A multi-ancestry genetic study of pain intensity in 598,339 veterans

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Abstract

Chronic pain is a common problem, with more than one-fifth of adult Americans reporting pain daily or on most days. It adversely affects quality of life and imposes substantial personal and economic costs. Efforts to treat chronic pain using opioids played a central role in precipitating the opioid crisis. Despite an estimated heritability of 25-50%, the genetic architecture of chronic pain is not well characterized, in part because studies have largely been limited to samples of European ancestry. To help address this knowledge gap, we conducted a cross-ancestry meta-analysis of pain intensity in 598,339 participants in the Million Veteran Program, which identified 126 independent genetic loci, 69 of which are novel. Pain intensity was genetically correlated with other pain phenotypes, level of substance use and substance use disorders, other psychiatric traits, education level, and cognitive traits. Integration of the GWAS findings with functional genomics data shows enrichment for putatively causal genes (n = 142) and proteins (n = 14) expressed in brain tissues, specifically in GABAergic neurons. Drug repurposing analysis identified anticonvulsants, beta-blockers, and calcium-channel blockers, among other drug groups, as having potential analgesic effects. Our results provide insights into key molecular contributors to the experience of pain and highlight attractive drug targets.

Introduction

Pain is an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage[1]. Acute pain typically lasts less than four weeks, while chronic pain lasts more than three months[2]. More than 50 million US adults report experiencing pain on most days or every day[3], making pain the most common reason for seeking medical treatment[4]. In the late 1980s many medical and pain organizations adopted policies to ensure the adequate assessment of pain, which was designated "the fifth vital sign"[2]. A dramatic increase in prescriptions for opioid analgesics resulted, contributing to the opioid epidemic and a doubling of opioid-related deaths in the 1990s[5,6].

Opioids are not efficacious in managing chronic non-cancer pain[7] and their long-term use is associated with addiction, sleep disturbances, opioid-induced hyperalgesia, endocrine changes, and cardiac and cognitive effects[8,9]. Non-opioid medications, such as non-steroidal anti-inflammatory and antiepileptic drugs, are effective for only some types of pain and can have significant adverse effects[10]. Thus, novel therapeutic targets for chronic pain are needed to facilitate the discovery or repurposing of safe, effective analgesics.

Notably, drug development efforts informed by genetics can double the rate of success[11]. Although the heritability (h^2) of individual differences in the susceptibility to develop chronic pain is estimated to be 25–50%[12], the mechanisms that underlie it are poorly understood[13]. Genome-wide association studies (GWAS) of chronic pain in large samples have focused on specific bodily sites[13–17] or aspects of an individual's sensitivity to experiencing and reporting pain[18–21]. GWAS have identified genome-wide significant (GWS) loci for headache[22], osteoarthritis[23], low back pain[16,17], knee pain[14], neuropathic pain[24], and multisite chronic pain[18,19], with high genetic correlations among them[25]. There are also significant genetic correlations between pain phenotypes and psychiatric, substance use, cognitive, anthropometric, and circadian traits[14,16–18,26]. This suggests that a common genetic susceptibility underlies a broad range of diverse chronic pain conditions[26] and common co-occurring conditions.

Most GWAS of pain traits have been conducted in predominantly European ancestry cohorts. However, biobanks linked to electronic health records (EHRs), with large, well-characterized, multi-ancestry samples, are now available for use in identifying genetic risk factors and therapeutic targets for chronic pain[27]. The Million Veteran Program (MVP)[28], an observational cohort study and mega-biobank implemented in the U.S. Department of Veterans Affairs (VA) health care system, includes data on routine pain screening. Pain ratings in the MVP use an 11-point ordinal numeric rating scale (NRS), which

has been a standard practice in VA primary care for more than a decade[29] and has been shown to be a consistent, valid measure of reported pain[30,31].

We conducted a cross-ancestry meta-analysis of the NRS in samples of African American (AA), European American (EA) and Hispanic American (HA) ancestries from the MVP (N = 598,339). Although the NRS is a report of pain intensity experienced at a specific point in time, we used the median of medians as a proxy for chronic pain. We also conducted a secondary analysis in a subsample of 566,959 individuals that excluded participants with a lifetime opioid use disorder (OUD) diagnosis to assess potential confounding by OUD, in a subsample of 291,759 participants that excluded those with pain ratings = 0, and in males and females separately (sex-stratified) (Extended Data Fig 1).

Results

Description of the sample

The study sample comprised 598,339 individuals (AA = 112,968, EA = 436,683, HA = 48,688), of whom 91.2% were male (Supplementary Table 1). The secondary analyses that excluded individuals with a lifetime OUD diagnosis were reduced by 5% across population groups (AA = 104,050, EA = 415,740, HA = 46,169) (Supplementary Table 1). The median ages were 61.4 (s.d = 14.0) and 61.7 (s.d = 14.1) in the full and non-OUD samples, respectively. Approximately half of individuals in both the full sample (51.2%) and the non-OUD sample (52.7%) reported a median NRS of 0, i.e., no pain. Mild (NRS 1-3), moderate (NRS 4-6) and severe pain (NRS 7-10) were reported by 24.4%, 19.2%, and 4.5%, respectively in the full sample, and by 24.6%, 18.2%, and 4.0%, respectively, in the non-OUD sample.

Identification of pain intensity risk loci

Our cross-ancestry meta-analysis of 16,254,110 imputed autosomal SNPs in the AA, EA, and HA samples identified 4,416 GWS variants represented by 158 LD-clumped index variants ($r^2 > 0.1$) (Fig. 1). No lead SNP showed evidence of heterogeneity across ancestries, based on the I^2 index (Supplementary Figure 1). In a cross-ancestry meta-analysis of chrX, we identified one GWS variant (*DASH2*-rs195035) (Supplementary Table 2). Analyses conditioned on the lead SNP left 126 (125 autosomal and 1 chrX) independent association signals (Supplementary Table 2), including 57 previously reported as pain-related loci[16,18] and 69 novel loci (Fig. 1, Supplementary Table 2). Eight independent variants are exonic, 85 reside within a gene transcript, and 33 are intergenic. Of the 8 exonic variants, 2 have likely damaging effects (PolyPhen > 0.5, CADD > 15; *SLC39A8*-rs13107325 and *WSCD2*-rs3764002) and 5 are potentially

deleterious (CADD > 15; *ANAPC4*-rs34811474, *MIER*-rs2034244, *NUCB2*-rs757081, *AKAP10*-rs203462 and *APOE*-rs429358) (Supplementary Table 2).

[Insert Figure 1 here]

We looked up the 126 independent variants in a recent meta-analysis of 17 United Kingdom Biobank (UKBB) pain-related traits[20], a common genetic pain factor consisting of 24 chronic pain conditions in the UKBB[26], and the human pain genes database (HPGD)[32]. Two variants (*TCF4*-rs618869 and *APOE*-rs429358) were GWS in the meta-analyses of pain traits (Supplementary Table 2). None of the 69 novel pain associations reported here were GWS in the published studies[20,26] or the HPGD[32], confirming their novelty.

Because inflammation appears to play a role in pain susceptibility[20], we explored the 126 independent pain intensity loci (within a 1-Mb buffer) for pleiotropy with immune traits in the GWAS catalog[33]. Of these, 25 (9 novel) were pleiotropic with immune/hematopoietic traits, such as C-reactive protein levels and blood cell counts (Supplementary Table 3).

The GWAS using 7,069,962 imputed autosomal SNPs in EAs yielded 103 LD clumps ($r^2 > 0.1$) across 86 independent loci (Extended Data Fig. 2, Supplementary Table 4). One chrX variant (*DASH2*-rs195035) was GWS in EAs (Supplementary Table 4). Of the 87 independent loci, 15 were not GWS in the cross-ancestry meta-analysis (Supplementary Table 4). We also identified 2 GWS variants in 1 locus (nearest gene *PPARD*; chr 6) in AAs (11,183,154 imputed SNPs), and 15 GWS variants in 2 loci (nearest genes *RNU6-461P*, chr 3 and *RNU6-741P*, chr 15) in HAs (5,859,313 imputed SNPs; Supplementary Table 5). No chrX locus was associated with pain intensity in AAs or HAs. We used a sign test to examine the 86 independent EA index autosomal variants in AAs and HAs, of which 57 and 74, respectively, were directly analyzed or had proxy SNPs in these populations (Supplementary Table 6). Most variants had the same direction of effect in both populations (N_{SNPs} AAs = 41, HAs = 61; sign test AAs $P = .0013$, HAs $P = 1.39 \times 10^{-8}$). Only 15 variants (N_{SNPs} AAs = 2, HAs = 13) were nominally associated ($P < 0.05$) and none survived multiple test correction (Supplementary Table 6). The cross-ancestry genetic-effect correlation (ρ_{pe}) was 0.71 (SE = 0.13, $P = 2.12 \times 10^{-2}$) between EAs and AAs and 0.74 (SE = 0.08, $P = 6.81 \times 10^{-4}$) between EAs and HAs. The cross-ancestry heritability estimates between AAs and HAs were too low to calculate ρ_{pe} between them.

Loci for non-OUD diagnosis, non-zero pain ratings and sex differences.

The secondary cross-ancestry meta-analysis that excluded participants with a lifetime OUD diagnosis identified 3,400 SNPs in 101 LD-independent risk loci (Supplementary Table 7). Of these, 88 were GWS in the primary GWAS, whereas 13 were $p < 10^{-6}$, including 10 that were novel (Supplementary Table 7). We also identified 18 ancestry-specific loci (17 in EAs and 1 in AAs) (Supplementary Tables 8 & 9).

The cross-ancestry meta-analysis of individuals with NRS>0 identified 461 SNPs in 12 independent risk loci (Supplementary Table 10). Of these, 8 were associated with pain intensity in the primary GWAS, whereas 4 loci were not, including 3 (*TNIK*-rs189788533, *RP11-99C10.1*-rs7124028, *FAM81A*-rs149493877) novel pain loci (Supplementary Table 10). In EAs and AAs, we identified 11 and 1 independent risk loci, respectively, including 3 (EA, *TNIK*-rs189788533 and *RP11-404L6.2*-rs6884145; AA, *FAM81A*-rs149493877) additional novel associations (Supplementary Table 11).

In a cross-ancestry meta-analysis that comprised males only, we identified 97 independent risk loci (one on chrX), including 8 that were not GWS in the primary GWAS and 7 novel associations for pain traits (*NASP*-rs2991977, *PDE11A*-rs16865764, *RP11-138I17.1*-rs1726312995, *CD14*-rs2569190, *RP11-572H4.1*-rs1122665, *SLITRK1*-rs1331928, and *SDK2*-rs150636180) (Supplementary Table 12). We also identified 75 independent risk loci (one in chrX) in EAs – including seven novel for pain traits – (Supplementary Table 13) and one novel locus each for AAs and HIS (Supplementary Table 14). No variant was GWS among females, though 28 LD-clumped variants ($r^2 > 0.1$) showed a suggestive level of association ($P < 5 \times 10^{-6}$, Supplementary Table 15). The direction of allele effects was highly correlated between males and females ($r = 0.68$, $P = 2.2 \times 10^{-16}$) (Supplementary Fig. 2), as was genetic correlation for pain intensity (EAs, $r_g = 0.87$, $P = 1.41 \times 10^{-35}$ and AAs, $r_g = 1$, $P = 6.8 \times 10^{-3}$). SNP heritability was moderate for both females (EAs = 0.12 and AAs = 0.05) and males (EAs = 0.08 and AAs = 0.06).

Overall, the per-allele effect sizes of lead risk variants between the primary and secondary GWASs were high, ranging from 0.88 to unity ($P < 2.2 \times 10^{-16}$; Extended Data Fig. 3). The genomic inflation factor (λ_{GC}) of the fixed-effect meta-analysis across all GWASs ranges from 1.03 to 1.23 (Supplementary Fig. 3), as expected for a polygenic trait[34,35]. Across all GWASs, the univariate LDSC intercept ranges from 0.99 to 1.2 (s.e. 0.01), which, being close to 1.0, suggests that most of the genome-wide elevation of the association statistics comes from true additive polygenic effects rather than a confounder such as population stratification. LDSC genetic correlations [r_g] between the primary and secondary GWASs were high, ranging from 0.89 to unity, with overlapping confidence intervals (Extended Data Fig. 4). In the primary GWAS, the LDSC ratio between the intercept and mean χ^2 statistic

(1.90) was 0.13, suggesting that 87% of the observed inflation in χ^2-statistic is due to the polygenicity of the pain trait.

Single-nucleotide polymorphism heritability and enrichment

The proportion of variation in pain intensity explained by common genetic variants (h^2_{SNP}) was similar both for the primary (AAs: 0.06 ± 0.009, EAs: 0.08 ± 0.003 and HAs: 0.07 ± 0.011) and the non-OUD GWAS (AAs: 0.07 ± 0.009, EAs: 0.08 ± 0.003 and HAs: 0.07 ± 0.011) (Supplementary Table 16).

Partitioning the SNP heritability for pain intensity revealed significant tissue-group enrichment in central nervous system (CNS) ($P = 1.47 \times 10^{-12}$), adrenal gland ($P = 8.97 \times 10^{-5}$), liver ($P = 3.15 \times 10^{-4}$), skeletal ($P = 8.50 \times 10^{-4}$), cardiovascular ($P = .001$), and immune/hematopoietic ($P = .004$) tissues (Figure 2A & B, Supplementary Table 17). In gene expression datasets derived from multiple tissues, we observed predominant h^2_{SNP} effects in brain ($P = 2.87 \times 10^{-5}$), including hippocampus ($P = 1.00 \times 10^{-4}$) and limbic system ($P = 1.15 \times 10^{-4}$) (Figures 2C & D, Supplementary Table 18). SNP-based heritability in histone modification data also showed robust enhancer (H3K27ac and H3K4me1) and active promoter (H3K4me3 and H3K9ac) enrichments in brain tissues, including the dorsolateral prefrontal cortex ($P < 1.32 \times 10^{-4}$), inferior temporal lobe ($P < 3.09 \times 10^{-4}$), angular gyrus ($P = 8.42 \times 10^{-5}$), and anterior caudate ($P = 1.12 \times 10^{-4}$) (Figure 2E, Supplementary Table 19). Similar results were obtained for the partitioned heritability analysis of the non-OUD GWAS (Supplementary Tables 17 & 18), though it also included significant expression effects in the cortex and cerebellum.

Although the SNP-based heritability and enrichment for the primary and non-OUD GWASs were similar, because the primary GWAS using the full sample yielded more risk loci, we based all downstream analyses (except r_g analyses) on the GWAS results from that sample.

[Insert Figure 2 here]

Gene-set enrichment in tissue and cell types

We mapped GWAS variants to genes via expression quantitative trait locus (eQTL) association and assessed the tissue enrichment of mapped genes. After correcting for multiple testing ($P = 9.25 \times 10^{-4}$) in the cross-ancestry and EA-specific GWASs, we uncovered significant transcriptomic enrichment only in brain tissues (Extended Data Fig. 5). Consistent with previous findings of brain tissue enrichment across different pain phenotypes in EAs[18,21,23], both our EA and cross-ancestry analyses showed notable enrichment in the cerebellum (cross-ancestry, $P = 2.48 \times 10^{-7}$; EA, $P = 2.90 \times 10^{-6}$),

cerebellar hemisphere (cross-ancestry, $P = 4 \times 10^{-7}$; EA, $P = 6.23 \times 10^{-6}$), cortex (cross-ancestry, $P = 2.79 \times 10^{-6}$; EA, $P = 3 \times 10^{-4}$), and frontal cortex (cross-ancestry, $P = 2.82 \times 10^{-6}$; EA, $P = 4.17 \times 10^{-4}$) (Extended Data Fig. 5). Among AAs there were no significantly enriched tissues (Supplementary Table 20).

To investigate enrichment at the level of cell types in the EA GWAS results, we conducted cell-type specific analysis in a collection of 13 human brain sc-RNAseq datasets. After adjusting for possible confounding due to correlated expression within datasets using a stepwise conditional analysis, we detected jointly significant cell-type enrichments (proportional significance, PS > 0.5) for GABAergic neurons largely in the human adult mid-brain ($P = 0.003$ $\beta = 0.206$, s.e. = 0.075, PS 0.56) and to a lesser extent in the prefrontal cortex ($P = 0.044$, $\beta = 0.045$, s.e. = 0.016, PS 0.39) (Supplementary Table 21).

Prioritization of candidate genes

To facilitate the biological interpretation and identification of druggable targets, we used a combination of gene-set and fine-mapping, transcriptomic, proteomic, and chromatin interaction models to prioritize high-confidence variants and genes that most likely drive GWAS associations. Assigning SNPs to genes using physical proximity, gene-based analyses identified 6 GWS genes in AAs, 203 in EAs, and 125 in the cross-ancestry results (Extended Data Fig. 6, Supplementary Table 22), but none in HAs. Gene-set analysis using cross-ancestry GWAS results identified significantly enriched biological processes in catecholamine uptake (GO:0051944; Bonferroni $P = 0.019$) and startle response (GO:0001964; Bonferroni $P = 0.024$). Negative regulation of synaptic transmission (GO:0050805; Bonferroni $P = 0.016$) was related to pain intensity in EAs (Supplementary Table 23).

For consistency with available reference data, we based the fine mapping procedure on EA GWAS results using 78 genomic regions (spanning 103 index variants) (Supplementary Table 24) defined by the maximum physical distance between the LD block of independent lead SNPs (Methods). Functional genomic prediction models used the full EA GWAS results (Extended Data Fig. 1).

We fine-mapped the 78 regions using the Bayesian method (Methods). For each region with independent causal signals (Supplementary Table 24), credible sets of variants (PP > 0.5) were constructed to capture 95% of the regional posterior probability ($k \leq 5$, Supplementary Table 25). Of these regions, 4 harbored 1 SNP (potentially indicating the causal variant), 20 regions 2 SNPs and 44 regions 3 or more SNPs (Supplementary Table 25). In total, fine-mapping prioritized 76 unique credible variants (N = 108, Figure 3A), including 26 independent lead SNPs and 18 novel pain loci (Figure 3B).

Most (50/76) of the credible variants map to protein-coding genes and are mostly eQTLs (Supplementary Table 25), and five harbor missense variants, of which three (*ANAPC4, APOE,* and *SLC39A8*) are known pain loci[18,23] and two (*RYR2* and *AKAP10*) are novel (Figure 3B). This small proportion of missense variants and high eQTL enrichment are consistent with an increased probability that the credible variants influence liability to pain intensity through gene expression modulation.

We performed TWAS and PWAS analyses to determine whether risk variants exert their effects via gene and/or protein expression. After correction for multiple testing, 196 unique genes (TWAS eQTL – 294, TWAS sQTL – 67 and PWAS – 32) were associated with pain intensity (Supplementary Tables 26 & 27). Of these, 69 represent novel associations (based on a window from the index GWAS locus > 1 MB). PWAS showed significant associations in the dorsolateral prefrontal cortex (dlPFC) that overlapped for 22 unique genes across multiple brain tissues in the TWAS (eQTL – 16, sQTL – 8) (Figure 3C).

[Insert Figure 3 here]

Chromatin interaction mapping using Hi-C data in adult and fetal brain identified 512 unique significantly interacting genes ($P = 2.84 \times 10^{-8}$) (Supplementary Table 28), of which 60 were associated with all six chromatin annotations (Supplementary Fig. 4) and 20 overlapped with TWAS and/or PWAS findings, including *DPYSL5*, *KHK*, *MAPRE3*, *MST1R*, *NEK4*, *GNL3*, *GRK4*, *UHRF1BP1* and *VKORC1* (Figure 3C, Supplementary Tables 26, 27 & 28).

Based on concordant evidence from colocalization analyses in TWAS and PWAS (COLOC PP4 > 0.80), 104 unique genes (TWAS eQTL – 139, TWAS sQTL – 20 and PWAS – 14) were putatively causal for pain intensity (Supplementary Tables 26 & 27), of which 10 (including *DPYSL5*, *GRK4*, *KHK* and *MST1R*) were validated by SMR analysis ($P_{HEIDI} > 0.05$) (Figure 3D, Supplementary Table 29). Among the 104 genes, 6 (*CHMP1A, GRIA1*, *GRK4*, *MST1R, STMN3* and *TRAF3*) captured 50% or more of the FINEMAP posterior probability (Supplementary Table 25). Notably, the *MST1R* intronic locus (rs9815930), which is in a credible set that harbors four other variants in high LD with the novel index variant rs2247036 (nearest gene – *TRAIP*) (Extended Data Fig. 7), displayed the most robust causal effects from COLOC and SMR in more than one brain tissue (Figure 3D).

We also explored enrichment of causal genes and proteins in the dorsal root ganglia (DRG), which are important for transduction of nociceptive signals from the periphery to the CNS. None of the causal genes or proteins (N = 104) were enriched in human or mouse DRG (Enrichment score > 0.5) (Supplementary Fig. 5A). Supporting results from TWAS and PWAS, 63 unique genes (human – 38 and

mouse – 49) were primarily enriched in the CNS, of which 22 (including *GRK4*, *GRIA1*, *MAPRE3*, *NEK4*, *STMN3* and *TRAF3*) showed common enrichment patterns across species (Supplementary Fig. 5B).

Integrating fine-mapping, colocalization and SMR prioritized 156 high-confidence genes underlying the pain intensity GWAS association, of which 5 are exonic and missense (Supplementary Table 30), and 151 exert their effect via gene or protein expression.

Phenotypic correlates of pain intensity

The strongest positive genetic correlations of pain intensity were with other pain phenotypes (e.g., multisite chronic pain r_g=0.789, osteoarthritis r_g=0.710, neck/shoulder pain r_g=0.669, back pain r_g=0.697, hip pain r_g=0.729, knee pain r_g=0.637; Figure 4). Of 72 medical, anthropometric, or psychiatric traits associated epidemiologically with pain severity, 56 were significantly genetically correlated with pain intensity in EAs (Bonferroni $P < 5.62 \times 10^{-4}$) (Figure 4, Supplementary Table 31).

[Insert Figure 4 here]

Notably, the liability to pain intensity was significantly positively genetically correlated with neuroticism, depression, insomnia, a variety of smoking-related measures, cannabis use disorder (CUD), alcohol dependence, OUD, and being overweight or obese (Figure 4). As in prior studies of other pain-related phenotypes[17,22,36], pain intensity was significantly negatively correlated with educational attainment, cognitive performance, intelligence, and age of smoking initiation (Figure 4). Relevant to drug repurposing, pain intensity was also positively correlated with the use of a variety of analgesic and anti-inflammatory drugs (Figure 4). We also found significant r_gs with pain intensity for several medical conditions and health outcomes in the UKBB (including genitourinary disease, chronic bronchitis, angina, etc., Bonferroni $P < 3.72 \times 10^{-5}$, Supplementary Table 32). In AAs, pain intensity was positively genetically correlated with PTSD-related features (e.g., re-experiencing, hyperarousal) and nominally associated ($p < 0.05$) with substance use traits (e.g., maximum alcohol intake and smoking trajectory, Supplementary Table 33).

In the Yale-Penn sample, we calculated PRS for 4,922 AAs and 5,709 EAs for use in phenome-wide association studies (PheWAS). Among AAs, no association survived Bonferroni correction (Supplementary Fig. 6, Supplementary Table 34). In EAs, PheWAS identified 147 phenotypes, including 107 in the substance-related domain (40 opioid-related, 30 cocaine-related, 20 tobacco-related, 12 alcohol-related, and 6 cannabis-related) and 39 in other domains (9 medical, 18 psychiatric [9 PTSD, 5 ADHD, 2 conduct disorder, and 2 antisocial], 7 early childhood environmental, and 5 demographic

phenotypes) significantly associated with the pain PRS (Supplementary Fig. 7, Supplementary Table 34). The most significant findings were a negative association of the pain PRS with educational attainment ($P = 2.39 \times 10^{-26}$) and a positive association with the Fagerström Test for Nicotine Dependence ($P = 4.71 \times 10^{-25}$). Opioid dependence was also positively associated with the pain PRS ($P = 3.87 \times 10^{-12}$) and remained significant for a PRS based on the supplementary GWAS that excluded individuals with an OUD diagnosis (OR = 1.27, $P = 1.35 \times 10^{-6}$).

In PMBB, we calculated PRS for 10,383 AAs and 29,355 EAs. In AAs, no association with the pain PRS survived Bonferroni correction (Supplementary Fig. 8, Supplementary Table 35). In EAs, the pain PRS was associated with 63 phenotypes, including 7 pain phenotypes and 6 psychiatric disorders (i.e., substance-, depression-, and anxiety-related traits). The pain PRS was also associated with circulatory system (n=11), infectious diseases (n=4), endocrine/metabolic (n=8), genitourinary (n=2), musculoskeletal (n=3), and neoplasms (n=4). The most significant findings were positive correlations with obesity ($P = 1.97 \times 10^{-45}$) and tobacco use disorder ($P = 1.55 \times 10^{-24}$) and a negative association with benign neoplasm of skin ($P = 2.67 \times 10^{-26}$) (Supplementary Fig. 9, Supplementary Table 35). In females, pain PRS was positively associated with sleep apnea and obstructive sleep apnea, and negatively associated with disorders of refraction, degenerative skin conditions and astigmatism ($P < 3.65 \times 10^{-5}$) (Supplementary Table 35). The pain PRS was negatively associated with elevated prostate specific antigen in males ($P = 1.03 \times 10^{-6}$) (Supplementary Table 35).

Two-sample MR between genetically correlated traits (N = 16) and pain intensity yielded 9 traits with evidence of heterogeneity (Cochran $P < 0.05$) and no horizontal pleiotropy (MR-Egger interval $P > 0.05$), 3 of which were bidirectional (Supplementary Table 36). Genetically predicted higher depressed affect subcluster, neuroticism, and smoking initiation had a significant positive bidirectional causal effect with pain intensity (Supplementary Table 36). Further, increased opioid use (N02A) positively predicted pain intensity.

Genetically inferred drug repurposing

Of the 156 genes in EAs with evidence supporting causality from fine-mapping and functional genomic prediction, 20 were present in the druggable genome database[37] (Supplementary Table 37). Of these druggable candidate genes, 11 (including *GRIA1*, *GRK4* and *MST1R*) are tier-1 candidates, which include targets of licensed drugs and drugs in clinical trials, 4 genes (e.g., *NEK4* and *RYR2*) are in tier 2, and 4 are in tier 3 (Supplementary Table 30). Within tier 1, drugs that interact with *GRK4* (a credible pain

gene locus in moderate LD with the novel index variant *NOP14**rs71597204 – Extended Data Fig. 8) are beta-blockers (atenolol and metoprolol) and a calcium-channel blocking agent (verapamil) (Figure 5), which have analgesic effects in osteoarthritis[38,39] and migraine[40]. Another tier-1 candidate gene – *GRIA1* – is targeted by anesthetics (sevoflurane, isoflurane, desflurane), antiepileptics (topiramate, perampanel), analgesics (methoxyflurane), psychoanaleptics (piracetam, aniracetam), and a diuretic (cyclothiazide) (Figure 5). Drug classes for pain intensity also included anti-hemorrhagic agents (e.g., fostamatinib [tier 1: *MST1R* and *FYN*; tier 2: *NEK4*] and menadione [*VKORC1*]) (Figure 5, Supplementary Table 37).

[Insert Figure 5 here]

Of the 7 genes associated with pain intensity in AAs, *PPARD*, which harbors the new genetic signal discovered in this study, is a tier-1 druggable candidate with 30 interacting drug classes (Supplementary Table 37). The *PPARD* negative modulator sulindac is an approved non-steroidal anti-inflammatory and antirheumatic drug used to treat osteoarthritis.

Discussion

In the largest multi-ancestry, single-sample GWAS of pain intensity to date, cross-ancestry analyses identified 126 independent risk loci, including 125 autosomal and one X-chromosomal loci, including 69 novel pain associations. Prior GWASs for chronic pain phenotypes identified 99 loci[16–20,24], though only in EA individuals. The diversity and size of the MVP sample enabled us to identify novel association signals in both AAs (*PPARD**rs9470000) and HAs (nearest genes *RNU6-461P**rs146862033, *RNU6-741P**rs1019597899).

Findings from gene set analysis, tissue enrichment, and cell-type specificity highlight novel biological pathways underlying pain, implicating the brain, and providing genetic support to the current understanding of the pathophysiology of pain severity[41]. Genes predominantly expressed in the CNS, particularly in the cerebellum, cerebellar hemisphere, and cortex, rather than in the DRG, are salient in modulating the intensity of pain as assessed here, consistent with prior associations of sustained chronic pain intensity with increased activity in these brain regions[42–44]. Our findings are also consistent with prior reports[17,18,45,46] of enriched gene expression in brain that contributes to pain intensity in a dose- and time-dependent manner and may involve specific neuronal processes in brain regions implicated in emotional processing[41]. Evidence that GABAergic neurons are cells of specific interest is a key novel finding. GABA has long been implicated in the modulation and perception of pain[47–49] and specific

GABAergic activity in the midbrain has been implicated as a modulator of pain and anxiety[50]. Altered GABA levels have been reported in individuals with various types of pain[51,52] and been associated with greater self-reported pain[53]. Targeting GABA function in brain regions enriched for pain intensity could be a novel therapeutic strategy.

Eleven of 156 prioritized genes encode druggable small molecules that are targets of licensed drugs or those in clinical trials, representing drug repurposing opportunities for treating chronic pain. We highlight *MST1R*, *GRK4* and *GRIA1*, each with at least three lines of evidence supporting their involvement in chronic pain. *MST1R* encodes a cell-surface receptor with tyrosine kinase activity that mediates the inflammatory response. The *MST1R* inhibitor fostamatinib – prioritized by our drug repurposing analyses – is a possible therapeutic target for rheumatoid arthritis[54]. Increased connectivity between frontal mid-brain regions implicated in affective pain processing has been reported in patients with rheumatoid arthritis[55]. Here, we demonstrated that *MST1R* is highly expressed in the adult brain cortex, cerebellum, and cerebellar hemisphere, suggesting that *MST1R* inhibitors may be effective in treating patients with inflammation-related pain.

GRK4 encodes G protein-coupled receptor kinase 4 and has been linked with hypertension[56], which is associated with chronic pain at the population level[57,58]. Of note, we showed that *GRK4* is significantly upregulated in the cerebellar hemisphere, fine maps to an intronic variant with > 95% PP, and is a target of beta-blockers. The use of beta-blockers has been associated with reduced osteoarthritis pain scores and prescription analgesic use[38] and fewer consultations for knee osteoarthritis, knee pain, and hip pain[39]. *GRIA1* encodes an ionotropic glutamate receptor subunit, an excitatory neurotransmitter receptor at many synapses in the CNS. Loss-of-function mutations in *GRIA1* are linked to neurodevelopmental impairments[59,60]. The *GRIA1* antagonist sevoflurane reduced pain in patients with chronic venous ulcer[61]. However, clinical trials of topiramate (another drug target for *GRIA1*) for treating neuropathic chronic pain were inconclusive[62]. Research on the mechanisms that underlie the biology of these potential drug targets for *GRK4* and *GRIA1* and their effects on the onset and severity of chronic pain are warranted.

Pain intensity was strongly genetically correlated with other chronic pain phenotypes, with the strongest genetic correlations with multisite chronic pain, followed by pain in specific bodily locations. In line with previous observations in GWASs of other pain-related phenotypes[17,18,20,21,36], there were also positive genetic correlations of pain intensity with psychiatric disorders, substance use and use disorders, and anthropometric traits.

PheWAS findings in both the Yale-Penn sample – enriched for individuals with substance-related traits – and the PMBB – comprising a medical population – were prominent in EAs. These findings underscore the influence of co-occurring substance-related, psychiatric, and medical pathology and educational achievement on the intensity of the pain experience. In contrast, the pain PRS yielded few associations in AAs in either of the target samples, which underscores the need for larger non-European samples for studies of pain intensity.

Two-sample MR analysis supported causal associations between pain and multiple traits. Smoking has previously been associated with greater pain intensity, but studies can be confounded by socioeconomic factors, and a bidirectional relationship has been proposed[63]. Here, we provide evidence for a bidirectional causal relationship between pain and smoking initiation. In line with previous findings[18,25], pain intensity had a bidirectional causal effect on the risk of both depressed affect sub-cluster and neuroticism, suggesting that greater pain could predispose individuals to increased risk for these psychiatric disorders and vice versa. Supporting the positive genetic correlation between opioid use and pain intensity, MR showed evidence of a causal effect of opioid use on pain intensity.

Pain intensity is a complex, polygenic trait with hundreds of genetic loci contributing to it. The evidence adduced here of pleiotropy of pain intensity with psychiatric traits such as neuroticism and depression reflect the contribution of non-physical factors to the experience of pain intensity. This is consistent with the observed significant tissue-group enrichment in CNS, the predominant gene expression findings in brain (including the hippocampus and limbic system), and the SNP-based enhancer enrichments in histone modification in brain tissues (including the dorsolateral prefrontal cortex, inferior temporal lobe, angular gyrus, and anterior caudate).

The NRS phenotype, although a quantitative trait and thus more informative than a binary trait, is based on subjective report. However, because the subjective experience of pain is a key defining feature of the clinical phenomenon[1,64] the phenotype has high public health significance. Pain scores recorded by clerks and nurses in a clinical setting may underestimate the patient's response. In earlier work that compared self-reported pain from a direct patient survey to scores recorded in a VA clinical setting[65], despite lower scores recorded in the clinic, the two reports correlated well. Nonetheless, the imprecise measurement of pain intensity likely yields lower power for gene discovery. We chose not to stratify the analyses using different types of pain (e.g., secondary to osteoarthritis vs. lower back pain vs. peripheral neuropathy) to maximize statistical power, but will examine different sources of pain in future analyses. We reduced the large number of pain assessments by taking individuals' median of

medians NRS scores as a trait for GWAS. In subsequent analyses, we will evaluate other methods for characterizing pain severity (e.g., pain trajectories). Our sample was also limited by being comprised predominantly of male veterans, which given sex differences in the experience and frequency of pain[19] limits the application of the findings to the general population. Studies of pain intensity in large samples with more even sex distributions are needed. Although our sample was more diverse than prior GWAS of pain traits, analyses in the AA and HA samples were underpowered. Finally, we lacked a suitable replication sample, so efforts are needed to replicate the findings reported here.

Despite these limitations, the large MVP sample and the informative quantitative trait measured repeatedly within subjects, which provided a proxy for chronic pain, identified many novel loci contributing to the trait. Downstream analyses localize the genetic effects largely to four CNS regions and using single-cell RNAseq data link them specifically to GABAergic neurons. Combined with drug repurposing findings that implicate 20 druggable targets, this study provides a basis for studies of novel, non-opioid medications for use in alleviating chronic pain.

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Author Contributions

S.T. conducted the main analyses and drafted the manuscript. R.V.S conducted phenotype-related analyses. Z.J and H.X conducted downstream analyses. D.S annotated gene findings. M.P.V and K.S helped conduct analyses. R.V.S, Z.J, H.X, D.S, E.H, M.P.V, K.S, K.X, J.G, D.A.J, C.T.R, M.C, E.S, and S.G.W helped to write the manuscript. A.C.J obtained funding to support the project and helped to write the manuscript. R.L.K supervised the analyses and helped to write the manuscript. H.R.K conceived the project, obtained funding to support it, and helped to supervise the analyses and write the manuscript. All authors reviewed and approved the final version of the manuscript

Competing Interests

H.R.K. is a member of advisory boards for Dicerna Pharmaceuticals, Sophrosyne Pharmaceuticals, Enthion Pharmaceuticals, and Clearmind Medicine; a consultant to Sobrera Pharmaceuticals; the recipient of research funding and medication supplies from Alkermes for an investigator-initiated study; and a member of the American Society of Clinical Psychopharmacology's Alcohol Clinical Trials Initiative, which was supported in the last three years by Alkermes, Dicerna, Ethypharm, Lundbeck, Mitsubishi, and Otsuka. HRK and JG are named as inventors on PCT patent application #15/878,640 entitled: "Genotype-guided dosing of opioid agonists," filed January 24, 2018. ES is a full-time employee of Regeneron Pharmaceuticals. The other authors have no disclosures to make.

Figure Legends

Figure 1. Manhattan plot for the pain intensity cross-ancestry GWAS meta-analysis (N = 598,339). This identified 126 independent index variants. The nearest gene to the 69 novel loci (68 autosomal and one X-chromosomal) are annotated. SNPs above the red line are GWS after correction for multiple testing ($P < 5 \times 10^{-8}$)

Figure 2. Enrichment of pain intensity in the brain. A, Partitioning heritability enrichment analyses using LDSC showing enrichment for pain intensity in the CNS, adrenal, liver, cardiovascular, skeletal and

immune/hematopoietic tissues. The dashed black lines indicate Bonferroni-corrected significance for multiple testing ($P < 0.005$). **B**, Proportion of heritability shows robust enrichment for SNPs in brain and immune-related tissues. Heritability enrichment analyses for gene expression (**C & D**) and chromatin interaction (top 35 annotations are shown in **E,** see Supplementary Table 17 for full details) using GTEx data show enrichment for pain intensity in brain regions previously associated with chronic pain. Bonferroni correction was applied within each tissue conditioned on the number of genes tested.

