1	TSEN2
CCDC11	FOXO1	MATN3	RASGRP2	TSEN34
CCDC22	FOXP1	MATR3	RASSF1	TSEN54
CCDC28B	FOXP2	MAVS	RAX	TSFM
CCDC39	FOXP3	MAX	RAX2	TSG101
CCDC40	FOXRED1	MBD1	RB1	TSHB
CCDC41	FPGS	MBD5	RB1CC1	TSHR
CCDC50	FPGT-TNNI3K	MBL2	RBBP8	TSHZ1
CCDC65	FPR1	MBTPS2	RBCK1	TSIX
CCDC78	FRAS1	MC1R	RBFOX1	TSNAX-DISC1
CCDC88C	FREM1	MC2R	RBM8A	TSPAN7

CCDC103	FREM2	MC3R	RBM10	TSPAN12
CCDC114	FRG1	MC4R	RBM15	TSPEAR
CCDC151	FRMD7	MCCC1	RBM20	TSPO
CCL2	FRMPD4	MCCC2	RBM28	TSPYL1
CCL3	FRZB	MCEE	RBMXL2	TST
CCL3L1	FSBP	MCFD2	RBMY1A1	TTBK2
CCL11	FSCN2	MCM4	RBMY1B	TTC7A
CCM2	FSHB	MCM6	RBP3	TTC8
CCND1	FSHR	MCOLN1	RBP4	TTC19
CCND2	FTCD	MCPH1	RBPJ	TTC21B
CCNO	FTH1	MDH1	RCBTB1	TTC37
CCR5	FTL	MDM2	RD3	TTI2
CCT2	FTO	ME2	RDH5	TTLL5
CCT5	FTSJ1	MECOM	RDH10	TTN
CD2AP	FUCA1	MECP2	RDH11	TTPA
CD3D	FUS	MED12	RDH12	TTR
CD3E	FUT2	MED13L	RDX	TUBA1A
CD3G	FUT6	MED17	RECQL4	TUBA8
CD4	FUZ	MED23	REEP1	TUBB
CD8A	FXN	MED25	REEP2	TUBB1
CD19	FXYD2	MED28	RELN	TUBB2A
CD27	FXYD6	MEF2A	REN	TUBB2B
CD36	FXYD6-FXYD2	MEF2C	RET	TUBB3
CD40	FYCO1	MEFV	RETN	TUBB4A
CD40LG	FZD4	MEGF8	RFC4	TUBG1
CD44	FZD6	MEGF10	RFT1	TUBGCP6
CD46	FZD9	MEN1	RFX5	TUFM
CD55	G6PC	MEOX1	RFX6	TULP1
CD59	G6PC2	MERTK	RFXANK	TUSC3
CD79A	G6PC3	MESP2	RFXAP	TWIST1

CD79B	G6PD	MEST	RGR	TWIST2
CD81	GAA	MET	RGS5	TXN2
CD82	GABBR2	METTL8	RGS9	TXNRD2
CD96	GABRA1	METTL23	RGS9BP	TYK2
CD151	GABRA2	MFF	RHAG	TYMP
CD207	GABRB3	MFN2	RHBDF2	TYMS
CD209	GABRD	MFRP	RHCE	TYMSOS
CD244	GABRG1	MFSD8	RHD	TYR
CD247	GABRG2	MGAT2	RHO	TYROBP
CD320	GABRG3	MGLL	RHOH	TYRP1
CDAN1	GAD1	MGME1	RILP	Telomerase-vert
CDC6	GAD2	MGP	RIMS1	UBA1
CDC42BPB	GALC	MGST3	RIN2	UBB
CDC73	GALE	MIAT	RIPK4	UBE2A
CDCA3	GALK1	MIATNB	RIT1	UBE2I
CDH1	GALNS	MIAT_exon1	RLBP1	UBE2R2
CDH3	GALNT3	MIAT_exon5_1	RMND1	UBE3A
CDH15	GALNT12	MIAT_exon5_2	RMRP	UBE3B
CDH23	GALT	MIAT_exon5_3	RNASE4	UBIAD1
CDHR1	GAMT	MIB1	RNASEH2A	UBQLN2
CDK4	GAN	MICALCL	RNASEH2B	UBR1
CDK5RAP2	GARS	MICU1	RNASEH2C	UCHL1
CDK6	GAS1	MID1	RNASEL	UCP1
CDK16	GAST	MID2	RNASET2	UCP2
CDKAL1	GATA1	MIF	RNF6	UCP3
CDKL5	GATA2	MINPP1	RNF135	UGT1A1
CDKN1B	GATA3	MIP	RNF139	UGT1A3
CDKN1C	GATA4	MIPOL1	RNF168	UGT1A4
CDKN2A	GATA5	MITF	RNF170	UGT1A5
CDKN2B	GATA6	MKKS	RNF212	UGT1A6

