frontiers

Supplementary Material:

Dissecting the effect of genetic variation on the hepatic expression of drug disposition genes across the collaborative cross mouse strains

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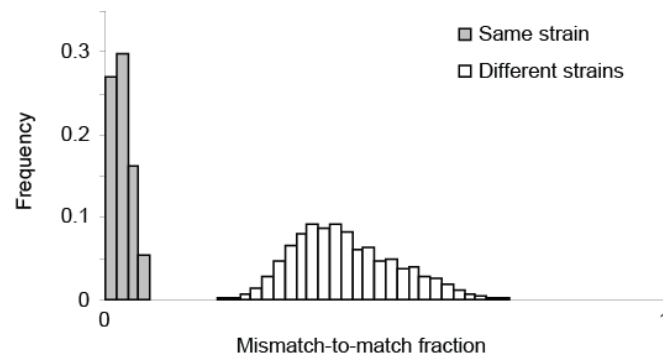
SUPPLEMENTARY TABLES AND FIGURES

1. Figures

Figure S1: Validation of genotyping data. The quality of genotyping was assessed using comparison between a standard array-based genotyping versus an RNA-Seq-based genotyping. Differences between the inferred genotypes (genotyping array against RNA-Seq-based genotyping) were assessed using the 'mismatch-to-match fraction' metric - defined as the fraction of mismatches to matches across all SNPs located in transcribed regions. The plot presents the distribution of mismatch-to-match fraction when using the *same* strain (gray), as well as the distribution of mismatch-to-match fraction when using one strain for the RNA-Seq-based genotyping and *another* strain for the array-based genotyping (white). The results indicate that the genotyping arrays are highly accurate (that is, low values of mismatch-to-match fraction when using the same strain).
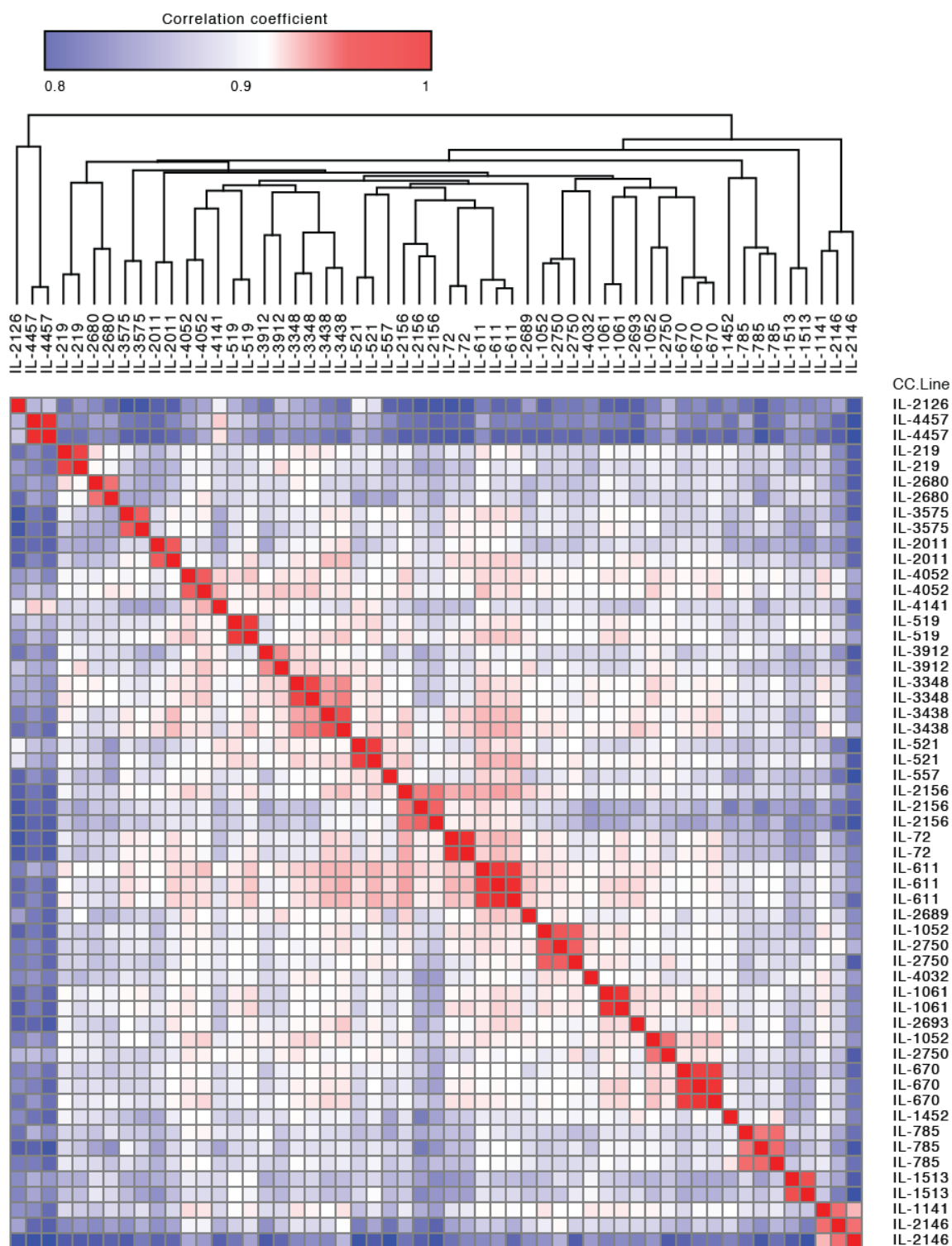
Figure S2. **Global analysis of total-expression traits.** Clustered correlation matrix of all CC individuals. The Spearman correlation coefficients (red blue color bar) was calculated using the total-expression values.
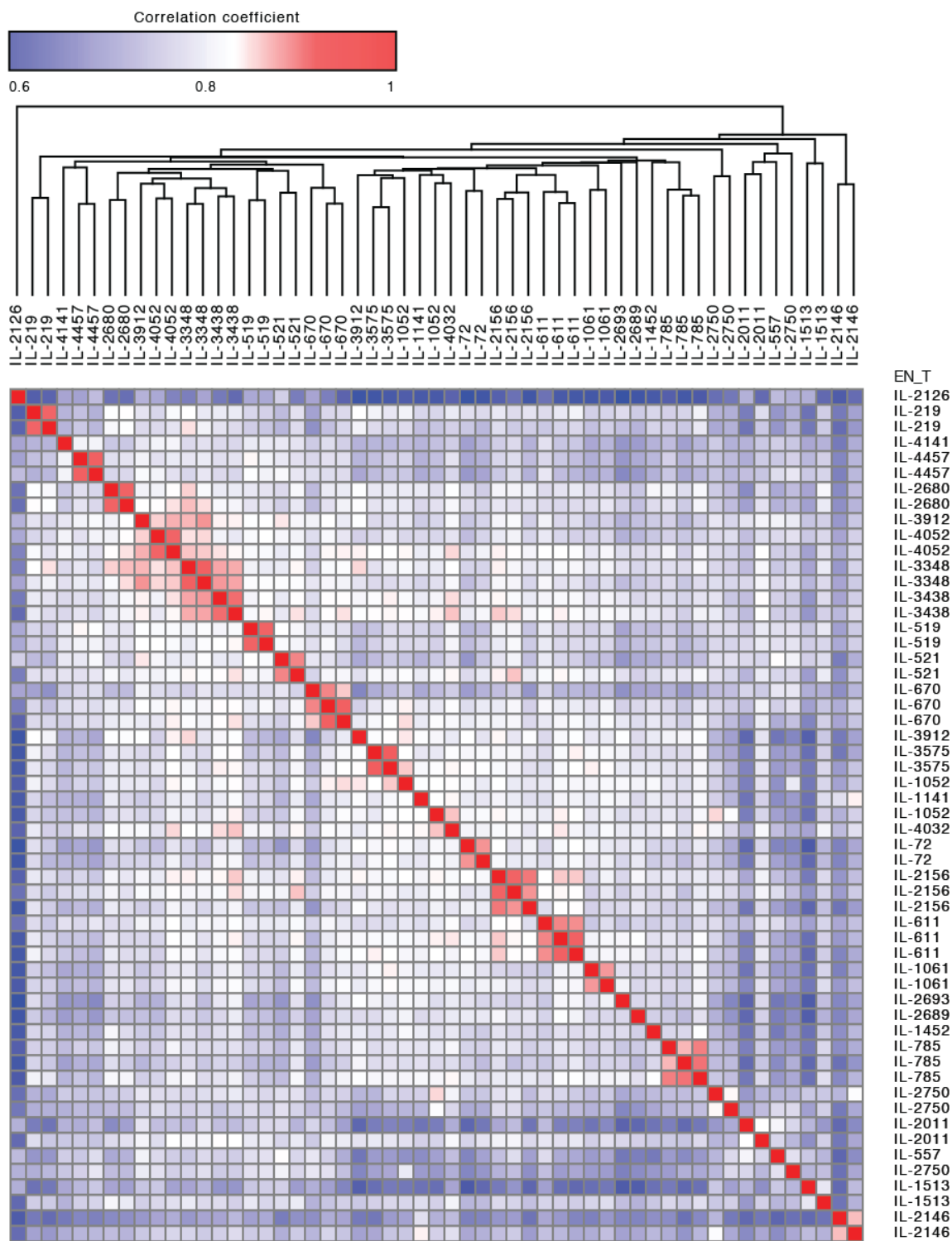
Figure S3. **Global analysis of isoform-ratio traits**. Clustered correlation matrix of all CC individuals. The Spearman correlation coefficients (red blue color bar) was calculated using the isoform-ratio values.
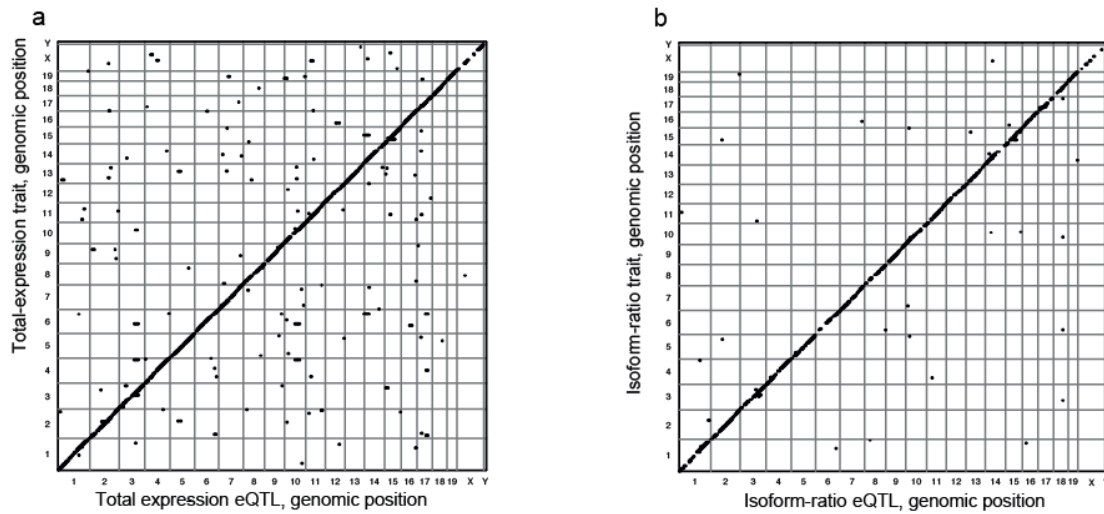
Figure S4: Genome–genome plots of total-expression eQTLs and isoform-ratio eQTLs. Shown are eQTL maps of a genome-wide eQTL analysis that was applied on the entire genome (without limitation to 5 Mbp), using an FDR cutoff of 0.1, for both total-expression traits (**a**) and isoform-ratio traits (**b**). In these eQTL maps, each point indicates the genomic position of the best-scoring variant (*x*-axis) and the position of its associated target (*y*-axis). We note that vertical bands in this map are typically induced by technical confounding factors (rather than by a regulatory hotspot, as demonstrated by Kang et al., 2008). Plots (**a**) and (**b**) demonstrate the absence of such vertical bands, providing an evidence for the validity of our results.
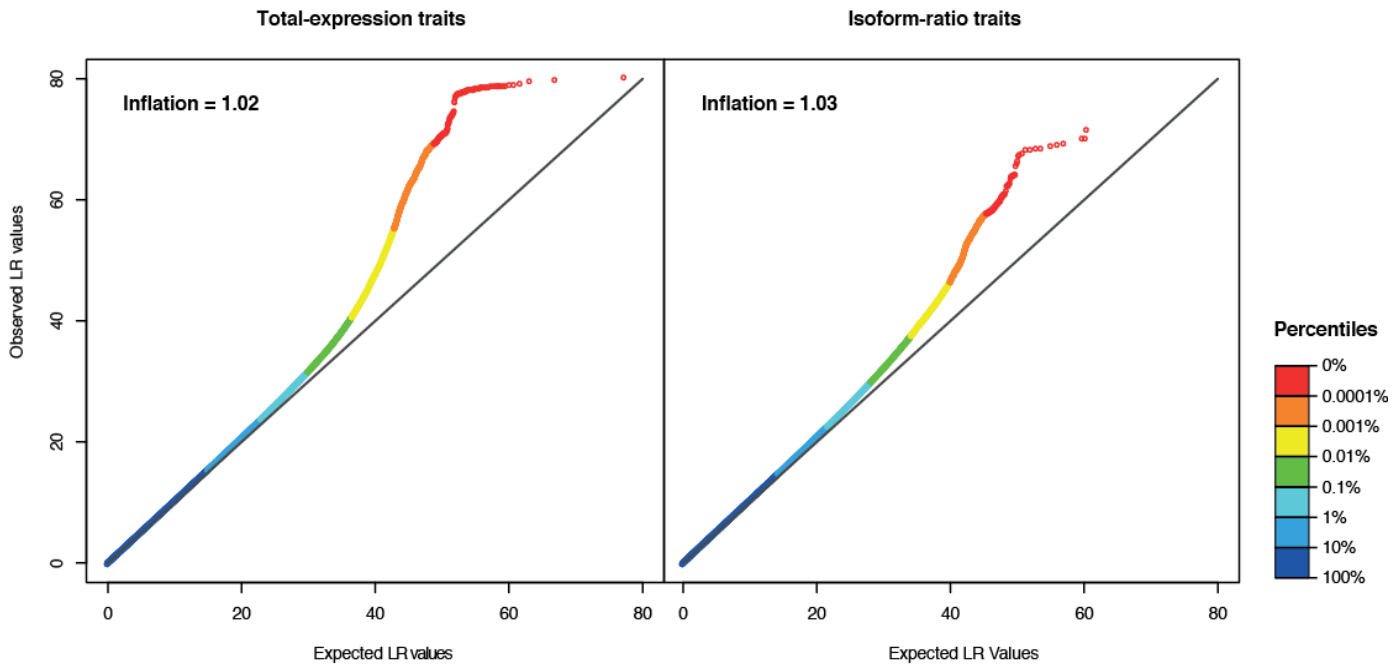
Figure S5: **Quantile-quantile (QQ) plots of total-expression and isoform-ratio traits**. The QQ plots present the null distribution of LR values (*x*-axis) compared to the distribution of observed LR values (*y*-axis). Results are shown across all total-expression traits or isoform-ratio traits (left and right, respectively) and across all SNPs. In both cases the inflation factor (the ratio of the median of the observed distribution to the median of the expected distribution) is smaller than 1.03, indicating that the identified eQTLs in this study are not due to confounding effects. Traits are color coded according to the percentile of their observed LR values.
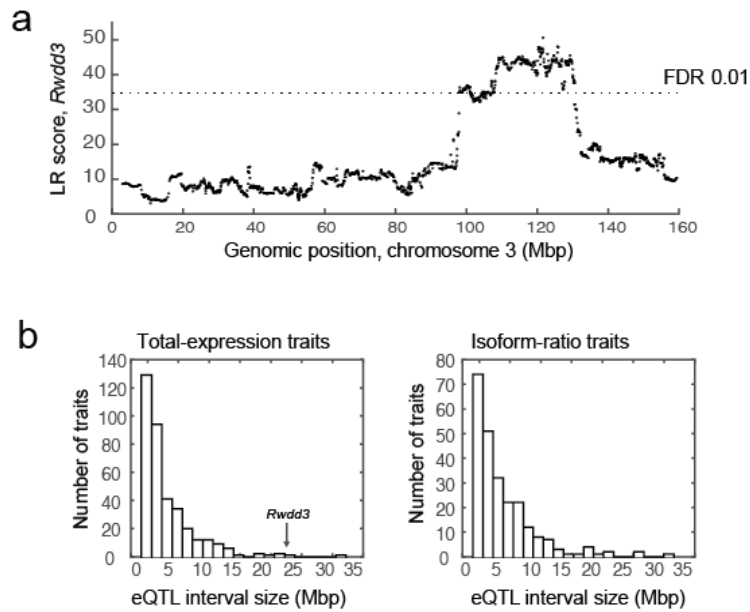
Figure S6: Imprecision of association. For each trait, its 'eQTL interval size' is the length of the proximal genome region that attained association scores exceeding an FDR of 0.01. (**a**) A representative example of a significant eQTL interval. Shown are the association scores (LR values; *y*-axis) across genomic positions in chromosome 3 (*x*-axis) for the total-expression of *Rwdd3*. The plot clearly demonstrates the large eQTL interval of *Rwdd3* (23.6 Mbp, between chr3:106,932,696 and chr3:130,535,749.5). (**b**) The distribution of eQTL interval sizes across the 365 total-expression traits (left) and the 243 isoform-ratio traits (right). The eQTL interval size of *Rwdd3* is marked with an arrow.
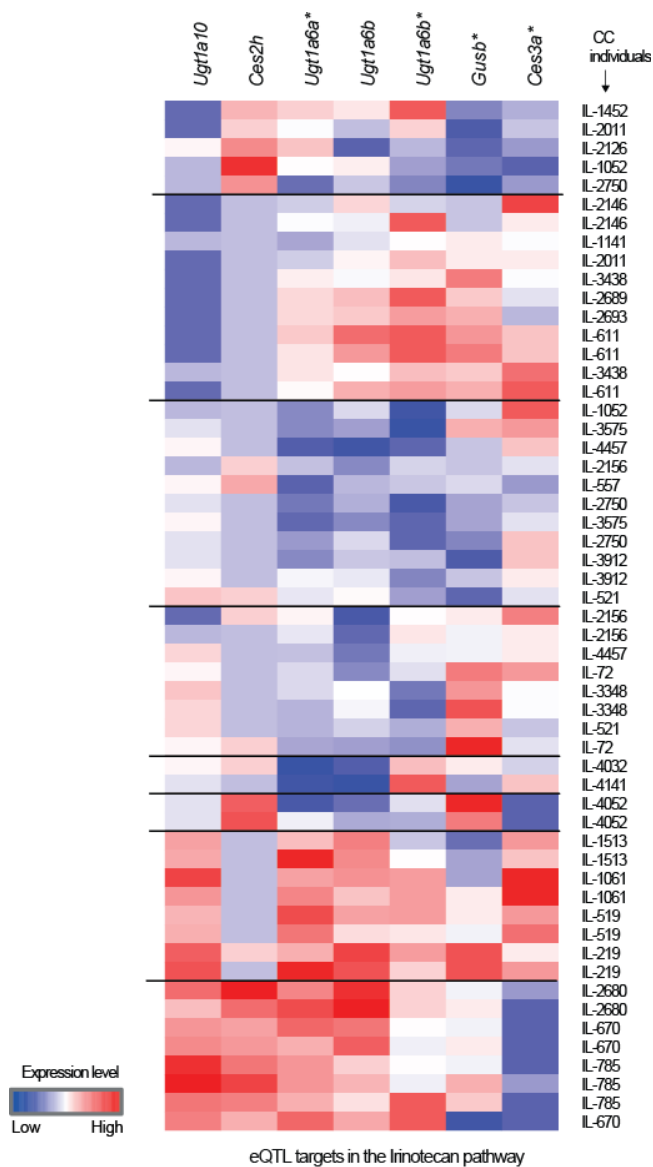
Figure S7. Expression profiles of CC mice across DMEs with proximal eQTLs in the Irinotecan pathway. The matrix presents the expression level of eQTL-associated traits within the Irinotecan pathway (columns) across different CC individuals (rows). High and low expression levels are in red and blue, respectively. Shown are three total-expression traits (*Ces2h*, *Ugt1a10* and *Ugt1a6b*) and four isoform-ratio traits (*Ces3a*, *Ugt1a6a*, *Gusb* and *Ugt1a6b*; indicated with asterisks). Each individual is annotated with the identifier of its CC strain. The clustering of the rows into eight groups is indicated as vertical lines.

