IPAD: the Integrated Pathway Analysis Database for Systematic Enrichment Analysis

Fan Zhang, Renee Drabier

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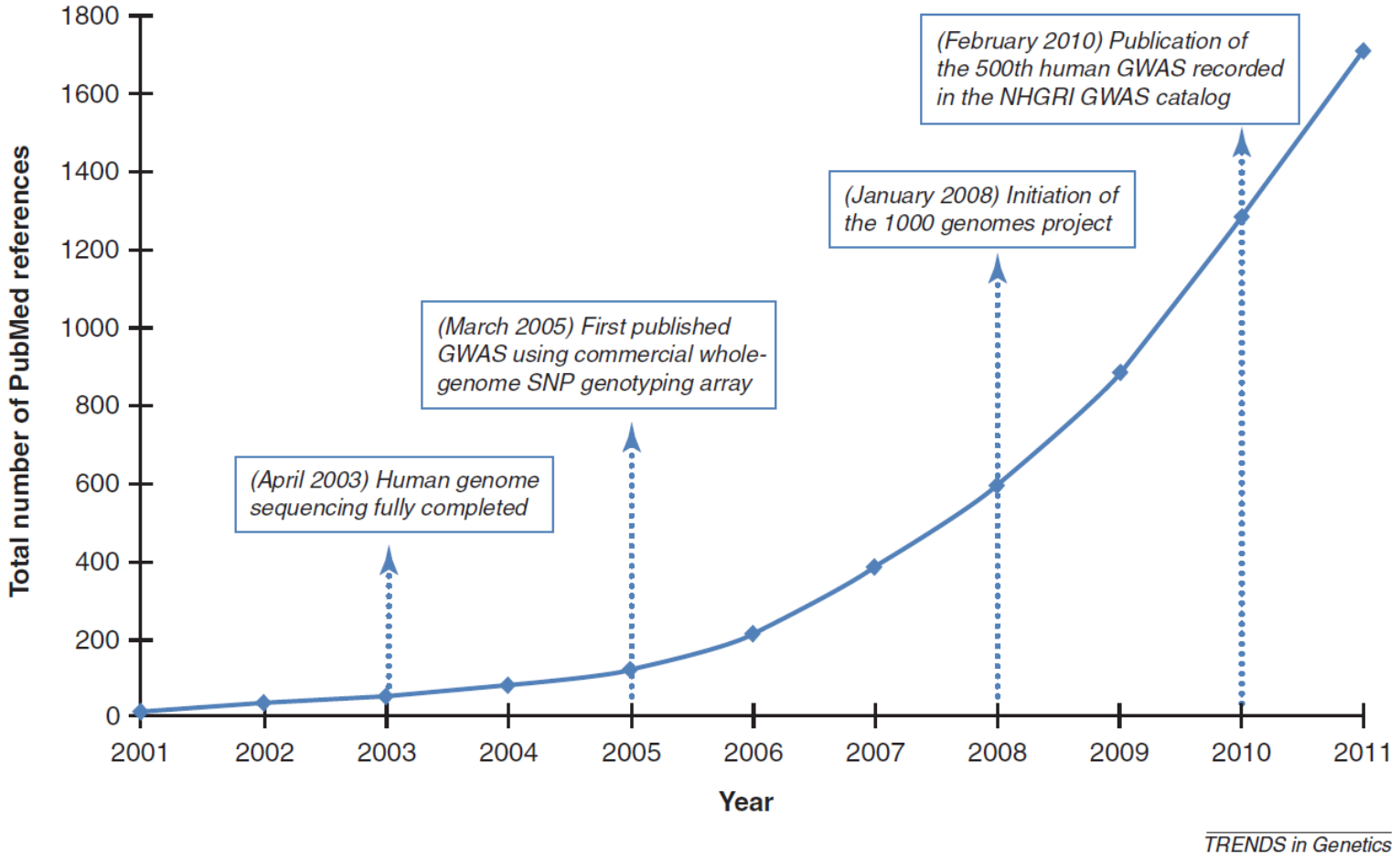
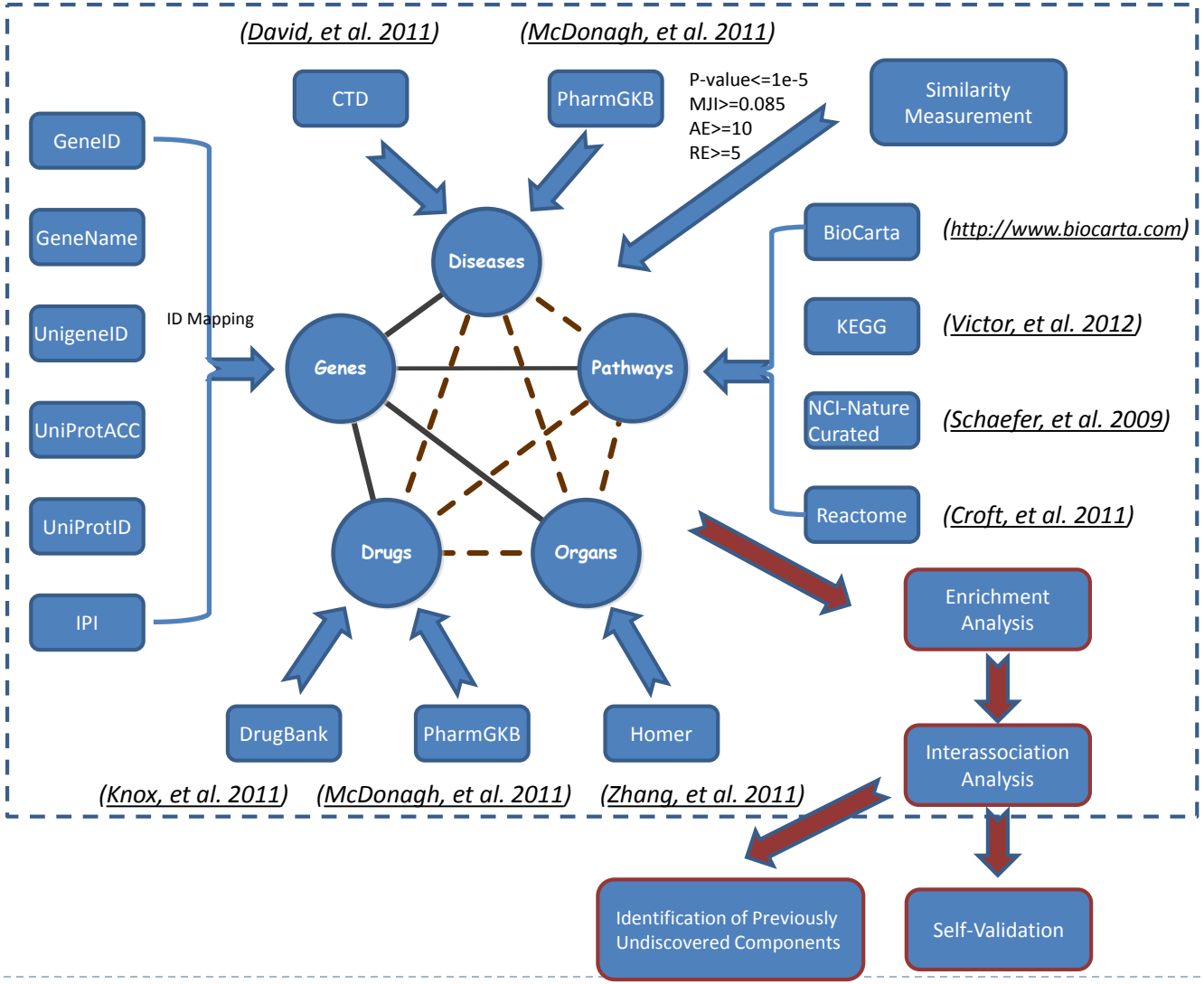
ACADEMIC AND INSTITUTIONAL RESOURCES AND TECHNOLOGY