CDON	GATAD1	MKRN3	RNF213	UGT1A7
CDSN	GATAD2B	MKS1	RNF216	UGT1A8
CDT1	GATM	MLC1	RNase_MRP	UGT1A9
CDY1	GATS	MLF1	ROBO1	UGT1A10
CDY2A	GBA	MLH1	ROBO2	UGT2B17
CEACAM16	GBA2	MLH3	ROBO3	UMOD
CEBPA	GBE1	MLPH	ROGDI	UMPS
CEBPE	GC	MLXIPL	ROM1	UNC13D
CECR1	GCDH	MLYCD	ROR2	UNC93B1
CEL	GCGR	MMAA	ROS1	UNC119
CENPE	GCH1	MMAB	RP1	UNG
CENPJ	GCK	MMACHC	RP1L1	UPB1
CENPV	GCKR	MMADHC	RP1-187N21.4	UPF3B
CENPW	GCLC	MMP1	RP2	UPK2
CEP19	GCLM	MMP2	RP4-608O15.3	UPK3A
CEP41	GCM2	MMP3	RP4-635E18.9	UQCC2
CEP57	GCNT2	MMP9	RP5-877J2.1	UQCC3
CEP63	GCSH	MMP12	RP5-972B16.2	UQCR10
CEP83	GDAP1	MMP13	RP9	UQCR11
CEP135	GDF1	MMP14	RP11-20I23.1	UQCRB
CEP152	GDF2	MMP20	RP11-47I22.4	UQCRC1
CEP164	GDF3	MN1	RP11-73M18.2	UQCRC2
CEP290	GDF5	MNX1	RP11-108O10.8	UQCRFS1
CERKL	GDF5OS	MOCOS	RP11-162P23.2	UQCRH
CERS3	GDF6	MOCS1	RP11-178L8.4	UQCRQ
CETP	GDF9	MOCS2	RP11-195F19.29	UROC1
CFB	GDI1	MOG	RP11-196G11.1	UROD
CFC1	GDNF	MOGS	RP11-201K10.3	UROS
CFD	GEMIN2	MPC1	RP11-286N22.8	USB1
CFH	GEN1	MPDU1	RP11-295K3.1	USF1