2. Tables

Table S1. Liver samples. For each individual mouse (column 1), the table presents the CC line (column 2), age (weeks, column 3) and weight (gr; column 4).

CC individual	CC Line	Age (weeks)	Body Weight (gr)
1	IL-72	9.4	23.0
2	IL-72	9.4	24.0
3	IL-219	9.1	21.7
4	IL-219	9.1	18.5
5	IL-519	8.0	19.9
6	IL-519	8.0	21.5
7	IL-521	9.9	23.2
8	IL-521	9.9	24.5
9	IL-557	8.4	23.0
10	IL-611	10.1	28.4
11	IL-611	10.1	26.9
12	IL-611	10.1	29.5
13	IL-670	9.1	20.2
14	IL-670	9.1	19.6
15	IL-670	9.1	21.8
16	IL-785	8.1	15.8
17	IL-785	8.3	15.4
18	IL-785	9.0	12.8
19	IL-1052	9.3	23.6
20	IL-1052	9.3	22.3
21	IL-1061	8.3	17.7
22	IL-1061	8.3	19.6
23	IL-1141	8.9	24.4
24	IL-1452	9.9	22.3
25	IL-1513	8.1	16.0
26	IL-1513	8.1	17.8
27	IL-2011	9.4	21.3
28	IL-2011	9.4	21.6
29	IL-2126	10.9	17.8
30	IL-2146	9.3	18.4
31	IL-2146	9.3	21.6
32	IL-2156	10.0	38.0
33	IL-2156	10.0	27.7

34	IL-2156	10.0	25.3
35	IL-2680	11.9	28.3
36	IL-2680	11.9	25.1
37	IL-2689	8.1	22.0
38	IL-2693	8.1	18.1
39	IL-2750	8.1	26.9
40	IL-2750	8.1	30.1
41	IL-2750	8.1	26.8
42	IL-3348	8.1	26.6
43	IL-3348	8.1	23.5
44	IL-3438	9.7	27.0
45	IL-3438	9.7	25.0
46	IL-3575	9.0	17.3
47	IL-3575	9.0	17.9
48	IL-3912	10.0	25.7
49	IL-3912	10.0	26.9
50	IL-4032	8.4	14.8
51	IL-4052	10.9	23.4
52	IL-4052	10.9	25.5
53	IL-4141	10.4	23.6
54	IL-4457	8.6	35.0
55	IL-4457	8.6	30.7

Table S2. The computational analysis pipeline. For each step of the analysis (column 1), reported is the software name (column 2), its reference (column 3) and additional links (column 4).

Pipeline step	Software	Reference	Link
RNA-Seq quantification	RSEM	Li and Dewey, 2011	http://deweylab.github.io/RSEM/
Data transformation	None		
Association tests			
- Haplotype probabilities	R HAPPY package	Mott et al., 2000	http://www.well.ox.ac.uk/happy/happyR.shtml
- Mixed model regression	R lme4 package	Bates et al., 2015	https://cran.r-project.org/web/packages/lme4/index.html
Analysis of splicing events			
- Alignment	TOPHAT	Kim et al., 2013	https://ccb.jhu.edu/software/tophat/index.shtml
- Visualization	IGV	Thorvaldsdóttir 2013	http://software.broadinstitute.org/software/igv/
Enrichment analysis	IPA	QIAGEN, CA	http://www.ingenuity.com/

Table S3. Predicted total-expression eQTLs in liver. For each total-expression trait (symbols; column 1), reported are the ensemble identifier (column 2), the genomic position of the trait (column 3), and the genomic position of its top ranking proximal total-expression eQTL (column 4). Column 5 indicates whether the gene is also significantly associated with an isoform-ratio eQTL, as detailed in **Table S4**.

