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# Analysis of telomerase target gene expression effects from murine models in patient cohorts by homology translation and random survival forest modeling

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### ABSTRACT

Acute myeloid leukemia (AML) is an aggressive and rapidly fatal blood cancer that affects patients of any age group. Despite an initial response to standard chemotherapy, most patients relapse and this relapse is mediated by leukemia stem cell (LSC) populations. We identified a functional requirement for telomerase in sustaining LSC populations in murine models of AML and validated this requirement using an inhibitor of telomerase in human AML. Here, we describe in detail the contents, quality control and methods of the gene expression analysis used in the published study (Gene Expression Omnibus GSE63242). Additionally, we provide annotated gene lists of telomerase regulated genes in AML and R code snippets to access and analyze the data used in the original manuscript.

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Specifications	
Organism/cell line/tissue	Mus musculus
Sequencer or array type	Illumina MouseWG-6 v2.0 expression beadchip
Data format	Raw and processed data
Experimental factors	G3 Terc –/ – LSC versus WT LSC
Experimental features	Total RNA obtained from G3 Terc $-/-$ LSCs compared
	to WT LSCs (MLLAF9+gfp+, Lin-, Kit+, FcgR+) purified
	from primary recipients at individual disease onset.
Consent	Public available data
Sample source location	N/A

# 1. Direct link to deposited data

The online data can be accessed at: http://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE63242

<sup>1</sup> Denotes equal contribution.

### 2. Experimental design, materials and methods

# 2.1. Objective

To determine whether the gene expression changes induced by telomerase loss in a mouse model of acute myeloid leukemia have relevance to human disease.

### 2.2. Preparation of mouse microarray samples

### 2.2.1. Generation of murine leukemia

Murine AML was generated by isolating purified hematopoietic stem and progenitor cell populations using fluorescent activated cell sorting (FACS on lineage<sup>negative</sup>Kit<sup>+</sup>Sca1<sup>+</sup>) from wild type C57Bl6 (WT) or 3rd generation Terc -/- mice. Stem cells were transduced with retrovirus pMIG-MLLAF9 [4,10] and injected into irradiated WT recipient mice (5.5Gy radiation) via the lateral tail vein. At disease onset, bone marrow was harvested from the mice and purified leukemia stem cell enriched populations were obtained by FACS (GFP<sup>+</sup> lineage<sup>negative</sup>Kit<sup>+</sup> Sca1<sup>-</sup> FcgR<sup>+</sup>).

### 2.2.2. Preparation of microarray samples

WT and G3 Terc -/- MLL-AF9 LSC were purified from primary recipients at AML onset. RNA was extracted with a QIAGEN RNeasy

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Micro Kit, preamplified with the Illumina TotalPrep RNA Amplification Kit, and hybridized on Illumina MouseWG-6 v2.0 BeadChip array.

### 2.3. Analysis of microarray data

### 2.3.1. Mouse Terc -/- expression array pre-processing

Illumina MouseWG-6 v2 BeadChip array images were processed with default parameters by Illumina GenomeStudio including trimming and collapsing of beads. The arrays were processed using a single color to determine the expression intensities (green). In R (programming language for statistical computing) [13] we imported the expression intensities from the resulting idat files using IDATreader (http://www. compbio.group.cam.ac.uk/software/idatreader). The IDATreader package imports the binary .idat-files and returns a data frame with values from GenomeStudio summarized over beads, including statistics on the background intensity and the number of good beads used for the trimmed, averaged, and binned final value for each probe that we used for further processing. The Illumina bin codes were used to correctly annotate each bin to probe with information acquired from Illumina webpage (http://support.illumina.com/array/downloads.html).

In order to import the dataset into R and make a standard expression Set class run the following code:

```
#install library if not present, and import
  if (!"GEOquery" %in% installed.packages())
  {source("http://bioconductor.org/biocLite.R");
biocLite("GEOquery") };
  library(GEOguery);
```

```
#download the data
geoData <-getGEO('GSE63242')
```

#extract the expressionSet class Geset <- geoData [[1]]

# use sample names in the expression matrix colnames (exprs (Geset)) = as.character (pDta (Geset) [['title']])

# 2.3.2. Quality control

In order to test for quality of the arrays we used the Bioconductor [5] package arrayQualityMetrics [9]. Here we found that one array failed



(7166151049\_F) and the density distribution was slightly more narrow (Fig. 1, higher blue stippled line). In the principle component analysis plot, which allows 2D inspection of the relation between samples using information from all probes (full dimensionality), we see that the sample marked for low quality lies in between all the rest of the samples, and does not look like an outlier. Hence, the biological signal (although having less quantitative intensity) is in line with the rest of the samples. We therefore decided to include it in the further analysis. The signal appears to be weaker, but not diverging from the replicates. For reuse of this data set some attention should be given to whether the signal in the sample is strong enough, if none of the replicates are used. Furthermore, we decided to include a technical replicate (7166151048\_F\_Grn) in the analysis to be able to better model between-array variance.

The data were background corrected with bgAjust, using the Illumina control probes and normalized using variance stabilization transformation [12] and quantile normalized (quantile bin size = 1, as described by Bolstad et al. [2]) in the multistep function lumiExpresso in the R package lumi [5] (Fig. 2).

It has been previously described that the provided probe annotation from Illumina includes imprecise or erroneous entries [2]. Therefore probes were re-annotated using a multiple sequence alignment based directory as described previously [7] (version mm9\_V1.0.0\_Aug09). For analysis where a very high specificity is preferred at the cost of the total measured transcripts a filtering for poor or unspecific probes was performed as described previously [1].

For differential expression analysis between Wild type mouse (WT) and Terc -/- groups, we used the standard limma package pipeline using eBayes on the Im Fit object of an expressionSet of all 12 samples. A top 140 probes were selected, corresponding to an unadjusted alpha of 0.001 (Table 1).

### 2.4. Translation of murine telomerase regulated genes into human AML

In order to translate differentially expressed genes into human homologs we used HomoloGene (downloaded at http://www.ncbi.nlm. nih.gov/homologene, build 67), which is a dictionary of speciesspecific genes translated into cross species genes identifiers. Currently, a more direct and precise solution for species conversion of genes could be obtained though the R interface to Biomart (http://www.

### Density profile for raw data

Fig 1. Density distribution of expression intensities of probes for the 12 arrays. One sample was marked outlier by arrayQualityMetrics based on a more narrow density profile (7166151049\_F).



**Fig. 2.** Principle component analysis of microarrays, showing clustering of wild type and G3 Terc -/- samples. Furthermore, one sample marked for low quality (sample 12, triangle) lies in center of the plot and does thus not drag the axis of the PCA, having a signal which is weaker than the rest of the samples, but not diverging from them. Right plot shows the normalized data (lumi package for R) and left is the un-normalized data. Here, the technical replicates are closely associated, as expected.

biomart.org). From this conversion 112 genes could be translated into human counterparts (see Table 1).

To assess whether differentially expressed genes from our mouse model could separate patient data we used unsupervised Hierarchical clustering with the 112 genes in R with the Hartigan–Wong algorithm [7] with ten random starts for robust clustering. The patient data was publicly available data from GSE15210, where the survival information can also be found. We did indeed see that the 5 groups of patients with distinct expression patterns of these genes displayed significantly different survival patterns.

In order to pinpoint the TERC related genes that were driving the difference in patient survival we used Random survival forest (RSF) models [3]. We built the RSF using censored (known date of death) and uncensored survival observations in a survival model as implemented by Ishwaran and Kogalur, 2010 [8]. We doubled the number of deregulated gene homologs from the Terc -/- experiment as training set for the model, in order to gain some depth of the trees, while still retaining only TERC associated genes. Our RSF consisted of 20,000 decision trees, each trained on a subset of the data (bootstrapping), in such a way that it best explains the survival of the patients; lastly a majority vote between the trees gives the final prediction for new samples. RSF analysis for survival models is a powerful way to assess driving genes since many genes are known to be co-regulated or otherwise show correlating expression patters. Since RSF is an ensemble model (results are summarized over multiple models) made with bootstrapping (only some of data is used to make each model) it is not sensitive to collinearity between the covariates, that is, the highly correlating genes A and B will not be featuring together in all models, and hence correct assessment of the impact of the individual contribution of A will be less dependent on B. Current standards like Cox proportional hazard regression assume no collinearity. In order to assess which genes are driving survival for the Terc -/- signature we used random permutation of a random selection of the labels, and thus the importance measure was the increase in error rate when a label was permuted, summarized over all the trees. In this way we are able to find which genes in our signature drive the importance of survival.

In order to work with the validation data from Metzeler et al. use GSE15210.

Random survival forest can be built on an expression matrix (here "training set") that should include two columns providing information on overall survival ("os") and censorship ("status").

RSF=rsf (Surv (os, status) ~ ., ntree=20000, importance="permute", proximity=TRUE, data=trainingset) IMPORTANT\_GENES=varSe1 (Surv (os, stat) ~ ., ntree=20000, data=trainingset)

### 3. Discussion

The healthy human hematopoietic system and the transformation to leukemia provide excellent, accessible and tractable models of normal cellular development and cancer progression. A number of high quality and well-annotated datasets from human donors with acute myeloid leukemia are publicly available for data driven cohort studies in a highly aggressive cancer. Here we describe a protocol for using these public datasets for hypothesis driven research, where they make findings from a knockout experiment in a model organism directly relevant in a clinical context. We translate a murine genetic signature of a 140 genes into 112 human homologs based on sequence similarity on protein and level and can show that the homolog signature impacts on patient survival, as expected from the mouse phenotype, and further we identify key driver genes in the signature.

Interspecies translations have given rise to a number of disappointments in the drug development industry and recently the species effect on gene expression was estimated higher than the tissue effect in the ENCODE mRNA expression studies [15], which was later confirmed [11]. However, careful reanalysis has greatly questioned this notion [6], also in line with previous studies [14]. The method proposed in this study, where a small binary list of genes, translated by evolutionary protein family, is used for investigating the clinical effect only is more conservative in both the means and conclusions. Furthermore, the effect of single genes, potentially misclassified, is greatly reduced by the following RSF model analysis for important contribution to survival. Rather than a species comparison we utilize a patient cohort study to enrich our data, support our findings from the animal model system, and further provide direct clinical relevance.

### Table 1

Designated Terc -/- regulated AML gene set (Table 1).

