

Table S1 Study abbreviation and number of cases

Study abbreviation	Study name	Number of cases
LAML	Acute myeloid leukemia	173
ACC	Adrenocortical carcinoma	78
BLCA	Bladder urothelial carcinoma	426
LGG	Brain lower grade glioma	527
BRCA	Breast invasive carcinoma	1201
CESC	Cervical squamous cell carcinoma and endocervical adenocarcinoma	299
CHOL	Cholangiocarcinoma	45
COAD	Colon adenocarcinoma	475
ESCA	Esophageal carcinoma	192
GBM	Glioblastoma multiforme	201
HNSC	Head and neck squamous cell carcinoma	561
KICH	Kidney chromophobe	89
KIRC	Kidney renal clear cell carcinoma	581
KIRP	Kidney renal papillary cell carcinoma	316
LIHC	Liver hepatocellular carcinoma	418
LUAD	Lung adenocarcinoma	569
LUSC	Lung squamous cell carcinoma	534
DLBC	Lymphoid neoplasm diffuse large B-cell lymphoma	48
MESO	Mesothelioma	87
OV	Ovarian serous cystadenocarcinoma	303
PAAD	Pancreatic adenocarcinoma	182
PCPG	Pheochromocytoma and paraganglioma	186
PRAD	Prostate adenocarcinoma	546
READ	Rectum adenocarcinoma	163
SARC	Sarcoma	259
SKCM	Cutaneous melanoma	469
STAD	Stomach adenocarcinoma	447
TGCT	Testicular germ cell tumors	138
THYM	Thymoma	121
THCA	Thyroid carcinoma	568
UCS	Uterine carcinosarcoma	57
UCEC	Uterine corpus endometrial carcinoma	550
UVM	Uveal melanoma	80

Table S2 The coefficient values of genes are included in the final model

Predictor	Coefficient value
<i>C2orf18</i>	0.300852407
<i>PTK2</i>	0.242215773
<i>FKBP5</i>	0.231662872
<i>DCN</i>	0.223877955
<i>FOSB</i>	0.221057365
<i>PTPRE</i>	0.210010009
<i>CAV1</i>	0.207495453
<i>CAMK2N1</i>	0.196625042
<i>ETV1</i>	0.194502905
<i>CHD3</i>	0.190458013
<i>EXT2</i>	0.188940626
<i>CD200</i>	0.185461899
<i>MMP9</i>	0.18499858
<i>RARG</i>	0.184466599
<i>SOX13</i>	0.18263483
<i>PDLIM4</i>	0.182004634
<i>HNRNPH2</i>	0.169171491
<i>NEK7</i>	0.159721077
<i>SULF2</i>	0.158557026
<i>JAZF1</i>	0.155588028
<i>DDRGK1</i>	0.154423318
<i>SORL1</i>	0.153924494
<i>LIMA1</i>	0.149032802
<i>UNC45A</i>	0.14470599
<i>ITIH5</i>	0.143173781
<i>ETNK1</i>	0.141935617
<i>GBAS</i>	0.141174046
<i>ALDH1A1</i>	0.138736872
<i>C1S</i>	0.138443724
<i>PIGQ</i>	0.131092706
<i>HSPA8</i>	0.126238315
<i>RTKN</i>	0.125980941
<i>VAPB</i>	0.123207175
<i>DHCR24</i>	0.123195818