Introduction



Vijay K. Ramanan et al. 2012

What is IPAD


(David, et al. 2011)
(McDonagh, et al. 2011)
CTD
PharmGKB
P-value<=1e-5
MJI>=0.085
AE>=10
RE>=5
Similarity Measurement
GeneID
GeneName
UnigeneID
UniProtACC
UniProtID
IPI
ID Mapping
Diseases
Genes
Pathways
Drugs
Organs
BioCarta
(http://www.biocarta.com)
KEGG
(Victor, et al. 2012)
NCI-Nature Curated
(Schaefer, et al. 2009)
Reactome
(Croft, et al. 2011)
Enrichment Analysis
Interassociation Analysis
Identification of Previously Undiscovered Components
Self-Validation
DrugBank
PharmGKB
Homer
(Knox, et al. 2011)
(McDonagh, et al. 2011)
(Zhang, et al. 2011)

Five criteria for designing the IPAD

- 1) comprehensive pathway coverage;
- 2) gene/protein to pathway/disease/drug/organ association;
- 3) interassociation between pathway, disease, drug, and organ;
- 4) multiple and quantitative measurement of enrichment and interassocaition;
- and 5) cross-linking of multiple available data sources.

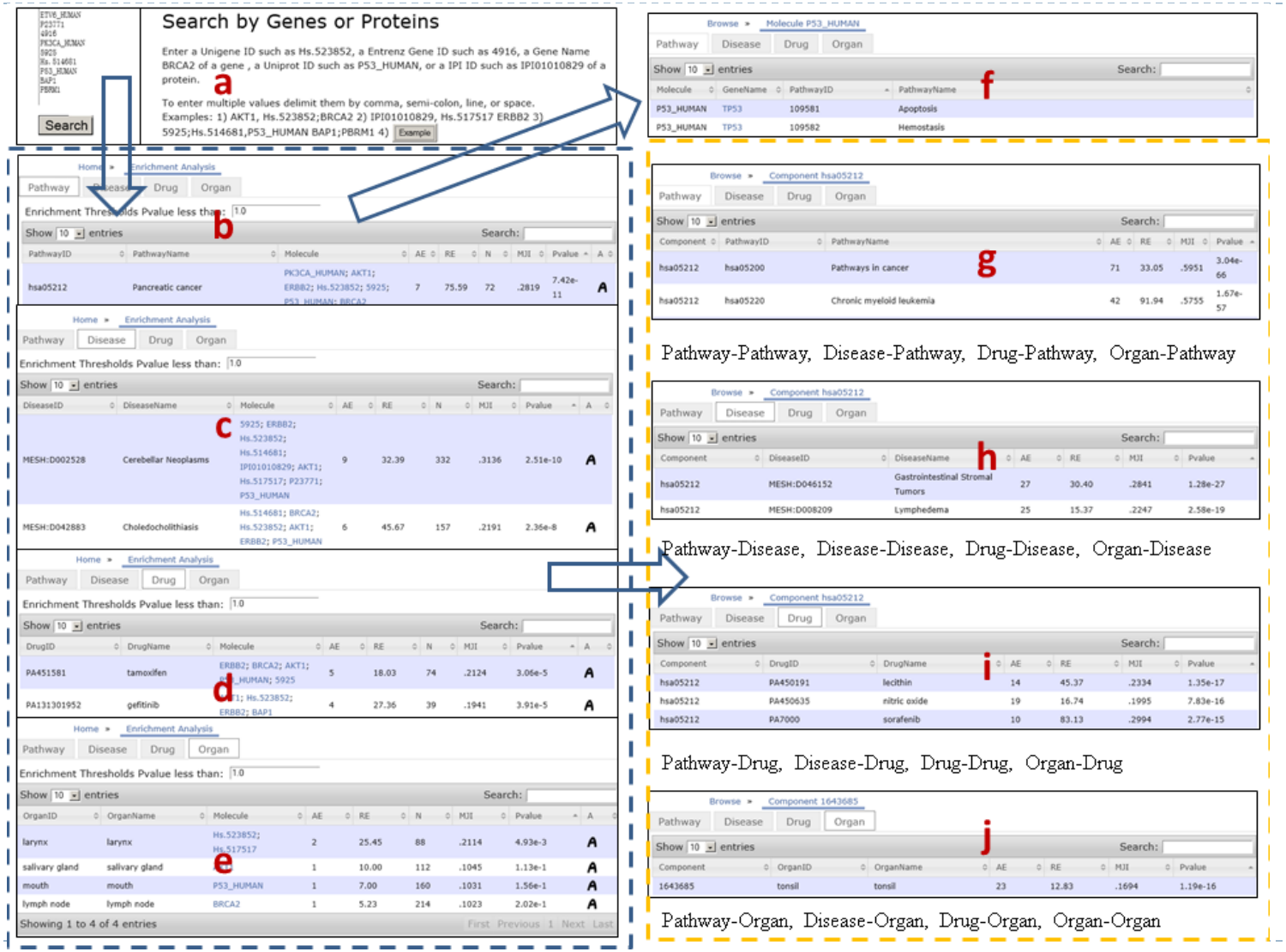
Current Statistics of IPAD

Pathways and Molecules	Count
Total Number of Pathways	1956 (BioCarta:310,KEGG:247, NCI-Nature curated:222, Reactome:1177)
Total Number of Molecules	11663
Diseases and Molecules	**Count**
Total Number of Diseases	6704 (CTD:5892, PharmGKB:812)
Total Number of Molecules	17925
Drugs and Molecules	**Count**
Total Number of Drugs	5615 (DrugBank:4604, PharmGKB:1011)
Total Number of Molecules	3735
Organs and Molecules	**Count**
Total Number of Organs	52
Total Number of Molecules	5599