Total-expression trait			Total-expression eQTL interval	Isoform-ratio eQTL
Symbol	**Ensembl identifier**	**Genomic position**		
Bmyc	ENSMUSG00000049086	chr2:25562399-25563237	chr2:14756526 - 26166145	
Cd59b	ENSMUSG00000068686	chr2:103910006-103931344	chr2:91222531 - 112919736	
Cyp3a16	ENSMUSG00000038656	chr5:146197178-146230592	chr5:141577494 - 148589118	
Cd1d2	ENSMUSG00000041750	chr3:86790508-86793455	chr3:82595175 - 86230898	
Lcn13	ENSMUSG00000062061	chr2:25555563-25558846	chr2:13547225 - 26166145	
Vnn3	ENSMUSG00000020010	chr10:23571268-23589649	chr10:18060806 - 25939589	
Cyp2d11	ENSMUSG00000068085	chr15:82219584-82224452	chr15:77983701 - 86626374	
Mettl21d	ENSMUSG00000049882	chr12:70678615-70684015	chr12:60119746 - 72584475	
H2-Q10	ENSMUSG00000067235	chr17:35607034-35611508	chr17:21774306 - 40179466	
6530401N04Rik	ENSMUSG00000020956	chr12:53089299-53107488	chr12:41770182 - 55456902	+
0610012H03Rik	ENSMUSG00000055312	chr2:105064477-105219953	chr2:75178001 - 107333276	
Ceacam2	ENSMUSG00000054385	chr7:26301061-26325023	chr7:17179335 - 26385736	
Rpl29	ENSMUSG00000048758	chr9:106331785-106333899	chr9:103301364 - 110507707	+
Mup15	ENSMUSG00000096674	chr4:60961073-61100775	chr4:51473949 - 62075481	
Msrb2	ENSMUSG00000023094	chr2:19293067-19316603	chr2:15280860 - 24520801	
Akr1c18	ENSMUSG00000021214	chr13:4131861-4149900	chr13:3220944 - 10959686	
Manba	ENSMUSG00000028164	chr3:135148575-135234368	chr3:132134304 - 141743698	
Gm4951	ENSMUSG00000073555	chr18:60371734-60407474	chr18:57441750 - 62191758	
Ttc39a	ENSMUSG00000028555	chr4:109079228-109117350	chr4:104091146 - 114241578	
Camk2b	ENSMUSG00000057897	chr11:5869647-5966365	chr11:3277587 - 8861158	
Rpl21	ENSMUSG00000041453	chr5:147644466-147648608	chr5:144455566 - 151532855	+
Poldip3	ENSMUSG00000041815	chr15:82956408-82979814	chr15:81956141 - 86727218	
Lrit1	ENSMUSG00000041044	chr14:37868016-37878132	chr14:27274289 - 47174572	
Nkiras1	ENSMUSG00000021772	chr14:19103650-19116456	chr14:5958958 - 19150979	
5730469M10Rik	ENSMUSG00000021792	chr14:41807029-41827077	chr14:41695864 - 45679115	
Fabp12	ENSMUSG00000027530	chr3:10244209-10301183	chr3:9819605 - 12083493	
Ugt3a2	ENSMUSG00000049152	chr15:9265305-9300710	chr15:6562190 - 10587824	
Ugt1a10	ENSMUSG00000090165	chr1:89951963-90115579	chr1:77680615 - 95825573	
Amd2	ENSMUSG00000063953	chr10:35428497-35431697	chr10:27594228 - 38447096	
5033411D12Rik	ENSMUSG00000055137	chr13:16949689-17786566	chr13:15649552 - 20208147	
Tmem19	ENSMUSG00000069520	chr10:114777795-114799318	chr10:111882514 - 122588223	
RP23-381B19.7	ENSMUSG00000093483	chr11:83105201-83108134	chr11:81945493 - 90361138	+
Pttg1	ENSMUSG00000020415	chr11:43233752-43239753	chr11:42218922 - 43922341	
Rwdd3	ENSMUSG00000028133	chr3:120858318-120874613	chr3:106932696 - 130535749	
Tmem9	ENSMUSG00000026411	chr1:137904796-137931607	chr1:134717887 - 135889744	
Zkscan1	ENSMUSG00000029729	chr5:138526312-138549050	chr5:132245840 - 136972814	
Bik	ENSMUSG00000016758	chr15:83357292-83375065	chr15:81150967 - 85446484	

Mup14	ENSMUSG00000073830	chr4:60961055-60965051	chr4:56286549 - 62628686	+
Dhx40	ENSMUSG00000018425	chr11:86582348-86621198	chr11:78160552 - 93000422	
Mccc1	ENSMUSG00000027709	chr3:35858234-35899600	chr3:30650923 - 38350217	
9530068E07Rik	ENSMUSG00000036275	chr11:52209930-52222230	chr11:49789178 - 54407017	
Mup18	ENSMUSG00000078674	chr4:61331211-61335170	chr4:50569829 - 62263957	
Glo1	ENSMUSG00000024026	chr17:30729811-30749604	chr17:28832865 - 34004810	+
Dhrs7	ENSMUSG00000021094	chr12:73751343-73765815	chr12:64596188 - 76093908	
Rplp0	ENSMUSG00000067274	chr5:116009476-116013736	chr5:113732014 - 120695426	
Cml5	ENSMUSG00000079494	chr6:85767215-85770966	chr6:84916136 - 87478531	
Ctse	ENSMUSG00000004552	chr1:133534883-133572080	chr1:130885402 - 137392496	
Fastkd1	ENSMUSG00000027086	chr2:69524872-69551573	chr2:63020015 - 68902080	
Cfhr2	ENSMUSG00000033898	chr1:141701945-141915481	chr1:135889744 - 156775182	+
Cd59a	ENSMUSG00000032679	chr2:103935958-103955511	chr2:101295269 - 112919736	+
Rps3a	ENSMUSG00000028081	chr3:85941862-85946624	chr3:84573560 - 87186087	
Rnaset2a	ENSMUSG00000095687	chr17:8321456-8340697	chr17:5764944 - 12772975	
Zfp945	ENSMUSG00000059142	chr17:22983664-23004101	chr17:16677765 - 23570054	
Fmo1	ENSMUSG00000040181	chr1:164759692-164796679	chr1:160125359 - 165053877	
Pop4	ENSMUSG00000030423	chr7:39047839-39056367	chr7:36431337 - 47726947	
Gm4952	ENSMUSG00000071633	chr19:12674506-12702106	chr19:3250617 - 12675766	
Pex7	ENSMUSG00000020003	chr10:19579735-19627495	chr10:18992291 - 23321540	
2810055F11Rik	ENSMUSG00000019718	chr12:73174415-73186426	chr12:71243758 - 74518762	
Krt23	ENSMUSG00000006777	chr11:99339288-99354451	chr11:96228660 - 98654237	
Rnf149	ENSMUSG00000048234	chr1:39608141-39634250	chr1:37382716 - 43147962	
Aldh8a1	ENSMUSG00000037542	chr10:21097097-21116391	chr10:18992291 - 23692494	
Ifi35	ENSMUSG00000010358	chr11:101309721-101320012	chr11:101084992 - 102590035	
Vps41	ENSMUSG00000041236	chr13:18809161-18958678	chr13:10959686 - 19993476	
Cfhr1	ENSMUSG00000057037	chr1:141443639-141456835	chr1:139843091 - 145874225	+
Hnf1aos1	ENSMUSG00000086054	chr5:115418793-115448055	chr2:117135467 - 121174432	
Ganc	ENSMUSG00000062646	chr2:120229632-120287436	chr5:114009955 - 116322846	+
Raet1d	ENSMUSG00000078452	chr10:22081700-22093945	chr10:18992291 - 23433558	
Rdh9	ENSMUSG00000056148	chr10:127196843-127229753	chr10:124997746 - 129614408	
Prelid2	ENSMUSG00000056671	chr18:42035350-42110848	chr18:39887772 - 41969216	
Lyz2	ENSMUSG00000069516	chr10:116714390-116719377	chr10:117418508 - 117499970	
Zfp672	ENSMUSG00000049755	chr11:58128616-58136848	chr11:52973921 - 54691456	+
Gbe1	ENSMUSG00000022707	chr16:70314194-70569961	chr16:67445464 - 76724606	
Alad	ENSMUSG00000028393	chr4:62170203-62180952	chr4:60933569 - 62628686	
Dpy19l1	ENSMUSG00000043067	chr9:24216220-24307584	chr7:48002471 - 51825053	
0610005C13Rik	ENSMUSG00000085214	chr7:52823165-52830697	chr9:13879037 - 26203964	+
Gm4723	ENSMUSG00000078898	chr2:175197937-175209702	chr2:172474381 - 178820577	
Gm4956	ENSMUSG00000025936	chr1:21275327-21288393	chr1:19809537 - 25632823	
Mup16	ENSMUSG00000078675	chr4:61176624-61180563	chr4:62263957 - 64029884	+
Tor1aip2	ENSMUSG00000050565	chr1:157882856-157900866	chr1:153141822 - 161901171	
Gm14400	ENSMUSG00000083817	chr2:177010178-177013668	chr2:173113613 - 174719530	

Rnaset2b	ENSMUSG00000094724	chr17:7183209-7202542	chr17:5764944 - 9038183	
Arsb	ENSMUSG00000042082	chr13:94541634-94712971	chr13:93099110 - 96407181	
Ido2	ENSMUSG00000031549	chr8:25642364-25686805	chr8:24904536 - 25400206	
U2af1	ENSMUSG00000061613	chr17:31784027-31795699	chr17:23904929 - 32075473	
Rpl3	ENSMUSG00000060036	chr15:79908211-79913836	chr15:77221461 - 81956141	
Acbd4	ENSMUSG00000056938	chr11:102962996-102973514	chr11:100977097 - 102706300	
H2-Q2	ENSMUSG00000091705	chr17:35479187-35483707	chr17:26680548 - 33591553	+
9630013D21Rik	ENSMUSG00000059027	chr4:109324134-109330458	chr4:108857593 - 115924444	
Gm13152	ENSMUSG00000078496	chr4:146866526-146887595	chr4:140490497 - 143862712	
Atp5e	ENSMUSG00000016252	chr2:174286573-174289606	chr2:174719530 - 180057625	
1300010F03Rik	ENSMUSG00000058997	chr14:79248985-79602117	chr14:76127589 - 83519019	
Ephx2	ENSMUSG00000022040	chr14:66703214-66743337	chr14:59746030 - 69947586	
Atp9a	ENSMUSG00000027546	chr2:168459938-168567909	chr2:168184899 - 169141273	+
Ak3	ENSMUSG00000024782	chr19:29095323-29122451	chr19:25336435 - 30239534	
Iqcc	ENSMUSG00000040795	chr4:129292370-129296343	chr4:128117594 - 128319434	
Cib1	ENSMUSG00000030538	chr7:87372042-87377699	chr7:83041480 - 83793063	
Atox1	ENSMUSG00000018585	chr11:55260143-55274741	chr11:54156015 - 58771634	
Mthfsl	ENSMUSG00000079427	chr9:88583443-88614636	chr9:86522016 - 94131022	+
Ces2h	ENSMUSG00000091813	chr8:107538350-107544310	chr8:112100634 - 114627710	
Acad12	ENSMUSG00000042647	chr5:122048293-122068947	chr5:120774344 - 123203687	+
Josd2	ENSMUSG00000038695	chr7:51723350-51727022	chr7:48002471 - 53769845	+
9130401M01Rik	ENSMUSG00000022362	chr15:57853831-57907980	chr15:55151291 - 55777903	
Gas5	ENSMUSG00000053332	chr1:162964553-162968670	chr1:162527085 - 164654736	+
Nnt	ENSMUSG00000025453	chr13:120124255-120197804	chr13:119378784 - 120116981	
Mppe1	ENSMUSG00000062526	chr18:67385184-67405484	chr18:63960511 - 68330850	
H2-K2	ENSMUSG00000067203	chr17:34111731-34115733	chr17:31981493 - 41053604	+
Mgst3	ENSMUSG00000026688	chr1:169302097-169323972	chr1:169137266 - 174631935	
Rsph3b	ENSMUSG00000023806	chr17:7109030-7153070	chr17:6102490 - 9315295	
Vps52	ENSMUSG00000024319	chr17:34092757-34103929	chr17:32134283 - 36234565	
Gfra1	ENSMUSG00000025089	chr19:58310094-58530399	chr19:57786621 - 58789289	
Tars2	ENSMUSG00000028107	chr3:95543899-95558900	chr3:97937294 - 105067333	
Rassf4	ENSMUSG00000042129	chr6:116583026-116623854	chr6:114969395 - 117731966	
Cyp3a13	ENSMUSG00000029727	chr5:138334160-138362847	chr5:135357302 - 139739343	
Tpm3	ENSMUSG00000027940	chr3:89876571-89904824	chr3:88125956 - 92375879	+
Rps29	ENSMUSG00000034892	chr12:70258709-70260173	chr12:59677221 - 71995861	
Btbd9	ENSMUSG00000062202	chr17:30352469-30713394	chr17:28832865 - 34004810	
Atxn10	ENSMUSG00000016541	chr15:85166768-85294266	chr15:88347170 - 88973247	
Tpmt	ENSMUSG00000021376	chr13:47120539-47140106	chr13:45215261 - 52593069	+
Timd2	ENSMUSG00000040413	chr11:46482462-46520563	chr11:44364024 - 47860405	+
Gm14327	ENSMUSG00000074521	chr2:177631801-177640489	chr2:178667105 - 178820577	
Bmp1	ENSMUSG00000022098	chr14:70874364-70920067	chr14:62241300 - 69947586	
Cisd3	ENSMUSG00000078695	chr11:97547140-97549935	chr11:96717713 - 99410147	
Aldh16a1	ENSMUSG00000007833	chr7:52396054-52409954	chr7:47774855 - 52606809	

