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Immune Epitope Database and Analysis Resource Program

2020 Annual IEDB Compendium

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Introduction

The Immune Epitope Database and Analysis Resource (IEDB) is a public repository of immune epitope data and is sponsored by the National Institute for Allergy and Infectious Diseases (NIAID). The IEDB development started in December 2003 and it became available to the public in a beta test phase on 15 February 2006. The IEDB primarily contains data related to antibody and T cell epitopes for humans, non-human primates, rodents, and other animal species. The IEDB also makes available a variety of analytical and epitope prediction tools and resources within its Analysis Resource.

This Compendium of the Immune Epitope Database and Analysis Resource, and consists of three sections. The first section contains a list of the antibody and T cell epitope information in the database as of January 2021. The second section describes the features of the IEDB 3.10 website and the Analysis Resource 2.24. The third section lists the scientific publications in 2020 for which the IEDB played a contributory role.

Since the publication of last year's 2019 Annual Compendium, the quantity of data available in the IEDB continues to increase significantly. As of January 2021, the IEDB contains data for over 1,306,000 epitopes, 67,000 antigens, 3,872,000 assays, and 171,800 receptors from more than 21,700 references. The focus of the IEDB remains on peptidic and non-peptidic epitope data relating to infectious diseases, allergens, autoimmune diseases, and transplant/alloantigens; with exceptions in respect to cancer and HIV.

1 Antibody and T Cell Epitopes

Many new references and many new species were added to the IEDB in 2020, as demonstrated in Table 1.1. The table lists the number of distinct B cell and T cell epitopes in the database by source species at the end of 2019 and 2020. Of the 4,060 species/strains listed, 189 were added in 2020. It should be noted that the source organism is the species/strain from which the epitopes originate, and may not be from an infecting organism or vaccine target. The curation of MHC binding peptides, cross-reactive epitopes, and autoimmune epitopes has resulted in the appearance of human (Homo sapiens) and mouse (Mus musculus) epitopes on the list.

In the table below, the leftmost column labeled "New" indicates with an "X" if epitopes for the species/strain was added to the IEDB in 2020. A font color of red is used to highlight the information in the row. The Organism ID matches the NCBI taxonomy ID if it exists. Otherwise, it represents an IEDB-assigned identifier, which are eight-digit numbers starting with “1000”. These are easily distinguishable from the NCBI identifiers which are six digits or less. The columns labeled "B 19", "T 19", "B 20", and "T 20" indicate the cumulative number of distinct B cell and T cell epitopes in the database at the end of 2019 and 2020, respectively. The two rightmost columns display the differences in the B and T cell epitope counts from 2019 to 2020. In 2020, the number of B cell epitopes increased by 29,737 from 55,916 to 85,653 and the number of T cell epitopes increased by 198,937 from 539,241 to 738,178.

Table 1.1 Summary of B and T cell epitopes contained in the IEDB

ID	NEW 2020	ORGANISM ID	SPECIES / STRAIN	B 19	T 19	B 20	T 20	DELTA B	DELTA T
1		2	Bacteria	57		57			
2		106	Runella slithyformis		1		1		
3		108	Spirosoma linguale	1		1			
4		139	Borreliella burgdorferi	78	45	93	45	15	
6		158	Treponema denticola		1		2		1
7		160	Treponema pallidum	7	2	7	2		
8	X	171	Leptospira			2		2	
9		173	Leptospira interrogans	6	4	7	4	1	
10		195	Campylobacter coli		2		2		
11		197	Campylobacter jejuni	115	30	115	30		
14		210	Helicobacter pylori	49	56	88	62	39	6
15		234	Brucella		28		28		
16		235	Brucella abortus	7	39	7	39		
17		236	Brucella ovis		3		3		
18		263	Francisella tularensis	4	14	4	15		1
19		266	Paracoccus denitrificans	3		3			
20		271	Thermus aquaticus	1		1			
21		274	Thermus thermophilus	1	1	1	1		
22		280	Xanthobacter autotrophicus		1		1		
23		286	Pseudomonas	1	1	1	1		
24		287	Pseudomonas aeruginosa	96	168	97	171	1	3
25		292	Burkholderia cepacia	3	2	3	2		
26		294	Pseudomonas fluorescens		4		15		11
28		300	Pseudomonas mendocina		1		2		1
29		303	Pseudomonas putida	1	8	1	8		
30		306	Pseudomonas sp.		1		1		
31		312	Pseudomonas sp. RS-16	1		1			
32	X	316	Pseudomonas stutzeri				2		2
33		319	Pseudomonas savastanoi pv. phaseolicola	1		1			
34	X	346	Xanthomonas citri				1		1
35		354	Azotobacter vinelandii		2		2		
36		358	Agrobacterium tumefaciens	1	2	1	2		
37		382	Sinorhizobium meliloti		1		1		
38		384	Rhizobium leguminosarum		1		1		
39		446	Legionella pneumophila	1	1	1	1		
40	X	469	Acinetobacter				1		1
41		470	Acinetobacter baumannii	2	1	10	8	8	7
42		471	Acinetobacter calcoaceticus		1		1		
43		480	Moraxella catarrhalis	10		10			

44		485	Neisseria gonorrhoeae	77	15	77	15		
45		487	Neisseria meningitidis	91	23	91	23		
46		491	Neisseria meningitidis serogroup B	46	1	46	1		
47		511	Alcaligenes faecalis	3	2	3	2		
48		520	Bordetella pertussis	338	218	352	218	14	
49		543	Enterobacteriaceae	4		4			
50		544	Citrobacter	1		1			
51		546	Citrobacter freundii	2		2			
52		548	Klebsiella aerogenes		1		1		
53		550	Enterobacter cloacae		9		10		1
54		554	Pectobacterium carotovorum	2		2			
55		556	Dickeya chrysanthemi	1		1			
56		562	Escherichia coli	275	182	279	186	4	4
57		573	Klebsiella pneumoniae	29	9	29	12		3
58		582	Morganella morganii	1		1			
59		583	Proteus	2		2			
60		584	Proteus mirabilis	7		7			
62		590	Salmonella	3		3			
63		596	Salmonella enterica subsp. enterica serovar Muenchen	1		1			
64		599	Salmonella sp.	1		1			
65		605	Salmonella enterica subsp. enterica serovar Pullorum		1		1		
66		611	Salmonella enterica subsp. enterica serovar Heidelberg	9		9			
67		615	Serratia marcescens	1	3	1	3		
68		621	Shigella boydii		2		2		
69		622	Shigella dysenteriae	6	2	6	2		
70		623	Shigella flexneri	77	11	77	11		
71		624	Shigella sonnei		1		1		
72		630	Yersinia enterocolitica	6	28	6	28		
73		632	Yersinia pestis	24	324	24	324		
74		633	Yersinia pseudotuberculosis		2		2		
76		644	Aeromonas hydrophila	9	3	9	3		
77		645	Aeromonas salmonicida	59		59			
78		659	Photobacterium phosphoreum		1		1		
79		666	Vibrio cholerae	38	91	38	92		1
80		670	Vibrio parahaemolyticus		57	1	57	1	
81		671	Vibrio proteolyticus	1		1			
82		672	Vibrio vulnificus	1	66	1	66		
83		674	Vibrio mimicus	2		2			
84		686	Vibrio cholerae O1 biovar El Tor	3	1	3	1		
85		703	Plesiomonas shigelloides		2		2		
86		714	Aggregatibacter actinomycetemcomitans	1	4	1	4		
87		715	Actinobacillus pleuropneumoniae		2		2		

88		727	Haemophilus influenzae	31	68	36	71	5	3
89		730	[Haemophilus] ducreyi	3	2	3	2		
90		738	Glaesserella parasuis	1		1			
91		747	Pasteurella multocida	1	10	1	10		
92		769	Anaplasma centrale		2		2		
93		770	Anaplasma marginale	25	14	25	14		
94		777	Coxiella burnetii	2	311	2	311		
95		779	Ehrlichia ruminantium	3	23	3	23		
96		781	Rickettsia conorii		13		13		
97		782	Rickettsia prowazekii		23		23		
98		783	Rickettsia rickettsii		1		1		
99		784	Orientia tsutsugamushi	87		87			
100		785	Rickettsia typhi		3		3		
101		787	Rickettsia australis		1		1		
102		788	Rickettsia canadensis		1		1		
103		813	Chlamydia trachomatis	208	69	241	69	33	
104		817	Bacteroides fragilis	27	3	27	3		
105		837	Porphyromonas gingivalis	108	22	111	22	3	
108		920	Acidithiobacillus ferrooxidans		1		1		
109		944	Ehrlichia canis	7	1	7	1		
110		945	Ehrlichia chaffeensis	14	1	14	1		
112		948	Anaplasma phagocytophilum	45		45			
113		955	Wolbachia pipientis	1		1			
114		1006	Marivirga tractuosa		1	1	1	1	
115		1018	Capnocytophaga ochracea		1		1		
116		1019	Capnocytophaga sputigena		1		1		
117		1022	Beggiatoa alba	1		1			
118		1063	Luteovulum sphaeroides		1		1		
119		1076	Rhodopseudomonas palustris		2		2		
120	X	1126	Microcystis aeruginosa			1		1	
121		1224	Proteobacteria	3		3			
122		1245	Leuconostoc mesenteroides	1		1			
123		1254	Pediococcus acidilactici	1		1			
124		1260	Finegoldia magna		1		1		
125		1265	Ruminococcus flavefaciens		1		1		
126		1270	Micrococcus luteus	1		1			
127		1279	Staphylococcus	1		1			
128		1280	Staphylococcus aureus	135	47	145	48	10	1
130		1292	Staphylococcus warneri	1		1			
131		1299	Deinococcus radiodurans	3		3			
132		1301	Streptococcus	3		3			
133		1303	Streptococcus oralis	12		12	1		1
135		1305	Streptococcus sanguinis		1		1		

136		1307	Streptococcus suis	1		4		3	
137		1309	Streptococcus mutans	146	89	146	89		
138		1310	Streptococcus sobrinus	1		1			
139		1311	Streptococcus agalactiae	18		19		1	
140		1313	Streptococcus pneumoniae	91	28	95	28	4	
141		1314	Streptococcus pyogenes	377	125	400	125	23	
142		1317	Streptococcus downei	2	1	2	1		
143		1319	Streptococcus sp. 'group B'	2		4		2	
145		1324	Streptococcus sp. G148	14	5	14	5		
146		1334	Streptococcus dysgalactiae	3	6	3	7		1
147		1336	Streptococcus equi	22	14	22	14		
148		1349	Streptococcus uberis	8		8			
149		1351	Enterococcus faecalis	2		2			
150		1352	Enterococcus faecium	6		6			
151		1358	Lactococcus lactis		2		2		
152	X	1386	Bacillus				1		1
153		1390	Bacillus amyloliquefaciens	18	3	18	3		
154		1392	Bacillus anthracis	403	209	403	209		
155		1396	Bacillus cereus	1	8	1	10		2
156		1402	Bacillus licheniformis		10		10		
157		1404	Priestia megaterium		1		1		
158		1405	Bacillus mycoides		1		1		
159	X	1406	Paenibacillus polymyxa			1		1	
160		1408	Bacillus pumilus		1		1		
161		1422	Geobacillus stearothermophilus	2	1	2	1		
162		1423	Bacillus subtilis	2	4	2	4		
163		1428	Bacillus thuringiensis	7	7	7	7		
164		1435	Bacillus thuringiensis serovar san diego		2		2		
165	X	1454	Calidifontibacillus azotoformans				1		1
166		1467	Lederbergia lentus		1		1		
167		1491	Clostridium botulinum	196	112	205	112	9	
168	X	1492	Clostridium butyricum				1		1
169		1496	Clostridioides difficile	66	1	98	1	32	
170		1502	Clostridium perfringens	41	1	41	1		
171		1513	Clostridium tetani	79	275	79	282		7
172		1520	Clostridium beijerinckii	1		1			
173	X	1542	Clostridium novyi				1		1
174	X	1569	Sporosarcina				1		1
175		1585	Lactobacillus delbrueckii subsp. bulgaricus	1		1			
176		1599	Latilactobacillus sakei		1		1		
177		1604	Lactobacillus amylovorus		1		1		
178		1613	Limosilactobacillus fermentum	1		1			
180		1638	Listeria ivanovii	1	1	1	2		1

181		1639	Listeria monocytogenes	22	99	24	99	2	
182		1641	Listeria grayi		1		1		
183		1642	Listeria innocua	2	2	2	2		
184		1646	Renibacterium salmoninarum	12		12			
185		1661	Trueperella pyogenes	7		7			
186		1664	Arthrobacter glacialis		1		1		
187		1681	Bifidobacterium bifidum		1		1		
188	X	1685	Bifidobacterium breve				1		1
189		1716	Corynebacterium		1		1		
190		1717	Corynebacterium diphtheriae	15	52	15	56		4
191		1718	Corynebacterium glutamicum		26		26		
192		1747	Cutibacterium acnes		2		2		
193		1752	Propionibacterium freudenreichii subsp. shermanii		1		1		
194		1763	Mycobacterium	29	21	29	22		1
195		1764	Mycobacterium avium	6	18	6	18		
196		1765	Mycobacterium tuberculosis variant bovis	49	327	50	327	1	
197		1766	Mycolicibacterium fortuitum		1		1		
198		1767	Mycobacterium intracellulare		1		1		
199		1768	Mycobacterium kansasii	9	12	9	12		
200		1769	Mycobacterium leprae	127	409	127	409		
201		1770	Mycobacterium avium subsp. paratuberculosis	105	15	106	15	1	
202		1771	Mycolicibacterium phlei		1		1		
203		1772	Mycolicibacterium smegmatis		28		28		
204		1773	Mycobacterium tuberculosis	643	2575	652	2613	9	38
205		1774	Mycobacteroides chelonae	1		1			
206		1778	Mycobacterium gordonae	1		1			
207		1781	Mycobacterium marinum		1		1		
208		1783	Mycobacterium scrofulaceum	4		4			
209		1795	Mycolicibacterium neoaurum		1		1		
210		1804	Mycolicibacterium gilvum		1		1		
211		1809	Mycobacterium ulcerans		10		10		
213		1828	Rhodococcus fascians		2		2		
214		1830	Rhodococcus ruber		1		1		
215		1833	Rhodococcus erythropolis		2		3		1
216		1836	Saccharopolyspora erythraea	2		4		2	
217		1895	Streptomyces avidinii	1		1			
218		1902	Streptomyces coelicolor		2		2		
219		1916	Streptomyces lividans	10		10	1		1
220	X	1943	Streptomyces griseoruber				1		1
221		1946	Streptomyces kasugaensis		1		1		
222		2039	Tropheryma whipplei	1		1			
223		2097	Mycoplasma genitalium		1		1		

224		2099	Mycoplasma hyopneumoniae	2		3		1	
225		2100	Mycoplasma hyorhinis	1		1			
226		2104	Mycoplasma pneumoniae	16	2	16	2		
228		2133	Spiroplasma citri		1		1		
229		2147	Acholeplasma	1		1			
230		2148	Acholeplasma laidlawii		2		2		
232		2190	Methanocaldococcus jannaschii		1		1		
233		2234	Archaeoglobus fulgidus	1	1	1	1		
234		2242	Halobacterium salinarum	1		1			
235	X	2261	Pyrococcus furiosus				1		1
236		2287	Saccharolobus solfataricus	1		1			
237		2336	Thermotoga maritima	2		2			
238		2439	Plasmid ColB2	1		1			
239		2465	Plasmid F	1		1			
241		2736	Verrucomicrobium spinosum	1		1			
242		2759	Eukaryota	1		1			
243		2864	Dinophyceae	1		1			
244		2903	Emiliania huxleyi		1		1		
245		3039	Euglena gracilis	1		1			
246		3068	Volvox carteri f. nagariensis		1		1		
247		3318	Pinaceae	2		2			
248	X	3346	Pinus pinea			37		37	
249		3352	Pinus taeda	4		4			
250		3369	Cryptomeria japonica	45	300	45	300		
251		3469	Papaver somniferum	1		1			
252		3505	Betula pendula	85	337	88	337	3	
253		3513	Quercus alba		5		5		
254		3517	Alnus glutinosa		17		17		
255	X	3559	Chenopodium album			3	2	3	2
256		3562	Spinacia oleracea	4		4			
258		3617	Fagopyrum esculentum	40		40			
259		3645	Bertholletia excelsa	7	24	7	24		
260		3656	Cucumis melo	13		13			
261		3677	Trichosanthes kirilowii	4		4			
262		3702	Arabidopsis thaliana	6	10	6	10		
263		3704	Armoracia rusticana	5		5			
264		3707	Brassica juncea	9		9			
266		3711	Brassica rapa	1		1			
267		3726	Raphanus sativus	1		1			
268		3728	Sinapis alba	2		2			
269		3750	Malus domestica	27	48	27	48		
270		3755	Prunus dulcis	19		19			
271		3758	Prunus domestica	4		4			

272		3760	Prunus persica	18	51	19	51	1	
273		3816	Abrus precatorius	1		99		98	
274		3818	Arachis hypogaea	478	263	483	263	5	
275		3847	Glycine max	608	2	611	2	3	
276		3864	Lens culinaris	19		19			
277		3885	Phaseolus vulgaris	10	3	10	3		
279		3972	Viscum album	17		17			
280		3981	Hevea brasiliensis	212	43	212	43		
281		3988	Ricinus communis	81	6	81	6		
282		4012	Rhus		1		1		
283		4026	Acer pseudoplatanus	1		2		1	
284		4039	Daucus carota		46		46		
285		4045	Apium graveolens		14		14		
286		4081	Solanum lycopersicum	3		3			
287		4097	Nicotiana tabacum	5		5			
288		4100	Nicotiana benthamiana	5		5			
290		4146	Olea europaea	70	19	76	19	6	
291		4163	Digitalis	1		1			
292		4182	Sesamum indicum	11		11			
293		4212	Ambrosia artemisiifolia	4	215	4	215		
294		4214	Ambrosia trifida		10		10		
295		4215	Ambrosia artemisiifolia var. elatior	9	12	9	12		
296		4220	Artemisia vulgaris	1	70	1	70		
297		4232	Helianthus annuus	18		18			
298		4479	Poaceae	1		1			
299		4498	Avena sativa		16		16		
300		4509	Dactylis glomerata		12		12		
301		4513	Hordeum vulgare		26		61		35
302		4522	Lolium perenne	44	123	44	123		
303		4530	Oryza sativa	2		2			
304		4545	Poa pratensis	34	35	34	35		
305		4550	Secale cereale	51	44	51	82		38
306		4558	Sorghum bicolor		1		1		
307		4565	Triticum aestivum	650	586	651	593	1	7
308		4567	Triticum turgidum subsp. durum		1		1		
309		4568	Triticum monococcum		1		1		
311		4577	Zea mays	3	1	3	1		
312		4606	Lolium arundinaceum	1		1			
313		4615	Ananas comosus	3		3			
314		4641	Musa acuminata	50	1	50	1		
315		4751	Fungi	4		6		2	
316		4754	Pneumocystis carinii	2	1	2	1		
317		4903	Cyberlindnera jadinii	12		12			

318	X	4920	Millerozyma farinosa				1		1
319		4932	Saccharomyces cerevisiae	29	14	31	17	2	3
320	X	4954	Zygosaccharomyces bailii				1		1
321	X	5037	Histoplasma capsulatum				1		1
322		5039	Blastomyces dermatitidis		1		1		
323		5052	Aspergillus	4		4			
324	X	5057	Aspergillus clavatus				1		1
325		5059	Aspergillus flavus	6		6	1		1
326		5060	Aspergillus giganteus		4		4		
327		5061	Aspergillus niger		1		3		2
328		5064	Aspergillus restrictus	1		1			
329		5067	Aspergillus parasiticus		1		1		
330		5076	Penicillium chrysogenum	45	19	45	19		
331		5077	Penicillium citrinum	13		13			
332		5141	Neurospora crassa	6	3	6	3		
333		5207	Cryptococcus neoformans	2	2	2	3		1
334	X	5325	Trametes versicolor				1		1
335		5334	Schizophyllum commune	1	1	1	1		
336	X	5346	Coprinopsis cinerea				1		1
337		5476	Candida albicans	111	80	111	82		2
338		5480	Candida parapsilosis	1		1			
339	X	5482	Candida tropicalis				2		2
340		5501	Coccidioides immitis		1		1		
341		5503	Curvularia lunata	20	10	20	10		
342	X	5507	Fusarium oxysporum				5		5
343		5518	Fusarium graminearum	6		9		3	
344		5551	Trichophyton rubrum	2	27	2	27		
345		5554	Cutaneotrichosporon cutaneum	1		1			
346		5599	Alternaria alternata	6	36	8	38	2	2
347		5658	Leishmania	4		4	1		1
348		5659	Leishmania amazonensis		15		15		
349		5660	Leishmania braziliensis	6		6			
350		5661	Leishmania donovani	25	96	30	102	5	6
351		5664	Leishmania major	30	184	32	186	2	2
352		5665	Leishmania mexicana	3	3	3	3		
353		5667	Leishmania aethiopica	16		16			
354		5671	Leishmania infantum	108	9	108	9		
355		5679	Leishmania panamensis	3	7	3	7		
356		5682	Leishmania pifanoi		20		20		
357		5691	Trypanosoma brucei	13	6	13	6		
358		5692	Trypanosoma congolense	1		1			
359		5693	Trypanosoma cruzi	164	454	164	462		8
360		5702	Trypanosoma brucei brucei	5		5			