Figure 3. Gene prioritization for pain intensity. A, Genomic annotation of credible sets using FINEMAP shows enrichment largely in non-coding regions and to a lesser extent in exons. **B**, Annotation of known and novel credible genes. Dashed lines indicate posterior probability > 0.5. **C**, Number of overlapping genes across functional prediction models. **D**, Tissue enrichment of prioritized genes using SMR and GTEx data shows enrichment in brain regions. The size of the circle reflects $-\log_{10}P$. Bonferroni correction was applied within each tissue conditioned on the number of genes tested.

Figure 4. Genetic correlation. Genetic correlation for pain intensity using LDSC. All points passing Bonferroni correction (Bonferroni correction threshold = 5.62×10^{-4} [0.05/89]) are plotted. The color of the circle indicates the phenotypic category.

Figure 5. Drug repurposing. Druggable targets and drug interactions for 8 credible genes associated with pain intensity. For a full list of credible drug targets see Supplementary Table 37.

References

1. Raja SN, Carr DB, Cohen M, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *PAIN*. 2020;161(9).
2. Scher C, Meador L, Van Cleave JH, Reid MC. Moving beyond pain as the fifth vital sign and patient satisfaction scores to improve pain care in the 21st century. *Pain Manag. Nurs*. 2018;19(2):125-129.
3. Yong RJ, Mullins PM, Bhattacharyya N. Prevalence of chronic pain among adults in the United States. *PAIN*. 2022;163(2):e328-e332.
4. Tompkins DA, Hobelmann JG, Compton P. Providing chronic pain management in the "Fifth Vital Sign" Era: Historical and treatment perspectives on a modern-day medical dilemma. *Drug Alcohol Depend*. 2017;173:S11-S21.
5. Humphreys K, Shover CL, Andrews CM, et al. Responding to the opioid crisis in North America and beyond: recommendations of the Stanford–Lancet Commission. *Lancet*. 2022;399(10324):555-604.
6. Friedman JR, Hansen H. Evaluation of increases in drug overdose mortality rates in the us by race and ethnicity before and during the covid-19 pandemic. *JAMA Psychiatry*. 2022;79(4):379-381.

7. Ballantyne JC, Shin NS. Efficacy of opioids for chronic pain: a review of the evidence. *Clin. J. Pain*. 2008;24(6):469-478.

8. Cheatle MD, Savage SR. Informed consent in opioid therapy: a potential obligation and opportunity. *J. Pain. Symptom. Manage*. 2012;44(1):105-116.

9. Els C, Jackson TD, Kunyk D, et al. Adverse events associated with medium- and long-term use of opioids for chronic non-cancer pain: an overview of Cochrane Reviews. *Cochrane Database Syst. Rev*. 2017;10(10):CD012509.

10. McDonagh M, Selph S, Buckley D. *Nonopioid Pharmacologic Treatments for Chronic Pain*. Rockville (MD): Agency for Healthcare Research and Quality (US); 2020.

11. Pushpakom S, Iorio F, Eyers PA, et al. Drug repurposing: progress, challenges and recommendations. *Nat. Rev. Drug Discov*. 2019;18(1):41-58.

12. Nielsen C, Knudsen G, Steingrímsdóttir Ó. Twin studies of pain. *Clin. Genet*. 2012;82(4):331-340.

13. Abboud C, Duveau A, Bouali-Benazzouz R, et al. Animal models of pain: Diversity and benefits. *J. Neurosci. Methods*. 2021;348:108997.

14. Meng W, Adams MJ, Palmer CNA, et al. Genome-wide association study of knee pain identifies associations with GDF5 and COL27A1 in UK Biobank. *Commun. Biol*. 2019;2(1):321.

15. Meng W, Chan BW, Harris C, et al. A genome-wide association study finds genetic variants associated with neck or shoulder pain in UK Biobank. *Hum. Mol. Genet*. 2020;29(8):1396-1404.

16. Suri P, Palmer MR, Tsepilov YA, et al. Genome-wide meta-analysis of 158,000 individuals of European ancestry identifies three loci associated with chronic back pain. *PLOS Genet*. 2018;14(9):e1007601.

17. Freidin MB, Tsepilov YA, Palmer M, et al. Insight into the genetic architecture of back pain and its risk factors from a study of 509,000 individuals. *PAIN*. 2019;160(6):1361-1373.

18. Johnston KJA, Adams MJ, Nicholl BI, et al. Genome-wide association study of multisite chronic pain in UK Biobank. *PLOS Genet*. 2019;15(6):e1008164.

19. Johnston KJA, Ward J, Ray PR, et al. Sex-stratified genome-wide association study of multisite chronic pain in UK Biobank. *PLOS Genet*. 2021;17(4):e1009428.

20. Mocci E, Ward K, Dorsey SG, Ament SA. GWAS meta-analysis reveals dual neuronal and immunological etiology for pain susceptibility. *medRxiv*. Published online January 1, 2021:2021.08.23.21262510.

21. Rahman MS, Winsvold BS, Chavez Chavez SO, et al. Genome-wide association study identifies RNF123 locus as associated with chronic widespread musculoskeletal pain. *Ann. Rheum. Dis*. 2021;80(9):1227-1235.

22. Meng W, Adams MJ, Hebert HL, Deary IJ, McIntosh AM, Smith BH. A genome-wide association study finds genetic associations with broadly-defined headache in UK Biobank (N=223,773). *EBioMedicine*. 2018;28:180-186.

23. Boer CG, Hatzikotoulas K, Southam L, et al. Deciphering osteoarthritis genetics across 826,690 individuals from 9 populations. *Cell*. 2021;184(18):4784-4818.e17.

24. Zorina-Lichtenwalter K, Parisien M, Diatchenko L. Genetic studies of human neuropathic pain conditions: a review. *PAIN*. 2018;159(3):583-594.

25. Meng W, Adams MJ, Reel P, et al. Genetic correlations between pain phenotypes and depression and neuroticism. *Eur. J. Hum. Genet*. 2020;28(3):358-366.

26. Zorina-Lichtenwalter K, Bango CI, Van Oudenhove L, et al. Genetic risk shared across 24 chronic pain conditions: identification and characterization with genomic structural equation modeling. *PAIN*. 2023 Oct 1;164(10):2239-2252

27. Troiani V, Crist RC, Doyle GA, et al. Genetics and prescription opioid use (GaPO): study design for consenting a cohort from an existing biobank to identify clinical and genetic factors influencing prescription opioid use and abuse. *BMC Med Genomics*. 2021;14(1):253.

28. Gaziano JM, Concato J, Brophy M, et al. Million Veteran Program: A mega-biobank to study genetic influences on health and disease. *J. Clin. Epidemiol*. 2016;70:214-223.

29. Luther SL, Finch DK, Bouayad L, et al. Measuring pain care quality in the Veterans Health Administration primary care setting. *PAIN*. 2022;163(6).

30. Farrar JT. A consideration of differences in pain scales used in clinical trials. *PAIN*. 2022;163(12).

31. Euasobhon P, Atisook R, Bumrungchatudom K, Zinboonyahgoon N, Saisavoey N, Jensen MP. Reliability and responsivity of pain intensity scales in individuals with chronic pain. *PAIN*. 2022;163(12).

32. Meloto CB, Benavides R, Lichtenwalter RN, et al. Human pain genetics database: a resource dedicated to human pain genetics research. *PAIN*. 2018;159(4).

33. Sollis E, Mosaku A, Abid A, et al. The NHGRI-EBI GWAS Catalog: knowledgebase and deposition resource. *Nucleic Acids Res*. 2023;51(D1):D977-D985.

34. Yang C, Farias F, Ibanez L, et al. Genomic atlas of the proteome from brain, CSF and plasma prioritizes proteins implicated in neurological disorders. *Nat Neurosci.* **24**, 1302–1312 (2021)

35. Uffelmann E, Huang QQ, Munung NS, et al. Genome-wide association studies. *Nat. Rev. Methods Primers*. 2021;1(1):59.

36. Tsepilov YA, Freidin MB, Shadrina AS, et al. Analysis of genetically independent phenotypes identifies shared genetic factors associated with chronic musculoskeletal pain conditions. *Commun. Biol*. 2020;3(1):329.

37. Finan C, Gaulton A, Kruger FA, et al. The druggable genome and support for target identification and validation in drug development. *Sci. Transl. Med*. 2017;9(383).

38. Valdes AM, Abhishek A, Muir K, Zhang W, Maciewicz RA, Doherty M. Association of Beta-Blocker Use With Less Prevalent Joint Pain and Lower Opioid Requirement in People With Osteoarthritis. *Arthritis Care Res. (Hoboken)*. 2017;69(7):1076-1081.

39. Nakafero G, Grainge MJ, Valdes AM, et al. β-blocker prescription is associated with lower cumulative risk of knee osteoarthritis and knee pain consultations in primary care: a propensity score-matched cohort study. *Rheumatology (Oxford)*. 2021;60(12):5686-5696.

40. Jackson JL, Cogbill E, Santana-Davila R, et al. A Comparative Effectiveness Meta-Analysis of Drugs for the Prophylaxis of Migraine Headache. *PLOS ONE*. 2015;10(7):e0130733.

41. Diatchenko L, Parisien M, Jahangiri Esfahani S, Mogil JS. Omics approaches to discover pathophysiological pathways contributing to human pain. *PAIN*. 2022;163(S1).

42. Mayr A, Jahn P, Stankewitz A, et al. Patients with chronic pain exhibit individually unique cortical signatures of pain encoding. *Hum. Brain Mapp*. 2022;43(5):1676-1693.

43. Lee JJ, Lee S, Lee DH, Woo CW. Functional brain reconfiguration during sustained pain. Ploner M, Behrens TE, Ploner M, Spisak T, eds. *eLife*. 2022;11:e74463.

44. Baliki MN, Chialvo DR, Geha PY, et al. Chronic Pain and the Emotional Brain: Specific Brain Activity Associated with Spontaneous Fluctuations of Intensity of Chronic Back Pain. *J Neurosci*. 2006;26(47):12165.

45. Bortsov AV, Parisien M, Khoury S, et al. Brain-specific genes contribute to chronic but not to acute back pain. *PAIN Rep*. 2022;7(5).

46. Khoury S, Parisien M, Thompson SJ, et al. Genome-wide analysis identifies impaired axonogenesis in chronic overlapping pain conditions. *Brain*. 2022;145(3):1111-1123.

47. Enna SJ, McCarson KE. The role of GABA in the mediation and perception of pain. *Adv. Pharmacol*. 2006;54:1-27.

48. Goudet C, Magnaghi V, Landry M, Nagy F, Gereau RW 4th, Pin JP. Metabotropic receptors for glutamate and GABA in pain. *Brain Res. Rev*. 2009;60(1):43-56.

49. Dong W, Jin SC, Allocco A, et al. Exome Sequencing Implicates Impaired GABA Signaling and Neuronal Ion Transport in Trigeminal Neuralgia. *iScience*. 2020;23(10):101552.

50. Xie L, Wu H, Chen Q, et al. Divergent modulation of pain and anxiety by GABAergic neurons in the ventrolateral periaqueductal gray and dorsal raphe. *Neuropsychopharmacology.* 48, 1509–1519 (2023)

51. Bridge H, Stagg CJ, Near J, Lau C ieong, Zisner A, Cader MZ. Altered neurochemical coupling in the occipital cortex in migraine with visual aura. *Cephalalgia*. 2015;35(11):1025-1030.

52. Foerster BR, Petrou M, Edden RAE, et al. Reduced insular γ-aminobutyric acid in fibromyalgia. *Arthritis Rheum*. 2012;64(2):579-583.

53. Wu X, Yuan J, Yang Y, et al. Elevated GABA level in the precuneus and its association with pain intensity in patients with postherpetic neuralgia: An initial proton magnetic resonance spectroscopy study. *Eur. J. Radiol*. 2022;157:110568.

54. Kang Y, Jiang X, Qin D, et al. Efficacy and safety of multiple dosages of fostamatinib in adult patients with rheumatoid arthritis: a systematic review and meta-analysis. *Front. Pharmacol*. 2019;10.

55. Flodin P, Martinsen S, Altawil R, et al. Intrinsic Brain Connectivity in Chronic Pain: A Resting-State fMRI Study in Patients with Rheumatoid Arthritis. *Front. Hum. Neurosci*. 2016;10.

56. Yang J, Hall JE, Jose PA, Chen K, Zeng C. Comprehensive insights in GRK4 and hypertension: From mechanisms to potential therapeutics. *Pharmacol. Ther*. 2022;239:108194.

57. Olsen RB, Bruehl S, Nielsen CS, Rosseland LA, Eggen AE, Stubhaug A. Hypertension prevalence and diminished blood pressure–related hypoalgesia in individuals reporting chronic pain in a general population: The Tromsø Study. *PAIN*. 2013;154(2).

58. Li CY, Lin WC, Lu CY, Chung YS, Cheng YC. Prevalence of pain in community-dwelling older adults with hypertension in the United States. *Sci. Rep*. 2022;12(1):8387.

59. Geisheker MR, Heymann G, Wang T, et al. Hotspots of missense mutation identify neurodevelopmental disorder genes and functional domains. *Nat. Neurosci*. 2017;20(8):1043-1051.

60. Ismail V, Zachariassen LG, Godwin A, et al. Identification and functional evaluation of GRIA1 missense and truncation variants in individuals with ID: An emerging neurodevelopmental syndrome. *Am. J. Hum. Genet*. 2022;109(7):1217-1241.

61. Aranke M, Pham CT, Yilmaz M, et al. Topical Sevoflurane: A Novel Treatment for Chronic Pain Caused by Venous Stasis Ulcers. *Anesth. Pain Med*. 2021;11(1):e112832.

62. Finnerup NB, Attal N, Haroutounian S, et al. Pharmacotherapy for neuropathic pain in adults: a systematic review and meta-analysis. *Lancet Neurol*. 2015;14(2):162-173.

63. Khan JS, Hah JM, Mackey SC. Effects of smoking on patients with chronic pain: a propensity-weighted analysis on the Collaborative Health Outcomes Information Registry. *PAIN*. 2019;160(10).

64. Nicholas M, Vlaeyen JWS, Rief W, et al. The IASP classification of chronic pain for ICD-11: chronic primary pain. *PAIN*. 2019;160(1):28-37.

65. Goulet JL, Brandt C, Crystal S, et al. Agreement between electronic medical record-based and self-administered pain numeric rating scale: clinical and research implications. *Med. Care*. 2013;51(3):245-250.

Methods

Overview of analyses

We conducted ancestry-specific GWASs of pain scores using an 11-point ordinal NRS in a) all AAs, EAs, and HAs with pain ratings from the MVP, b) a subset of these participants that excluded those with a lifetime OUD diagnosis, c) a subset of participants that excluded those with pain ratings = 0 and d) males and females separately (sex-stratified), each followed by a cross-ancestry meta-analysis. Details on phenotyping are provided below. Downstream analyses are based principally on the GWAS of pain scores in the full sample, complemented by the estimated heritability and genetic correlations (r_gs) for the sample exclusive of participants with OUD and stratified by sex.

Million Veteran Program cohort

The MVP[28] is an EHR-based cohort comprising >900,000 veterans recruited at 63 VA medical centers nationwide. All participants provided written informed consent, a blood sample for DNA extraction and genotyping, and approval to securely access their EHR for research purposes. The protocol and consent were approved by the Central Veterans Affairs Institutional Review Board (IRB) and all site-specific IRBs. All relevant guidelines for work with human participants were followed in the conduct of the study.

Phenotype description

As early as 2000, the VA recommended using the NRS to routinely measure pain in clinical practice as a "fifth vital sign"[66]. Since that time, veterans have been asked to rate their pain severity in response to the question: "Are you in pain?" They then rated their current pain on a scale of 0-10 where "0 is no pain and 10 is the worst pain imaginable". Participants had at least one inpatient or outpatient pain rating in the EHR. We included 598,339 individuals with 76,798,104 NRS scores (median number of scores = 109, IQR = 28 – 351) in the primary GWAS. To reduce the large number of pain observations, we calculated the median pain score by year for each participant and the median of the annual median pain scores. In a secondary GWAS we excluded individuals with a documented ICD-9/10 diagnosis code for OUD in the EHR, yielding a total of 566,959 study participants. Demographic characteristics for the secondary analysis sample are presented in Supplementary Table 1.

Genotyping and imputation

DNA samples were genotyped on the Affymetrix Axiom Biobank Array (MVP Release 4). For genotyped SNPs, standard quality control (QC) and subsequent imputation were implemented. Full details about SNP and sample QC by the MVP Genomics Working Group are published[67]. Briefly, DNA samples were removed for sex mismatch, having seven or more relatives in MVP (kinship > 0.08), excessive heterozygosity, or genotype call rate < 98.5%. Variants were removed if they were monomorphic, had a high degree of missingness (call rate < 0.8) or a Hardy–Weinberg equilibrium (HWE) threshold of $P < 1 \times 10^{-6}$ both in the entire sample using a principal-component analysis (PCA)-adjusted method and within one of the three major ancestral groups (AA, EA and HA).

Genotype phasing and imputation were performed using SHAPEIT4 (v.4.1.3)[68] and Minimac4 software[69], respectively. Biallelic SNPs were imputed using the African Genome Resources reference panel by the Sanger Institute (comprising all samples from the 1000 Genomes Project phase 3, version 5 reference panel[70], and 1,500 unrelated pan-African samples). Non-biallelic SNPs and indels were imputed in a secondary imputation step using the 1000 Genomes Project phase 3, version 5 reference panel[70], with indels and complex variants from the second imputation merged into the African Genome Resources imputation.

We randomly removed one individual from each pair of related individuals (kinship > 0.08, N = 31,010). The HARE method[71] was used to classify subjects into major ancestral groups (AA = 112,968, EA = 436,683, HA = 48,688) and QC of imputed variants was performed within each ancestral group. Additional QC steps were carried out for the X-chromosome (chrX) analysis to reduce the risk of false-positive associations from sex-specific genotyping errors. For this, we excluded variants in pseudo-autosomal regions based on excessive heterozygosity rates. For both autosomal and chrX analysis, SNPs with imputation quality (INFO) score < 0.7; minor allele frequency (MAF) in AAs < 0.005, EAs < 0.001, and HAs < 0. 01; a genotype call rate < 0.95; or an HWE $P < 1 \times 10^{-6}$ were excluded.

Association analyses and risk locus definition

Genome-wide association testing was based on a linear regression model using PLINK (v.2.0)[72] and was adjusted for sex, mean age of assessment, and the first 10 within-ancestry genetic principal components (PCs). For the chrX association analysis, we implemented a standard linear regression model using PLINK assuming x-inactivation (males were coded as 0/2, females as 0/1/2), adjusting for mean age of assessment and the first 10 PCs. Both autosomal and chrX analysis was performed within

ancestry groups in (a) all participants and (b) in males and females separately. Due to substantial differences in sample size across ancestral groups, meta-analyses were performed using a sample-size weighted method in METAL[73]. Variants with $P < 5 \times 10^{-8}$ were considered genome-wide significant (GWS). Because the LD intercept (1.1, se = 0.01) and attenuation ratio (0.13, se = 0.01) of the LDSC showed minimal evidence of inflation or confounding, suggesting that none of the GWS lead SNPs showed evidence of heterogeneity across ancestries, we did not select the genomic control option in METAL.

To identify risk loci and their lead variants, we performed LD clumping in FUMA[74] at a range of 3,000 kb, $r^2 > 0.1$, and the respective ancestry 1000 Genomes reference panel[70]. Following clumping, genomic risk loci within 1 Mb of one another were incorporated into the same locus. We used GCTA COJO[75] to define independent variants by conditioning them on the most significant variant within the locus. After conditioning, significant variants ($P < 5 \times 10^{-8}$) were considered independently associated. We performed a sign test to compare the direction of SNP effects across individual ancestral datasets. Independent lead variants in EAs were examined in AAs and HAs and a binomial test used to evaluate the null hypothesis that 50% of variants have the same effect direction across ancestries. For lead SNPs in EAs that were absent in AAs and HAs, we considered proxy GWS SNPs ($p < 5\times10^{-8}$) in high LD with the EA lead variant ($r^2 \geq 0.8$).

To prioritize credible sets of variants driving our GWAS results, we used FINEMAP[76] to fine-map regions defined by LD clumps ($r^2 > 0.1$). Because fine-mapping requires data from all markers in the region of interest[77], we merged LD clumps that physically overlapped (within a 1-MB window of the lead variant) and excluded SNPs in the major histocompatibility complex (MHC) region due to its complexity. FINEMAP credible set reports the likelihood of causality using the marginal posterior probability (PP), which ranges from 0 to 1, with values closer to 1 being most likely causal.

SNP-based heritability and functional enrichment

We used the linkage disequilibrium score (LDSC) regression[78] method to estimate the SNP-based heritability (h^2_{SNP}) of pain intensity (in both the full and supplementary samples) in all ancestry groups based on common SNPs in HapMap3[79]. To ensure matching of the population LD structure, pre-calculated LD scores for EAs were derived from the 1000 Genomes European reference population (version 3)[70] using LDSC[78]. In-sample LD scores for AAs and HAs were calculated from MVP AA and HA genotype data using cov-LDSC[80].

We used S-LDSC to partition the SNP heritability for pain intensity among EAs and explored the enrichment of the partitioned heritability by functional genomic categories[81,82] using three models: (a) a baseline-LD model that contains 75 overlapping annotations, including coding and regulatory regions of the genome and epigenomic features[81] (b) a specific tissue model that examines 10 overlapping cell-type groups derived from 220 cell-type-specific histone marks, including methylated histone H3 Lys4 (H3K4me1), trimethylated histone H3 Lys4 (H3K4me3), acetylated histones H3 Lys4 (H3K4ac) and H3K27ac[82] and (c) a multi-tissue model based on gene expression and chromatin datasets generated by GTEx[83] and the Roadmap Epigenomics Mapping Consortium[84]. For each model, we excluded multi-allelic and MHC region variants. Functional categories within each model were considered significantly enriched based on a Bonferroni-corrected *P* value.

Gene-set functional characterization

We applied multi-marker analysis of genomic annotation (MAGMA) v.1.08[85] in FUMA (v1.3.6a)[74] to identify genes and gene sets associated with the findings from the pain intensity GWAS and meta-analysis. Using the default setting in MAGMA, we mapped GWS SNPs to 18,702 protein-coding genes according to their physical position in NCBI build 37. We also used chromatin interaction (Hi-C) coupled MAGMA (H-MAGMA)[86] to assign non-coding (intergenic and intronic) SNPs to genes based on their chromatin interactions. H-MAGMA uses six Hi-C datasets derived from fetal brain, adult brain (N = 3), induced pluripotent stem cell (iPSC)-derived neurons and iPSC-derived astrocytes[87]. We applied a Bonferroni correction (MAGMA, α = 0.05/18,702; H-MAGMA, α = 0.05/293,157/6) to identify genes significantly associated with pain intensity, correcting for all genes tested in each analysis (see Supplementary Tables 15 and 21 for full lists).

To determine the plausible tissue enrichment of mapped genes, we integrated our cross-ancestry and EA GWAS results with gene expression data from 54 tissues (GTEx v8) in FUMA[74]. Next, we used FUMA to curate gene sets and Gene Ontology terms (from the Molecular Signature Database v.7.0[88]). We corrected for gene size, density of variants, and LD pattern between genes in each tissue (Bonferroni-corrected α = 0.05/54).

Enrichment for cell-type specific (CTS) transcriptomic profiles was performed in FUMA[74] using 13 human single-cell RNA-sequencing (sc-RNAseq) datasets derived from brain[89] (see Supplementary Table 14 for a detailed list). FUMA estimates CTS transcriptomic enrichment from the sc-RNAseq in three ways: (1) per selected dataset, (2) within datasets using a conditionally independent analysis (based on

stepwise conditional testing of *P* values for each cell type that passes Bonferroni correction within the same dataset), and (3) across datasets (testing for proportional significance across the results from step 2). Proportional significance (PS) reports the confidence level for observed cell type enrichment as low significance: < 0.5, jointly significant: 0.5 – 0.8; and independently significant: > 0.8. We considered CTS enrichments with conditional independent signals ($P < 0.05$) and PS > 0.5 to be driven by joint/independent genetic signals in our pain intensity GWAS results.

Transcriptomic and proteomic regulation

To identify genes and proteins whose expression is associated with pain intensity, we integrated EA GWAS results with human brain transcriptomic (eQTL, N = 452; and sQTL, N = 452)[83,90] and proteomic (N = 722)[91] data. We also obtained pretrained models of gene expression from GTEx v.8 for five brain tissues significantly enriched in MAGMA analyses – cerebellum, cerebellar hemisphere, cortex, frontal cortex, and anterior cingulate cortex[83]. Human brain transcriptomic and proteomic data for dorsolateral prefrontal cortex were derived from the study by Wingo et al[90]. Transcriptome-wide association study (TWAS) and proteome-wide association study (PWAS) analyses were performed using the FUSION pipeline[92] with Bonferroni correction ($\alpha = 0.05$/N genes tested) to account for multiple testing.

We used colocalization (coloc R package[93] in FUSION[92]) as our primary method to identify SNPs that mediate association with pain intensity through effects on gene and protein expression and a posterior colocalization probability (PP) of 80% to denote a shared causal signal. To test the robustness of the colocalized signals, we also performed summary-based Mendelian randomization (SMR) analyses[94]. We applied the HEIDI test[94] to filter out SMR signals ($P_{HEIDI} < 0.05$) due to linkage disequilibrium between pain-associated variants and eQTLs/sQTLs. Human brain cis-eQTL and cis-sQTL summary data were obtained from Qi et al[95] and GTEx[83]. For genomic regions containing multiple genes with significant SMR associations, we selected the top-associated cis-eQTL. We used Bonferroni correction to correct for multiple testing ($\alpha = 0.05$/N genes tested).

To explore the enrichment of causal genes and proteins in the dorsal root ganglia (DRG), we accessed human and mouse RNA-seq data from 13 tissues (6 neural and 7 non-neural) from the DRG sensoryomics repository[96]. The data contain relative gene abundances in standardized transcripts per million mapped reads and have been normalized to allow comparison across genes. The proportions of gene expression in the CNS (neural proportion score) and DRG (DRG enrichment score) in the context of

profiled tissues were calculated, as described in Ray et al[96]. Scores ranging from 0 to 1 were used to denote the strength of tissue enrichment.

Drug repurposing

We examined the drug repurposing status of genes in EAs (N = 156) with high causal probability from fine mapping and transcriptomic and proteomic analyses using the Druggable Genome database[37]. For completeness, we also included the significantly associated genes mapped to GWS variants and MAGMA results in AAs (N = 7) and HAs (N = 2). The Druggable Genome database contains 4,479 coding gene sets with the potential to be modulated by a drug-like small molecule based on their nucleotide sequence and structural similarity to targets of existing drugs[37]. This druggable genome was divided into three tiers. Tier 1 (N = 1,427) contains targets of licensed small molecules and biotherapeutic drugs (curated from the ChEMBL database[97]) and drugs in clinical development. Tier 2 (N = 682) includes targets with verified bioactive drug-like small molecule binding partners and > 50% identity with approved drug targets based on their nucleotide sequence. Tier 3 (N = 2,370) comprises targets or secreted proteins with more distant similarity with an approved drug and members of active protein complexes not included in Tiers 1 and 2. All causal genes and those reported in any of the three tiers of the Druggable Genome were also examined for interaction with prescription drug targets in clinical development using the Drug-Gene Interaction database (DGIdb)[98], which compiles clinical trial information from the FDA, PharmGKB, Therapeutic Target Database, and DrugBank databases, among others. We categorized each prescription drug identified using the Anatomical Therapeutic Chemical classification system, retrieved from the Kyoto Encyclopedia of Genes and Genomics (https://www.genome.jp/kegg/drug/).

Genetic correlation

We used LDSC[78] to calculate the r_g of pain intensity with (a) 89 other published pain, substance use, medication use, psychiatric, and anthropometric traits from EA datasets selected using prior epidemiological evidence and (b) 12 psychiatric, substance use, and anthropometric traits based on available AA GWAS summary data (see Supplementary Tables 24 and 26 for detailed lists). In EAs, all traits were tested using pre-computed LD scores for HapMap3[79], while in AAs, LD scores derived using cov-LDSC[80] from MVP AA genotype data were used. In a hypothesis-neutral manner, we also calculated r_gs of pain intensity with 1344 published and unpublished traits from the UKBB using the Complex Trait Virtual Lab (CTG-VL) (https://genoma.io/). CTG-VL is a free open-source platform that incorporates

publicly available GWAS data that allow for the calculation of r_g for complex traits using LDSC[99]. Each set of r_g analyses was Bonferroni corrected to control for multiple comparisons ($\alpha = 0.05$/number of traits tested).

We also estimated the cross-ancestry r_gs for pain intensity between AAs, EAs and HAs using Popcorn[100], a computational method that determines the correlation of causal-variant effect sizes at SNPs common across population groups using GWAS summary-level data and LD information. Ancestry-specific LD scores were derived from the 1000 Genomes reference population[70].

Polygenic risk score-based phenome-wide association studies

We calculated polygenic risk scores (PRS) for pain intensity and performed a PheWAS analysis in two samples – the Yale-Penn sample and the Penn Medicine Biobank (PMBB). The Yale-Penn sample[101] was deeply phenotyped using the Semi-Structured Assessment for Drug Dependence and Alcoholism (SSADDA), a comprehensive psychiatric instrument that assesses physical, psychosocial, and psychiatric aspects of SUDs and comorbid psychiatric traits[102,103]. As described in detail previously[101], genotyping was performed using the Illumina HumanOmni1-Quad microarray, the Illumina HumanCoreExome array, or the Illumina Multi-Ethnic Global array, followed by imputation using Minimac3[104] and the 1000 Genomes Project phase3 reference panel[70] implemented on the Michigan imputation server (https://imputationserver.sph.umich.edu). SNPs with imputation quality (INFO) score < 0.7, MAF < 0.01, missingness > 0.01, or an allele frequency difference between batches > 0.04; and individuals with genotype call rate < 0.95 and related individuals with pi-hat > 0.25 were excluded. PCs were used to determine genetic ancestry based on the 1000 Genomes Project phase3[70]. The resulting dataset included 4,922 AAs and 5,709 EAs.

The PMBB[105] is linked to EHR phenotypes. PMBB samples were genotyped with the GSA genotyping array. Genotype phasing was performed using EAGLE[104] and imputation was performed using Minimac3[104] on the TOPMed Imputation server[69]. Following QC (INFO< 0.3, missingness >0.95, MAF > 0.5, sample call rate > 0.9), PLINK 1.90 was used to identify and remove related individuals based on identity by descent (Pi-hat > 0.25). To estimate genetic ancestry, PCs were calculated using SNPs common to the PMBB and the 1000 Genomes Project phase3[70] and the smartpca module of the Eigensoft package (https://github.com/DReichLab/EIG). Participants were assigned to an ancestral group based on the distance of 10 PCs from the 1000 Genomes reference populations. The resulting dataset included 10,383 AAs and 29,355 EAs.

PRSs for pain intensity were calculated in the Yale-Penn and the PMBB datasets using PRS-Continuous shrinkage software (PRS-CS)[106], with the default setting used to estimate the shrinkage parameters and the random seed fixed to 1 for reproducibility. To identify associations between the pain intensity PRSs and phenotypes, we performed a PheWAS in each dataset by fitting logistic regression models for binary traits and linear regression models for continuous traits. Analyses were conducted using the PheWAS v0.12 R package[107] with adjustment for sex, age at enrollment (in PMBB) or at interview (in Yale-Penn) and the first 10 PCs within each genetic ancestry. We Bonferroni corrected each ancestry-specific analysis (Yale-Penn EAs and AAs: $P < 7.87 \times 10^{-5}$, PMBB EAs and AAs: $P < 3.65 \times 10^{-5}$).

Mendelian Randomization

We used two-sample Mendelian randomization[108] to evaluate causal associations between genetically correlated traits and pain intensity among EAs only because the two other population groups provided inadequate statistical power for the analysis. Of the 56 traits that showed significant r_g, we removed traits with phenotypic similarity across each of the tested r_g categories (Supplementary Table 31), selected traits with higher r_g and excluded traits without known biopsychosocial associations with pain. This left 16 traits for MR analysis. Instrumental variants (IVs) were SNPs associated with exposure at $P < 1 \times 10^{-5}$ and a clumping threshold of $r^2 = 0.01$.

To quantify the strength of IVs, we calculated the F-statistics of all genetic instruments using the per-allele effect size of SNP association with the phenotype (β) and standard error (SE) using the following formula[109,110]: F-statistic = $(\beta/SE)^2$. IVs with F-statistic estimates < 10 were considered weak instruments that could bias results[111]. We used Steiger's test[112] to determine whether the SNP-outcome correlation is greater than the SNP-exposure correlation. SNPs that fail Steiger's test may not be primarily associated with the exposure (Steiger $P > 0.05$) and were filtered out before MR analysis. Because pleiotropy can bias MR findings[113], we investigated its possible presence by assessing heterogeneity in the MR estimates across SNPs, using the I^2 index and the Cochran's Q heterogeneity test[114]. Finally, MR-Egger intercepts were used to access the bias due to weak IVs and the possibility of horizontal pleiotropy. Potential causal effects were those for which at least two MR tests were significant after multiple correction ($P = 3.13 \times 10^{-3}$, 0.05/16) and did not violate the assumption of horizontal pleiotropy (MR-Egger intercept $P > 0.05$).

Data Availability. The cross-ancestry and within-ancestry GWAS and meta-analysis summary-level association data will be available in dbGaP (https://www.ncbi.nlm.nih.gov/gap/) under accession phs001672 "Veterans Administration (VA) Million Veteran Program (MVP) Summary Results from Omics Studies". Registration and approval are needed following dbGaP's data access process.

Code Availability. Imputation was performed in the MVP using SHAPEIT4 (https://odelaneau.github.io/shapeit4/) and Minimac4 (https://genome.sph.umich.edu/wiki/Minimac4). GWAS was performed using PLINK2 (https://www.cog-genomics.org/plink2). Meta-analyses were performed using METAL (https://genome.sph.umich.edu/wiki/METAL_Documentation). GCTA-COJO (https://cnsgenomics.com/software/gcta/#Overview) was used for identification of independent loci. FINEMAP (http://www.christianbenner.com/) was used to fine-map genomic risk loci. FUMA (https://fuma.ctglab.nl/) was used for gene association, functional enrichment, and gene-set enrichment analyses. Transcriptomic and proteomic analyses were performed using FUSION (https://github.com/gusevlab/fusion_twas). Validation of transcriptomic analyses was performed using SMR (https://yanglab.westlake.edu.cn/software/smr/#Overview). Chromatin accessibility analyses were performed using H-MAGMA (https://github.com/thewonlab/H-MAGMA). LDSC (https://github.com/bulik/ldsc) was used for heritability estimation, genetic correlation analysis (also using the CTG-VL; https://genoma.io) and heritability enrichment analyses. Trans-ancestry genetic correlation was estimated using Popcorn (https://github.com/brielin/Popcorn). Genotyping and sample QC in the PMBB was performed using PLINK1.9 (https://www.cog-genomics.org/plink/). Genotype phasing and imputation in Yale-Penn and PMBB was performed using Minimac3 (https://genome.sph.umich.edu/wiki/Minimac3). Genetic ancestry in PMBB was estimated using Eigensoft (https://github.com/DReichLab/EIG). PRS analyses were performed using PRS-CS (https://github.com/getian107/PRScs). PheWAS analyses were run using the PheWAS R package (https://github.com/PheWAS/PheWAS). The MendelianRandomization R package (https://cran.r-project.org/web/packages/MendelianRandomization/index.html) was used for MR analyses.

References

66. Department of Veterans Affairs. Pain Management - VHA Directive 2009-053. Published online October 28, 2009.

67. Hunter-Zinck H, Shi Y, Li M, et al. Genotyping Array Design and Data Quality Control in the Million Veteran Program. *Am. J. Hum. Genet*. 2020;106(4):535-548.

68. Delaneau O, Zagury JF, Robinson MR, Marchini JL, Dermitzakis ET. Accurate, scalable and integrative haplotype estimation. *Nat. Commun*. 2019;10(1):5436.

69. Das S, Forer L, Schönherr S, et al. Next-generation genotype imputation service and methods. *Nat. Genet*. 2016;48(10):1284-1287.

70. Auton A, Abecasis GR, Altshuler DM, et al. A global reference for human genetic variation. *Nature*. 2015;526(7571):68-74.