Pet112l	ENSMUSG00000028085	chr3:85378041-85459544	chr3:86230898 - 87489032	
Camk1d	ENSMUSG00000039145	chr2:5214503-5635561	chr2:3046350 - 5376261	
Sort1	ENSMUSG00000068747	chr3:108087009-108164429	chr3:108797979 - 115203958	
Psmc5	ENSMUSG00000020708	chr11:106117468-106124434	chr11:101297382 - 106288549	
Gm14324	ENSMUSG00000080709	chr2:177469005-177473462	chr2:178820577 - 179458127	
Ugt1a6b	ENSMUSG00000090145	chr1:89999827-90115578	chr1:89753059 - 99119962	+
Nme7	ENSMUSG00000026575	chr1:166243010-166334805	chr1:161327007 - 162059087	+
Slc39a2	ENSMUSG00000072572	chr14:52512564-52516420	chr14:48333656 - 52864014	
Tmem66	ENSMUSG00000031532	chr8:35217617-35233899	chr8:34524120 - 46579264	
Smyd1	ENSMUSG00000055027	chr6:71163934-71272227	chr6:71680163 - 73284518	
Fam84b	ENSMUSG00000072568	chr15:60650551-60656635	chr15:62178117 - 63343000	
Gm16286	ENSMUSG00000024571	chr18:80403504-80409480	chr18:78803726 - 79776136	+
Fxn	ENSMUSG00000059363	chr19:24335943-24355095	chr19:24024008 - 24849073	
Ttc38	ENSMUSG00000035944	chr15:85662734-85689252	chr15:86679283 - 87408379	
Srp54a	ENSMUSG00000021020	chr12:56181557-56214680	chr15:9358458 - 12552201	
Fyb	ENSMUSG00000022148	chr15:6529871-6613321	chr12:56326785 - 59981234	
Mup12	ENSMUSG00000094793	chr4:60732255-60736198	chr4:59800888 - 62628686	+
BC029722	ENSMUSG00000074649	chr2:155643466-155645162	chr2:152091534 - 162469673	
Mettl6	ENSMUSG00000021891	chr14:32291506-32308216	chr14:31712196 - 32638945	
1810046J19Rik	ENSMUSG00000002580	chr11:98299022-98300305	chr11:102078561 - 104078038	
Sfxn2	ENSMUSG00000025036	chr19:46647855-46671388	chr19:44610432 - 44782956	
Ptprd	ENSMUSG00000028399	chr4:75587142-77857865	chr4:74351764 - 75560945	
Twf1	ENSMUSG00000022451	chr15:94408382-94420320	chr15:94121629 - 94561654	
Gm10499	ENSMUSG00000073403	chr17:36278703-36282868	chr17:36883101 - 41053604	+
Tsen15	ENSMUSG00000014980	chr1:154217865-154233818	chr1:155133452 - 156057381	
Akr1c19	ENSMUSG00000071551	chr13:4227946-4247927	chr13:3220944 - 6511231	
Cutc	ENSMUSG00000025193	chr19:43827486-43843128	chr19:40118496 - 40951709	
Mthfs	ENSMUSG00000066442	chr9:89094217-89135064	chr9:87569635 - 94042526	
H2-Bl	ENSMUSG00000073406	chr17:36201920-36221168	chr17:32219846 - 40179466	
Cyp2d12	ENSMUSG00000096852	chr15:82385538-82389843	chr15:84471561 - 86334924	
Cyp2c44	ENSMUSG00000025197	chr19:44079512-44103737	chr19:40658504 - 40951709	
Hist1h4i	ENSMUSG00000060639	chr13:22132685-22133221	chr13:20135475 - 23208302	
Agmat	ENSMUSG00000040706	chr4:141302587-141315178	chr4:141057905 - 142565855	
Gm5970	ENSMUSG00000085977	chr18:60380497-60381712	chr18:57441750 - 61265879	
Aen	ENSMUSG00000030609	chr7:86040740-86056095	chr7:86216568 - 86490361	+
Icam1	ENSMUSG00000037405	chr9:20820404-20833241	chr9:13182953 - 18108766	
BC026585	ENSMUSG00000033488	chr1:159388711-159419191	chr1:161327007 - 162059087	
Fam173a	ENSMUSG00000057411	chr17:25927453-25929332	chr17:26680548 - 29365788	
Gm14305	ENSMUSG00000078878	chr2:176493037-176506522	chr2:178329262 - 178581580	
Gm10768	ENSMUSG00000074828	chr19:43913293-43915218	chr19:35104083 - 42200247	
Fam173b	ENSMUSG00000039065	chr15:31531607-31550982	chr15:34086691 - 34700085	
Mtdh	ENSMUSG00000022255	chr15:34012449-34072141	chr15:33266937 - 34209722	
Hemk1	ENSMUSG00000032579	chr9:107230023-107240681	chr9:103912182 - 106461499	

Aga	ENSMUSG00000031521	chr8:54597080-54608776	chr8:55357356 - 55474478	
Sympk	ENSMUSG00000023118	chr7:19609726-19639967	chr7:17732740 - 17769986	
Pccb	ENSMUSG00000032527	chr9:100882451-100935317	chr9:102836554 - 103753663	
Npc1	ENSMUSG00000024413	chr18:12348202-12394909	chr18:10294491 - 12958657	
Tbcb	ENSMUSG00000006095	chr7:31009150-31017291	chr7:30068013 - 30342030	
Cd63	ENSMUSG00000025351	chr10:128345975-128349872	chr10:124997746 - 127910154	
Snrnp25	ENSMUSG00000040767	chr11:32105415-32108984	chr11:35248737 - 35431622	
Fam114a2	ENSMUSG00000020523	chr11:57296492-57332146	chr11:56772816 - 57104608	+
Steap3	ENSMUSG00000026389	chr1:122087334-122169282	chr1:124179367 - 125357830	
Rhoc	ENSMUSG00000002233	chr3:104591929-104597377	chr3:105422273 - 106995838	
Trim44	ENSMUSG00000027189	chr2:102140276-102247985	chr2:101511867 - 102765376	
Zfp949	ENSMUSG00000032425	chr9:88442858-88465924	chr9:87645120 - 88392923	
Cyp3a25	ENSMUSG00000029630	chr5:146788770-146821194	chr5:145222513 - 147514088	+
Ttc32	ENSMUSG00000066637	chr12:9036803-9043200	chr12:7608369 - 10569545	
Tgtp1	ENSMUSG00000078922	chr11:48798829-48807674	chr11:45817537 - 47002325	
Psma7	ENSMUSG00000027566	chr2:179771078-179777138	chr2:178581580 - 179823855	
Pex19	ENSMUSG00000003464	chr1:174056886-174066624	chr1:172963069 - 173836444	
Enpep	ENSMUSG00000028024	chr3:128972093-129035638	chr3:127014677 - 127812337	
Siae	ENSMUSG00000001942	chr9:37421432-37455903	chr9:40327804 - 40363766	
Hmga1	ENSMUSG00000046711	chr17:27693565-27700619	chr17:27449729 - 28040946	
Tmem51	ENSMUSG00000040616	chr4:141586907-141640219	chr4:144378497 - 144928744	
Swi5	ENSMUSG00000044627	chr2:32134336-32143595	chr2:31941411 - 34714988	
Nedd4l	ENSMUSG00000024589	chr18:65047410-65377480	chr18:65669450 - 67177732	
Sarnp	ENSMUSG00000078427	chr10:128258827-128314694	chr10:122443727 - 123707083	
Trmt2b	ENSMUSG00000067369	chr20:130756878-130811523	chr20:128535461 - 128695239	
Fam32a	ENSMUSG00000003039	chr8:74743629-74747663	chr18:70047972 - 70244965	
Ccdc68	ENSMUSG00000038903	chr18:70085080-70129138	chr8:76941137 - 79402559	
Tmem128	ENSMUSG00000067365	chr5:38651424-38660861	chr5:36737332 - 37813528	+
1500003O03Rik	ENSMUSG00000014077	chr2:119373433-119412763	chr2:115859084 - 115994093	
Rpl35a	ENSMUSG00000060636	chr16:33056539-33060275	chr16:36387277 - 37305160	
Sulf2	ENSMUSG00000006800	chr2:165898589-165981163	chr2:166865009 - 167656617	
D2hgdh	ENSMUSG00000073609	chr1:95721817-95748925	chr1:93545218 - 93919426	
Adh6-ps1	ENSMUSG00000090306	chr3:138037085-138051255	chr3:135696847 - 138761310	
Thnsl2	ENSMUSG00000054474	chr6:71078160-71094340	chr6:74630425 - 76434273	
Mup2	ENSMUSG00000078688	chr4:60080259-60167161	chr4:59981393 - 61954886	+
Nsmce2	ENSMUSG00000059586	chr15:59205753-59433238	chr15:43929680 - 55777903	
C1rb	ENSMUSG00000098470	chr6:124462790-124531062	chr6:118394139 - 120845297	
1100001G20Rik	ENSMUSG00000051748	chr11:83560442-83566144	chr11:83275936 - 88099515	
Hook1	ENSMUSG00000028572	chr4:95633931-95692104	chr4:90384356 - 91196614	
Acads	ENSMUSG00000029545	chr5:115560308-115569355	chr5:115648291 - 116322846	
Alg1	ENSMUSG00000039427	chr16:5233714-5245005	chr16:3451115 - 3451115	
Churc1	ENSMUSG00000090258	chr12:77866525-77884167	chr12:76093908 - 80830398	+
Ilvbl	ENSMUSG00000032763	chr10:78037245-78047243	chr7:13023046 - 16816078	

Clptm1	ENSMUSG00000002981	chr7:20216930-20250379	chr10:80277553 - 83776508	
1110034B05Rik	ENSMUSG00000048495	chr1:57445081-57463945	chr1:58868976 - 59359404	
Tuba1a	ENSMUSG00000072235	chr15:98780272-98783982	chr15:97987449 - 100348493	
Hist1h2bl	ENSMUSG00000094338	chr13:21807632-21808012	chr13:22102442 - 25377069	
Tff3	ENSMUSG00000024029	chr17:31262251-31266591	chr7:51368098 - 51825053	
Ocel1	ENSMUSG00000002396	chr8:73895197-73903260	chr17:29365788 - 31626873	
Coq5	ENSMUSG00000041733	chr5:115729675-115746981	chr5:115648291 - 116793513	
Abcc6	ENSMUSG00000030834	chr7:53231750-53285672	chr8:70997820 - 71556831	
Pde9a	ENSMUSG00000041119	chr17:31523179-31613255	chr17:27582938 - 28832865	
Rpl7a	ENSMUSG00000062647	chr2:26766284-26768838	chr2:20233324 - 23363299	
Acss3	ENSMUSG00000035948	chr10:106373220-106560724	chr10:101832662 - 104599234	
Pnpt1	ENSMUSG00000020464	chr11:29030744-29061828	chr11:32354761 - 33472055	
Fam134a	ENSMUSG00000049339	chr1:75139360-75144483	chr1:73851881 - 74132316	
Tnfsf10	ENSMUSG00000039304	chr3:27215950-27241349	chr3:26448202 - 27787352	
B4galnt1	ENSMUSG00000006731	chr10:126602247-126609385	chr10:127032881 - 127910154	
Ercc3	ENSMUSG00000024382	chr18:32399954-32429805	chr18:32937368 - 34093517	
Hddc3	ENSMUSG00000030532	chr7:87488023-87490983	chr7:85815782 - 86057235	
Syngr1	ENSMUSG00000022415	chr15:79921764-79949931	chr15:77983701 - 81455222	
Kmo	ENSMUSG00000039783	chr1:177550512-177592247	chr1:175192149 - 175751076	+
Sil1	ENSMUSG00000024357	chr18:35426054-35658579	chr18:36845793 - 37673413	
Jkamp	ENSMUSG00000005078	chr12:73186576-73202448	chr15:52238867 - 54813063	
Colec10	ENSMUSG00000038591	chr15:54242329-54297913	chr12:71045072 - 71327447	
Ddx21	ENSMUSG00000020075	chr10:62042996-62065046	chr10:65944206 - 66992234	
Srp54b	ENSMUSG00000079108	chr12:56181483-56290200	chr3:129316175 - 130169386	
Cyp2u1	ENSMUSG00000027983	chr3:130993409-131006145	chr12:57292411 - 58167435	
Eci3	ENSMUSG00000021416	chr13:35038483-35055679	chr13:37544128 - 37602829	
Rab13	ENSMUSG00000027935	chr3:90017617-90030307	chr3:87369064 - 87489032	
Gm5834	ENSMUSG00000085867	chr1:141836178-141890782	chr1:139144555 - 139947892	
Cyp2a22	ENSMUSG00000091867	chr7:27716650-27724405	chr7:28693083 - 28747632	
5730455O13Rik	ENSMUSG00000054237	chr19:38262971-38298628	chr19:38276072 - 40577851	
Srd5a3	ENSMUSG00000029233	chr5:76569296-76584529	chr5:75464587 - 76367953	
Cfhr3	ENSMUSG00000090623	chr1:141471762-141524888	chr1:145976100 - 150856928	
Gm14325	ENSMUSG00000095362	chr2:177566496-177575041	chr2:172826969 - 172979768	
Cyp46a1	ENSMUSG00000021259	chr12:109572587-109600441	chr12:109150983 - 110221637	
Ublcp1	ENSMUSG00000041231	chr11:44268073-44284000	chr20:165220180 - 165475735	
Pir	ENSMUSG00000031379	chr20:160707303-160810943	chr11:47252882 - 47763140	
Pctp	ENSMUSG00000020553	chr11:89843979-89864208	chr11:86695966 - 87603851	
Zbtb8os	ENSMUSG00000057572	chr4:129012939-129031791	chr4:130090374 - 130374753	
Pebp1	ENSMUSG00000032959	chr5:117732660-117737634	chr5:121209392 - 121422550	
Dsg2	ENSMUSG00000044393	chr18:20716575-20763022	chr18:21391462 - 22172698	
Cast	ENSMUSG00000021585	chr13:74831691-74945958	chr13:77005581 - 77081304	
H2-T10	ENSMUSG00000079491	chr17:36252821-36258410	chr12:113819608 - 114430776	