361		5722	Trichomonas vaginalis	75	1	80	1	5	
362		5741	Giardia intestinalis	1	13	1	13		
363		5755	Acanthamoeba castellanii	14	3	14	3		
364		5759	Entamoeba histolytica	30	14	30	14		
365		5801	Eimeria acervulina	1		1			
366		5802	Eimeria tenella	8		8			
367		5807	Cryptosporidium parvum	4	31	4	31		
368		5811	Toxoplasma gondii	85	103	99	103	14	
369		5820	Plasmodium	3	4	3	4		
370		5821	Plasmodium berghei	20	50	20	58		8
371		5823	Plasmodium berghei ANKA	7	65	7	65		
372		5824	Plasmodium brasilianum	2		2			
373		5825	Plasmodium chabaudi	4	4	4	4		
374		5827	Plasmodium cynomolgi	2		2			
376		5833	Plasmodium falciparum	804	813	3380	842	2576	29
377		5834	Plasmodium falciparum RO-33	8	1	8	1		
378		5835	Plasmodium falciparum CAMP/Malaysia	36	3	36	3		
379		5836	Plasmodium falciparum CDC/Honduras	18		18			
380		5837	Plasmodium falciparum FC27/Papua New Guinea	47	60	47	60		
381		5838	Plasmodium falciparum FCR-3/Gambia	94		94			
382		5839	Plasmodium falciparum K1	18	19	18	19		
383		5840	Plasmodium falciparum LE5		2		2		
384		5841	Plasmodium falciparum Mad20/Papua New Guinea	8	47	8	47		
385		5842	Plasmodium falciparum NF7/Ghana	4		4			
386		5843	Plasmodium falciparum NF54	20	31	21	31	1	
387		5846	Plasmodium falciparum T4/Thailand	25	1	25	1		
388		5848	Plasmodium falciparum isolate WELLCOME	25	51	25	51		
389		5850	Plasmodium knowlesi	2	17	2	17		
390		5851	Plasmodium knowlesi strain H	41	10	41	10		
391		5852	Plasmodium knowlesi strain Nuri		10		10		
392		5855	Plasmodium vivax	369	176	372	176	3	
393		5857	Plasmodium fragile		5		5		
394		5858	Plasmodium malariae	1		1			
395		5861	Plasmodium yoelii	17	39	17	39		
396		5865	Babesia bovis	5	8	5	8		
397		5866	Babesia bigemina		3		3		
398		5868	Babesia microti	5		5			
399		5872	Theileria equi	8		8			
400		5874	Theileria annulata	1		1			
401		5875	Theileria parva	28	20	28	20		
403	X	5970	Exophiala dermatitidis				1		1
404		6035	Encephalitozoon cuniculi		5		5		

405		6100	Aequorea victoria	4	5	5	5	1	
406		6181	Schistosoma	3		3			
407		6182	Schistosoma japonicum	43	53	1207	53	1164	
408		6183	Schistosoma mansoni	102	52	102	52		
409		6184	Schistosoma bovis	2		2			
410		6192	Fasciola hepatica	300	28	320	28	20	
411	X	6198	Opisthorchis viverrini			4		4	
412		6203	Taenia ovis	8		8			
413		6204	Taenia solium	29	4	29	4		
414		6206	Taenia saginata	13		13			
415		6207	Taenia crassiceps	11	1	11	1		
416		6210	Echinococcus granulosus	41	2	41	2		
417		6211	Echinococcus multilocularis	6		14	6	8	6
418		6238	Caenorhabditis briggsae	1		1			
419		6239	Caenorhabditis elegans	2	10	2	10		
421		6253	Ascaris suum	1	1	1	1		
422		6265	Toxocara canis	3		3			
423		6269	Anisakis simplex	38	28	38	28		
424		6279	Brugia malayi	10	5	10	5		
425		6280	Brugia pahangi	1		1			
426		6282	Onchocerca volvulus	4394	39	4394	39		
427		6289	Haemonchus contortus	3		3			
428		6293	Wuchereria bancrofti	13	8	13	8		
429		6299	Litomosoides carinii	3		3			
430		6334	Trichinella spiralis	16	7	18	7	2	
431		6339	Heligmosomoides polygyrus	3		3			
432		6421	Hirudo medicinalis		3		3		
433		6454	Haliotis rufescens	1		1			
434		6491	Conus geographus	30		30			
435		6492	Conus magus	2		2			
436		6493	Conus striatus	11		11			
438		6536	Helix pomatia	1		1			
439		6594	Macrocallista nimbosa	1		1			
440		6661	Artemia franciscana	2		2			
441		6687	Penaeus monodon	10	23	10	23		
442		6689	Penaeus vannamei	140		143		3	
443		6690	Penaeus aztecus	51	31	51	31		
444		6728	Procambarus clarkii	3		3			
445		6761	Scylla serrata	13		13			
446		6850	Limulus polyphemus		1		1		
447		6853	Tachypleus tridentatus	1		1			
448		6858	Androctonus australis	9		9			
449		6860	Androctonus mauritanicus mauritanicus	1		1			

450		6878	Centruroides noxius	10		10			
451		6887	Tityus serrulatus	92		92			
452		6925	Latrodectus tredecimguttatus		1		1		
453		6938	Ornithodoros moubata	20		20			
454		6941	Rhipicephalus microplus	1		2		1	
455		6945	Ixodes scapularis	11		11			
456		6953	Dermatophagoides		578		578		
457		6954	Dermatophagoides farinae	41	111	58	111	17	
458		6956	Dermatophagoides pteronyssinus	133	300	148	326	15	26
459		6958	Euroglyphus maynei		10		10		
460		6973	Blattella germanica	23	501	23	501		
461		6978	Periplaneta americana	25	6	25	6		
462		7088	Lepidoptera		1		1		
463		7108	Spodoptera frugiperda		4		4		
464		7130	Manduca sexta		3		3		
465		7137	Galleria mellonella	2		2			
466		7154	Chironomus thummi	2	3	2	3		
467		7155	Chironomus thummi thummi	58	27	58	27		
468		7160	Aedes albopictus	7		7			
469		7165	Anopheles gambiae	8	2	8	2		
470		7227	Drosophila melanogaster	11	17	11	17		
471		7234	Drosophila persimilis	1		1			
472		7386	Sarcophaga peregrina		1		1		
473		7441	Dolichovespula maculata	11	20	11	20		
474		7444	Vespa basalis	1		1			
475		7453	Vespula maculifrons	1		1			
476		7454	Vespula vulgaris	2	95	2	95		
477		7460	Apis mellifera	15	108	15	108		
478		7469	Apis mellifera ligustica		1		1		
479		7515	Ctenocephalides felis		2		2		
480		7719	Ciona intestinalis	2		2			
481		7726	Styela plicata	6		6			
482		7742	Vertebrata	4		4			
483		7777	Chondrichthyes	1		1			
484		7787	Tetronarce californica	151	75	151	75		
485		7788	Torpedo marmorata	3	3	3	3		
486		7955	Danio rerio	2	3	2	3		
487		7957	Carassius auratus	3	1	3	1		
488		7962	Cyprinus carpio	6	1	6	1		
489		8005	Electrophorus electricus	4		4			
490		8018	Oncorhynchus keta		6		6		
491		8022	Oncorhynchus mykiss	1		1			
492		8030	Salmo salar	35		35			

493		8049	Gadus morhua	44		44			
494		8053	Gadus morhua callarias	10		10			
495		8090	Oryzias latipes	2	1	2	1		
496		8255	Paralichthys olivaceus	1		1			
497		8342	Anura	1		1			
498		8355	Xenopus laevis	4	3	4	5		2
499		8364	Xenopus tropicalis	2	2	2	2		
500		8554	Heloderma suspectum		1		1		
501		8613	Bungarus fasciatus	1		1			
502		8616	Bungarus multicinctus	17	3	17	3		
503		8620	Dendroaspis polylepis polylepis	22		22			
504		8654	Naja nigricollis	3	2	3	2		
506		8656	Naja atra	14		14			
507		8657	Naja oxiana	4		4			
508		8658	Naja pallida	1	1	1	1		
509		8663	Notechis scutatus	2		2			
510		8667	Oxyuranus scutellatus scutellatus	4		4			
511		8671	Pseudechis porphyriacus	3		3			
512		8704	Vipera ammodytes	1		1			
513		8722	Bothrops asper	28		28			
514		8724	Bothrops jararaca	5		5			
515		8725	Bothrops atrox	13		13			
516		8726	Bothrops jararacussu	13		13			
517		8732	Crotalus durissus terrificus	4		31		27	
518		8753	Lachesis muta muta	45		45			
519		8801	Struthio camelus	2		2			
520		8839	Anas platyrhynchos	2		2			
521		8845	Anser cygnoides	2		2			
522		8855	Cairina moschata	2	1	2	1		
523		8932	Columba livia		10		10		
524		8996	Numida meleagris	1		1			
525		9014	Colinus virginianus	1	3	1	3		
526		9031	Gallus gallus	340	370	406	371	66	1
527		9057	Phasianus colchicus colchicus	1		1			
529		9103	Meleagris gallopavo	6		8		2	
530		9258	Ornithorhynchus anatinus		1		1		
531		9322	Macropus sp.	1		1			
532		9337	Trichosurus vulpecula	45		45			
533		9397	Chiroptera	1		1			
535		9447	Lemur catta	1		1			
536		9479	Platyrrhini	1		1			
537		9483	Callithrix jacchus	1	4	1	4		
538		9488	Saguinus mystax	1		1			

539		9491	Saguinus imperator	1		1			
540		9502	Alouatta caraya	1		1			
541		9505	Aotus trivirgatus	1		1			
542		9509	Ateles geoffroyi		1		1		
543		9510	Ateles paniscus	1		1			
544		9511	Ateles sp.	1		1			
545		9515	Sapajus apella	1		1			
546		9519	Lagothrix lagotricha	1		1			
547		9521	Saimiri sciureus	1		1			
548		9534	Chlorocebus aethiops		5		5		
549		9538	Erythrocebus patas		1		1		
550		9541	Macaca fascicularis	3	3	3	4		1
551		9544	Macaca mulatta	3	5	3	5		
553		9548	Macaca radiata	14	1	14	1		
554		9555	Papio anubis	1		1			
555		9556	Papio cynocephalus	1		1			
556		9580	Hylobates lar		1		1		
557		9593	Gorilla gorilla		2		2		
558		9595	Gorilla gorilla gorilla		6		6		
559		9597	Pan paniscus		1		1		
560		9598	Pan troglodytes	7	25	7	25		
561		9600	Pongo pygmaeus		2		2		
562		9601	Pongo abelii		2		2		
563		9606	Homo sapiens	9637	368769	33825	556619	24188	187850
564		9615	Canis lupus familiaris	19	1937	21	1937	2	
565		9627	Vulpes vulpes	1		1			
566		9666	Mustela lutreola	1		1			
567		9685	Felis catus	42	117	42	117		
568		9721	Cetacea	1		1			
569		9755	Physeter catodon	1	34	2	34	1	
570		9796	Equus caballus	54	57	56	57	2	
571		9798	Equus przewalskii		1		1		
572		9823	Sus scrofa	121	55	125	55	4	
573		9825	Sus scrofa domesticus		5		5		
574		9844	Lama glama	1		1			
575		9860	Cervus elaphus	6		6			
576		9864	Cervus canadensis nelsoni	5		5			
577		9874	Odocoileus virginianus	2		2			
578		9913	Bos taurus	1338	855	1346	856	8	1
579		9925	Capra hircus	11		11			
580		9940	Ovis aries	95	17	96	17	1	
581		9978	Ochotona princeps		1		1		

582		9986	Oryctolagus cuniculus	67	10	67	10		
583		10029	Cricetulus griseus	9		9			
584		10036	Mesocricetus auratus	58		58			
585		10042	Peromyscus maniculatus		1		1		
586		10090	Mus musculus	716	26702	750	33667	34	6965
587		10092	Mus musculus domesticus		12		12		
588		10095	Mus sp.	1		1			
589		10114	Rattus	11		11			
590		10116	Rattus norvegicus	279	33145	294	33150	15	5
592		10141	Cavia porcellus	37	86	37	86		
593		10243	Cowpox virus		26		26		
594		10244	Monkeypox virus	5	2	5	2		
595		10245	Vaccinia virus	11	610	11	646		36
596		10247	Vaccinia virus WR 65-16		4		4		
597		10248	Vaccinia virus LC16M8		5		5		
598		10249	Vaccinia virus Copenhagen	31	846	31	851		5
599		10251	Vaccinia virus IHD-J	1		1			
600		10253	Vaccinia virus Tian Tan		21		21		
601		10254	Vaccinia virus WR	31	6822	31	6823		1
602		10255	Variola virus		248		249		1
603		10258	Orf virus	1		1			
604		10261	Fowlpox virus		7		7		
605		10263	Fowlpox virus isolate HP-438/Munich		1		1		
606		10273	Myxoma virus		4		4		
607		10276	Swinepox virus		2		2		
608		10292	Herpesviridae		1		1		
609		10298	Human alphaherpesvirus 1	181	585	183	585	2	
610		10299	Human alphaherpesvirus 1 strain 17	44	46	44	64		18
611		10301	Human alphaherpesvirus 1 strain Angelotti		4		4		
612		10303	Human alphaherpesvirus 1 strain HFEM	2		2			
613		10304	Human alphaherpesvirus 1 strain F	17	5	17	5		
614		10306	Human alphaherpesvirus 1 strain KOS	17	4	17	4		
615		10308	Human alphaherpesvirus 1 strain Patton	3		3			
616		10309	Human alphaherpesvirus 1 strain SC16	5	2	5	2		
617		10310	Human alphaherpesvirus 2	295	229	295	229		
618		10312	Human herpesvirus 2 strain 186	1	1	1	1		
619		10313	Human herpesvirus 2 strain 333	2	5	2	5		
620		10315	Human herpesvirus 2 strain HG52		32		32		
621		10317	Cercopithecine alphaherpesvirus 2		1		1		
622		10320	Bovine alphaherpesvirus 1	6	40	7	40	1	
623		10323	Bovine herpesvirus type 1.1 (strain Cooper)	9	17	9	17		
624		10324	Bovine herpesvirus type 1.1 (strain P8-2)	1		1			

625		10325	Macacine alphaherpesvirus 1	366		366			
626		10326	Equid alphaherpesvirus 1	7	218	7	218		
627		10331	Equid alphaherpesvirus 4	6		6			
628		10335	Human alphaherpesvirus 3	10	132	10	132		
629		10338	Human herpesvirus 3 strain Dumas		29		29		
630		10345	Suid alphaherpesvirus 1	13	3	13	3		
631		10349	Suid herpesvirus 1 (strain NIA-3)	4		4			
632		10359	Human betaherpesvirus 5	123	626	124	628	1	2
633		10360	Human herpesvirus 5 strain AD169	233	456	235	456	2	
634		10363	Human herpesvirus 5 strain Towne	94	26	95	26	1	
635		10366	Murid betaherpesvirus 1	2	64	2	64		
636		10367	Murine cytomegalovirus (strain Smith)		32		32		
638		10369	Human herpesvirus 6 (strain GS)	2		2			
639		10370	Human herpesvirus 6 (strain Uganda-1102)	2	4	2	4		
640		10372	Human betaherpesvirus 7	2	4	2	4		
641		10373	Macaca mulatta cytomegalovirus		76		76		
642		10376	Human gammaherpesvirus 4	2362	659	2367	703	5	44
643		10377	Human herpesvirus 4 strain B95-8	187	355	187	373		18
644		10378	Human herpesvirus 4 strain RAJI	1		1			
645		10381	Saimiriine gammaherpesvirus 2		3		3		
646		10390	Gallid alphaherpesvirus 2		1		1		
647		10407	Hepatitis B virus	277	712	299	760	22	48
648		10408	Hepatitis B virus subtype adw2	82	61	82	61		
649		10409	Hepatitis B virus adr4		13		13		
650		10410	Hepatitis B virus adw/991	2	2	2	2		
651		10411	Hepatitis B virus alpha1		24		24		
652		10412	Hepatitis B virus adw/Indonesia/PIDW420		3		3		
653		10414	Hepatitis B virus LSH/chimpanzee		2		2		
654		10415	Hepatitis B virus adw/Okinawa/PODW282		5		5		
655		10418	Hepatitis B virus subtype ayw	57	185	57	185		
656		10419	Hepatitis B virus subtype adyw	4	45	4	45		
657		10430	Woodchuck hepatitis virus 1	3		3			
658		10433	Woodchuck hepatitis virus 8		34		34		
659		10479	Thermoproteus tenax virus 1	1		1			
660		10497	African swine fever virus	5	26	5	26		
661		10498	African swine fever virus BA71V	55		56		1	
663		10515	Human adenovirus 2	28	16	28	16		
664		10519	Human adenovirus 7	4		4			
665		10521	Human adenovirus 14	4		4			
666		10524	Human adenovirus 41	1		1			
667		10529	Human adenovirus 31		7		7		
668		10530	Murine adenovirus 1	1	2	1	2		

669		10533	Human adenovirus 1		1		1		
670		10541	Human adenovirus 11		12		12		
671		10562	Bos taurus papillomavirus 4	10	3	10	3		
672		10566	Human papillomavirus	3	1	3	1		
673		10573	human papillomavirus 13	1	1	1	1		
675		10580	human papillomavirus 11	9	43	9	43		
676		10583	Human papillomavirus type 1a	8	15	8	15		
677		10585	human papillomavirus 31	13	7	13	7		
678		10586	human papillomavirus 33	6	9	6	9		
679		10587	human papillomavirus 35	1	1	1	1		
680		10588	human papillomavirus 39	1	1	1	1		
681		10589	Human papillomavirus type 41		1		1		
682		10592	human papillomavirus 44		1		1		
683		10593	human papillomavirus 45	2	9	2	9		
684		10595	human papillomavirus 51	1	1	1	1		
685		10596	human papillomavirus 56	1	5	1	5		
686		10598	human papillomavirus 58	49	34	49	34		
687		10600	Human papillomavirus type 6b	11	29	11	29		
688		10611	human papillomavirus 30	1		1			
689		10614	Human papillomavirus 3		3		3		
690		10615	human papillomavirus 40	1	1	1	1		
691		10617	Human papillomavirus 4		4		4		
692		10618	human papillomavirus 52	1	36	1	36		
693		10620	Human papillomavirus type 7	1	3	1	3		
694		10623	Kappapapillomavirus 2	5	7	5	7		
695		10631	BK virus strain AS		1		1		
696		10632	JC polyomavirus	9	78	9	96		18
697		10636	Murine polyomavirus strain A2		3	1	3	1	
698		10638	Kilham polyomavirus		1		1		
699		10665	Escherichia virus T4	10	20	10	20		
700		10678	Escherichia virus P1		6		6		
701		10703	Corynephage beta	2		2			
702		10710	Escherichia virus Lambda		6		6		
703		10754	Salmonella virus P22	5		6		1	
704		10760	Escherichia phage T7	1		1			
705		10783	Aleutian mink disease parvovirus (STRAIN G)	3		3			
706		10786	Feline panleukopenia virus		4		4		
707		10788	Canine parvovirus	23	20	23	20		
708		10790	Canine parvovirus strain CPV-D CORNELL 320	1		1			
709		10791	Canine parvovirus strain N	47		47			
710		10793	Mink enteritis virus strain Abashiri	1		1			
711		10796	Porcine parvovirus	40		40			

712		10798	Human parvovirus B19	94	44	94	44		
713		10804	Adeno-associated virus - 2	42	153	42	153		
714		10847	Escherichia virus phiX174	1		1			
715		10863	Enterobacteria phage f1	1	1	1	1		
716		10864	Enterobacteria phage fd	7	1	7	1		
717		10879	Pseudomonas virus phi6	7		7			
718		10884	Mammalian orthoreovirus 1 Lang	3		3			
719		10886	Mammalian orthoreovirus 3 Dearing	1		1			
720		10891	Reovirus sp.		2		2		
721		10900	Bluetongue virus (serotype 10 / American isolate)	3		3			
722		10903	Bluetongue virus 17	4		4			
723		10904	Bluetongue virus (serotype 1 / isolate Australia)	7		7			
724		10906	Bluetongue virus 10	3		3			
725		10915	Porcine rotavirus serotype 5/strain OSU	1		1			
726		10917	Porcine rotavirus strain Gottfried	2		2			
727		10919	Porcine rotavirus strain YM	2	1	2	1		
728		10923	Simian rotavirus A/SA11	8	5	8	5		
729		10927	Bovine rotavirus	9	1	9	1		
730		10933	Bovine rotavirus strain RF	12	7	12	7		
731		10934	Bovine rotavirus strain UK/G6		1		1		
732		10941	Human rotavirus A	14	84	14	84		
733		10950	Human rotavirus (SEROTYPE 2 / STRAIN DS1)	1		1			
734		10952	Human rotavirus strain KU	9		9			
735		10957	Human rotavirus strain P	1	4	1	4		
736		10958	Human rotavirus strain RRV	1		1			
737		10960	Human rotavirus G4 strain St. Thomas 3	6		6			
738		10962	Human rotavirus strain WA	10	7	10	7		
739		10995	Infectious bursal disease virus	12		12			
740		10996	Infectious bursal disease virus 52/70		10		10		
741		10997	Infectious bursal disease virus 002-73/AUS	1		1			
742		11002	Infectious pancreatic necrosis virus	1		1			
743		11021	Eastern equine encephalitis virus	47	2	47	2		
744		11022	Eastern equine encephalitis virus (STRAIN VA33[TEN BROECK])		1		1		
745		11029	Ross River virus		1	1	1	1	
746		11032	Ross river virus (STRAIN T48)	3		11		8	
747		11033	Semliki Forest virus	36	5	36	5		
748		11034	Sindbis virus	26		26			
749		11036	Venezuelan equine encephalitis virus	2	5	2	5		
750		11037	Venezuelan equine encephalitis virus (strain TC-83)	25		25			
751		11038	Venezuelan equine encephalitis virus (strain Trinidad donkey)	15		15			
752		11039	Western equine encephalitis virus		1		1		