CFHR1	GFAP	MPDZ	RP11-315D16.2	USH1C
CFHR2	GFER	MPI	RP11-318A15.7	USH1G
CFHR3	GFI1	MPL	RP11-343C2.9	USH2A
CFHR4	GFI1B	MPLKIP	RP11-343C2.12	USMG5
CFHR5	GFM1	MPO	RP11-366L20.2	USP9X
CFI	GFM2	MPV17	RP11-449H3.3	USP9Y
CFL2	GFPT1	MPZ	RP11-505K9.4	USP24
CFP	GFRA1	MR1	RP11-514O12.4	USP26
CFTR	GGCX	MRAP	RP11-545J16.1	UTP14C
CHAT	GH1	MRAP2	RP11-548K23.11	UTP23
CHCHD10	GHR	MRE11A	RP11-565P22.6	UTRN
CHD1	GHRHR	MROH8	RP11-566K11.2	UVSSA
CHD2	GHRL	MRPL3	RP11-571M6.15	VAMP1
CHD7	GHSR	MRPL44	RP11-574F21.3	VANGL1
CHD8	GIF	MRPL48	RP11-603J24.9	VANGL2
CHDH	GIGYF2	MRPS2	RP11-618P17.4	VAPB
CHEK1	GIPC3	MRPS16	RP11-644F5.10	VARS2
CHEK2	GJA1	MRPS22	RP11-724O16.1	VAV1
CHGB	GJA3	MRRF	RP11-903H12.5	VAX1
CHI3L1	GJA5	MS4A1	RP11-1012A1.4	VCAN
CHIT1	GJA8	MS4A2	RP11-1035H13.3	VCL
CHKB	GJB1	MSH2	RPE65	VCP
CHM	GJB2	MSH3	RPGR	VCY
CHML	GJB3	MSH6	RPGRIP1	VDAC1
CHMP1A	GJB4	MSMB	RPGRIP1L	VDR
CHMP2B	GJB6	MSMO1	RPIA	VEGFA
CHMP4B	GJC1	MSR1	RPL5	VEGFC
CHN1	GJC2	MSRB3	RPL10	VEZT
CHPT1	GK	MSTN	RPL11	VHL
CHRDL1	GLA	MSX1	RPL15	VIM

CHRM3	GLB1	MSX2	RPL19	VIPAS39
CHRNA1	GLCCI1	MTAP	RPL26	VKORC1
CHRNA2	GLDC	MTCH2	RPL35A	VLDLR
CHRNA3	GLE1	MTFMT	RPN2	VMA21
CHRNA4	GLI1	MTHFD1	RPP30	VPS13A
CHRNA5	GLI2	MTHFD1L	RPS4Y2	VPS13B
CHRNA7	GLI3	MTHFR	RPS6KA3	VPS33B
CHRNB1	GLIS2	MTHFS	RPS7	VPS35
CHRNB2	GLIS3	MTM1	RPS10	VPS37A
CHRND	GLMN	MTMR1	RPS10-NUDT3	VPS45
CHRNE	GLO1	MTMR2	RPS11	VPS53
CHRNG	GLRA1	MTMR14	RPS14	VPS54
CHST3	GLRB	MTNR1B	RPS17	VRK1
CHST6	GLRX5	MTO1	RPS19	VSX1
CHST8	GLS	MTOR	RPS24	VSX2
CHST14	GLUD1	MTPAP	RPS26	VWF
CHSY1	GLUL	MTR	RPS29	WARS2
CHUK	GLYCTK	MTRR	RPSA	WAS
CIB2	GM2A	MTTP	RRM1	WASF3
CIDEC	GMPPA	MUC1	RRM2B	WDPCP
CIITA	GMPPB	MUC5B	RS1	WDR11
CILP	GNA11	MUC7	RSPH1	WDR13
CIRH1A	GNA13	MURC	RSPH4A	WDR19
CISD2	GNA14	MUSK	RSPH9	WDR34
CISH	GNAI2	MUT	RSPO1	WDR35
CITED2	GNAI3	MUTYH	RSPO4	WDR36
CIZ1	GNAL	MVK	RTEL1	WDR45
CKM	GNAO1	MXD1	RTN2	WDR60
CKS1B	GNAQ	MXI1	RTN4R	WDR62
CLCC1	GNAS	MYBPC1	RTTN	WDR65