Probe number	Illumina probe ID	mgi Symbol	Gene group	HUGO homolog	Terc $-/-$ vs WT
1,770,767	ILMN_2483493	abParts	NA		DOWN
3,120,619	ILMN_2815138	Myom1	31,196	MYOM1	DOWN
70,431	ILMN_2428798	5031439G07Rik	15,140	KIAA0930	DOWN
7,210,458	ILMN_1259339	Cdk5r1	31,200	CDK5R1	DOWN
5,050,072	ILMN_2481902	Plxnc1	4211	PLXNC1	DOWN
130,437	ILMN_2642571	Mxd3	32,333	MXD3	DOWN
3,710,544	ILMN_1238479	Mgst3	3327	MGST3	DOWN
7,160,133	ILMN_2507232	Gas213	18,386	GAS2L3	DOWN
1,710,377	ILMN_1251616	Skp2	55,942	SKP2	DOWN
4,640,414	ILWIN_2541675	5830418K08KIK	27,936	KIAAI/3I PDID1	DOWN
2,070,242	ILIVIN_2043003	Clepp	32,700 11 129		DOWN
6 420 215	ILMN 1235363	Csg7	49.236	CSC2	DOWN
4 210 619	ILMN 2615035	Most3	3327	MGST3	DOWN
110.039	ILMN 2785454	Hist2h2ab	111.318	HIST2H2AB	DOWN
6,290,689	ILMN_1237886	Enc1	2694	ENC1	DOWN
1,510,132	ILMN_1243663	G2e3	32,362	G2E3	DOWN
5,860,139	ILMN_2817151	Chchd8	9567	COA4	DOWN
50,446	ILMN_2589960	Gins3	41,496	GINS3	DOWN
2,320,102	ILMN_2524519	Rasgef1a	17,067	RASGEF1A	DOWN
6,760,088	ILMN_1258300	Ifngr2	4041	IFNGR2	DOWN
4,050,711	ILMN_2627660	Lig1	197	LIG1	DOWN
70,546	ILMN_2981801	Hist1h2ag	69,326	HIST1H2AG	DOWN
730,743	ILMN_2537961	Mcm7	4323	MCM7	DOWN
160,253	ILMN_2760244	Snx7	22,941	SNX7	DOWN
5,090,332	ILMN_1224268	Mrps15	32,636	MRPS15	DOWN
7,210,470	ILMN_2517171	IUDa4a	68,496		DOWN
7,050,005	ILWIN_2511401 ILWIN_2622402	Up13a Chak2	23,393	CHEV2	DOWN
5,00,400	ILMIN_2000492	Smc4	20,209 4015	SMC4	DOWN
6 220 609	II MN 2461345	7fn41	65 280	7FP41	DOWN
4 290 524	ILMN 3080371	Fert2	74 300	FER	DOWN
1.980.431	ILMN 1231587	BC030867	69.368	C17orf53	DOWN
2,070,458	ILMN_2989480	Dsn1	49,806	DSN1	DOWN
7,040,612	ILMN_2525289	C330018D20Rik	35,412	C5orf63	DOWN
1,470,050	ILMN_2664593	Hist1h1b	110,910	HIST1H1B	DOWN
2,340,403	ILMN_3137980	Zfp41	65,280	ZFP41	DOWN
4,850,059	ILMN_2483253	Dicer1	13,251	DICER1	DOWN
450,678	ILMN_2826161	Taf12	68,477	TAF12	DOWN
5,700,646	ILMN_2658153	Zcchc17	32,319	ZCCHC17	DOWN
3,180,170	ILMN_1248181	Zbtb7a	7820	ZBTB7A	DOWN
3,890,519	ILMN_3055904	Cbx5	7257	CBX5	DOWN
5,360,368	ILMN_2511868	2310002B06Rik	NA	LUCT 1 LO AN	DOWN
4,610,129	ILIVIN_1248830	Histinzan Clav2	69,326	HIST THZAN	DOWN
3,010,170	ILMN 2692414	GIIXZ Spf9	41,098 5220	GLKAZ SNE9	DOWN
5 490 035	ILMIN_2003414	Jino Usp27	10.858		DOWN
670 739	II MN 1246108	Hist1h2ah	130 520	HIST1H2AI	DOWN
540.037	ILMN 1216285	Creb3	31 375	CREB3	DOWN
3.520.221	ILMN 2694275	Lxn	36.361	LXN	DOWN
5,560,451	ILMN_1251771	Cyc1	55,617	CYC1	DOWN
6,250,446	ILMN_1248184	Senp1	8731	SENP1	DOWN
4,830,291	ILMN_2718861	1600012H06Rik	57,051	C6orf120	DOWN
5,960,491	ILMN_2593872	Mrps15	32,636	MRPS15	DOWN
6,840,170	ILMN_2707291	Prdm2	40,822	PRDM2	DOWN
3,990,360	ILMN_3137920	Sel11	31,286	SEL1L	DOWN
4,220,504	ILMN_1256203	L3mbtl2	12,882	L3MBTL2	DOWN
2,340,494	ILMN_2665625	Fadd	2836	FADD	DOWN
2,350,221	ILMN_1246502	E330016A19KIK	NA 1028	E330016A19KIK	DOWN
1,990,731 E 810 E 64	ILIVIN_2390297	Dut	1038	DD1 SCAMP2	DOWN
2 400 754	ILMN 2010422	Cdc451	4104 NA	SCAMPS	DOWN
7 050 612	ILMN 2822131	Hmgel	150	НМССІ	DOWN
1 300 358	ILMN 2971481	Znrd1	40.960	7NRD1	DOWN
2,370,474	ILMN_3026137	Dbndd2	12,276	DBNDD2	DOWN
2,140,092	ILMN_2856861	Nudc-ps1	NA		DOWN
940,427	ILMN_2686509	Sgol1	23,642	SGOL1	DOWN
3,120,672	ILMN_2542231	Ppig	3520	PPIG	DOWN
1,300,725	ILMN_2900216	Ndufb10	3343	NDUFB10	DOWN
2,570,398	ILMN_2983714	Apitd1	66,004	APITD1	DOWN
5,690,593	ILMN_1218592	Tes	41,051	TES	DOWN
7,610,450	ILMN_3155180	Itpr2	37,593	ITPR2	DOWN
7,550,121	ILMN_3084954	Tes	41,051	TES	DOWN
510,673	ILMN_2488125	Vrk1	2541	VRK1	DOWN
6,900,762	ILMN_1218128	Tatdn1	57,158	TATDN1	DOWN