2810002N01Rik	ENSMUSG00000037787	chr12:112951472-112993191	chr17:36047232 - 37823197	
Pigr	ENSMUSG00000026417	chr1:132723261-132748826	chr1:127042332 - 128332495	
Ugt3a1	ENSMUSG00000072664	chr15:9203074-9244787	chr15:11689950 - 11786564	
Gm8909	ENSMUSG00000073402	chr17:36301388-36305482	chr17:40593701 - 41133516	
Rhot2	ENSMUSG00000025733	chr17:25975402-25981796	chr17:27582938 - 28082777	
Oxnad1	ENSMUSG00000021906	chr14:32898560-32916388	chr14:32638945 - 33480782	
Wbscr27	ENSMUSG00000040557	chr5:135408238-135418507	chr6:123129728 - 123951869	
Gm10319	ENSMUSG00000071204	chr6:122086646-122102034	chr5:135656531 - 136308711	
Gm14326	ENSMUSG00000078862	chr2:177670698-177692002	chr2:173679868 - 174719530	
C920025E04Rik	ENSMUSG00000073405	chr17:36245531-36248633	chr17:32219846 - 32532642	
Ceacam1	ENSMUSG00000074272	chr7:26246721-26262644	chr7:25938623 - 26080030	
Acyp1	ENSMUSG00000008822	chr12:86613348-86629388	chr12:88200646 - 88322904	
Iigp1	ENSMUSG00000054072	chr18:60535683-60552281	chr18:58671982 - 59474939	
Cst3	ENSMUSG00000027447	chr2:148697458-148701428	chr2:146734052 - 147092254	
Dmgdh	ENSMUSG00000042102	chr13:94444388-94522786	chr13:96175325 - 96407181	
Slco1a1	ENSMUSG00000041698	chr6:141855803-141895483	chr6:142550412 - 143061552	
Hn1l	ENSMUSG00000024165	chr17:25079101-25097581	chr17:18081650 - 21525383	
Top1mt	ENSMUSG00000000934	chr15:75487465-75509230	chr15:73873324 - 73956847	
Fam176a	ENSMUSG00000035104	chr6:81991037-82043093	chr6:85419119 - 86219915	
Tbrg4	ENSMUSG00000000384	chr11:6515601-6526070	chr11:6566421 - 7497501	
Cyp2d41-ps	ENSMUSG00000058613	chr15:82608361-82612540	chr15:80218764 - 81051691	
Cobl	ENSMUSG00000020173	chr11:12136611-12364963	chr11:11775990 - 12418467	
Wdr83	ENSMUSG00000005150	chr8:87598934-87605205	chr17:31313309 - 32075473	
H2-T23	ENSMUSG00000067212	chr17:36166718-36169800	chr15:62178117 - 62265191	
E430025E21Rik	ENSMUSG00000022350	chr15:59163553-59205722	chr8:88491121 - 91129945	
Gm14421	ENSMUSG00000083111	chr2:176838221-176841543	chr2:179033792 - 179133740	
Ppie	ENSMUSG00000028651	chr4:122804358-122817194	chr4:127491886 - 127646156	
Mgmt	ENSMUSG00000054612	chr7:144086294-144319870	chr7:142321560 - 144278127	
Prkcz	ENSMUSG00000029053	chr4:154634238-154735470	chr4:154337446 - 154497501	
Anapc5	ENSMUSG00000029472	chr5:123237478-123271348	chr5:126043804 - 126124155	
Hist1h2bk	ENSMUSG00000062727	chr13:22127690-22128168	chr13:21469813 - 22102442	
Gm13305	ENSMUSG00000073876	chr4:42029565-42039326	chr4:40452083 - 40936506	
Spg21	ENSMUSG00000032388	chr9:65308744-65336277	chr7:53502241 - 53769845	
Raet1c	ENSMUSG00000053219	chr10:21893327-21903720	chr10:22318517 - 23185062	
Gm15545	ENSMUSG00000087138	chr7:52242270-52249967	chr9:64763234 - 65386738	
Pkig	ENSMUSG00000035268	chr2:163484122-163551894	chr2:178329262 - 178423190	
Gm4724	ENSMUSG00000078897	chr2:175247801-175261308	chr2:162539490 - 162618549	
Rmnd1	ENSMUSG00000019763	chr10:5914153-5944626	chr10:8739506 - 9159166	
Igsf11	ENSMUSG00000022790	chr16:38901584-39027272	chr16:37075355 - 37305160	
Rab4a	ENSMUSG00000019478	chr8:126329885-126359187	chr8:125239089 - 125446525	
H2-Ke2	ENSMUSG00000024309	chr17:34075766-34077288	chr4:93276507 - 94618325	
Cyp2j5	ENSMUSG00000052520	chr4:96295464-96330845	chr17:33839211 - 34542617	
Ngrn	ENSMUSG00000047084	chr7:87406101-87410264	chr7:82936839 - 83263051	

Srp54c	ENSMUSG00000073079	chr12:56331155-56377912	chr12:60468769 - 61291973	
Fam55b	ENSMUSG00000032028	chr9:48126089-48161537	chr9:49404442 - 49601221	
Abhd3	ENSMUSG00000002475	chr18:10644409-10706769	chr18:5607870 - 6596284	
1110031I02Rik	ENSMUSG00000025169	chr11:121038905-121066025	chr11:118563976 - 118676908	
F830016B08Rik	ENSMUSG00000090942	chr18:60453034-60462670	chr18:63831810 - 64160832	
Brap	ENSMUSG00000029458	chr5:122110572-122137257	chr5:122321928 - 122959060	
Sel1l3	ENSMUSG00000029189	chr5:53498323-53604691	chr5:53749401 - 53831096	
Gm16363	ENSMUSG00000085513	chr2:177326386-177327262	chr2:173113613 - 173333432	
Ndufs5	ENSMUSG00000028648	chr4:123389953-123395445	chr4:125979990 - 126162299	
Frrs1	ENSMUSG00000033386	chr3:116581145-116606668	chr3:111987339 - 114102206	
Glrx2	ENSMUSG00000018196	chr1:145586159-145596806	chr1:145874225 - 146136935	
H2-T22	ENSMUSG00000056116	chr17:36174073-36179692	chr17:35604221 - 36047232	
Cox16	ENSMUSG00000091803	chr12:82460013-82586114	chr12:82787731 - 83122752	
Plekhb2	ENSMUSG00000026123	chr1:34906804-34936425	chr1:30403172 - 31692631	
Dnajc8	ENSMUSG00000054405	chr4:132091465-132109657	chr4:132517235 - 133530440	
Ttc39c	ENSMUSG00000024424	chr18:12758435-12895559	chr18:15241946 - 15486956	
Gstz1	ENSMUSG00000021033	chr12:88488668-88505673	chr12:90750572 - 90850469	
Cyb5r4	ENSMUSG00000032872	chr9:86916849-86972609	chr9:86419856 - 87123415	
St3gal1	ENSMUSG00000013846	chr15:66934437-66945922	chr15:64806921 - 65641372	
Tpd52	ENSMUSG00000027506	chr3:8928626-9004723	chr3:10458755 - 10606549	
Nat8	ENSMUSG00000030004	chr6:85780382-85782076	chr6:85262721 - 85493102	
Cyp4f17	ENSMUSG00000091586	chr17:32643407-32665839	chr17:28200597 - 28832865	
2010305A19Rik	ENSMUSG00000048351	chr4:108000745-108014149	chr4:106639513 - 106967190	
Mup5	ENSMUSG00000058523	chr4:61492353-61496267	chr4:62952000 - 63947895	
Nudcd2	ENSMUSG00000020328	chr11:40547169-40553548	chr11:38705716 - 38870559	
S100a13	ENSMUSG00000042312	chr3:90318357-90328503	chr3:90523021 - 92375879	
Mnd1	ENSMUSG00000033752	chr3:83891856-83959708	chr3:84042371 - 84105429	
Slc27a5	ENSMUSG00000030382	chr7:13573695-13583541	chr7:12686189 - 12867799	
Serpina1a	ENSMUSG00000066366	chr12:105091799-105104137	chr12:104830971 - 104919487	
4833420G17Rik	ENSMUSG00000062822	chr13:120251566-120274924	chr13:119442736 - 119522520	
Serpine2	ENSMUSG00000026249	chr1:79790772-79855271	chr1:82355538 - 83263723	
Rap2a	ENSMUSG00000051615	chr14:120877666-120906416	chr14:120888799 - 121011608	
Mup17	ENSMUSG00000096688	chr4:61252961-61256903	chr4:62703129 - 62952000	
Galk2	ENSMUSG00000027207	chr2:125684845-125810035	chr2:126817478 - 127285668	
Plscr2	ENSMUSG00000032372	chr9:92170440-92192573	chr14:47590381 - 47757281	
Mapk1ip1l	ENSMUSG00000021840	chr14:47917966-47948460	chr9:87473903 - 87569635	
Rsph3a	ENSMUSG00000073471	chr17:8138518-8172689	chr3:105067333 - 105195661	
Gstm6	ENSMUSG00000068762	chr3:107741765-107746667	chr17:15328351 - 15407471	
9030025P20Rik	ENSMUSG00000079709	chr17:15115829-15127768	chr17:11420026 - 11598843	
Gtf3a	ENSMUSG00000016503	chr5:147760233-147767190	chr5:148760942 - 149413154	
Ces1g	ENSMUSG00000057074	chr8:95826268-95861207	chr8:99063260 - 99362813	
Rbfa	ENSMUSG00000024570	chr18:80389004-80397397	chr18:78880086 - 79065141	

Pigp	ENSMUSG00000022940	chr16:94580370-94592622	chr16:94079235 - 94454536	
Zfp68	ENSMUSG00000058291	chr5:139045844-139060989	chr7:106498296 - 106611242	
1810020D17Rik	ENSMUSG00000035642	chr7:104698844-104728007	chr5:138303964 - 139201081	
Oasl1	ENSMUSG00000041827	chr5:115373249-115387924	chr5:116889885 - 116986242	
2510006D16Rik	ENSMUSG00000028797	chr4:129277912-129301303	chr4:128418274 - 128505791	
Rpl27a	ENSMUSG00000046364	chr7:116662661-116665881	chr7:112298484 - 112483463	
Pxn	ENSMUSG00000029528	chr5:115956685-116005996	chr5:116049346 - 116193364	
Selenbp2	ENSMUSG00000068877	chr3:94497478-94508335	chr3:90170556 - 90301424	
Snap47	ENSMUSG00000009894	chr11:59220636-59264688	chr11:59342773 - 59436822	
2210010C17Rik	ENSMUSG00000040498	chr7:20522654-20536092	chr7:25192586 - 25335537	
Gbp11	ENSMUSG00000092021	chr5:105755499-105772948	chr5:105285093 - 105513638	
Tmem125	ENSMUSG00000050854	chr4:118213546-118216649	chr4:116498165 - 116616203	
Acsm5	ENSMUSG00000030972	chr7:126669818-126687307	chr7:130938204 - 131532412	
Gm14420	ENSMUSG00000078866	chr2:177249438-177262834	chr2:179077649 - 179133740	
Accn5	ENSMUSG00000028008	chr3:81786212-81825155	chr3:82780632 - 82959559	
Zcchc9	ENSMUSG00000021621	chr13:91936138-91947301	chr13:91865145 - 91965826	
Hdhd2	ENSMUSG00000025421	chr18:77168865-77211641	chr18:76819460 - 76893898	
Numb	ENSMUSG00000021224	chr12:85134984-85262884	chr12:88200646 - 88252032	
D1Bwg0212e	ENSMUSG00000003135	chr1:39591837-39603726	chr8:123951818 - 124054881	
2810004N23Rik	ENSMUSG00000031984	chr8:127363255-127386929	chr1:37651077 - 37747157	
Mup1	ENSMUSG00000078683	chr4:60510884-60514832	chr9:109234033 - 109461562	
Hyal1	ENSMUSG00000010051	chr9:107479258-107485174	chr4:60933569 - 61881691	
Gm6710	ENSMUSG00000078887	chr2:175868351-175880380	chr2:178513997 - 178581580	
Txnl4a	ENSMUSG00000057130	chr18:80403534-80420272	chr18:79010972 - 79065141	
Vkorc1l1	ENSMUSG00000066735	chr5:130417979-130460615	chr5:127894444 - 127957589	
Gm7120	ENSMUSG00000074634	chr13:120276748-120284312	chr13:119108936 - 119187691	
Akr1c13	ENSMUSG00000021213	chr13:4190430-4204842	chr13:3220944 - 3220944	
Nudt19	ENSMUSG00000034875	chr7:36332204-36341323	chr7:37141541 - 37086470	
Clybl	ENSMUSG00000025545	chr14:122580916-122801454	chr14:122415589 - 122275768	

Table S4. Predicted isoform-ratio eQTLs in liver. Shown are 243 gene symbols (column 1), their ensemble identifiers (column 2), genomic positions (column 3), and the genomic positions of their top ranking proximal isoform-ratio eQTLs (column 4). Column 5 indicates whether the gene is also significantly associated with a total-expression eQTL, as detailed in **Table S3**.