CLCF1	GNAT1	MYBPC3	RUNX1	WDR72
CLCN1	GNAT2	MYC	RUNX2	WDR81
CLCN2	GNB1	MYCN	RUVBL1	WEE1
CLCN4	GNB3	MYD88	RXFP2	WFS1
CLCN5	GNB4	MYF6	RXRA	WHSC1
CLCN7	GNE	MYH2	RYR1	WIPF1
CLCNKA	GNG10	MYH3	RYR2	WISP3
CLCNKB	GNMT	MYH6	SAA1	WNK1
CLDN1	GNPAT	MYH7	SACS	WNK4
CLDN14	GNPTAB	MYH8	SAG	WNT1
CLDN16	GNPTG	MYH9	SALL1	WNT3
CLDN19	GNRH1	MYH10	SALL2	WNT4
CLEC7A	GNRHR	MYH11	SALL4	WNT5A
CLIC2	GNS	MYH14	SAMD9	WNT7A
CLIC5	GOLGA5	MYL2	SAMHD1	WNT10A
CLMP	GOPC	MYL3	SAR1B	WNT10B
CLN3	GORAB	MYL5	SARDH	WRAP53
CLN5	GOSR2	MYLK	SARS2	WRN
CLN6	GOT1	MYLK2	SART3	WT1
CLN8	GP1BA	MYO1A	SAT1	WWC1
CLP1	GP1BB	MYO1C	SATB2	WWOX
CLPP	GP5	MYO1E	SBDS	WWTR1
CLRN1	GP6	MYO1F	SBF1	XBP1
CLU	GP9	MYO3A	SBF2	XDH
CLYBL	GPAM	MYO5A	SC5D	XIAP
CMC1	GPC1	MYO5B	SCARB1	XIST
CMSS1	GPC3	MYO6	SCARB2	XIST_intron
CNBP	GPC4	MYO7A	SCARF2	XK
CNGA1	GPC5	MYO9B	SCGB1A1	XKRY
CNGA3	GPC6	MYO15A	SCGB3A2	XPA

CNGB1	GPD1	MYOC	SCGN	XPC
CNGB3	GPD1L	MYOM1	SCN1A	XPNPEP2
CNKSR2	GPD2	MYOT	SCN1B	XPNPEP3
CNKSR3	GPHN	MYOZ1	SCN2A	XRCC2
CNNM2	GPI	MYOZ2	SCN2B	XRCC3
CNNM4	GPIHBP1	MYPN	SCN3A	XRCC4
CNR1	GPR56	NAA10	SCN3B	XXbac-BPG116M5.17
CNTN1	GPR98	NADK	SCN4A	XXbac-BPG246D15.9
CNTN2	GPR113	NADK2	SCN4B	XYLT1
CNTNAP2	GPR143	NAGA	SCN5A	XYLT2
CNTNAP5	GPR179	NAGLU	SCN7A	Xist_exon1
COA5	GPSM2	NAGPA	SCN8A	Xist_exon4
COASY	GPX1	NAGS	SCN9A	YAP1
COCH	GPX4	NALCN	SCN10A	YARS
COG1	GRB10	NANOS1	SCN11A	YARS2
COG4	GREM1	NARS2	SCNN1A	YWHAE
COG5	GRHL2	NAT2	SCNN1B	YWHAZ
COG6	GRHL3	NAT8L	SCNN1G	ZACN
COG7	GRHPR	NBAS	SCO1	ZAP70
COG8	GRIA3	NBEAL2	SCO2	ZBTB12
COL1A1	GRIK2	NBN	SCP2	ZBTB16
COL1A2	GRIN1	NCF1	SDC3	ZBTB18
COL2A1	GRIN2A	NCF2	SDCCAG8	ZBTB20
COL3A1	GRIN2B	NCF4	SDHA	ZBTB24
COL4A1	GRIP1	NCOA4	SDHAF1	ZBTB25
COL4A2	GRK1	NCR3	SDHAF2	ZC3H14
COL4A3	GRK4	NCSTN	SDHB	ZC4H2
COL4A4	GRM1	NDE1	SDHC	ZCCHC12