### Table 1 (continued)

94.96.01ILNN.123023Tmen12060.222MEM1208OWN233.03ILNN.273883Vps40.312VF54DOWN230.03ILNN.273883Vps40.312VF54DOWN230.03ILNN.273883Vps40.312VF54DOWN240.04ILNN.274881Wps43122VF54DOWN600.04ILNN.274488Nup88101NUP88DOWN5.886.02ILNN.274288Nup88101NUP88DOWN5.886.02ILNN.274288Nup88101NUP88DOWN5.001.01ILNN.250.01Rep322.1275NUP81DOWN5.002.01ILNN.250.01Rep322.1276NUP81DOWN5.003.01ILNN.250.01Tar52.1276NUP51DOWN5.004.01ILNN.250.01Nup24.137NUP51DOWN5.004.01ILNN.250.01Nup24.137NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01Nup2S.127NUP51DOWN5.004.01ILNN.250.01	Probe number	Illumina probe ID	mgi Symbol	Gene group	HUGO homolog	Terc -/- vs WT
513.0.477LIMM.121592Sec1 tr6624SEC1 tr9744DOWN4.300.073LIMM.2402113Miph b432MFA1DOWN4.300.073LIMM.2402113Miph b432MFA1DOWN4.300.073LIMM.2402113Miph b432MFA1DOWN4.780.388LIMM.2402791Zipo2a23.460Ziri Ciri Ciri Ciri Ciri Ciri Ciri Ciri	4,540,619	ILMN_1259294	Tmem126b	10,222	TMEM126B	DOWN
2.23.037LIMM 2.738603Vp440.132VP540.132VP54001.460.731LIMM 2.40146Torl b3.6,77TOKI BDOWN1.460.731LIMM 2.40146Torl b3.6,677TOKI BDOWN1.460.731LIMM 2.40146Torl b3.6,677TOKI BDOWN5.080.832LIMM 2.742488Nup81901NUP8DOWN5.280.215LIMM 2.94248Nup81901NUP8DOWN5.280.217LIMM 2.95412Itcl S2.3,63IKTS DDOWN5.280.218LIMM 2.95412Itcl S2.3,63IKTS DDOWN5.280.219LIMM 2.95412Itcl S2.7,73IKTS DDOWN5.280.211LIMM 2.95412Itcl S2.7,73IKTS DDOWN5.280.612LIMM 2.429460Ord 7b10.624OTD RDOWN5.280.613LIMM 2.429460Ord 7b10.624OTD RDOWN5.370.746LIMM 2.429460Ord 7b817BIRTDOWN5.370.746LIMM 2.429450Nu108179TITG DOWNDOWN5.380.388LIMM 2.42972Sin7BIRTDOWNDOWN5.380.388LIMM 2.429730Titg DSin7BIRTDOWN5.380.388LIMM 2.429730Titg DSin7BIRTDOWN5.380.388LIMM 2.429730Titg DSin7BIRTDOWN5.380.388LIMM 2.429730Titg DSin7DOWND5.380.388LI	5,130,497	ILMN_1221592	Sec11c	8624	SEC11C	DOWN
4,330,075LINN, 2802,013Mign b432MFADOWN1,460,271LINN, 1214007Stat0 a38,122STR.10DOWN6,202,047LINN, 1214007Stat0 a38,122STR.10DOWN6,202,047LINN, 244285Str.1038,122STR.10DOWN3,400,0519LINN, 252,114Str.104577StG.10DOWN3,400,0519LINN, 252,114Str.102,303,03ICZ5DOWN3,400,0519LINN, 265,112Str.10RLNStG.10DOWN3,400,0519LINN, 265,112LKL52,707,93RKA5DOWN3,101,131LINN, 253,015Mign 44,107RKA5DOWN3,102,1319LINN, 253,015Mign 44,506YERA5DOWN3,104,131LINN, 253,015Mign 4St66MIRITDOWN3,406,632LINN, 253,015Mign 4St66MIRITDOWN3,406,632LINN, 253,016TirchSt61TIRCDOWN3,406,632LINN, 253,016TirchSt77St71St71DOWN3,406,632LINN, 253,016TirchSt74TIRCDOWN3,406,632LINN, 253,016TirchSt74TIRCDOWN3,406,632LINN, 253,016TirchSt73St71DOWN3,406,632LINN, 253,016TirchSt74TIRCDOWN3,406,632LINN, 253,016TirchSt73St71DOWN3,406,632LINN, 253,016 <td>2,320,367</td> <td>ILMN_2798803</td> <td>Vps4a</td> <td>69,132</td> <td>VPS4A</td> <td>DOWN</td>	2,320,367	ILMN_2798803	Vps4a	69,132	VPS4A	DOWN
1.450.731LIAN.1.24046Torlb56.677TORISDOWN6.202.047LIAN.2.42271Zhol31.22STR10DOWN4.780.383LIAN.2.42271ZholZholZholDOWN5.290.215LIAN.2.42271ZholZholDOWNDOWN5.290.215LIAN.2.967412Hefs23.363HKG1DOWN5.290.215LIAN.2.967412Hefs23.363HKG2DOWN5.290.215LIAN.2.967412Hefs23.463HKG2DOWN5.200.161LIAN.2.96742Tafs27.079TKASDOWN5.200.161LIAN.2.96462Tafs27.079TKASDOWN5.200.161LIAN.2.240662Nuf241.473NRE72DOWN3.120.438LIAN.2.240660Outl/Tn66.64MIRLIDOWN2.500.501LIAN.2.240661Tuch85.12SHT7DOWN2.500.502LIAN.2.250762SHT765.12SHT7DOWN2.500.503LIAN.2.250761Tuch85.12SHT7DOWN2.500.503LIAN.2.20060Wifc1085.79WITC10DOWN4.260.019LIAN.2.20060Wifc1085.79WITC10DOWN4.260.019LIAN.2.20050Tuch83.79WITC10DOWN4.260.019LIAN.2.20050Tuch83.79WITC10DOWN4.260.019LIAN.2.20050Tuch83.79WITC10DOWN4.260.019LIAN.2.20050Tuch83.79WITC10 <td>4,390,075</td> <td>ILMN_2802103</td> <td>Mfap1b</td> <td>4332</td> <td>MFAP1</td> <td>DOWN</td>	4,390,075	ILMN_2802103	Mfap1b	4332	MFAP1	DOWN
6220,047ILMM. 12.4607Sk 0035,122STA 10DOWN5300.071ILMM. 24238Nuk22012221.450NUK25DOWN5300.072ILMM. 24238Nuk26100NUK25DOWN10.327ILMM. 242384Nuk2623.333IK275DOWN110.327ILMM. 2613904Hpp263.189HSTEDOWN110.327ILMM. 2613904Hpp263.189HSTEDOWN110.327ILMM. 255165Nuk241.473NRH72DOWN12.466.01ILMM. 2450.147Zp23821.276ZNT28DOWN13.124.073ILMM. 2423848Out7841.473NRH72DOWN2.456.012ILMM. 2423848Out7863.52SRT7DOWN3.400.622ILMM. 253970Str.755.12SRT7DOWN3.400.622ILMM. 253970Str.755.12SRT7DOWN3.400.622ILMM. 253970Str.753.52SRT7DOWN3.400.621ILMM. 253970Str.7St.52SRT7DOWN3.400.622ILMM. 253970Str.7St.52SRT7DOWN3.400.621ILMM. 253970Str.7St.52SRT7DOWN3.400.622ILMM. 253970Str.7St.52ST.7DOWN3.400.622ILMM. 253970Str.7St.52ST.7DOWN3.400.622ILMM. 253970St.7St.7St.7DOWN3.400.622ILMM. 254933St.7DOWNDOWN<	1,450,731	ILMN_1240146	Tor1b	56,677	TOR1B	DOWN
4.780.388LIAM. 24627912.722.a2.34602.74468DOWN3.400.619LIAM. 245271Surt ASurt ADOWN3.400.619LIAM. 24521Surt ASurt ADOWN5.806.652LIAM. 24521Fund ASurt ADOWN6.020.161LIAM. 245121Fund ASurt ADOWN6.020.161LIAM. 245124Turd B27.079TURD CDOWN6.020.161LIAM. 245147Z/D.25821.276Z/R.738DOWN5.102.77LIAM. 245147Z/D.25821.276Z/R.738DOWN5.120.458LIAM. 255155Nufe41.473NURP2DOWN5.260.661LIAM. 255467Mirl BSide GMIRIDOWN2.860.650LIAM. 255476Ord TurbSide GC/RS1LDOWN5.370.466LIAM. 250761CY6.57143.662C/RS1LDOWN5.370.466LIAM. 250761Side GSide GC/RS1LDOWN5.370.466LIAM. 250761TurbSide GC/RS1LDOWN5.370.466LIAM. 250761TurbSide GC/RS1LDOWN5.370.466LIAM. 250761TurbSide GC/RS1LDOWN5.370.466LIAM. 250761TurbSide GC/RS1LDOWN5.370.466LIAM. 250771RS1TurbSide GTurbLIAM. 2507715.370.466LIAM. 250771RS1TurbSide GRS1AUP5.370.474LIAM. 2508766TurbSide G	6,020,047	ILMN_1214907	Stk10	38,122	STK10	DOWN
5,886,552ILMX_272,498Nug8s1901NUR8DOWN5,200,215ILMX_272,498Nur514577SMC1ADOWN5,200,215ILMX_255114Inc52,333BICTADOWN5,200,215ILMX_255141Inc52,333BICTADOWN7,301,316ILMX_355412Tro52,2073TRA55DOWN7,301,318ILMX_355455Ntnf241,473NRB12DOWN2,456,651ILMX_355455Ntnf241,473NRB12DOWN2,456,651ILMX_355455Mrg18S566MR118DOWN3,400,52ILMX_355455Mrg18S566MR118DOWN5,470,376ILMX_365492Mrg18S566MR118DOWN5,470,376ILMX_362001Tbo581TBCDOWN5,480,388ILMX_362001Tbo581TBCDOWN5,480,388ILMX_362001Tbo581TBCDOWN5,480,389ILMX_262001TboS81TBCDOWN4,120,191ILMX_362004VIC10813TBCDOWN4,120,192ILMX_1243722201100581kNAUPUP4,130,192ILMX_262061Troen441332TBCA43UP1,130,273ILMX_2700565Troen4311,532TBCA43UP1,132,274ILMX_2700565Troen4311,532TBCA43UP1,132,274ILMX_2700565Troen4311,532TBCA43UP1,132,274<	4,780,398	ILMN_2462791	Zfp322a	23,460	ZNF322	DOWN
3406.059ILMX_255214Sincla4597SIACIADOWN110.27.7ILMX_251594Ikz52.3333IRZ75DOWN110.27.7ILMX_251594Hpb26.5,189Hp72DOWN110.32.7ILMX_351594Hpb26.5,189Hp72DOWN110.484ILMN_255935NhD21.4,73NBE32DOWN110.484ILMN_255935NhD21.4,73NBE32DOWN2450.612ILMN_264964Ond7h0.634OTUD78DOWN2450.612ILMN_265972Mp118556CWESRLDOWN3400.652ILMN_265970Sir175.5,152SIRT7DOWN3400.652ILMN_263061Tbch981TCRSDOWN3400.652ILMN_263061Tbch8813TCRDOWN4260.019ILMA_289135Hp4b1672ITFR3UP4260.019ILMA_289135Hp4b1672ITFR3UP530.6238ILMA_289135N1010081kNAUPUP2370.136ILMA_289135Rati1.010081kNAUP2370.136ILMA_209565Trace43308TDRED4UP2370.136ILMA_269569Faraa3280.45TDKH43UP2370.136ILMA_269569Faraa3280.45HDM3.45UP2370.137ILMA_269569Faraa3280.45HDM3.45UP2370.136ILMA_265697Term431.352TMEM43UP2370.137ILMA_2649	5,080,632	ILMN_2742498	Nup88	1901	NUP88	DOWN
5,393,015ILMR_2695.412IR.2523.363IR.27DOWN10.327ILMR_361504Hab.263.189HSP.25DOWN6.308,1051ILMN_345014772.023821.276PMC8DOWN5.308,1051ILMN_345014772.023821.276NBE2DOWN2.450,612ILMN_3256865Nnd241.473NBE82DOWN2.450,612ILMN_3256865Nnd2Mp1188566MRT18DOWN6.370,746ILMN_3465180Cybsirl45.506MRT18DOWN5.480,538ILMN_4620661Tbcb981TCRDOWN5.480,538ILMN_3620661Tbcb884PMC10DOWN4.400,109ILMN_3630163Pyt2846,79PM72UP5.480,338ILMN_2620661Tbcb814PMC10DOWN4.400,109ILMN_260063Pyt2846,79PM74UP4.180,132ILMN_260063Tarem4311.52TME43UP4.180,132ILMN_2700565Sarla30.80TME44UP1.183,703ILMN_2700565Tarem4311.52TME43UP1.294,716ILMN_2700565Tarem4311.52TME43UP1.320,624ILMN_270353Rmf13.52HM43UP1.320,634ILMN_270153Sarla37.24BCRUP3.50,644ILMN_270153Sarla37.24BCRUP3.50,644ILMN_270153RmfUPUPUP <t< td=""><td>3,400,619</td><td>ILMN_2952114</td><td>Smc1a</td><td>4597</td><td>SMC1A</td><td>DOWN</td></t<>	3,400,619	ILMN_2952114	Smc1a	4597	SMC1A	DOWN
110.2.1LDN, Apl.384Hsp2B, B3HsP2DAWN2020.1LDN, Apl.384Trab.5Trab.5Z1007TRAD.5DOWN7.10.038LDN, Apl.3845Trab.5Z1007TRAD.5DOWN7.10.038LDN, Apl.3845Trab.5DOWNDOWN7.10.038LDN, Apl.3845DownDOWNDOWN7.10.038LDN, Apl.3845DownDOWN7.10.038LDN, Apl.3845DownDOWN2.680.030LDN, 265972Mp1188566CYISKIDOWN3.400.522LDN, 225970Sir75.152Sir7DOWN3.400.522LDN, 220661Tbcb981TEGEDOWN3.400.523LDN, 220636WiG1086.879WTC10DOWN4.120.039LDN, 220848Pyr2283.43WTC10DOWN4.120.031LDN, 220848Pyr2237.94NTDUP4.120.037LDN, 220848Trab.5DOSNMTDUP2.970.166LDN, 220848Trab.5DOSNMTDUP2.970.167LDN, 220848Sarta3208NTDUP2.970.168LDN, 220849Fras320.6SartaUP2.970.164LDN, 220849Fras320.6NTDUP2.970.164LDN, 220849Fras320.6NTTUP2.970.164LDN, 220849Fras320.6NTTUP2.970.164LDN, 220849GrasTrab.5UPUP2	5,290,215	ILMN_2963412	Ikzt5	23,363	IKZF5	DOWN