Isoform-ratio trait			Isoform-ratio eQTL interval	Total-expression eQTL
Symbol	**Ensembl identifier**	**Genomic position**		
H2-K1	ENSMUSG00000061232	chr17:34132962-34137278	chr17:33696256 - 41264486	
Rpl29	ENSMUSG00000048758	chr9:106331785-106333899	chr9:103912182 - 113029682	+
Rpl21	ENSMUSG00000041453	chr5:147644466-147648608	chr5:141365337 - 152052722	+
6530401N04Rik	ENSMUSG00000020956	chr12:53089299-53107488	chr12:36564946 - 55557209	+
Gcap14	ENSMUSG00000058690	chr14:37688122-37781950	chr14:32360414 - 48125148	
Apoa2	ENSMUSG00000005681	chr1:173155185-173156510	chr1:172174211 - 178009435	
Hsd3b2	ENSMUSG00000063730	chr3:98513178-98528499	chr3:90170556 - 121682115	
H2-Q2	ENSMUSG00000091705	chr17:35479187-35483707	chr17:26680548 - 44813750	+
Mup2	ENSMUSG00000078688	chr4:60080259-60167161	chr4:51674433 - 62549879	+
Mki67ip	ENSMUSG00000026377	chr1:120218416-120230399	chr1:108999635 - 134466386	
Vps28	ENSMUSG00000062381	chr15:76452518-76456457	chr15:65156561 - 86334924	
Shb	ENSMUSG00000044813	chr4:45436150-45545342	chr4:36170536 - 46266471	
Uqcr10	ENSMUSG00000059534	chr11:4601976-4604345	chr11:3277587 - 11627495	
Foxo3	ENSMUSG00000048756	chr10:41901647-41996561	chr10:27920057 - 46222885	
Mup1	ENSMUSG00000078683	chr4:60510884-60514832	chr4:57030717 - 64029884	+
Churc1	ENSMUSG00000090258	chr12:77866525-77884167	chr12:76015302 - 83122752	+
Tpm3	ENSMUSG00000027940	chr3:89876571-89904824	chr3:87773377 - 93283619	+
Pxmp4	ENSMUSG00000000876	chr2:154411494-154429444	chr2:150446861 - 158740971	
Gas5	ENSMUSG00000053332	chr1:162964553-162968670	chr1:160670702 - 167827635	+
Nr2f6	ENSMUSG00000002393	chr8:73898022-73905859	chr8:50980992 - 76089799	
Nr1i3	ENSMUSG00000005677	chr1:173144101-173150832	chr4:32428283 - 38124758	
1810030N24Rik	ENSMUSG00000028295	chr4:34715913-34725672	chr1:172174211 - 176903126	
Mbd1	ENSMUSG00000024561	chr18:74427926-74442339	chr18:73164943 - 78880086	
Qdpr	ENSMUSG00000015806	chr5:45825271-45841474	chr5:41119435 - 46916453	
Ifi27l1	ENSMUSG00000064215	chr12:104672421-104678449	chr12:103862248 - 108419338	
Slc35a1	ENSMUSG00000028293	chr4:34610506-34634687	chr4:32428283 - 36531816	
Nol12	ENSMUSG00000033099	chr15:78765363-78774064	chr15:77221461 - 86900034	
Glo1	ENSMUSG00000024026	chr17:30729811-30749604	chr17:26633727 - 33696256	+
Slc17a3	ENSMUSG00000036083	chr13:23931303-23952583	chr13:19993476 - 26089173	
Fxc1	ENSMUSG00000089847	chr7:112788570-112804262	chr7:116005580 - 119226564	
Dctn4	ENSMUSG00000024603	chr18:60685868-60718416	chr18:52905351 - 59555613	
Mrap	ENSMUSG00000039956	chr16:90738569-90750030	chr16:90526174 - 97132278	
Ubb	ENSMUSG00000019505	chr11:62364673-62366715	chr11:58771634 - 62822705	
Prg4	ENSMUSG00000006014	chr1:152296542-152313295	chr17:32075473 - 49104468	
Gm10499	ENSMUSG00000073403	chr17:36278703-36282868	chr1:135334922 - 156165867	+

Cd59a	ENSMUSG00000032679	chr2:103935958-103955511	chr2:101420603 - 106279697	+
Josd2	ENSMUSG00000038695	chr7:51723350-51727022	chr7:47726947 - 53584602	+
H2-Q4	ENSMUSG00000035929	chr17:35516562-35522235	chr17:32219846 - 41264486	
Pqlc1	ENSMUSG00000034006	chr18:80450031-80489464	chr18:77531636 - 81587895	
Mrpl55	ENSMUSG00000036860	chr11:59015988-59019636	chr11:58771634 - 67636607	
RP23-381B19.7	ENSMUSG00000093483	chr11:83105201-83108134	chr11:81945493 - 93000422	+
Timm9	ENSMUSG00000021079	chr12:72224160-72237662	chr12:65056299 - 74687060	
Agphd1	ENSMUSG00000035878	chr9:54765090-54797731	chr9:49846132 - 58199303	
Nme7	ENSMUSG00000026575	chr1:166243010-166334805	chr1:158184453 - 169750862	+
Cyp3a25	ENSMUSG00000029630	chr5:146788770-146821194	chr5:145152196 - 148390455	+
Gm7120	ENSMUSG00000074634	chr13:120276748-120284312	chr13:118816801 - 120116981	+
Ugt1a6a	ENSMUSG00000054545	chr1:89999827-90116577	chr1:89636728 - 101912869	
Arsg	ENSMUSG00000020604	chr11:109334688-109434644	chr11:107799738 - 111598527	
Mvk	ENSMUSG00000041939	chr5:114894278-114910600	chr5:114009955 - 120774344	
Snx24	ENSMUSG00000024535	chr18:53405316-53550477	chr6:144468689 - 146236620	
Lyrm5	ENSMUSG00000040370	chr6:145159654-145165459	chr18:43474200 - 54635554	
Itih1	ENSMUSG00000006529	chr14:31742366-31756475	chr14:27732837 - 33480782	
Ganc	ENSMUSG00000062646	chr2:120229632-120287436	chr2:120175083 - 128189764	+
Abhd1	ENSMUSG00000006638	chr5:31252439-31257464	chr5:30282706 - 33446960	
Dpys	ENSMUSG00000022304	chr15:39600031-39689016	chr15:38781717 - 42160335	
Trim12c	ENSMUSG00000057143	chr7:111487268-111501876	chr7:116311909 - 119108602	
Gm4788	ENSMUSG00000070594	chr1:141594212-141677816	chr1:137571698 - 139144555	
Adhfe1	ENSMUSG00000025911	chr1:9538029-9568051	chr1:6084735 - 16834035	
1600014C10Rik	ENSMUSG00000054676	chr7:38968236-38982582	chr7:38626755 - 47606066	
Mup12	ENSMUSG00000094793	chr4:60732255-60736198	chr4:55261729 - 63321340	+
Prr13	ENSMUSG00000023048	chr15:102289459-102293237	chr15:102056859 - 103031732	
Cops6	ENSMUSG00000019494	chr5:138602299-138605874	chr5:139008481 - 141365337	
Echdc1	ENSMUSG00000019883	chr10:29032972-29066467	chr10:26226262 - 26336604	
Mup14	ENSMUSG00000073830	chr4:60961055-60965051	chr4:51843614 - 62549879	+
Eif4g2	ENSMUSG00000005610	chr7:118211499-118226544	chr7:115518460 - 116412535	
Gatad1	ENSMUSG00000007415	chr5:3632932-3647934	chr5:3230193 - 15543723	
Masp2	ENSMUSG00000028979	chr4:147976663-147989608	chr4:142312877 - 144928744	
Gsta2	ENSMUSG00000057933	chr9:78178825-78203595	chr9:74596134 - 87645120	
Creg1	ENSMUSG00000040713	chr1:167693877-167705439	chr1:164792505 - 165053877	
Glyctk	ENSMUSG00000020258	chr9:106055188-106060469	chr9:108409204 - 110507707	
Ngef	ENSMUSG00000026259	chr1:89373409-89470445	chr1:88974625 - 92401117	
Ccbl2	ENSMUSG00000040213	chr3:142364015-142407874	chr3:138761310 - 144815433	
Tor1aip1	ENSMUSG00000026466	chr1:157851729-157883610	chr1:156775182 - 158059865	
Slc25a42	ENSMUSG00000002346	chr8:72708239-72736204	chr8:70997820 - 74364169	
Ugt1a6b	ENSMUSG00000090145	chr1:89999827-90115578	chr1:88974625 - 91699637	+
Anp32e	ENSMUSG00000015749	chr3:95733169-95751313	chr3:96706017 - 97638598	

Ankrd33b	ENSMUSG00000022237	chr15:31221234-31297514	chr15:30367069 - 34700085	
Spp1	ENSMUSG00000029304	chr5:104864137-104870069	chr5:100739111 - 109031314	
Mthfsl	ENSMUSG00000079427	chr9:88583443-88614636	chr9:87218402 - 94328348	+
Mettl21a	ENSMUSG00000025956	chr1:64653047-64663816	chr1:61626676 - 71075258	
Hint3	ENSMUSG00000019791	chr10:30327947-30338285	chr10:27594228 - 41368505	
Mpg	ENSMUSG00000020287	chr11:32126505-32132700	chr11:31310649 - 31765528	
Acad12	ENSMUSG00000042647	chr5:122048293-122068947	chr5:121512914 - 123695117	+
Serpina3g	ENSMUSG00000041481	chr12:105474455-105480149	chr12:108048615 - 109150983	
Zfp672	ENSMUSG00000049755	chr11:58128616-58136848	chr11:53568444 - 55970063	+
Acox2	ENSMUSG00000021751	chr14:9058025-9091867	chr14:5958958 - 13070109	
2210015D19Rik	ENSMUSG00000083844	chr11:5662132-5684713	chr11:4690979 - 10361203	
Slc6a13	ENSMUSG00000030108	chr6:121250245-121287751	chr6:116721425 - 121028700	
Calcoco1	ENSMUSG00000023055	chr15:102537210-102552609	chr15:95717110 - 97902919	
Timd2	ENSMUSG00000040413	chr11:46482462-46520563	chr11:45086945 - 49043144	+
Kmo	ENSMUSG00000039783	chr1:177550512-177592247	chr1:175448899 - 183127455	+
Nudt1	ENSMUSG00000036639	chr5:140807814-140814091	chr5:134927477 - 141365337	
Aen	ENSMUSG00000030609	chr7:86040740-86056095	chr7:86397253 - 86783593	+
Mtfmt	ENSMUSG00000059183	chr9:65283589-65300861	chr9:65328543 - 68509840	
Cyp2c40	ENSMUSG00000025004	chr19:39841561-39887304	chr19:40466136 - 40728030	
Gm16286	ENSMUSG00000024571	chr18:80403504-80409480	chr18:79868185 - 81414476	+
Thyn1	ENSMUSG00000035443	chr9:26807262-26814915	chr9:21613279 - 23988491	
Acaa1a	ENSMUSG00000036138	chr9:119248794-119259417	chr9:119632778 - 122144220	
Ces3a	ENSMUSG00000069922	chr8:107572499-107582314	chr8:102596452 - 106583721	
Pih1d1	ENSMUSG00000003423	chr7:52409673-52415439	chr7:48002471 - 51963704	
Glrx2	ENSMUSG00000018196	chr1:145586159-145596806	chr1:140315338 - 145874225	+
Ttc39b	ENSMUSG00000038172	chr4:82866204-82970159	chr4:77800490 - 82942547	
Phldb2	ENSMUSG00000033149	chr16:45746346-45953711	chr16:48719143 - 66177584	
Mtap7	ENSMUSG00000019996	chr10:19868277-20001393	chr10:18060806 - 19086406	
Apobec1	ENSMUSG00000040613	chr6:122527810-122552462	chr6:126059914 - 127554876	
Ubc	ENSMUSG00000008348	chr5:125866335-125870572	chr5:121667878 - 127060447	
Sc5d	ENSMUSG00000032018	chr9:42062260-42072383	chr9:41639078 - 42317393	
Zscan21	ENSMUSG00000037017	chr5:138558131-138575493	chr5:135115239 - 138303964	
Gm8909	ENSMUSG00000073402	chr17:36301388-36305482	chr17:26680548 - 32134283	+
1700001C19Rik	ENSMUSG00000047150	chr17:47549683-47574325	chr17:44407282 - 47565243	
Cd55	ENSMUSG00000026399	chr1:132335604-132359321	chr1:130086065 - 130382461	
Ttll12	ENSMUSG00000016757	chr15:83405549-83425587	chr15:82800868 - 83770961	
Slc35e1	ENSMUSG00000019731	chr8:75001895-75016513	chr8:77148392 - 78866020	
Cfhr1	ENSMUSG00000057037	chr1:141443639-141456835	chr1:137392496 - 140315338	+
Prorsd1	ENSMUSG00000032673	chr11:29411757-29415033	chr11:29934542 - 31420627	
Nit1	ENSMUSG00000013997	chr1:173268139-173275777	chr1:168178002 - 173836444	
H2-D1	ENSMUSG00000073411	chr17:35399675-35404444	chr17:34642923 - 41264486	