71. Fang H, Hui Q, Lynch J, et al. Harmonizing Genetic Ancestry and Self-identified Race/Ethnicity in Genome-wide Association Studies. *Am. J. Hum. Genet*. 2019;105(4):763-772.

72. Chang CC, Chow CC, Tellier LC, Vattikuti S, Purcell SM, Lee JJ. Second-generation PLINK: rising to the challenge of larger and richer datasets. *GigaScience*. 2015;4(1):s13742-015-0047-0048.

73. Willer CJ, Li Y, Abecasis GR. METAL: fast and efficient meta-analysis of genomewide association scans. *Bioinformatics*. 2010;26(17):2190-2191.

74. Watanabe K, Taskesen E, van Bochoven A, Posthuma D. Functional mapping and annotation of genetic associations with FUMA. *Nat. Commun*. 2017;8(1):1826.

75. Yang J, Lee SH, Goddard ME, Visscher PM. GCTA: a tool for genome-wide complex trait analysis. *Am. J. Hum. Genet*. 2011;88(1):76-82.

76. Benner C, Spencer CCA, Havulinna AS, Salomaa V, Ripatti S, Pirinen M. FINEMAP: efficient variable selection using summary data from genome-wide association studies. *Bioinformatics*. 2016;32(10):1493-1501.

77. Benner C, Havulinna AS, Järvelin MR, Salomaa V, Ripatti S, Pirinen M. Prospects of Fine-Mapping Trait-Associated Genomic Regions by Using Summary Statistics from Genome-wide Association Studies. *Am. J. Hum. Genet*. 2017;101(4):539-551.

78. Bulik-Sullivan BK, Loh PR, Finucane HK, et al. LD Score regression distinguishes confounding from polygenicity in genome-wide association studies. *Nat. Genet*. 2015;47(3):291-295.

79. Altshuler DM, Gibbs RA, Peltonen L, et al. Integrating common and rare genetic variation in diverse human populations. *Nature*. 2010;467(7311):52-58.

80. Luo Y, Li X, Wang X, et al. Estimating heritability and its enrichment in tissue-specific gene sets in admixed populations. *Hum. Mol. Genet*. 2021;30(16):1521-1534.

81. Finucane HK, Bulik-Sullivan B, Gusev A, et al. Partitioning heritability by functional annotation using genome-wide association summary statistics. *Nat. Genet*. 2015;47(11):1228-1235.

82. Finucane HK, Reshef YA, Anttila V, et al. Heritability enrichment of specifically expressed genes identifies disease-relevant tissues and cell types. *Nat. Genet*. 2018;50(4):621-629.

83. The GTEx consortium, Aguet François, Anand Shankara, et al. The GTEx Consortium atlas of genetic regulatory effects across human tissues. *Science*. 2020;369(6509):1318-1330.

84. Bernstein BE, Stamatoyannopoulos JA, Costello JF, et al. The NIH Roadmap Epigenomics Mapping Consortium. *Nat. Biotechnol*. 2010;28(10):1045-1048.

85. de Leeuw CA, Mooij JM, Heskes T, Posthuma D. MAGMA: Generalized Gene-Set Analysis of GWAS Data. *PLOS Computat. Biol*. 2015;11(4):e1004219.

86. Sey NYA, Hu B, Mah W, et al. A computational tool (H-MAGMA) for improved prediction of brain-disorder risk genes by incorporating brain chromatin interaction profiles. *Nat. Neurosci*. 2020;23(4):583-593.

87. Rajarajan P, Borrman T, Liao W, et al. Neuron-specific signatures in the chromosomal connectome associated with schizophrenia risk. *Science*. 2018;362(6420).

88. Liberzon A, Birger C, Thorvaldsdóttir H, Ghandi M, Mesirov JP, Tamayo P. The Molecular Signatures Database (MSigDB) hallmark gene set collection. *Cell Syst*. 2015;1(6):417-425.

89. Watanabe K, Umićević Mirkov M, de Leeuw CA, van den Heuvel MP, Posthuma D. Genetic mapping of cell type specificity for complex traits. *Nat. Commun*. 2019;10(1):3222.

90. Fromer M, Roussos P, Sieberts SK, et al. Gene expression elucidates functional impact of polygenic risk for schizophrenia. *Nat. Neurosci*. 2016;19(11):1442-1453.

91. Wingo TS, Liu Y, Gerasimov ES, et al. Shared mechanisms across the major psychiatric and neurodegenerative diseases. *Nat. Commun*. 2022;13(1):4314.

92. Gusev A, Ko A, Shi H, et al. Integrative approaches for large-scale transcriptome-wide association studies. *Nat. Genet*. 2016;48(3):245-252.

93. Giambartolomei C, Vukcevic D, Schadt EE, et al. Bayesian test for colocalisation between pairs of genetic association studies using summary statistics. *PLOS Genet*. 2014;10(5):e1004383.

94. Zhu Z, Zhang F, Hu H, et al. Integration of summary data from GWAS and eQTL studies predicts complex trait gene targets. *Nat. Genet*. 2016;48(5):481-487.

95. Qi T, Wu Y, Fang H, et al. Genetic control of RNA splicing and its distinct role in complex trait variation. *Nat. Genet*. 2022;54(9):1355-1363.

96. Ray P, Torck A, Quigley L, et al. Comparative transcriptome profiling of the human and mouse dorsal root ganglia: an RNA-seq–based resource for pain and sensory neuroscience research. *PAIN*. 2018;159(7).

97. Gaulton A, Bellis LJ, Bento AP, et al. ChEMBL: a large-scale bioactivity database for drug discovery. *Nucleic Acids Res*. 2012;40(Database issue):D1100-1107.

98. Cotto KC, Wagner AH, Feng YY, et al. DGIdb 3.0: a redesign and expansion of the drug–gene interaction database. *Nucleic Acids Res*. 2018;46(D1):D1068-D1073.

99. Cuéllar-Partida G, Lundberg M, Kho PF, et al. Complex-Traits Genetics Virtual Lab: A community-driven web platform for post-GWAS analyses. *bioRxiv*. Published online January 1, 2019:518027.

100. Brown BC, Ye CJ, Price AL, Zaitlen N. Transethnic genetic-correlation estimates from summary statistics. *Am. J. Hum. Genet*. 2016;99(1):76-88.

101. Kember RL, Hartwell EE, Xu H, et al. Phenome-wide Association Analysis of Substance Use Disorders in a Deeply Phenotyped Sample. *Biol. Psychiatry*. 2023 Mar 15;93(6):536-545.

102. Pierucci-Lagha A, Gelernter J, Feinn R, et al. Diagnostic reliability of the Semi-structured Assessment for Drug Dependence and Alcoholism (SSADDA). *Drug Alcohol Depend*. 2005;80(3):303-312.

103. Pierucci-Lagha A, Gelernter J, Chan G, et al. Reliability of DSM-IV diagnostic criteria using the semi-structured assessment for drug dependence and alcoholism (SSADDA). *Drug Alcohol Depend*. 2007;91(1):85-90.

104. Fuchsberger C, Abecasis GR, Hinds DA. minimac2: faster genotype imputation. *Bioinformatics*. 2015;31(5):782-784.

105. Verma A, Damrauer SM, Naseer N, et al. The Penn Medicine BioBank: Towards a Genomics-Enabled Learning Healthcare System to Accelerate Precision Medicine in a Diverse Population. *J. Pers. Med*. 2022;12(12).

106. Ge T, Chen CY, Ni Y, Feng YCA, Smoller JW. Polygenic prediction via Bayesian regression and continuous shrinkage priors. *Nat. Commun*. 2019;10(1):1776.

107. Denny JC, Ritchie MD, Basford MA, et al. PheWAS: demonstrating the feasibility of a phenome-wide scan to discover gene–disease associations. *Bioinformatics*. 2010;26(9):1205-1210.

108. Hemani G, Zheng J, Elsworth B, et al. The MR-Base platform supports systematic causal inference across the human phenome. *eLife*. 2018;7.

109. Hayes BL, Vabistsevits M, Martin RM, Lawlor DA, Richmond RC, Robinson T. Establishing causal relationships between sleep and adiposity traits using Mendelian randomization. *Obesity*. 2023;31(3):861-870.

110. Xiao G, Wang H, Hu J, et al. Estimating the causal effect of frailty index on vestibular disorders: A two-sample Mendelian randomization. *Front. Neurosci*. 2022;16.

111. Palmer TM, Lawlor DA, Harbord RM, et al. Using multiple genetic variants as instrumental variables for modifiable risk factors. *Stat Methods Med Res*. 2012;21(3):223-242.

112. Hemani G, Tilling K, Davey Smith G. Orienting the causal relationship between imprecisely measured traits using GWAS summary data. *PLOS Genet*. 2017;13(11):e1007081.

113. Sheehan NA, Didelez V, Burton PR, Tobin MD. Mendelian Randomisation and Causal Inference in Observational Epidemiology. *PLOS Med*. 2008;5(8):e177.

114. Greco M FD, Minelli C, Sheehan NA, Thompson JR. Detecting pleiotropy in Mendelian randomisation studies with summary data and a continuous outcome. *Stat Med*. 2015;34(21):2926-2940.

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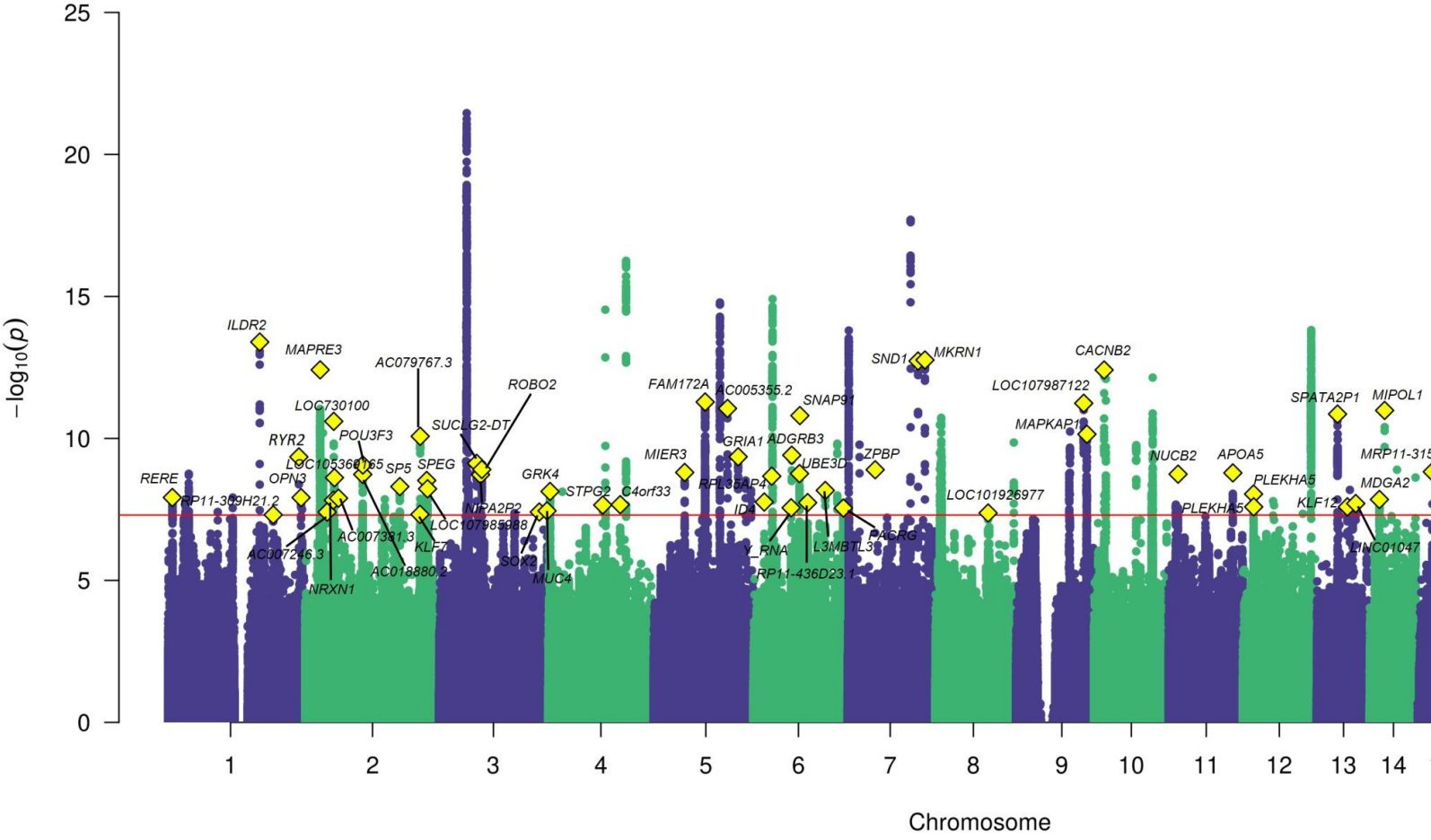
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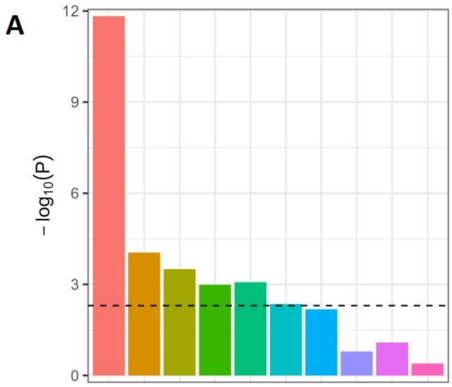
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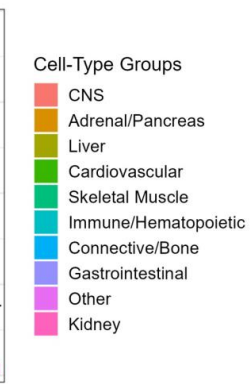
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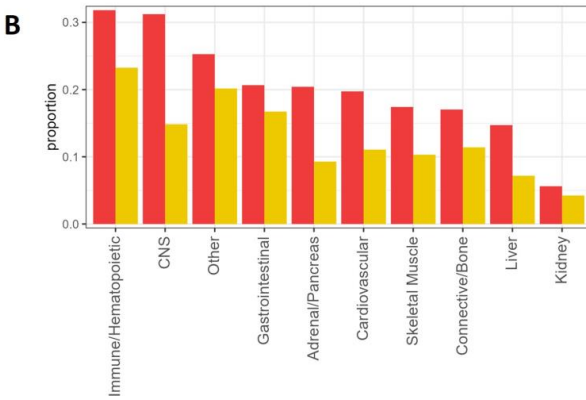
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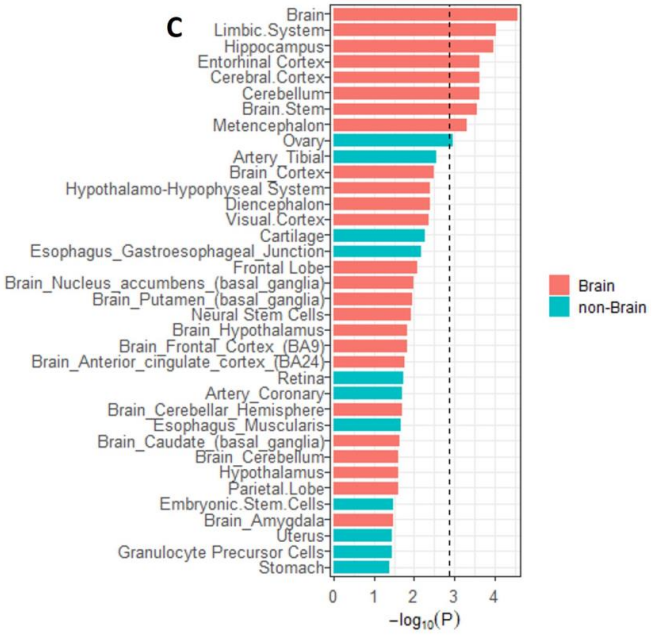
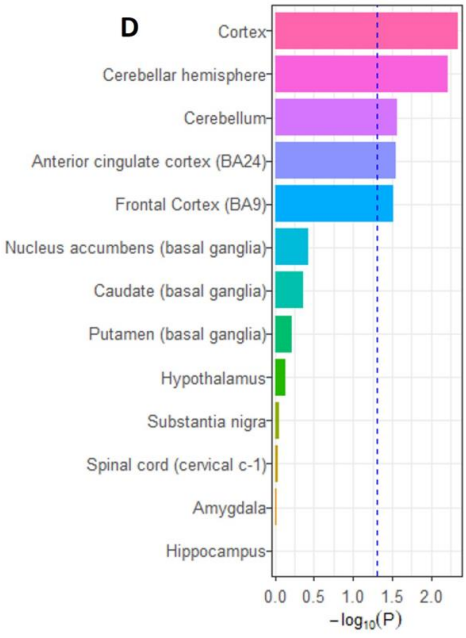
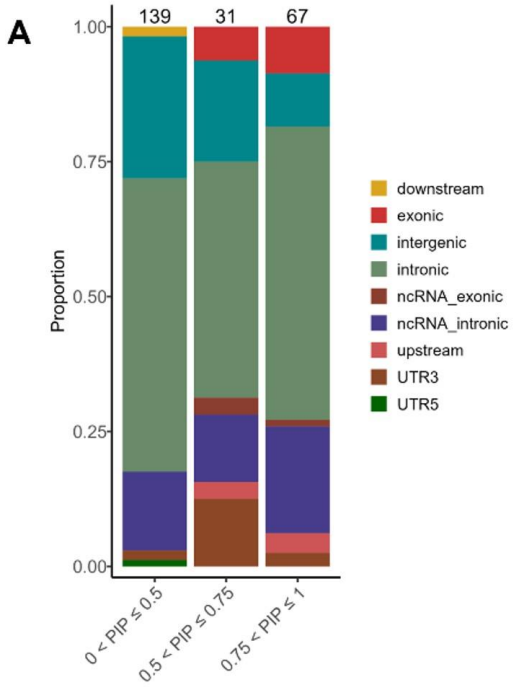
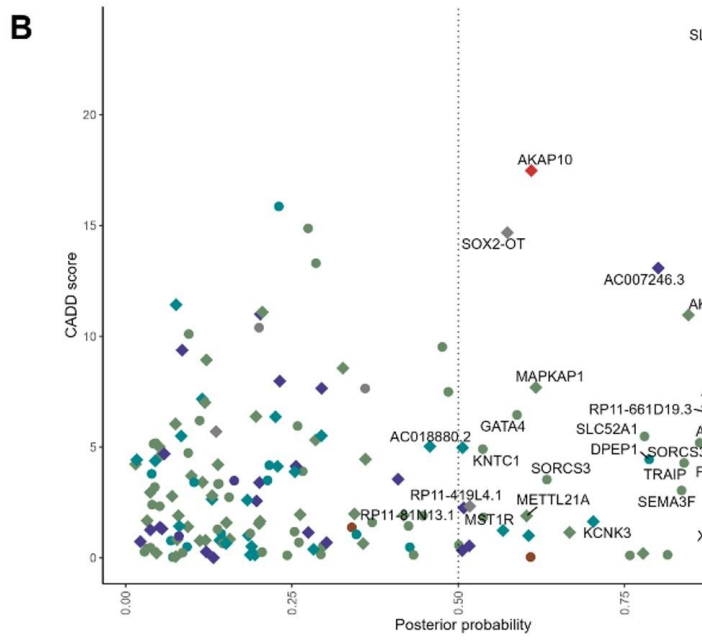
Connective/Bone
Liver
Kidney

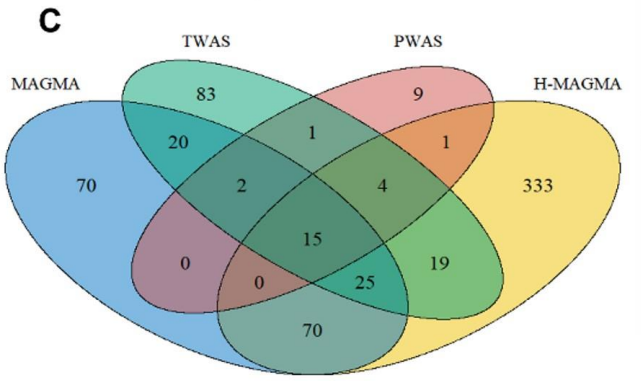

C
Brain
Limbic.System
Hippocampus
Entorhinal.Cortex
Cerebral.Cortex
Cerebellum
Brain.Stem
Metencephalon
Ovary
Artery_Tibial
Brain_Cortex
Hypothalamo-Hypophyseal System
Diencephalon
Visual.Cortex
Cartilage
Esophagus_Gastroesophageal_Junction
Frontal Lobe
Brain_Nucleus_accumbens_(basal_ganglia)
Brain_Putamen_(basal_ganglia)
Neural Stem Cells
Brain_Hypothalamus
Brain_Frontal_Cortex_(BA9)
Brain_Anterior_cingulate_cortex_(BA24)
Retina
Artery_Coronary
Brain_Cerebellar_Hemisphere
Esophagus_Muscularis
Brain_Caudate_(basal_ganglia)
Brain_Cerebellum
Hypothalamus
Parietal.Lobe
Embryonic.Stem.Cells
Brain_Amygdala
Uterus
Granulocyte Precursor Cells
Stomach
0 1 2 3 4
$-\log_{10}(P)$
Brain
non-Brain

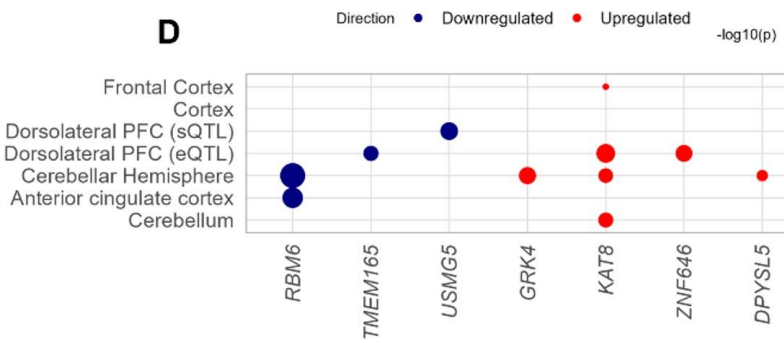

D
Cortex
Cerebellar hemisphere
Cerebellum
Anterior cingulate cortex (BA24)
Frontal Cortex (BA9)
Nucleus accumbens (basal ganglia)
Caudate (basal ganglia)
Putamen (basal ganglia)
Hypothalamus
Substantia nigra
Spinal cord (cervical c-1)
Amygdala
Hippocampus
0.0 0.5 1.0 1.5 2.0
$-\log_{10}(P)$

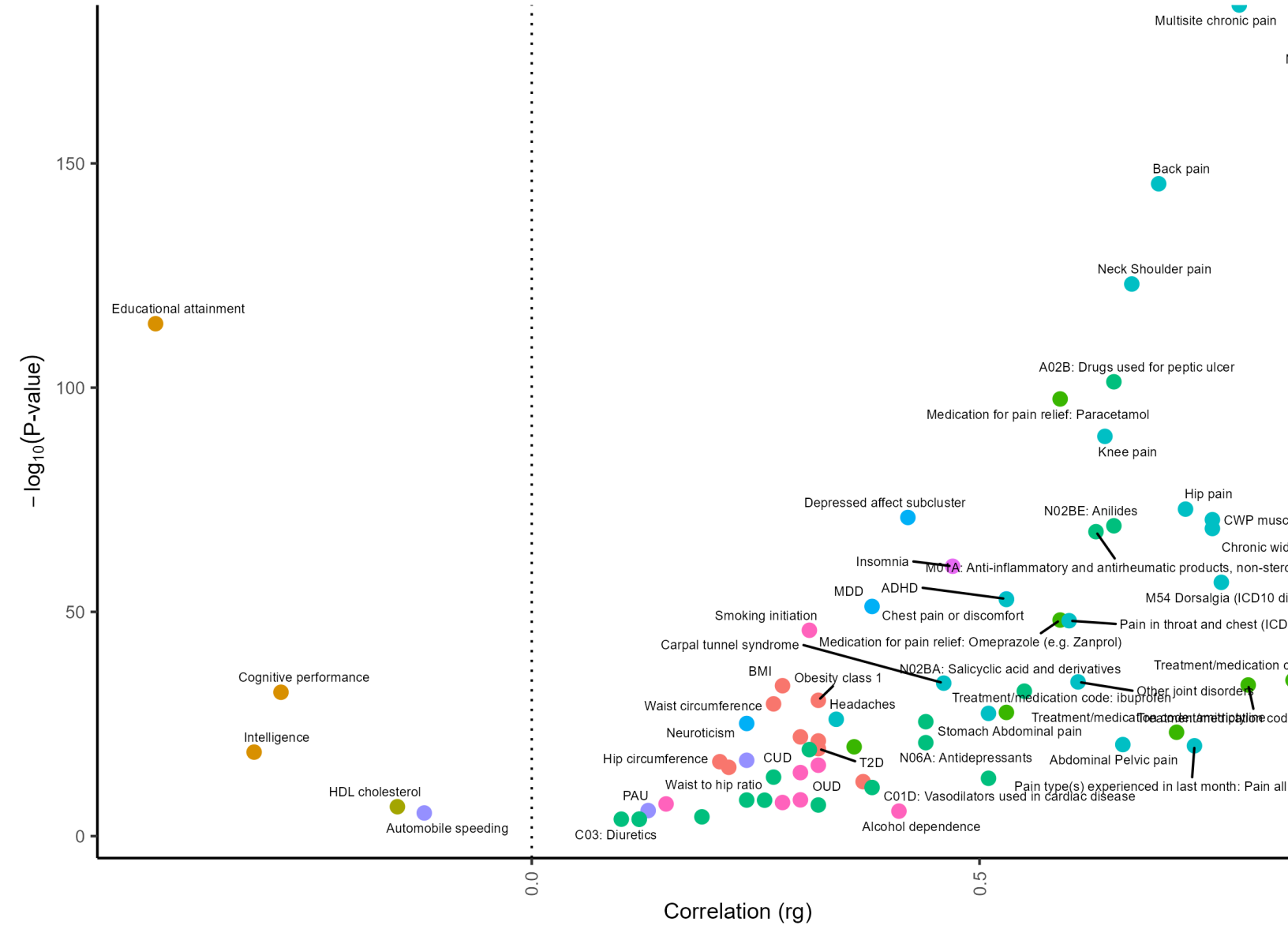

E
Fetal Brain Fe
Fetal Bra
Fetal Brain
Dorsolateral Prefrontal Co
Fetal Brain
Inferior Temporal
Angular G
Fetal Brain Fe
Germinal M
Anterior Cau
Dorsolateral Prefrontal C
Anterior Ca
Inferior Temporal L
Angular
Dorsolateral Prefrontal Co
Anterior Cau
Dorsolateral Prefrontal Co
Cingulate
Cingulate G
Inferior Tempora
Germinal M
Angular Gy
Colon-Sigm EN
Angular Gy
Cortex derived primary cultured neurosphe
Fetal Brain Fem
Cingulate Gy
Ganglion Eminence derived primary cultured neurosphe
Pancreatic Is
Anterior Cau
Dorsolateral Prefrontal Cor
Ganglion Eminence derived primary cultured neurosphe
Testis EN

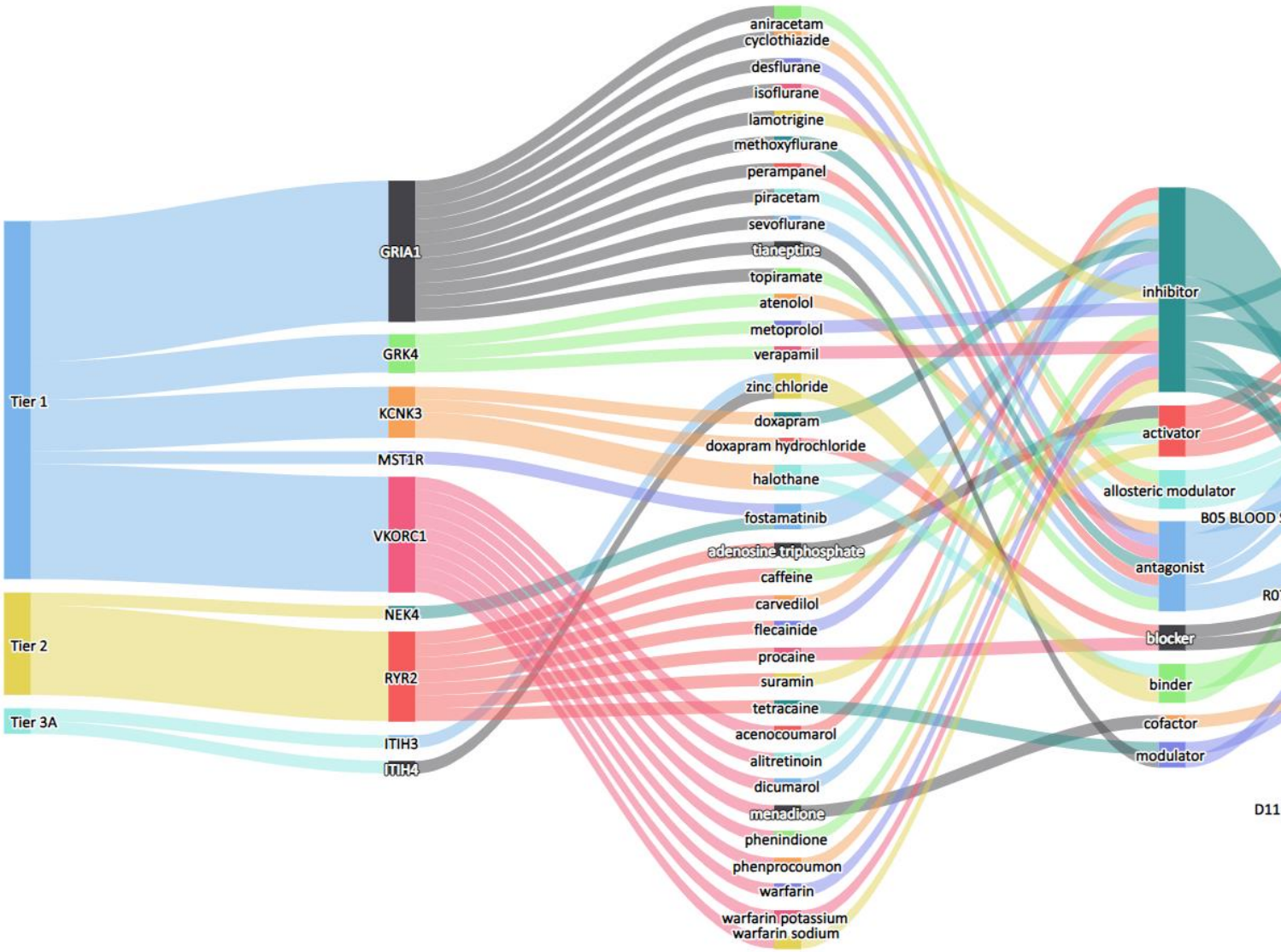

A
139
31
67
1.00
0.75
0.50
0.25
0.00
Proportion
0 < PIP ≤ 0.5
0.5 < PIP ≤ 0.75
0.75 < PIP ≤ 1
downstream
exonic
intergenic
intronic
ncRNA_exonic
ncRNA_intronic
upstream
UTR3
UTR5

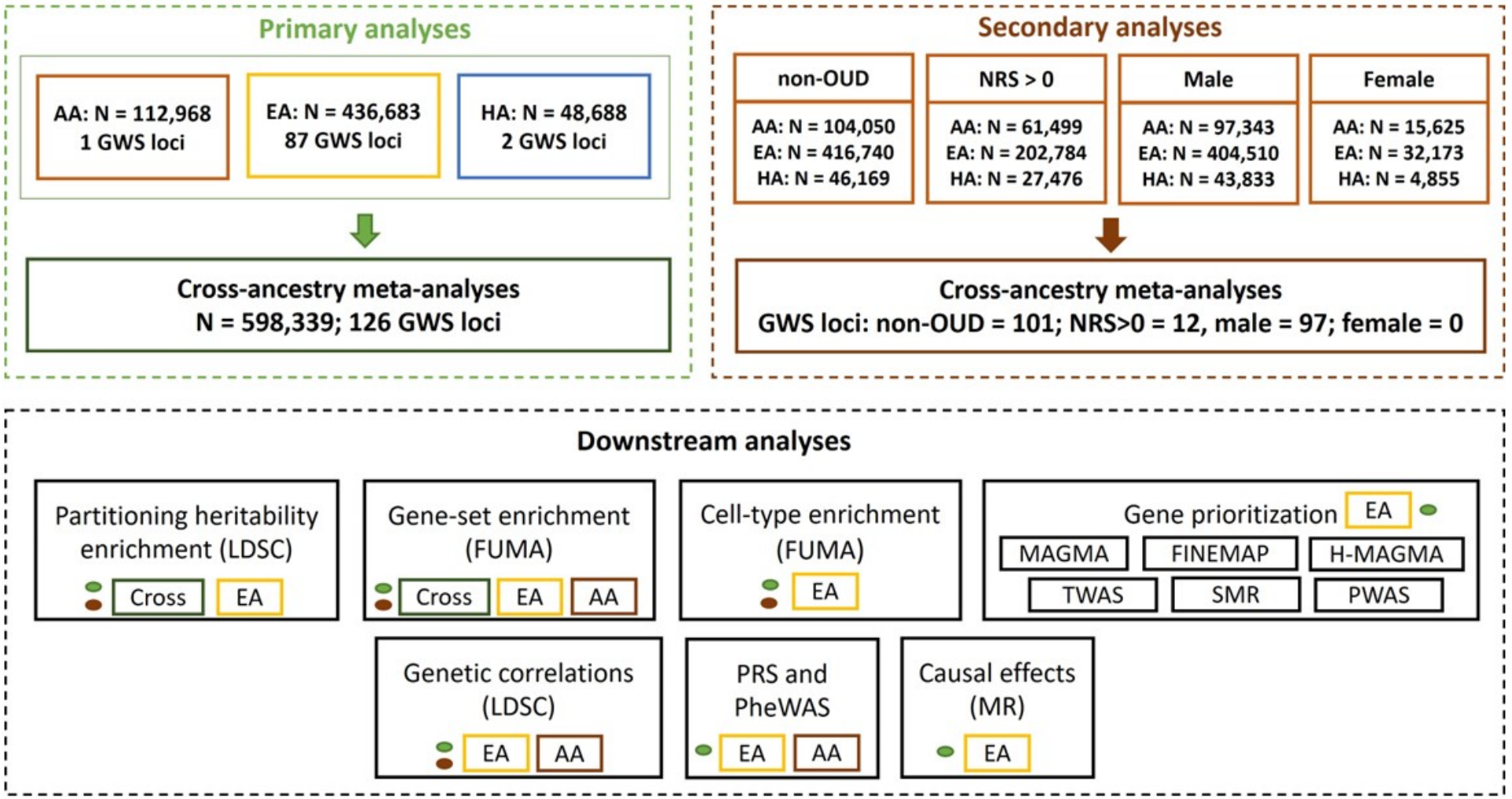

B
CADD score
Posterior probability
AKAP10
SOX2-OT
AC007246.3
MAPKAP1
RP11-661D19.3
GATA4
SLC52A1
AC018880.2
DPEP1
KNTC1
SORCS3
TRAIP
RP11-419L4.1
METTL21A
SEMA3F
RP11-61N13.1
MST1R
KCNK3