753		11041	Rubella virus	81	100	81	100		
754		11043	Rubella virus strain M33	3	11	3	11		
755		11044	Rubella virus vaccine strain RA27/3	2	6	2	6		
756		11045	Rubella virus strain Therien	20	35	20	35		
757		11047	Equine arteritis virus	3		3			
758		11048	Lactate dehydrogenase-elevating virus	14		14			
759		11049	Lelystad virus	66	12	66	12		
760		11053	Dengue virus 1	90	625	91	629	1	4
761		11057	Dengue virus 1 Thailand/AHF 82-80/1980		1		1		
762		11059	Dengue virus 1 Nauru/West Pac/1974	4	50	4	50		
763		11060	Dengue virus 2	191	739	193	743	2	4
764		11062	Dengue virus 2 Malaysia M2	1		1			
765		11064	Dengue virus 2 Jamaica/1409/1983	264	1254	267	1254	3	
766		11065	Dengue virus 2 Thailand/NGS-C/1944	20	146	20	146		
767		11066	Dengue virus 2 Puerto Rico/PR159-S1/1969	32	21	32	21		
768		11067	Dengue virus 2 Tonga/EKB194/1974		3		3		
769		11069	Dengue virus 3	129	674	129	679		5
770		11070	Dengue virus 4	83	461	85	468	2	7
771		11072	Japanese encephalitis virus	49	143	49	173		30
772		11073	Japanese encephalitis virus strain SA-14	6	1	6	2		1
773		11075	Japanese encephalitis virus strain JAOARS982	4	4	4	4		
774		11076	Japanese encephalitis virus strain Nakayama	2	2	2	2		
775		11077	Kunjin virus	12	1	12	1		
776		11078	Kunjin virus (STRAIN MRM61C)		4		4		
777		11079	Murray Valley encephalitis virus	21	9	21	9		
778		11080	Saint Louis encephalitis virus	9	1	9	1		
779		11081	St. Louis encephalitis virus (strain MS1-7)	7		7			
780		11082	West Nile virus	51	442	52	451	1	9
781		11083	Powassan virus	1	3	1	3		
782		11084	Tick-borne encephalitis virus	18	146	18	146		
783		11085	Langat virus		1		1		
784		11086	Louping ill virus	1		1			
785		11087	Tick-borne encephalitis virus (STRAIN SOFJIN)	6		6			
786		11089	Yellow fever virus		1352		1364		12
787		11090	Yellow fever virus 17D	2	364	2	583		219
788		11092	Kumlinge virus	26		26			
789		11096	Classical swine fever virus	15	4	15	4		
790		11098	Classical swine fever virus - Brescia	4		4			
791		11099	Bovine viral diarrhea virus 1	1	12	1	12		
792		11100	Bovine viral diarrhea virus 1-NADL	4	3	4	3		
793		11103	Hepacivirus C	693	1147	720	1152	27	5
794		11104	Hepatitis C virus (isolate 1)	37	256	37	256		

795		11105	Hepatitis C virus (isolate BK)	3	90	3	90		
796		11108	Hepatitis C virus (isolate H)	163	84	166	84	3	
797		11110	Hepatitis C virus HCT18	1		1			
798		11113	Hepatitis C virus isolate HC-J6	8	3	8	3		
799		11115	Hepatitis C virus isolate HC-J8	1	1	1	1		
800		11116	Hepatitis C virus (isolate Japanese)	6	19	6	19		
801		11120	Infectious bronchitis virus	10	5	10	5		
802		11127	Avian infectious bronchitis virus (strain M41)	4	3	4	3		
803		11128	Bovine coronavirus	7		7			
804		11137	Human coronavirus 229E		2		8		6
805		11138	Murine hepatitis virus	3	31	3	31		
806		11142	Murine hepatitis virus strain A59	26	4	26	4		
807		11144	Murine hepatitis virus strain JHM	25	21	25	21		
808		11149	Transmissible gastroenteritis virus	15	1	15	1		
809		11150	Porcine transmissible gastroenteritis coronavirus strain FS772/70	2		2			
810		11151	Porcine transmissible gastroenteritis coronavirus strain Purdue	14		14			
811		11152	Turkey coronavirus	1		1			
813		11169	Mumps virus strain Kilham	1		1			
814		11173	Mumps virus strain SBL-1	6		6			
815		11177	Newcastle disease virus (STRAIN AUSTRALIA-VICTORIA/32)	4		4			
816		11178	Newcastle disease virus strain Beaudette C/45	12		12			
817		11180	Newcastle disease virus strain D26/76	4		4			
818		11186	Newcastle disease virus strain Queensland/66	4		4			
819		11191	Murine respirovirus	63	10	63	10		
820		11194	Sendai virus (strain Enders)	7	11	7	11		
821		11195	Sendai virus (strain Fushimi)		1		1		
822		11196	Sendai virus (strain Harris)	2		2			
823		11198	Sendai virus (Z)		2		2		
824		11214	Human parainfluenza virus 2 (strain Toshiba)	3		3			
825		11215	Bovine respirovirus 3	3	1	3	1		
826		11216	Human respirovirus 3	3		3			
827		11217	Human parainfluenza 3 virus (strain NIH 47885)	8		8	12		12
828		11232	Canine morbillivirus	14	9	14	9		
829		11233	Canine distemper virus strain Onderstepoort	6	34	6	34		
830		11234	Measles morbillivirus	64	39	64	39		
831		11235	Measles virus strain Edmonston	167	210	167	210		
832		11236	Measles virus strain Halle		34		34		
833		11241	Rinderpest morbillivirus	2	3	2	3		
834		11243	Rinderpest virus (strain L)	6		6			
835		11246	Bovine orthopneumovirus	3	2	3	2		

836		11249	Bovine respiratory syncytial virus (strain RB94)	4		4			
837		11250	Human orthopneumovirus	35	207	35	207		
838		11251	Human respiratory syncytial virus (subgroup B / strain 18537)	2	1	2	1		
839		11252	Human respiratory syncytial virus (strain RSB642)	2		2			
841		11255	Human respiratory syncytial virus (strain RSB6190)	6		6			
842		11256	Human respiratory syncytial virus (strain RSB6256)	11		11			
843		11259	Human respiratory syncytial virus A2	94	211	98	245	4	34
844		11260	Human respiratory syncytial virus A strain Long	129	31	129	94		63
845		11263	Murine orthopneumovirus		14		14		
846		11269	Marburg marburgvirus	5	104	6	104	1	
847		11276	Vesicular stomatitis virus		10		10		
848		11277	Vesicular stomatitis Indiana virus	9	7	9	7		
849		11278	Vesicular stomatitis Indiana virus strain Glasgow		1		1		
850		11279	Vesicular stomatitis Indiana virus strain Mudd-Summers	1		1			
852		11285	Vesicular stomatitis Indiana virus strain San Juan		1		1		
853		11288	Viral hemorrhagic septicemia virus 07-71	12	1	12	1		
854		11290	Infectious hematopoietic necrosis virus	8		8			
855		11292	Rabies lyssavirus	14	26	15	26	1	
856		11293	Rabies virus AVO1		3		3		
857		11294	Rabies virus CVS-11	3		3			
858		11295	Rabies virus ERA	10	27	10	27		
859		11296	Rabies virus HEP-FLURY	7	1	7	1		
860		11298	Rabies virus Nishigahara RCEH	1		1			
861		11307	Sonchus yellow net nucleorhabdovirus		1		1		
862		11318	Dhori thogotovirus	1		1			
863		11320	Influenza A virus	74	592	78	616	4	24
865		11384	Influenza A virus (A/chicken/FPV/Weybridge(H7N7))		2		2		
866		11408	Influenza A virus (STRAIN A/EQUINE/NEW MARKET/76)		1		1		
867		11448	Influenza A virus (A/parrot/Ulster/73(H7N1))		1		1		
868		11484	Influenza A virus (A/whale/Maine/1/84(H13N9))	3		3			
869		11520	Influenza B virus	4	452	4	459		7
870		11521	Influenza B virus (B/Ann Arbor/1/1986)		3		3		
871		11532	Influenza B virus (STRAIN B/HT/84)		1		1		
872		11541	Influenza B virus (B/Oregon/5/80)	16		16			
873		11550	Influenza B virus (B/Yamagata/1/73)		3		3		
874		11552	Influenza C virus		1		1		
875		11553	Influenza C virus (C/Ann Arbor/1/50)	16		16			
876		11577	La Crosse virus	2	1	2	1		
877		11578	La Crosse virus L74		2		2		

878		11583	HoJo virus		1		1		
879		11588	Rift Valley fever virus	13	27	13	67		40
880		11589	Rift valley fever virus (STRAIN ZH-548 M12)		2		2		
881		11602	Hantaan virus 76-118	14	132	14	132		
882		11605	Puumala virus Hallnas B1		1		1		
883		11607	Sapporo rat virus	1	4	1	4		
884		11610	Seoul virus SR11	1		1			
885		11620	Lassa mammarenavirus	15	706	15	707		1
886		11621	Lassa virus GA391		55		55		
887		11622	Lassa virus Josiah	10	409	10	451		42
888		11623	Lymphocytic choriomeningitis mammarenavirus	5	655	5	655		
889		11624	Lymphocytic choriomeningitis virus (strain Armstrong)		1158		1158		
890		11625	Lymphocytic choriomeningitis virus (strain Pasteur)		5		5		
891		11626	Lymphocytic choriomeningitis virus (strain Traub)		3		3		
892		11627	Lymphocytic choriomeningitis virus (strain WE)		74		74		
893		11628	Machupo mammarenavirus	1	801	1	801		
894		11629	Mopeia mammarenavirus		14		14		
895		11631	Tacaribe mammarenavirus		106		106		
896		11636	Reticuloendotheliosis virus	2	5	2	5		
897		11660	Caprine arthritis encephalitis virus	14	1	14	1		
898		11661	Caprine arthritis encephalitis virus strain Cork	9		9			
899		11662	Caprine arthritis encephalitis virus G63	6		6			
900		11665	Equine infectious anemia virus	93	112	93	112		
901		11670	Equine infectious anemia virus (CLONE 1369)		1		1		
902		11671	Equine infectious anemia virus (STRAIN WSU5)		19		19		
903		11673	Feline immunodeficiency virus		30		30		
904		11674	Feline immunodeficiency virus (isolate Petaluma)	2	4	2	4		
905		11675	Feline immunodeficiency virus (isolate San Diego)		1		1		
906		11676	Human immunodeficiency virus 1	276	514	314	531	38	17
907		11678	Human immunodeficiency virus type 1 BH10	2	27	2	29		2
908		11679	Human immunodeficiency virus type 1 (CLONE 12)		7		7		
910		11682	Human immunodeficiency virus type 1 (BH5 ISOLATE)		1		1		
911		11683	Human immunodeficiency virus type 1 (Z2/CDC-Z34 ISOLATE)		1		1		
913		11685	HIV-1 M:B_ARV2/SF2	1	44	1	44		
914		11686	Human immunodeficiency virus type 1 (BRU ISOLATE)	1	4	1	4		
915		11687	Human immunodeficiency virus type 1 (CDC-451 ISOLATE)		3		3		
916		11688	Human immunodeficiency virus type 1 (JRCSF ISOLATE)	4	37	4	37		
917		11689	Human immunodeficiency virus type 1 (ELI ISOLATE)		7		7		

918		11690	Human immunodeficiency virus type 1 (SF33 ISOLATE)		3		3		
919		11691	Human immunodeficiency virus type 1 (SF162 ISOLATE)	2	1	2	1		
920		11694	Human immunodeficiency virus type 1 (JH3 ISOLATE)		4		4		
921		11695	Human immunodeficiency virus type 1 (NDK ISOLATE)		8		8		
922		11696	HIV-1 M:B_MN	11	27	11	27		
923		11697	Human immunodeficiency virus type 1 (MAL ISOLATE)		8		8		
924		11698	Human immunodeficiency virus type 1 (NEW YORK-5 ISOLATE)	2	2	2	2		
925		11699	Human immunodeficiency virus type 1 (OYI ISOLATE)		3		3		
926		11701	Human immunodeficiency virus type 1 (RF/HAT ISOLATE)	1	19	1	19		
927		11703	Human immunodeficiency virus type 1 (STRAIN UGANDAN / ISOLATE U455)		15		15		
928		11704	Human immunodeficiency virus type 1 (MFA ISOLATE)		2		2		
929		11705	Human immunodeficiency virus type 1 (WMJ2 ISOLATE)		1		1		
930		11706	HIV-1 M:B_HXB2R	15	17	15	18		1
931		11708	Human immunodeficiency virus type 1 (ZAIRE 6 ISOLATE)		1		1		
932		11709	Human immunodeficiency virus 2	1	8	1	8		
933		11711	Simian immunodeficiency virus - mac		1		1		
934		11713	Human immunodeficiency virus type 2 (ISOLATE D194)		1		1		
935		11714	Human immunodeficiency virus type 2 (ISOLATE BEN)		12		12		
936		11715	Human immunodeficiency virus type 2 (ISOLATE CAM2)		2		2		
937		11716	Human immunodeficiency virus type 2 (ISOLATE D205,7)		2		2		
938		11717	Human immunodeficiency virus type 2 (ISOLATE GHANA-1)		7		7		
939		11718	Human immunodeficiency virus type 2 (ISOLATE SBLISY)		2		2		
940		11720	Human immunodeficiency virus type 2 (ISOLATE ROD)		2		2		
941		11723	Simian immunodeficiency virus		239		245		6
942		11730	Simian immunodeficiency virus (AGM3 ISOLATE)		1		1		
945		11733	Simian immunodeficiency virus (MM142-83 ISOLATE)		102		102		
946		11734	Simian immunodeficiency virus (MM251 ISOLATE)		1		1		
947		11735	Simian immunodeficiency virus - mac K6W		125		125		
948		11736	Simian immunodeficiency virus (K78 ISOLATE)		29		29		
949		11737	Simian immunodeficiency virus (F236/SMH4 ISOLATE) (SOOTY MANGABEY)		17		17		
950		11738	Simian immunodeficiency virus (PBJ/BC13 ISOLATE) (SOOTY MANGABEY)		2		2		
951		11742	Visna lentivirus (strain 1514)	1		1			
952		11743	Visna lentivirus (strain 1514 / clone LV1-1KS1)	4		4			
953		11746	Jaagsiekte sheep retrovirus	1		1			

954		11757	Mouse mammary tumor virus		12		12		
955		11764	Baboon endogenous virus strain M7	1		1			
956		11769	Feline leukemia virus strain A/Glasgow-1	6		6			
957		11780	Snyder-Theilen feline sarcoma virus	1		1			
958		11786	Murine leukemia virus	1	23	1	23		
959		11790	AKT8 murine leukemia virus	1		1			
960		11791	AKR (endogenous) murine leukemia virus		13		13		
961		11795	Friend murine leukemia virus	6	53	6	53		
962		11801	Moloney murine leukemia virus		5		5		
963		11812	Murine sarcoma virus 3611	4		4			
964		11824	Gardner-Arnstein feline leukemia oncovirus B	13		13			
965		11827	Human endogenous retrovirus	1	1	1	1		
966		11861	Avian erythroblastosis virus	1		1			
967		11864	Avian leukosis virus	4		5		1	
968		11886	Rous sarcoma virus	4	4	4	4		
969		11901	Bovine leukemia virus	108	40	108	40		
971		11908	Human T-cell leukemia virus type I	236	280	238	280	2	
972		11909	Human T-lymphotropic virus 2	63	2	63	2		
973		11926	Human T-cell lymphotrophic virus type 1 (strain ATK)	30	118	30	118		
974		11927	Human T-cell lymphotrophic virus type 1 (Caribbean isolate)		6		6		
975		11928	Human T-cell lymphotrophic virus type 1 (isolate MT-2)	1		1			
976		11942	Simian retrovirus 1	1		1			
977		11963	Human spumaretrovirus	1		1			
978		11966	Aids-associated retrovirus		2		2		
979		11976	Rabbit hemorrhagic disease virus	4		4	6		6
980		11978	Feline calicivirus	4	1	4	1		
981		11980	Feline calicivirus strain Japanese F4	6		6			
982		11981	Feline calicivirus strain F9	2		2			
983		11983	Norwalk virus	4	1	4	1		
984		11984	Southampton virus	1		1			
985		12022	Escherichia phage MS2	1		1			
986		12060	Echovirus E9	1		1			
987		12063	Human parechovirus 1	7		7			
988		12064	Enterovirus E	17		17			
989		12065	Bovine enterovirus strain VG-5-27	6		6			
990		12066	Coxsackievirus	1		1			
991		12067	Coxsackievirus A9	30		30			
992		12071	Coxsackievirus B1	12		12			
993		12072	Coxsackievirus B3	7	15	7	18		3
994		12073	Coxsackievirus B4	17	51	17	51		
995		12075	Swine vesicular disease virus	1		1			
996		12076	Swine vesicular disease virus (STRAIN H/3 '76)	5		5			

997		12077	Swine vesicular disease virus (STRAIN UKG/27/72)	3		3			
998		12078	Echovirus E11	1		1			
999		12080	Human poliovirus 1	6	1	6	1		
1000		12081	Human poliovirus 1 Mahoney	62	31	62	31		
1001		12082	Human poliovirus 1 strain Sabin	7		8		1	
1002		12086	Human poliovirus 3	5	2	5	2		
1003		12088	Poliovirus type 3 (strains P3/LEON/37 AND P3/LEON 12A[1]B)	4	15	4	15		
1004		12092	Hepatovirus A	26	22	30	22	4	
1005		12098	Human hepatitis A virus Hu/Australia/HM175/1976	87	83	87	83		
1006		12104	Encephalomyocarditis virus		1		1		
1007		12107	Mengo virus	5	13	5	13		
1008		12110	Foot-and-mouth disease virus	30	5	33	5	3	
1009		12111	Foot-and-mouth disease virus - type A	3	6	3	7		1
1010		12112	Foot-and-mouth disease virus (strain A10-61)	8		8			
1011		12113	Foot-and-mouth disease virus (strain A5)	3		3			
1012		12114	Foot-and-mouth disease virus (strain A12)	21	1	21	1		
1013		12115	Foot-and-mouth disease virus (strain A24 Cruzeiro)	17	32	17	32		
1014		12116	Foot-and-mouth disease virus - type C	6	26	6	26		
1015		12117	Foot-and-mouth disease virus (strain C3 Indaial)	2		2			
1016		12118	Foot-and-mouth disease virus - type O	45	8	46	9	1	1
1017		12120	Foot-and-mouth disease virus (strain C1-Santa Pau)	1		1			
1018		12121	Foot-and-mouth disease virus C1	1	4	1	4		
1019		12123	Foot-and-mouth disease virus - type SAT 3		1		1		
1020		12124	Theiler's encephalomyelitis virus	1	18	1	18		
1021		12125	Theiler's encephalomyelitis virus (STRAIN BEAN 8386)	16	52	16	52		
1022		12126	Theiler's encephalomyelitis virus (STRAIN DA)	3	2	3	2		
1023		12130	Human rhinovirus A2	11		11			
1024		12131	Rhinovirus B14	15	1	17	1	2	
1025		12132	Human rhinovirus A89	3		3			
1026		12134	Human rhinovirus 1A		19		19		
1027		12146	Tomato bushy stunt virus (STRAIN BS-3)	3		3			
1028		12161	Beet yellows virus	5		5			
1029		12162	Citrus tristeza virus	8		8			
1030		12211	Plum pox virus	1		1			
1031		12213	Plum pox virus isolate NAT		1		1		
1032		12216	Potato virus Y	2		2			
1033		12219	Potato virus Y strain N	1		1			
1034		12220	Potato virus Y strain O	7		7			
1035		12232	Zucchini yellow mosaic virus	1		1			
1036		12242	Tobacco mosaic virus	142	13	142	13		