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>TTC3</i>	0.118698045
<i>OXCT1</i>	0.118598478
<i>TBC1D1</i>	0.116858115
<i>PCMT1</i>	0.116309156
<i>PPP2R5A</i>	0.114435214
<i>PSMD1</i>	0.113489528
<i>CRISPLD2</i>	0.113425698
<i>MRPS24</i>	0.113278028
<i>SPRED2</i>	0.113043484
<i>WIPI2</i>	0.110292944
<i>LY6E</i>	0.109968565
<i>NRIP1</i>	0.10895298
<i>CCT4</i>	0.108176808
<i>TXNIP</i>	0.107679718
<i>PPP1R9A</i>	0.106847612
<i>AKT2</i>	0.105905525
<i>ITGA2</i>	0.10515576
<i>MLPH</i>	0.100495855
<i>NFKB1</i>	0.100488573
<i>GDE1</i>	0.099253853
<i>NF1</i>	0.09861373
<i>C1QTNF1</i>	0.098279261
<i>MARCH6</i>	0.09818392
<i>RETSAT</i>	0.097431727
<i>FBXO34</i>	0.094880043
<i>NFATC4</i>	0.094651548
<i>C5orf62</i>	0.092537745
<i>ATF5</i>	0.092266395
<i>SAMD4A</i>	0.091851926
<i>C10orf58</i>	0.091821872
<i>LPHN1</i>	0.091206168
<i>ADCY6</i>	0.089464002
<i>CD55</i>	0.089235938
<i>CCND1</i>	0.088506258

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
SFRP2	0.087677229
ZNF83	0.087546468
TPD52L1	0.085712481
LPIN2	0.084126614
GTF2IP1	0.083390487
S100A4	0.08288983
PXN	0.082238383
MYO1E	0.081908354
STK17B	0.080614539
SMG6	0.080131022
MYO5B	0.078605001
TRIB1	0.078588893
SERPING1	0.077370566
EIF3I	0.077357538
SQSTM1	0.077295597
GLOD4	0.07718981
NDUFA10	0.07701059
CCDC6	0.076946383
RNF144A	0.076929418
FYN	0.076595277
CCNG2	0.07645841
ELP2	0.076066824
MFSD1	0.074244674
STC1	0.072967766
PCGF2	0.072520212
PYGO2	0.071519324
SGK223	0.070781512
SNX9	0.068813508
RARRES2	0.068414047
PTPRU	0.068397909
TXNDC12	0.06819452
YWHAE	0.067861886
ATF7IP	0.067669038
NCS1	0.067328748

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
SUMO1	0.066229742
ATP1B1	0.065661254
TCEAL8	0.065435389
AGPAT3	0.065368532
EP400	0.064906137
NBL1	0.063939314
RTN3	0.063369972
NAP1L1	0.062870275
SMC5	0.061187484
PAFAH1B1	0.060463032
TCIRG1	0.060099389
FMOD	0.059363374
SFRS6	0.059319976
TRAK1	0.059221807
DNAJA4	0.058812443
TTC19	0.058609681
UPF1	0.058099781
BBX	0.057647272
SERPINF1	0.057243117
ADAM15	0.057133469
ITPRIPL2	0.056725428
UBB	0.056092814
PSIP1	0.055793463
AKAP2	0.055220868
ATP6V0E2	0.054865422
GGCT	0.05395249
LRRC8A	0.052489697
SMARCC2	0.052266561
RRM1	0.052092938
TMEM9	0.051126731
CD59	0.05071526
SEC11C	0.050690072
ECHDC1	0.050320647
FOSL2	0.050100302

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>TBL1XR1</i>	0.050044447
<i>POLE3</i>	0.050011027
<i>PRDX6</i>	0.049746269
<i>SCYL1</i>	0.04970137
<i>KIAA0284</i>	0.04952663
<i>TMEM115</i>	0.049371505
<i>ASAP2</i>	0.048787608
<i>EWSR1</i>	0.048755607
<i>RAP1GAP2</i>	0.04844853
<i>SPTBN1</i>	0.048277591
<i>TMED3</i>	0.048243962
<i>RELL1</i>	0.047672887
<i>C2orf28</i>	0.046125098
<i>NR2F2</i>	0.045858868
<i>SLC29A1</i>	0.045743246
<i>NUP50</i>	0.045634565
<i>MSN</i>	0.045223306
<i>NAP1L4</i>	0.045084993
<i>GTPBP2</i>	0.044673267
<i>PDGFRA</i>	0.044646466
<i>EFR3B</i>	0.044415726
<i>MCM5</i>	0.044285624
<i>C20orf3</i>	0.043861156
<i>NDUFB9</i>	0.04328223
<i>SKAP2</i>	0.043165334
<i>ETV4</i>	0.042880029
<i>SPOCK2</i>	0.042529934
<i>SEC61G</i>	0.042423094
<i>USP48</i>	0.042373017
<i>CNIH</i>	0.041370304
<i>ERRFI1</i>	0.041155552
<i>SH3GLB2</i>	0.0411296
<i>C1orf116</i>	0.040877909
<i>CTAGE5</i>	0.04087093