COL4A5	GRM6	NDEL1	SDHD	ZDHHC9
COL4A6	GRN	NDN	SEC23A	ZDHHC15
COL5A1	GRPR	NDP	SEC23B	ZEB1
COL5A2	GRXCR1	NDRG1	SEC61A1	ZEB2
COL5A3	GRXCR2	NDST1	SEC63	ZFAT
COL6A1	GSC	NDUFA1	SECISBP2	ZFHX3
COL6A2	GSN	NDUFA2	SELE	ZFHX4
COL6A3	GSPT2	NDUFA3	SELP	ZFP57
COL7A1	GSR	NDUFA4	SEMA3A	ZFPM2
COL8A2	GSS	NDUFA5	SEMA3E	ZFY
COL9A1	GSTM1	NDUFA6	SEMA4A	ZFYVE26
COL9A2	GSTP1	NDUFA7	SEMA7A	ZFYVE27
COL9A3	GSTZ1	NDUFA8	SEPN1	ZIC1
COL10A1	GTDC2	NDUFA9	SEPSECS	ZIC2
COL11A1	GTF2H5	NDUFA10	SEPT6	ZIC3
COL11A2	GUCA1A	NDUFA11	SEPT9	ZIC4
COL12A1	GUCA1B	NDUFA12	SEPT12	ZMPSTE24
COL17A1	GUCA2B	NDUFA13	SERAC1	ZMYM3
COL18A1	GUCY1A3	NDUFAB1	SERPINA1	ZMYND10
COL27A1	GUCY2C	NDUFAF1	SERPINA3	ZMYND11
COLEC11	GUCY2D	NDUFAF2	SERPINA6	ZMYND15
COLQ	GUSB	NDUFAF3	SERPINA7	ZNF41
COMP	GYG1	NDUFAF4	SERPINA10	ZNF81
COMT	GYPA	NDUFAF5	SERPINB6	ZNF141
COPB2	GYPB	NDUFAF6	SERPINB7	ZNF335
COQ2	GYPC	NDUFAF7	SERPINC1	ZNF365
COQ3	GYS1	NDUFB1	SERPIND1	ZNF407
COQ4	GYS2	NDUFB2	SERPINE1	ZNF423
COQ5	H6PD	NDUFB3	SERPINF1	ZNF469
COQ6	H19	NDUFB4	SERPINF2	ZNF507

COQ7	H19_1	NDUFB5	SERPING1	ZNF513
COQ9	H19_2	NDUFB6	SERPINH1	ZNF526
CORIN	HABP2	NDUFB7	SERPINI1	ZNF575
CORO1A	HADH	NDUFB8	SETBP1	ZNF592
COX4I1	HADHA	NDUFB9	SETD5	ZNF644
COX4I2	HADHB	NDUFB10	SETX	ZNF674
COX5A	HAGH	NDUFB11	SF3B1	ZNF711
COX5B	HAL	NDUFC1	SF3B4	ZNF750
COX6A1	HAMP	NDUFC2	SFTPA1	ZNF804A
COX6A2	HARS	NDUFC2-KCTD14	SFTPA2	ZNF829
COX6B1	HARS2	NDUFS1	SFTPB	ZNHIT6
COX6C	HAVCR1	NDUFS2	SFTPC	ZP1
COX7A1	HAX1	NDUFS3	SFTPD	ZRANB3
COX7A2	HBA1	NDUFS4	SFXN4	ZSWIM6
COX7A2L	HBA2	NDUFS5	SGCA	hsa-mir-96
COX7B	HBB	NDUFS6	SGCB	hsa-mir-182
COX7B2	HBD	NDUFS7	SGCD	hsa-mir-183
COX7C	HBE1	NDUFS8	SGCE	hsa-mir-184
COX8A	HBG1	NDUFV1	SGCG	hsa-mir-2861
COX10	HBG2	NDUFV2	SGSH	hsa-mir-3960