1037		12243	Tobacco mosaic virus (vulgare)	1		1			
1038		12246	Tobacco mosaic virus strain Dahlemense	2		2			
1039		12260	Bean pod mottle virus	2		2			
1040		12264	Cowpea mosaic virus		1		1		
1041	X	12274	Grapevine fanleaf virus			1		1	
1042		12305	Cucumber mosaic virus	1		1			
1043		12455	Borna disease virus	8	4	8	4		
1044		12461	Hepatitis E virus	153	91	153	91		
1045		12475	Hepatitis delta virus	56	66	56	66		
1046		12509	Human herpesvirus 4 type 2	2	10	2	10		
1047		12557	Seoul virus 80-39		3		3		
1048		12618	Chicken anemia virus	3		3			
1049		12637	Dengue virus	52	588	58	589	6	1
1050		12639	Duck hepatitis B virus	262	20	262	20		
1051		12643	Ectromelia virus		45		45		
1052		12663	Feline coronavirus		1	64	2	64	1
1053		12701	Human astrovirus 2	2		2			
1054	X	12721	Human immunodeficiency virus				58		58
1055		12750	Visna/maedi virus EV1	1		1			
1056		12760	Murine hepatitis virus strain 4		5		5		
1057		12814	Respiratory syncytial virus	5	5	5	5		
1058		12870	Variola major virus		17		17		
1059		13101	Juniperus ashei	13		13			
1060		13187	Parietaria officinalis	2		2			
1061		13286	Theromyzon tessulatum	1		1			
1062		13373	Burkholderia mallei	3	49	3	49		
1063		13415	Chamaecyparis obtusa	5	68	5	68		
1064		13451	Corylus avellana	27	57	33	57	6	
1065		13469	Cupressus sempervirens		8		8		
1066		13557	Hapalemur griseus		1		1		
1067		13616	Monodelphis domestica	1	4	1	4		
1068		13618	Myrmecia pilosula	2		2			
1069		13677	Scomber scombrus	1		1			
1070	X	13684	Parastagonospora nodorum				2		2
1071		13687	Sphingomonas	1	4	1	4		
1073		15368	Brachypodium distachyon	1		1			
1074		15957	Phleum pratense	64	1158	65	1163	1	5
1075		16719	Juglans nigra	1		1			
1076		27990	Plasmodium vivax-like sp.	3	1	3	1		
1077	X	28037	Streptococcus mitis				1		1
1078		28038	Latilactobacillus curvatus		1		1		
1079		28080	Campylobacter upsaliensis	3		3			
1080		28108	Alteromonas macleodii		1		1		

1081		28130	Prevotella disiens		1		1		
1082		28131	Prevotella intermedia		2		2		
1085		28172	Vibrio metschnikovii	1		1			
1086		28227	Mycoplasma penetrans	40		40			
1087		28276	Human adenovirus 15	1		1			
1088		28280	Human adenovirus E4	1		1			
1089		28282	Human adenovirus 12	11	3	11	3		
1090		28284	Human adenovirus 40	2	1	2	1		
1091		28285	Human adenovirus 5	27	186	27	186		
1092		28295	Porcine epidemic diarrhea virus	13		15		2	
1093		28300	Heron hepatitis B virus		1		1		
1094		28314	Aleutian mink disease virus	10		10			
1095		28327	Murine rotavirus		3		3		
1096		28344	Porcine reproductive and respiratory syndrome virus	90	54	90	156		102
1097		28375	Soil-borne wheat mosaic virus	1		1			
1098		28448	Komagataeibacter xylinus		1		1		
1099		28450	Burkholderia pseudomallei	19	9	19	9		
1100		28479	Phalaris aquatica		12		12		
1101		28869	Ovine respiratory syncytial virus	1		1			
1102		28871	Taterapox virus		4		4		
1103		28873	Camelpox virus		2		2		
1104		28875	Rotavirus A	2		2			
1105		28901	Salmonella enterica		141		144		3
1106		28903	Mycoplasma bovis	21		21			
1107		28909	Cynodon dactylon	27	48	27	48		
1108	X	29073	Ursus maritimus			1		1	
1109		29159	Crassostrea gigas	7		7			
1110		29176	Neospora caninum	2	17	3	17	1	
1111		29271	Dasheen mosaic virus	1		1			
1112		29292	Pyrococcus abyssi		1		1		
1113		29320	Paenarthrobacter nicotinovorans	1		1			
1114		29339	Bacillus thuringiensis serovar kurstaki	3		3			
1115		29362	Ruminiclostridium papyrosolvens		1		1		
1116		29371	Ruminiclostridium cellobioparum subsp. termitidis	1		1			
1117		29388	Staphylococcus capitis	1		1			
1118		29430	Acinetobacter haemolyticus	1		1			
1119		29442	Pseudomonas tolaasii		1		1		
1120		29447	Xanthomonas albilineans		1		1		
1121		29459	Brucella melitensis	19	95	19	95		
1122		29461	Brucella suis	1	8	1	8		
1123		29477	Salmonella enterica subsp. enterica serovar Essen	1		1			
1124		29491	Aeromonas salmonicida subsp. salmonicida		1		1		

1125		29507	Leptospira kirschneri	1		1			
1126		29518	Borreliella afzelii	6	1	6	1		
1127		29519	Borreliella garinii	6	29	6	29		
1128		29661	Anthoxanthum odoratum		3		3		
1129		29679	Holcus lanatus	14	3	14	3		
1130		29715	Ambrosia psilostachya		10		10		
1131		29760	Vitis vinifera	1		1			
1132		29780	Mangifera indica	1		1			
1133	X	29908	Sporothrix schenckii				2		2
1134		29916	Fusarium sp.	3		3			
1135		29918	Cladosporium herbarum		18		18		
1136		29960	Penaeus indicus	2		2			
1137	X	30011	Pyrophorus plagiophthalamus				1		1
1138		30069	Anopheles stephensi	1		1			
1140		30538	Vicugna pacos	1		2		1	
1141		31271	Plasmodium chabaudi chabaudi		3		3		
1142		31273	Plasmodium vivax strain Belem	6	31	9	31	3	
1143		31276	Perkinsus marinus		1		1		
1144		31285	Trypanosoma brucei gambiense	2		2			
1145		31286	Trypanosoma brucei rhodesiense	1	9	1	9		
1146		31330	Ephydatia fluviatilis		1		1		
1147		31512	Hepatitis B virus adr/mutant		1		1		
1148		31525	Human herpesvirus 4 strain CAO		1		1		
1149		31531	Vaccinia virus L-IPV		8		8		
1150		31545	Human adenovirus D8	1	1	1	1		
1151		31552	Human papillomavirus type 6	12	4	12	4		
1152		31560	Infectious bursal disease virus E	1		1			
1153		31569	Human rotavirus (serotype 2 / strain RV-5)	1		1			
1154		31604	Small ruminant morbillivirus	13	31	13	31		
1155		31608	Simian virus 5 (isolate canine/CPI+)	1		1			
1156		31611	Bovine respiratory syncytial virus (strain 391-2)	3		3			
1157		31615	Tacaribe virus strain V5		1		1		
1158		31616	Tacaribe virus strain V7		1		1		
1159		31621	Four Corners hantavirus	2	8	2	8		
1160		31631	Human coronavirus OC43		1		9		8
1161		31634	Dengue virus 2 Thailand/16681/84	32	62	32	62		
1162		31635	Dengue virus 2 16681-PDK53	4	80	4	80		
1163		31636	Dengue virus 2 China/D2-04		5		5		
1164		31637	Dengue virus 2 Thailand/TH-36/1958		4		4		
1165		31641	Yellow fever virus 1899/81		36		36		
1166		31644	Hepatitis C virus HCV-KF	1	1	1	1		
1167		31645	Hepatitis C virus (isolate Taiwan)	3	15	3	15		

1168		31646	Hepatitis C virus subtype 1a	206	399	206	399		
1169		31647	Hepatitis C virus subtype 1b	608	293	609	293	1	
1170		31649	Hepatitis C virus subtype 2a	80	22	80	22		
1171		31650	Hepatitis C virus subtype 2b	103	4	103	4		
1172		31653	Hepatitis C virus subtype 4a	1	1	1	1		
1173		31654	Hepatitis C virus subtype 5a	1	1	1	1		
1174		31655	Hepatitis C virus subtype 6a		1		1		
1175		31678	Human immunodeficiency virus type 1 (WMJ1 isolate)		16		16		
1177		31682	Simian immunodeficiency virus - mac1A11		18		18		
1178		31683	Simian immunodeficiency virus - stm		7		7		
1179		31684	Simian immunodeficiency virus (isolate AGM / clone GRI-1)		2		2		
1181		31704	Coxsackievirus A16	4		4			
1182		31708	Human rhinovirus A16	9	30	9	30		
1183		31715	Bean-pod mottle virus (strain Kentucky G7)	9	1	9	1		
1184		31721	Beet necrotic yellow vein virus	10		10			
1185		31767	Hepatitis E virus (strain Burma)	160		160			
1186		31768	Hepatitis E virus (strain Mexico)	31		31			
1187		32008	Burkholderia	1		1			
1188		32019	Campylobacter fetus subsp. fetus	3		3			
1189		32022	Campylobacter jejuni subsp. jejuni	2		2			
1190		32025	Helicobacter hepaticus		1		1		
1191		32049	Synechococcus sp. PCC 7002		1		1		
1192		32201	Carya illinoinensis	19		19			
1193		32278	Metapenaeus ensis	1	6	1	6		
1194		32603	Human betaherpesvirus 6A	2	7	2	7		
1195		32604	Human betaherpesvirus 6B	2	4483	2	4522		39
1196		32605	Buffalopox virus		1		1		
1197		32606	Rabbitpox virus		2		2		
1198		32614	Convict Creek 107 virus	1	3	1	3		
1199		32630	synthetic construct		1		1		
1200		32644	unidentified		22559		23254		695
1202	X	33075	Acidobacterium capsulatum				1		1
1203		33090	Viridiplantae	1		1			
1204		33127	Parietaria judaica	65	2	65	2		
1205		33178	Aspergillus terreus	2		2			
1206		33703	Suid herpesvirus 1 strain Kaplan	4		4			
1207		33706	Caviid betaherpesvirus 2	3	3	3	3		
1208		33708	Murid gammaherpesvirus 4	1	53	1	54		1
1209		33717	Bluetongue virus (serotype 13 / isolate USA)	2		2			
1210		33718	Bluetongue virus (serotype 17 / isolate USA)	4		4			
1211		33727	Marburg virus - Musoke, Kenya, 1980	3	84	3	84		

1212		33728	Lake Victoria marburgvirus - Popp	3	15	3	15		
1213		33734	Feline infectious peritonitis virus (strain 79-1146)	15	14	15	14		
1214		33741	Dengue virus 1 Singapore/S275/1990		245		245		
1215		33745	Hepatitis C virus genotype 4	1	10	1	10		
1216		33746	Hepatitis C virus genotype 5		2		2		
1217		33747	Simian T-lymphotropic virus 1		14		14		
1218		33758	Echovirus		1		1		
1219		33892	Mycobacterium tuberculosis variant bovis BCG	12	147	13	288	1	141
1220		33934	Anoxybacillus flavithermus		1		1		
1221	X	33959	Lactobacillus johnsonii			1		1	
1222		33990	Rickettsia bellii	1		1			
1223		34054	Yersinia enterocolitica (type O:8)		1		1		
1224		34245	Zinnia elegans		1		1		
1225	X	34610	Amblyomma variegatum			1		1	
1226		34613	Ixodes ricinus	1		2		1	
1227		34631	Rhipicephalus appendiculatus	1		2		1	
1228		34632	Rhipicephalus sanguineus	1		1			
1229		34828	Eulemur mongoz	1		1			
1230		34862	Otospermophilus beecheyi		1		1		
1231		35241	Lactococcus phage Tuc2009	1		1			
1232		35258	Lambdapapillomavirus 2		25		25		
1233		35269	Woodchuck hepatitis virus	4	6	4	6		
1234		35275	Murine endogenous retrovirus		13		14		1
1235		35288	Grapevine virus A	12		12			
1236		35292	Foot-and-mouth disease virus - type SAT 2	1	1	1	1		
1237		35297	Striped jack nervous necrosis virus	1		1			
1238		35305	California encephalitis virus		1		1		
1239		35327	Bluetongue virus 1	4		4			
1240		35329	Bluetongue virus 11	6		6			
1241		35330	Bluetongue virus 13	1		1			
1242		35331	Bluetongue virus 15	7		7			
1243		35336	Rotavirus G4		1		1		
1244		35345	Lactococcus phage TP901-1	3		3			
1245		35670	Naja naja	3		3			
1246		35725	Macrophomina phaseolina		1		1		
1247		35788	Rickettsia africae		1		1		
1248		35791	Rickettsia massiliae		1		1		
1249		35793	Rickettsia sibirica		4		4		
1250		35795	Ehrlichia muris	2	3	2	3		
1252	X	36080	Mucor circinelloides				3		3
1253		36329	Plasmodium falciparum 3D7	1166	270	1176	281	10	11
1254		36351	Human herpesvirus 6 strain Z29	1	146	1	146		

1255		36352	Human herpesvirus 4 type 1	4	14	4	14		
1256		36372	Feline immunodeficiency virus (strain UK8)		1		1		
1257		36374	Visna/maedi virus EV1 KV1772	2		2			
1258		36375	Human immunodeficiency virus type 1 (KB-1 isolate)		2		2		
1259		36382	Venezuelan equine encephalitis virus (strain 3880)		1		1		
1260		36386	Louping ill virus (strain 31)	1		1			
1261		36409	Rinderpest virus (strain RBOK)	33	5	33	5		
1262		36412	Human parainfluenza 1 virus (strains A1426 / 86-315 / 62M-753)		1		1		
1263		36418	Influenza A virus (A/chicken/Brescia/1902(H7N7))		1		1		
1264		36420	H1N1 swine influenza virus		13		13		
1265		36421	African horse sickness virus 4	42	4	42	4		
1266		36439	Bovine rotavirus strain NCDV/G6	1		1			
1267		36470	Streptococcus sp. 'group A'	21		21			
1268		36596	Prunus armeniaca	4		4			
1269		36809	Mycobacteroides abscessus		19		19		
1270		36826	Clostridium botulinum A	46		46			
1271		36827	Clostridium botulinum B	29		29			
1272		36829	Clostridium botulinum D	2		2			
1273		36830	Clostridium botulinum E	3	3	3	3		
1274		36831	Clostridium botulinum F	3		3			
1275		36855	Brucella canis		4		4		
1276		36911	Clavispora lusitaniae	1		1	1		1
1277	X	36914	Lodderomyces elongisporus				3		3
1278		36936	Lepidoglyphus destructor	5	10	5	10		
1280		37111	Human papillomavirus 28		1		1		
1281		37112	Human papillomavirus 29		1		1		
1282		37115	human papillomavirus 59	2	1	2	1		
1283		37120	human papillomavirus 67	2		2			
1284		37121	human papillomavirus 69		1		1		
1285		37124	Chikungunya virus	78	22	83	22	5	
1286		37128	Potato mop-top virus	8		8			
1287		37132	Rabies virus Ontario fox	3		3			
1288		37137	Simian rotavirus A/SA11-both	20	2	20	2		
1289		37207	Rio Segundo hantavirus	1		1			
1290		37296	Human gammaherpesvirus 8	26	488	26	488		
1291		37325	Muscovy duck parvovirus	11		11			
1292		37326	Nocardia brasiliensis	6		6			
1293		37329	Nocardia farcinica		1		1		
1294		37347	Tupaia belangeri		1		1		
1295		37546	Glossina morsitans morsitans	2		2			
1297	X	37731	Secale strictum subsp. africanum				2		2
1298	X	37734	Enterococcus casseliflavus				1		1

1299		37762	Escherichia coli B	1	1	1	1		
1300	X	37769	Cryptococcus gattii VGI				1		1
1301		38020	marmosets	3		3			
1302		38033	Chaetomium globosum	1		1			
1303		38171	Avian reovirus strain S1133	6		6			
1304		38251	Goose parvovirus	9		10		1	
1305		38323	Bartonella henselae	1		1			
1306		38347	Leptospira interrogans serovar Hardjo-prajitno	1		1			
1307		38832	Micromonas		1		1		
1308		38873	Fraxinus excelsior		3		3		
1309		38973	Influenza A virus (A/Memphis/4/1973(H3N2))		2		2		
1310		39002	Puumala virus sotkamo/v-2969/81	196		196			
1311		39015	Human T-cell lymphotropic virus type 1 (african isolate)		2		2		
1312		39054	Enterovirus A71	128	1	129	1	1	
1314		39113	Hepatitis GB virus B		4		4		
1315		39152	Methanococcus maripaludis	1		1			
1316		39414	Plantago lanceolata		2		2		
1317		39442	Mus musculus musculus		1		1		
1318		39457	Human papillomavirus type 70		1		1		
1321		39803	Escherichia virus Qbeta		2		2		
1322		39947	Oryza sativa Japonica Group	5	1	5	1		
1323		40051	Bluetongue virus	12	1	12	1		
1324		40214	Acinetobacter johnsonii		1		1		
1325		40271	Hepatitis C virus genotype 2	42	6	42	6		
1326		40674	Mammalia	6	2	6	2		
1327		40697	Blomia tropicalis	19	6	31	6	12	
1328		41514	Salmonella enterica subsp. arizonae serovar 62:z4,z23:-		4		4		
1329	X	41846	Echovirus E30			2		2	
1330		41856	Hepatitis C virus genotype 1	4	177	4	178		1
1331		41857	Influenza A virus H3N2	3	50	6	50	3	
1332		41858	Simian foamy virus-gorilla	1		1			
1333		41953	Pseudo-nitzschia	1		1			
1334	X	41997	Enterococcus saccharolyticus				1		1
1335		42097	Isla Vista hantavirus	1	2	1	2		
1336		42182	Hepatitis C virus genotype 6		7		7		
1337		42229	Prunus avium	3	1	3	1		
1338		42345	Phoenix dactylifera		3		3		
1339		42358	Hantavirus Monongahela-3		5		5		
1340	X	42374	Candida dubliniensis				2		2
1341		42764	Oliveros mammarenavirus		2		2		
1342		42769	Coxsackievirus A10	3		3			
1343		42782	Coxsackievirus A20	1		1			

1344		42789	Enterovirus D68	3		16		13	
1345		42792	Hepatitis C virus subtype 3g	1		1			
1346		42862	Rickettsia felis		1		1		
1347		42897	Shigella flexneri 2a	35		35			
1348		43304	Mycolicibacterium peregrinum	2		2			
1349		43765	Corynebacterium amycolatum		1		1		
1350		43767	Rhodococcus hoagii	18	3	18	3		
1351		43852	Toxicodendron	1	1	1	1		
1352		43853	Toxicodendron radicans	1		1			
1353		44026	Sepik virus		1		1		
1354		44088	Canarypox virus		8		8		
1355		44104	Vibrio cholerae 569B	37		37			
1356		44271	Leishmania chagasi	3		3			
1357		44275	Leptospira interrogans serovar Copenhageni	2		2			
1358		44276	Leptospira interrogans serovar Pomona	2	3	2	3		
1359	X	44386	Haemaphysalis longicornis			1		1	
1360		44561	Murine type C retrovirus		1		1		
1361		44689	Dictyostelium discoideum	1	1	1	1		
1362		44755	New York hantavirus		2		2		
1363		45029	Bluetongue virus 16	3		3			
1364		45201	Mannheimia haemolytica serotype 1	82		82			
1365		45219	Guanarito mammarenavirus		842		842		
1366		45240	human papillomavirus 68		1		1		
1367		45409	Feline immunodeficiency virus (isolate wo)	3		3			
1368		45410	Hepatitis B virus adw4/Brazil/isolate w4b		12		12		
1369		45455	Macacine gammaherpesvirus 4		27		27		
1370		45582	[Candida] saitoana	1		1			
1371		45617	Human endogenous retrovirus K	14		14			
1372		45659	Human adenovirus B3	29	2	29	2		
1374		46015	Autographa californica nucleopolyhedrovirus		1		1		
1375		46221	Porcine circovirus	1	49	1	49		
1376		46242	Spodoptera litura nucleopolyhedrovirus		2		2		
1377		46245	Drosophila pseudoobscura pseudoobscura	1		1			
1378		46290	Foot-and-mouth disease virus C3	4	1	4	1		
1379		46457	Cycloclasticus oligotrophus		1		1		
1381		46506	Bacteroides stercoris		1		1		
1382		46771	Simian virus 12	1		1			
1383		46835	Fasciola gigantica	3		3			
1384		46919	Whitewater Arroyo mammarenavirus		349		349		
1385		46920	Rio Mamore hantavirus	1	1	1	1		
1386		46921	Human adenovirus D13	1		1			
1387		46941	Human adenovirus 46	1		1			

1389	X	47466	Borrelia miyamotoi			73		73	
1391		47929	Macacine betaherpesvirus 3		99		101		2
1392		48409	Salmonella enterica subsp. enterica serovar Virchow		1		1		
1393		48483	Reclinomonas americana		1		1		
1394		48935	Novosphingobium aromaticivorans		1		1		
1395		49011	Hesperocyparis arizonica	2	6	2	6		
1396	X	49511	Piper longum			1		1	
1398		50557	Insecta	7		7			
1399		51031	Necator americanus	17		17			
1400		51033	human papillomavirus 73		1		1		
1401		51240	Juglans regia	34	19	34	19		
1402		53182	Feline foamy virus	7		7			
1403		53258	Variola minor virus		93		93		
1404		53751	Echinacea purpurea	1		1			
1405		54290	GB virus C	16		16			
1406		54315	Bovine viral diarrhea virus 2	1		1			
1407		54388	Salmonella enterica subsp. enterica serovar Paratyphi A		4		4		
1408		54390	Micrurus corallinus	125		125			
1409	X	54736	Salmonella bongori				1		1
1410		55097	Mobala mammarenavirus	1		1			
1412		55429	Megathura crenulata	1		1			
1413		55513	Pistacia vera		6		6		
1414		55532	Influenza A virus (A/swine/Quebec/1192/1986(H1))		1		1		
1415		55601	Vibrio anguillarum	1		1			
1416		55635	Inula helenium		1		1		
1417		55951	Grapevine leafroll-associated virus 3	1		1			
1418		56636	Aeropyrum pernix	3	2	3	2		
1419		57068	Acanthisitta chloris		1		1		
1420		57266	Plasmodium falciparum 7G8	42	52	43	52	1	
1421		57270	Plasmodium falciparum Palo Alto/Uganda	38		38			
1422		57278	Human herpesvirus 7 strain JI		1		1		
1424		57372	Mycoplasma suis	3		3			
1425		57482	European bat 1 lyssavirus		1		1		
1426		57486	Mus musculus molossinus		1		1		
1427		57667	Simian-Human immunodeficiency virus	1		1	5		5
1428		57678	Leptospira interrogans serovar Lai	10	10	10	10		
1429		58024	Spermatophyta	4	1	4	1		
1430		58216	Loxosceles gaucho	1		1			
1431		58217	Loxosceles laeta	2		2			
1432		58218	Loxosceles intermedia	83		83			
1433	X	58291	Rhizopus microsporus				1		1
1434		59201	Salmonella enterica subsp. enterica		18		18		