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>HIPK2</i>	0.040434807
<i>NXN</i>	0.040413567
<i>UBA1</i>	0.040376974
<i>AK3</i>	0.040244489
<i>TIMP1</i>	0.039665115
<i>VPS53</i>	0.038876352
<i>GBP4</i>	0.038021839
<i>CHD2</i>	0.037810724
<i>NEAT1</i>	0.037157293
<i>MAP3K5</i>	0.037037163
<i>PIGY</i>	0.036502849
<i>RPS17</i>	0.036204355
<i>LSM4</i>	0.03558709
<i>TESC</i>	0.035548457
<i>PRDM1</i>	0.035180784
<i>FAM111A</i>	0.034755251
<i>CBR1</i>	0.0346988
<i>PACSIN2</i>	0.034450275
<i>RRP7A</i>	0.033567084
<i>HCP5</i>	0.033013885
<i>IFNGR2</i>	0.032854811
<i>AFAP1L2</i>	0.032535422
<i>GLG1</i>	0.032162567
<i>DLST</i>	0.032072897
<i>ZNF385A</i>	0.03205089
<i>CDK14</i>	0.032021909
<i>SPTBN2</i>	0.031855716
<i>PLXNB2</i>	0.031240957
<i>TM7SF3</i>	0.031234756
<i>PTP4A2</i>	0.03115106
<i>KIAA1797</i>	0.030899719
<i>NFKBIA</i>	0.030786842
<i>R3HDM2</i>	0.030557894
<i>MBP</i>	0.029986966

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>SUDS3</i>	0.029841016
<i>SCD5</i>	0.029156601
<i>ANGPTL2</i>	0.029023953
<i>RBM15B</i>	0.028549076
<i>MAT2B</i>	0.028383461
<i>BTG1</i>	0.028292035
<i>SIPA1L1</i>	0.027565644
<i>NFIC</i>	0.026843709
<i>HBP1</i>	0.026437415
<i>TGFBR1</i>	0.02628822
<i>HES6</i>	0.026094211
<i>TGFB1</i>	0.026006626
<i>GOLGA2</i>	0.025942691
<i>GHDC</i>	0.025767253
<i>WTAP</i>	0.025103408
<i>GSDMD</i>	0.02419907
<i>GUSB</i>	0.024128359
<i>CYB5R3</i>	0.023177287
<i>MAGEF1</i>	0.023152326
<i>SYAP1</i>	0.022540284
<i>SLC38A5</i>	0.022433217
<i>MCM2</i>	0.022196407
<i>RTN4</i>	0.021069441
<i>MAFF</i>	0.020695304
<i>FNBP4</i>	0.020363354
<i>PSAT1</i>	0.019667722
<i>ARHGAP29</i>	0.01859355
<i>CHMP5</i>	0.018396141
<i>CD109</i>	0.018370657
<i>SAE1</i>	0.018175123
<i>PUM2</i>	0.017946844
<i>ANO6</i>	0.017709732
<i>IPO9</i>	0.017702399
<i>TNIP1</i>	0.01745877