Du20,11         LDAY, 2048.32         1725         21,073         1.0453         DUWN           3.466.612         LDAY, 2450.47         21,223         21,271         2NT235         DUWN           3.466.612         LDAY, 2450.47         21,023         21,271         2NT235         DUWN           3.466.612         LDAY, 2450.47         Hord Th         16,524         DUWN         DUWN           6.370.746         LDAY, 2450.47         45,506         MEPLIS         DUWN           6.370.746         LDAY, 269752         MrgH 18         55,652         SIRT         DUWN           5.460.338         LDAY, 269061         Tob         S61.52         SIRT         DUWN           5.460.344         LDAY, 260061         Tob         S63.79         WFC2         UP           5.460.344         LDAY, 260135         Liph         1672         TFRA         UP           5.480.384         LDAY, 124372         S201000581K         NA         UP         UP           5.480.374         LDAY, 260659         Fract         3280         FRACA         UP           5.480.374         LDAY, 260659         Fract         3280         FRACA         UP           5.480.472         LDAY, 260659	110,327	ILMN_2613904	Hspb2	68,189	HSPB2	DOWN
1,381,133         LDNL-245014'         21,204         21,214         NNR22         DVNN           21,204,433         LDNL-2450172         NNR12         14,724         NNR27         DVNN           2,550,530         LDNL-255572         NnP118         65,564         CVSSE         DOWN           3,400,532         LDNL-255572         NnP118         65,552         CVSSE         DOWN           3,400,532         LDNL-255970         Sir7         55,152         Sir7         DOWN           3,400,532         LDNL-255970         Sir7         55,152         Sir7         DOWN           4,420,019         LDNL-2691735         Lipkb         172,6         RFR         DOWN           4,420,019         LDNL-289548         Pyrc2         83,43         PYrC10         DOWN           4,130,132         LDNL-281433         Lipk         12,116         RFL         UP           4,130,132         LDNL-281433         LIpk         13,517         TMRA         UP           1,300,703         LDNL-281433         Lipk         NA         UP         13,52         TMRA3         UP           1,300,703         LDNL-284595         Tmer43         1,532         TMRA3         UP         14,63,437 <td>6,020,161 7,280,102</td> <td>ILIVIN_3046362</td> <td>117815</td> <td>27,079</td> <td>TKAF5</td> <td>DOWN</td>	6,020,161 7,280,102	ILIVIN_3046362	117815	27,079	TKAF5	DOWN
AddisDMR_AddisDmr TroppedDOWNAddisLIMP_AddisDmr TroppedDOWN6.370.746LIMP_AddisSp615SiftDOWN6.370.746LIMP_AddisDOWNSiftSp6152SiftDOWN5.860.328LIMP_A25060Drb981TEGDOWN5.860.328LIMP_A20060WickB6.879WFDC10DOWN4.260.019LIMP_A20060WickB6.879WFDC2UP4.260.019LIMP_A20060WickB6.879WFDC10DOWN4.260.019LIMP_A20060WickB6.879WFDC10UP4.260.019LIMP_A20133LIMPLIPUPUP4.260.019LIMP_A20133LIMPUPUPUP4.80.92LIMP_124272P220100088ikNAUPUP3.190.477LIMP_220050Sar1aS0.897SAR1AUP2.370.186LIMP_220050Fara3280FARAUP2.370.187LIMP_200505Fara3724NFAA3UP4.810.347LIMP_2200536Kara374NTEA43UP4.810.347LIMP_200505Fara3724NFAAUP4.810.347LIMP_200505Fara3724NTEA43UP4.810.347LIMP_200505Fara3724NTEA3UP4.810.347LIMP_200505Fara170KL194UP4.810.347LIMP_200505Gara1563UPUP4.81	7,560,195	ILMN 2526265	ZIPZ38 Nrbf2	21,270	LINE230 NIDDED	DOWN
3.580.050ILM. 25579/2Megil 188566MEPL 19DOWN3.400.532ILM. 255370Sin755.152SIRT7DOWN3.400.532ILM. 125370Sin755.152SIRT7DOWN3.400.532ILM. 2520061ToD88.73WEDC10DOWN6.480.184ILM. 230006Widc1088.73WEDC10DOWN6.480.184ILM. 2305848Pyr283.43PyrC2ILM6.420.019ILM. 298548Pyr283.43PyrC2ILM6.400.184ILM. 250174Rff12.116RFLIP4.120.039ILM. 124172S230110(08/RikNAIP4.130.192ILM. 210056Tmed430.80TMEP4IP1.930.477ILM. 270056Tmed430.80TMEP4IP1.930.477ILM. 270056Tmed432.80FAISAIP1.930.472ILM. 2700565Tmed432.80FAISAIP1.930.472ILM. 270155Rick37.4NC2UP1.930.472ILM. 270135Sicka7.04NC2UP1.930.472ILM. 270135Sicka7.04NC2UP1.930.472ILM. 274121Tmem18144.77NEEP4UP1.930.774ILM. 27417Pid22440.850UCUP1.930.774ILM. 274131Uc240.850UCUP1.930.774ILM. 274533Serpinb166.99SerPINB1UP1.930.774ILM. 274535	2 450 612	ILMN 2429469	Otud7b	10.624	OTLID7B	DOWN
370.746LIML 2465100CybSit45.066CYBSILDOWN3400.632LIML 225370Sir 7756.152SIR 77DOWN5.860.388LIML 225370Sir 7756.152SIR 77DOWN4.80.184LIML 2500611Tbrb88.879WTPC10DOWN4.260.019LIML 2300680Wife1088.879WTPC10DOWN4.260.019LIML 298548Pyr228343PYR22UP6.860.388LIML 1251074RIflL2116RFLUP6.860.389LIML 124287292301100881kNAUP7.109.07.03LIML 2290636Sarta90.897SARIAUP2.970.196LIML 2290536Tmend 311.532TMEPAI 3UP2.970.196LIML 2269636Tmend 311.532TMEPAI 3UP2.100.528LIML 226939Farsa3280FARSAUP2.100.528LIML 226939Sicbas7.544SISAUP2.100.528LIML 226935Gns1568GNSUP7.6068LIML 226935Gns1568GNSUP7.6063LIML 2261717Mic21240.859URUP7.603370LIML 2261717AK01 460NAUP7.603370LIML 2261717KIG2240.859URUP7.6045LIML 248536UrUPSister 14UP7.60330LIML 248538Ingris7.5458NMTUP7.60340LIML 227417Mic22	2,430,012	ILMN 2659762	Mrp118	8566	MRPI 18	DOWN
1400.622ILM. 125370SirfSirfSit2SIRTDOWNS400.38ILM. 2630061Tub981TG.BDOWN6.480.184ILM. 2630060Wife(1086.879WFDC10DOWN6.480.184ILM. 298848PyG28343PyG2ILMPy4.120.039ILM. 298848PyG28343PyG2UPUP6.800.388ILM. 1251074Rff12.116RFLUP4.180.192ILM. 1242729230110K0881KNAUP1.900.472ILM. 2740565Sarla90.897SARIAUP1.900.472ILM. 2760566Tmed450.8TMED4UP1.900.703ILM. 276056Tmed450.8TMED4UP1.930.472ILM. 276055Tmern431.52.2TMEM43UP1.930.474ILM. 276035Rmat3280FARSAUP1.930.474ILM. 2769335Runt256.4RNATUP1.930.474ILM. 279335Runt256.4RNATUP1.780.725ILM. 2569856Grs558.4RNATUP1.780.726ILM. 2569856Grs568.4RNATUP1.780.727ILM. 2589856GrsS67.9ILM. 266.4UP1.780.726ILM. 258973Serpinb1a63.99SERNIN1UP1.780.727ILM. 2589876GrsS70.9ILM. 266.4UP1.780.726ILM. 258977FarS0UFUP1.780.727 <t< td=""><td>6 370 746</td><td>ILMN 2466190</td><td>Cyb5rl</td><td>45 506</td><td>CYB5RI</td><td>DOWN</td></t<>	6 370 746	ILMN 2466190	Cyb5rl	45 506	CYB5RI	DOWN
Se02398ILMN 2620061Tick941TICBDOWN6480.184ILMN 263060Wife10086.879WFDC10DOWN4.260.019ILMN 2630135Itpkb1572WFDC10DOWN4.260.019ILMN 2631135Itpkb172.116RFLUP6.860.398ILMN, 1248729210100081KNAUP3.190.472ILMN 24333ItpinNAUP3.190.472ILMN 263060Tined45308TMED4UP2.970.196ILMN 263060Tined43508TMED4UP2.970.196ILMN 263060Tined43280FARSAUP4.810.347ILMN 263069Farsa3280FARSAUP2.100.528ILMN 2630699Farsa374NCF2UP5.500.474ILMN 250393Rint2816RNMTUP5.500.474ILMN 250393Rint2816RNMTUP7.0058ILMN 2704315Serpinb163.39SERPINB1UP7.00570ILMN 250837Rint24.6240.850UP7.0058ILMN 274121Tinem18144.787TMEM181UP7.00570ILMN 262717PACD32.40UPUP7.00537ILMN 2627317PACD40.850UCC2UP7.00545ILMN 124838Inpfl30.66DHD12UP7.00545ILMN 124837Serpinb140.850UCC2UP7.00545ILMN 264527Drind240.850 <t< td=""><td>3 400 632</td><td>ILMN 1253970</td><td>Sirt7</td><td>56 152</td><td>SIRT7</td><td>DOWN</td></t<>	3 400 632	ILMN 1253970	Sirt7	56 152	SIRT7	DOWN
6,480,184ILMN_283066Wife(1086,879WFDC10DOWN4260,019ILMN_298548Pyr285,879WFCR2UP4,120,039ILMN_29154Itpkb1672IFWBUP4,180,132ILMN_1240729230110K085kNAUP1,190,427ILMN_24729230110K085kNAUP1,303,03ILMN_2790366Sarla90,897SARIAUP1,303,03ILMN_209666Tmend311,552TMED4UP1,350,0544ILMN_209666Tmend311,552TMED4UP1,10444ILMN_209869Farsa37,944ENSAUP4,810,347ILMN_2649101NC237,944SICA9AUP6,554,046ILMN_2649101Ref237,944SICA9AUP6,554,047ILMN_2649101NC121658CNSUP1,780,725ILMN_2649101NC121658CNSUP1,780,725ILMN_279335Gras1586CNSUP1,780,726ILMN_27917Pid2b32,405UC12UP7,6058ILMN_265921Pins32,405UPUP5,360,061ILMN_265737Pins32,405UPUP5,40639ILMN_264931UC4240,850UC12UP5,40639ILMN_265731PinsS1,642UPUP5,40639ILMN_265731PinsS1,642UPUP5,40643ILMN_265861UG142S1,642UP	5,860,398	ILMN 2620061	Tbcb	981	TBCB	DOWN
4,260.019ILIAN,2691.35Itypkb843.3PYCR2UP6,860.398ILIAN,2691.13Npkb12.116RFLUP6,860.398ILIAN,124.07282.011060881kNAUP3,190.427ILIAN,244.333LginNAUP3,190.427ILIAN,249.336Sar1.490.875SAR1.4UP2,970.196ILIAN,2698.06Tmed.45.08TMED.4UP2,970.196ILIAN,2698.06Tmed.43.03SAR1.4UP2,970.196ILIAN,2698.06Tmed.43.280FARSAUP6,110.044ILIAN,2698.05Farsa3.280FARSAUP2,100.228ILIAN,2698.05Gras3.74NCF2UP2,100.228ILIAN,259.35Rmnt2.816RNATUP2,500.44ILIAN,259.35Gras1.56RNATUP2,500.46ILIAN,259.35Gras1.56NATUP2,500.47ILIAN,259.35Gras1.56NATUP2,600.32ILIAN,257.17PACD2.402.40NATUP2,470.30ILIAN,267.217PACD6.39SERPINB1UP2,470.30ILIAN,267.217PACD6.364DIPD.2UP2,470.30ILIAN,256.37UPUPUP1.564,800.31ILIAN,256.37EprilSTOWPUP4,800.32ILIAN,256.37EprilSTOWPUP4,800.31ILIAN,256.37ILIA	6,480,184	ILMN_2830060	Wfdc10	86,879	WFDC10	DOWN
1,120.039LINN.25013Tipkic172ITPKBUP6,860.398LINN.125107RIII1.116RFF.UP1,130,427LINN.1248173IginNAUP1,030,703LINN.2481433IginNAUP1,030,703LINN.2590866Sarla90.897SARIAUP1,030,703LINN.2700955Trend30.807SARIAUP5,200,344LINN.2698806Frara37.924ENSAUP1,10,444LINN.2698806Frara37.924ENSAUP2,100,252LINN.2698806Gras37.924ENSAUP2,100,252LINN.2698806Gras37.924ENSAUP2,100,252LINN.2598195Gras37.924ENSAUP2,100,252LINN.2598195Gras37.924ENSAUP2,100,252LINN.2598195Gras37.941SLOA86UP2,000,354LINN.259815Gras1668CNSUP7,000,351LINN.242819Serpinb1a63.999SERPINB1UP2,470,309LINN.124717AK011460NAUPUP2,470,309LINN.124731UPUPUPUP2,470,309LINN.124813UPUPUPUP3,810,472LINN.25642717AK011460NAUPUP1,890,524LINN.124819UPUPUPUPUP1,890,524LINN.124813UPUPUPUP <td>4,260,019</td> <td>ILMN_2998548</td> <td>Pycr2</td> <td>8343</td> <td>PYCR2</td> <td>UP</td>	4,260,019	ILMN_2998548	Pycr2	8343	PYCR2	UP