1435		59202	Salmonella enterica subsp. salamae		1		1		
1436		59203	Salmonella enterica subsp. arizonae		1		1		
1437		59205	Salmonella enterica subsp. houtenae		1		1		
1438	X	59300	Getah virus			9		9	
1439	X	59301	Mayaro virus			1		1	
1440		59375	Influenza A virus (A/South Carolina/1/1918(H1N1))	9	1	9	1		
1441		59538	Pantholops hodgsonii		1		1		
1442		59729	Taeniopygia guttata		1		1		
1443		59799	Angomonas deanei		2		2		
1444		60189	Rhipicephalus decoloratus	5		6		1	
1446		60552	Burkholderia vietnamiensis		2		2		
1447		60876	Pixuna virus		1		1		
1448		60879	Cabassou virus		1		1		
1449		60893	Desulfobacca acetoxidans		1		1		
1450		61466	Gnathostoma binucleatum	10		10			
1451		61673	Porcine endogenous retrovirus	2	11	2	11		
1452		62319	Halococcus saccharolyticus		1		1		
1453	X	62322	Shewanella baltica				1		1
1454		62330	Fagopyrum tataricum	5		5			
1455		62446	Influenza A virus (A/Argentina/3779/94(H3N2))		1		1		
1456		62478	Influenza A virus (A/Kitakyushu/93(H3N2))		1		1		
1457		62488	Influenza A virus (A/Nanchang/58/1993(H3N2))		1		1		
1458		62496	Influenza A virus (A/New_York/17/94(H3N2))		1		1		
1459		62503	Influenza A virus (A/Ohio/3/95(H3N2))		1		1		
1460		62512	Influenza A virus (A/Shangdong/5/94(H3N2))		1		1		
1461		62541	Influenza A virus (A/Christchurch/2/1988(H3N2))		1		1		
1462		62549	Influenza A virus (A/Fukuoka/C29/1985(H3N2))	5		5			
1463		62559	Influenza A virus (A/Los Angeles/1987(H3N2))	5		5			
1464		62564	Influenza A virus (A/New_York/15/94(H3N2))		1		1		
1465		62575	Influenza A virus (A/Sichuan/2/1987(H3N2))		5		5		
1466		62596	Influenza A virus (A/USSR/26/1985(H3N2))		1		1		
1468		63106	Influenza A virus (A/Wuhan/359/1995(H3N2))	5		5			
1469		63221	Homo sapiens neanderthalensis		1		1		
1470		63330	Hendra henipavirus	9	2	9	2		
1471		63363	Aquifex aeolicus	2	3	2	7		4
1472		63421	Swine hepatitis E virus	10		12		2	
1473		63673	Turbo cornutus	2		2			
1474		63737	Nostoc punctiforme PCC 73102		2		2		
1475		63746	Hepatitis C virus (isolate H77)	165	208	177	208	12	

1476		64284	Saboya virus		1		1		
1477		64289	Carey Island virus		2		2		
1478		64293	Tembusu virus	2	10	2	10		
1479		64320	Zika virus	112	630	124	650	12	20
1480		64382	Human Endogenous Retrovirus IDDMK1,2-22	3		3			
1481		64495	Rhizopus oryzae	4	1	4	1		
1482		65690	AK7 murine leukemia virus		1		1		
1483		65699	Neisseria meningitidis serogroup A	5		5			
1484		65743	Blackcurrant reversion virus	2		2			
1485		66692	Bacillus clausii KSM-K16		1		1		
1487		67351	Streptomyces californicus	1		1			
1488		68621	Classical swine fever virus strain Riems		5		5		
1489	X	68825	Rasamsonia emersonii				1		1
1490		68887	Torque teno virus	5	94	5	94		
1491		68909	Deinococcus geothermalis	1		1			
1492		69008	Juniperus oxycedrus		3		3		
1493		69153	Human enterovirus 71 (strain BRCR)	1		1			
1494		69156	Murine cytomegalovirus (strain K181)	2	14	2	15		1
1495		69245	Lechiguanas virus		9		9		
1497		69247	Oran virus		2		2		
1498		69248	Pergamino virus		1		1		
1499		70146	Measles virus strain Edmonston-B	2	78	2	78		
1500		70149	Measles virus strain Edmonston-Zagreb	1		1			
1501		70175	Androctonus australis hector	24		24			
1502		70203	Vibrio virus fs1		1		1		
1503		70865	Murine rotavirus EDIM		27		27		
1504		71238	Pseudomonas sp. G-179		1		1		
1505	X	71366	Staphylococcus phage PVL			1		1	
1506		71421	Haemophilus influenzae Rd KW20		3		3		
1509		72132	Rotavirus G1	1	1	1	1		
1510		72539	Physalis mottle virus	2		2			
1511		72556	Achromobacter piechaudii	1		1			
1512		72590	Salmonella sp. 'group B'	6		6			
1513		72664	Eutrema salsugineum	2		2			
1514		73036	Rotavirus G3		1		1		
1515		73239	Plasmodium yoelii yoelii	22	42	22	42		
1516		73482	Foot-and-mouth disease virus (strain O1)	38	1	38	1		
1517		73484	Human immunodeficiency virus type 2 (isolate KR)		3		3		
1518		74138	Pseudomonas sp. DJ-12		1		1		
1519		74537	Vladivostok virus	1		1			
1521		74722	Stachybotrys chartarum	11		11			
1522		74942	Hantavirus CRF355		1		1		

1524	X	75325	Orf virus strain D1701				36		36
1525		75922	Mycolicibacterium tusciae		2		2		
1528		76777	Malassezia sympodialis	1		1			
1529		76832	Myroides odoratimimus		1		1		
1530		76869	Pseudomonas putida GB-1		1		1		
1532		77009	Hordeum vulgare subsp. spontaneum		2		2		
1533	X	77044	Rosellinia necatrix				1		1
1534		77095	Prevotella bryantii		2		2		
1535		77153	Muscovy duck reovirus	1		1			
1536		77643	Mycobacterium tuberculosis complex		5		5		
1537		78245	Xanthobacter autotrophicus Py2		1		1		
1538		79692	Human respiratory syncytial virus B1	1	25	1	25		
1539		79695	Influenza A virus (A/Memphis/1/71H-A/Bellamy/42N)		1		1		
1540		79698	Merluccius bilinearis	1		1			
1541		79889	Bovine herpesvirus type 1.1	2		2			
1542		79923	Clonorchis sinensis	2	1	2	1		
1543		80365	Laminaria digitata	2		2			
1544		80859	Streptomyces ribosidificus		1		1		
1545		80956	Pomacentrus moluccensis		1		1		
1546		81475	Frateuria aurantia	1		1			
1547		81847	Trichophyton quinckeanum	1		1			
1548		81985	Capsella rubella	1		1			
1549		82070	Drimia maritima	1		1			
1550		82300	Adeno-associated virus - 5	9		9			
1551		82372	Influenza A virus (A/Sydney/05/97-like(H3N2))		1		1		
1552		82470	Bovine viral diarrhea virus strain Oregon C24V	5	3	5	3		
1553		82639	Coxsackievirus B2	2		2			
1554	X	82658	Lordsdale virus				1		1
1555		82659	Sapporo virus-Manchester		1		1		
1556		82823	Bovine respiratory syncytial virus strain lelystad	1		1			
1557		82824	Bovine respiratory syncytial virus strain snook	1	75	1	75		
1558		82830	Epstein-barr virus strain ag876	16	1	16	1		
1559		82831	Equid herpesvirus type 2 strain 86/87	1		1			
1561		83192	Topografov hantavirus	1		1			
1562		83206	Influenza A virus (A/swine/Scotland/410440/94(H1N2))		5		5		
1563		83262	Mycobacteroides immunogenum		5		5		
1564		83331	Mycobacterium tuberculosis CDC1551		42		42		
1565		83332	Mycobacterium tuberculosis H37Rv	62	973	62	975		2
1566		83333	Escherichia coli K-12	33	19	33	19		
1567		83334	Escherichia coli O157:H7	3	123	3	123		
1568		83455	Myxococcus stipitatus		1		1		

1569		83554	Chlamydia psittaci	102	6	102	6		
1570		83555	Chlamydia abortus	32		32			
1571		83556	Chlamydia felis	12		12			
1572		83557	Chlamydia caviae	14		14			
1573		83558	Chlamydia pneumoniae	110	24	110	24		
1574		83559	Chlamydia suis	19		19			
1575		83560	Chlamydia muridarum	17	3	17	3		
1576		83810	Thosea asigna virus		1		1		
1577	X	85057	Trypanosoma cruzi cruzi				1		1
1578		85106	Adeno-associated virus - 1		11		11		
1579		85223	Laurus nobilis		1		1		
1580		85552	Scylla paramamosain	88		95		7	
1581		85569	Salmonella enterica subsp. enterica serovar Typhimurium str. DT104	1		1			
1582		85698	Achromobacter xylosoxidans	1		1			
1583		85708	Porcine circovirus 2	34	1	36	1	2	
1584		85709	Porcine circovirus type 2-B	6		18		12	
1585		85777	Agelas mauritiana		1		1		
1586	X	85929	Sphaerulina musiva				1		1
1587		85962	Helicobacter pylori 26695	40	10	40	10		
1588		85963	Helicobacter pylori J99		53		53		
1589		85991	Chlamydia pecorum	142		142			
1590	X	86049	Cladophialophora carrionii				2		2
1591		86107	Coxsackievirus A6	1		1			
1592	X	86385	Porcine circovirus type 2-D			1		1	
1593		86600	Discosoma sp.		1		1		
1594		86782	Amur virus		35		35		
1596		87883	Burkholderia multivorans	1	2	1	2		
1597		88036	Selaginella moellendorffii		1		1		
1598		88085	Lachesis stenophrys	13		13			
1599		88086	Protobothrops elegans	7		7			
1600		88087	Protobothrops flavoviridis	3		3			
1601		88103	Influenza A virus (A/Hong Kong/532/1997(H5N1))		1		1		
1602		88104	Influenza A virus (A/Hong Kong/483/1997(H5N1))	3	10	3	10		
1603		88776	Influenza A virus (A/Brevig Mission/1/1918(H1N1))		1		1		
1604	X	89059	Ligilactobacillus acidipiscis				1		1
1605		89169	Influenza A virus (A/Chicken/Pennsylvania/13552-1/98 (H7N2NSB))	1		1			
1606		89172	Influenza A virus (A/quail/Arkansas/16309-7/94 (H7N3NSA))	1		1			
1608		89462	Bubalus bubalis	7	1	7	1		
1610		90370	Salmonella enterica subsp. enterica serovar Typhi	15	112	15	112		
1611		90371	Salmonella enterica subsp. enterica serovar Typhimurium	16	76	16	76		

1612		91465	Pseudomonas sp. MIS38		1		1		
1613	X	91626	Mucor ambiguus				1		1
1614		92050	Macruronus magellanicus	2		2			
1615	X	92637	Metarhizium acridum				1		1
1616		92652	Shrimp white spot syndrome virus	3		3			
1617		93061	Staphylococcus aureus subsp. aureus NCTC 8325	5	1	5	1		
1618		93062	Staphylococcus aureus subsp. aureus COL	17	1	17	1		
1619		93621	Heteropneustes fossilis		1		1		
1620		93678	TTV-like mini virus		1		1		
1621		93838	Influenza A virus (A/goose/Guangdong/1/1996(H5N1))	1	9	1	10		1
1622		94432	Human rotavirus MP409	1	1	1	1		
1623		94966	Bluetongue virus 12	15		15			
1624		94967	Bluetongue virus 4	7		7			
1627		95486	Burkholderia cenocepacia	1	1	1	1		
1628		95602	Eriocheir sinensis	10		10			
1629		95888	Influenza A virus (A/mallard duck/PA/10218/84(H5N2))	8		8			
1631	X	97138	Clostridium sp. MD294				2		2
1633		97348	Influenza A virus (A/Chicken/Hong Kong/G23/97(H9N2))		1		1		
1634		97353	Influenza A virus (A/Chicken/Hong Kong/739/94(H9N2))		1		1		
1635		97477	Acetomicrobium mobile		1		1		
1636		98360	Salmonella enterica subsp. enterica serovar Dublin		2		2		
1637		99287	Salmonella enterica subsp. enterica serovar Typhimurium str. LT2		78		78		
1638		99586	Echis ocellatus	5		5			
1639		99875	Leishmania donovani donovani	1		1			
1640		99883	Tetraodon nigroviridis		2		2		
1641		100226	Streptomyces coelicolor A3(2)	1	1	1	1		
1642		100835	Influenza A virus (A/Chicken/Hong Kong/258/97 (H5N1))	1		1			
1643		101350	Porcine rotavirus strain A253	2		2			
1644		102617	Helicobacter pylori SS1	4	3	4	3		
1645		102793	H5N1 subtype	27	36	27	40		4
1646		102796	H9N2 subtype	2		2			
1647		102862	Proteus penneri	1		1			
1648		103448	Pleistophora sp. LS		1		1		
1649		103903	Coxsackievirus B3 (strain Nancy)	13	30	13	32		2
1650		103905	Coxsackievirus B4 (strain E2)	7	41	7	41		
1651		103906	Coxsackievirus B4 (strain JVB / Benschoten / New York/51)		76		76		
1652		103920	Guinea pig cytomegalovirus (strain 22122 / ATCC VR682) (GPCMV)	1		1			
1653	X	103922	Human enterovirus 71 (strain 7423/MS/87)			4		4	
1654		103929	Rabies virus strain Pasteur vaccin	2	1	2	1		
1655		103930	Rhesus cytomegalovirus strain 68-1		18		18		

1656		104102	Acetobacter tropicalis		1		1		
1657	X	104355	Gloeophyllum trabeum				1		1
1658		105751	Aeromonas bestiarum		1		1		
1659	X	106654	Acinetobacter nosocomialis				1		1
1660		106820	Hepatitis B virus subtype adr	23	25	23	25		
1661		106821	Hepatitis B virus subtype adw	17	76	17	76		
1662		107404	Influenza B virus (B/Beijing/184/93)		1		1		
1663		107406	Influenza B virus (B/Chiba/447/98)		1		1		
1664		107493	Influenza A virus (A/Cordoba/3278/96(H3N2))		1		1		
1665		107558	Influenza A virus (A/France/75/97(H3N2))		1		1		
1666		107819	Clostridium perfringens D	45		45			
1667		108098	Human mastadenovirus B	1		1			
1668		110195	Foot-and-mouth disease virus - type Asia 1	10	3	10	3		
1669		112509	Hordeum vulgare subsp. vulgare		18		26		8
1670	X	114497	Cordyceps fumosorosea				1		1
1671		114727	H1N1 subtype	16	49	16	49		
1672		114729	H2N2 subtype		1		1		
1673		114742	Pythium insidiosum	2		2			
1674		115711	Chlamydia pneumoniae AR39	1		1			
1675		115713	Chlamydia pneumoniae CWL029	34	48	73	48	39	
1676		117125	Cucumber mosaic virus (strain Pepo)	1		1			
1677		117187	Fusarium verticillioides	1		1			
1678		117204	African horse sickness virus 3	21		21			
1679	X	118161	Pleurocapsa sp. PCC 7319				1		1
1680		119210	H3N2 subtype	6	23	6	23		
1681		119211	H3N8 subtype	1		1			
1682	X	119215	H7N3 subtype			2		2	
1683		119218	H7N7 subtype		1		1		
1684		119220	H5N2 subtype	1		1			
1685		119602	Streptococcus dysgalactiae subsp. equisimilis	21		21			
1686		119856	Francisella tularensis subsp. tularensis		5		5		
1687		119912	Salmonella enterica subsp. enterica serovar Choleraesuis		3		3		
1688		120505	Baboon cytomegalovirus		1		1		
1689		121224	Pediculus humanus corporis	2		2			
1690		121723	Photobacterium sp. SKA34		1		1		
1691		121759	Paracoccidioides brasiliensis	4	16	4	16		
1692		121791	Nipah henipavirus	5		7	11	2	11
1693		122291	Kappapapillomavirus 1	2		2			
1694		122355	Pseudomonas psychrophila	1		1			
1695		122586	Neisseria meningitidis MC58	17		18		1	
1696		122928	Norovirus GI	2		2			
1697		122929	Norovirus GII	2		2	19		19

1699		126283	Herpes simplex virus unknown type		1		1		
1700		126793	Plasmodium vivax Sal-1	22		24		2	
1701		126794	Vaccinia virus Ankara		127		127		
1702	X	127886	Alkalihalobacillus hemicellulosilyticus				1		1
1703		127906	Vibrio cholerae O1	9		9			
1704		127999	Tanacetum parthenium		1		1		
1705		128947	Ebola virus - Gabon (1994-1997)		18		18		
1706		128948	Sudan virus - Boniface, Sudan,1976	2	1	3	1	1	
1707		128949	Sudan ebolavirus - Maleo (1979)		30		30		
1708		128951	Ebola virus - Zaire (1995)		3		3		
1709		128952	Ebola virus - Mayinga, Zaire, 1976	37	13	40	13	3	
1710		128982	Influenza A virus (A/Swine/Indiana/9K035/99 (H1N2))		2		2		
1711		128987	Grass carp reovirus		1		1		
1712		128999	Tai Forest virus - Cote d'Ivoire, Cote d'Ivoire, 1994	1	3	1	3		
1713		129000	Ebola virus - Eckron (Zaire, 1976)		12		12		
1714		129003	Reston ebolavirus - Reston	2	27	2	27		
1715		129052	Catelliglobosispora koreensis		1		1		
1716		129138	Pseudomonas amygdali pv. morsprunorum	2		2			
1717		129727	Bovine papular stomatitis virus		2		2		
1718	X	129788	Ruditapes philippinarum			3		3	
1719		129875	Human mastadenovirus A		1		1		
1720		129951	Human mastadenovirus C	1	3	1	3		
1721		130663	Fowl aviadenovirus 4	3		3			
1722		130760	Influenza A virus (A/Hong Kong/1073/99(H9N2))	1	25	1	25		
1723		130763	Influenza A virus (A/Hong Kong/156/97(H5N1))	4	26	4	26		
1724	X	131110	Schaalia radingae				1		1
1725		132475	Yaba-like disease virus		3		3		
1726		132487	Measles virus strain Schwarz	1	1	1	1		
1727		132504	Influenza A virus (A/X-31(H3N2))	78	189	78	189		
1729		132783	Influenza A virus (A/Netherlands/626/89 (H3N2))		1		1		
1730		132841	Influenza A virus (A/Netherlands/785e/90 (H3N2))		1		1		
1731		132884	Influenza A virus (A/Netherlands/458/98 (H3N2))		1		1		
1732		133704	Porcine circovirus 1	5		6		1	
1733	X	133926	Olsenella uli				1		1
1734		134537	Paraburkholderia fungorum	1		1			
1736		135661	Influenza A virus (A/environment/Hong Kong/437-10/99 (H5N1))		1		1		
1737		135720	Neisseria meningitidis serogroup C	3		3			
1738		136371	Umbilicaria papulosa	1		1			
1739		136474	Influenza A virus (A/Swine/Colorado/23619/99(H3N2))		1		1		
1740		136966	SEN virus		7		7		