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>POLR2J3</i>	0.017379979
<i>USP53</i>	0.0171379
<i>GNG12</i>	0.017052882
<i>ARAP2</i>	0.016630591
<i>NPM1</i>	0.016008692
<i>ENO2</i>	0.015019148
<i>DCAKD</i>	0.014914673
<i>LOC729678</i>	0.014413783
<i>ENPP2</i>	0.013956892
<i>FBLN2</i>	0.013531858
<i>MAP3K11</i>	0.013529472
<i>RB1CC1</i>	0.013283522
<i>PFKFB2</i>	0.013252072
<i>EIF4B</i>	0.013235598
<i>UXS1</i>	0.013038237
<i>ATP6V1H</i>	0.012893538
<i>MAN2C1</i>	0.012775558
<i>RSL24D1</i>	0.011258685
<i>PLDN</i>	0.011236057
<i>SEPN1</i>	0.010736932
<i>SPTLC1</i>	0.01025044
<i>TNS1</i>	0.010233013
<i>ERGIC1</i>	0.010142683
<i>BTN3A2</i>	0.009788192
<i>VTI1B</i>	0.009341172
<i>GPBP1</i>	0.009219948
<i>LLGL1</i>	0.008821434
<i>BASP1</i>	0.008584885
<i>LYN</i>	0.008461498
<i>CHPF</i>	0.008158752
<i>ZNF655</i>	0.008016446
<i>TBC1D9B</i>	0.007769478
<i>GPRC5B</i>	0.007600647
<i>GCNT1</i>	0.007451532

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
DEF8	0.006858562
ELOVL5	0.006762684
NFIX	0.006750099
MAP1S	0.006531209
GLTP	0.005668953
HSPA1B	0.005262617
SURF4	0.005211659
TMEM106B	0.005012405
HR	0.004917522
ATOH8	0.004234544
RXRA	0.003809947
BCL9	0.003490803
MTMR3	0.003296681
GOLPH3	0.002587358
RHEB	0.002064214
CYFIP1	0.001686961
WBSCR22	0.0012452
NDN	0.000731356
CBX1	0.000396352
TSKU	0.000355837
OLA1	9.93E-05
SEC11A	3.87E-05
LMBR1	-0.000257917
RALB	-0.000790209
CPNE1	-0.000876725
EIF1	-0.001085181
HNRNPA3	-0.00119446
SNX30	-0.001462602
MXD4	-0.001550677
DDX17	-0.001758997
MDC1	-0.001947092
SNN	-0.003317511
GPR116	-0.003493555
SMG7	-0.003980306

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
LAPTM4B	-0.004413844
PRDX2	-0.004693262
SLC22A18	-0.00470786
CYB5B	-0.00500726
PRKCZ	-0.005328095
IGSF3	-0.005849043
ERP29	-0.005982709
RPS18	-0.006011407
KIF5B	-0.006309243
AP2B1	-0.006360396
SPIRE1	-0.006815129
IRAK1	-0.00695366
LPCAT3	-0.00799526
CCNB1IP1	-0.00806399
RPS28	-0.008142391
CLIC4	-0.008265078
UNC13B	-0.009548794
ARHGAP21	-0.010145058
NRAS	-0.010344558
MYL12A	-0.010957177
CABC1	-0.011429478
CKB	-0.011443354
TFG	-0.0117612
BTF3	-0.011766326
ATHL1	-0.011953832
SMARCD2	-0.012226032
BAT2	-0.012854295
RPL9	-0.012874824
ATF6B	-0.013189555
COBLL1	-0.013254689
TGFBR2	-0.013435888
CCDC47	-0.013680079
GBP3	-0.013936651
VWA1	-0.014001641

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>PTP4A1</i>	-0.01433804
<i>TMEM8B</i>	-0.014942868
<i>HEBP1</i>	-0.015682821
<i>SOD3</i>	-0.015693624
<i>NR1D1</i>	-0.015990961
<i>FOXO1</i>	-0.016082349
<i>RAB32</i>	-0.016466656
<i>STXBP2</i>	-0.016960306
<i>TOP2B</i>	-0.017124383
<i>WFDC2</i>	-0.017529991
<i>AUTS2</i>	-0.018320643
<i>CDCA7L</i>	-0.019269484
<i>TRAF4</i>	-0.019329704
<i>EMD</i>	-0.020966912
<i>NT5E</i>	-0.021106556
<i>KIAA0114</i>	-0.02136284
<i>BRP44</i>	-0.02167878
<i>VWF</i>	-0.02247171
<i>TUBB6</i>	-0.023098405
<i>KIF13A</i>	-0.023113696
<i>ZNF185</i>	-0.023218593
<i>DBNDD2</i>	-0.023256556
<i>FXVD6</i>	-0.023258567
<i>RDBP</i>	-0.023456228
<i>VAMP3</i>	-0.023808528
<i>CEBPG</i>	-0.024574337
<i>C13orf23</i>	-0.024595323
<i>ST6GALNAC2</i>	-0.024782139
<i>PDIA3P</i>	-0.025981466
<i>GALNT2</i>	-0.026150768
<i>RPL22</i>	-0.026237191
<i>ANXA6</i>	-0.026695156
<i>UACA</i>	-0.026806383
<i>SH3GLB1</i>	-0.02773001