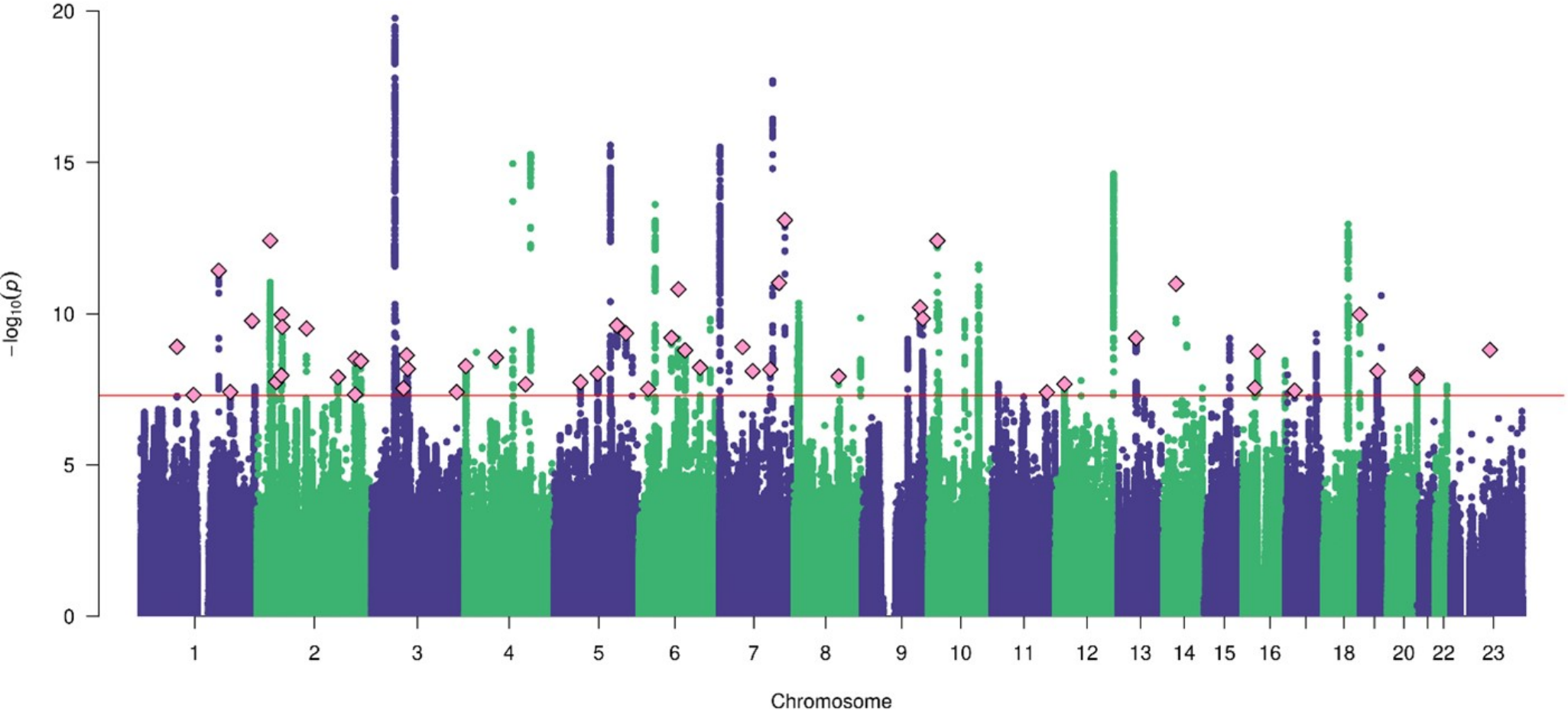

C
MAGMA
TWAS
PWAS
H-MAGMA
70
83
9
333
20
1
1
2
4
15
0
0
25
19
70

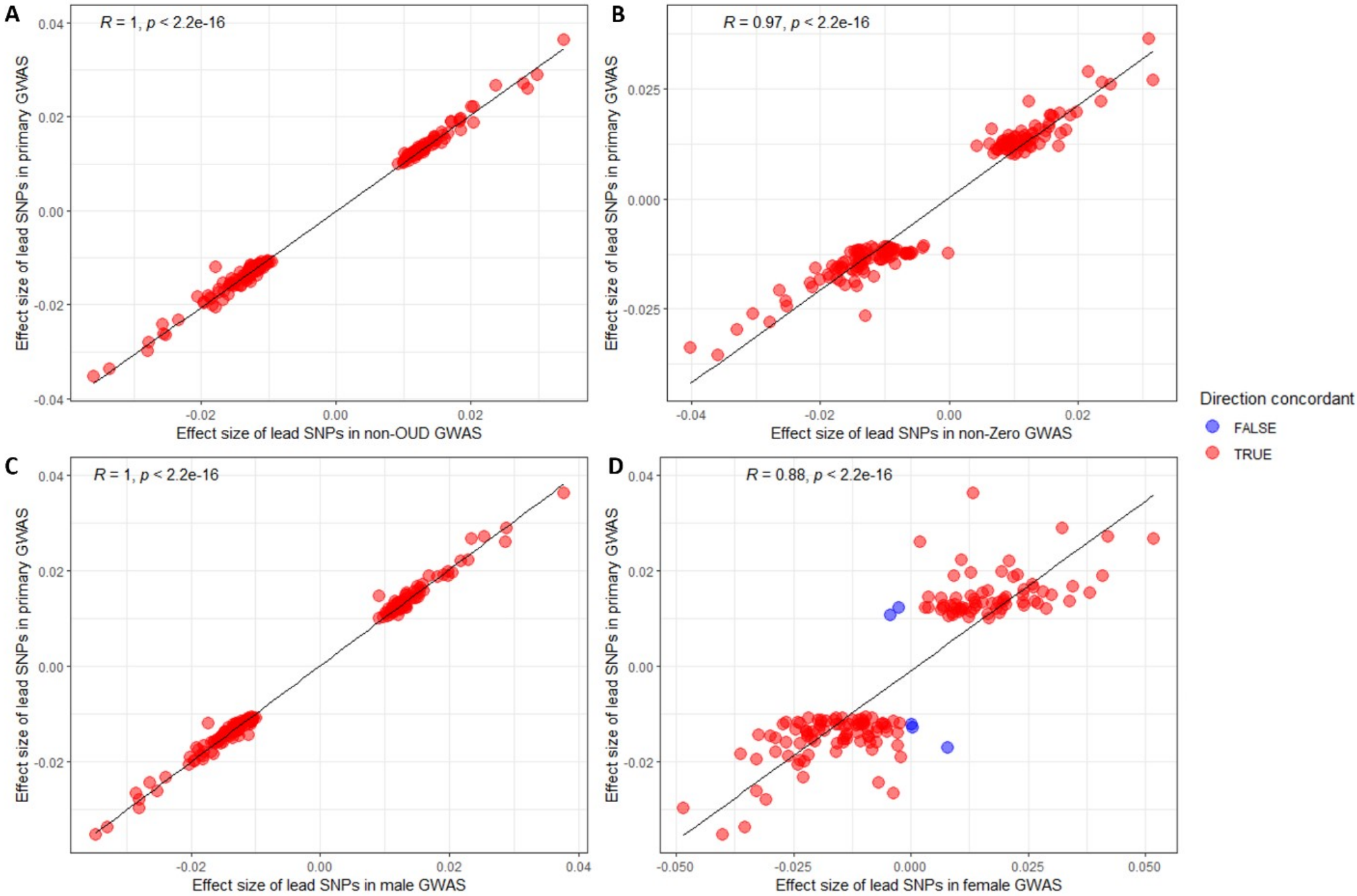

D
Direction
Downregulated
Upregulated
-log10(p)
Frontal Cortex
Cortex
Dorsolateral PFC (sQTL)
Dorsolateral PFC (eQTL)
Cerebellar Hemisphere
Anterior cingulate cortex
Cerebellum
RBM6
TMEM165
USMG5
GRK4
KAT8
ZNF646
DPYSL5

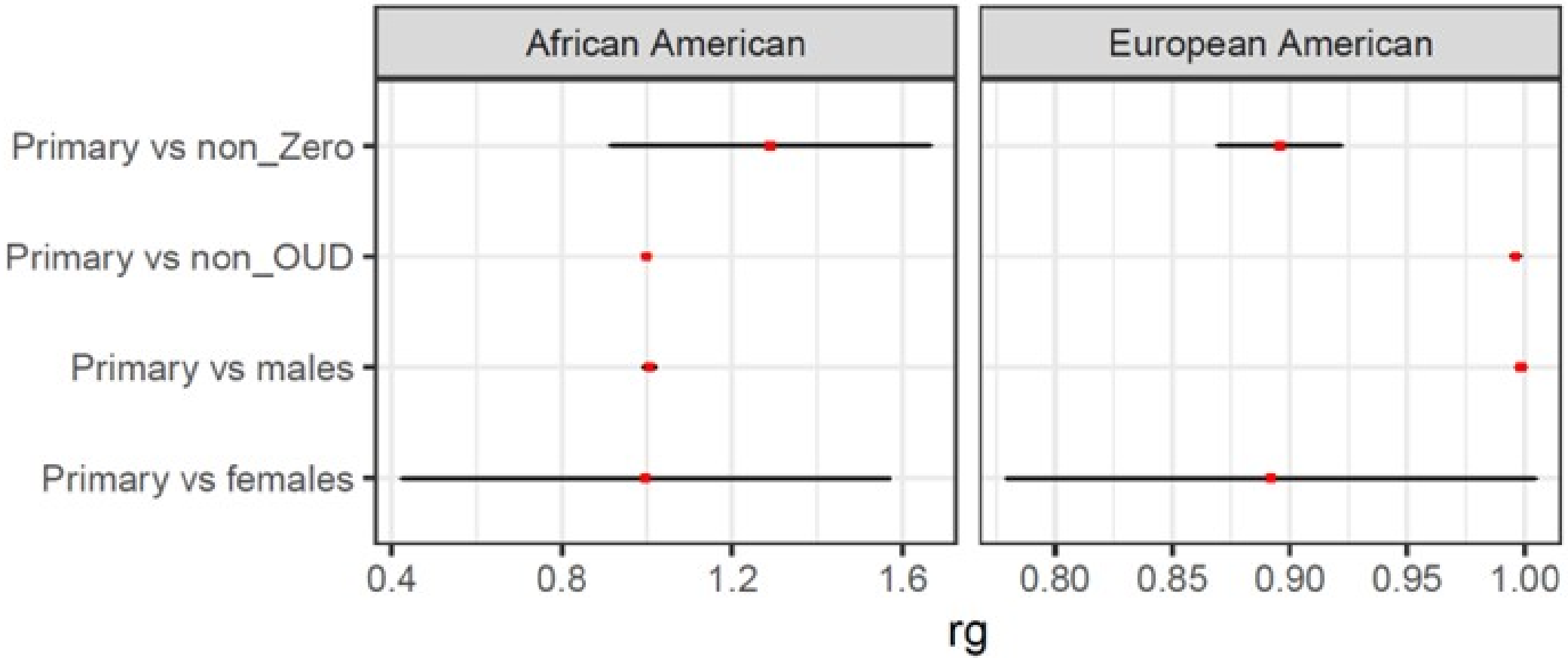

Multisite chronic pain
Back pain
Neck Shoulder pain
Educational attainment
A02B: Drugs used for peptic ulcer
Medication for pain relief: Paracetamol
Knee pain
Hip pain
Depressed affect subcluster
N02BE: Anilides
CWP musc
Chronic wid
Insomnia
M01A: Anti-inflammatory and antirheumatic products, non-sterc
M54 Dorsalgia (ICD10 di
MDD
ADHD
Chest pain or discomfort
Smoking initiation
Pain in throat and chest (ICD
Carpal tunnel syndrome
Medication for pain relief: Omeprazole (e.g. Zanprol)
Treatment/medication c
BMI
Obesity class 1
N02BA: Salicyclic acid and derivatives
Other joint disorders
Cognitive performance
Waist circumference
Headaches
Treatment/medication code: ibuprofen
Neuroticism
Stomach Abdominal pain
Intelligence
Hip circumference
CUD
T2D
N06A: Antidepressants
Abdominal Pelvic pain
HDL cholesterol
Waist to hip ratio
OUD
Pain type(s) experienced in last month: Pain all
PAU
C01D: Vasodilators used in cardiac disease
Automobile speeding
Alcohol dependence
C03: Diuretics
150
100
50
0
0.0
0.5
– log10(P-value)
Correlation (rg)

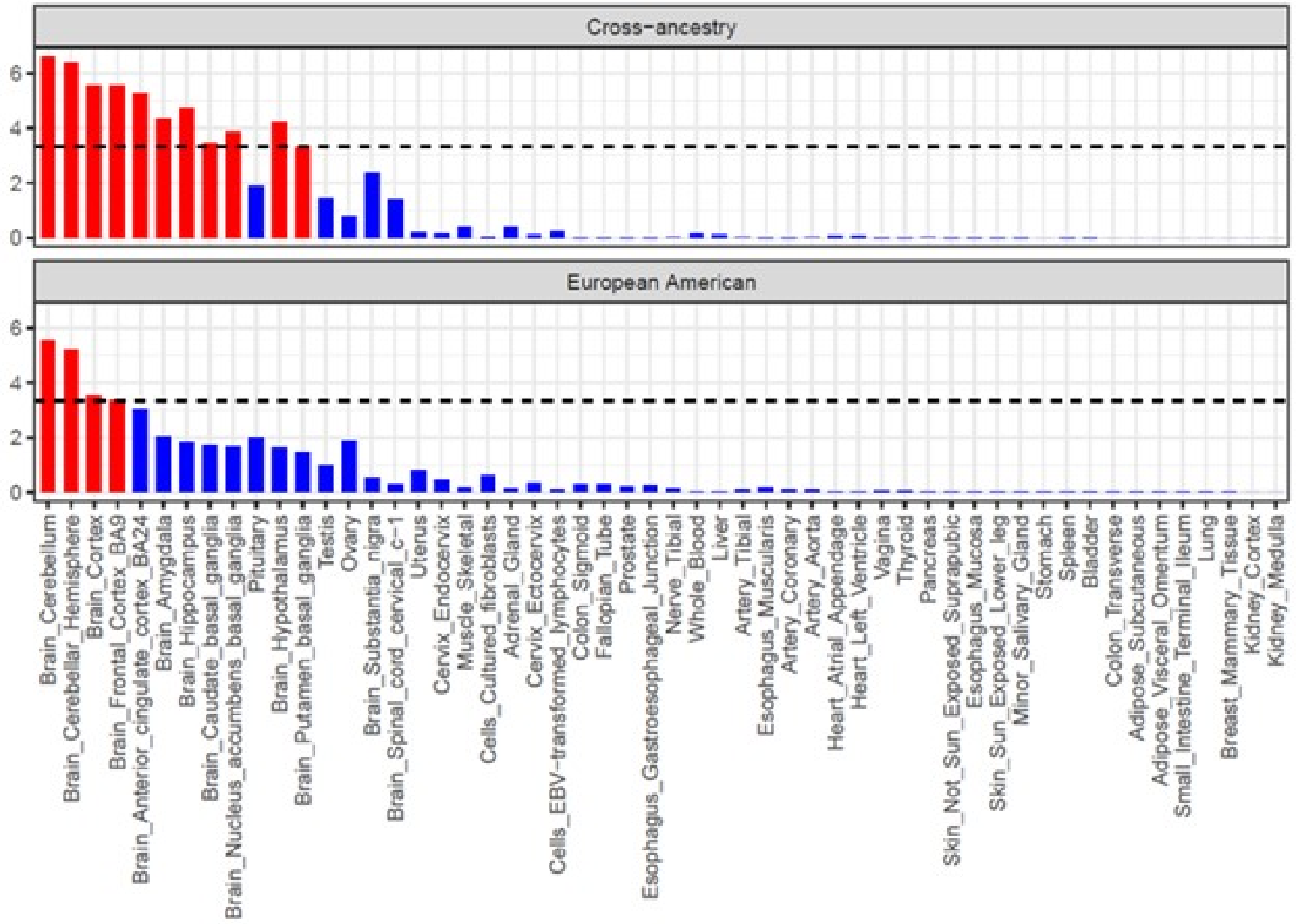

Tier 1
Tier 2
Tier 3A
GRIA1
GRK4
KCNK3
MST1R
VKORC1
NEK4
RYR2
ITIH3
ITIH4
aniracetam
cyclothiazide
desflurane
isoflurane
lamotrigine
methoxyflurane
perampanel
piracetam
sevoflurane
tianeptine
topiramate
atenolol
metoprolol
verapamil
zinc chloride
doxapram
doxapram hydrochloride
halothane
fostamatinib
adenosine triphosphate
caffeine
carvedilol
flecainide
procaine
suramin
tetracaine
acenocoumarol
alitretinoin
dicumarol
menadione
phenindione
phenprocoumon
warfarin
warfarin potassium
warfarin sodium
inhibitor
activator
allosteric modulator
antagonist
blocker
binder
cofactor
modulator
B05 BLOOD
D11

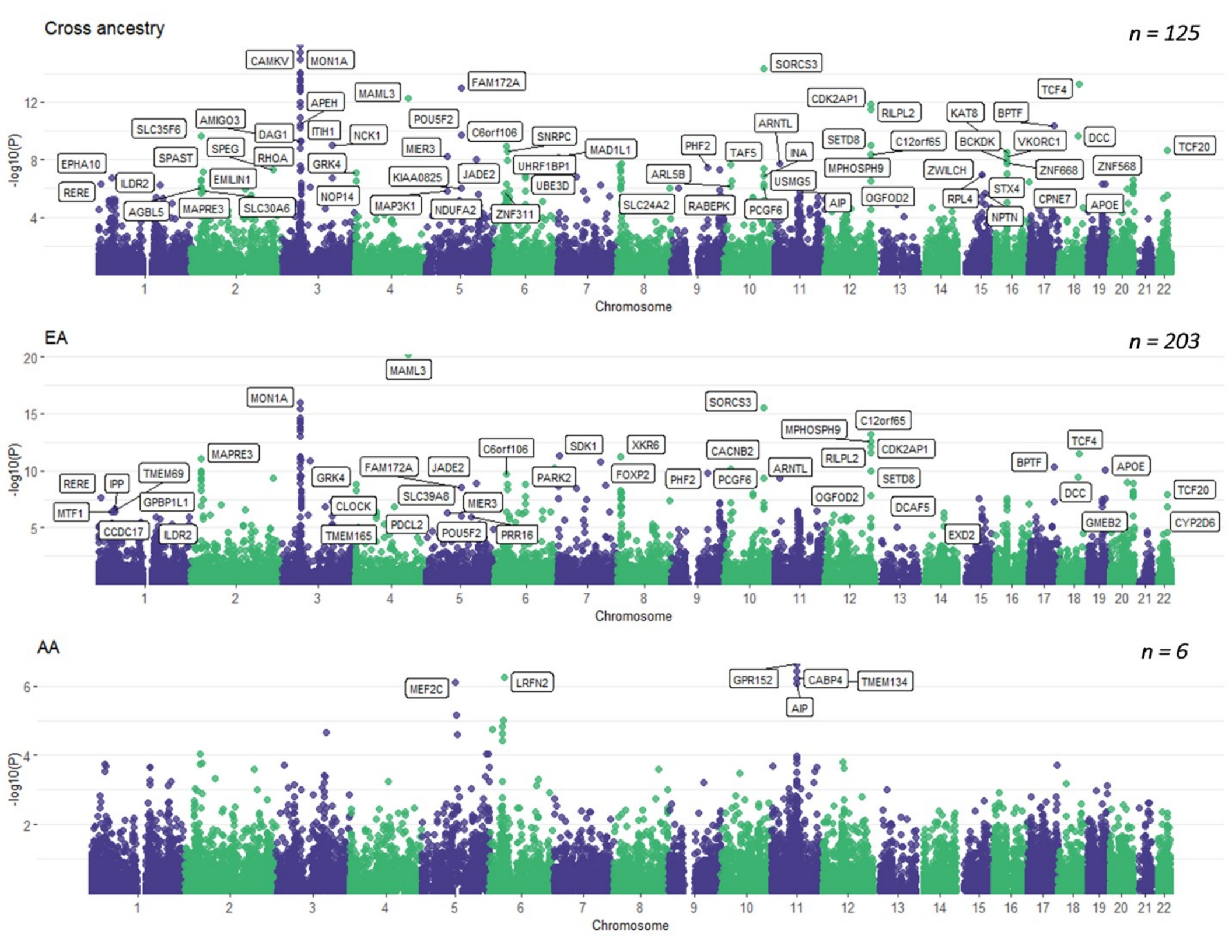

Primary analyses
AA: N = 112,968
1 GWS loci
EA: N = 436,683
87 GWS loci
HA: N = 48,688
2 GWS loci
Cross-ancestry meta-analyses
N = 598,339; 126 GWS loci
Secondary analyses
non-OUD
AA: N = 104,050
EA: N = 416,740
HA: N = 46,169
NRS > 0
AA: N = 61,499
EA: N = 202,784
HA: N = 27,476
Male
AA: N = 97,343
EA: N = 404,510
HA: N = 43,833
Female
AA: N = 15,625
EA: N = 32,173
HA: N = 4,855
Cross-ancestry meta-analyses
GWS loci: non-OUD = 101; NRS>0 = 12, male = 97; female = 0
Downstream analyses
Partitioning heritability enrichment (LDSC)
Cross
EA
Gene-set enrichment (FUMA)
Cross
EA
AA
Cell-type enrichment (FUMA)
EA
Gene prioritization
EA
MAGMA
FINEMAP
H-MAGMA
TWAS
SMR
PWAS
Genetic correlations (LDSC)
EA
AA
PRS and PheWAS
EA
AA
Causal effects (MR)
EA

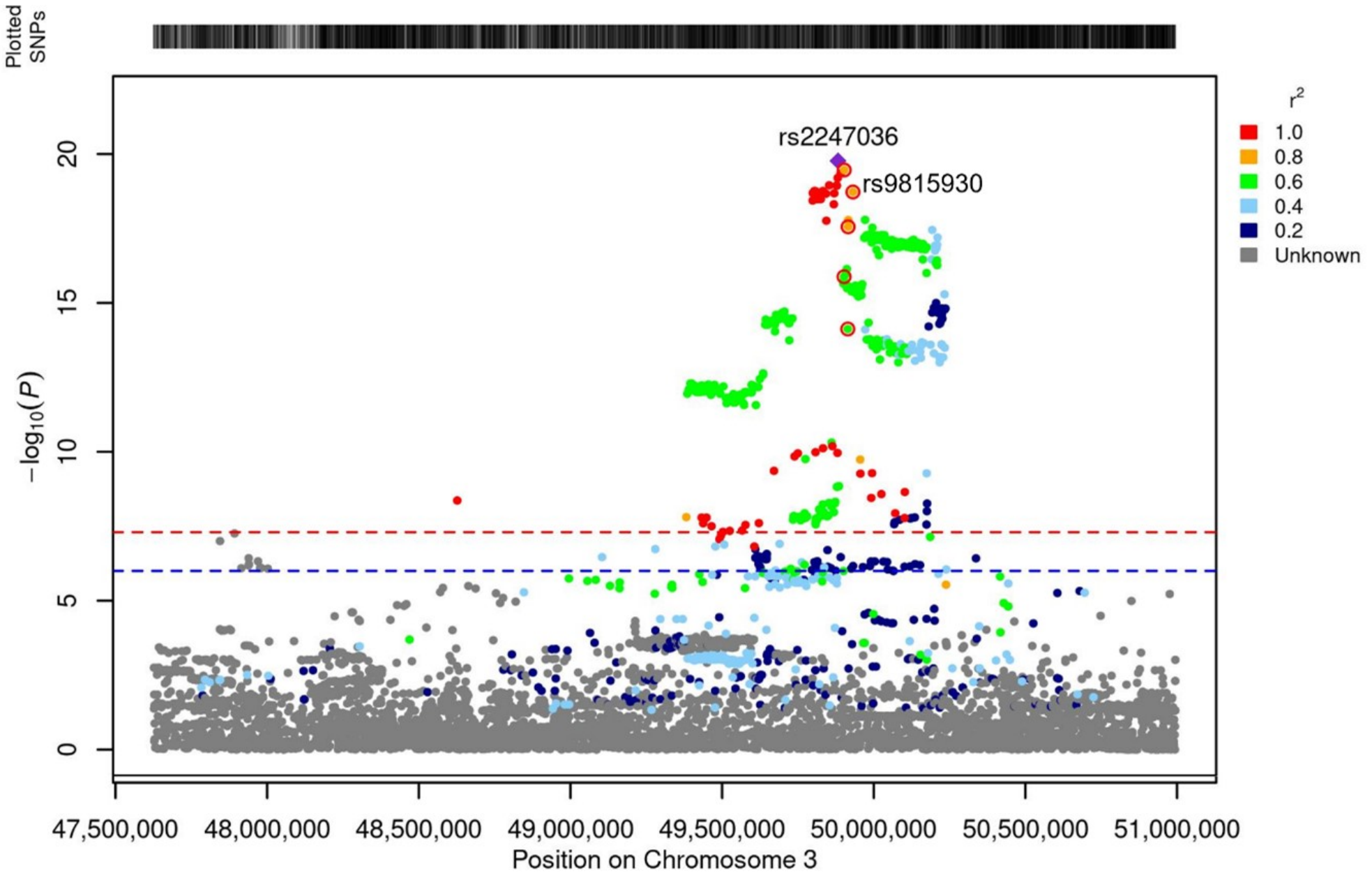

20
15
10
5
0
$-\log_{10}(p)$
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
18
20
22
23
Chromosome

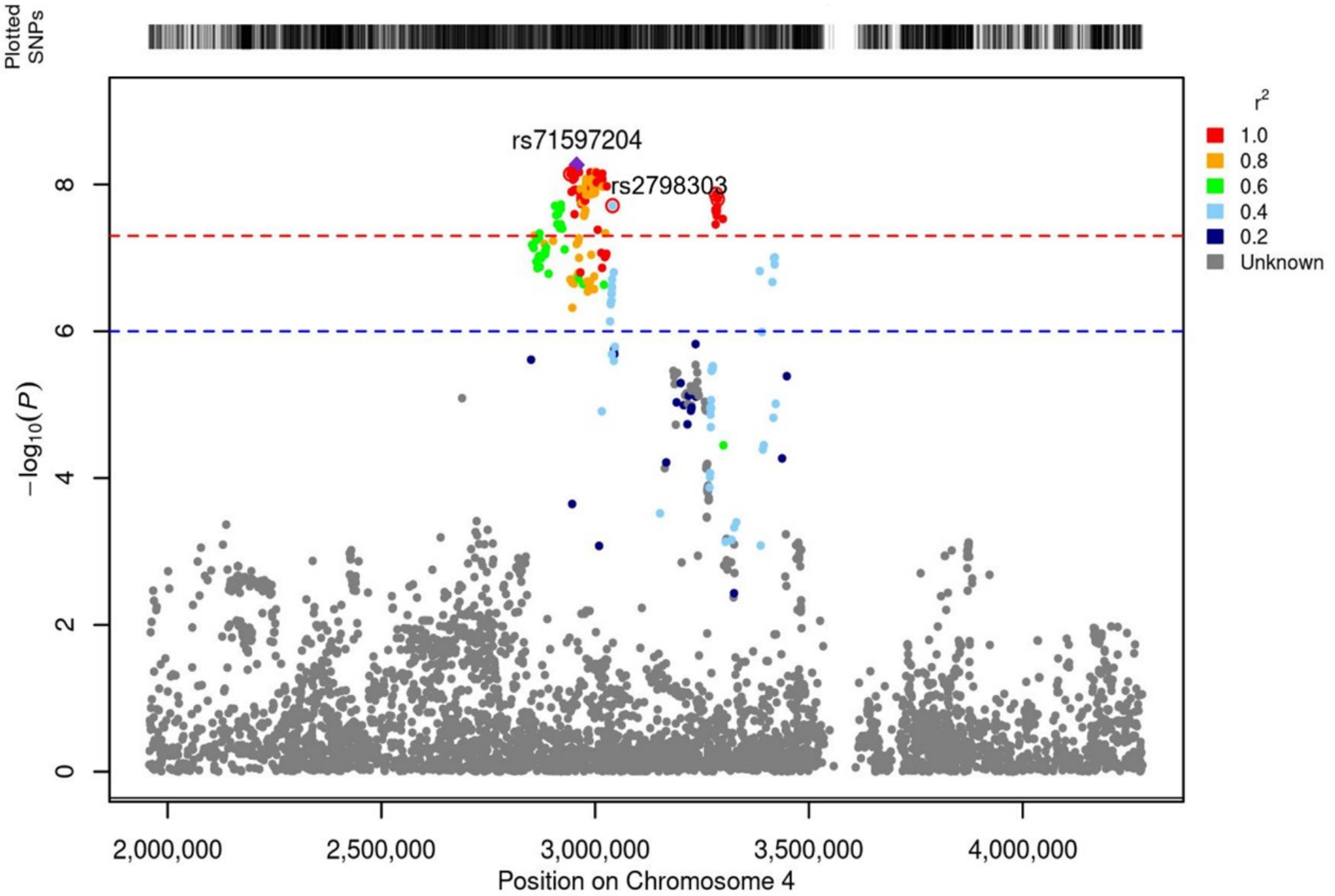

A
R = 1, p < 2.2e-16
Effect size of lead SNPs in primary GWAS
Effect size of lead SNPs in non-OUD GWAS
B
R = 0.97, p < 2.2e-16
Effect size of lead SNPs in primary GWAS
Effect size of lead SNPs in non-Zero GWAS
C
R = 1, p < 2.2e-16
Effect size of lead SNPs in primary GWAS
Effect size of lead SNPs in male GWAS
D
R = 0.88, p < 2.2e-16
Effect size of lead SNPs in primary GWAS
Effect size of lead SNPs in female GWAS
Direction concordant
FALSE
TRUE


African American
European American
Primary vs non_Zero
Primary vs non_OUD
Primary vs males
Primary vs females
0.4
0.8
1.2
1.6
0.80
0.85
0.90
0.95
1.00
rg


Cross−ancestry
European American
0
2
4
6
Brain_Cerebellum
Brain_Cerebellar_Hemisphere
Brain_Cortex
Brain_Frontal_Cortex_BA9
Brain_Anterior_cingulate_cortex_BA24
Brain_Amygdala
Brain_Hippocampus
Brain_Caudate_basal_ganglia
Brain_Nucleus_accumbens_basal_ganglia
Pituitary
Brain_Hypothalamus
Brain_Putamen_basal_ganglia
Testis
Ovary
Brain_Substantia_nigra
Brain_Spinal_cord_cervical_c−1
Uterus
Cervix_Endocervix
Muscle_Skeletal
Cells_Cultured_fibroblasts
Adrenal_Gland
Cervix_Ectocervix
Cells_EBV−transformed_lymphocytes
Colon_Sigmoid
Fallopian_Tube
Prostate
Esophagus_Gastroesophageal_Junction
Nerve_Tibial
Whole_Blood
Liver
Artery_Tibial
Esophagus_Muscularis
Artery_Coronary
Artery_Aorta
Heart_Atrial_Appendage
Heart_Left_Ventricle
Vagina
Thyroid
Pancreas
Skin_Not_Sun_Exposed_Suprapubic
Esophagus_Mucosa
Skin_Sun_Exposed_Lower_leg
Minor_Salivary_Gland
Stomach
Spleen
Bladder
Colon_Transverse
Adipose_Subcutaneous
Adipose_Visceral_Omentum
Small_Intestine_Terminal_Ileum
Lung
Breast_Mammary_Tissue
Kidney_Cortex
Kidney_Medulla


Cross ancestry
n = 125
-log10(P)
Chromosome
CAMKV
MON1A
FAM172A
MAML3
SORCS3
CDK2AP1
TCF4
APEH
POU5F2
RILPL2
KAT8
BPTF
AMIGO3
SLC35F6
DAG1
ITIH1
NCK1
C6orf106
SNRPC
ARNTL
SETD8
C12orf65
BCKDK
VKORC1
DCC
MIER3
MAD1L1
PHF2
TAF5
INA
TCF20
SPEG
SPAST
RHOA
GRK4
UHRF1BP1
MPHOSPH9
ZWILCH
ZNF668
ZNF568
EPHA10
KIAA0825
JADE2
ARL5B
USMG5
STX4
ILDR2
EMILIN1
UBE3D
RERE
NOP14
MAP3K1
NDUFA2
ZNF311
SLC24A2
RABEPK
PCGF6
AIP
OGFOD2
RPL4
CPNE7
APOE
AGBL5
MAPRE3
SLC30A6
NPTN
EA
n = 203
MAML3
MON1A
SORCS3
MPHOSPH9
C12orf65
TCF4
MAPRE3
C6orf106
SDK1
XKR6
CACNB2
CDK2AP1
RILPL2
BPTF
APOE
TMEM69
FAM172A
JADE2
PARK2
FOXP2
PHF2
PCGF6
ARNTL
SETD8
RERE
IPP
GRK4
DCC
TCF20
GPBP1L1
SLC39A8
MIER3
CLOCK
OGFOD2
DCAF5
MTF1
PDCL2
GMEB2
CYP2D6
CCDC17
ILDR2
TMEM165
POU5F2
PRR16
EXD2
AA
n = 6
MEF2C
LRFN2
GPR152
CABP4
TMEM134
AIP


Plotted SNPs
rs2247036
rs9815930
r²
1.0
0.8
0.6
0.4
0.2
Unknown
−log10(P)
0
5
10
15
20
47,500,000
48,000,000
48,500,000
49,000,000
49,500,000
50,000,000
50,500,000
51,000,000
Position on Chromosome 3


Plotted SNPs
rs71597204
rs2798303
r²
1.0
0.8
0.6
0.4
0.2
Unknown
−log10(P)
0
2
4
6
8
2,000,000
2,500,000
3,000,000
3,500,000
4,000,000
Position on Chromosome 4

Supplementary Information for

A multi-ancestry genetic study of pain intensity in 598,339 veterans

VA Million Veteran Program Core Acknowledgement for Publications
Last updated August 3, 2021

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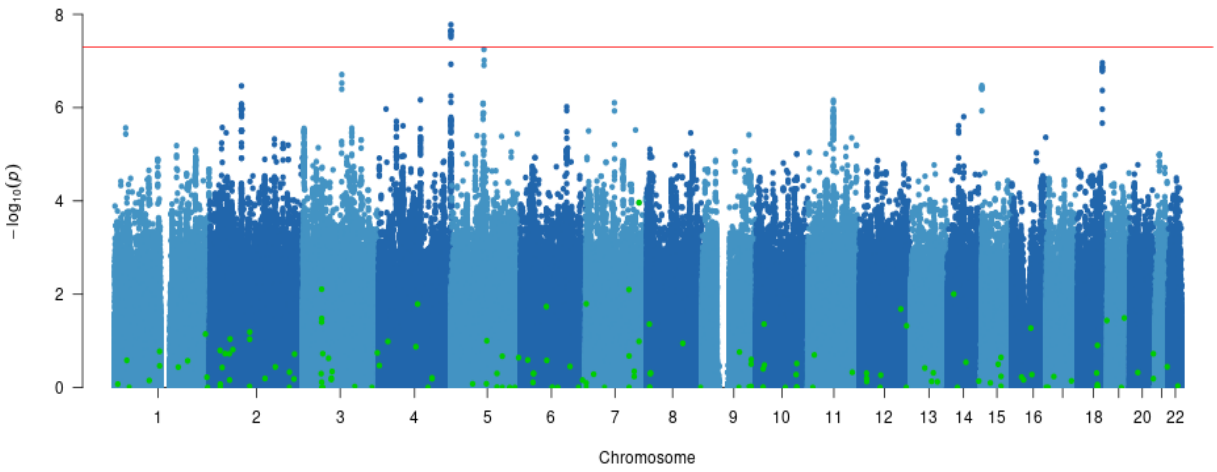
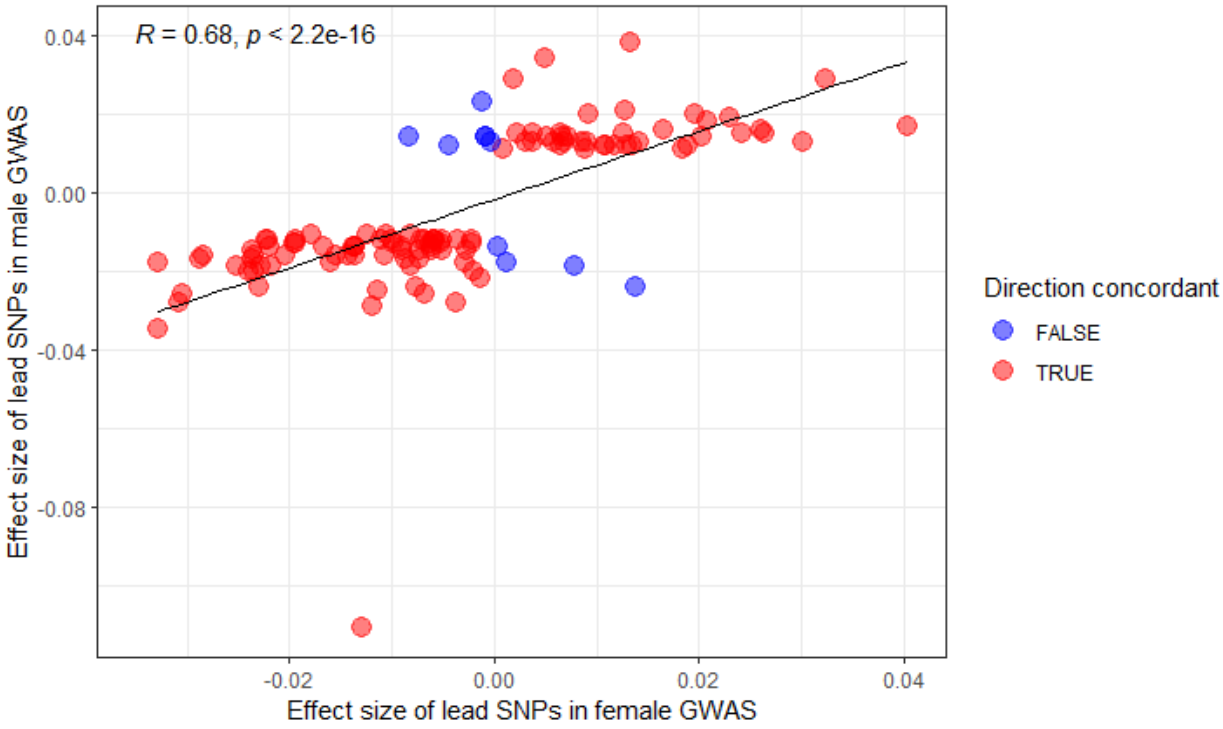
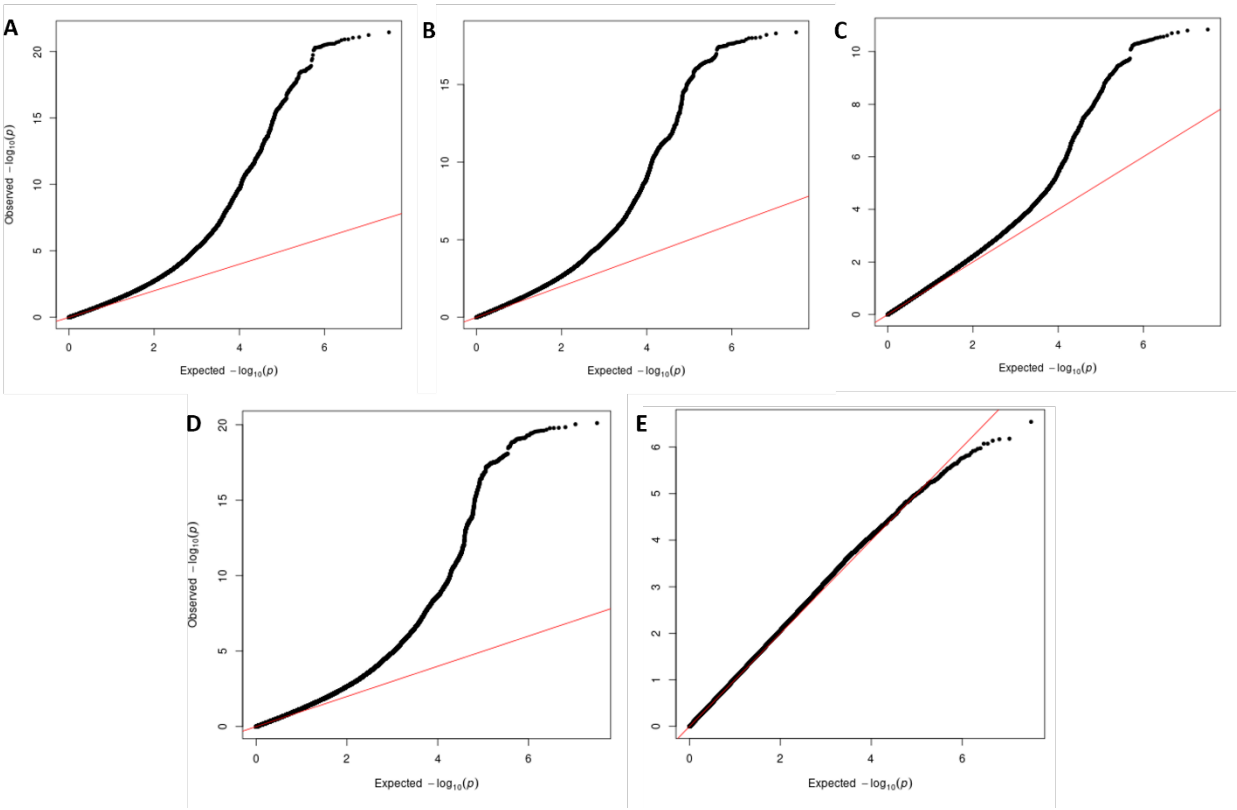
- VA Pacific Islands Health Care System (Daryl Fujii, Ph.D.)
- VA Palo Alto Health Care System (Philip Tsao, Ph.D.)
- VA Pittsburgh Health Care System (Patrick Strollo, Jr., M.D.)
- VA Puget Sound Health Care System (Edward Boyko, M.D.)
- VA Salt Lake City Health Care System (Jessica Walsh, M.D.)
- VA San Diego Healthcare System (Samir Gupta, M.D., M.S.C.S.)
- VA Sierra Nevada Health Care System (Mostaqul Huq, Pharm.D., Ph.D.)
- VA Southern Nevada Healthcare System (Joseph Fayad, M.D.)
- VA Tennessee Valley Healthcare System (Adriana Hung, M.D., M.P.H.)
- Washington DC VA Medical Center (Jack Lichy, M.D., Ph.D.)
- W.G. (Bill) Hefner VA Medical Center (Robin Hurley, M.D.)
- White River Junction VA Medical Center (Brooks Robey, M.D.)
- William S. Middleton Memorial Veterans Hospital (Prakash Balasubramanian, M.D.)