1741		137578	Influenza A virus (A/England/939/69 x A/PR/8/34)		2		2		
1742		137885	Influenza A virus (A/parakeet/Chiba/1/97(H9N2))		4		4		
1743		137886	Influenza A virus (A/parakeet/Narita/92A/98(H9N2))		2		2		
1744		138948	Enterovirus A	1		8		7	
1745	X	138949	Enterovirus B			7		7	
1746		138950	Enterovirus C	6	3	13	3	7	
1747	X	138951	Enterovirus D			7		7	
1749		142786	Norovirus		1		8		7
1750		142948	Influenza A virus (A/ruddy turnstone/Delaware/67/1998(H12N4))		1		1		
1751		144549	Mycolicibacterium fortuitum subsp. fortuitum		1		1		
1752		145262	Methanothermobacter thermautotrophicus		1		1		
1753		145306	Influenza A virus (A/swine/Hong Kong/10/98(H9N2))	5		5			
1754		145307	Influenza A virus (A/swine/Hong Kong/9/98(H9N2))	2		2			
1755		147095	Influenza A virus (A/Swine/Italy/25823/94(H3N2))		2		2		
1756		147272	Paspalum notatum		16		16		
1758		148360	Watermelon mosaic virus 2 (isolate USA)	2		2			
1759		148363	Helicoverpa armigera nucleopolyhedrovirus G4	2		2			
1760		149539	Salmonella enterica subsp. enterica serovar Enteritidis	1	3	1	3		
1761		150080	Norovirus isolates	1		1			
1762		150127	Influenza B virus (B/Osaka/983/97-V3)	1		1			
1763		150340	Vibrio antiquarius		15		15		
1764		150396	Pseudomonas sp. MT-1		1		1		
1765		150846	Enterovirus 5865/sin/000009	2		2			
1766		151250	Kali turgidum	1	22	1	22		
1767		152219	Menangle virus	2		2			
1768		152794	Corynebacterium efficiens		5		5		
1769	X	153496	Kozakia baliensis				1		1
1770		153969	Influenza A virus (A/Hong Kong/497/97(H3N2))		1		1		
1771		154540	Influenza A virus (A/Kayano/57(H2N2))		1		1		
1772		155091	Secale cereale subsp. afghanicum		2		2		
1773		155218	Influenza A virus (A/Hong Kong/482/97(H5N1))	7	1	7	1		
1774		155220	Influenza A virus (A/Hong Kong/542/97(H5N1))	1		1			
1775		155222	Influenza A virus (A/Hong Kong/488/97(H5N1))		1		1		
1776		155225	Influenza A virus (A/Hong Kong/507/97(H5N1))		5		5		
1777		155226	Influenza A virus (A/Hong Kong/514/97(H5N1))		1		1		
1778		155227	Influenza A virus (A/Hong Kong/516/97(H5N1))		2		2		
1779		155864	Escherichia coli O157:H7 str. EDL933	4	32	4	32		
1780		155917	Influenza A virus (A/NWS/33HA-A/tern/Australia/G70C/75NA(H1N9))	1		1			

1781		156230	Karenia brevis	1		1			
1782		156586	Flavobacteria bacterium BBFL7		1		1		
1784		157703	Murine polyomavirus strain A3		4		4		
1785		157914	Ziziphus mauritiana	4		4			
1786		158306	Influenza A virus (A/swine/Cotes d'Armor/800/00(H1N2))		1		1		
1787		158465	Human calicivirus Hu/NLV/GII/MD145-12/1987/US	1		1	1		1
1788		158474	Bovine viral diarrhea virus strain Trangie Y546	1		1			
1789		158879	Staphylococcus aureus subsp. aureus N315		5		5		
1790		159091	Pseudomonas sp. KIE171		1		1		
1791		159449	Embleya scabrispora	1		1			
1792		159471	Influenza A virus (A/eq/Sussex/89/(H3N8))	4		4			
1793		159479	Saaremaa hantavirus		21		21		
1794		160490	Streptococcus pyogenes M1 GAS	13	2	13	2		
1795		160491	Streptococcus pyogenes str. Manfredo	3	35	3	35		
1796	X	160691	Tiger frog virus				1		1
1797		160753	Simian immunodeficiency virus 17E-Fr		2		2		
1798		161502	Influenza A virus (A/swine/Italy/1509-6/97(H1N1))		15		15		
1799		161600	Yellow grouper nervous necrosis virus	1		1			
1800		161727	Foot-and-mouth disease virus A10/Holland	11	14	11	14		
1801		161934	Beta vulgaris	5		5			
1802		162145	Human metapneumovirus	8	130	8	130		
1803		162326	Influenza A virus (A/Hong Kong/1143/99(H3N2))	1		1			
1804	X	162425	Aspergillus nidulans				1		1
1805		163164	Wolbachia endosymbiont of Drosophila melanogaster		1		1		
1806		164326	Influenza A virus (A/Hong Kong/1131/1998(H1N1))	1	1	1	1		
1807		164756	Mycobacterium sp. MCS		73		73		
1808		164757	Mycobacterium sp. JLS		77		77		
1809		165420	Influenza A virus (A/Turkey/MO/24093/99(H1N2))		4		4		
1810		165512	Influenza A virus (A/goose/Guangdong/3/1997(H5N1))	3	1	3	1		
1813		167758	TTV-like virus DXL1		10		10		
1814		168278	Influenza A virus (A/swine/Finistere/127/99(H3N2))		4		4		
1815		168807	Escherichia coli O127:H6	1		1			
1816		169166	Influenza A virus (A/swine/Italy/1521/98(H1N2))		4		4		
1817		169169	Influenza A virus (A/swine/Cotes d'Armor/1482/1999(H1N1))		1		1		
1818		169173	Choclo virus		3		3		
1820		169963	Listeria monocytogenes EGD-e	5	64	5	64		
1822		170187	Streptococcus pneumoniae TIGR4		2		2		
1823		170325	Canid alphaherpesvirus 1		1		1		
1824		170342	Influenza A virus (A/swine/Italy/1654-1/99(H1N2))		1		1		

1825		170500	H1N9 subtype	1		1			
1826		170525	Measles virus genotype D4	1		1			
1827		170529	Measles virus genotype D7	1		1			
1828		170955	Amur virus Solovey/AP63/1999		2		2		
1829		171101	Streptococcus pneumoniae R6	1	12	1	12		
1830		171264	Measles virus genotype D3	1		1			
1831		171425	Influenza B virus (B/Kobe/87/2001)	1		1			
1832		171631	Fusarium oxysporum species complex	8		8			
1833		171929	Anacardium occidentale	64	10	64	10		
1834		172148	Alkhumra hemorrhagic fever virus		4		4		
1835		172149	Influenza A virus (A/swine/Quebec/192/81(H1N1))	1		1			
1836		172851	Avian hepatitis E virus	20		20			
1837		173473	Influenza A virus (A/swine/Hong Kong/2106/98(H9N2))		2		2		
1838		173477	Influenza A virus (A/swine/Hong Kong/3297/98(H9N2))		3		3		
1839	X	176275	Beauveria bassiana				1		1
1841		176672	Influenza A virus (A/Duck/Hong Kong/ww461/2000(H5N1))		1		1		
1843		177128	Influenza A virus (A/SW/MN/12883/00(H1N2))		2		2		
1844		177131	Influenza A virus (A/SW/KS/13481-T/00(H1N2))		1		1		
1845		177188	Influenza A virus (A/SW/MN/3227/00(H1N2))		1		1		
1846		177416	Francisella tularensis subsp. tularensis SCHU S4		92		92		
1847		178876	Cryptococcus neoformans var. grubii	1		1			
1848		180454	Anopheles gambiae str. PEST	6	2	6	2		
1849		180498	Jatropha curcas	6		6			
1850		182082	Chlamydia pneumoniae TW-183	7		7			
1851		182781	Influenza A virus (A/Goose/Hong Kong/385.3/2000(H5N1))		1		1		
1852		182785	Mycobacterium tuberculosis subsp. tuberculosis		1		1		
1853		183741	Influenza A virus (A/Chicken/Shanghai/F/98(H9N2))	5		5			
1854		183764	Influenza A virus (A/Puerto Rico/8/34/Mount Sinai(H1N1))	7	100	7	100		
1855		183778	Influenza A virus (A/quail/Hong Kong/SF550/00(H6N1))		2		2		
1856		183783	Influenza A virus (A/duck/Hong Kong/3096/99(H6N2))		2		2		
1857		184816	Influenza B virus (B/Kadoma/122/99)	2		2			
1858		184922	Giardia lamblia ATCC 50803		249		249		
1859		185431	Trypanosoma brucei brucei TREU927		1		1		
1860		185579	Hepatitis E virus type 1	3		3			
1861		185580	Hepatitis E virus type 4	1		1			
1862		185794	Influenza A virus (A/mallard/NZ/1/97(H5N2))		1		1		
1863	X	185894	Human rhinovirus A15			3		3	
1864		185905	Human rhinovirus A34		54		54		
1865		185907	Human rhinovirus A39		1		1		

1866		185949	Sphingomonas aurantiaca		1		1		
1867		186460	Influenza A virus (A/swine/New Jersey/11/1976(H1N1))	1		1			
1868		186536	Ebolavirus	61	1	61	1		
1869		186538	Zaire ebolavirus	124	897	128	898	4	1
1870		186539	Reston ebolavirus	1	11	1	11		
1871		186540	Sudan ebolavirus	4	292	6	292	2	
1872		186541	Tai Forest ebolavirus		1		1		
1873		187164	Influenza A virus (A/Swine/Minnesota/55551/2000(H1N2))		1		1		
1874		187410	Yersinia pestis KIM10+		11		11		
1875		187420	Methanothermobacter thermautotrophicus str. Delta H		1		1		
1876	X	188538	Human parainfluenza virus 1 strain Washington/1964				11		11
1877		188763	Panine betaherpesvirus 2		4		4		
1878		189518	Leptospira interrogans serovar Lai str. 56601	1		1			
1879		189918	Mycobacterium sp. KMS		69		69		
1880		191090	Influenza A virus (A/Weiss/1943(H1N1))		1		1		
1881		191218	Bacillus anthracis str. A2012		29		29		
1882		192087	Pseudomonas syringae pv. atrofaciens	4		4			
1883		192222	Campylobacter jejuni subsp. jejuni NCTC 11168 = ATCC 700819	10	22	10	22		
1884		192535	Influenza A virus (A/Saudi Arabia/7971/2000(H1N1))		1		1		
1885		192549	Influenza A virus (A/Egypt/96/2002(H1N2))		1		1		
1886		192720	Influenza A virus (A/Saudi Arabia/2581/2001(H1N2))		1		1		
1888		194601	Vipera aspis aspis	3		3			
1889		194958	Porcine endogenous retrovirus A	2		2			
1890		194959	Porcine endogenous retrovirus B	1		1			
1891		195055	Human parechovirus 3	1		4		3	
1892		195099	Campylobacter jejuni RM1221		13		13		
1893		195102	Clostridium perfringens str. 13		1		1		
1894		195700	Avian rotavirus PO-13	6		6			
1895		196164	Corynebacterium efficiens YS-314		4		4		
1896		196403	Baboon endogenous virus	1	1	1	1		
1897		196462	Influenza A virus (A/chicken/California/1002a/00(H6N2))	1	1	1	1		
1898		196600	Vibrio vulnificus YJ016		75		75		
1899		196620	Staphylococcus aureus subsp. aureus MW2		7		7		
1900		196627	Corynebacterium glutamicum ATCC 13032		14		14		
1901		197575	Haemophilus aegyptius	1		1			
1902		197579	Influenza A virus (A/Chicken/Guangdong/11/97(H9N2))		1		1		
1903		197585	Influenza A virus (A/chicken/Shandong/6/96(H9N2))	1		1			
1904		197589	Influenza A virus (A/Quail/Shanghai/8/96(H9N2))		1		1		
1905		197780	Bluetongue virus 8	2	21	2	21		

1906		198059	Influenza A virus (A/England/627/01(H1N2))		2		2		
1907		198094	Bacillus anthracis str. Ames		2		2		
1908		198214	Shigella flexneri 2a str. 301		4		4		
1909		198215	Shigella flexneri 2a str. 2457T		2		2		
1910		199306	Coccidioides posadasii		10		10		
1911		199310	Escherichia coli CFT073	1	2	1	2		
1912		199738	uncultured Chlamydia sp.	2		2			
1913	X	200454	Pseudomonas tremae				1		1
1914		201444	Aracatuba virus		5		5		
1915		202812	Adeno-associated virus - 7		2		2		
1916		202813	Adeno-associated virus - 8	17	14	17	14		
1917		202950	Acinetobacter baylyi		2		2		
1918		203119	Hungateiclostridium thermocellum ATCC 27405		1		1		
1919		203124	Trichodesmium erythraeum IMS101		2		2		
1920		203126	Influenza A virus (A/Kamata/14/91(H3N2))	1		1			
1921		203129	Influenza A virus (A/Aichi/2/1994(H3N2))		1		1		
1922		203172	Camelpox virus CMS		28		28		
1923		203173	Camelpox virus M-96		133		133		
1924		203174	Camelpox virus CP1		1		1		
1926	X	204038	Dickeya dadantii			2		2	
1927		204428	Chlamydiae	16		16			
1928		204711	Theilovirus		10		10		
1929		204722	Brucella suis 1330	1	29	1	29		
1931		205488	Ebola virus sp.		2		2		
1932		205913	Bifidobacterium longum DJO10A		2		2		
1933		205914	Histophilus somni 129PT		2		2		
1934		205920	Ehrlichia chaffeensis str. Arkansas	23		23			
1935		205946	Influenza A virus (A/Chicken/Beijing/1/95(H9N2))		1		1		
1937		206203	Influenza B virus (B/Hong Kong/330/2001)		23		23		
1938		207401	Influenza A virus (A/finch/Canada/NS1301/2001(H3N8))		1		1		
1939	X	208226	Alkaliphilus metalliredigens				1		1
1940		208435	Streptococcus agalactiae 2603V/R	1	2	1	2		
1941		208726	Human hepatitis A virus	4	1	4	1		
1942		208893	Human respiratory syncytial virus A	30	4	31	4	1	
1944		208899	Cupixi mammarenavirus		1		1		
1945		208963	Pseudomonas aeruginosa UCBPP-PA14		23		23		
1946		208964	Pseudomonas aeruginosa PAO1	2	39	2	39		
1947		209261	Salmonella enterica subsp. enterica serovar Typhi str. Ty2		16		16		
1948		209841	Actinobacillus pleuropneumoniae serovar 7	1		1			
1949		209882	Fusobacterium nucleatum subsp. vincentii ATCC 49256		2		2		

1950		210655	Influenza A virus (A/Duck/Shantou/2144/00(H9N2))		1		1		
1951		210656	Influenza A virus (A/Duck/Shantou/1881/00(H9N2))		1		1		
1952		210659	Influenza A virus (A/Duck/Shantou/2088/01(H9N2))		1		1		
1953		210663	Influenza A virus (A/Duck/Shantou/2134/00(H9N2))		1		1		
1954		211044	Influenza A virus (A/Puerto Rico/8/1934(H1N1))	36	538	36	546		8
1955		211110	Streptococcus agalactiae NEM316		1		1		
1956		211882	Leptospira interrogans serovar Australis	2		2			
1957		212042	Anaplasma phagocytophilum str. HZ	21		21			
1958		212045	Bacillus anthracis str. Western North America USA6153		1		1		
1959		212361	Anabaena aequalis	1		1			
1960		212717	Clostridium tetani E88		16		16		
1961		214092	Yersinia pestis CO92	39	22	39	22		
1962		214675	Leptospira interrogans serovar Manilae	1		1			
1963		214697	Musa acuminata AAA Group	1		1			
1965		214856	Alistipes finegoldii		1		1		
1966	X	215243	Exophiala oligosperma				1		1
1967	X	215358	Larimichthys crocea			3		3	
1968		215862	Influenza A virus (A/Chicken/Nanchang/2-220/2001(H3N6))		1		1		
1970		216466	Streptococcus agalactiae serogroup V	1		1			
1971		216495	Streptococcus agalactiae serogroup III	12		14		2	
1972		216592	Escherichia coli 042	2		2			
1973		216594	Mycobacterium marinum M		29		29		
1974		216597	Salmonella enterica subsp. enterica serovar Typhimurium str. SL1344		2		2		
1975		216600	Streptococcus pneumoniae 23F	6		6			
1976		216877	Influenza A virus (A/quail/Hong Kong/FY298/00(H9N2))		4		4		
1977		216895	Vibrio vulnificus CMCP6		53		53		
1978		217686	Little cherry virus 1		1		1		
1979		217992	Escherichia coli O6		7		7		
1980		218497	Chlamydia abortus S26/3	29		29			
1981		220341	Salmonella enterica subsp. enterica serovar Typhi str. CT18		92		92		
1982		220837	Cryptosporidium sp. MNJ-1		1		1		
1983		220977	Influenza A virus (A/England/10/67(H2N2))		1		1		
1984		221012	Influenza A virus (A/Rio/6/69(H3N2))		1		1		
1985		221703	Simian foamy virus Pongo pygmaeus pygmaeus	2		2			
1986		221918	Bovine viral diarrhea virus VEDEVAC	6		6			
1987		221988	[Mannheimia] succiniciproducens MBEL55E		2		2		
1988		222523	Bacillus cereus ATCC 10987		1		1		
1989		223337	Tobacco leaf curl Zimbabwe virus		1		1		
1990		223926	Vibrio parahaemolyticus RIMD 2210633	2	17	2	17		

1991		223931	Influenza A virus (A/Bangkok/10/1983(H1N1))		1		1		
1993		223935	Influenza A virus (A/Okuda/1957(H2N2))	1	9	1	9		
1994		223947	Influenza A virus (A/Hokkaido/20/89(H3N2))		3		3		
1995		223997	Murine norovirus 1	4	1	8	1	4	
1996		224197	Influenza C virus (C/Nara/1/85)		1		1		
1997		224206	Simian immunodeficiency virus - mon		1		1		
1998		224308	Bacillus subtilis subsp. subtilis str. 168		1		1		
1999		224324	Aquifex aeolicus VF5	2	1	2	1		
2000		224326	Borreliella burgdorferi B31	113	10	113	10		
2001		224819	Influenza A virus (A/Nagasaki/76/98(H3N2))		1		1		
2002		224914	Brucella melitensis bv. 1 str. 16M	6	14	6	14		
2003		224964	Influenza B virus (B/Johannesburg/5/99)	1		1			
2004		225071	Influenza A virus (A/Tokyo/1566/98(H3N2))		1		1		
2005		225085	Influenza A virus (A/Aichi/2/68 (Ao))		9		9		
2006		225088	Influenza A virus (A/Kitakyushu/159/93(H3N2))		1		1		
2007		225089	Influenza A virus (A/equine/NewMarket/D64/79(H3N8))		1		1		
2008		226186	Bacteroides thetaiotaomicron VPI-5482		1		1		
2009		226900	Bacillus cereus ATCC 14579		2		2		
2010		227377	Coxiella burnetii RSA 493		13		13		
2011		227941	Chlamydia caviae GPIC	11		11			
2012		227984	SARS coronavirus Tor2	171	2205	177	2205	6	
2013		228330	SARS coronavirus Urbani	26	52	26	67		15
2014		228399	Actinobacillus pleuropneumoniae serovar 1 str. 4074	2	1	2	1		
2015		228400	Histophilus somni 2336	1		1			
2017		228407	SARS coronavirus BJ01	64	28	68	28	4	
2018		228928	Influenza A virus (A/Memphis/31/98(H3N2))	6		6			
2019		229032	Porcine epidemic diarrhea virus CV777	5		10		5	
2020		229051	Influenza A virus (A/81/HO)		6		6		
2021		229992	SARS coronavirus Frankfurt 1	5	26	5	26		
2022		231428	Avian infectious bronchitis virus (strain Vic S)	11	8	11	8		
2023		231455	Dyella japonica	1		1			
2024		231851	Influenza A virus (A/Hong Kong/1774/99(H3N2))		1		1		
2025		233262	Bovine enteric coronavirus (strain 98TXSF-110-ENT)		1		1		
2026		233412	[Haemophilus] ducreyi 35000HP	1		1			
2027		233413	Mycobacterium tuberculosis variant bovis AF2122/97		54		54		
2028		234267	Candidatus Solibacter usitatus Ellin6076		2		2		
2029		234603	Sapovirus Mc114		1		1		
2030		234826	Anaplasma marginale str. St. Maries	16	28	16	28		
2031		235279	Helicobacter hepaticus ATCC 51449	2		2			
2032		235455	Adeno-associated virus 9	10		10			

2034		237561	Candida albicans SC5314		3		3		
2035		237609	Pseudomonas alkylphenolica		1		1		
2036		237631	Ustilago maydis 521		2		2		
2037		237895	Cryptosporidium hominis		3		3		
2040		240426	Squirrelpox virus		1		1		
2042		242619	Porphyromonas gingivalis W83	4		4			
2043		243160	Burkholderia mallei ATCC 23344		40		40		
2044		243161	Chlamydia muridarum str. Nigg	11	42	11	72		30
2045		243164	Dehalococcoides mccartyi 195		1		1		
2046		243230	Deinococcus radiodurans R1	2		2			
2047		243232	Methanocaldococcus jannaschii DSM 2661	3	1	3	1		
2048		243243	Mycobacterium avium 104		43		43		
2049		243273	Mycoplasma genitalium G37	8	1	8	1		
2050		243274	Thermotoga maritima MSB8	1		1			
2051		243276	Treponema pallidum subsp. pallidum str. Nichols	283	9	283	9		
2052		243277	Vibrio cholerae O1 biovar El Tor str. N16961	4	3	4	3		
2053		244320	Escherichia coli O55:H7		1		1		
2054		244367	Foot-and-mouth disease virus C-S8c1	15	17	15	18		1
2055		246196	Mycolicibacterium smegmatis MC2 155		61		61		
2056		246202	Streptococcus sobrinus 6715	4	4	4	4		
2057		246437	Tupaia chinensis	1		1	1		1
2058		246618	Bifidobacterium thermacidophilum	1		1			
2059		246878	Canine parvovirus 2	3		3			
2060		249372	Influenza A virus (A/duck/Hokkaido/13/00(H9N2))	2		2			
2061		251297	Influenza A virus (A/Netherlands/127/03(H7N7))		1		1		
2062		253182	Human Respiratory syncytial virus 9320	1		1			
2063		253446	Avian orthoreovirus strain 1017-1	1		1			
2064		253682	Influenza A virus (A/swine/Hong Kong/5190/99(H3N2))		3		3		
2065		253686	Influenza A virus (A/swine/Hong Kong/74/02(H3N2))		1		1		
2066		254252	Lactococcus virus P2	2		2			
2067		254355	Small ruminant lentivirus	1		1			
2068		255681	Influenza A virus (A/Yokohama/22/2002(H1N2))		2		2		
2069		255682	Influenza A virus (A/Yokohama/47/2002(H1N2))		1		1		
2070		256045	Influenza A virus (A/swine/Chiai/77-10/2001(H3N1))		1		1		
2071		256080	Influenza B virus (B/Kobe/1/2003)	1		1			
2072		257313	Bordetella pertussis Tohama I		11		15		4
2073		257363	Rickettsia typhi str. Wilmington		6		6		
2074		260799	Bacillus anthracis str. Sterne	5	4	5	4		
2075		260806	Influenza A virus (A/FPV/Dutch/1927(H7N7))	1		1			
2076		260965	Cercopithecine herpesvirus 1 (strain E2490)	18		18			