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
<i>RAF1</i>	-0.027736061
<i>WIPI1</i>	-0.027825138
<i>CLMN</i>	-0.027856652
<i>CRELD1</i>	-0.0279438
<i>GNB4</i>	-0.028291925
<i>CERK</i>	-0.028322649
<i>PLEKHG4</i>	-0.028333032
<i>NAGLU</i>	-0.028679814
<i>CHD7</i>	-0.028934513
<i>LASP1</i>	-0.029179397
<i>KAT2B</i>	-0.03025785
<i>PHF10</i>	-0.03044976
<i>TRIM26</i>	-0.031257552
<i>BAIAP2L1</i>	-0.031640993
<i>SLC6A6</i>	-0.0318446
<i>LAP3</i>	-0.032119672
<i>C14orf147</i>	-0.032932233
<i>RGS3</i>	-0.033292326
<i>MSL1</i>	-0.033626781
<i>CDH3</i>	-0.033715721
<i>ZC3H15</i>	-0.033864524
<i>NID1</i>	-0.033926048
<i>SELM</i>	-0.034511258
<i>OAT</i>	-0.03490598
<i>MXRA7</i>	-0.034935448
<i>MICALL1</i>	-0.036654621
<i>TGFBI</i>	-0.036719332
<i>CDC42EP4</i>	-0.03689641
<i>PPIC</i>	-0.036911223
<i>RRAS</i>	-0.038003268
<i>COASY</i>	-0.038211104
<i>WDR46</i>	-0.038339238
<i>FADS2</i>	-0.038479982
<i>XPO6</i>	-0.040258807

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
CBS	-0.040436944
P4HA2	-0.040516737
TP53I11	-0.040963114
CPNE2	-0.041063973
PER3	-0.042268341
FLOT2	-0.04245193
MOGS	-0.043317534
MEPCE	-0.043440585
IK	-0.043984375
UBP1	-0.044100347
POLDIP2	-0.045119453
RAB20	-0.04546407
SYNPO	-0.046583199
SREBF1	-0.046636772
DDB1	-0.047282074
VASP	-0.047463586
ProSAPIP1	-0.048404754
CTR9	-0.048547135
KCTD10	-0.05021229
SH3BP4	-0.050842515
FERMT3	-0.051149121
SLC2A4RG	-0.051497112
LIMD1	-0.051648348
SEPT11	-0.051733494
TMEM87A	-0.051892977
RHOB	-0.053096316
HLA-F	-0.054014581
GALC	-0.054115181
IDH3G	-0.054639863
SLFN11	-0.054945433
CDC16	-0.056489981
GRAMD1A	-0.056871659
TAPBPL	-0.056949825
ACADM	-0.057122018

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
CISH	-0.057345796
CAPN2	-0.05738308
ADAMTS1	-0.057389454
ATP5G3	-0.057841547
STOML2	-0.057904155
GM2A	-0.058118052
C1orf9	-0.058571428
SEMA5A	-0.05870784
UBE2D2	-0.059462263
CALR	-0.06083565
SLC39A7	-0.060907386
CD97	-0.06165926
SLC11A2	-0.062257361
TIMM17B	-0.062804166
APOLD1	-0.063116755
FAM198B	-0.063272058
NME4	-0.063512399
GIT1	-0.064421909
ELF1	-0.065827339
PTK7	-0.066277901
NOMO1	-0.066736764
TRIM47	-0.068284061
PURB	-0.068406362
BAK1	-0.068698233
SCRN2	-0.069026122
CORO7	-0.069467822
PTEN	-0.069512183
SLC39A10	-0.070002984
PIK3R1	-0.070371231
THBS1	-0.070565654
JHDM1D	-0.07084167
PIGS	-0.071583087
PTP4A3	-0.07162628
PLCE1	-0.071852887