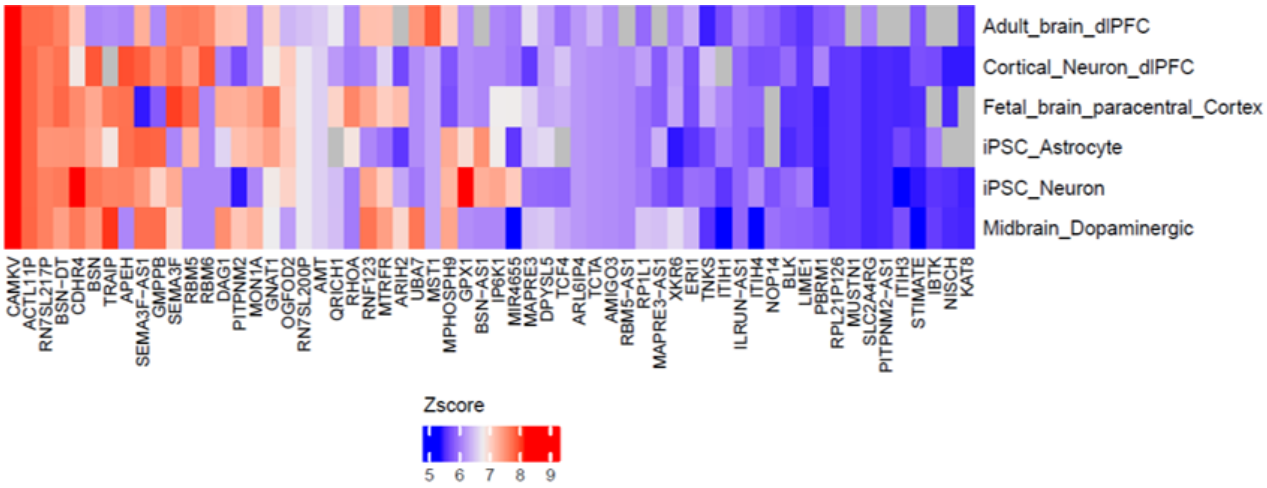
Supplementary Figure 1. Heterogeneity Plot of pain intensity cross-ancestry meta-analysis results indicates no signs of heterogeneity (I^2). *P*-values are derived from I^2 test (one-sided). Cross-ancestry meta-analysis lead SNPs are highlighted in green.



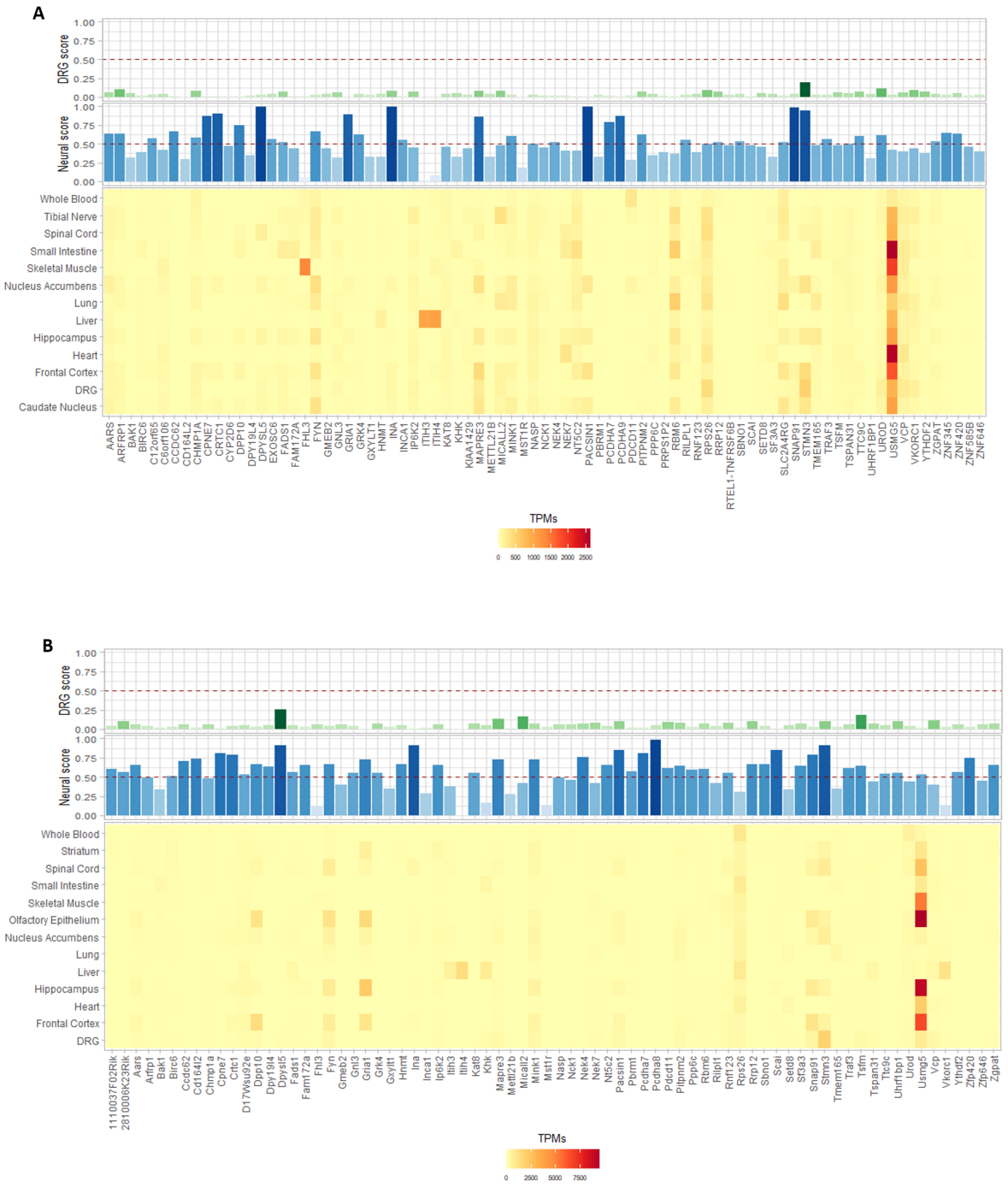
Supplementary Figure 2. Effect-effect plot comparing effect sizes of male cross-ancestry meta-analyses lead SNPs vs female GWAS. The magnitude and direction of the effect sizes are plotted for each GWAS. The results show significant ($P < 2.2 \times 10^{-16}$) high correlation (Pearson *r* test, one-sided) between the effect sizes (β) of pain intensity lead SNPs for males versus females.



Supplementary Figure 3. Quantile–quantile plot of the SNP-based associations with pain intensity in the (A) primary (B) non-OUD (C) non-zero (D) males and (E) females GWASs. Lambda values show minimal inflation for both primary (λ_{GC} = 1.23) and secondary GWASs (non-OUD; λ_{GC} = 1.22, non-zero; λ_{GC} = 1.09, male; λ_{GC} = 1.22, and female; λ_{GC} = 1.03), however, the LDSC intercept (1.1; standard error (s.e.) = 0.01) and ratio (13%) both indicate that the inflation is largely due to true polygenicity and the large sample size. SNP *P* values were computed in METAL using a two-sided, sample-size-weighted *z*-score method. QQ plots estimated were generated using a chi-squared test.



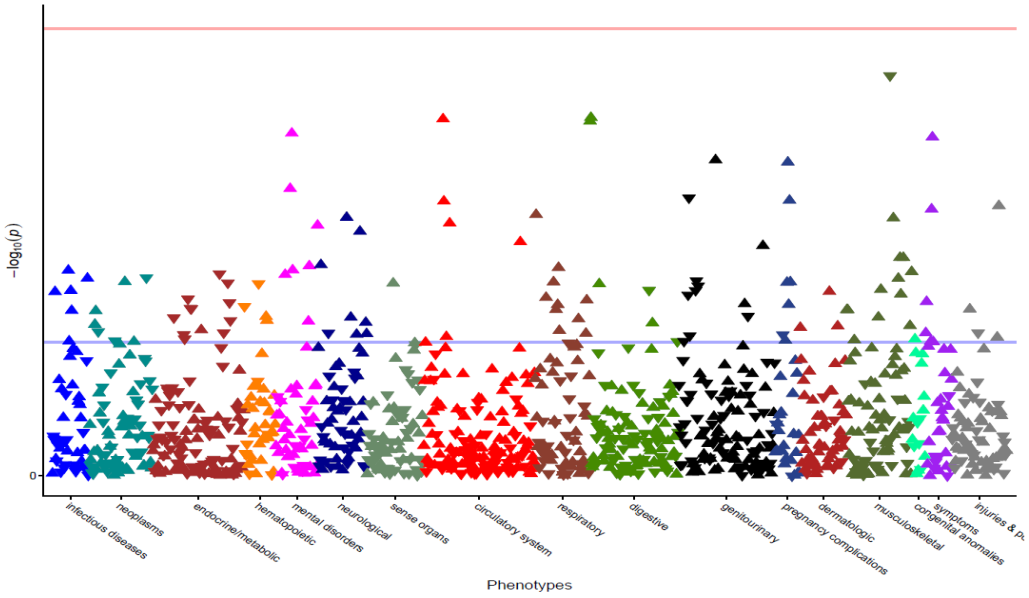
Supplementary Figure 4. H-MAGMA Gene-Tissue pairs for pain intensity. Genes that survive multiple correction across six tissues are plotted. (Bonferroni $p = 2.84 \times 10^{-8}$)



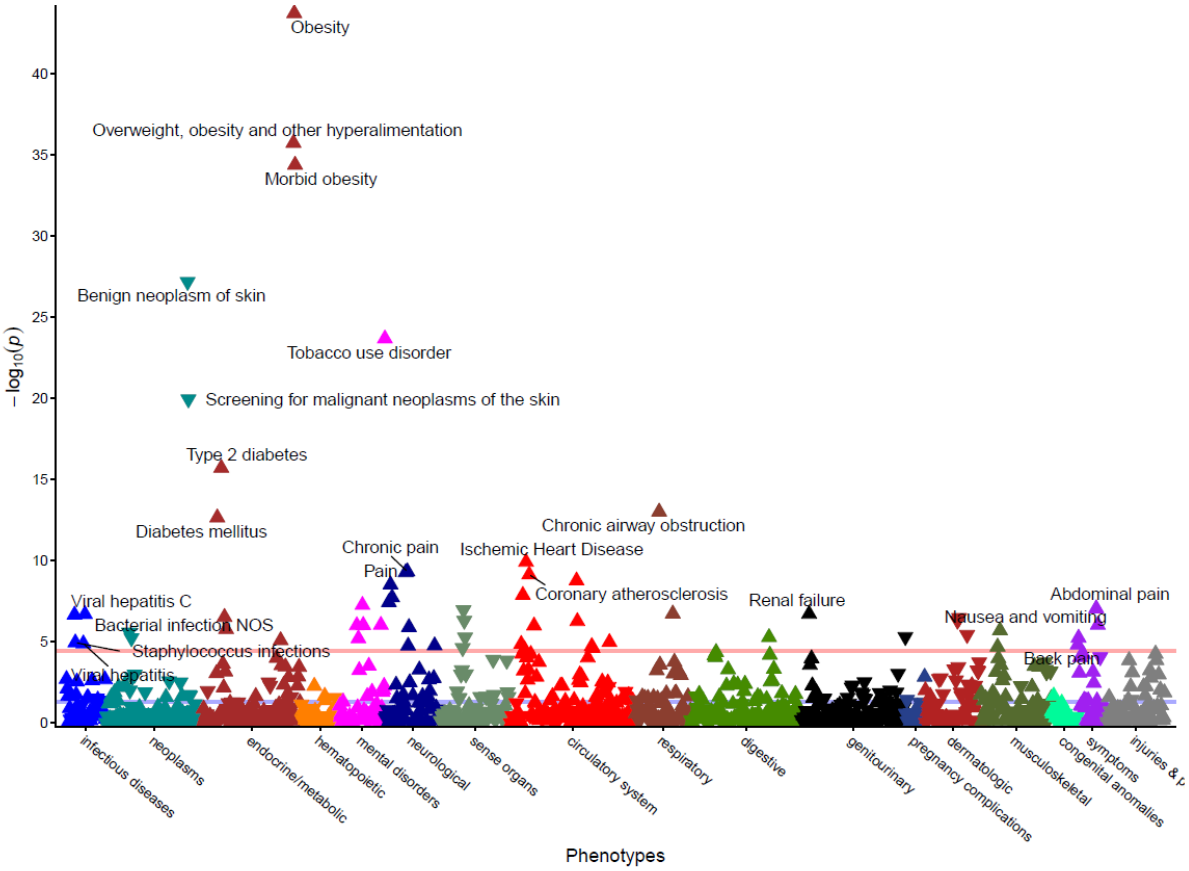
Supplementary Figure 5. Identification of tissue enrichment gene expression patterns. Causal genes and proteins that are differentially expressed in CNS and DRG in (A) humans and (B) mouse. DRG, dorsal root ganglia; TPM, transcripts per million. Red dashed line shows the Enrichment score threshold > 0.5.

Supplementary Figure 6. PheWAS in Yale-Penn African American individuals. PheWAS plot for pain intensity PRS in European Americans from Yale-Penn. No phenotypes passed multiple testing correction (Bonferroni correction threshold = $P < 7.83 \times 10^{-5}$ (0.05/638).

Supplementary Figure 7. PheWAS in Yale-Penn European American individuals. PheWAS plot for pain intensity PRS in European Americans from Yale-Penn. Phenotypes that pass multiple testing correction (black dashed line) are annotated (Bonferroni correction threshold = $P < 7.83 \times 10^{-5}$ (0.05/638).



Supplementary Figure 8. PheWAS in PMBB African American individuals. PheWAS plot for pain intensity PRS in African Americans from PMBB. No phenotypes passed multiple testing correction (Bonferroni correction threshold = $P < 3.68 \times 10^{-5}$ (0.05/1360).



Supplementary Figure 9. PheWAS in PMBB European American individuals. PheWAS plot for pain intensity PRS in European Americans from PMBB. Phenotypes that pass multiple testing correction (red line) are annotated (Bonferroni correction threshold = $P < 3.65 \times 10^{-5}$ (0.05/1360).

Supplementary Table 37. Druggable targets for pain intensity identified by the Druggable Genome and Drug

Gene prioritization method	gene_nam	gene_claim_	description	druggabili	small_mol	bio_drugg	adme_gen
Fine-mapping	BLK	BE0009413	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	640	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	640	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	640	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	P51451	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
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Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BE0009413	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
Fine-mapping	BLK	BLK	B lymphoid t	Tier 1	Y	N	N
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
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MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

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MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	BE0002363	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	Debrisoquin	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	BE0002363	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y

MAGMA and TWAS	CYP2D6	BE0002363	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
MAGMA and TWAS	CYP2D6	CYP2D6	cytochrome	Tier 1	Y	N	Y
Fine-mapping	DPEP1	P16444	dipeptidase	Tier 1	Y	Y	Y
Fine-mapping	DPEP1	P16444	dipeptidase	Tier 1	Y	Y	Y
Fine-mapping	DPEP1	Dehydropep	dipeptidase	Tier 1	Y	Y	Y
Fine-mapping	DPEP1	BE0001148	dipeptidase	Tier 1	Y	Y	Y
Fine-mapping	DPEP1	MDP	dipeptidase	Tier 1	Y	Y	Y
Fine-mapping	DPEP1	DPEP1	dipeptidase	Tier 1	Y	Y	Y
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	P06241	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	P06241	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	Fyn tyrosine	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	BE0000839	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	2534	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	2534	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	2534	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	FYN	FYN oncoger	Tier 1	Y	N	N
TWAS	FYN	BE0000839	FYN oncoger	Tier 1	Y	N	N
GWAS, TWAS, and Fine-mappi	GRIA1	Glutamate re	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N

GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	Glutamate re	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	Glutamate re	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N

GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	2890	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	P42261	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GRIA1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	GLUH1	glutamate re	Tier 1	Y	Y	N
GWAS, TWAS, and Fine-mappi	GRIA1	BE0000640	glutamate re	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	2868	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	GRK4	GRK4	G protein-co	Tier 1	Y	N	N
HMAGMA and TWAS	HNMT	Histamine N	histamine N-	Tier 1	Y	N	Y
HMAGMA and TWAS	HNMT	BE0002436	histamine N-	Tier 1	Y	N	Y
HMAGMA and TWAS	HNMT	HNMT	histamine N-	Tier 1	Y	N	Y
HMAGMA and TWAS	HNMT	Histamine N	histamine N-	Tier 1	Y	N	Y
HMAGMA and TWAS	HNMT	HNMT	histamine N-	Tier 1	Y	N	Y
Fine-mapping	KCNK3	BE0003582	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	KCNK3	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	3777	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	BE0003582	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	3777	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
Fine-mapping	KCNK3	TASK	potassium ch	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	50488	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	50488	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N

TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	BE0009487	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	MINK1	misshapen-li	Tier 1	Y	N	N
TWAS	MINK1	BE0009487	misshapen-li	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS, SI	MST1R	PTK8	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	RON	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	Q04912	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	PTK8	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	4486	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	4486	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	Macrophage	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	4486	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	RON	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage	Tier 1	Y	Y	N

MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	BE0009490	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	MST1R	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA, TWAS, SI	MST1R	BE0009490	macrophage Tier 1	Y	Y	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Vitamin K ep	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKORC1	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	79001	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Vitamin K ep	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKORC1	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKOR	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	79001	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKOR	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Vitamin K ep	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	79001	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Vitamin K ep	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKORC1	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKORC1	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKORC1	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	79001	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Vitamin K ep	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKOR	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKOR	vitamin K ep Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	VKOR	vitamin K ep Tier 1	Y	N	N

MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep	Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	BE0000713	vitamin K ep	Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	Q9BQB6	vitamin K ep	Tier 1	Y	N	N
MAGMA, HMAGMA and PWA	VKORC1	79001	vitamin K ep	Tier 1	Y	N	N
MAGMA, HMAGMA, TWAS an	KHK	KHK	ketohexokin	Tier 2	Y	N	N
MAGMA, HMAGMA, TWAS an	NEK4	BE0009498	NIMA-relate	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	RYR2	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	BE0005295	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	BE0005295	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	Ryanodine re	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	RYR2	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	RYR2	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
GWAS, MAGMA, and Fine-ma	RYR2	6262	ryanodine re	Tier 2	Y	N	N
TWAS	VCP	VCP	valosin conta	Tier 2	Y	N	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	APOE	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	BE0001119	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	BE0001119	apolipoprote	Tier 3A	N	Y	N
GWAS, MAGMA, HMAGMA ar	APOE	BE0001119	apolipoprote	Tier 3A	N	Y	N
HMAGMA and PWAS	ITIH3	BE0009081	inter-alpha-t	Tier 3A	N	Y	N
HMAGMA and PWAS	ITIH3	ITIH3	inter-alpha-t	Tier 3A	N	Y	N
HMAGMA and PWAS	ITIH3	BE0009081	inter-alpha-t	Tier 3A	N	Y	N
MAGMA, HMAGMA and TWA	ITIH4	BE0009082	inter-alpha-t	Tier 3A	N	Y	N
MAGMA, HMAGMA and TWA	ITIH4	BE0009082	inter-alpha-t	Tier 3A	N	Y	N
Fine-mapping	KCNG2	KCNF2	potassium vo	Tier 3B	Y	N	N
Fine-mapping	KCNG2	KCNF2	potassium vo	Tier 3B	Y	N	N
Fine-mapping	KCNG2	KCNF2	potassium vo	Tier 3B	Y	N	N

Fine-mapping	KCNG2	KCNF2	potassium v	Tier 3B	Y	N	N
PWAS	AARS	BE0000294					
MAGMA, HMAGMA, TWAS an	GNL3	GNL3					
MAGMA, HMAGMA, TWAS an	GNL3	GNL3					
MAGMA, HMAGMA, TWAS an	GNL3	GNL3					
TWAS	NT5C2	NT5C2					
TWAS	NT5C2	NT5C2					
TWAS	NT5C2	NT5C2					
TWAS	NT5C2	NT5C2					
TWAS	NT5C2	BE0000261					
TWAS	NT5C2	NT5C2					
TWAS	NT5C2	NT5C2					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					
MAGMA, HMAGMA and TWA	PBRM1	PBRM1					

Gene Interaction Database

European Americans				
interaction_claim_sour	**molecular_n**	**drug_claim_name**	**drug_claim_primary**	**drug_name**
DrugBank	inhibitor	DB15035	Zanubrutinib	ZANUBRUTINIB
DTC		KD-025	KD-025	CHEMBL2005186
GuideToPharmacology	inhibitor	310264693	ACALABRUTINIB	ACALABRUTINIB
ChemblInteractions	inhibitor	CHEMBL3545085	XL-228	XL-228
GuideToPharmacology	inhibitor	249565869	CEP-11981	CEP-11981
ChemblInteractions	inhibitor	CHEMBL403989	TG100-801	TG100-801
DTC		AZD-1152-HQPA	AZD-1152-HQPA	AZD-1152-HQPA
TALC	inhibitor	NINTEDANIB	NINTEDANIB	NINTEDANIB
GuideToPharmacology	inhibitor	178103494	IBRUTINIB	IBRUTINIB
TdgClinicalTrial		ENMD-2076	ENMD-2076	ENMD-2076
DTC		GNF-PF-2301	GNF-PF-2301	CHEMBL578061
ChemblInteractions	inhibitor	CHEMBL52885	ENMD-981693	ENMD-981693
DTC		MLN-8054	MLN-8054	MLN-8054
DTC		LAUROGUADINE	LAUROGUADINE	LAUROGUADINE
DTC		ALISERTIB	ALISERTIB	ALISERTIB
DTC	inhibitor	HESPERADIN	HESPERADIN	HESPERADIN
ChemblInteractions	inhibitor	CHEMBL1980297	ILORASERTIB	ILORASERTIB
DTC		ILORASERTIB	ILORASERTIB	ILORASERTIB
DTC		ERLOTINIB	ERLOTINIB	ERLOTINIB
DTC		OSI-632	OSI-632	OSI-632
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB
DTC		ALSTERPAULLONE	ALSTERPAULLONE	ALSTERPAULLONE
DTC		GO-6976	GO-6976	GO-6976
DTC		ENTRECTINIB	ENTRECTINIB	ENTRECTINIB
DTC		TAMATINIB	TAMATINIB	R-406
DTC		DOVITINIB	DOVITINIB	DOVITINIB
DTC		LINIFANIB	LINIFANIB	LINIFANIB
ChemblInteractions	inhibitor	CHEMBL1421	DASATINIB	DASATINIB
DTC		GW441756X	GW441756X	GW441756X
DTC		CYC-116	CYC-116	CYC-116
DTC		TOZASERTIB	TOZASERTIB	TOZASERTIB
DTC		GEFITINIB	GEFITINIB	GEFITINIB
DTC		SORAFENIB	SORAFENIB	SORAFENIB
DTC		RG-1530	RG-1530	RG-1530
DTC		SP-600125	SP-600125	SP-600125
DTC		PF-562271	PF-562271	PF-00562271
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
DTC		TAE-684	TAE-684	TAE-684
DTC		CENISERTIB	CENISERTIB	CENISERTIB
PharmGKB		sparteine	sparteine	SPARTEINE
FDA		Eliglustat	Eliglustat	ELIGLUSTAT
PharmGKB		desipramine	desipramine	DESIPRAMINE
FDA		Desipramine	Desipramine	DESIPRAMINE

DTC	DESIPRAMINE	DESIPRAMINE	DESIPRAMINE
PharmGKB	eliglustat	eliglustat	ELIGLUSTAT
DTC	TIMOLOL	TIMOLOL	TIMOLOL
PharmGKB	hydrocodone	hydrocodone	HYDROCODONE
PharmGKB	timolol	timolol	TIMOLOL
FDA	Trimipramine	Trimipramine	TRIMIPRAMINE
PharmGKB	trimipramine	trimipramine	TRIMIPRAMINE
DTC	CLEBOPRIDE	CLEBOPRIDE	CLEBOPRIDE
DTC	PIMETHIXENE	PIMETHIXENE	PIMETHIXENE
PharmGKB	tolperisone	tolperisone	TOLPERISONE
DTC	PIPENZOLATE	PIPENZOLATE	PIPENZOLATE
DTC	PENICILLIN V BENZ	PENICILLIN V BENZA	PENICILLIN V BENZA
DTC	METHAPYRILENE	METHAPYRILENE	METHAPYRILENE
DTC	PRIDINOL	PRIDINOL	PRIDINOL
FDA	Valbenazine	Valbenazine	VALBENAZINE
PharmGKB	valbenazine	valbenazine	VALBENAZINE
DTC	BUCLADESINE	BUCLADESINE	BUCLADESINE
FDA	Tolterodine	Tolterodine	TOLTERODINE
PharmGKB	tolterodine	tolterodine	TOLTERODINE
DTC	TICRYNAFEN	TICRYNAFEN	TICRYNAFEN
PharmGKB	ketorolac	ketorolac	KETOROLAC
PharmGKB	propafenone	propafenone	PROPAFENONE
PharmGKB	palonosetron	palonosetron	PALONOSETRON
FDA	Meclizine	Meclizine	MECLIZINE
DTC	MECLIZINE	MECLIZINE	MECLIZINE
FDA	Tetrabenazine	Tetrabenazine	TETRABENAZINE
NCI	MEXILETINE	MEXILETINE	MEXILETINE
FDA	Galantamine	Galantamine	GALANTAMINE
PharmGKB	galantamine	galantamine	GALANTAMINE
PharmGKB	mexiletine	mexiletine	MEXILETINE
PharmGKB	meclizine	meclizine	MECLIZINE
PharmGKB	tetrabenazine	tetrabenazine	TETRABENAZINE
FDA	Propafenone	Propafenone	PROPAFENONE
FDA	Palonosetron	Palonosetron	PALONOSETRON
FDA	Modafinil	Modafinil	MODAFINIL
DTC	BUFLOMEDIL	BUFLOMEDIL	BUFLOMEDIL
DTC	BENZETHONIUM	BENZETHONIUM	BENZETHONIUM
NCI	MODAFINIL	MODAFINIL	MODAFINIL
FDA	Mirabegron	Mirabegron	MIRABEGRON
PharmGKB	modafinil	modafinil	MODAFINIL
PharmGKB	mirabegron	mirabegron	MIRABEGRON
DTC	ISOXSUPRINE	ISOXSUPRINE	ISOXSUPRINE
DTC	MODAFINIL	MODAFINIL	MODAFINIL
PharmGKB	nebivolol	nebivolol	NEBIVOLOL
DTC	DIMETHISOQUIN	DIMETHISOQUIN	DIMETHISOQUIN
PharmGKB	desvenlafaxine	desvenlafaxine	DESVENLAFAXINE
DTC	PIPERIDOLATE	PIPERIDOLATE	PIPERIDOLATE

FDA	Desvenlafaxine	Desvenlafaxine	DESVENLAFAXINE
DTC	DIMETACRINE	DIMETACRINE	DIMETACRINE
DTC	TRIFLUPERIDOL	TRIFLUPERIDOL	TRIFLUPERIDOL
DTC	ANTAZOLINE	ANTAZOLINE	ANTAZOLINE
PharmGKB	ethylmorphine	ethylmorphine	ETHYLMORPHINE
FDA	Nebivolol	Nebivolol	NEBIVOLOL
DTC	BENZYDAMINE	BENZYDAMINE	BENZYDAMINE
DTC	METHOCARBAMOI	METHOCARBAMOL	METHOCARBAMOL
PharmGKB	cevimeline	cevimeline	CEVIMELINE
PharmGKB	dapoxetine	dapoxetine	DAPOXETINE
DTC	GLAFENINE	GLAFENINE	GLAFENINE
PharmGKB	hydromorphone	hydromorphone	HYDROMORPHONE
FDA	Cevimeline	Cevimeline	CEVIMELINE
DTC	GUAIFENESIN	GUAIFENESIN	GUAIFENESIN
DTC	TROLEANDOMYCIN	TROLEANDOMYCIN	TROLEANDOMYCIN
FDA	Formoterol	Formoterol	FORMOTEROL
FDA	Protriptyline	Protriptyline	PROTRIPTYLINE
PharmGKB	perhexiline	perhexiline	PERHEXILINE
DTC	PERHEXILINE	PERHEXILINE	PERHEXILINE
PharmGKB	formoterol	formoterol	FORMOTEROL
DTC	PROTRIPTYLINE	PROTRIPTYLINE	PROTRIPTYLINE
DTC	NEOSTIGMINE BRC	NEOSTIGMINE BROM	NEOSTIGMINE BRO
PharmGKB	protriptyline	protriptyline	PROTRIPTYLINE
DTC	IPRONIAZID	IPRONIAZID	IPRONIAZID
FDA	Tamsulosin	Tamsulosin	TAMSULOSIN
PharmGKB	pitolisant	pitolisant	PITOLISANT
DTC	THONZONIUM	THONZONIUM	THONZONIUM
DTC	BENPERIDOL	BENPERIDOL	BENPERIDOL
DTC	MEPIVACAINE	MEPIVACAINE	MEPIVACAINE
FDA	Pitolisant	Pitolisant	PITOLISANT
DTC	CROMOLYN	CROMOLYN	CROMOLYN
PharmGKB	tamsulosin	tamsulosin	TAMSULOSIN
FDA	Brexpiprazole	Brexpiprazole	BREXPIPRAZOLE
DTC	DEXTROMETHORP	DEXTROMETHORPH/	DEXTROMETHORPH
PharmGKB	donepezil	donepezil	DONEPEZIL
DTC	CHLOROPYRAMINE	CHLOROPYRAMINE	CHLOROPYRAMINE
DTC	TACRINE	TACRINE	TACRINE
PharmGKB	brexpiprazole	brexpiprazole	BREXPIPRAZOLE
PharmGKB	ketoprofen	ketoprofen	KETOPROFEN
FDA	Upadacitinib	Upadacitinib	UPADACITINIB
DTC	DIPHENYLPYRALIN	DIPHENYLPYRALINE	DIPHENYLPYRALINE
PharmGKB	cariprazine	cariprazine	CARIPRAZINE
PharmGKB	zuclopenthixol	zuclopenthixol	ZUCLOPENTHIXOL
DTC	PLICAMYCIN	PLICAMYCIN	PLICAMYCIN
DTC	LINEZOLID	LINEZOLID	LINEZOLID
DTC	BENOXINATE	BENOXINATE	BENOXINATE
FDA	Umeclidinium	Umeclidinium	UMECLIDINIUM