Tpmt	ENSMUSG00000021376	chr13:47120539-47140106	chr13:49978779 - 51831996	+
Commd5	ENSMUSG00000055041	chr15:76730340-76731735	chr15:76022303 - 77511010	
Hmgn2	ENSMUSG00000003038	chr4:133520653-133524565	chr4:132435803 - 133999708	
Atp9a	ENSMUSG00000027546	chr2:168459938-168567909	chr2:168184899 - 171243709	+
Fbxo6	ENSMUSG00000055401	chr4:147519825-147526249	chr4:149254022 - 149330421	
Vwa5a	ENSMUSG00000023186	chr9:38525853-38550922	chr9:36885503 - 37959805	
2310001H17Rik	ENSMUSG00000097354	chr6:129158430-129188000	chr6:128552862 - 129021548	
Rpn2	ENSMUSG00000027642	chr2:157104753-157152055	chr2:154972094 - 158740971	
Itgb1bp1	ENSMUSG00000062352	chr12:21246686-21292098	chr12:17297580 - 25481963	
H2-K2	ENSMUSG00000067203	chr17:34111731-34115733	chr17:36047232 - 41133516	+
Mrps23	ENSMUSG00000023723	chr11:88017890-88025009	chr11:90361138 - 94477781	
Lbp	ENSMUSG00000016024	chr2:158132229-158158588	chr2:153804191 - 159415169	
Ddah1	ENSMUSG00000028194	chr3:145421639-145557241	chr3:144235126 - 147918027	
Usf1	ENSMUSG00000026641	chr1:173341444-173349273	chr1:170263553 - 171567355	
Fam114a2	ENSMUSG00000020523	chr11:57296492-57332146	chr11:51857731 - 57286381	+
Alg6	ENSMUSG00000073792	chr4:99382355-99430151	chr4:96160448 - 99642114	
Faf2	ENSMUSG00000025873	chr13:54723145-54765429	chr13:57740157 - 59623286	
Sfr1	ENSMUSG00000025066	chr19:47806246-47810078	chr19:45632134 - 48048757	
Fgf1	ENSMUSG00000036585	chr18:38998327-39089058	chr18:38200091 - 39987692	
Echdc3	ENSMUSG00000039063	chr2:6109511-6134079	chr2:5292024 - 5758389	
Prodh2	ENSMUSG00000036892	chr7:31278641-31298421	chr7:31704657 - 34621203	
App	ENSMUSG00000022892	chr16:84954685-85173952	chr16:86503354 - 87950231	
Ccl9	ENSMUSG00000019122	chr11:83386421-83392138	chr11:81251449 - 81887279	
Lyrm2	ENSMUSG00000045854	chr4:32887228-32888534	chr4:28543236 - 28683004	
Atp5sl	ENSMUSG00000057229	chr7:26404433-26410570	chr7:25192586 - 25938623	
Cnot7	ENSMUSG00000031601	chr8:41577894-41601201	chr8:35673393 - 39952821	
2310045N01Rik	ENSMUSG00000002345	chr8:72663398-72691387	chr8:70997820 - 73879588	
Tmem128	ENSMUSG00000067365	chr5:38651424-38660861	chr5:39164410 - 39444524	+
Sdhc	ENSMUSG00000058076	chr1:173057296-173080734	chr1:172825382 - 173057579	
Ublcp1	ENSMUSG00000041231	chr11:44268073-44284000	chr11:43991141 - 44500887	+
Sec22b	ENSMUSG00000027879	chr3:97705113-97727199	chr3:96120832 - 96418053	
Hfe	ENSMUSG00000006611	chr13:23793903-23802723	chr13:20208147 - 23042409	
Gnl2	ENSMUSG00000028869	chr4:124693829-124732624	chr16:8667124 - 10746532	
Clec16a	ENSMUSG00000068663	chr16:10545457-10744971	chr4:123543905 - 124034675	
Ahcy	ENSMUSG00000027597	chr2:154885046-154900233	chr2:158960764 - 161046235	
Eif2b4	ENSMUSG00000029145	chr5:31489931-31495803	chr5:29356890 - 31080804	
AI182371	ENSMUSG00000035875	chr2:34939566-34957063	chr2:30440952 - 34714988	
Gm16573	ENSMUSG00000090038	chr14:57226098-57239350	chr14:57822416 - 58490911	
1810058I24Rik	ENSMUSG00000073155	chr6:35202654-35213496	chr6:34219246 - 35793923	
Slc17a4	ENSMUSG00000021336	chr13:23989607-24006876	chr13:25090371 - 26931853	
Aimp2	ENSMUSG00000029610	chr5:144663573-144670716	chr5:139008481 - 139739343	

Gene	Ensembl ID	Location 1	Location 2	Flag
Fkbp4	ENSMUSG00000030357	chr6:128379753-128388695	chr6:127554876 - 129517957	
Fermt2	ENSMUSG00000037712	chr14:46078467-46149793	chr14:45679115 - 47174572	
Mup9	ENSMUSG00000078686	chr4:60430918-60434824	chr4:59702851 - 62075481	
Stk40	ENSMUSG00000042608	chr4:125781201-125818273	chr4:123718522 - 124472264	
Blvrb	ENSMUSG00000040466	chr7:28232997-28251163	chr7:28218143 - 28450232	
Tnks1bp1	ENSMUSG00000033955	chr2:84888179-84913205	chr2:126170268 - 127446389	
Pldn	ENSMUSG00000005804	chr2:122564239-122575211	chr2:79562534 - 80052816	
Parp3	ENSMUSG00000023249	chr9:106372653-106379280	chr9:108409204 - 108797772	
Mup11	ENSMUSG00000073834	chr4:60671338-60675283	chr4:63068642 - 63718975	
Stt3a	ENSMUSG00000032116	chr9:36538860-36575264	chr9:40177368 - 40327804	
0610005C13Rik	ENSMUSG00000085214	chr7:52823165-52830697	chr7:48002471 - 50737476	+
Ccbl1	ENSMUSG00000039648	chr2:30040644-30061367	chr2:28032120 - 30440952	
H2-T23	ENSMUSG00000067212	chr17:36166718-36169800	chr17:35135941 - 37608019	+
Dcaf8	ENSMUSG00000026554	chr1:174078146-174126524	chr1:170102936 - 170218291	
I7Rn6	ENSMUSG00000062797	chr7:97066039-97089709	chr7:100211530 - 100340215	
Bbox1	ENSMUSG00000041660	chr2:110102854-110154717	chr2:108029677 - 108172897	
C4a	ENSMUSG00000015451	chr17:34946037-34960409	chr17:36883101 - 42313195	
Snhg3	ENSMUSG00000085241	chr4:131903929-131909601	chr4:128174195 - 131589425	
4933403F05Rik	ENSMUSG00000038121	chr18:68419841-68459987	chr18:67495307 - 68330850	
Uggt1	ENSMUSG00000037470	chr1:36198375-36301150	chr1:33161004 - 33324614	
Tec	ENSMUSG00000029217	chr5:73146957-73259722	chr5:74415579 - 75342154	
Ccndbp1	ENSMUSG00000023572	chr2:120834139-120842640	chr2:124952741 - 133240610	
Rnf135	ENSMUSG00000020707	chr11:79997353-80013259	chr11:77929454 - 81142274	
Mrpl45	ENSMUSG00000018882	chr11:97177030-97191234	chr11:100723879 - 101189035	
Med16	ENSMUSG00000013833	chr10:79357452-79371683	chr10:82162516 - 82279659	
Slc44a1	ENSMUSG00000028412	chr4:53453285-53635350	chr4:53920065 - 54489084	
Ghr	ENSMUSG00000055737	chr15:3267760-3533492	chr5:121667878 - 126901042	
Diablo	ENSMUSG00000029433	chr5:123959774-123974185	chr15:6270762 - 6461965	
Zcrb1	ENSMUSG00000022635	chr15:93216528-93228765	chr1:161391572 - 161990260	
Acbd6	ENSMUSG00000033701	chr1:157405250-157534363	chr15:90396617 - 90833320	
Ube2j1	ENSMUSG00000028277	chr4:33118391-33139338	chr4:32890927 - 33243086	
Ceacam1	ENSMUSG00000074272	chr7:26246721-26262644	chr7:28450232 - 28693083	+
Abcg8	ENSMUSG00000024254	chr17:85075642-85099673	chr17:85738579 - 86000112	
Bdh1	ENSMUSG00000046598	chr16:31422366-31458987	chr16:29515137 - 29744925	
Man1a	ENSMUSG00000003746	chr10:53624594-53795602	chr10:56694372 - 56846902	
Uroc1	ENSMUSG00000034456	chr6:90283283-90314545	chr6:91305711 - 91473103	
Ext1	ENSMUSG00000061731	chr15:52895593-53177714	chr15:55032882 - 55151291	
Rbms1	ENSMUSG00000026970	chr2:60588250-60801261	chr2:56580607 - 56793825	
Gas2l1	ENSMUSG00000034201	chr11:4954135-4965330	chr11:4752207 - 6298684	
Dnase2a	ENSMUSG00000003812	chr8:87432459-87446814	chr8:83097136 - 83295171	
Rer1	ENSMUSG00000029048	chr4:154448219-154460491	chr4:154269781 - 154567496	