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
COL4A1	-0.072707057
RAP2A	-0.072733308
PCIF1	-0.073744716
TP53INP1	-0.074066594
RAPH1	-0.074366176
DUS1L	-0.074762256
BMI1	-0.07703215
PDIA3	-0.078121799
COL17A1	-0.07873817
AEN	-0.079981193
SLC39A8	-0.081255312
NRBP1	-0.081584261
INTS10	-0.081838736
RMND5A	-0.082888045
HES1	-0.084381521
PPP1R3B	-0.086304276
PRDX1	-0.087152088
NNT	-0.089377209
CAPNS1	-0.090180193
PLIN2	-0.091672262
C11orf95	-0.093546732
EIF2AK4	-0.093723433
FLOT1	-0.09394406
IRS1	-0.094171528
DDX27	-0.094357701
PPT1	-0.094385778
EXTL3	-0.096233924
DAZAP2	-0.096820772
PRDX5	-0.098132458
PDZK1IP1	-0.099555814
THNSL2	-0.10147727
YARS	-0.10168223
LAMA1	-0.102704687
IGF2R	-0.102987157

Table S2 (continued)

Table S2 (continued)

Predictor	Coefficient value
CHST3	-0.104077894
GLYR1	-0.107735232
ALKBH7	-0.109885778
TMEM64	-0.110595607
PHC2	-0.111057907
GLCE	-0.111719993
PBRM1	-0.112828642
RGMB	-0.120761461
GPCPD1	-0.125270358
PPM1H	-0.125579953
DGAT2	-0.126890155
INPP5D	-0.127119869
INPPL1	-0.127660696
OXR1	-0.132848307
SLC39A11	-0.135392652
SPOCK1	-0.137435566
NKIRAS2	-0.137814176
SPRY4	-0.148713899
TMEM132A	-0.150682888
ERBB2IP	-0.156661288
ECM1	-0.157230177
EPDR1	-0.157640704
NEO1	-0.161370461
GSPT1	-0.16385327
RHOA	-0.165882881
EIF4EBP2	-0.174006524
SH3BGRL	-0.178800121
GALNT10	-0.178853545
CASK	-0.184428293
IER2	-0.191224485
TBC1D5	-0.21945529
PLCB4	-0.232494231
VAV3	-0.235682487
EGR1	-0.266768911
CRYZ	-0.27413205
IQSEC1	-0.280122156

Table S3 Gene ontology test result

PANTHER Pathways	Homo sapiens - REFLIST (20,595)	Predictor genes (544)	Predictor genes (expected)	Predictor genes (over/under)	Predictor genes (fold enrichment)	Predictor genes (raw P value)	Predictor genes (FDR)
Insulin/IGF pathway- protein kinase B signaling cascade (P00033)	39	7	1.03	+	6.8	1.61E-04	4.49E-03
PI3 kinase pathway (P00048)	57	9	1.51	+	5.98	4.65E-05	1.94E-03
Endothelin signaling pathway (P00019)	85	8	2.25	+	3.56	2.74E-03	5.09E-02
Integrin signalling pathway (P00034)	193	18	5.1	+	3.53	9.57E-06	7.99E-04
Apoptosis signaling pathway (P00006)	118	11	3.12	+	3.53	5.12E-04	1.22E-02
T cell activation (P00053)	86	8	2.27	+	3.52	2.93E-03	4.90E-02
CCKR signaling map (P06959)	172	15	4.54	+	3.3	1.05E-04	3.51E-03
Inflammation mediated by chemokine and cytokine signaling pathway (P00031)	255	20	6.74	+	2.97	3.26E-05	1.81E-03
Gonadotropin- releasing hormone receptor pathway (P06664)	231	15	6.1	+	2.46	1.87E-03	3.89E-02
Unclassified (UNCLASSIFIED)	17,977	435	474.85	-	0.92	2.64E-06	4.40E-04

FDR, false discovery rate; CCKR, cholecystokinin receptors; IGF, insulin-like growth factor.