6,860.398ILMN_1251074Rfl12,116RFLUP3,190.427ILMN_2814333IgmNAUP3,190.427ILMN_2814333IgmNAUP1,030,703ILMN_270056Sarla90.897SAR1AUP2,970,196ILMN_2608060Tmed45308TMEM43UP5,500,34ILMN_260869Farsa3280TMEM43UP6,110,044ILMN_260869Farsa3280FARSAUP2,100,528ILMN_2649101Ncl2374.4SLGA8UP5,500,474ILMN_250395Ramt2316RNMTUP5,500,474ILMN_2503935Ramt2316RNMTUP7,00375ILMN_2502935Ramt63399SER91NB1UP7,00376ILMN_2502935Serpinb1a63399SER91NB1UP7,00376ILMN_2502937PrelA2b23039SER91NB1UP7,00376ILMN_25029717AK01460NAUPUP2,470,309ILMN_2627177AK01460NAUPUP2,470,309ILMN_262717PrelA2b2360,47ILGAUP2,470,309ILMN_262717AK01460NAUPUP2,470,309ILMN_256487ILGA40,850UCC2UP1,800,72ILMN_256487BohdAS050UCC2UP2,470,309ILMN_256487Bohd319.1RC14UP1,800,72ILMN_256487ILGA377.4ILGA <t< td=""><td>4,120,039</td><td>ILMN_2691135</td><td>Itpkb</td><td>1672</td><td>ITPKB</td><td>UP</td></t<>	4,120,039	ILMN_2691135	Itpkb	1672	ITPKB	UP
4,180,192LMM,24872S230110K08kkNAUP1,030,703LLMN,249806Sarla90,897SAR1AUP1,030,703LLMN,270056Sarla90,897SAR1AUP3,520,634LLMN,270055Tmend4532TMEM4UP3,520,634LLMN,270055Tmend315.52TMEM4UP4,810,347LLMN,270055Farsa37.924ENSAUP4,810,347LLMN,2698069Farsa37.924ENSAUP5,500,468LLMN,269810Nc7237.944ENSAUP5,500,474LLMN,2698105Gns1568GNSUP5,500,476LLMN,2793135RumtSCARARMMTUP1,780,725LLMN,2784135Gns1568GNSUP7,603,67LLMN,2784135Grapha1568GNSUP7,603,70LLMN,2784135Serpinb1UPUP7,603,73LLMN,2627217PAK2b32,405HCR2UP2,470,309LLMN,2627217AK011460NAUPUP2,470,309LLMN,124313UPUPUPUP4,801,33LLMN,2627217AK011460NAUPUP2,470,309LLMN,2627217AK011460NAUPUP4,480,430LLMN,2627217AK011460NAUPUP4,480,430LLMN,2627217AK011460NAUPUP4,490,639LLMN,264632UPUPUPUP <t< td=""><td>6,860,398</td><td>ILMN_1251074</td><td>Rffl</td><td>12,116</td><td>RFFL</td><td>UP</td></t<>	6,860,398	ILMN_1251074	Rffl	12,116	RFFL	UP
3,196,427ILMN_25433IgnNAUP1,030,703ILMN_25065Sarla0,897SARLAUP2,970,196ILMN_2698605Tmed45308TMED4UP5,206,34ILMN_2698605Farsa3280FARSAUP6,110,044ILMN_2698695Farsa3280FARSAUP2,100,528ILMN_2698695Farsa379,244ENSAUP2,100,528ILMN_269101Nc2374NC72UP6,550,474ILMN_2759335Rant2816RNMTUP1,780,725ILMN_2508035Cras1568GNS 1UP7,0508ILMN_2759335Rant2816RNMTUP7,050370ILMN_2508035Cras1568GNS 1UP7,050370ILMN_2508035Cras32,405PK22UP7,050370ILMN_2452717PI442b32,405NME2BUP7,050370ILMN_2452717PI442b32,405IUCUP7,050370ILMN_245431UCUCUP14,405,305UP5,810,070ILMN_245431UCVAUP14,405,305UP4,400,639ILMN_245431UCUP14,405,305UP5,800,610ILMN_2546472Ddh266,466DHD12UP5,900,156ILMN_2564672Ddh2Q100MP63UP5,900,156ILMN_2564672Sams111,48SAMSN1UP1,900,254ILMN_2564672Sams1	4,180,192	ILMN_1242872	9230110K08Rik	NA		UP
1,030,703LMN_2598063Sarla90,897SARIAUP2,570,164LMN_2698066Tmend45308TMED4UP3,520,634LMN_2698069Farsa3280FARSAUP4,810,347LMN_312185Ensa37,924ENSAUP2,100,528LMN_2698010NC237,40NC72UP5,560,474LMN_259835Gras1568RNNTUP5,560,474LMN_259835Cns1568CNSUP7,0603LMN_258085Cns1568CNSUP7,050,370LMN_280836UCk240,850UCK2UP7,050,370LMN_280836Uck240,850UCK2UP4,780,328LMN_12431573Serpinb1a63,399SER/NB1UP2,470,309LMN_124717AK011460NAUP14,850,133UNN_124839InppskTS505UP4,890,331LMN_124839Inppsk75,059NPP5KUP14,850,133UP4,490,639LMN_12484717AK011460NAUP14,850,133UP4,490,639LMN_12484717Uck240,850UCK2UP5,800,70LMN_124818UpUP14,80UP5,800,70LMN_124818UPUP14,80UP6,800,01LMN_1264612Dihl2G6,646DHD12UP5,900,156LMN_256028LI2rg31,076MSNN1UP6,903,001LMN_256028LI2rg31,0	3,190,427	ILMN_2814333	Lgtn	NA		UP
2.970,196ILMN_2898606Tmed45308TMED4UP5.520,634ILMN_2700505Tmem4311,532TMED43UP6,110,044ILMN_2698699Farsa3280FARSAUP2.100,528ILMN_2698699Farsa37,924ENSAUP2.100,528ILMN_2694101Nc237,4NcF2UP5.500,474ILMN_279335Runt2816RNMTUP5.500,474ILMN_258085Gra1568CNSUP7.0608ILMN_274121Tmem18144,787TMEM181UP7.0503,770ILMN_288055Gra69,399SER/NN11UP7.0503,770ILMN_288055Gra0,399SER/NN11UP7.0503,770ILMN_2842717PI4L2b32,405HaK2BUP5.300,474ILMN_2452717PI4L2b32,405UCK2UP4.800,639ILMN_124373UcK240,850UCK2UP4.800,639ILMN_124631UcK240,850UCK2UP4.900,564ILMN_2564872Ddd126,646DDHD2UP5.900,70ILMN_2564872Ddd123164MDH1UP5.900,70ILMN_2564872Ddd123164MDH1UP5.900,156ILMN_2564872Ddd123164MDH1UP5.900,156ILMN_2564872Sms1111,48SAMSN1UP7.975,75ILMN_2564872Sms1111,48SAMSN1UP7.900,156ILMN_256	1,030,703	ILMN_2790636	Sar1a	90,897	SAR1A	UP
3,520,634ILMN_2709605Tmem4311,52IMEM43UP4,810,347ILMN_2696109Farsa3220FARSAUP4,810,347ILMN_26112185Ensa37,24ISKAUP6,550,404ILMN_261010NcP2374NCF2UP6,550,404ILMN_275335Romt2816RMTTUP1,780,725ILMN_275355Romt2816RMTTUP7,0603ILMN_2780356Grs1586GNSUP7,060370ILMN_280556Uck240,850Uck2UP7,050,370ILMN_280536Uck240,850Uck2UP4,780,328ILMN_12431573Serpinb1a69,399SERPINB1UP2,470,309ILMN_2452717PI4k2b32,405PI4K2BUP2,470,309ILMN_246313Uck240,850UCK2UP4,850,133ILMN_124318Inpp5kUPUP5,810,070ILMN_124631Uck240,850UCK2UP4,900,650ILMN_2564872Dehd26,66,466DDHD2UP19,90,524UP19,90,54UP5,900,156ILMN_2566028II23Mbn123,186MBN1.1UP19,90,54UP5,900,156ILMN_256612Sams111,148SAMSN1UP19,90,54UP6,920,400ILMN_266492Sams111,41430,776TTOTO19H081KUP1,800,402ILMN_266493Moj6330,776TTOEUP1,450,735 <td>2,970,196</td> <td>ILMN_2698606</td> <td>Tmed4</td> <td>5308</td> <td>TMED4</td> <td>UP</td>	2,970,196	ILMN_2698606	Tmed4	5308	TMED4	UP
6,110,044ILMN_25986989Farsa3280PARSAUP4,810,347ILNN_3112185Ensa37,924ISASAUP2,100,528ILNN_2649101NcZ37,4NcF2UP5,500,474ILNN_279335Runt2816RNMTUP5,500,478ILNN_2580895Gns1568CNSUP7,0608ILNN_274121Tmem18144,787TIMEM181UP7,050,370ILNN_280536Uck240,850Uck2Uck2Uck2Uck27,050,370ILNN_280536Uck240,850Uck2UPUCk2UP5,360,474ILNN_2452717P44,2b32,405PHK2BUPUP5,360,474ILNN_2452717P44,2b32,405Uck2UPUP4,490,639ILNN_1246318Uck240,850UCK2UPUP4,490,639ILNN_1254631Uck240,850UCK2UPUP1,990,524ILNN_2564872Dhd219,806BUN11UP1,890,402ILNN_26623Mbh11UPUPUP1,890,402ILNN_26630ILNN_26632Samsn1URUP1,890,402ILNN_266490ILTA11,148SAMSN1UP1,800,403ILNN_125475Myo5a20,1071700109H08RKUP1,800,402ILNN_266490ILTA10,711SIC4A42UP1,800,402ILNN_266490ILTA10,711SIC4A42UP1,800,403ILNN_125	3,520,634	ILMN_2700505	Tmem43	11,532	TMEM43	UP
4,810,347ILMM_2649101Nrf2IPNAOPP6,550,474ILMM_22649101Nrf2374NCF2UP6,550,474ILMM_279335Rumt2816RUNTUP1,780,725ILMN_2580895Gns1568GNSUP7,0508ILMN_274121Tmem18144,787TMEM181UP7,0503ILMN_2880536Uck240,850UCK2UP4,780,328ILMN_262717Pi4k2b32,405VK22UP2,470,309ILMN_2452717AK01460NAUP2,470,309ILMN_2452717AK01460NAUP4,850,133ILMN_124839Inpp5K75,059INPFSKUP5,810,070ILMN_124631Uck240,850UCK2UP5,810,070ILMN_124631Uck240,850UCK2UP7,90,554ILMN_2564872Dehd266,646DDHD2UP7,90,445ILMN_2664522Samsn111,148SAMSN1UP7,90,455ILMN_266452Samsn111,48SAMSN1UP6,020,400ILMN_266452Samsn111,48SAMSN1UP1,450,755ILMN_124576Myo5a20,100MYO5AUP1,450,755ILMN_124576Myo5a20,100MYO5AUP1,450,755ILMN_124576Myo5a20,100MYO5AUP1,50,019ILMN_1265491I700109H08Rik130,776TO109H08RikUP1,450,755ILMN_2665492Amas13	6,110,044	ILMN_2698699	Farsa	3280	FARSA	UP
2,100,228LLMN_120339NC23/4NC20P5,560,474ILMN_2759335Rnmt2816RNMTUP5,560,408ILMN_2759335Rnmt2816RNMTUP7,0608ILMN_274121Tnem1814,787TMEM181UP7,050370ILMN_280536Uck240,850UCk2UP7,050370ILMN_280536Uck240,850UCk2UP7,050370ILMN_280536Vck240,850UCk2UP5,360,474ILMN_262717Pi4k2b3,240Pi4K2BUP5,360,474ILMN_124839Inpp5k7,5059INP5KUP4,850,133ILMN_124631Uck240,850UCK2UP4,90639ILMN_1254631Uck240,850UCK2UP1,990,524ILMN_2564872Dthd266,646DHD2UP1,990,524ILMN_2564872Dthd266,646DHD2UP7,704,45ILMN_266432Sams111,148SAMSN1UP1,850,402ILMN_266432Sams111,148SAMSN1UP1,850,402ILMN_266432Sams111,148SAMSN1UP1,850,403ILMN_2656028Itaf3,776T00109H08RiKUP1,850,404ILMN_2656028Mon1130,776HICA34AUP1,850,402ILMN_2656101SIC4420,711SIC44A2UP1,850,305ILMN_2656101SIC44210,711SIC44A2UP1,850,305 <td< td=""><td>4,810,347</td><td>ILMN_3112185</td><td>Ensa</td><td>37,924</td><td>ENSA</td><td>UP</td></td<>	4,810,347	ILMN_3112185	Ensa	37,924	ENSA	UP
b.330,474         LUMN_L250335         Rint         SLeyA         DLP           5,560,408         LUMN_2573355         Rint         2816         RNMT         UP           1,780,725         LUMN_244121         Tmem181         44,787         TMEM181         UP           7,0503         LUMN_244121         Tmem181         44,787         TMEM181         UP           4,780,328         LLMN_280536         Uck2         40,850         UCK2         UP           5,360,474         LLMN_280537         Serpinb1a         69,399         SERPINB1         UP           2,470,309         LLMN_2452717         Pi4k2b         32,405         Pi4k2B         UP           4,450,133         ILMN_1245318         Uck2         40,850         UCK2         UP           4,490,639         ILMN_1256437         Duhd2         66,664         DUH02         UP           5,900,16         ILMN_2564872         Duhd2         66,664         DUH02         UP           5,900,156         ILMN_266322         Samsn1         1,148         SAMSN1         UP           5,900,156         ILMN_2646322         Samsn1         1,148         SAMSN1         UP           5,900,156         ILMN_264632         <	2,100,528	ILMN_2649101	Ncf2	3/4	NCF2	UP