Ggnbp1	ENSMUSG00000048731	chr17:27110162-27173323	chr17:21670293 - 22939394	
Zdhhc4	ENSMUSG00000001844	chr5:144078168-144090935	chr5:148390455 - 148589118	
D2Wsu81e	ENSMUSG00000039660	chr2:30028967-30033979	chr2:29305900 - 30440952	
Uqcrq	ENSMUSG00000044894	chr11:53241424-53244333	chr10:81730570 - 81973250	
Mbd3	ENSMUSG00000035478	chr10:79855284-79862295	chr11:50984651 - 51081191	
Sec11a	ENSMUSG00000025724	chr7:88049775-88092666	chr7:84237109 - 84763098	
4930581F22Rik	ENSMUSG00000070315	chr9:34924313-34938507	chr9:33781733 - 33881803	
Sigmar1	ENSMUSG00000036078	chr4:41685366-41703030	chr4:45710215 - 46097584	
Nmd3	ENSMUSG00000027787	chr3:69525907-69552964	chr3:70833134 - 71078481	
Dguok	ENSMUSG00000014554	chr6:83430211-83456963	chr6:81487563 - 81699073	
Pfdn4	ENSMUSG00000052033	chr2:170321928-170344623	chr2:165616921 - 165702733	
1810029B16Rik	ENSMUSG00000025591	chr8:68998229-69010429	chr8:72763528 - 73988884	
Cfhr2	ENSMUSG00000033898	chr1:141701945-141915481	chr11:69070924 - 69179181	+
Asgr1	ENSMUSG00000020884	chr11:69867587-69871396	chr1:139521843 - 139731243	
Ubp1	ENSMUSG00000009741	chr9:113840052-113886317	chr9:118200536 - 118322463	
Gapdh	ENSMUSG00000057666	chr6:125111871-125116485	chr6:125623688 - 125808439	
Serpina11	ENSMUSG00000063232	chr12:105218453-105228167	chr12:105256106 - 105294707	
Ndufc1	ENSMUSG00000037152	chr3:51208599-51212910	chr3:49789152 - 50312406	
Mup16	ENSMUSG00000078675	chr4:61176624-61180563	chr4:64434195 - 65164876	+
Apol9b	ENSMUSG00000057346	chr15:77559502-77566811	chr15:80350701 - 80736040	
Apoe	ENSMUSG00000002985	chr7:20281458-20284515	chr7:20107716 - 20245770	
Gusb	ENSMUSG00000025534	chr5:130464881-130478919	chr5:129706169 - 130085213	
Bdh2	ENSMUSG00000028167	chr3:134944185-134967390	chr3:137785490 - 138158838	
Bola3	ENSMUSG00000045160	chr6:83299141-83310130	chr6:80550131 - 81145978	
Ftcd	ENSMUSG00000001155	chr10:76038393-76053083	chr10:74913774 - 75004980	
Isoc2b	ENSMUSG00000052605	chr7:4796561-4817795	chr7:5912336 - 6245609	
Plbd2	ENSMUSG00000029598	chr5:120933291-120953634	chr5:113845542 - 116049346	
Cradd	ENSMUSG00000045867	chr10:94637380-94786767	chr10:95892008 - 96014123	
BC017158	ENSMUSG00000030780	chr7:135414893-135441684	chr7:132468721 - 133317628	
Fbxl20	ENSMUSG00000020883	chr11:97943868-98011717	chr11:100891837 - 100977097	
Moap1	ENSMUSG00000091931	chr12:103978040-103996882	chr12:103208606 - 103283852	
Mup10	ENSMUSG00000078680	chr4:60591132-60595071	chr4:59981393 - 61881691	
Th1l	ENSMUSG00000016253	chr2:174241305-174253003	chr2:178667105 - 178796335	
H2-Q6	ENSMUSG00000073409	chr17:35561795-35567000	chr17:32322784 - 32433789	
Gnaq	ENSMUSG00000024639	chr19:16207321-16461953	chr19:3250617 - 11384096	
Zap70	ENSMUSG00000026117	chr1:36818695-36839663	chr2:74724352 - 74844038	
Metap1d	ENSMUSG00000041921	chr2:71291333-71363251	chr1:33324614 - 33973089	
Gm2788	ENSMUSG00000085995	chr7:56133328-56141978	chr7:60448010 - 60593267	
Zhx1	ENSMUSG00000022361	chr15:57878558-57908096	chr15:56489504 - 56575711	
Adora1	ENSMUSG00000042429	chr1:136095800-136132008	chr1:136588819 - 136870351	
Znhit1	ENSMUSG00000059518	chr5:137458034-137463891	chr5:139739343 - 139827590	

Clcc1	ENSMUSG00000027884	chr3:108456831-108481758	chr3:108013537 - 108096986	
Rmnd1	ENSMUSG00000019763	chr10:5914153-5944626	chr10:3082438 - 3217673	+
Fxyd1	ENSMUSG00000036570	chr7:31836700-31840675	chr7:35979575 - 35926459	

Table S5. The connectivity of drugs to eQTLs through drug disposition enzymes. For each drug (column 1), reported are the relevant drug disposition processes (column 2). For each such process, reported are the eQTL-associated genes that are involved in the process, either based on a direct evidence regarding the gene (column 3), or an evidence regarding the EC number of a gene (column 4).

Drug	Drug disposition process	Enzymes (direct evidence)	Enzymes (indirect evidence)
5-fluorouracil	formation of 5-fluorouracil	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
6-mercaptopurine	metabolism of 6-mercaptopurine	Tpmt	-
Acetaminophen	toxicity of acetaminophen	Nr1i3	-
Acetaminophen	glucuronidation of acetaminophen	Ugt1a6b	-
Acetaminophen	activation of acetaminophen	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Acetaminophen	metabolism of acetaminophen	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Aldesleukin	synthesis of aldesleukin	Cd1d2	-
Alitretinoin	metabolism of alitretinoin	Aldh8a1,Rdh9	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Almotriptan	metabolism of almotriptan	Fmo1	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Alprazolam	metabolism of alprazolam	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Amiodarone	metabolism of amiodarone	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Atorvastatin	transport of atorvastatin	Slco1a1	-
Bosentan	uptake of bosentan	Slco1a1	-
Caffeine	metabolism of caffeine	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Cerivastatin	metabolism of cerivastatin	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Chloramphenicol	glucuronidation of chloramphenicol	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
Cimetidine	uptake of cimetidine	Slco1a1	-
Cladribine	phosphorylation of cladribine	Dguok	-
Cocaine	metabolism of cocaine	-	Ces3a,Ces2h,Ces1g
Coumarin	metabolism of coumarin	Ugt1a6b,Ugt1a10	Ugt1a6a,Ugt3a1,Ugt3a2,Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Cyclophosphamide	metabolism of cyclophosphamide	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Desipramine	conversion of desipramine	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Dextromethorphan	modification of dextromethorphan	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Diazepam	metabolism of diazepam	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25

Diclofenac	metabolism of diclofenac	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2,Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Diflunisal	glucuronidation of diflunisal	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
D-methylphenidate	hydrolysis of D-methylphenidate	-	Ces3a,Ces2h,Ces1g
Docetaxel	metabolism of docetaxel	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Epoprostenol	synthesis of epoprostenol	Tnfsf10	-
Etoposide	metabolism of etoposide	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Fluoxetine	modification of fluoxetine	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Flutamide	metabolism of flutamide	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Haloperidol	binding of haloperidol	Sigmar1	-
Haloperidol	metabolism of haloperidol	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Heparin	synthesis of heparin	Ext1	-
Heparin	binding of heparin	Fgf1,Sulf2	-
Hydrocortisone	metabolism of hydrocortisone	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Ibuprofen	metabolism of ibuprofen	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Ifosfamide	metabolic process of ifosfamide	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Imipramine	metabolism of imipramine	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Indinavir	metabolism of indinavir	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Indomethacin	glucuronidation of indomethacin	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
Irinotecan	hydrolysis of irinotecan	Ces2h,Ces3a	Ces1g
Irinotecan	**metabolism of irinotecan**	Gusb,Ces2h,Ces3a,Ugt1a10,Ugt1a6b,Ugt1a6a	Ces1g,Ugt3a1,Ugt3a2
Lovastatin	transport of lovastatin	Slco1a1	-
Methadone	metabolism of methadone	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Midazolam	metabolism of midazolam	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Morphine	glucuronidation of morphine	Ugt1a6b,Ugt1a10	Ugt1a6a,Ugt3a1,Ugt3a2,Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Morphine	conversion of morphine	Ugt1a10	Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
Muscimol	binding of muscimol	Adhfe1	-
Nicotine	metabolism of nicotine	Ugt1a10,Ugt1a6b,Ugt1a6a,Fmo1,Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44	Ugt3a1,Ugt3a2,Cyp2d12,Cyp2d11,Cyp3a25
Nifedipine	metabolism of nifedipine	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25

Norepinephrine	flow of norepinephrine	Adora1	-
Norepinephrine	release of norepinephrine	Adora1,Nr2f6	-
Norepinephrine	concentration of norepinephrine	App	-
Omeprazole	metabolism of omeprazole	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Paclitaxel	uptake of paclitaxel	Slco1a1	-
Paclitaxel	metabolism of paclitaxel	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Pravastatin	transport of pravastatin	Slco1a1	-
Propranolol	glucuronidation of propranolol	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
Ritonavir	metabolism of ritonavir	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Simvastatin	transport of simvastatin	Slco1a1	-
Tamoxifen	metabolism of tamoxifen	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Terfenadine	metabolism of terfenadine	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Thalidomide	metabolism of thalidomide	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Theophylline	metabolism of theophylline	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Thioguanine	metabolism of thioguanine	Tpmt	-
Tolbutamide	metabolism of tolbutamide	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Tretinoin	synthesis of tretinoin	Rdh9	-
Tretinoin	metabolism of tretinoin	Aldh8a1,Cyp3a16,Cyp3a13,Rdh9	Cyp2c40,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Tretinoin	hydroxylation of tretinoin	-	Cyp2c40,Cyp3a13,Cyp3a16,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Tretinoin	glucuronidation of tretinoin	-	Ugt1a10,Ugt1a6b,Ugt1a6a,Ugt3a1,Ugt3a2
Triazolam	metabolism of triazolam	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Trichloroethylene (TCE)	**metabolism of TCE**	Cyp2c40,Cyp2c44,Gsta2,Gstm6,Mgst3,Ccbl1, Ccbl2	Cyp3a13,Cyp3a16,Cyp2d12
Verapamil	metabolism of verapamil	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25
Voriconazole	metabolism of voriconazole	Cyp3a16	Cyp2c40,Cyp3a13,Cyp2c44,Cyp2d12,Cyp2d11,Cyp3a25

Table S6. A summary of the eQTL-drug map. For each drug (column 1), the table presents the relevant eQTL-associated drug disposition genes (columns 2,3) and the number of underlying eQTLs (column 4). The annotation of enzymes is either based on direct evidence on particular enzymes (column 2) or based on information about EC numbers (column 3). The total number of different enzyme classes is indicated in column 5 (including both direct and indirect evidence). Abbreviations: CYPs, Cytochromes P450; CES, Carboxyl esterase; UGTs, UDP-glucuronosyl transferases; GSTs, Glutathione S-transferases (see **Table 1** for details).

Drug	Enzymes (direct)	Enzymes (indirect)	# eQTLs	# Enzyme classes
Tretinoin	Aldh8a1,CYPs,Rdh9	UGTs	>2	4
Acetaminophen	Nr1i3, UGTs, CYPs	-	>2	3
Alitretinoin	Aldh8a1,Rdh9	CYPs	>2	3
Heparin	Fgf1,Sulf2,Ext1	-	>2	3
Irinotecan	Gusb,CES,UGTs	-	>2	3
Nicotine	UGTs,Fmo1,CYPs	-	>2	3
Norepinephrine	Adora1,Nr2f6,App	-	>2	3
Trichloroethylene (TCE)	CYPs,GSTs,Ccbl1/2	-	>2	3
Almotriptan	Fmo1	CYPs	>2	2
Coumarin	UGTs	CYPs	>2	2
Diclofenac	-	UGTs, CYPs	>2	2
Haloperidol	Sigmar1,CYPs	-	>2	2
Paclitaxel	Slco1a1,CYPs	-	>2	2
Caffeine	-	CYPs	>2	1
Cerivastatin	-	CYPs	>2	1
Cyclophosphamide	-	CYPs	>2	1
Desipramine	-	CYPs	>2	1
Fluoxetine	-	CYPs	>2	1
Flutamide	-	CYPs	>2	1
Ibuprofen	-	CYPs	>2	1
Ifosfamide	-	CYPs	>2	1
Imipramine	-	CYPs	>2	1
Methadone	-	CYPs	>2	1
Omeprazole	-	CYPs	>2	1
5-fluorouracil	CYPs	-	>2	1
Alprazolam	CYPs	-	>2	1
Amiodarone	CYPs	-	>2	1
Dextromethorphan	CYPs	-	>2	1
Diazepam	CYPs	-	>2	1
Docetaxel	CYPs	-	>2	1
Etoposide	CYPs	-	>2	1
Hydrocortisone	CYPs	-	>2	1
Indinavir	CYPs	-	>2	1

Midazolam	CYPs	-	>2	1
Nifedipine	CYPs	-	>2	1
Ritonavir	CYPs	-	>2	1
Tamoxifen	CYPs	-	>2	1
Terfenadine	CYPs	-	>2	1
Thalidomide	CYPs	-	>2	1
Theophylline	CYPs	-	>2	1
Tolbutamide	CYPs	-	>2	1
Triazolam	CYPs	-	>2	1
Verapamil	CYPs	-	>2	1
Voriconazole	CYPs	-	>2	1
Morphine	UGTs	-	2	1
Chloramphenicol	-	UGTs	2	1
Diflunisal	-	UGTs	2	1
Indomethacin	-	UGTs	2	1
Propranolol	-	UGTs	2	1
6-mercaptopurine	Tpmt	-	1	1
Aldesleukin	Cd1d2	-	1	1
Atorvastatin	Slco1a1	-	1	1
Bosentan	Slco1a1	-	1	1
Cimetidine	Slco1a1	-	1	1
Cladribine	Dguok	-	1	1
Epoprostenol	Tnfsf10	-	1	1
Lovastatin	Slco1a1	-	1	1
Muscimol	Adhfe1	-	1	1
Pravastatin	Slco1a1	-	1	1
Simvastatin	Slco1a1	-	1	1
Thioguanine	Tpmt	-	1	1
Cocaine	-	CES	1	1
D-methylphenidate	-	CES	1	1