NCI	VORICONAZOLE	VORICONAZOLE	VORICONAZOLE
DTC	CYPROTERONE	CYPROTERONE	CYPROTERONE
DTC	CIPROFLOXACIN	CIPROFLOXACIN	CIPROFLOXACIN
PharmGKB	darifenacin	darifenacin	DARIFENACIN
DTC	AZTREONAM	AZTREONAM	AZTREONAM
DTC	OXYBUTYNIN	OXYBUTYNIN	OXYBUTYNIN
DTC	LEVOBUPIVACAINE	LEVOBUPIVACAINE	LEVOBUPIVACAINE
FDA	Donepezil	Donepezil	DONEPEZIL
FDA	Darifenacin	Darifenacin	DARIFENACIN
DTC	ISOPROPAMIDE	ISOPROPAMIDE	ISOPROPAMIDE
DTC	METARAMINOL	METARAMINOL	METARAMINOL
DTC	SULFADOXINE	SULFADOXINE	SULFADOXINE
PharmGKB	umeclidinium	umeclidinium	UMECLIDINIUM
FDA	Fesoterodine	Fesoterodine	FESOTERODINE
DTC	HALOFANTRINE HY	HALOFANTRINE HYD	HALOFANTRINE HY
DTC	SULFAPHENAZOLE	SULFAPHENAZOLE	SULFAPHENAZOLE
PharmGKB	upadacitinib	upadacitinib	UPADACITINIB
DTC	FERROUS SULFATE	FERROUS SULFATE	FERROUS SULFATE
FDA	Cariprazine	Cariprazine	CARIPRAZINE
PharmGKB	tropisetron	tropisetron	TROPISETRON
PharmGKB	fesoterodine	fesoterodine	FESOTERODINE
DTC	NALBUPHINE	NALBUPHINE	NALBUPHINE
DTC	AMPHOTERICIN B	AMPHOTERICIN B	AMPHOTERICIN B
PharmGKB	ciprofloxacin	ciprofloxacin	CIPROFLOXACIN
DTC	FLUNISOLIDE	FLUNISOLIDE	FLUNISOLIDE
DTC	BERGAPTEN	BERGAPTEN	BERGAPTEN
DTC	ALVERINE CITRATE	ALVERINE CITRATE	ALVERINE CITRATE
DTC	SELEGILINE	SELEGILINE	SELEGILINE
DTC	AZITHROMYCIN	AZITHROMYCIN	AZITHROMYCIN
DTC	KETOTIFEN	KETOTIFEN	KETOTIFEN
DTC	DOMPERIDONE	DOMPERIDONE	DOMPERIDONE
PharmGKB	thioridazine	thioridazine	THIORIDAZINE
DTC	PHENYLBUTAZONE	PHENYLBUTAZONE	PHENYLBUTAZONE
DTC	BECLOMETHASONI	BECLOMETHASONE	BECLOMETHASONE
DTC	SOTALOL	SOTALOL	SOTALOL
DTC	NIACIN	NIACIN	NIACIN
DTC	NITROFURANTOIN	NITROFURANTOIN	NITROFURANTOIN
DTC	REMOXIPRIDE	REMOXIPRIDE	REMOXIPRIDE
DTC	MEFENAMIC ACID	MEFENAMIC ACID	MEFENAMIC ACID
DTC	INDINAVIR	INDINAVIR	INDINAVIR
DTC	DIPHENHYDRAMIN	DIPHENHYDRAMINE	DIPHENHYDRAMIN
FDA	Lofexidine	Lofexidine	LOFEXIDINE
PharmGKB	vernakalant	vernakalant	VERNAKALANT
PharmGKB	acetaminophen	acetaminophen	ACETAMINOPHEN
DTC	CLEMASTINE	CLEMASTINE	CLEMASTINE
PharmGKB	lofexidine	lofexidine	LOFEXIDINE
DTC	ECADOTRIL	ECADOTRIL	ECADOTRIL

DTC	SULPIRIDE	SULPIRIDE	SULPIRIDE
PharmGKB	terbinafine	terbinafine	TERBINAFINE
DTC	HYDROXYZINE	HYDROXYZINE	HYDROXYZINE
DTC	TORSEMIDE	TORSEMIDE	TORSEMIDE
PharmGKB	pimozide	pimozide	PIMOZIDE
PharmGKB	amphetamine	amphetamine	AMPHETAMINE
DTC	NAPHAZOLINE	NAPHAZOLINE	NAPHAZOLINE
PharmGKB	perphenazine	perphenazine	PERPHENAZINE
PharmGKB	oxymorphone	oxymorphone	OXYMORPHONE
DTC	RAUWOLFIA SERPE	RAUWOLFIA SERPEN	RAUWOLFIA SERPE
PharmGKB	eletriptan	eletriptan	ELETRIPTAN
DTC	METYROSINE	METYROSINE	METYROSINE
DTC	RILMENIDINE	RILMENIDINE	RILMENIDINE
DTC	PYRAZINAMIDE	PYRAZINAMIDE	PYRAZINAMIDE
FDA	Thioridazine	Thioridazine	THIORIDAZINE
DTC	PROPRANOLOL	PROPRANOLOL	PROPRANOLOL
DTC	DANTROLENE	DANTROLENE	DANTROLENE
DTC	LEUCINE	LEUCINE	LEUCINE
DTC	KETANSERIN TARTI	KETANSERIN TARTRA	KETANSERIN TARTF
PharmGKB	vortioxetine	vortioxetine	VORTIOXETINE
DTC	TRIMETHOPRIM	TRIMETHOPRIM	TRIMETHOPRIM
DTC	NATEGLINIDE	NATEGLINIDE	NATEGLINIDE
DTC	PERPHENAZINE	PERPHENAZINE	PERPHENAZINE
DTC	CLOMETHIAZOLE	CLOMETHIAZOLE	CLOMETHIAZOLE
DTC	PROPANTHELINE	PROPANTHELINE	PROPANTHELINE
FDA	Pimozide	Pimozide	PIMOZIDE
DTC	FIPEXIDE	FIPEXIDE	FIPEXIDE
PharmGKB	flibanserin	flibanserin	FLIBANSERIN
FDA	Flibanserin	Flibanserin	FLIBANSERIN
DTC	CHLORPROPAMIDE	CHLORPROPAMIDE	CHLORPROPAMIDE
DTC	FLUCONAZOLE	FLUCONAZOLE	FLUCONAZOLE
NCI	HYDROXYCHLOROC	HYDROXYCHLOROQU	HYDROXYCHLOROC
DTC	IPRATROPIUM	IPRATROPIUM	IPRATROPIUM
DTC	MIDODRINE	MIDODRINE	MIDODRINE
PharmGKB	iloperidone	iloperidone	ILOPERIDONE
DTC	ACETAMINOPHEN	ACETAMINOPHEN	ACETAMINOPHEN
PharmGKB	chlorpheniramine	chlorpheniramine	CHLORPHENIRAMI
DTC	MITOMYCIN	MITOMYCIN	MITOMYCIN
FDA	Atomoxetine	Atomoxetine	ATOMOXETINE
DTC	DOFETILIDE	DOFETILIDE	DOFETILIDE
DTC	ATOMOXETINE	ATOMOXETINE	ATOMOXETINE
DTC	OXETHAZAINE	OXETHAZAINE	OXETHAZAINE
NCI	AMPHETAMINE	AMPHETAMINE	AMPHETAMINE
DTC	LEUPROLIDE	LEUPROLIDE	LEUPROLIDE
FDA	Iloperidone	Iloperidone	ILOPERIDONE
DTC	ENOXOLONE	ENOXOLONE	ENOXOLONE
FDA	Vortioxetine	Vortioxetine	VORTIOXETINE

DTC		FLAVOXATE	FLAVOXATE	FLAVOXATE
DTC		MESTRANOL	MESTRANOL	MESTRANOL
DTC		OFLOXACIN	OFLOXACIN	OFLOXACIN
DTC		BROMPERIDOL	BROMPERIDOL	BROMPERIDOL
DTC		DAPSONE	DAPSONE	DAPSONE
DTC		IOBENGUANE	IOBENGUANE	IOBENGUANE
DTC		DILTIAZEM	DILTIAZEM	DILTIAZEM
DTC		NAPROXEN	NAPROXEN	NAPROXEN
DTC		ROPINIROLE	ROPINIROLE	ROPINIROLE
DTC		CARMUSTINE	CARMUSTINE	CARMUSTINE
FDA		Perphenazine	Perphenazine	PERPHENAZINE
DTC		OXATOMIDE	OXATOMIDE	OXATOMIDE
DTC		NILUTAMIDE	NILUTAMIDE	NILUTAMIDE
DTC		FELBAMATE	FELBAMATE	FELBAMATE
DTC		PYRIDOSTIGMINE	PYRIDOSTIGMINE	PYRIDOSTIGMINE
DTC		MECAMYLAMINE	MECAMYLAMINE	MECAMYLAMINE
PharmGKB		mianserin	mianserin	MIANSERIN
DTC		LIDOFLAZINE	LIDOFLAZINE	LIDOFLAZINE
FDA		Amphetamine	Amphetamine	AMPHETAMINE
FDA		Propranolol	Propranolol	PROPRANOLOL
DTC		PIROXICAM	PIROXICAM	PIROXICAM
DTC		CEFOPERAZONE	CEFOPERAZONE	CEFOPERAZONE
DTC		PIMOZIDE	PIMOZIDE	PIMOZIDE
DTC		LIOTHYRONINE	LIOTHYRONINE	LIOTHYRONINE
DTC		RANITIDINE	RANITIDINE	RANITIDINE
DTC		METHOXSALEN	METHOXSALEN	METHOXSALEN
PharmGKB		quetiapine	quetiapine	QUETIAPINE
DTC		VALPROIC ACID	VALPROIC ACID	VALPROIC ACID
DTC		ERYTHROMYCIN	ERYTHROMYCIN	ERYTHROMYCIN
DTC		DIAZOXIDE	DIAZOXIDE	DIAZOXIDE
DTC		LOVASTATIN	LOVASTATIN	LOVASTATIN
DTC		ETHINYL ESTRADIO	ETHINYL ESTRADIOL	ETHINYL ESTRADIO
FDA		Codeine	Codeine	CODEINE
DTC		PHENOXYBENZAM	PHENOXYBENZAMIN	PHENOXYBENZAMI
FDA		Fluvoxamine	Fluvoxamine	FLUVOXAMINE
DrugBank	inhibitor	DB11994	Diacerein	DIACEREIN
DTC		PIRIBEDIL	PIRIBEDIL	PIRIBEDIL
PharmGKB		granisetron	granisetron	GRANISETRON
DTC		ALLOPURINOL	ALLOPURINOL	ALLOPURINOL
DTC		RALOXIFENE	RALOXIFENE	RALOXIFENE
DTC		OXYMETAZOLINE	OXYMETAZOLINE	OXYMETAZOLINE
DTC		CYCLOBENZAPRINE	CYCLOBENZAPRINE	CYCLOBENZAPRINE
DTC		BUDESONIDE	BUDESONIDE	BUDESONIDE
NCI		TACROLIMUS	TACROLIMUS	TACROLIMUS
FDA		Dextromethorphar	Dextromethorphan	DEXTROMETHORPH
DTC		DIDANOSINE	DIDANOSINE	DIDANOSINE
DTC		PHENOBARBITAL	PHENOBARBITAL	PHENOBARBITAL

DTC	AMSACRINE	AMSACRINE	AMSACRINE
DTC	CIMETIDINE	CIMETIDINE	CIMETIDINE
DTC	CLOFAZIMINE	CLOFAZIMINE	CLOFAZIMINE
DTC	MAPROTILINE HYD	MAPROTILINE HYDR	MAPROTILINE HYDI
DTC	SULINDAC	SULINDAC	SULINDAC
PharmGKB	phenytoin	phenytoin	PHENYTOIN
PharmGKB	morphine	morphine	MORPHINE
DTC	COLCHICINE	COLCHICINE	COLCHICINE
DTC	PYRILAMINE	PYRILAMINE	PYRILAMINE
PharmGKB	tiotropium	tiotropium	TIOTROPIUM
DTC	DYCLONINE	DYCLONINE	DYCLONINE
DTC	CLOFIBRATE	CLOFIBRATE	CLOFIBRATE
DTC	LORATADINE	LORATADINE	LORATADINE
DTC	MONTELUKAST	MONTELUKAST	MONTELUKAST
DTC	DROPERIDOL	DROPERIDOL	DROPERIDOL
DTC	PROMAZINE	PROMAZINE	PROMAZINE
TTD	Glutethimide	Glutethimide	GLUTETHIMIDE
FDA	Amitriptyline	Amitriptyline	AMITRIPTYLINE
DTC	CLOMIPRAMINE	CLOMIPRAMINE	CLOMIPRAMINE
DTC	TAMOXIFEN CITRA	TAMOXIFEN CITRATI	TAMOXIFEN CITRAT
DTC	CLONIDINE	CLONIDINE	CLONIDINE
DTC	CLARITHROMYCIN	CLARITHROMYCIN	CLARITHROMYCIN
DTC	FLUOXETINE	FLUOXETINE	FLUOXETINE
FDA	Nefazodone	Nefazodone	NEFAZODONE
DTC	DICYCLOMINE	DICYCLOMINE	DICYCLOMINE
PharmGKB	fentanyl	fentanyl	FENTANYL
DTC	PREDNISONE	PREDNISONE	PREDNISONE
DTC	GLYCINE	GLYCINE	GLYCINE
DTC	AMITRIPTYLINE	AMITRIPTYLINE	AMITRIPTYLINE
DTC	PROCHLORPERAZI	PROCHLORPERAZINE	PROCHLORPERAZIN
DTC	SULFASALAZINE	SULFASALAZINE	SULFASALAZINE
DTC	AMOXICILLIN	AMOXICILLIN	AMOXICILLIN
PharmGKB	paliperidone	paliperidone	PALIPERIDONE
DTC	ZAFIRLUKAST	ZAFIRLUKAST	ZAFIRLUKAST
DTC	STAVUDINE	STAVUDINE	STAVUDINE
PharmGKB	sertindole	sertindole	SERTINDOLE
DTC	DIETHYLSTILBESTR	DIETHYLSTILBESTRO	DIETHYLSTILBESTRO
FDA	Nortriptyline	Nortriptyline	NORTRIPTYLINE
DTC	ASTEMIZOLE	ASTEMIZOLE	ASTEMIZOLE
DTC	CEFTRIAXONE	CEFTRIAXONE	CEFTRIAXONE
PharmGKB	rucaparib	rucaparib	RUCAPARIB
DTC	CHLOROQUINE	CHLOROQUINE	CHLOROQUINE
DTC	GUANFACINE	GUANFACINE	GUANFACINE
DTC	MAPROTILINE	MAPROTILINE	MAPROTILINE
DTC	PHENELZINE	PHENELZINE	PHENELZINE
NCI	ALBUMIN	ALBUMIN	ALBUMIN HUMAN
PharmGKB	chlorpromazine	chlorpromazine	CHLORPROMAZINE

FDA	Metoprolol	Metoprolol	METOPROLOL
DTC	AZATHIOPRINE	AZATHIOPRINE	AZATHIOPRINE
DTC	PROPYLTHIOURACI	PROPYLTHIOURACIL	PROPYLTHIOURACI
DTC	CILOSTAZOL	CILOSTAZOL	CILOSTAZOL
DTC	CHLORPROMAZINE	CHLORPROMAZINE	CHLORPROMAZINE
DTC	CYPROHEPTADINE	CYPROHEPTADINE	CYPROHEPTADINE
FDA	Metoclopramide	Metoclopramide	METOCLOPRAMIDE
DTC	PAPAVERINE	PAPAVERINE	PAPAVERINE
PharmGKB	levomepromazine	levomepromazine	LEVOMEPROMAZIN
PharmGKB	amoxapine	amoxapine	AMOXAPINE
PharmGKB	amiodarone	amiodarone	AMIODARONE
DTC	LOPERAMIDE	LOPERAMIDE	LOPERAMIDE
DTC	DICLOFENAC	DICLOFENAC	DICLOFENAC
DTC	MINOCYCLINE	MINOCYCLINE	MINOCYCLINE
DTC	PHENTOLAMINE M	PHENTOLAMINE ME	PHENTOLAMINE M
DTC	NEVIRAPINE	NEVIRAPINE	NEVIRAPINE
DTC	TRIFLUPROMAZINE	TRIFLUPROMAZINE	TRIFLUPROMAZINE
DTC	ALPROSTADIL	ALPROSTADIL	ALPROSTADIL
DTC	CAFFEINE	CAFFEINE	CAFFEINE
NCI	ACTH	ACTH	CORTICOTROPIN
PharmGKB	ritonavir	ritonavir	RITONAVIR
FDA	Imipramine	Imipramine	IMIPRAMINE
DTC	HYDRALAZINE	HYDRALAZINE	HYDRALAZINE
DTC	MICONAZOLE	MICONAZOLE	MICONAZOLE
DTC	KETOCONAZOLE	KETOCONAZOLE	KETOCONAZOLE
DTC	GENTAMICIN	GENTAMICIN	GENTAMICIN
DTC	TERAZOSIN	TERAZOSIN	TERAZOSIN
DTC	TETRACYCLINE	TETRACYCLINE	TETRACYCLINE
PharmGKB	disopyramide	disopyramide	DISOPYRAMIDE
DTC	MERCAPTOPURINE	MERCAPTOPURINE	MERCAPTOPURINE
DTC	PHENTOLAMINE	PHENTOLAMINE	PHENTOLAMINE
PharmGKB	yohimbine	yohimbine	YOHIMBINE
DTC	NISOLDIPINE	NISOLDIPINE	NISOLDIPINE
DTC	ACEPROMAZINE	ACEPROMAZINE	ACEPROMAZINE
DTC	ZIDOVUDINE	ZIDOVUDINE	ZIDOVUDINE
DTC	DEQUALINIUM	DEQUALINIUM	DEQUALINIUM
DTC	FLOXURIDINE	FLOXURIDINE	FLOXURIDINE
DTC	LABETALOL	LABETALOL	LABETALOL
DTC	FINASTERIDE	FINASTERIDE	FINASTERIDE
PharmGKB	nicotine	nicotine	NICOTINE
PharmGKB	bepridil	bepridil	BEPRIDIL
DTC	TICLOPIDINE	TICLOPIDINE	TICLOPIDINE
DTC	IMIPRAMINE	IMIPRAMINE	IMIPRAMINE
PharmGKB	clonidine	clonidine	CLONIDINE
FDA	Venlafaxine	Venlafaxine	VENLAFAXINE
DTC	CHLORHEXIDINE	CHLORHEXIDINE	CHLORHEXIDINE
DTC	CLEMIZOLE	CLEMIZOLE	CLEMIZOLE

DTC	IBUDILAST	IBUDILAST	IBUDILAST
DTC	PHENYTOIN	PHENYTOIN	PHENYTOIN
FDA	Rucaparib	Rucaparib	RUCAPARIB
DTC	BUSULFAN	BUSULFAN	BUSULFAN
DTC	NORTRIPTYLINE	NORTRIPTYLINE	NORTRIPTYLINE
PharmGKB	quinine	quinine	QUININE
PharmGKB	quinidine	quinidine	QUINIDINE
DTC	PIRENZEPINE	PIRENZEPINE	PIRENZEPINE
PharmGKB	ranolazine	ranolazine	RANOLAZINE
DTC	TESTOSTERONE	TESTOSTERONE	TESTOSTERONE
PharmGKB	esomeprazole	esomeprazole	ESOMEPRAZOLE
DTC	AMIODARONE	AMIODARONE	AMIODARONE
PharmGKB	lovastatin	lovastatin	LOVASTATIN
DTC	METHANTHELINE	METHANTHELINE	METHANTHELINE
DTC	DIGOXIN	DIGOXIN	DIGOXIN
PharmGKB	promethazine	promethazine	PROMETHAZINE
DTC	OMEPRAZOLE	OMEPRAZOLE	OMEPRAZOLE
PharmGKB	nefazodone	nefazodone	NEFAZODONE
FDA	Ondansetron	Ondansetron	ONDANSETRON
PharmGKB	fluphenazine	fluphenazine	FLUPHENAZINE
DTC	RIFAMPICIN	RIFAMPICIN	RIFAMPIN
FDA	Fluoxetine	Fluoxetine	FLUOXETINE
DTC	ETIDRONIC ACID	ETIDRONIC ACID	ETIDRONIC ACID
PharmGKB	nevirapine	nevirapine	NEVIRAPINE
DTC	DACARBAZINE	DACARBAZINE	DACARBAZINE
DTC	TRIAMCINOLONE	TRIAMCINOLONE	TRIAMCINOLONE
DTC	AMOXAPINE	AMOXAPINE	AMOXAPINE
DTC	TROGLITAZONE	TROGLITAZONE	TROGLITAZONE
DTC	ESTRADIOL	ESTRADIOL	ESTRADIOL
FDA	Clomipramine	Clomipramine	CLOMIPRAMINE
DTC	DACTINOMYCIN	DACTINOMYCIN	DACTINOMYCIN
DTC	NIMESULIDE	NIMESULIDE	NIMESULIDE
DTC	DANAZOL	DANAZOL	DANAZOL
DTC	DEXTROMETHORP	DEXTROMETHORPH/	DEXTROMETHORPH
DTC	FLUPHENAZINE	FLUPHENAZINE	FLUPHENAZINE
FDA	Quinidine	Quinidine	QUINIDINE
DTC	XYLOMETAZOLINE	XYLOMETAZOLINE	XYLOMETAZOLINE
DTC	FLUPIRTINE	FLUPIRTINE	FLUPIRTINE
DTC	MINOXIDIL	MINOXIDIL	MINOXIDIL
FDA	Paliperidone	Paliperidone	PALIPERIDONE
FDA	Amoxapine	Amoxapine	AMOXAPINE
PharmGKB	colchicine	colchicine	COLCHICINE
PharmGKB	ethanol	ethanol	ALCOHOL
DTC	DOXORUBICIN	DOXORUBICIN	DOXORUBICIN
DTC	DIPYRIDAMOLE	DIPYRIDAMOLE	DIPYRIDAMOLE
FDA	Paroxetine	Paroxetine	PAROXETINE
DTC	CLOTRIMAZOLE	CLOTRIMAZOLE	CLOTRIMAZOLE

PharmGKB		bromazepam	bromazepam	BROMAZEPAM
FDA		Carvedilol	Carvedilol	CARVEDILOL
DTC		HALOPERIDOL	HALOPERIDOL	HALOPERIDOL
FDA		Gefitinib	Gefitinib	GEFITINIB
FDA		Doxepin	Doxepin	DOXEPIN
FDA		Duloxetine	Duloxetine	DULOXETINE
DTC		INDOMETHACIN	INDOMETHACIN	INDOMETHACIN
DTC		DEXAMETHASONE	DEXAMETHASONE	DEXAMETHASONE
DTC		NICLOSAMIDE	NICLOSAMIDE	NICLOSAMIDE
DrugBank	inhibitor,sub	DB14011	Nabiximols	NABIXIMOLS
DTC		FASUDIL	FASUDIL	FASUDIL
PharmGKB		ibrutinib	ibrutinib	IBRUTINIB
DTC		METHYLDOPA	METHYLDOPA	METHYLDOPA
DTC		DALFAMPRIDINE	DALFAMPRIDINE	DALFAMPRIDINE
FDA		Aripiprazole	Aripiprazole	ARIPIPRAZOLE
DTC		LANSOPRAZOLE	LANSOPRAZOLE	LANSOPRAZOLE
DTC		MIRTAZAPINE	MIRTAZAPINE	MIRTAZAPINE
DTC		PSEUDOEPHEDRIN	PSEUDOEPHEDRINE	PSEUDOEPHEDRINE
DTC		IBUPROFEN	IBUPROFEN	IBUPROFEN
DTC		ETOPOSIDE	ETOPOSIDE	ETOPOSIDE
DTC		APOMORPHINE	APOMORPHINE	APOMORPHINE
PharmGKB		dronedarone	dronedarone	DRONEDARONE
PharmGKB		atorvastatin	atorvastatin	ATORVASTATIN
FDA		Citalopram	Citalopram	CITALOPRAM
NCI		METHYLPHENIDAT	METHYLPHENIDATE	METHYLPHENIDATE
FDA		Tamoxifen	Tamoxifen	TAMOXIFEN
NCI		STREPTOZOTOCIN	STREPTOZOTOCIN	STREPTOZOCIN
DTC		FLUSPIRILENE	FLUSPIRILENE	FLUSPIRILENE
DTC		CYTARABINE	CYTARABINE	CYTARABINE
DTC		TRIFLUOPERAZINE	TRIFLUOPERAZINE	TRIFLUOPERAZINE
DTC		RISPERIDONE	RISPERIDONE	RISPERIDONE
DTC		METHOTREXATE	METHOTREXATE	METHOTREXATE
DTC		ASPIRIN	ASPIRIN	ASPIRIN
PharmGKB		fluvastatin	fluvastatin	FLUVASTATIN
DTC		PROGESTERONE	PROGESTERONE	PROGESTERONE
NCI		ERLOTINIB	ERLOTINIB	ERLOTINIB
DTC		GLYBURIDE	GLYBURIDE	GLYBURIDE
DTC		CYCLOPHOSPHAM	CYCLOPHOSPHAMID	CYCLOPHOSPHAMI
DTC		CARBAMAZEPINE	CARBAMAZEPINE	CARBAMAZEPINE
DTC		SIMVASTATIN	SIMVASTATIN	SIMVASTATIN
FDA		Risperidone	Risperidone	RISPERIDONE
DTC		CYCLOSPORINE	CYCLOSPORINE	CYCLOSPORINE
DTC		CLOPIDOGREL	CLOPIDOGREL	CLOPIDOGREL
DTC		NIFEDIPINE	NIFEDIPINE	NIFEDIPINE
FDA		Tramadol	Tramadol	TRAMADOL
FDA		Clozapine	Clozapine	CLOZAPINE
PharmGKB		aspirin	aspirin	ASPIRIN

DrugBank	inhibitor	DB09061	Cannabidiol	CANNABIDIOL
DTC		LAMOTRIGINE	LAMOTRIGINE	LAMOTRIGINE
DTC		MIBEFRADIL	MIBEFRADIL	MIBEFRADIL
DTC		MENADIONE	MENADIONE	MENADIONE
FDA		Escitalopram	Escitalopram	ESCITALOPRAM
TEND		CILASTATIN	CILASTATIN	CILASTATIN
TdgClinicalTrial		CILASTATIN	CILASTATIN	CILASTATIN
TTD		Cilastatin	Cilastatin	CILASTATIN
DrugBank	inhibitor	DB01597	Cilastatin	CILASTATIN
ChemblInteractions	inhibitor	CHEMBL1201057	CILASTATIN SODIUM	CILASTATIN SODIUI
NCI		DEXAMETHASONE	DEXAMETHASONE	DEXAMETHASONE
NCI		IL-2	IL-2	ALDESLEUKIN
TdgClinicalTrial		DASATINIB	DASATINIB	DASATINIB
TEND		DASATINIB	DASATINIB	DASATINIB
TTD		Dasatinib	Dasatinib	DASATINIB
ChemblInteractions	inhibitor	CHEMBL1421	DASATINIB	DASATINIB
DrugBank	multitarget	DB01254	Dasatinib	DASATINIB
GuideToPharmacology	inhibitor	310264693	ACALABRUTINIB	ACALABRUTINIB
TALC	inhibitor	NINTEDANIB	NINTEDANIB	NINTEDANIB
GuideToPharmacology	inhibitor	178103494	IBRUTINIB	IBRUTINIB
GuideToPharmacology	inhibitor	178102336	BOSUTINIB	BOSUTINIB
DTC		VANDETANIB	VANDETANIB	VANDETANIB
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB
DTC		PAZOPANIB	PAZOPANIB	PAZOPANIB
DTC		ENTRECTINIB	ENTRECTINIB	ENTRECTINIB
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
TTD		E-2007	E-2007	PERAMPANEL
DrugBank	antagonist	DB08883	Perampanel	PERAMPANEL
ChemblInteractions	antagonist	CHEMBL1214124	PERAMPANEL	PERAMPANEL
TdgClinicalTrial		PERAMPANEL	PERAMPANEL	PERAMPANEL
DrugBank		DB04982	Talampanel	TALAMPANEL
TdgClinicalTrial		TALAMPANEL	TALAMPANEL	TALAMPANEL
DTC		PIRACETAM	PIRACETAM	PIRACETAM
GuideToPharmacology	allosteric mc	178101105	PIRACETAM	PIRACETAM
DrugBank	modulator	DB09289	Tianeptine	TIANEPTINE
DrugBank		DB06247	CX516	CX516
GuideToPharmacology	allosteric mc	178100985	CX516	CX516
GuideToPharmacology	antagonist	178101062	TEZAMPANEL	TEZAMPANEL
TdgClinicalTrial		TEZAMPANEL	TEZAMPANEL	TEZAMPANEL
ChemblInteractions	antagonist	CHEMBL14935	TEZAMPANEL	TEZAMPANEL
ChemblInteractions	antagonist	CHEMBL119625	ZONAMPANEL	ZONAMPANEL
ChemblInteractions	positive moc	CHEMBL1277001	MIBAMPATOR	MIBAMPATOR
ChemblInteractions	antagonist	CHEMBL3545042	Selurampanel	SELURAMPANEL
ChemblInteractions	positive moc	CHEMBL3707401	MK-8777	MK-8777
ChemblInteractions	antagonist	CHEMBL2107735	BECAMPANEL	BECAMPANEL
ChemblInteractions	positive moc	CHEMBL3707379	PF-04958242	PF-04958242
TdgClinicalTrial		BGG-492	BGG-492	SELURAMPANEL

ChemblInteractions	positive moc	CHEMBL3707399	CX1739	CX1739
ChemblInteractions	positive moc	CHEMBL1276138	FARAMPATOR	FARAMPATOR
TdgClinicalTrial		DESFLURANE	DESFLURANE	DESFLURANE
TEND		DESFLURANE	DESFLURANE	DESFLURANE
DrugBank	antagonist	DB01189	Desflurane	DESFLURANE
ChemblInteractions	antagonist	CHEMBL2103869	DASOLAMPANEL	DASOLAMPANEL
TdgClinicalTrial		SEVOFLURANE	SEVOFLURANE	SEVOFLURANE
DrugBank	antagonist	DB01236	Sevoflurane	SEVOFLURANE
TEND		SEVOFLURANE	SEVOFLURANE	SEVOFLURANE
DrugBank	antagonist	DB00237	Butabarbital	BUTABARBITAL
TEND		ISOFLURANE	ISOFLURANE	ISOFLURANE
DrugBank	antagonist	DB00753	Isoflurane	ISOFLURANE
TdgClinicalTrial		ISOFLURANE	ISOFLURANE	ISOFLURANE
DrugBank	antagonist	DB01028	Methoxyflurane	METHOXYFLURANE
NCI		SALINE	SALINE	SODIUM CHLORIDE
PharmGKB		asparaginase	asparaginase	ASPARAGINASE
TTD		NBQX	NBQX	NBQX
GuideToPharmacology	antagonist	178101081	NBQX	NBQX
GuideToPharmacology	allosteric mc	178100955	ANIRACETAM	ANIRACETAM
GuideToPharmacology	allosteric mc	178100987	CYCLOTHIAZIDE	CYCLOTHIAZIDE
DrugBank		DB00142	Glutamic acid	GLUTAMIC ACID
TdgClinicalTrial		ENFLURANE	ENFLURANE	ENFLURANE
TEND		ENFLURANE	ENFLURANE	ENFLURANE
DrugBank	inhibitor	DB00555	Lamotrigine	LAMOTRIGINE
ChemblInteractions	antagonist	CHEMBL29741	IRAMPANEL	IRAMPANEL
NCI		HALOPERIDOL	HALOPERIDOL	HALOPERIDOL
TEND		PHENOBARBITAL	PHENOBARBITAL	PHENOBARBITAL
TdgClinicalTrial		PHENOBARBITAL	PHENOBARBITAL	PHENOBARBITAL
PharmGKB		haloperidol	haloperidol	HALOPERIDOL
ChemblInteractions	antagonist	CHEMBL220492	TOPIRAMATE	TOPIRAMATE
DrugBank		DB00898	Ethanol	ALCOHOL
TTD		E-2007	E-2007	PERAMPANEL
DrugBank	antagonist	DB08883	Perampanel	PERAMPANEL
ChemblInteractions	antagonist	CHEMBL1214124	PERAMPANEL	PERAMPANEL
TdgClinicalTrial		PERAMPANEL	PERAMPANEL	PERAMPANEL
DTC		PIRACETAM	PIRACETAM	PIRACETAM
GuideToPharmacology	allosteric mc	178101105	PIRACETAM	PIRACETAM
DrugBank	modulator	DB09289	Tianeptine	TIANEPTINE
TdgClinicalTrial		DESFLURANE	DESFLURANE	DESFLURANE
TEND		DESFLURANE	DESFLURANE	DESFLURANE
DrugBank	antagonist	DB01189	Desflurane	DESFLURANE
TdgClinicalTrial		SEVOFLURANE	SEVOFLURANE	SEVOFLURANE
DrugBank	antagonist	DB01236	Sevoflurane	SEVOFLURANE
TEND		SEVOFLURANE	SEVOFLURANE	SEVOFLURANE
TEND		ISOFLURANE	ISOFLURANE	ISOFLURANE
DrugBank	antagonist	DB00753	Isoflurane	ISOFLURANE
TdgClinicalTrial		ISOFLURANE	ISOFLURANE	ISOFLURANE

DrugBank	antagonist	DB01028	Methoxyflurane	METHOXYFLURANE
NCI		SALINE	SALINE	SODIUM CHLORIDE
PharmGKB		asparaginase	asparaginase	ASPARAGINASE
GuideToPharmacology	allosteric mc	178100955	ANIRACETAM	ANIRACETAM
GuideToPharmacology	allosteric mc	178100987	CYCLOTHIAZIDE	CYCLOTHIAZIDE
DrugBank		DB00142	Glutamic acid	GLUTAMIC ACID
TdgClinicalTrial		ENFLURANE	ENFLURANE	ENFLURANE
TEND		ENFLURANE	ENFLURANE	ENFLURANE
DrugBank	inhibitor	DB00555	Lamotrigine	LAMOTRIGINE
NCI		HALOPERIDOL	HALOPERIDOL	HALOPERIDOL
TEND		PHENOBARBITAL	PHENOBARBITAL	PHENOBARBITAL
TdgClinicalTrial		PHENOBARBITAL	PHENOBARBITAL	PHENOBARBITAL
PharmGKB		haloperidol	haloperidol	HALOPERIDOL
ChemblInteractions	antagonist	CHEMBL220492	TOPIRAMATE	TOPIRAMATE
DrugBank		DB00898	Ethanol	ALCOHOL
PharmGKB	inhibitor	metoprolol	metoprolol	METOPROLOL
GuideToPharmacology	inhibitor	249565822	BALANOL	BALANOL
PharmGKB	antagonist	atenolol	atenolol	ATENOLOL
PharmGKB	inhibitor	verapamil	verapamil	VERAPAMIL
PharmGKB		metoprolol	metoprolol	METOPROLOL
PharmGKB		atenolol	atenolol	ATENOLOL
PharmGKB		verapamil	verapamil	VERAPAMIL
TTD		Amodiaquine	Amodiaquine	AMODIAQUINE
DrugBank	inhibitor	DB00613	Amodiaquine	AMODIAQUINE
DTC		DABIGATRAN	DABIGATRAN	DABIGATRAN
TTD		Diphenhydramine	Diphenhydramine	DIPHENHYDRAMIN
PharmGKB		aspirin	aspirin	ASPIRIN
DrugBank	inhibitor	DB00561	Doxapram	DOXAPRAM
ChemblInteractions	blocker	CHEMBL1200876	DOXAPRAM HYDRO(	DOXAPRAM HYDRC
PharmGKB		candesartan	candesartan	CANDESARTAN
GuideToPharmacology	activator	135650346	HALOTHANE	HALOTHANE
DrugBank	binder	DB01159	Halothane	HALOTHANE
ChemblInteractions		CHEMBL931	HALOTHANE	HALOTHANE
GuideToPharmacology	blocker	135651438	ANANDAMIDE	ANANDAMIDE
ChemblInteractions		CHEMBL1200733	DESFLURANE	DESFLURANE
ChemblInteractions		CHEMBL1257	ENFLURANE	ENFLURANE
ChemblInteractions		CHEMBL1200694	SEVOFLURANE	SEVOFLURANE
ChemblInteractions		CHEMBL1256	ISOFLURANE	ISOFLURANE
DTC		SB-242235	SB-242235	SB-242235
GuideToPharmacology	inhibitor	249565859	PF-03715455	PF-03715455
GuideToPharmacology	inhibitor	363894211	PEXMETINIB	PEXMETINIB
DTC		AZD-1080	AZD-1080	AZD-1080
DTC		TAK-715	TAK-715	TAK-715
DTC		SB-203580	SB-203580	SB-203580
DTC		SB-220025	SB-220025	SB-220025
DTC		BAY-613606	BAY-613606	CHEMBL541400
DTC		SNS-314	SNS-314	SNS-314

DTC		PD-0166285	PD-0166285	PD-0166285
DTC		ERLOTINIB	ERLOTINIB	ERLOTINIB
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB
DTC		OSI-632	OSI-632	OSI-632
DTC		681640	681640	CHEMBL379975
DTC		ALSTERPAULLONE	ALSTERPAULLONE	ALSTERPAULLONE
DTC		TOZASERTIB	TOZASERTIB	TOZASERTIB
DTC		LINIFANIB	LINIFANIB	LINIFANIB
DTC		SOTRASTAURIN	SOTRASTAURIN	SOTRASTAURIN
DTC		PHA-767491	PHA-767491	CHEMBL225519
DTC		GW441756X	GW441756X	GW441756X
DTC		GEFITINIB	GEFITINIB	GEFITINIB
DTC		ILORASERTIB	ILORASERTIB	ILORASERTIB
DTC		PF-562271	PF-562271	PF-00562271
DTC		DOVITINIB	DOVITINIB	DOVITINIB
DTC		DASATINIB	DASATINIB	DASATINIB
DTC		SORAFENIB	SORAFENIB	SORAFENIB
DTC		TAE-684	TAE-684	TAE-684
DTC		CENISERTIB	CENISERTIB	CENISERTIB
DTC		SP-600125	SP-600125	SP-600125
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
DTC		ERLOTINIB	ERLOTINIB	ERLOTINIB
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB
DTC		GEFITINIB	GEFITINIB	GEFITINIB
DTC		DASATINIB	DASATINIB	DASATINIB
DTC		SORAFENIB	SORAFENIB	SORAFENIB
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
ChemblInteractions	inhibitor	CHEMBL2323775	MK-8033	MK-8033
TALC	inhibitor	MGCD265	MGCD265	GLESATINIB
TdgClinicalTrial		MGCD265	MGCD265	GLESATINIB
ChemblInteractions	inhibitor	CHEMBL254760	MGCD-265	MGCD-265
GuideToPharmacology	inhibitor	249565636	BMS-777607	BMS-777607
DTC		BMS-754807	BMS-754807	BMS-754807
GuideToPharmacology	inhibitor	249565645	MK-2461	MK-2461
TTD		MK-2461	MK-2461	MK-2461
GuideToPharmacology	inhibitor	363894135	MERESTINIB	MERESTINIB
TALC	inhibitor	FORETINIB	FORETINIB	FORETINIB
DTC		AZD-1152-HQPA	AZD-1152-HQPA	AZD-1152-HQPA
DTC		681640	681640	CHEMBL379975
DTC		DNDI1417467	DNDI1417467	CHEMBL1997335
DTC		ALSTERPAULLONE	ALSTERPAULLONE	ALSTERPAULLONE
DTC		JNJ-7706621	JNJ-7706621	JNJ-7706621
DTC		ENTRECTINIB	ENTRECTINIB	ENTRECTINIB
DTC		PD-0166285	PD-0166285	PD-0166285
DTC		SOTRASTAURIN	SOTRASTAURIN	SOTRASTAURIN
DTC		PALBOCICLIB	PALBOCICLIB	PALBOCICLIB
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB

DTC		LINIFANIB	LINIFANIB	LINIFANIB
DTC		TOZASERTIB	TOZASERTIB	TOZASERTIB
DTC		ILORASERTIB	ILORASERTIB	ILORASERTIB
DTC		TAE-684	TAE-684	TAE-684
DTC		RG-1530	RG-1530	RG-1530
DTC		DOVITINIB	DOVITINIB	DOVITINIB
DTC		PF-562271	PF-562271	PF-00562271
DTC		CENISERTIB	CENISERTIB	CENISERTIB
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
DTC		ENTRECTINIB	ENTRECTINIB	ENTRECTINIB
DTC		PALBOCICLIB	PALBOCICLIB	PALBOCICLIB
DTC		CEDIRANIB	CEDIRANIB	CEDIRANIB
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
TEND		ACENOCOUMAROI	ACENOCOUMAROL	ACENOCOUMAROL
TTD		Acenocoumarol	Acenocoumarol	ACENOCOUMAROL
DrugBank	inhibitor	DB01418	Acenocoumarol	ACENOCOUMAROL
PharmGKB		acenocoumarol	acenocoumarol	ACENOCOUMAROL
TdgClinicalTrial		ACENOCOUMAROI	ACENOCOUMAROL	ACENOCOUMAROL
TdgClinicalTrial		PHENPROCOUMOI	PHENPROCOUMON	PHENPROCOUMON
GuideToPharmacology	inhibitor	178103445	PHENPROCOUMON	PHENPROCOUMON
DrugBank	inhibitor	DB00946	Phenprocoumon	PHENPROCOUMON
TTD		Phenprocoumon	Phenprocoumon	PHENPROCOUMON
PharmGKB		phenprocoumon	phenprocoumon	PHENPROCOUMON
TEND		PHENPROCOUMOI	PHENPROCOUMON	PHENPROCOUMON
ChemblInteractions	inhibitor	CHEMBL16694	PHENPROCOUMON	PHENPROCOUMON
DrugBank	inhibitor	DB00498	Phenindione	PHENINDIONE
GuideToPharmacology	inhibitor	178103444	PHENINDIONE	PHENINDIONE
TEND		PHENINDIONE	PHENINDIONE	PHENINDIONE
TdgClinicalTrial		PHENINDIONE	PHENINDIONE	PHENINDIONE
ChemblInteractions	inhibitor	CHEMBL711	PHENINDIONE	PHENINDIONE
TTD		Phenindione	Phenindione	PHENINDIONE
GuideToPharmacology	inhibitor	178103459	WARFARIN	WARFARIN
TdgClinicalTrial		WARFARIN	WARFARIN	WARFARIN
TEND		WARFARIN	WARFARIN	WARFARIN
TTD		Warfarin	Warfarin	WARFARIN
FDA		Warfarin	Warfarin	WARFARIN
PharmGKB		warfarin	warfarin	WARFARIN
DrugBank	inhibitor	DB00682	Warfarin	WARFARIN
PharmGKB		fluindione	fluindione	FLUINDIONE
TEND		DICUMAROL	DICUMAROL	DICUMAROL
DrugBank	inhibitor	DB00266	Dicoumarol	DICUMAROL
GuideToPharmacology	inhibitor	178103414	DICUMAROL	DICUMAROL
TTD		Dicumarol	Dicumarol	DICUMAROL
ChemblInteractions	inhibitor	CHEMBL1466	DICUMAROL	DICUMAROL
TdgClinicalTrial		DICUMAROL	DICUMAROL	DICUMAROL
ChemblInteractions	inhibitor	CHEMBL1200879	WARFARIN SODIUM	WARFARIN SODIUM
ChemblInteractions	inhibitor	CHEMBL1200772	WARFARIN POTASSI	WARFARIN POTASS

TEND		MENADIONE	MENADIONE	MENADIONE
DrugBank	cofactor	DB00170	Menadione	MENADIONE
TdgClinicalTrial		MENADIONE	MENADIONE	MENADIONE
GuideToPharmacology	inhibitor	135651418	ALITRETINOIN	ALITRETINOIN
PharmGKB		fructose	fructose	FRUCTOSE
DrugBank	inhibitor	DB12010	Fostamatinib	FOSTAMATINIB
PharmGKB		cerivastatin	cerivastatin	CERIVASTATIN
GuideToPharmacology	blocker,activ	178101120	RYANODINE	RYANODINE
DrugBank	modulator	DB09085	Tetracaine	TETRACAINE
DrugBank	inhibitor	DB01195	Flecainide	FLECAINIDE
TTD		Dantrolene	Dantrolene	DANTROLENE
GuideToPharmacology	blocker	178101108	PROCAINE	PROCAINE
PharmGKB		simvastatin	simvastatin	SIMVASTATIN
PharmGKB		atorvastatin	atorvastatin	ATORVASTATIN
GuideToPharmacology	inhibitor	135650057	CARVEDILOL	CARVEDILOL
GuideToPharmacology	activator	135652675	CAFFEINE	CAFFEINE
GuideToPharmacology	activator	135651219	SURAMIN	SURAMIN
GuideToPharmacology	activator	135651446	ATP	ADENOSINE TRIPHO
DTC		HEXACHLOROPHEI	HEXACHLOROPHENE	HEXACHLOROPHEN
NCI		LUTEIN	LUTEIN	LUTEIN
NCI		GANCICLOVIR	GANCICLOVIR	GANCICLOVIR
NCI		INTRALIPID	INTRALIPID	SOYBEAN OIL
PharmGKB		acenocoumarol	acenocoumarol	ACENOCOUMAROL
NCI		IRBESARTAN	IRBESARTAN	IRBESARTAN
PharmGKB		ritonavir	ritonavir	RITONAVIR
PharmGKB		fluvastatin	fluvastatin	FLUVASTATIN
NCI		LORAZEPAM	LORAZEPAM	LORAZEPAM
NCI		TRIAMCINOLONE	TRIAMCINOLONE	TRIAMCINOLONE
PharmGKB		pravastatin	pravastatin	PRAVASTATIN
PharmGKB		warfarin	warfarin	WARFARIN
PharmGKB		atorvastatin	atorvastatin	ATORVASTATIN
NCI		PREDNISONE	PREDNISONE	PREDNISONE
PharmGKB		fenofibrate	fenofibrate	FENOFIBRATE
NCI		TROGLITAZONE	TROGLITAZONE	TROGLITAZONE
NCI		STAUROSPORINE	STAUROSPORINE	STAUROSPORINE
PharmGKB		simvastatin	simvastatin	SIMVASTATIN
DrugBank	antagonist	DB14533	Zinc chloride	ZINC CHLORIDE
DrugBank		DB01593	Zinc	METHYLDOPA
DrugBank		DB09130	Copper	COPPER
DrugBank	binder	DB14533	Zinc chloride	ZINC CHLORIDE
PharmGKB		clozapine	clozapine	CLOZAPINE
DrugBank		DB01593	Zinc	METHYLDOPA
DrugBank	binder	DB14533	Zinc chloride	ZINC CHLORIDE
DrugBank		DB01593	Zinc	METHYLDOPA
ChemblInteractions	blocker	CHEMBL113461	TEDISAMIL	TEDISAMIL
ChemblInteractions	blocker	CHEMBL1200728	GUANIDINE HYDROC	GUANIDINE HYDRO
ChemblInteractions	blocker	CHEMBL284348	DALFAMPRIDINE	DALFAMPRIDINE

ChemblInteractions	blocker	CHEMBL2107762	NERISPIRDINE	NERISPIRDINE
DrugBank		DB00160	Alanine	ALANINE
PharmGKB		epirubicin	epirubicin	EPIRUBICIN
PharmGKB		cyclophosphamide	cyclophosphamide	CYCLOPHOSPHAMI
PharmGKB		fluorouracil	fluorouracil	FLUOROURACIL
PharmGKB		didanosine	didanosine	DIDANOSINE
PharmGKB		mercaptopurine	mercaptopurine	MERCAPTOPURINE
CIViC		MERCAPTOPURINE	MERCAPTOPURINE	MERCAPTOPURINE
CIViC		THIOGUANINE	THIOGUANINE	THIOGUANINE
DrugBank		DB00171	ATP	ADENOSINE TRIPHO
PharmGKB		gemcitabine	gemcitabine	GEMCITABINE
PharmGKB		cytarabine	cytarabine	CYTARABINE
CIViC		IPILIMUMAB	IPILIMUMAB	IPILIMUMAB
CIViC		DURVALUMAB	DURVALUMAB	DURVALUMAB
CIViC		NIVOLUMAB	NIVOLUMAB	NIVOLUMAB
CIViC		ATEZOLIZUMAB	ATEZOLIZUMAB	ATEZOLIZUMAB
CIViC		PEMBROLIZUMAB	PEMBROLIZUMAB	PEMBROLIZUMAB
CIViC		EVEROLIMUS	EVEROLIMUS	EVEROLIMUS
CGI		Everolimus	Everolimus	EVEROLIMUS
DTC		ALPRAZOLAM	ALPRAZOLAM	ALPRAZOLAM
DTC		TRIAZOLAM	TRIAZOLAM	TRIAZOLAM
CIViC		SUNITINIB	SUNITINIB	SUNITINIB

drug_concept_id	interactio	PMIDs	atc	atc_class	Analyses	gene_nam
chembl:CHEMBL3	0.3	##########	D11422	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL2	0.15		NA	NA	GWAS	PPARD
chembl:CHEMBL3	0.11		D10893	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL3	0.09		NA	NA	GWAS	PPARD
chembl:CHEMBL2	0.08		NA	NA	GWAS	PPARD
chembl:CHEMBL4	0.08		NA	NA	GWAS	PPARD
chembl:CHEMBL2	0.07		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.07		D10481	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL1	0.06		D10223	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL4	0.06		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.06		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.06		NA	NA	GWAS	PPARD
chembl:CHEMBL2	0.06		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.05		NA	NA	GWAS	PPARD
chembl:CHEMBL4	0.04		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.04	19035792	NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.03		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.03		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.03		D07907	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL2	0.03		NA	NA	GWAS	PPARD
chembl:CHEMBL4	0.03		D08881	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL5	0.03		NA	NA	GWAS	PPARD
chembl:CHEMBL3	0.03		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.03		D10926	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL4	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL2	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.02		D03658	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL1	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL4	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL5	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL9	0.02		D01977	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL1	0.02		D08524	L01 ANTINEOPLASTIC AGENTS	GWAS	PPARD
chembl:CHEMBL1	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.02		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.01		NA	NA	GWAS	PPARD
chembl:CHEMBL2	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS	GWAS	PPARD
chembl:CHEMBL5	0.01		NA	NA	GWAS	PPARD
chembl:CHEMBL1	0.01		NA	NA	GWAS	PPARD
chembl:CHEMBL4	1.63	##########	D01041	C01 CARDIAC THERAPY	GWAS	PPARD
chembl:CHEMBL2	0.14		D09893	A16 OTHER ALIMENTARY TRACT AN	GWAS	PPARD
chembl:CHEMBL7	0.14	##########	D07791	N06 PSYCHOANALEPTICS	GWAS	PPARD
chembl:CHEMBL7	0.14		D07791	N06 PSYCHOANALEPTICS	GWAS	PPARD

chembl:CHEMBL72	0.14		D07791	N06 PSYCHOANALEPTICS	GWAS	PPARD
chembl:CHEMBL21	0.14	20864621	D09893	A16 OTHER ALIMENTARY TRACT AN	GWAS	PPARD
chembl:CHEMBL49	0.13		D08600	C07 BETA BLOCKING AGENTS	GWAS	PPARD
chembl:CHEMBL14	0.13	##########	D08045	R05 COUGH AND COLD PREPARATI	GWAS	PPARD
chembl:CHEMBL49	0.13	##########	D08600	C07 BETA BLOCKING AGENTS	GWAS	PPARD
chembl:CHEMBL64	0.12		D00394	N06 PSYCHOANALEPTICS	GWAS	PPARD
chembl:CHEMBL64	0.12	##########	D00394	N06 PSYCHOANALEPTICS	GWAS	PPARD
chembl:CHEMBL32	0.1		D03534	A03 DRUGS FOR FUNCTIONAL GAST	GWAS	PPARD
chembl:CHEMBL15	0.1		D07406	R06 ANTIHISTAMINES FOR SYSTEM	GWAS	PPARD
chembl:CHEMBL10	0.1	25953735	D08617	M02 TOPICAL PRODUCTS FOR JOIN	GWAS	PPARD
chembl:CHEMBL16	0.1		D07084	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR		
chembl:CHEMBL13	0.1		D05411	J01 ANTIBACTERIALS FOR SYSTEMIC USE		
chembl:CHEMBL14	0.1		C11114	R06 ANTIHISTAMINES FOR SYSTEMIC USE		
chembl:CHEMBL40	0.1		D08418	M03 MUSCLE RELAXANTS		
chembl:CHEMBL23	0.1		D10675	N07 OTHER NERVOUS SYSTEM DRUGS		
chembl:CHEMBL23	0.1		D10675	N07 OTHER NERVOUS SYSTEM DRUGS		
chembl:CHEMBL48	0.1		D07546	C01 CARDIAC THERAPY		
chembl:CHEMBL13	0.08		D00646	G04 UROLOGICALS		
chembl:CHEMBL13	0.08	##########	D00646	G04 UROLOGICALS		
chembl:CHEMBL26	0.06	22931300	D02386	C03 DIURETICS		
chembl:CHEMBL46	0.06	17986163	D08104	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU		
chembl:CHEMBL63	0.06	##########	D08435	C01 CARDIAC THERAPY		
chembl:CHEMBL11	0.06		D07175	A04 ANTIEMETICS AND ANTINAUSEANTS		
chembl:CHEMBL16	0.06		D08163	R06 ANTIHISTAMINES FOR SYSTEMIC USE		
chembl:CHEMBL16	0.06	22931300	D08163	R06 ANTIHISTAMINES FOR SYSTEMIC USE		
chembl:CHEMBL11	0.06		D08575	N07 OTHER NERVOUS SYSTEM DRUGS		
chembl:CHEMBL55	0.06	9806111	D08215	C01 CARDIAC THERAPY		
chembl:CHEMBL65	0.06		D04292	N06 PSYCHOANALEPTICS		
chembl:CHEMBL65	0.06	23503455	D04292	N06 PSYCHOANALEPTICS		
chembl:CHEMBL55	0.06		D08215	C01 CARDIAC THERAPY		
chembl:CHEMBL16	0.06		D08163	R06 ANTIHISTAMINES FOR SYSTEMIC USE		
chembl:CHEMBL11	0.06	23280482	D08575	N07 OTHER NERVOUS SYSTEM DRUGS		
chembl:CHEMBL63	0.06		D08435	C01 CARDIAC THERAPY		
chembl:CHEMBL11	0.06		D07175	A04 ANTIEMETICS AND ANTINAUSEANTS		
chembl:CHEMBL13	0.05		D01832	N06 PSYCHOANALEPTICS		
chembl:CHEMBL18	0.05		D07176	C04 PERIPHERAL VASODILATORS		
chembl:CHEMBL11	0.05		D01140	D08 ANTISEPTICS AND DISINFECTANTS		
chembl:CHEMBL13	0.05	10820139	D01832	N06 PSYCHOANALEPTICS		
chembl:CHEMBL20	0.05		D09535	G04 UROLOGICALS		
chembl:CHEMBL13	0.05		D01832	N06 PSYCHOANALEPTICS		
chembl:CHEMBL20	0.05		D09535	G04 UROLOGICALS		
chembl:CHEMBL11	0.05		D08092	C04 PERIPHERAL VASODILATORS		
chembl:CHEMBL13	0.05	22931300	D01832	N06 PSYCHOANALEPTICS		
chembl:CHEMBL43	0.05		D05127	C07 BETA BLOCKING AGENTS		
chembl:CHEMBL12	0.05		D08462	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC		
chembl:CHEMBL11	0.05	29327975	D07793	N06 PSYCHOANALEPTICS		
chembl:CHEMBL16	0.05		D08382	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR		

chembl:CHEMBL11	0.05		D07793	N06 PSYCHOANALEPTICS
chembl:CHEMBL13	0.05		D02565	N06 PSYCHOANALEPTICS
chembl:CHEMBL15	0.05		D02625	N05 PSYCHOLEPTICS
chembl:CHEMBL13	0.05		D07458	R01 NASAL PREPARATIONS
chembl:CHEMBL17	0.05		D07929	R05 COUGH AND COLD PREPARATIONS
chembl:CHEMBL43	0.05		D05127	C07 BETA BLOCKING AGENTS
chembl:CHEMBL12	0.05		D07516	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL12	0.04	22931300	D00402	M03 MUSCLE RELAXANTS
chembl:CHEMBL16	0.04		D07667	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL21	0.04	26937172	D03649	G04 UROLOGICALS
chembl:CHEMBL14	0.04	22931300	D01351	N02 ANALGESICS
chembl:CHEMBL39	0.04	17986163	D08047	N02 ANALGESICS
chembl:CHEMBL16	0.04		D07667	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL98	0.04	22931300	D00337	R05 COUGH AND COLD PREPARATIONS
chembl:CHEMBL56	0.04	22931300	D01322	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL12	0.04		D07990	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL66	0.04		D08447	N06 PSYCHOANALEPTICS
chembl:CHEMBL75	0.04		D08340	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL75	0.04	22931300	D08340	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL12	0.04		D07990	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL66	0.04		D08447	N06 PSYCHOANALEPTICS
chembl:CHEMBL54	0.04	22931300	D08261	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL66	0.04		D08447	N06 PSYCHOANALEPTICS
chembl:CHEMBL92	0.04	22931300	D02579	N06 PSYCHOANALEPTICS
chembl:CHEMBL83	0.03		D08560	G04 UROLOGICALS
chembl:CHEMBL46	0.03		D10749	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL12	0.03		D02139	S02 OTOLOGICALS
chembl:CHEMBL29	0.03		D02627	N05 PSYCHOLEPTICS
chembl:CHEMBL10	0.03	22931300	D08181	N01 ANESTHETICS
chembl:CHEMBL46	0.03		D10749	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL42	0.03	22931300	D07753	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL83	0.03		D08560	G04 UROLOGICALS
chembl:CHEMBL21	0.03		D10309	N05 PSYCHOLEPTICS
chembl:CHEMBL12	0.03		D10208	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL50	0.03	##########	D07869	N06 PSYCHOANALEPTICS
chembl:CHEMBL11	0.03		D07195	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL95	0.03	22931300	D02565	N06 PSYCHOANALEPTICS
chembl:CHEMBL21	0.03		D10309	N05 PSYCHOLEPTICS
chembl:CHEMBL57	0.03	25989235	D00132	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL36	0.03		D10994	L04 IMMUNOSUPPRESSANTS
chembl:CHEMBL14	0.03		D07862	R06 ANTIHISTAMINES FOR SYSTEMIC USE
chembl:CHEMBL20	0.03		D09997	N05 PSYCHOLEPTICS
chembl:CHEMBL53	0.03	##########	D03556	N05 PSYCHOLEPTICS
chembl:CHEMBL12	0.03	22931300	D00468	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL12	0.03	24044938	D00947	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL12	0.03		D08319	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL11	0.03		D10533	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES

chembl:CHEMBL63	0.03	16141569	D00578	J02 ANTIMYCOTICS FOR SYSTEMIC USE
chembl:CHEMBL14	0.03	22931300	D07766	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL8	0.03	22931300	D11582	D07 CORTICOSTEROIDS, DERMATOLOGICAL PREPARATIO
chembl:CHEMBL13	0.03		D03654	G04 UROLOGICALS
chembl:CHEMBL15	0.03	22931300	D00240	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL12	0.03	22931300	D00465	G04 UROLOGICALS
chembl:CHEMBL12	0.03		D08116	N01 ANESTHETICS
chembl:CHEMBL50	0.03		D07869	N06 PSYCHOANALEPTICS
chembl:CHEMBL13	0.03		D03654	G04 UROLOGICALS
chembl:CHEMBL12	0.03		C07055	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL12	0.03	22931300	D08192	C01 CARDIAC THERAPY
chembl:CHEMBL15	0.03	22931300	D02448	P01 ANTIPROTOZOALS
chembl:CHEMBL11	0.03		D10533	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL12	0.03		D07226	G04 UROLOGICALS
chembl:CHEMBL12	0.03		D08033	P01 ANTIPROTOZOALS
chembl:CHEMBL11	0.03	22931300	D01954	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL36	0.03		D10994	L04 IMMUNOSUPPRESSANTS
chembl:CHEMBL12	0.03	22931300	D08016	B03 ANTIANEMIC PREPARATIONS
chembl:CHEMBL20	0.03		D09997	N05 PSYCHOLEPTICS
chembl:CHEMBL56	0.03	##########	D02130	A04 ANTIEMETICS AND ANTINAUSEANTS
chembl:CHEMBL12	0.03		D07226	G04 UROLOGICALS
chembl:CHEMBL89	0.03	22931300	D08246	N02 ANALGESICS
chembl:CHEMBL26	0.03	22931300	D00203	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL8	0.03	27469576	D11582	D07 CORTICOSTEROIDS, DERMATOLOGICAL PREPARATIO
chembl:CHEMBL15	0.02	22931300	C07005	R01 NASAL PREPARATIONS
chembl:CHEMBL24	0.02		D07521	D05 ANTIPSORIATICS
chembl:CHEMBL14	0.02		D07440	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL97	0.02	22931300	D03731	N04 ANTI-PARKINSON DRUGS
chembl:CHEMBL52	0.02	22931300	D07486	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL53	0.02		D08105	R06 ANTIHISTAMINES FOR SYSTEMIC USE
chembl:CHEMBL21	0.02		D01745	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL47	0.02	##########	D00373	N05 PSYCHOLEPTICS
chembl:CHEMBL10	0.02	22931300	D00510	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL15	0.02	22931300	D07495	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL47	0.02	22931300	D08525	C07 BETA BLOCKING AGENTS
chembl:CHEMBL57	0.02	22931300	D00036	A11 VITAMINS
chembl:CHEMBL57	0.02	22931300	D00439	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL22	0.02	22931300	D02682	N05 PSYCHOLEPTICS
chembl:CHEMBL68	0.02	22931300	D00151	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL11	0.02	22931300	C07051	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL65	0.02	22931300	D00300	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL17	0.02		D08141	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL21	0.02		D06665	C01 CARDIAC THERAPY
chembl:CHEMBL11	0.02	##########	D08695	N02 ANALGESICS
chembl:CHEMBL16	0.02	22931300	D03535	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL17	0.02		D08141	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL15	0.02		D08464	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,

chembl:CHEMBL26	0.02	22931300	D01226	N05 PSYCHOLEPTICS
chembl:CHEMBL82	0.02		D02375	D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
chembl:CHEMBL89	0.02	22931300	D08054	N05 PSYCHOLEPTICS
chembl:CHEMBL11	0.02	22931300	D00382	C03 DIURETICS
chembl:CHEMBL14	0.02	##########	D00560	N05 PSYCHOLEPTICS
chembl:CHEMBL40	0.02		D07445	N06 PSYCHOANALEPTICS
chembl:CHEMBL76	0.02		D08253	R01 NASAL PREPARATIONS
chembl:CHEMBL56	0.02	2743709	D00503	N05 PSYCHOLEPTICS
chembl:CHEMBL96	0.02		D08323	N02 ANALGESICS
chembl:CHEMBL12	0.02		D05705	C02 ANTIHYPERTENSIVES
chembl:CHEMBL15	0.02		D07887	N02 ANALGESICS
chembl:CHEMBL12	0.02	22931300	D00762	C02 ANTIHYPERTENSIVES
chembl:CHEMBL28	0.02		D08482	C02 ANTIHYPERTENSIVES
chembl:CHEMBL61	0.02	22931300	D00144	J04 ANTIMYCOBACTERIALS
chembl:CHEMBL47	0.02		D00373	N05 PSYCHOLEPTICS
chembl:CHEMBL27	0.02	22931300	D08443	C07 BETA BLOCKING AGENTS
chembl:CHEMBL12	0.02	22931300	D02347	M03 MUSCLE RELAXANTS
chembl:CHEMBL29	0.02	22931300	D07350	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL12	0.02		D02363	C02 ANTIHYPERTENSIVES
chembl:CHEMBL21	0.02		D10184	N06 PSYCHOANALEPTICS
chembl:CHEMBL22	0.02	22931300	D00145	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL78	0.02	22931300	D01111	A10 DRUGS USED IN DIABETES
chembl:CHEMBL56	0.02		D00503	N05 PSYCHOLEPTICS
chembl:CHEMBL31	0.02		D07330	N05 PSYCHOLEPTICS
chembl:CHEMBL11	0.02		C07506	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL14	0.02		D00560	N05 PSYCHOLEPTICS
chembl:CHEMBL25	0.02		D07345	N06 PSYCHOANALEPTICS
chembl:CHEMBL23	0.02		D02577	G02 OTHER GYNECOLOGICALS
chembl:CHEMBL23	0.02		D02577	G02 OTHER GYNECOLOGICALS
chembl:CHEMBL49	0.02	22931300	D00271	A10 DRUGS USED IN DIABETES
chembl:CHEMBL10	0.02	22931300	D00322	D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
chembl:CHEMBL15	0.02	10848718	D08050	P01 ANTIPROTOZOALS
chembl:CHEMBL16	0.02	22931300	D02212	R01 NASAL PREPARATIONS
chembl:CHEMBL12	0.02	22931300	D08220	C01 CARDIAC THERAPY
chembl:CHEMBL14	0.02	23277250	D02666	N05 PSYCHOLEPTICS
chembl:CHEMBL11	0.02	22931300	D08695	N02 ANALGESICS
chembl:CHEMBL50	0.02		D04044	N02 ANALGESICS
chembl:CHEMBL10	0.02	22931300	D00208	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL64	0.02		D07473	N06 PSYCHOANALEPTICS
chembl:CHEMBL47	0.02	22931300	D00647	C01 CARDIAC THERAPY
chembl:CHEMBL64	0.02		D07473	N06 PSYCHOANALEPTICS
chembl:CHEMBL12	0.02		D01152	C05 VASOPROTECTIVES
chembl:CHEMBL40	0.02	9264312	D07445	N06 PSYCHOANALEPTICS
chembl:CHEMBL12	0.02	22931300	D08113	L02 ENDOCRINE THERAPY
chembl:CHEMBL14	0.02		D02666	N05 PSYCHOLEPTICS
chembl:CHEMBL23	0.02	22931300	D07615	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL21	0.02		D10184	N06 PSYCHOANALEPTICS

chembl:CHEMBL14	0.02		D07961	G04 UROLOGICALS
chembl:CHEMBL12	0.02	22931300	D04464	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL4	0.02	22931300	D11582	D07 CORTICOSTEROIDS, DERMATOLOGICAL PREPARATIO
chembl:CHEMBL28	0.02		D01101	N05 PSYCHOLEPTICS
chembl:CHEMBL10	0.02	22931300	D00592	D10 ANTI-ACNE PREPARATIONS
chembl:CHEMBL81	0.02		D04557	V09 DIAGNOSTIC RADIOPHARMACEUTICALS
chembl:CHEMBL23	0.02	22931300	D07845	C05 VASOPROTECTIVES
chembl:CHEMBL15	0.02	22931300	D00118	G02 OTHER GYNECOLOGICALS
chembl:CHEMBL58	0.02		D08489	N04 ANTI-PARKINSON DRUGS
chembl:CHEMBL51	0.02	22931300	D00254	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL56	0.02		D00503	N05 PSYCHOLEPTICS
chembl:CHEMBL13	0.02		D01773	R06 ANTIHISTAMINES FOR SYSTEMIC USE
chembl:CHEMBL12	0.02	22931300	D00965	L02 ENDOCRINE THERAPY
chembl:CHEMBL10	0.02	22931300	D00536	N03 ANTIEPILEPTICS
chembl:CHEMBL11	0.02	22931300	C07410	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL26	0.02	22931300	C07511	C02 ANTIHYPERTENSIVES
chembl:CHEMBL64	0.02	##########	D08216	N06 PSYCHOANALEPTICS
chembl:CHEMBL92	0.02		D04733	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL40	0.02		D07445	N06 PSYCHOANALEPTICS
chembl:CHEMBL27	0.02		D08443	C07 BETA BLOCKING AGENTS
chembl:CHEMBL52	0.02	22931300	D00127	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL50	0.02	22931300	D07645	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL14	0.02		D00560	N05 PSYCHOLEPTICS
chembl:CHEMBL15	0.02	22931300	D01011	H03 THYROID THERAPY
chembl:CHEMBL17	0.01	22931300	D00422	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL41	0.01		D00139	D05 ANTIPSORIATICS
chembl:CHEMBL71	0.01	##########	D08456	N05 PSYCHOLEPTICS
chembl:CHEMBL10	0.01	22931300	D00399	N03 ANTIEPILEPTICS
chembl:CHEMBL53	0.01	22931300	D10602	D10 ANTI-ACNE PREPARATIONS
chembl:CHEMBL18	0.01		D00294	C02 ANTIHYPERTENSIVES
chembl:CHEMBL50	0.01	22931300	D00359	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL69	0.01	22931300	D10590	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL48	0.01		D07831	N02 ANALGESICS
chembl:CHEMBL75	0.01	22931300	D08358	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL81	0.01		D07984	N06 PSYCHOANALEPTICS
chembl:CHEMBL41	0.01	18814214	D07270	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL13	0.01		D07305	N04 ANTI-PARKINSON DRUGS
chembl:CHEMBL28	0.01	16551910	D04370	A04 ANTIEMETICS AND ANTINAUSEANTS
chembl:CHEMBL14	0.01	22931300	D00224	M04 ANTIGOUT PREPARATIONS
chembl:CHEMBL81	0.01	22931300	D08465	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL76	0.01		D08322	R01 NASAL PREPARATIONS
chembl:CHEMBL66	0.01		D07758	M03 MUSCLE RELAXANTS
chembl:CHEMBL13	0.01	22931300	D00246	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL26	0.01	17202802	D08556	D11 OTHER DERMATOLOGICAL PREPARATIONS
chembl:CHEMBL52	0.01		D10208	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL14	0.01	22931300	D00296	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL40	0.01	22931300	D00506	N03 ANTIEPILEPTICS

chembl:CHEMBL43	0.01	22931300	D02321	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL30	0.01	22931300	D00295	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL12	0.01		D00278	J04 ANTIMYCOBACTERIALS
chembl:CHEMBL12	0.01		D02566	N06 PSYCHOANALEPTICS
chembl:CHEMBL15	0.01	22931300	D00120	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL16	0.01	24915025	D00512	N03 ANTIEPILEPTICS
chembl:CHEMBL70	0.01	##########	D07460	G04 UROLOGICALS
chembl:CHEMBL10	0.01	22931300	D00570	M04 ANTIGOUT PREPARATIONS
chembl:CHEMBL51	0.01		D08183	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL19	0.01		D10744	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL12	0.01		D07881	N01 ANESTHETICS
chembl:CHEMBL56	0.01	22931300	D00279	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL99	0.01		D10252	R01 NASAL PREPARATIONS
chembl:CHEMBL78	0.01	22931300	D08229	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL11	0.01		D03852	N01 ANESTHETICS
chembl:CHEMBL56	0.01		D00270	N05 PSYCHOLEPTICS
chembl:CHEMBL11	0.01		D00574	L02 ENDOCRINE THERAPY
chembl:CHEMBL62	0.01		D07448	N06 PSYCHOANALEPTICS
chembl:CHEMBL41	0.01		D07727	N06 PSYCHOANALEPTICS
chembl:CHEMBL78	0.01		D08559	L02 ENDOCRINE THERAPY
chembl:CHEMBL13	0.01		D00281	C02 ANTIHYPERTENSIVES
chembl:CHEMBL17	0.01	22931300	D10246	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL41	0.01	22931300	D00326	N06 PSYCHOANALEPTICS
chembl:CHEMBL62	0.01		D08257	N06 PSYCHOANALEPTICS
chembl:CHEMBL11	0.01		D07820	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL59	0.01	25825958	D00320	N01 ANESTHETICS
chembl:CHEMBL63	0.01	22931300	C07370	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL77	0.01	22931300	D08016	B03 ANTIANEMIC PREPARATIONS
chembl:CHEMBL62	0.01	22931300	D07448	N06 PSYCHOANALEPTICS
chembl:CHEMBL72	0.01	22931300	D00493	N05 PSYCHOLEPTICS
chembl:CHEMBL42	0.01	22931300	D00448	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL10	0.01	22931300	D09742	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL16	0.01		D05339	N05 PSYCHOLEPTICS
chembl:CHEMBL60	0.01	22931300	D00411	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL99	0.01	22931300	D00445	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL12	0.01		D00561	N05 PSYCHOLEPTICS
chembl:CHEMBL41	0.01	22931300	D00577	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL44	0.01		D08288	N06 PSYCHOANALEPTICS
chembl:CHEMBL29	0.01		D00234	R06 ANTIHISTAMINES FOR SYSTEMIC USE
chembl:CHEMBL16	0.01	22931300	D07659	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL11	0.01		D10079	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL76	0.01	22931300	D02366	P01 ANTIPROTOZOALS
chembl:CHEMBL86	0.01		D08031	C02 ANTIHYPERTENSIVES
chembl:CHEMBL21	0.01	22931300	D02566	N06 PSYCHOANALEPTICS
chembl:CHEMBL10	0.01		D08349	N06 PSYCHOANALEPTICS
chembl:CHEMBL12	0.01	11246175	D02792	B05 BLOOD SUBSTITUTES AND PERFUSION SOLUTIONS
chembl:CHEMBL71	0.01	8739822	D00270	N05 PSYCHOLEPTICS

chembl:CHEMBL13	0.01		D02358	C07 BETA BLOCKING AGENTS
chembl:CHEMBL15	0.01	22931300	D00238	L04 IMMUNOSUPPRESSANTS
chembl:CHEMBL15	0.01	22931300	D00562	H03 THYROID THERAPY
chembl:CHEMBL79	0.01	22931300	D01896	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL71	0.01		D00270	N05 PSYCHOLEPTICS |
chembl:CHEMBL51	0.01		D07765	R06 ANTIHISTAMINES FOR SYSTEMIC USE
chembl:CHEMBL86	0.01		D00726	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL19	0.01		D07425	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL17	0.01	##########	D00403	N05 PSYCHOLEPTICS |
chembl:CHEMBL11	0.01		D00228	N06 PSYCHOANALEPTICS
chembl:CHEMBL63	0.01		D02910	C01 CARDIAC THERAPY
chembl:CHEMBL84	0.01		D08144	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL13	0.01	22931300	D07816	D11 OTHER DERMATOLOGICAL PREPARATIONS
chembl:CHEMBL14	0.01	22931300	D05045	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL12	0.01		D08362	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL57	0.01	22931300	D00435	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL57	0.01		D00390	N05 PSYCHOLEPTICS |
chembl:CHEMBL49	0.01	22931300	D00180	C01 CARDIAC THERAPY
chembl:CHEMBL11	0.01	22931300	D04044	N02 ANALGESICS |
chembl:CHEMBL12	0.01	12571407	D00146	H01 PITUITARY AND HYPOTHALAMIC HORMONES AND AI
chembl:CHEMBL16	0.01	24433361	D00427	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL11	0.01		D08070	N06 PSYCHOANALEPTICS
chembl:CHEMBL27	0.01	22931300	D04265	C02 ANTIHYPERTENSIVES
chembl:CHEMBL91	0.01		D00416	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL15	0.01	22931300	D00351	D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
chembl:CHEMBL30	0.01	22931300	D08013	D06 ANTIBIOTICS AND CHEMOTHERAPEUTICS FOR DERM
chembl:CHEMBL61	0.01	22931300	D08569	G04 UROLOGICALS |
chembl:CHEMBL14	0.01	22931300	D00201	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL51	0.01		D00303	C01 CARDIAC THERAPY
chembl:CHEMBL14	0.01	22931300	D04931	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL59	0.01		D08362	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL15	0.01	15289791	D08685	G04 UROLOGICALS |
chembl:CHEMBL17	0.01	22931300	D00618	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL39	0.01		D07065	N05 PSYCHOLEPTICS |
chembl:CHEMBL12	0.01	22931300	D00413	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL33	0.01		D01575	D08 ANTISEPTICS AND DISINFECTANTS
chembl:CHEMBL91	0.01	22931300	D04197	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL42	0.01	22931300	D08106	C07 BETA BLOCKING AGENTS
chembl:CHEMBL71	0.01	22931300	D00321	D11 OTHER DERMATOLOGICAL PREPARATIONS
chembl:CHEMBL3	0.01	##########	D03365	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL10	0.01	16508157	D07520	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL83	0.01	22931300	D08594	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL11	0.01	22931300	D08070	N06 PSYCHOANALEPTICS
chembl:CHEMBL13	0.01		D00281	C02 ANTIHYPERTENSIVES
chembl:CHEMBL63	0.01		D08670	N06 PSYCHOANALEPTICS
chembl:CHEMBL79	0.01		D07668	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL14	0.01		D02336	J01 ANTIBACTERIALS FOR SYSTEMIC USE