2077		261202	Alto Paraguay hantavirus		3		3		
2078		261204	Itapua hantavirus		10		10		
2079		261594	Bacillus anthracis str. 'Ames Ancestor'		1		1		
2080		261658	Cavenderia fasciculata		1		1		
2081		262307	Measles virus genotype A	4		4			
2082		262316	Mycobacterium avium subsp. paratuberculosis K-10	4	58	4	58		
2083		262698	Brucella abortus bv. 1 str. 9-941		1		1		
2084		262722	Mycoplasma hyopneumoniae 7448	1		1			
2085		262724	Thermus thermophilus HB27	1		1			
2086		262727	Haemophilus influenzae R2846		6		6		
2087		262728	Haemophilus influenzae R2866		2		2		
2088		263683	Bovine herpesvirus 5 strain TX89	2		2			
2089		263815	Pneumocystis murina	3		3			
2090		264202	Chlamydia felis Fe/C-56	14		14			
2091		264510	Influenza A virus (A/chicken/Thailand/LV1NF/2004(H5N1))		1		1		
2093		264635	Acholeplasma granularum	1		1			
2094		264730	Pseudomonas savastanoi pv. phaseolicola 1448A		1		1		
2095		264732	Moorella thermoacetica ATCC 39073		1		1		
2096		265120	Influenza A virus (A/turkey/Italy/214845/2002(H7N3))	1		1			
2097		265619	Ornithodoros erraticus	22		22			
2098		265669	Listeria monocytogenes serotype 4b str. F2365		7		7		
2099		265872	Cowpox virus (Brighton Red)		1		1		
2100		266093	Influenza A virus (A/chicken/Yamaguchi/7/2004(H5N1))	3		3			
2101		266264	Cupriavidus metallidurans CH34		3		3		
2102		266779	Chelativorans sp. BNC1		4		4		
2103		266827	Influenza A virus (A/Thailand/1(KAN-1)/2004(H5N1))	4		4			
2104		266834	Sinorhizobium meliloti 1021		3		3		
2105		266940	Kineococcus radiotolerans SRS30216 = ATCC BAA-149		2		2		
2106		267212	Neisseria bacilliformis	1		1			
2107		267377	Methanococcus maripaludis S2	1		1			
2108		267409	Listeria monocytogenes serotype 1/2a str. F6854		3		3		
2109		267410	Listeria monocytogenes serotype 4b str. H7858		25		25		
2110		267671	Leptospira interrogans serovar Copenhageni str. Fiocruz L1-130	11		11			
2111		269482	Burkholderia vietnamiensis G4		9		9		
2112		269484	Ehrlichia canis str. Jake	16		16			
2113		269638	Bovine enterovirus type 2	2		2			
2114		269798	Cytophaga hutchinsonii ATCC 33406		1		1		
2116		269801	Bacillus cereus G9241		41		41		
2117		270338	Human poliovirus 3 strain Sabin	80	1	80	1		
2118		270473	Pneumonia virus of mice J3666		10		10		

2119		270478	Zantedeschia mild mosaic virus	1		1			
2120		270484	Influenza A virus (A/tiger/Thailand/CU-LV/2004(H5N1))		2		2		
2121		270490	Influenza A virus (A/chicken/Nakorn-Patom/Thailand/CU-K3/2004(H5N1))		1		1		
2122		270510	Influenza A virus (A/chicken/Vietnam/HD1/2004(H5N1))		3		3		
2123		270945	Influenza A virus (A/Thailand/4(SP-528)/2004(H5N1))		21		21		
2124		271108	Bombyx mori nucleopolyhedrovirus	2		2			
2125		271848	Burkholderia thailandensis E264		2		2		
2126		272560	Burkholderia pseudomallei K96243	3	735	3	735		
2127		272561	Chlamydia trachomatis D/UW-3/CX	51	26	51	26		
2128		272562	Clostridium acetobutylicum ATCC 824		1		1		
2129	X	272563	Clostridioides difficile 630			1		1	
2130		272564	Desulfitobacterium hafniense DCB-2		3		3		
2131		272620	Klebsiella pneumoniae subsp. pneumoniae MGH 78578	28		28			
2133		272624	Legionella pneumophila subsp. pneumophila str. Philadelphia 1	1		1			
2134		272627	Magnetospirillum magnetotacticum MS-1		5		5		
2135		272631	Mycobacterium leprae TN		30		30		
2136		272634	Mycoplasma pneumoniae M129	9		9			
2137		272636	Adeno-associated virus		18		18		
2138		272831	Neisseria meningitidis FAM18	1		1			
2139		272843	Pasteurella multocida subsp. multocida str. Pm70		5		5		
2140		272943	Rhodobacter sphaeroides 2.4.1		1		1		
2141		272944	Rickettsia conorii str. Malish 7		5		5		
2142		272947	Rickettsia prowazekii str. Madrid E		8		8		
2143		272951	Rickettsia sibirica 246		27		27		
2144		272989	Salmonella enterica subsp. enterica serovar Enteritidis str. LK5		1		1		
2145		273123	Yersinia pseudotuberculosis IP 32953		1		1		
2147		274828	Influenza A virus (A/duck/Fujian/13/2002(H5N1))		1		1		
2148		274829	Influenza A virus (A/duck/Fujian/17/2001(H5N1))		1		2		1
2149	X	277944	Human coronavirus NL63				5		5
2150		278137	Mycolicibacterium gilvum Spyr1		53		53		
2151		279150	Classical swine fever virus 96TD	2		2			
2152		279329	Influenza B virus (B/Shandong/7/97)	1	1	1	1		
2153		279797	Influenza A virus (A/egret/Hong Kong/757.3/2002(H5N1))		3		3		
2155		279889	Triticum spelta var. arduini		3		3		
2156		280240	Nocardiopsis baichengensis	1		1			
2157		280463	Emiliania huxleyi CCMP1516		1		1		
2158	X	280855	Seoul virus BjHD01			2		2	
2159		281310	Haemophilus influenzae 86-028NP	13		13			
2160		281689	Desulfuromonas acetoxidans DSM 684		1		1		
2161		282124	Influenza A virus (A/mallard/Alberta/127/00(H3N8))		1		1		

2162		282458	Staphylococcus aureus subsp. aureus MRSA252	86		86			
2163		283166	Bartonella henselae str. Houston-1		1		1		
2164		283643	Cryptococcus neoformans var. neoformans B-3501A	1	3	1	3		
2165	X	283877	Leucobacter chromiireducens				1		1
2166		284168	Influenza A virus (A/Ck/HK/2133.1/2003(H5N1))		1		1		
2167		284177	Influenza A virus (A/Ck/HK/YU22/2002(H5N1))	1		1			
2168		284190	Influenza A virus (A/Ck/Viet Nam/36/2004(H5N1))	1		1			
2169		284195	Influenza A virus (A/Ck/YN/115/2004(H5N1))		1		1		
2170		284202	Influenza A virus (A/Dk/ST/5048/2001(H3N8))	1		1			
2171		284218	Influenza A virus (A/Viet Nam/1203/2004(H5N1))	74	134	74	134		
2172	X	284581	Priestia koreensis				1		1
2173		284672	SARS coronavirus TJF		14		14		
2174		284813	Encephalitozoon cuniculi GB-M1		28		28		
2175		285006	Saccharomyces cerevisiae RM11-1a		2		2		
2176		286239	Influenza A virus (A/red knot/Delaware/2561/1987(H10N5))		1		1		
2177		286542	Soochong virus-2		1		1		
2178		286636	Streptococcus pyogenes MGAS10394		1		1		
2179		286783	Salmonella enterica subsp. enterica serovar Indiana		1		1		
2180		287752	Aurantimonas manganoxydans SI85-9A1		1		1		
2181		288118	Mandrillus leucophaeus foamy virus	1		1			
2183		289338	Influenza B virus (B/Nanchang/12/98)		1		1		
2184		289365	Human parvovirus 4		3		3		
2185	X	290028	Human coronavirus HKU1				6		6
2187		290512	Prosthecochloris aestuarii DSM 271		1		1		
2188		291592	Influenza A virus (A/crow/Kyoto/53/2004(H5N1))	1		1			
2189		292039	Influenza A virus (A/chicken/HongKong/SF1/03(H9N2))	1		1			
2190		292045	Influenza A virus (A/chicken/HongKong/YU427/03(H9N2))	1		1			
2191		292348	Canine calicivirus (strain 48)	2		2			
2192		292349	Feline calicivirus (strain Urbana)	1		3		2	
2193		292590	Influenza A virus (A/swine/Ontario/42729A/01(H3N3))	1		1			
2194		292633	Dragon grouper nervous necrosis virus	20		20			
2195		293054	Influenza A virus (A/turkey/Ontario/6213/66(H5N?))	1		1			
2196		293055	Influenza A virus (A/mallard/Ohio/556/1987(H5N9))		1		1		
2197		293090	Influenza A virus (A/Fujian/411/2002(H3N2))		1		1		
2198		293614	Rickettsia akari str. Hartford		1		1		
2199		294381	Entamoeba histolytica HM-1:IMSS		103		103		
2200		295027	Human herpesvirus 5 strain Merlin	2	3	2	3		
2201		295319	Salmonella enterica subsp. enterica serovar Paratyphi A str. ATCC 9150		3		3		

2202		295358	Mycoplasma hyopneumoniae 232	21		21			
2203		298339	Pan troglodytes foamy virus	1		1			
2204		298653	Frankia sp. EAN1pec		2		2		
2205		298713	Influenza A virus (A/chicken/Korea/SNU0091/00(H9N2))		1		1		
2206		298716	Influenza A virus (A/chicken/Korea/SNU1035C/00(H9N2))		1		1		
2207		299386	Equine arteritis virus Bucyrus	2		2			
2208		299390	Influenza A virus (A/Viet Nam/HN/2004(H5N1))		6		6		
2209		299730	Influenza A virus (A/chicken/Viet Nam/AG-010/2004(H5N1))		1		1		
2211		300015	Lactate dehydrogenase elevating virus C	1		1			
2212		300016	Lactate dehydrogenase elevating virus Plagemann	1		1			
2213		300180	Mopeia Lassa virus reassortant 29		4		4		
2214		300267	Shigella dysenteriae Sd197		5		5		
2215		300268	Shigella boydii Sb227		5		5		
2216		300269	Shigella sonnei Ss046		9		9		
2217		300559	PRRSV VR2332	21	7	21	7		
2218		300563	PRRSV HB-1(sh)/2002	1		1			
2219		300748	Influenza A virus (A/swine/Korea/S190/2004(H9N2))		3		3		
2220		300749	Influenza A virus (A/swine/Korea/S452/2004(H9N2))		1		1		
2221		300750	Influenza A virus (A/chicken/Korea/S1/2003(H9N2))		1		1		
2222		300852	Thermus thermophilus HB8		1		1		
2223		301448	Streptococcus pyogenes serotype M3	1		1			
2224		301449	Streptococcus pyogenes serotype M5	56	57	56	57		
2225		301450	Streptococcus pyogenes serotype M6	9	7	9	7		
2226		301451	Streptococcus pyogenes serotype M18	1		1			
2227		301452	Streptococcus pyogenes serotype M49	1		1			
2228		301478	Murray valley encephalitis virus (strain MVE-1-51)	11	14	11	14		
2229		301964	CY1014 virus		1		1		
2230		302272	Sendai virus (strain Ohita)	1		1			
2231		303316	Influenza A virus (A/Hatay/2004/(H5N1))	3		3			
2232		304883	Influenza A virus (A/Belfast/53582/2004(H3N?))		2		2		
2233		304895	Catenulispora acidiphila		1		1		
2234		305674	Deerpox virus W-848-83		2		2		
2235		306061	Influenza A virus (A/swine/IDT/Bakum1832/2000(H1N2))		1		1		
2236		306254	Campylobacter coli RM2228		3		3		
2237		306263	Campylobacter lari RM2100		1		1		
2238		306264	Campylobacter upsaliensis RM3195		1		1		
2239		306537	Corynebacterium jeikeium K411		1		1		
2240		307044	West Nile virus strain 385-99	22	12	22	12		
2241		307685	Merluccius australis polylepis	1		1			
2242		307819	Influenza A virus (A/Jiangsu/38/2004(H3N2))		1		1		

2243		308061	Hantavirus HPR/02-73		1		1		
2244		308159	Araucaria virus		6		6		
2245		310542	Chimpanzee adenovirus	2		2			
2246		311169	Influenza A virus (A/duck/Korea/S10/03(H3N2))		1		1		
2247		311339	Human herpesvirus 5 strain Toledo	9		9			
2248	X	311410	Labrenzia alba				1		1
2249		311596	Influenza A virus (A/New York/18/2003(H3N2))		9		9		
2250		311695	Influenza A virus (A/New York/124/2001(H3N2))		1		1		
2252		311775	Influenza A virus (A/New York/205/2001(H1N1))		12		12		
2253		313589	Janibacter sp. HTCC2649		1		1		
2254		313596	Robiginitalea biformata HTCC2501		1		1		
2255		313606	Microscilla marina ATCC 23134		1		1		
2256		313627	Bacillus sp. NRRL B-14911		2		2		
2257		314262	Roseobacter sp. MED193		1		1		
2258		314275	Alteromonas mediterranea		1		1		
2259		314278	Nitrococcus mobilis Nb-231		1		1		
2260		314283	Reinekea blandensis MED297		1		1		
2261		314285	Congregibacter litoralis KT71		1		1		
2262		314288	Vibrio alginolyticus 12G01		3		3		
2263		314291	Vibrio splendidus 12B01		2		2		
2264		314292	Photobacterium angustum S14		1		1		
2265		315277	Chlamydia trachomatis A/HAR-13	6	1	6	1		
2266		315456	Rickettsia felis URRWXCal2		7		7		
2267		315730	Bacillus mycoides KBAB4		5		5		
2268		315749	Bacillus cytotoxicus NVH 391-98		3		3		
2269		316056	Rhodopseudomonas palustris BisB18		1		1		
2270		316068	Leadbetterella byssophila		1		1		
2271		316287	Ceratogyrus marshalli	1		1			
2272		316385	Escherichia coli str. K-12 substr. DH10B		3		3		
2273		316401	Escherichia coli ETEC H10407	64	31	64	31		
2274		316407	Escherichia coli str. K-12 substr. W3110		1		1		
2275		317652	Influenza A virus (A/Hong Kong/2/68(H3N2))		4		4		
2276		317655	Sphingopyxis alaskensis RB2256		1		1		
2277		318586	Paracoccus denitrificans PD1222		2		2		
2278		319224	Shewanella putrefaciens CN-32		1		1		
2279		320306	Influenza A virus (A/crested eagle/Belgium/01/2004(H5N1))	2		2			
2280		320372	Burkholderia pseudomallei 1710b		4		4		
2281		320373	Burkholderia pseudomallei 668		10		10		
2282		320374	Burkholderia pseudomallei S13		2		2		
2283		320388	Burkholderia mallei SAVP1		29		29		
2284		320390	Burkholderia mallei GB8 horse 4		1		1		

2285		320483	Anaplasma marginale str. Florida	19	61	19	61		
2286		320667	Trichosanthes dioica	1		1			
2287		321314	Salmonella enterica subsp. enterica serovar Choleraesuis str. SC-B67		5		5		
2288		322053	Konjac mosaic virus	1		1			
2289		322564	Influenza A virus (A/tiger/Thailand/CU-T4/04(H5N1))		5		5		
2290		322566	Influenza A virus (A/tiger/Thailand/CU-T6/04(H5N1))		1		1		
2291		322710	Azotobacter vinelandii DJ		2		2		
2293		325240	Shewanella baltica OS155		2		2		
2294		327105	HIV-1 O_ANT70	1		1			
2295		327205	Influenza A virus (A/New York/348/2003(H1N1))		150		150		
2296		327310	Influenza A virus (A/Kinmen/645/04(H3N2))		1		1		
2297		327311	Influenza A virus (A/Yilan/515/03(H3N2))		1		1		
2298		328670	Banana streak GF virus	4		4			
2299		328671	Banana streak OL virus	4		4			
2301		329389	Hepatitis C virus (isolate Glasgow)	3	4	3	4		
2302		329593	Influenza A virus (A/chicken/Fujian/25/00(H9N2))		6		6		
2303		329854	Bacteroides intestinalis		1		1		
2304		330879	Aspergillus fumigatus Af293		18		18		
2305		331111	Escherichia coli O139:H28 str. E24377A		36		36		
2306		331112	Escherichia coli HS		14		14		
2307		331271	Burkholderia cenocepacia AU 1054		7		7		
2308		331272	Burkholderia cenocepacia HI2424		1		1		
2309		331635	Chlamydia pecorum E58	29		29			
2310		331636	Chlamydia psittaci 6BC	1		1			
2311		331978	Burkholderia pseudomallei Pasteur 52237		1		1		
2312		332193	Vaccinia Virus Acambis 3000 MVA		20		20		
2314		332747	Influenza A virus (A/swine/Tennessee/25/1977(H1N1))	1		1			
2315	X	332884	Norovirus Hu/GII.4/Sydney715D/04S/AU				1		1
2316		333278	H7N9 subtype	7	26	7	26		
2317		333284	Hepatitis C virus (isolate Con1)	4	3	4	3		
2318		333367	Enterocloster asparagiformis		1		1		
2319		333668	Theileria parva strain Muguga	14	19	14	19		
2320		333751	Human papillomavirus type 2		7		7		
2321		333754	Alphapapillomavirus 10	4		4			
2322		333760	Human papillomavirus type 16	349	492	350	492	1	
2323		333761	Human papillomavirus type 18	26	104	26	104		
2324		333762	Human papillomavirus type 26		1		1		
2325		333763	Human papillomavirus type 32	1	1	1	1		
2326		333765	Human papillomavirus type 53		1		1		
2327		333849	Enterococcus faecium DO		1		1		
2328		333923	Human papillomavirus 5	1		1			

2329		333990	Carnobacterium sp. AT7	1		1			
2330		334203	Mupapillomavirus 1	1	38	1	38		
2331		334380	Orientia tsutsugamushi str. Ikeda		1		1		
2332		334426	Angiostrongylus costaricensis	1	1	1	1		
2334		334590	Influenza A virus (A/Moscow/343/2003(H3N2))		1		1		
2335		334802	Burkholderia mallei FMH		1		1		
2336		334803	Burkholderia mallei JHU		2		2		
2337		335333	Influenza A virus (A/New York/384/2005(H3N2))		64		64		
2338		335337	Influenza A virus (A/New York/388/2005(H3N2))		14		14		
2339		335358	Influenza A virus (A/New York/232/2004(H3N2))		110		110		
2340		335812	Influenza B virus (B/Shanghai/361/2002)	1		1			
2341		336092	Influenza A virus (A/black-headed goose/Qinghai/1/2005(H5N1))	2		2			
2342		336205	Influenza A virus (A/swine/Bakum/5/95(H1N1))		2		2		
2343		336207	Influenza A virus (A/swine/Bakum/1832/2000(H1N2))		3		3		
2344		336238	Influenza A virus (A/Bar-headed Goose/Qinghai/61/05(H5N1))		8		8		
2345	X	336306	Enterobacter cloacae subsp. cloacae				1		1
2346		336407	Rickettsia bellii RML369-C		7		7		
2347		336794	Influenza A virus (A/equine/Massachussetts/213/2003(H3N8))		1		1		
2348		336800	Influenza A virus (A/equine/New York/1/1999(H3N8))		3		3		
2349		336982	Mycobacterium tuberculosis F11		24		24		
2350		337042	Alphapapillomavirus 7	11		11			
2351		337043	Alphapapillomavirus 4		1		1		
2352		337052	Deltapapillomavirus 4	24		24			
2353		337090	Chlorobium chlorochromatii		1		1		
2354		338079	African green monkey simian foamy virus	3		3			
2355		338188	Bacteroides finegoldii		1		1		
2356		338478	Macaque simian foamy virus	1		1			
2357		338966	Pelobacter propionicus DSM 2379		3		3		
2358		339670	Burkholderia ambifaria AMMD		4		4		
2359		339854	Bacillus thuringiensis serovar israelensis ATCC 35646		6		6		
2360		340177	Chlorobium chlorochromatii CaD3		1		1		
2361		340184	Escherichia coli B7A		5		5		
2362		340185	Escherichia coli E22		13		13		
2363		340186	Escherichia coli E110019		2		2		
2364		340197	Escherichia coli F11		12		12		
2366		341663	Aspergillus terreus NIH2624	2		2			
2367		341946	Woodchuck hepatitis virus 2	4		4			
2368		341980	Human herpesvirus 3 strain Oka vaccine	3	62	4	151	1	89
2369		342023	Streptococcus pyogenes serotype M12	3	1	3	1		