J.Jody Ads         Link Z.253         Mint         2300         NMM         OF           J.780, 725         ILMN Z.580895         Gns         1568         GNS         UP           7060, 370         ILMN Z.800895         Gns         4,787,77         TMEM181         UP           4,780, 328         ILMN Z.800366         Uck2         40,850         UCK2         UP           4,780, 328         ILMN Z.800366         Uck2         40,850         UCK2         UP           4,780, 328         ILMN Z.627217         Pi4k2b         32,405         Pi4C2B         UP           4,470, 390         ILMN Z.627217         AK011460         NA         UP           4,490, 639         ILMN L.248389         Inpp5k         75,059         INPF5K         UP           4,490, 639         ILMN Z.256431         Uck2         40,850         UCK2         UP           4,490, 639         ILMN Z.2564372         Ddhd2         66,646         DDHD2         UP           5,980, 601         ILMN Z.2564872         Ddhd2         56,646         DDHD2         UP           5,900, 156         ILMN Z.2564872         Sams11         11,48         SMSN11         UP           5,900, 101         ILMN Z.2564736	5 560 409	ILMN 2750225	SIC9do	2916	DNIMT	UP
1,700,72.0         LIMN 2,244121         Timen181         44,787         TMEM181         UP           7,0508         LIMN 2,280536         Uck2         40,850         UCK2         UP           7,0503,700         LIMN 1,231573         Serpinb1a         69,399         SERPINB1         UP           7,0504         LIMN 1,231573         Serpinb1a         69,399         SERPINB1         UP           5,360,6744         LIMN 2,452717         AK011460         NA         UP           2,470,309         LIMN 2,452717         AK011460         NA         UP           4,490,639         LIMN 2,45283         Upp5k         75,059         UP         UP           5,810,070         LIMN 1,24631         Uck2         40,850         UCK2         UP           1,990,524         LIMN 2,564631         Uck2         40,850         UCK2         UP           5,980,601         LIMN 2,564632         Ddhd2         66,646         DDHD2         UP           5,090,156         LIMN 2,564628         II27g         172         II27G         UP           5,090,156         LIMN 2,564628         Samsn1         11,148         SAMSN1         UP           5,001,201         LIMN 2,264540         Hy6 </td <td>2,200,400 1 780 725</td> <td>ILIVIN_2739353</td> <td>Cinc</td> <td>1569</td> <td>CNS</td> <td>UP</td>	2,200,400 1 780 725	ILIVIN_2739353	Cinc	1569	CNS	UP
7.050.37         ILMN.2480536         Uck2         40.850         Uck2         40.850           4.780.328         ILMN.280536         Uck2         40.850         Uck2         40.850           5.360.474         ILMN.262717         Pi4k2b         32.405         Pi4k2B         UP           2.470.309         ILMN.2452717         AK011460         NA         UP           4.850.133         ILMN.124839         Inpp5k         75.059         IPKS         UP           4.490.639         ILMN.124613         Uck2         40.850         UCk2         UP           6.980.601         ILMN.2564872         Ddhd2         66.646         DDHD2         UP           6.980.601         ILMN.2564872         Ddhd2         66.646         DDHD2         UP           7.0445         ILMN.2564872         Ddhd2         66.646         DDHD2         UP           7.0445         ILMN.26632         Sams1         11,148         SAMSN1         UP           1.850.402         ILMN.26632         Sams1         11,148         SAMSN1         UP           1.850.402         ILMN.266490         Itaf         37,974         ITAF         UP           1.850.402         ILMN.266452         Sams1	70.608	ILMN 2744121	Tmem181	44 787	TMFM181	UI LIP
4780.328         ILMN.1231573         Serpinb1a         69.399         SERPINB1         UP           5,360,474         ILMN.262717         Pi4k2b         32,405         Pi4k2B         UP           2,470.309         ILMN.2452717         AK011460         NA         UP           4,850,133         ILMN.1248389         Inpp5k         75.059         INPP5K         UP           4,890,639         ILMN.124631         Uck2         40.850         UCK2         UP           1,990,524         ILMN.256431         Uck2         40.850         UCK2         UP           6,980,601         ILMN.2554631         Uck2         40.850         UCK2         UP           5,090,156         ILMN.266872         Ddhd2         66.666         DDHD2         UP           5,090,156         ILMN.266828         Il2rg         172         IL2RG         UP           6,020,400         ILMN.266822         Samsn1         11,148         SAMSN1         UP           150,019         ILMN.266432         Samsn1         11,148         SAMSN1         UP           3,310,291         ILMN.266432         Moris         130,776         170019H08Rik         UP           1,450,735         ILMN.266436	7 050 370	ILMN 2880536	Lick2	40.850	LICK2	LIP
5360,474ILMN_2627217Pi4k2b32,405PI4K2BUP2,470,309ILMN_2452717AK011460NAUP4,450,133ILMN_1248389Inpp5k75,059INPP5KUP5,810,070ILMN_1242013Uck240,850UCK2UP4,490,639ILMN_125631Uck240,850UCK2UP5,800,010ILMN_2557957Eprs5870EPRSUP6,980,011ILMN_2564872Ddhd266,646DDHD2UP5,900,156ILMN_2766253Mbnl123,186MBNL1UP5,020,040ILMN_266482Samsn111,148SAMSN1UP7,05,75ILMN_1254736Myo5a20,100MYO5AUP7,05,75ILMN_1254736Myo5a20,100MYO5AUP7,05,75ILMN_125475T00109H08Rik13,0766T00109H08RikUP1,450,735ILMN_125454T100109H08Rik130,776UPUP1,450,735ILMN_125455H1fx4397H1FXUP1,450,735ILMN_12563Tmem18144,787TMEM181UP1,980,021ILMN_268567Pi4da220,857MNA2UP1,980,021ILMN_268567Pi4da38233PHLDA3UP1,980,021ILMN_268567Pi4da38233PHLDA3UP1,980,0315ILMN_268567Pi4da38233PHLDA3UP2,630,605ILMN_268567Pi4da38233PHLDA3UP2,63	4,780,328	ILMN 1231573	Serpinb1a	69.399	SERPINB1	UP
2,470,309ILMN_2452717AK011460NAUP4,850,133ILMN_1248389Inpp5k75,059INPP5KUP4,490,639ILMN_1254631Uck240,850UCK2UP1,90,524ILMN_257957Eprs5870EPRSUP6,980,601ILMN_264872Dahd266,646DDHD2UP770,445ILMN_264872Dahd266,646DDHD2UP5,090,156ILMN_266328Il2rg172IL2RGUP6,020,400ILMN_256028Il2rg172IL2RGUP6,020,400ILMN_266322Samsn111,148SAMSN1UP770,575ILMN_125376Myo5a20,100MYO5AUP150,019ILMN_266390Litaf37,974ILTAFUP3,310,291ILMN_125805T700109H08Rik130,7761700109H08RiKUP1,450,735ILMN_124845H1fx4397H1FXUP4,570,504ILMN_268630Tmem18144,787TMEM181UP1,980,021ILMN_268567Phida38233PHIDA3UP2,630,055ILMN_268567Ras475,128CAS4UP2,630,055ILMN_268567Phida38233PHIDA3UP2,630,055ILMN_268567Phida38233PHIDA3UP2,630,055ILMN_268567Phida38233PHIDA3UP2,630,055ILMN_268567Phida38233PHIDA3UP2,630,055ILMN	5,360,474	ILMN 2627217	Pi4k2b	32.405	PI4K2B	UP
4,850,133ILMN_1248389Inpp5k75,059INPP5KUP5,810,070ILMN_1242013Uck240,850UCK2UP4,490,639ILMN_1254631Uck20,850UCK2UP1,990,524ILMN_2557957Eprs5870EPRSUP6,980,001ILMN_2564872Ddhd266,646DDHD2UP5,090,156ILMN_2766253Mbnl123,186MBNL1UP6,020,400ILMN_266802Il2rg172ILZRGUP6,020,400ILMN_266322Samsn11,148SAMSN1UP150,019ILMN_1254736Myo5a20,100MYO5AUP150,019ILMN_2665490Liaf37,974ITAFUP3,310,291ILMN_2681601Sic44a210,711Sic44a2UP4,670,504ILMN_1242503Tmem18144,787TMEM181UP4,670,504ILMN_2681601Sic44a220,857ANXA2UP1,980,021ILMN_268367PhIda38233PHIDA3UP2,630,605ILMN_268367PhIda38233PHIDA3UP2,630,605ILMN_266453AK005145NAUP10,0191,240,338ILMN_280507B02018G12RikNAUP12,03,03UP2,630,605ILMN_280547PhIda38233PHIDA3UP2,90,328ILMN_281344Per1966PER1UP2,630,635ILMN_2702102D630023F18Rik12,9674C26780UP	2,470,309	ILMN_2452717	AK011460	NA		UP
\$,810,070ILMN_1242013Uck24,0850UCK2UP4,490,639ILMN_1254631Uck240,850UCK2UP1,990,524ILMN_2557957Eprs5870EPRSUP6,980,601ILMN_2564872Ddhd266,646DHD2UP7,70,445ILMN_124840Bcl93191BCL9UP5,900,156ILMN_2766253Mbnl123,186MBNL1UP1,850,402ILMN_266828II2rg172IZRGUP6,020,400ILMN_266320Samsn111,148SAMSN1UP1,500,19ILMN_266490Litaf3,7974UTAFUP1,450,755ILMN_1254736H700109H08Rik130,7761700109H08RikUP1,450,754ILMN_266490Litaf4397HIFXUP3,310,291ILMN_266490Ict4a210,711SLC44A2UP1,450,755ILMN_1232475HT6X4787TMEM181UP3,840,600ILMN_2681601SIc44a220,857ANXA2UP1,450,750ILMN_263867PhIda3B233PHIDA3UP2,630,065ILMN_260376B02018G12RikNAUP19,00341,980,021ILMN_280507B02018G12RikNAUP2,90,328ILMN_203607PHIda3UP19,0034UP2,90,328ILMN_20364Per15MAUP2,90,328ILMN_20364Per151966PER1UP2,60,036ILMN_20354 <td< td=""><td>4,850,133</td><td>ILMN_1248389</td><td>Inpp5k</td><td>75,059</td><td>INPP5K</td><td>UP</td></td<>	4,850,133	ILMN_1248389	Inpp5k	75,059	INPP5K	UP