Three Innovative Functions

-) The most interesting and novel aspect is "inter-association analysis", which predicts relationships between components (pathways, diseases, drugs, and organs) on the basis of intermediating gene sets,
- 2) ability to identify previously undiscovered components (pathways, diseases, drugs, and organs) by the traditional pathway enrichment analysis.
- 3) ability to self-validate by enrichment analysis and inter-association analysis,

IPAD Search Interface

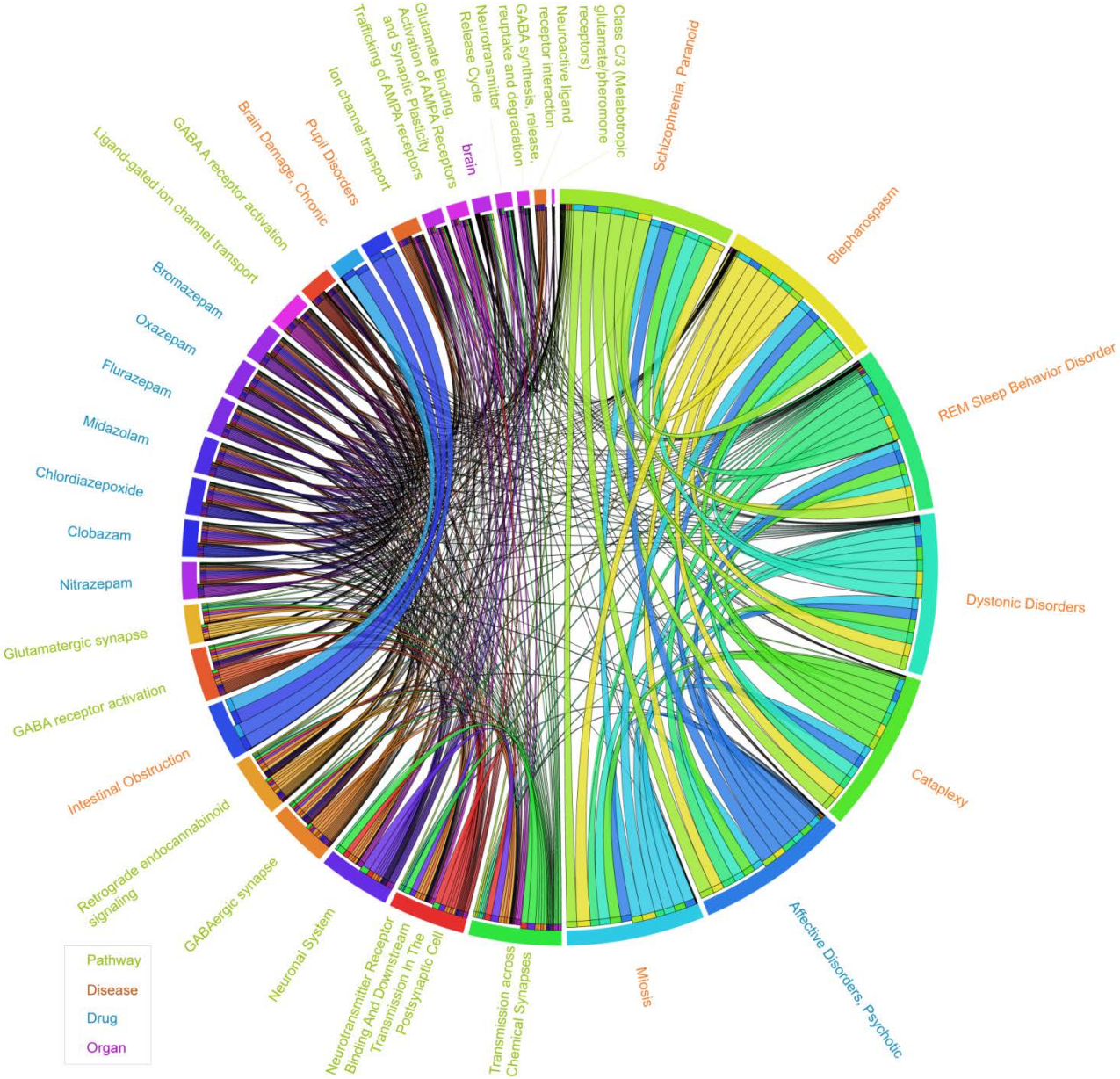


http://bioinfo.hsc.unt.edu/ipad

Identification of Previously Undiscovered Components

Novel	pathwayid	pathwayname	p-value	C	AE	RE	MJI
yes	381150	Diabetes pathways	1.76E-96	2	108.00	52.19	0.701
yes	109582	Hemostasis	4.33E-64	1	78.00	24.87	0.583
yes	913709	O-linked glycosylation of mucins	1.61E-57	1	63.00	30.85	0.583
yes	76005	Response to elevated platelet cytosolic Ca2+	1.06E-110	1	78.00	140.52	0.970
yes	597592	Post-translational protein modification	1.68E-154	1	183.00	30.85	0.742
yes	391251	Protein folding	9.19E-50	1	54.00	30.85	0.571
yes	446203	Asparagine N-linked glycosylation	3.60E-76	1	85.00	30.85	0.612
Novel	Diseaseid	DiseaseName	p-value	C	AE	RE	MJI
yes	MESH:D058729	Peripheral Arterial Disease	2.58E-19	1	29.00	11.82	0.211
yes	MESH:D056006	Leprosy, Multibacillary	3.92E-19	1	26.00	13.83	0.201
yes	MESH:C537153	Hypomagnesemia primary	9.35E-21	1	31.00	12.15	0.223
yes	MESH:D001025	Aortitis	2.09E-19	1	31.00	10.79	0.218
yes	MESH:D001661	Biliary Tract Neoplasms	4.82E-20	1	31.00	11.42	0.221