chembl:CHEMBL19	0.01		D01385	R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
chembl:CHEMBL16	0.01	22931300	D00512	N03 ANTIEPILEPTICS
chembl:CHEMBL11	0.01		D10079	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL82	0.01	22931300	D00248	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL44	0.01		D08288	N06 PSYCHOANALEPTICS
chembl:CHEMBL17	0.01		D08267	M09 OTHER DRUGS FOR DISORDERS OF THE MUSCULO-S
chembl:CHEMBL12	0.01		D08458	C01 CARDIAC THERAPY
chembl:CHEMBL99	0.01		D08389	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL14	0.01		D05700	C01 CARDIAC THERAPY
chembl:CHEMBL38	0.01	22931300	D00408	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL12	0.01		D07917	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL63	0.01		D02910	C01 CARDIAC THERAPY
chembl:CHEMBL50	0.01	22281720	D00359	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL12	0.01		C07849	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL17	0.01	22931300	D07555	C01 CARDIAC THERAPY
chembl:CHEMBL64	0.01	17986163	D00494	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL15	0.01	22931300	D00455	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL62	0.01		D08257	N06 PSYCHOANALEPTICS
chembl:CHEMBL46	0.01		D00456	A04 ANTIEMETICS AND ANTINAUSEANTS
chembl:CHEMBL72	0.01		D07977	N05 PSYCHOLEPTICS
chembl:CHEMBL37	0.01	22931300	D00211	J04 ANTIMYCOBACTERIALS
chembl:CHEMBL41	0.01		D00326	N06 PSYCHOANALEPTICS
chembl:CHEMBL87	0.01	22931300	D02373	M05 DRUGS FOR TREATMENT OF BONE DISEASES
chembl:CHEMBL57	0.01		D00435	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL47	0.01	22931300	D00288	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.01	22931300	D00385	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL11	0.01		D00228	N06 PSYCHOANALEPTICS
chembl:CHEMBL40	0.01	22931300	D00395	A10 DRUGS USED IN DIABETES
chembl:CHEMBL13	0.01	22931300	D04460	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL41	0.01		D07727	N06 PSYCHOANALEPTICS
chembl:CHEMBL15	0.01	22931300	D00214	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL56	0.01	22931300	D01049	M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODU
chembl:CHEMBL14	0.01	22931300	D00289	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL52	0.01	21422192	D10208	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL72	0.01		D07977	N05 PSYCHOLEPTICS
chembl:CHEMBL12	0.01		D08458	C01 CARDIAC THERAPY
chembl:CHEMBL31	0.01		D08684	R01 NASAL PREPARATIONS
chembl:CHEMBL25	0.01		D07978	N02 ANALGESICS
chembl:CHEMBL80	0.01	22931300	D00418	C02 ANTIHYPERTENSIVES
chembl:CHEMBL16	0.01		D05339	N05 PSYCHOLEPTICS
chembl:CHEMBL11	0.01		D00228	N06 PSYCHOANALEPTICS
chembl:CHEMBL10	0.01	25645282	D00570	M04 ANTIGOUT PREPARATIONS
chembl:CHEMBL54	0	24611668	D05158	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL53	0	22931300	D03899	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL93	0		D00302	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL49	0		D02362	N06 PSYCHOANALEPTICS
chembl:CHEMBL10	0		D00282	A01 STOMATOLOGICAL PREPARATIONS

chembl:CHEMBL27	0		D01245	N05 PSYCHOLEPTICS |
chembl:CHEMBL72	0		D00255	C07 BETA BLOCKING AGENTS
chembl:CHEMBL54	0		D00136	N05 PSYCHOLEPTICS |
chembl:CHEMBL93	0		D01977	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL16	0		D07875	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL11	0		D07880	N06 PSYCHOANALEPTICS
chembl:CHEMBL6	0	22931300	D00141	C01 CARDIAC THERAPY
chembl:CHEMBL38	0	22931300	D00292	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL14	0		D00436	P02 ANTHELMINTICS |
chembl:CHEMBL38	0	26264914	D09317	N02 ANALGESICS |
chembl:CHEMBL38	0		D07941	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL18	0		D10223	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL45	0	22931300	D08205	C02 ANTIHYPERTENSIVES
chembl:CHEMBL28	0		D04127	N07 OTHER NERVOUS SYSTEM DRUGS
chembl:CHEMBL11	0		D01164	N05 PSYCHOLEPTICS |
chembl:CHEMBL48	0		D00355	A02 DRUGS FOR ACID RELATED DISORDERS
chembl:CHEMBL65	0		D00563	N06 PSYCHOANALEPTICS
chembl:CHEMBL15	0		D08449	R01 NASAL PREPARATIONS
chembl:CHEMBL52	0	22931300	D10449	A03 DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISOR
chembl:CHEMBL44	0	22931300	D00125	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL53	0		D07460	G04 UROLOGICALS |
chembl:CHEMBL18	0		D02537	C01 CARDIAC THERAPY
chembl:CHEMBL14	0	17700359	D07474	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL54	0		D07704	N06 PSYCHOANALEPTICS
chembl:CHEMBL79	0	10831022	D04999	N06 PSYCHOANALEPTICS
chembl:CHEMBL83	0		D08559	L02 ENDOCRINE THERAPY
chembl:CHEMBL16	0	6305526	D05932	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL46	0		D02629	N05 PSYCHOLEPTICS |
chembl:CHEMBL80	0	22931300	D00168	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL42	0		D08636	N05 PSYCHOLEPTICS |
chembl:CHEMBL85	0		D00426	N05 PSYCHOLEPTICS |
chembl:CHEMBL34	0	22931300	D00142	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL25	0	22931300	D00109	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL22	0		D07983	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL10	0	22931300	D08166	G03 SEX HORMONES AND MODULATORS OF THE GENITA
chembl:CHEMBL55	0	17575239	D07907	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL47	0		D00336	A10 DRUGS USED IN DIABETES
chembl:CHEMBL88	0	22931300	D07760	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL10	0	22931300	D00252	N03 ANTIEPILEPTICS |
chembl:CHEMBL10	0	22931300	D10258	A10 DRUGS USED IN DIABETES
chembl:CHEMBL85	0		D00426	N05 PSYCHOLEPTICS |
chembl:CHEMBL16	0	22931300	D00184	L04 IMMUNOSUPPRESSANTS
chembl:CHEMBL17	0		D07729	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL19	0	22931300	C07FB02	C07 BETA BLOCKING AGENTS
chembl:CHEMBL12	0		D09999	N02 ANALGESICS |
chembl:CHEMBL42	0		D00283	N05 PSYCHOLEPTICS |
chembl:CHEMBL25	0		D00109	A01 STOMATOLOGICAL PREPARATIONS

chembl:CHEMBL19	0	26264914	D10915	N03 ANTIEPILEPTICS
chembl:CHEMBL74	0	22931300	D00354	N03 ANTIEPILEPTICS
chembl:CHEMBL45	0		D08217	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL59	0		D02335	B02 ANTIHEMORRHAGICS
chembl:CHEMBL15	0		D07913	N06 PSYCHOANALEPTICS
chembl:CHEMBL76	265.09		D00344	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL76	265.09		D00344	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL76	265.09		D00344	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL76	265.09	##########	D00344	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL12	18.94		D00344	J01 ANTIBACTERIALS FOR SYSTEMIC USE
chembl:CHEMBL38	0.44	9806799	D00292	A01 STOMATOLOGICAL PREPARATIONS
wikidata:Q208017	0.17	##########	D00748	L03 IMMUNOSTIMULANTS
chembl:CHEMBL14	0.16		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.16		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.16		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.16		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.16	##########	D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL37	0.1		D10893	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL50	0.07		D10481	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL18	0.06		D10223	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL28	0.06		D03252	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL24	0.03		D06407	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL49	0.03		D08881	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL47	0.03		D05380	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL19	0.02		D10926	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL21	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL12	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL12	2.15	21635236	D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL12	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL12	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL61	2.15	##########	NA	NA
chembl:CHEMBL61	2.15		NA	NA
chembl:CHEMBL36	1.29	20163115	D01914	N06 PSYCHOANALEPTICS
chembl:CHEMBL36	1.29		D01914	N06 PSYCHOANALEPTICS
chembl:CHEMBL12	0.86	19704408	D02575	N06 PSYCHOANALEPTICS
chembl:CHEMBL13	0.86		NA	NA
chembl:CHEMBL13	0.86		NA	NA
chembl:CHEMBL14	0.52		NA	NA
chembl:CHEMBL14	0.52		NA	NA
chembl:CHEMBL14	0.52		NA	NA
chembl:CHEMBL11	0.43		NA	NA
chembl:CHEMBL12	0.43		NA	NA
chembl:CHEMBL35	0.43		NA	NA
chembl:CHEMBL37	0.43		NA	NA
chembl:CHEMBL39	0.43		NA	NA
chembl:CHEMBL37	0.43		NA	NA
chembl:CHEMBL35	0.43		NA	NA

chembl:CHEMBL3	0.43		NA	NA
chembl:CHEMBL1	0.43		NA	NA
chembl:CHEMBL1	0.34		D00546	N01 ANESTHETICS
chembl:CHEMBL1	0.34		D00546	N01 ANESTHETICS
chembl:CHEMBL1	0.34	##########	D00546	N01 ANESTHETICS
chembl:CHEMBL2	0.34		NA	NA
chembl:CHEMBL1	0.3		D00547	N01 ANESTHETICS
chembl:CHEMBL1	0.3	7509043	D00547	N01 ANESTHETICS
chembl:CHEMBL1	0.3		D00547	N01 ANESTHETICS
chembl:CHEMBL4	0.29	##########	NA	NA
chembl:CHEMBL1	0.26		D00545	N01 ANESTHETICS
chembl:CHEMBL1	0.26	##########	D00545	N01 ANESTHETICS
chembl:CHEMBL1	0.26		D00545	N01 ANESTHETICS
chembl:CHEMBL1	0.26	##########	D00544	N02 ANALGESICS
chembl:CHEMBL1	0.25	16037950	D02056	A12 MINERAL SUPPLEMENTS
chembl:CHEMBL2	0.23	20592726	D02997	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL2	0.23		NA	NA
chembl:CHEMBL2	0.23		NA	NA
chembl:CHEMBL3	0.19		D01883	N06 PSYCHOANALEPTICS
chembl:CHEMBL6	0.17		D01256	C03 DIURETICS
chembl:CHEMBL5	0.16	##########	D07539	A09 DIGESTIVES, INCL. ENZYMES
chembl:CHEMBL1	0.15		D00543	N01 ANESTHETICS
chembl:CHEMBL1	0.15		D00543	N01 ANESTHETICS
chembl:CHEMBL7	0.13	##########	D00354	N03 ANTIEPILEPTICS
chembl:CHEMBL2	0.12		NA	NA
chembl:CHEMBL5	0.09	8843098	D00136	N05 PSYCHOLEPTICS
chembl:CHEMBL4	0.09		D00506	N03 ANTIEPILEPTICS
chembl:CHEMBL4	0.09		D00506	N03 ANTIEPILEPTICS
chembl:CHEMBL5	0.09	27023437	D00136	N05 PSYCHOLEPTICS
chembl:CHEMBL2	0.04		D00537	N03 ANTIEPILEPTICS
chembl:CHEMBL5	0.03	19270242	D05158	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL1	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL1	2.15	21635236	D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL1	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL1	2.15		D08964	N03 ANTIEPILEPTICS
chembl:CHEMBL3	1.29	20163115	D01914	N06 PSYCHOANALEPTICS
chembl:CHEMBL3	1.29		D01914	N06 PSYCHOANALEPTICS
chembl:CHEMBL1	0.86	19704408	D02575	N06 PSYCHOANALEPTICS
chembl:CHEMBL1	0.34		D00546	N01 ANESTHETICS
chembl:CHEMBL1	0.34		D00546	N01 ANESTHETICS
chembl:CHEMBL1	0.34	##########	D00546	N01 ANESTHETICS
chembl:CHEMBL1	0.3		D00547	N01 ANESTHETICS
chembl:CHEMBL1	0.3	7509043	D00547	N01 ANESTHETICS
chembl:CHEMBL1	0.3		D00547	N01 ANESTHETICS
chembl:CHEMBL1	0.26		D00545	N01 ANESTHETICS
chembl:CHEMBL1	0.26	##########	D00545	N01 ANESTHETICS
chembl:CHEMBL1	0.26		D00545	N01 ANESTHETICS

chembl:CHEMBL13	0.26	##########	D00544	N02 ANALGESICS
chembl:CHEMBL12	0.25	16037950	D02056	A12 MINERAL SUPPLEMENTS
chembl:CHEMBL21	0.23	20592726	D02997	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL36	0.19		D01883	N06 PSYCHOANALEPTICS
chembl:CHEMBL61	0.17		D01256	C03 DIURETICS
chembl:CHEMBL57	0.16	##########	D07539	A09 DIGESTIVES, INCL. ENZYMES
chembl:CHEMBL12	0.15		D00543	N01 ANESTHETICS
chembl:CHEMBL12	0.15		D00543	N01 ANESTHETICS
chembl:CHEMBL74	0.13	##########	D00354	N03 ANTIEPILEPTICS
chembl:CHEMBL54	0.09	8843098	D00136	N05 PSYCHOLEPTICS
chembl:CHEMBL40	0.09		D00506	N03 ANTIEPILEPTICS
chembl:CHEMBL40	0.09		D00506	N03 ANTIEPILEPTICS
chembl:CHEMBL54	0.09	27023437	D00136	N05 PSYCHOLEPTICS
chembl:CHEMBL22	0.04		D00537	N03 ANTIEPILEPTICS
chembl:CHEMBL54	0.03	19270242	D05158	C04 PERIPHERAL VASODILATORS
chembl:CHEMBL13	1.78		D02358	C07 BETA BLOCKING AGENTS
chembl:CHEMBL60	1.01		NA	NA
chembl:CHEMBL24	0.84	22949529	D00235	C07 BETA BLOCKING AGENTS
chembl:CHEMBL69	0.57	22949529	D02356	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL13	1.78		D02358	C07 BETA BLOCKING AGENTS
chembl:CHEMBL24	0.84	22949529	D00235	C07 BETA BLOCKING AGENTS
chembl:CHEMBL69	0.57	22949529	D02356	C08 CALCIUM CHANNEL BLOCKERS
chembl:CHEMBL68	8.52		D02922	P01 ANTIPROTOZOALS
chembl:CHEMBL68	8.52	##########	D02922	P01 ANTIPROTOZOALS
chembl:CHEMBL48	1.58	22494098	D07144	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL65	0.89		D00300	D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETIC
chembl:CHEMBL25	0.19	19178400	D00109	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL17	8.42	##########	D07873	R07 OTHER RESPIRATORY SYSTEM PRODUCTS
chembl:CHEMBL12	3.16		D07873	R07 OTHER RESPIRATORY SYSTEM PRODUCTS
chembl:CHEMBL10	1.4	31327267	D00522	C09 AGENTS ACTING ON THE RENIN-ANGIOTENSIN SYSTE
chembl:CHEMBL93	0.73		D00542	N01 ANESTHETICS
chembl:CHEMBL93	0.73	##########	D00542	N01 ANESTHETICS
chembl:CHEMBL93	0.73		D00542	N01 ANESTHETICS
chembl:CHEMBL15	0.39		NA	NA
chembl:CHEMBL12	0.21		D00546	N01 ANESTHETICS
chembl:CHEMBL12	0.19		D00543	N01 ANESTHETICS
chembl:CHEMBL12	0.19		D00547	N01 ANESTHETICS
chembl:CHEMBL12	0.19		D00545	N01 ANESTHETICS
chembl:CHEMBL95	0.27		NA	NA
chembl:CHEMBL19	0.24		NA	NA
chembl:CHEMBL35	0.13		NA	NA
chembl:CHEMBL19	0.11		NA	NA
chembl:CHEMBL36	0.08		NA	NA
chembl:CHEMBL10	0.07		NA	NA
chembl:CHEMBL27	0.06		NA	NA
chembl:CHEMBL54	0.05		NA	NA
chembl:CHEMBL48	0.05		NA	NA

chembl:CHEMBL4	0.04		NA	NA
chembl:CHEMBL5	0.04		D07907	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL4	0.04		D08881	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL2	0.04		NA	NA
chembl:CHEMBL3	0.04		NA	NA
chembl:CHEMBL5	0.04		NA	NA
chembl:CHEMBL5	0.03		NA	NA
chembl:CHEMBL2	0.03		NA	NA
chembl:CHEMBL5	0.03		NA	NA
chembl:CHEMBL2	0.03		NA	NA
chembl:CHEMBL1	0.03		NA	NA
chembl:CHEMBL9	0.03		D01977	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL5	0.02		NA	NA
chembl:CHEMBL1	0.02		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL1	0.02		D08524	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL5	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL2	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL5	0.04		D07907	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL4	0.04		D08881	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL9	0.03		D01977	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL1	0.02		D03658	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL1	0.02		D08524	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL2	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL2	1.05		NA	NA
chembl:CHEMBL3	0.53		NA	NA
chembl:CHEMBL3	0.53		NA	NA
chembl:CHEMBL2	0.35		NA	NA
chembl:CHEMBL4	0.35		NA	NA
chembl:CHEMBL5	0.32	19778024	NA	NA
chembl:CHEMBL1	0.3		NA	NA
chembl:CHEMBL1	0.3		NA	NA
chembl:CHEMBL3	0.26		NA	NA
chembl:CHEMBL1	0.15		NA	NA
chembl:CHEMBL2	0.1		NA	NA
chembl:CHEMBL3	0.05		NA	NA
chembl:CHEMBL1	0.05		NA	NA
chembl:CHEMBL5	0.04		NA	NA
chembl:CHEMBL1	0.04		NA	NA
chembl:CHEMBL1	0.04		D10926	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL4	0.04		NA	NA
chembl:CHEMBL5	0.04		NA	NA
chembl:CHEMBL1	0.04		D10372	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL4	0.04		D08881	L01 ANTINEOPLASTIC AGENTS

chembl:CHEMBL2	0.03		NA	NA
chembl:CHEMBL5	0.03		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL5	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL5	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL1	0.02		NA	NA
chembl:CHEMBL2	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL1	0.04		D10926	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL1	0.04		D10372	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL4	0.04		D08881	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL2	0.01	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL3	50.78		D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL3	50.78		D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL3	50.78	##########	D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL3	50.78	22920394,264	D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL3	50.78		D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84		D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84		D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84	##########	D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84		D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84	22920394,264	D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84		D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	39.84		D05457	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82	##########	D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82		D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82		D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82		D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82		D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL7	25.82		D08354	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31	20072124,211	D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	23.31	##########	D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL2	10.33	21883387	D07969	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46		D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46	##########	D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46		D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46		D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46		D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	6.46		D03798	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	5.16		D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL1	2.58		D08682	B01 ANTITHROMBOTIC AGENTS

chembl:CHEMBL59	1.25		D02335	B02 ANTIHEMORRHAGICS
chembl:CHEMBL59	1.25	##########	D02335	B02 ANTIHEMORRHAGICS
chembl:CHEMBL59	1.25		D02335	B02 ANTIHEMORRHAGICS
chembl:CHEMBL70	0.43		D02815	D11 OTHER DERMATOLOGICAL PREPARATIONS
chembl:CHEMBL60	56.81	24915143	C01496	C01 CARDIAC THERAPY
chembl:CHEMBL21	0.03	26516587	D09347	B02 ANTIHEMORRHAGICS
chembl:CHEMBL14	2.37	21386754	D07661	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL21	1.58		NA	NA
chembl:CHEMBL69	1.09	##########	D00551	C05 VASOPROTECTIVES
chembl:CHEMBL65	0.95	25274603	D07962	C01 CARDIAC THERAPY
chembl:CHEMBL12	0.53		D02347	M03 MUSCLE RELAXANTS
chembl:CHEMBL56	0.36		D08422	C05 VASOPROTECTIVES
chembl:CHEMBL10	0.25	##########	D10258	A10 DRUGS USED IN DIABETES
chembl:CHEMBL14	0.22	##########	D07474	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL72	0.15		D00255	C07 BETA BLOCKING AGENTS
chembl:CHEMBL11	0.13		D04044	N02 ANALGESICS
chembl:CHEMBL26	0.12		D00808	P01 ANTIPROTOZOALS
chembl:CHEMBL14	0.08		D00045	C01 CARDIAC THERAPY
chembl:CHEMBL49	0.33		D00859	D08 ANTISEPTICS AND DISINFECTANTS
chembl:CHEMBL17	2.84	11413081	NA	NA
chembl:CHEMBL18	1.42	16322528	D00333	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL12	1.14	3021887	NA	NA
chembl:CHEMBL39	0.95	29432897	D07064	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL15	0.47	12827021	D00523	C09 AGENTS ACTING ON THE RENIN-ANGIOTENSIN SYSTE
chembl:CHEMBL16	0.43	##########	D00427	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL22	0.39	##########	D07983	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL58	0.25	15699298	D00365	N05 PSYCHOLEPTICS
chembl:CHEMBL14	0.25	9150415	D00385	A01 STOMATOLOGICAL PREPARATIONS
chembl:CHEMBL11	0.24	##########	D08410	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL14	0.23	##########	D08682	B01 ANTITHROMBOTIC AGENTS
chembl:CHEMBL14	0.22	##########	D07474	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL63	0.18	3185288	C07370	A07 ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY,
chembl:CHEMBL67	0.18	12042669	D00565	C10 LIPID MODIFYING AGENTS
chembl:CHEMBL40	0.17	15057551	D00395	A10 DRUGS USED IN DIABETES
chembl:CHEMBL38	0.11	11948667	NA	NA
chembl:CHEMBL10	0.1	10736278	D10258	A10 DRUGS USED IN DIABETES
chembl:CHEMBL12	0.06	26117305	D02058	B05 BLOOD SUBSTITUTES AND PERFUSION SOLUTIONS
chembl:CHEMBL45	0.04	23896426	D08205	C02 ANTIHYPERTENSIVES
chembl:CHEMBL55	0.04	24971061	D02159	D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
chembl:CHEMBL12	0.59	##########	D02058	B05 BLOOD SUBSTITUTES AND PERFUSION SOLUTIONS
chembl:CHEMBL42	0.47	27396837	D00283	N05 PSYCHOLEPTICS
chembl:CHEMBL45	0.24	23896426	D08205	C02 ANTIHYPERTENSIVES
chembl:CHEMBL12	0.88	##########	D02058	B05 BLOOD SUBSTITUTES AND PERFUSION SOLUTIONS
chembl:CHEMBL45	0.36	23896426	D08205	C02 ANTIHYPERTENSIVES
chembl:CHEMBL21	0.36		D06652	C01 CARDIAC THERAPY
chembl:CHEMBL12	0.36		NA	NA
chembl:CHEMBL28	0.33		D04127	N07 OTHER NERVOUS SYSTEM DRUGS

chembl:CHEMBL21	0.28		NA	NA
chembl:CHEMBL12	26.22	##########	V06CA	V06 GENERAL NUTRIENTS
chembl:CHEMBL41	0.63		D07901	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL88	0.24		D07760	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL18	0.18		D00584	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	1.25	23315321	D00296	J05 ANTIVIRALS FOR SYSTEMIC USE
chembl:CHEMBL14	1.13	15990089	D04931	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	1.13	##########	D04931	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL72	0.94	##########	D08603	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL14	0.43	##########	D00045	C01 CARDIAC THERAPY
chembl:CHEMBL88	0.3	##########	D02368	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL80	0.19		D00168	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL17	2.52	29301960	D04603	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL33	2.1	29301960	D10808	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL21	1.26	##########	D10316	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL37	0.97	29301960	D10773	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL31	0.57	29301960	D10574	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL19	0.46	27751729	D02714	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL19	0.46		D02714	L01 ANTINEOPLASTIC AGENTS
chembl:CHEMBL66	0.42	22137933	D00225	N05 PSYCHOLEPTICS
chembl:CHEMBL64	0.42	22137933	D00387	N05 PSYCHOLEPTICS
chembl:CHEMBL53	0.29	27751729	D08552	L01 ANTINEOPLASTIC AGENTS

gene_clair	descriptio	druggat	small_r	bio_dru	adme_gene	interactio	interactior	drug_claim_name
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		MOSAPRAMINE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		PROGLUMETACIN
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		TROVAFLOXACIN MES
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		EMETINE DIHYDROCHI
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		SERATRODAST
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		CINACALCET HYDROCH
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank	agonist	DB01393
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		BEZAFIBRATE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		PENFLURIDOL
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		BAZEDOXIFENE ACETA
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		ROSIGLITAZONE MALE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		PROPRANOLOL HYDRC
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank	negative m	DB00605
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		DESLORATADINE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		IDEBENONE
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank	agonist	DB00374
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		HYMECROMONE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		ISOCONAZOLE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		HYDRALAZINE HYDRO
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		FLUOXETINE HYDROCH
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		PROMETHAZINE HYDR
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		BIFONAZOLE
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank	agonist	DB09462
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		IDARUBICIN HYDROCH
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		ASTEMIZOLE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		NITROXOLINE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		DICHLOROPHEN
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		FLUSPIRILENE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		TRIAMTERENE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		TAMOXIFEN CITRATE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		CHLORPROMAZINE HY
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank		DB00197
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		DACTINOMYCIN
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		RALOXIFENE HYDROCH
PPARD	peroxisom	Tier 1	Y	N	Y	PharmGKB		thalidomide
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		THIORIDAZINE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		BITHIONOL
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		CLOMIPRAMINE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		CHLORHEXIDINE
BE000100	peroxisom	Tier 1	Y	N	Y	DrugBank		DB00412
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		CLOTRIMAZOLE
PPARD	peroxisom	Tier 1	Y	N	Y	NCI		ETHANOL
PPARD	peroxisom	Tier 1	Y	N	Y	DTC		PIMOZIDE

PPARD	peroxisom	Tier 1	Y	N	Y	DTC	MITOXANTRONE DIHY
PPARD	peroxisom	Tier 1	Y	N	Y	NCI	ATORVASTATIN
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	PAZOPANIB
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	DISULFIRAM
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	DOXORUBICIN HYDRO
5467	peroxisom	Tier 1	Y	N	Y	GuideToPł agonist	135651435
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	HEXACHLOROPHENE
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	MENADIONE
PPARD	peroxisom	Tier 1	Y	N	Y	PharmGKB	docetaxel
PPARD	peroxisom	Tier 1	Y	N	Y	DTC	DASATINIB

.DERS

ICTS

CS, ETC.

.DERS

/ANTIINFECTIVE AGENTS

CS, ETC.

JCTS

CS, ETC.

.L SYSTEM
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ICTS
/ANTIINFECTIVE AGENTS

ICTS

CS, ETC.

CS, ETC.

/ANTIINFECTIVE AGENTS

.DERS

.L SYSTEM
NS

ICTS

.L SYSTEM

ICTS

.L SYSTEM

/ANTIINFECTIVE AGENTS

ICTS

CS, ETC.

DERS

/ANTIINFECTIVE AGENTS

/ANTIINFECTIVE AGENTS

L SYSTEM

.DERS
.DERS

/ANTIINFECTIVE AGENTS

NALOGUES

ATOLOGICAL USE

KELETAL SYSTEM

L SYSTEM

DERS

S, ETC.

L SYSTEM

JCTS
L SYSTEM

CS, ETC.

DERS

L SYSTEM

CS, ETC.

M

:M

/ANTIINFECTIVE AGENTS

African Americans					
drug_claim_prim	drug_name	drug_concept_id	interaction_	PMIDs	atc
MOSAPRAMINE	MOSAPRAMINE	chembl:CHEMBL2	0.39		D08235
PROGLUMETACIN	PROGLUMETACIN	chembl:CHEMBL2	0.39		D08427
TROVAFLOXACIN	TROVAFLOXACIN ME	chembl:CHEMBL1	0.2		D08654
EMETINE DIHYDR	EMETINE HYDROCHL	chembl:CHEMBL4	0.2		C09421
SERATRODAST	SERATRODAST	chembl:CHEMBL7	0.2		D01123
CINACALCET HYD	CINACALCET HYDROC	chembl:CHEMBL1	0.2		D03504
Bezafibrate	BEZAFIBRATE	chembl:CHEMBL2	0.17	16168052	D01366
BEZAFIBRATE	BEZAFIBRATE	chembl:CHEMBL2	0.17		D01366
PENFLURIDOL	PENFLURIDOL	chembl:CHEMBL4	0.13		D02630
BAZEDOXIFENE A	BAZEDOXIFENE ACET	chembl:CHEMBL2	0.13		D10579
ROSIGLITAZONE M	ROSIGLITAZONE MAL	chembl:CHEMBL8	0.13		D10244
PROPRANOLOL H	PROPRANOLOL HYDR	chembl:CHEMBL1	0.13		D08443
Sulindac	SULINDAC	chembl:CHEMBL1	0.11	16418176,	D00120
DESLORATADINE	DESLORATADINE	chembl:CHEMBL1	0.1		D10252
IDEBENONE	IDEBENONE	chembl:CHEMBL2	0.1		D01750
Treprostinil	TREPROSTINIL	chembl:CHEMBL1	0.09	16239641	D06213
HYMECROMONE	HYMECROMONE	chembl:CHEMBL1	0.08		D00170
ISOCONAZOLE	ISOCONAZOLE	chembl:CHEMBL1	0.08		D04624
HYDRALAZINE HY	HYDRALAZINE HYDRC	chembl:CHEMBL5	0.07		D04265
FLUOXETINE HYD	FLUOXETINE HYDROC	chembl:CHEMBL1	0.07		D00326
PROMETHAZINE H	PROMETHAZINE HYD	chembl:CHEMBL1	0.05		D00494
BIFONAZOLE	BIFONAZOLE	chembl:CHEMBL2	0.04		D01775
Glycerin	GLYCERIN	chembl:CHEMBL6	0.04		D00028
IDARUBICIN HYDI	IDARUBICIN HYDROC	chembl:CHEMBL1	0.03		D08062
ASTEMIZOLE	ASTEMIZOLE	chembl:CHEMBL2	0.03		D00234
NITROXOLINE	NITROXOLINE	chembl:CHEMBL1	0.03		D07245
DICHLOROPHEN	DICHLOROPHEN	chembl:CHEMBL3	0.02		C14292
FLUSPIRILENE	FLUSPIRILENE	chembl:CHEMBL4	0.02		D02629
TRIAMTERENE	TRIAMTERENE	chembl:CHEMBL5	0.02		D00386
TAMOXIFEN CITR	TAMOXIFEN CITRATE	chembl:CHEMBL7	0.02		D08559
CHLORPROMAZIN	CHLORPROMAZINE H	chembl:CHEMBL1	0.02		D00270
Troglitazone	TROGLITAZONE	chembl:CHEMBL4	0.02	11779144	D00395
DACTINOMYCIN	DACTINOMYCIN	chembl:CHEMBL1	0.02		D00214
RALOXIFENE HYD	RALOXIFENE HYDROC	chembl:CHEMBL1	0.02		D08465
thalidomide	THALIDOMIDE	chembl:CHEMBL4	0.02	20038957	D00754
THIORIDAZINE	THIORIDAZINE	chembl:CHEMBL4	0.02		D00373
BITHIONOL	BITHIONOL	chembl:CHEMBL2	0.02		D00802
CLOMIPRAMINE	CLOMIPRAMINE	chembl:CHEMBL4	0.02		D07727
CHLORHEXIDINE	CHLORHEXIDINE	chembl:CHEMBL7	0.02		D07668
Rosiglitazone	ROSIGLITAZONE	chembl:CHEMBL1	0.02	11779144	D10244
CLOTRIMAZOLE	CLOTRIMAZOLE	chembl:CHEMBL1	0.01		D00282
ETHANOL	ALCOHOL	chembl:CHEMBL5	0.01	12641735	D05158
PIMOZIDE	PIMOZIDE	chembl:CHEMBL1	0.01		D00560

MITOXANTRONE	MITOXANTRONE HYD	chembl:CHEMBL1	0.01		D08224
ATORVASTATIN	ATORVASTATIN	chembl:CHEMBL1	0.01	16139565	D07474
PAZOPANIB	PAZOPANIB	chembl:CHEMBL4	0.01		D05380
DISULFIRAM	DISULFIRAM	chembl:CHEMBL9	0.01		D00131
DOXORUBICIN HY	DOXORUBICIN HYDR(	chembl:CHEMBL3	0.01		D03899
TRETINOIN	TRETINOIN	chembl:CHEMBL3	0.01		D00094
HEXACHLOROPHE	HEXACHLOROPHENE	chembl:CHEMBL4	0.01		D00859
MENADIONE	MENADIONE	chembl:CHEMBL5	0.01		D02335
docetaxel	DOCETAXEL	chembl:CHEMBL9	0.01	20038957	D07866
DASATINIB	DASATINIB	chembl:CHEMBL1	0		D03658

atc_class
N05 PSYCHOLEPTICS
M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODUCTS
J01 ANTIBACTERIALS FOR SYSTEMIC USE
P01 ANTIPROTOZOALS
R03 DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES
H05 CALCIUM HOMEOSTASIS
C10 LIPID MODIFYING AGENTS
C10 LIPID MODIFYING AGENTS
N05 PSYCHOLEPTICS
G03 SEX HORMONES AND MODULATORS OF THE GENITAL SYSTEM
A10 DRUGS USED IN DIABETES
C07 BETA BLOCKING AGENTS
M01 ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODUCTS
R01 NASAL PREPARATIONS
N06 PSYCHOANALEPTICS
B01 ANTITHROMBOTIC AGENTS
A05 BILE AND LIVER THERAPY
D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
C02 ANTIHYPERTENSIVES
N06 PSYCHOANALEPTICS
D04 ANTIPRURITICS, INCL. ANTIHISTAMINES, ANESTHETICS, ETC.
D01 ANTIFUNGALS FOR DERMATOLOGICAL USE
A06 DRUGS FOR CONSTIPATION
L01 ANTINEOPLASTIC AGENTS
R06 ANTIHISTAMINES FOR SYSTEMIC USE
J01 ANTIBACTERIALS FOR SYSTEMIC USE
P02 ANTHELMINTICS
N05 PSYCHOLEPTICS
C03 DIURETICS
L02 ENDOCRINE THERAPY
N05 PSYCHOLEPTICS
A10 DRUGS USED IN DIABETES
L01 ANTINEOPLASTIC AGENTS
G03 SEX HORMONES AND MODULATORS OF THE GENITAL SYSTEM
L04 IMMUNOSUPPRESSANTS
N05 PSYCHOLEPTICS
D10 ANTI-ACNE PREPARATIONS
N06 PSYCHOANALEPTICS
A01 STOMATOLOGICAL PREPARATIONS
A10 DRUGS USED IN DIABETES
A01 STOMATOLOGICAL PREPARATIONS
C04 PERIPHERAL VASODILATORS
N05 PSYCHOLEPTICS

L01 ANTINEOPLASTIC AGENTS
C10 LIPID MODIFYING AGENTS
L01 ANTINEOPLASTIC AGENTS
N07 OTHER NERVOUS SYSTEM DRUGS
L01 ANTINEOPLASTIC AGENTS
D10 ANTI-ACNE PREPARATIONS
D08 ANTISEPTICS AND DISINFECTANTS
B02 ANTIHEMORRHAGICS
L01 ANTINEOPLASTIC AGENTS
L01 ANTINEOPLASTIC AGENTS