4.490.639ILMN.125631Uck20.850UCK2UP1.990.524ILMN.2557957Eprs5870EPRSUP6.6980.601ILMN.2564872Ddhd266.640DDHD2UP770.445ILMN.1264840Bcl93191BCL9UP5.090.156ILMN.2766233Mbn1123.186MBNL1UP6.020.400ILMN.266022Samsn111.148SAMSN1UP770.575ILMN.266320Samsn111.148SAMSN1UP750.575ILMN.1254736Myo5a20.00MYO5AUP150.019ILMN.2665490Litaf37.974ITAFUP3,310.291ILMN.2681601Slc44a210711SIC44A2UP4,670.504ILMN.2681601Slc44a210,711SIC44A2UP1,980.021ILMN.268567Phida38233PHLDA3UP4,503.05ILMN.2638567Phida38233PHLDA3UP5,603.15ILMN.2603976Cass475.128CASS4UP5,603.15ILMN.2805207B02018C12RikNAUPUP2,630.051ILMN.280540Phida38233PHLDA3UP2,670.037ILMN.2813484Per11966PER1UP2,670.037ILMN.2813484Per119667PER1UP2,670.035ILMN.2701020Poid5344071120,674UP2,670.035ILMN.2702102L63020L63020UPL63158PUP <t< td=""><td>5,810,070</td><td>ILMN_1242013</td><td>Uck2</td><td>40,850</td><td>UCK2</td><td>UP</td></t<>	5,810,070	ILMN_1242013	Uck2	40,850	UCK2	UP
1.990.524ILMN.2557957Eprs5870EPRSUP6,980.601ILMN.2564872Ddhd266.646DDHD2UP770.454ILMN.1224840Bcl93191BCL9UP5,090.156ILMN.2766253Mbnl123.186MBNL1UP1,850.402ILMN.2568028II2rg172IL2RGUP6,020,400ILMN.26646322Samsn111,148SAMSN1UP70,575ILMN.2646324Myo5a20.100MYO5AUP150,019ILMN.265490Litaf37,974ILTAFUP3,310,291ILMN.1250451700109H08Rik130,7761700109H08RikUP1,450,735ILMN.12250451700109H08Rik4397H1FXUP3,840,600ILMN.2681601SIc44a210,711SLC44A2UP4,670,504ILMN.263867PhIda38233PHLDA3UP1,980,021ILMN.263976Cass475,128CASS4UP2,630,605ILMN.280507PhIda38233PHLDA3UP2,630,605ILMN.23017ArX05145NAUP12,690,204ILMN.230547PhIda38233PHLDA3UP2,690,204ILMN.230547PhIda38233PHLDA3UP2,690,338ILMN.230547PhIda38233PHLDA3UP2,690,348ILMN.23034PhIda38233PHLDA3UP2,690,348ILMN.23034PhIda38233PHIDA3UP <t< td=""><td>4,490,639</td><td>ILMN_1254631</td><td>Uck2</td><td>40,850</td><td>UCK2</td><td>UP</td></t<>	4,490,639	ILMN_1254631	Uck2	40,850	UCK2	UP
6,696.01ILMN_2564872Ddh2266,646DDHD2UP770,445ILMN_1224840Bcl93191BCL9UP5,090,156ILMN_2766253Mbn1123,186MBNL1UP1,850,402ILMN_266322Samsn111,148SAMSN1UP6,020,400ILMN_2664322Samsn111,148SAMSN1UP770,575ILMN_1254736Myo5a20,100MYO5AUP3,310,291ILMN_2665490Litaf37,974ITAFUP1,450,735ILMN_12250451700109H08Rik130,7761700109H08RiKUP1,450,735ILMN_2681601SI<44a2	1,990,524	ILMN_2557957	Eprs	5870	EPRS	UP
770,445ILMN_1224840Bcl93191BCL9UP5,090,156ILMN_2766253Mbnl123,186MBNL1UP1,850,402ILMN_2666322Samsn111,148SAMSN1UP6,020,400ILMN_2646322Samsn111,148SAMSN1UP770,575ILMN_1254736Myo5a20,100MYO5AUP150,019ILMN_2665490Litaf37,974ITAFUP3,310,291ILMN_12250451700109H08Rik30,7761700109H08RiKUP1,450,735ILMN_1225045H1fx4397H1FXUP3,840,600ILMN_2681601Slc44a210,711Slc44a2UP4,670,504ILMN_2628567Phida38233PHLDA3UP4,150,370ILMN_266453Arxa220,857ANXA2UP2,630,605ILMN_266453Arxa200,857ANXA2UP2,630,605ILMN_266453Arxa2UPUP1,420,338UP1,240,338ILMN_2805207B02018612RikNAUPUP2,650,345ILMN_2923607Phida38233PHLDA3UP2,650,348ILMN_2703144Per11966PER1UP2,570,037ILMN_2813484Per11966PER1UP2,570,033ILMN_270320D630023F18Rik129,674C20780UP2,570,053ILMN_270354Lgals3bp4067LGALS3BPUP	6,980,601	ILMN_2564872	Ddhd2	66,646	DDHD2	UP
5,090,156         ILMN_2766253         Mbn11         23,186         MBN11         UP           1,850,402         ILMN_2666232         Samsn1         172         IL2RG         UP           6,020,400         ILMN_2646322         Samsn1         11,148         SAMSN1         UP           770,575         ILMN_1254736         Myo5a         20,100         MYO5A         UP           3,310,291         ILMN_2665490         Litaf         37,974         UTAF         UP           3,310,291         ILMN_1252045         1700109H08Rik         4397         H1FX         UP           3,840,600         ILMN_2681601         Slc44a2         10,711         SLC44A2         UP           4,670,504         ILMN_2628567         Phlda3         8233         PHLDA3         UP           1,980,021         ILMN_263976         Cass4         75,128         CASS4         UP           2,630,605         ILMN_266453         AK005145         NA         UP            2,630,605         ILMN_266453         AK005145         NA         UP            2,630,605         ILMN_2805207         B020018C12Rik         NA         UP            2,903,28         ILMN_2923607 <td>770,445</td> <td>ILMN_1224840</td> <td>Bcl9</td> <td>3191</td> <td>BCL9</td> <td>UP</td>	770,445	ILMN_1224840	Bcl9	3191	BCL9	UP
1,850,402       ILMN_2568028       II2rg       1/2       IL2RG       0P         6,020,400       ILMN_2646322       Samsn1       11,148       SAMSN1       UP         770,575       ILMN_1254736       Myo5a       20,100       MY05A       UP         150,019       ILMN_2665490       Litaf       37,974       LITAF       UP         3,310,291       ILMN_3122845       1700109H08Rik       130,776       1700109H08RIK       UP         1,450,735       ILMN_3122845       H1fx       43997       H1FX       UP         4,670,504       ILMN_2681601       Slc44a2       10,711       SLC44A2       UP         1,980,021       ILMN_1245263       Tmem181       44,787       TMEM181       UP         2,630,605       ILMN_266453       Anxa2       20,857       ANXA2       UP         2,630,605       ILMN_266453       AK005145       NA       UP       UP         2,630,605       ILMN_2805207       B02018G12Rik       NA       UP       UP         1,240,338       ILMN_1239814       AK011411       NA       UP       UP         2,690,348       ILMN_270354       Pend5b       4,911       DENND5B       UP         2,690	5,090,156	ILMN_2766253	Mbnl1	23,186	MBNL1	UP
6.02,400       ILMN_2646322       Samsn1       11,148       SAMSN1       UP         770,575       ILMN_264532       Myo5a       20,100       MYO5A       UP         150,019       ILMN_265490       Litaf       37,974       ITAF       UP         3,310,291       ILMN_1225045       1700109H08Rik       130,776       1700109H08RiK       UP         1,450,735       ILMN_3122845       H1fx       4397       H1FX       UP         3,840,600       ILMN_2681601       Slc44a2       10,711       SLC44A2       UP         4,670,504       ILMN_2628567       Phlda3       8233       PHLDA3       UP         1,980,021       ILMN_2603976       Cass4       75,128       CASS4       UP         2,630,605       ILMN_2603976       Cass4       75,128       CASS4       UP         5,560,315       ILMN_2805207       B020018G12Rik       NA       UP       UP         1,240,338       ILMN_2923607       Phlda3       8233       PHLDA3       UP         2,570,037       ILMN_2923607       Phlda3       8233       PHLDA3       UP         2,690,348       ILMN_2700354       Per1       1966       PER1       UP         2,690	1,850,402	ILMN_2568028	ll2rg	172	IL2RG	UP
ILVIR_1234730         MY05A         20,100         MY05A         UP           150,019         ILMN_2665490         Litaf         37,974         LITAF         UP           3,310,291         ILMN_1225045         1700109H08Rik         30,776         1700109H08RIK         UP           3,40,600         ILMN_2681601         Slc44a2         10,711         SLC44A2         UP           4,670,504         ILMN_1245263         Tmem181         44,787         TMEM181         UP           1,880,021         ILMN_2628567         Phda3         8233         PHLDA3         UP           4,670,504         ILMN_2603976         Cass4         75,128         CASS4         UP           4,150,370         ILMN_246453         Ak005145         NA         UP           5,560,315         ILMN_2466453         AK005145         NA         UP           5,560,315         ILMN_2805207         B020018G12Rik         NA         UP           1,240,338         ILMN_2923607         Phlda3         8233         PHLDA3         UP           2,570,037         ILMN_2813484         Per1         NA         UP           2,630,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP	0,020,400 770 575	ILIVIN_2040322	Samsn I MuoFa	11,148	SAIVISIN I	UP
150019       ILMN_2605490       ILda       37,974       ILMA       ILMA       0P         3,310,291       ILMN_1225045       1700109H08Rik       130,776       1700109H08RiK       UP         1,450,735       ILMN_3122845       H1fx       4397       H1FX       UP         3,840,600       ILMN_2681601       Slc44a2       10,711       Slc44A2       UP         4,670,504       ILMN_2628567       Plda3       8233       PHLDA3       UP         4,150,370       ILMN_2603976       Cass4       75,128       CASS4       UP         5,660,315       ILMN_2466453       AK005145       NA       UP       UP         5,690,204       ILMN_2805207       B020018G12Rik       NA       UP       UP         2,430,338       ILMN_21239814       AK011411       NA       UP       UP         2,630,635       ILMN_2805207       Phlda3       8233       PHLDA3       UP         2,630,328       ILMN_2923607       Phlda3       8233       PHLDA3       UP         2,630,348       ILMN_201354       Per1       1966       PER1       UP         2,630,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP	//0,5/5	ILMN_1254736	WIYO5a	20,100	MYUSA	UP