yes	MESH:D002754	Choanal Atresia	7.89E-19	1	26.00	13.41	0.199
yes	MESH:D002528	Cerebellar Neoplasms	6.22E-28	1	38.00	15.34	0.276
yes	MESH:D008850	Microphthalmos	4.81E-19	1	30.00	10.96	0.213
yes	MESH:D009175	Mycoplasma Infections	2.55E-20	1	30.00	12.30	0.218
yes	MESH:D008947	Mixed Connective Tissue Disease	3.62E-21	1	29.00	14.03	0.219
yes	MESH:D012555	Schistosomiasis mansoni	1.72E-22	1	37.00	10.78	0.253
yes	MESH:D008179	\Lupus Erythematosus, Discoid\	6.06E-22	1	26.00	18.44	0.218
yes	MESH:D011665	Pulmonary Valve Insufficiency	2.76E-22	1	27.00	17.74	0.221
yes	MESH:D018188	Cardiovirus Infections	1.22E-22	1	37.00	10.90	0.253
yes	MESH:D008010	Lichen Planus	4.45E-22	1	28.00	16.25	0.222
yes	MESH:D007918	Leprosy	1.05E-20	1	32.00	11.53	0.227
Novel	DrugID	DrugName	p-value	C	AE	RE	MJI
yes	PA131301952	gefitinib	8.52E-17	8	29.88	10.84	0.395
yes	PA451283	rosiglitazone	7.73E-22	5	41.40	10.58	0.386
yes	PA448803	carboplatin	2.57E-15	5	27.00	11.36	0.397
yes	PA449552	etoposide	2.32E-18	4	33.25	11.28	0.400
yes	PA450198	leucovorin	9.91E-16	4	31.25	10.94	0.423
yes	PA450947	phenytoin	2.13E-15	3	27.67	10.62	0.366
yes	PA448771	capecitabine	7.75E-16	2	26.50	11.68	0.412
yes	PA449165	cyclophosphamide	2.35E-23	2	40.50	10.94	0.385
yes	PA449015	citalopram	8.78E-17	1	31.00	10.02	0.465
yes	DB00143	Glutathione	3.34E-18	1	32.00	10.65	0.432
Novel	OrganID	OrganName	p-value	C	AE	RE	MJI
yes	tonsil	tonsil	5.26E-18	23	20.52	37.17	0.263

Self-Validation



Thank you for your attention!