1,450,735       ILMN_3122845       H1fx       4397       H1FX       UP         3,840,600       ILMN_2681601       Slc44a2       0,711       SLC4A22       UP         4,670,504       ILMN_268567       Phlda3       8233       PHLDA3       UP         4,150,370       ILMN_2603976       Cass4       20,857       ANXA2       UP         2,630,605       ILMN_2603976       Cass4       75,128       CASS4       UP         5,090,204       ILMN_2805207       B020018G12Rik       NA       UP       UP         1,240,338       ILMN_2805207       Phlda3       8233       PHLDA3       UP         2,932,8       ILMN_2805207       B020018G12Rik       NA       UP       UP         2,932,8       ILMN_2805207       Phlda3       8233       PHLDA3       UP         2,932,8       ILMN_2805207       Phlda3       8233       PHLDA3       UP         2,932,8       ILMN_2813484       Per1       1966       PER1       UP         2,690,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP         2,570,053       ILMN_2702102       D630023F18Rik       129,674       C2orf80       UP         2,570,053<	2 210 201	ILMN 1225045		120 776		UP
1,50,753       ILMN_2628567       IILM       45,77       IILM       01         3,840,600       ILMN_2681601       SIc44a2       10,711       SIc44A2       UP         1,980,021       ILMN_2628567       PhIda3       8233       PHLDA3       UP         4,150,370       ILMN_2603976       Cass4       75,128       CASS4       UP         2,630,605       ILMN_2466453       AK005145       NA       UP         5,090,204       ILMN_280507       B020018G12Rik       NA       UP         1,240,338       ILMN_2803976       AK0011411       NA       UP         2,930,328       ILMN_280307       PhIda3       8233       PHLDA3       UP         2,570,037       ILMN_2813484       Per1       NA       UP       UP         2,690,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP         2,570,053       ILMN_2702102       D630023F18Rik       129,674       C2orf80       UP         2,570,053       ILMN_1258526       Lgals3bp       4067       LGALS3BP       UP	1 450 735	ILMN 3122845	H1fv	130,770	H1FY	UP
J. 50,000       ILMN_1245263       Tmem181       44,787       TMEM181       UP         1,980,021       ILMN_2628567       Phlda3       8233       PHLDA3       UP         4,150,370       ILMN_1233117       Anxa2       20,857       ANXA2       UP         2,630,605       ILMN_2603976       Cass4       75,128       CASS4       UP         5,560,315       ILMN_2466453       AK005145       NA       UP         5,090,204       ILMN_2805207       B020018G12Rik       NA       UP         1,240,338       ILMN_1239814       AK011411       NA       UP         2,93,28       ILMN_2805207       Phlda3       8233       PHLDA3       UP         2,570,037       ILMN_2813484       Per1       1966       PER1       UP         2,690,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP         2,570,053       ILMN_2702102       D630023F18Rik       129,674       C2orf80       UP         2,570,053       ILMN_1258526       Lgals3bp       4067       LGALS3BP       UP	3 840 600	ILMN 2681601	Slc44a2	10 711	SIC44A2	LIP
1.980,021       ILMN_2628567       Phida3       8233       PHLDA3       UP         4,150,370       ILMN_1233117       Anxa2       20,857       ANXA2       UP         2,630,605       ILMN_2603976       Cass4       75,128       CASS4       UP         5,560,315       ILMN_2466453       AK005145       NA       UP         5,000,204       ILMN_2805207       B020018G12Rik       NA       UP         1,240,338       ILMN_1239814       AK011411       NA       UP         2,932.8       ILMN_2923607       Phida3       8233       PHLDA3       UP         2,570,037       ILMN_2813484       Per1       1966       PER1       UP         2,690,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP         2,570,053       ILMN_2702102       D630023F18Rik       129,674       C2orf80       UP         2,663       ILMN_1258526       Lgals3bp       4067       LGALS3BP       UP	4 670 504	ILMN 1245263	Tmem181	44 787	TMFM181	LIP
4,150,370       ILMN_1233117       Anxa2       20,857       ANXA2       UP         2,630,605       ILMN_2603976       Cass4       75,128       CASS4       UP         5,560,315       ILMN_2466453       AK005145       NA       UP         5,000,204       ILMN_2805207       B020018G12Rik       NA       UP         1,240,338       ILMN_1239814       AK011411       NA       UP         290,328       ILMN_2923607       Phida3       8233       PHLDA3       UP         2,570,037       ILMN_2813484       Per1       1966       PER1       UP         2,690,348       ILMN_2700354       Dennd5b       44,911       DENND5B       UP         2,570,053       ILMN_2702102       D630023F18Rik       129,674       C2orf80       UP         160,463       ILMN_1258526       Lgals3bp       4067       LGALS3BP       UP	1,980,021	ILMN_2628567	Phlda3	8233	PHLDA3	UP
2,630,605         ILMN_2603976         Cass4         75,128         CASS4         UP           5,560,315         ILMN_2466453         AK005145         NA         UP           5,000,204         ILMN_2805207         B020018G12Rik         NA         UP           1,240,338         ILMN_293814         AK011411         NA         UP           290,328         ILMN_2923607         Phida3         8233         PHLDA3         UP           2,570,037         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C2orf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	4,150,370	ILMN_1233117	Anxa2	20,857	ANXA2	UP
5,560,315         ILMN_2466453         AK005145         NA         UP           5,090,204         ILMN_2805207         B020018G12Rik         NA         UP           1,240,338         ILMN_1239814         AK011411         NA         UP           290,328         ILMN_2923607         Phlda3         8233         PHLDA3         UP           2,570,037         ILMN_2813484         Per1         1966         PER1         UP           2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C20rf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	2,630,605	ILMN_2603976	Cass4	75,128	CASS4	UP
5,090,204         ILMN_2805207         B020018G12Rik         NA         UP           1,240,338         ILMN_1239814         AK011411         NA         UP           290,328         ILMN_2923607         Phlda3         8233         PHLDA3         UP           2,570,037         ILMN_2813484         Per1         1966         PER1         UP           2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C20rt80         UP           160,463         ILMN_1258266         Lgals3bp         4067         LGALS3BP         UP	5,560,315	ILMN_2466453	AK005145	NA		UP
1,240,338         ILMN_1239814         AK011411         NA         UP           290,328         ILMN_2923607         Phlda3         8233         PHLDA3         UP           2,570,037         ILMN_2813484         Per1         1966         PER1         UP           2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C20rt80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	5,090,204	ILMN_2805207	B020018G12Rik	NA		UP
290,328         ILMN_2923607         Phlda3         8233         PHLDA3         UP           2,570,037         ILMN_2813484         Per1         1966         PER1         UP           2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C20rf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	1,240,338	ILMN_1239814	AK011411	NA		UP
2,570,037         ILMN_2813484         Per1         1966         PER1         UP           2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C2orf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	290,328	ILMN_2923607	Phlda3	8233	PHLDA3	UP
2,690,348         ILMN_2700354         Dennd5b         44,911         DENND5B         UP           2,570,053         ILMN_2702102         D630023F18Rik         129,674         C2orf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	2,570,037	ILMN_2813484	Per1	1966	PER1	UP
2,570,053         ILMN_2702102         D630023F18Rik         129,674         C2orf80         UP           160,463         ILMN_1258526         Lgals3bp         4067         LGALS3BP         UP	2,690,348	ILMN_2700354	Dennd5b	44,911	DENND5B	UP
160,463 ILMN_1258526 Lgals3bp 4067 LGALS3BP UP	2,570,053	ILMN_2702102	D630023F18Rik	129,674	C2orf80	UP
	160,463	ILMN_1258526	Lgals3bp	4067	LGALS3BP	٩U

In conclusion, we devise a protocol for analyzing gene expression effects from model organisms in patient cohorts, by means of homology translation and RSF models. We present our pipeline for analyzing a two-condition Illumina expression array study, with considerations on probe re-annotation, outlier detection and batch effects. All the presented data are available in raw and processed on GSE63242.

# Acknowledgments

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