2370		342137	Influenza A virus (A/chicken/CA/375TR/2002(H6N2))		1		1		
2371		342145	Influenza A virus (A/turkey/MN/735/79(H6N2))		2		2		
2372		342207	Influenza A virus (A/shorebird/Delaware/141/2002(H9N9))		1		1		
2373		342210	Influenza A virus (A/shorebird/Delaware/275/2001(H9N7))		1		1		
2374		342221	Influenza A virus (A/chicken/Korea/S4/2003(H9N2))		1		1		
2375		342396	Influenza A virus (A/turkey/Canada-Ontario/NS-01839-1/05(H3))		1		1		
2376	X	342409	White spot syndrome virus			1		1	
2377		342508	Influenza A virus (A/New York/444/2001(H1N1))		25		25		
2379		342610	Pseudoalteromonas atlantica T6c		1		1		
2380		342613	Streptococcus agalactiae 18RS21	2		2			
2381		342614	Streptococcus agalactiae 515	1		1			
2382		342615	Streptococcus agalactiae H36B	1		1			
2383		342617	Streptococcus agalactiae CJB111	2		2			
2384		343462	Human adenovirus 11p	7		7			
2385		343463	Human adenovirus 11a	1		1			
2386		344598	Influenza A virus (A/whooper swan/Mongolia/6/05(H5N1))		1		1		
2387		344601	Escherichia coli B171		25		25		
2388		344609	Shigella boydii CDC 3083-94		20		20		
2389		344610	Escherichia coli 53638		1		1		
2390		345072	Vibrio cholerae MO10		1		1		
2391		345073	Vibrio cholerae O395		4		4		
2392		345074	Vibrio cholerae RC385		2		2		
2393		345075	Vibrio cholerae V51		3		3		
2394		345076	Vibrio cholerae V52		32		32		
2395	X	345840	Palaemon modestus			74		74	
2396		347257	Mycoplasma agalactiae PG2	3		3			
2397		347495	Bacillus cereus F837/76		1		1		
2398		347515	Leishmania major strain Friedlin	29	38	29	38		
2399		348776	Mycobacterium tuberculosis C		177		177		
2400		349101	Rhodobacter sphaeroides ATCC 17029		1		1		
2401		349163	Acidiphilium cryptum JF-5		1		1		
2402		349344	Bat SARS CoV Rp3/2004		1		1		
2403	X	349741	Akkermansia muciniphila ATCC BAA-835				4		4
2404		349746	Yersinia pestis Angola		3		3		
2405		349747	Yersinia pseudotuberculosis IP 31758		9		9		
2406		349966	Yersinia frederiksenii ATCC 33641		2		2		
2407		349967	Yersinia mollaretii ATCC 43969		3		3		
2408		349968	Yersinia bercovieri ATCC 43970		5		5		
2409		350054	Mycolicibacterium gilvum PYR-GCK		64		64		
2410		350058	Mycolicibacterium vanbaalenii PYR-1		55		55		
2411		350702	Burkholderia cenocepacia PC184		1		1		

2412		350703	Pseudomonas aeruginosa 2192		2		2		
2413		350704	Pseudomonas aeruginosa C3719		2		2		
2414		351071	Newcastle disease virus AF2240	1		1			
2415		351073	Mammalian orthoreovirus		1		1		
2416		351277	Influenza A virus (A/Nanchang/0058/1994(H3N2))		1		1		
2417		351581	Francisella tularensis subsp. holarctica FSC200		1		1		
2418		351607	Acidothermus cellulolyticus 11B		2		2		
2419		351627	Caldicellulosiruptor saccharolyticus DSM 8903		1		1		
2420		351745	Shewanella sp. W3-18-1		1		1		
2421		351746	Pseudomonas putida F1		6		6		
2422		352034	Influenza A virus (A/duck/Potsdam/1402-6/1986(H5N2))	1		1			
2423		352348	Influenza A virus (A/chicken/Hong Kong/17/1977(H6N1))		1		1		
2424		352520	Influenza A virus (A/mallard/Alberta/35/1976(H1N1))	1	6	1	6		
2425		352561	Influenza A virus (A/duck/Australia/341/1983(H15N8))		1		1		
2426		352564	Influenza A virus (A/mallard/Astrakhan/263/1982(H14N5))	1		1			
2427		352764	Influenza A virus (A/mallard/Alberta/202/1996(H2N5))	1		1			
2428		352914	Plasmodium yoelii yoelii 17XNL	6	3	6	3		
2429		352963	Influenza A virus (A/California/7/2004(H3N2))		1		1		
2430		353152	Cryptosporidium parvum Iowa II		84		84		
2431		353153	Trypanosoma cruzi strain CL Brener	2059	10	2059	10		
2432		353154	Theileria annulata strain Ankara		4		4		
2433		353253	Influenza A virus (A/duck/Novosibirsk/56/2005(H5N1))	6	2	6	2		
2434		353466	Influenza A virus (A/Canterbury/236/2005(H3N2))		1		1		
2435		354228	Influenza A virus (A/Gf/HK/SSP607/2003(H9N2))		1		1		
2436		354235	Influenza A virus (A/Ck/HK/CSW161/2003(H9N2))		1		1		
2437		354242	Campylobacter jejuni subsp. jejuni 81-176		4		4		
2438		355315	Streptococcus agalactiae serogroup Ia	1		1			
2440		356114	Hepatitis C virus genotype 3	121	20	121	20		
2441		356386	Hepatitis C virus (isolate India)		1		1		
2442		356391	Hepatitis C virus (isolate 6a33)		11		11		
2443		356410	Hepatitis C virus (isolate HC-G9)	1	1	1	1		
2444		356411	Hepatitis C virus JFH-1	8	5	8	5		
2445		356413	Hepatitis C virus (isolate BEBE1)		14		14		
2446		356415	Hepatitis C virus (isolate NZL1)	1	3	1	3		
2447		356416	Hepatitis C virus (isolate HCV-K3a/650)		21		21		
2448		356417	Hepatitis C virus (isolate JK049)		6		6		
2449		356418	Hepatitis C virus ED43	3	1	3	1		
2450		356419	Hepatitis C virus (isolate EUH1480)		5		5		
2451		356421	Hepatitis C virus (isolate Th580)		7		7		

2452		356424	Hepatitis C virus (isolate VN004)		1		1		
2453		356426	Hepatitis C virus subtype 3a	12	105	12	105		
2454		357205	Influenza A virus (A/chicken/Hong Kong/3123.1/2002(H5N1))		1		1		
2455		357208	Influenza A virus (A/Vietnam/CL26/2004(H5N1))		79		79		
2456		357210	Influenza A virus (A/Vietnam/CL100/2004(H5N1))	1		1			
2457		357244	Orientia tsutsugamushi str. Boryong	2	2	2	2		
2458		357348	Burkholderia pseudomallei 1106a		2		2		
2459		357355	Hepatitis C virus (isolate Tr Kj)		3		3		
2460		358708	Shigella dysenteriae 1012		1		1		
2461		358709	Escherichia coli 101-1		5		5		
2462		358769	Classical swine fever virus - Alfort/187	70		70			
2463		358805	Classical swine fever virus - Alfort/Tuebingen	5		5			
2464		358812	Classical swine fever virus - C	2		2			
2465		359391	Brucella abortus 2308		31		31		
2466		359787	Staphylococcus aureus subsp. aureus JH1	1	1	1	1		
2467		359921	Influenza A virus (A/Australian shelduck/Western Australia/1756/1983(H15N2))	1		1			
2468		360095	Bartonella bacilliformis KC583		1		1		
2469		360102	Yersinia pestis Antiqua		36		36		
2470		360112	Campylobacter jejuni subsp. jejuni HB93-13		2		2		
2471		360115	Coxiella burnetii RSA 331		8		8		
2472		360116	Coxiella burnetii 'MSU Goat Q177'		7		7		
2473		360117	Coxiella burnetii Q321		14		14		
2474		360118	Burkholderia pseudomallei 406e		2		2		
2475		360549	Themiste hennahi	1		1			
2476		360910	Bordetella avium 197N		1		1		
2477		362242	Mycobacterium ulcerans Agy99		16		16		
2478		362651	Human immunodeficiency virus type 1 (isolate YU2)	16	21	16	21		
2479		362663	Escherichia coli 536		65		65		
2480		363020	Avian leukosis virus HPRS103	1		1			
2482		364106	Escherichia coli UTI89		2		2		
2483		364132	Influenza A virus (A/New York/504/1998(H3N2))		1		1		
2484		365044	Polaromonas naphthalenivorans CJ2		2		2		
2486		365078	Influenza A virus (A/duck/Guangxi/1586/2004(H5N1))		1		1		
2487		365080	Influenza A virus (A/duck/Guangxi/1793/2004(H5N1))		1		1		
2488		365129	Influenza A virus (A/chicken/Vietnam/DT171/2004(H5N1))		1		1		
2490		366394	Sinorhizobium medicae WSM419		1		1		
2492		367120	Influenza A virus (A/Fort Monmouth/1/1947(H1N1))	1		1			
2493		367400	Neembucu hantavirus		5		5		
2494		367737	Arcobacter butzleri RM4018	1		1			

2495		367830	Staphylococcus aureus subsp. aureus USA300	1		1			
2496		368445	Crocodilepox virus		2		2		
2497		370127	Influenza A virus (A/Victoria/1968(H3N2))		1		1		
2498		370128	Influenza A virus (A/Northern Territory/60/1968(H3N2))		3		3		
2499		370354	Entamoeba dispar SAW760		19		19		
2500		370810	Influenza A virus (A/Anhui/1/2005(H5N1))	7		7			
2501		370811	Influenza A virus (A/Anhui/2/2005(H5N1))	1		1			
2502		370813	Influenza A virus (A/duck/IT/701/2005(H10N7))		1		1		
2503		370830	Hantaan virus Q32		4		4		
2504		371082	Influenza A virus (A/Taiwan/2/2006(H1N1))		7		7		
2505		371094	Chikungunya virus strain S27-African prototype	24		24			
2506		371214	Influenza A virus (A/chicken/Taiwan/0329/01(H6N1))	5		5			
2507		373098	Gambierdiscus toxicus	6		7		1	
2509		373153	Streptococcus pneumoniae D39		61		61		
2510		373384	Shigella flexneri 5 str. 8401		23		23		
2511		373665	Yersinia pestis biovar Orientalis str. IP275		1		1		
2512		374405	Influenza C virus (C/Yamagata/15/2004)	2		2			
2513		374507	Human rotavirus G9 isolate F45	7		7			
2514		374927	Haemophilus influenzae 22.1-21		3		3		
2515		374928	Haemophilus influenzae PittAA		2		2		
2516		374931	Haemophilus influenzae PittGG		1		1		
2517		374932	Haemophilus influenzae PittHH	1		1			
2518		374933	Haemophilus influenzae PittII		3		3		
2519		375177	Haemophilus influenzae 3655	6	1	6	1		
2520		375432	Haemophilus influenzae R3021		2		2		
2521		375450	Yersinia pestis FV-1		2		2		
2522		376619	Francisella tularensis subsp. holarctica LVS	10	291	10	291		
2523		376721	Influenza A virus (A/chicken/Kurgan/05/2005(H5N1))	1		1			
2524		377628	Yersinia pestis Nepal516		135		135		
2525		378131	Influenza A virus (A/Memphis/13/1978(H1N1))		1		1		
2526		378139	Influenza A virus (A/Memphis/1/1978(H1N1))		7		7		
2527		378809	Ravn virus - Ravn, Kenya, 1987	2	32	2	32		
2528		378830	Lake Victoria marburgvirus - Angola2005	6	18	8	18	2	
2530		380210	Influenza A virus (A/England/333/1980(H1N1))	1	1	1	1		
2531		380213	Influenza A virus (A/Taiwan/1/1986(H1N1))		1		1		
2532		380217	Influenza A virus (A/swine/Hong Kong/4/1976(H3N2))		1		1		
2533		380282	Influenza A virus (A/Fort Monmouth/1/1947-mouse adapted(H1N1))		47		47		
2534		380284	Influenza A virus (A/England/268/1996(H7N7))	1	1	1	1		

2535		380285	Influenza A virus (A/turkey/Ireland/1378/1983(H5N8))		1		1		
2536		380299	Influenza A virus (A/turkey/Wisconsin/1968(H5N9))		1		1		
2537		380301	Influenza A virus (A/turkey/Ontario/7732/1966(H5N9))	5	8	5	8		
2538		380330	Influenza A virus (A/goose/Hong Kong/8/1976(H1N1))		2		2		
2539		380332	Influenza A virus (A/swine/Hong Kong/273/1994(H1N1))		1		1		
2540		380337	Influenza A virus (A/equine/Prague/1/1956(H7N7))		1		1		
2541		380339	Influenza A virus (A/equine/Tennessee/5/1986(H3N8))		1		1		
2542		380340	Influenza A virus (A/equine/London/1416/1973(H7N7))	1	1	1	1		
2543		380342	Influenza A virus (A/swine/Iowa/15/1930(H1N1))	1		1			
2544		380343	Influenza A virus (A/ruddy turnstone/New Jersey/47/1985(H4N6))		2		2		
2545		380346	Influenza A virus (A/Wisconsin/3523/1988(H1N1))	2		2			
2547		380836	Influenza A virus (A/chicken/Vietnam/5/2003(H5N1))		1		1		
2548		380842	Influenza A virus (A/duck/Vietnam/15/2003(H5N1))		3		3		
2549		380905	Influenza A virus (A/X-47(H3N2))	3	2	3	2		
2550		380950	Influenza A virus (A/Beijing/32/1992(H3N2))		54		54		
2551		380951	Influenza A virus (A/Hebei/19/1995(H3N2))	1		1			
2552		380960	Influenza A virus (A/Tokyo/3/1967(H2N2))	2		2			
2553		380964	Influenza A virus (A/Texas/36/1991(H1N1))		1		1		
2554		380978	Influenza A virus (A/Wisconsin/4755/1994(H1N1))		5		5		
2555		380979	Influenza A virus (A/Wisconsin/4754/1994(H1N1))		1		1		
2556		380982	Influenza A virus (A/WSN(H1N1))		1		1		
2557		380984	Influenza A virus (A/Leningrad/134/17/1957(H2N2))		2		3		1
2558		380985	Influenza A virus (A/Chile/1/1983(H1N1))		4		4		
2559		381512	Influenza A virus (A/New Caledonia/20/1999(H1N1))	39	243	39	247		4
2560		381513	Influenza A virus (A/Panama/2007/1999(H3N2))	10	14	10	16		2
2561		381516	Influenza A virus (A/USSR/90/1977(H1N1))	12		12			
2562		381517	Influenza A virus (A/Udorn/307/1972(H3N2))		5		5		
2563		381518	Influenza A virus (A/Wilson-Smith/1933(H1N1))	1	150	1	158		8
2564		381666	Cupriavidus necator H16		1		1		
2565		382781	Influenza A virus (A/Singapore/1/1957(H2N2))	1	32	1	32		
2566		382813	Influenza A virus (A/Japan/305+/1957(H2N2))	2		2			
2567		382825	Influenza A virus (A/Philippines/2/1982(H3N2))	1	1	1	1		
2568		382828	Influenza A virus (A/RI/5-/1957(H2N2))		1		1		
2569		382832	Influenza A virus (A/VM113-V1(H1N1))	1		1			
2570		382835	Influenza A virus (A/WSN/1933(H1N1))	13	3	13	3		

2571		382842	Influenza A virus (A/swine/29/1937(H1N1))		2		2		
2572		382848	Influenza A virus (A/swine/Hong Kong/126/1982(H3N2))		1		1		
2573		383028	Influenza A virus (A/New York/687/1995(H3N2))	1		1			
2574		383121	Influenza A virus (A/Waikato/7/2000(H3N2))		2		2		
2575		383152	Influenza A virus (A/Wellington/22/2001(H3N2))		1		1		
2576		383231	Influenza A virus (A/Wellington/8/2004(H3N2))		2		2		
2577		383281	Influenza A virus (A/Otago/5/2005(H1N1))		1		1		
2578		383379	Toxoplasma gondii RH	27	23	27	23		
2579		383531	Influenza A virus (A/swine/Italy/2/1979(H1N1))		4		5		1
2580		383537	Influenza A virus (A/swine/Iowa/1946(H1N1))		1		1		
2581		383550	Influenza A virus (A/duck/England/1/1956(H11N6))		2		2		
2583		383561	Influenza A virus (A/swine/Italy/1850/1977(H3N2))		1		1		
2584		383566	Influenza A virus (A/swine/Italy/425/1976(H1N1))		1		1		
2585		383568	Influenza A virus (A/Shanghai/11/1987(H3N2))		1		1		
2587		383571	Influenza A virus (A/Memphis/6/1986(H3N2))	4	1	4	1		
2588		383574	Influenza A virus (A/Memphis/2/1985(H3N2))	1		1			
2589		383577	Influenza A virus (A/Memphis/1/1990(H3N2))		1		1		
2590		383578	Influenza A virus (A/Memphis/4/1980(H3N2))		1		1		
2591		383586	Influenza A virus (A/Memphis/1/1971(H3N2))	19	11	19	11		
2592		383602	Influenza A virus (A/Anas acuta/Primorje/695/1976(H2N3))		17		17		
2593		383603	Influenza A virus (A/turkey/Minnesota/833/1980(H4N2))		1		1		
2595		384483	Influenza A virus (A/swine/Hong Kong/127/1982(H3N2))		1		1		
2596		384484	Influenza A virus (A/swine/Hong Kong/81/1978(H3N2))		12		12		
2597		384487	Influenza A virus (A/Swine/Indiana/1726/1988(H1N1))		2		2		
2598		384493	Influenza A virus (A/seal/Mass/1/1980(H7N7))	1	1	1	1		
2599		384495	Influenza A virus (A/Kiev/59/1979(H1N1))		5		5		
2600		384498	Influenza A virus (A/Ann Arbor/6/1960(H2N2))		270		271		1
2601		384499	Influenza A virus (A/gull/Maryland/704/1977(H13N6))		1		1		
2602		384500	Influenza A virus (A/Beijing/11/1956(H1N1))		30		30		
2604		384505	Influenza A virus (A/nt/60/1968(H3N2))	1	69	1	70		1
2605		384509	Influenza A virus (A/tern/Australia/G70C/1975(H11N9))	9		9			
2606		384510	Influenza A virus (A/tern/South Africa/1961(H5N3))	1		1			
2607		384527	Influenza A virus (A/Cameron/1946(H1N1))		1		1		
2608		384676	Pseudomonas entomophila L48		1		1		
2609		384946	Influenza A virus (A/duck/Hungary/1/1970(H6N2))		1		1		

2610		385576	Influenza A virus (A/Alaska/6/1977(H3N2))		2		2		
2611		385580	Influenza A virus (A/duck/Ukraine/1/1963(H3N8))	3		3			
2612		385583	Influenza A virus (A/Denver/1957(H1N1))		2		2		
2613		385585	Influenza A virus (A/equine/Jilin/1/1989(H3N8))	1		1			
2614		385586	Influenza A virus (A/chicken/Pennsylvania/1/1983(H5N2))		1		1		
2615		385587	Influenza A virus (A/budgerigar/Hokkaido/1/1977(H4N6))		10		10		
2616		385599	Influenza A virus (A/udorn/1972(H3N2))		1		1		
2617		385600	Influenza A virus (A/Puerto Rico/8/1934(Cambridge)(H1N1))	1		1			
2618		385605	Influenza A virus (A/equine/Kentucky/2/1986(H3N8))		3		3		
2619		385616	Influenza A virus (A/ruddy turnstone/NJ/60/1985(N9))		1		1		
2620		385617	Influenza A virus (A/chicken/Pennsylvania/1370/1983(H5N2))	1		1			
2621		385624	Influenza A virus (A/Port Chalmers/1/1973(H3N2))	7	1	7	1		
2622		385630	Influenza A virus (A/Bangkok/1/1979(H3N2))	1	7	1	7		
2623		385640	Influenza A virus (A/Memphis/102/1972(H3N2))		8		8		
2624		385644	Influenza A virus (A/swine/Ukkel/1/1984(H3N2))		1		1		
2625		386032	Reston ebolavirus - Reston (1989)		4		4		
2626		386033	Sudan ebolavirus - Uganda (2000)	1	6	1	6		
2627		386043	Listeria welshimeri serovar 6b str. SLCC5334		3		3		
2628		386056	Paraburkholderia ferrariae		1		1		
2629		386415	Clostridium novyi NT		2		2		
2630		386585	Escherichia coli O157:H7 str. Sakai		17		17		
2631		386656	Yersinia pestis Pestoides F		2		2		
2632	X	387090	Phocaeicola coprophilus				2		2
2633		387093	Sulfurovum sp. NBC37-1		1		1		
2634		387139	Influenza A virus (A/Aichi/2/1968(H3N2))	12	11	12	11		
2635		387147	Influenza A virus (A/England/878/1969(H3N2))	1	2	1	2		
2636		387156	Influenza A virus (A/Harbin/1/1988(H1N2))		17		17		
2637		387161	Influenza A virus (A/Japan/305/1957(H2N2))	4	29	5	29	1	
2638		387191	Influenza A virus (A/camel/Mongolia/1982(H1N1))		8		8		
2639		387203	Influenza A virus (A/duck/Bavaria/2/1977(H1N1))		1		1		
2640		387207	Influenza A virus (A/duck/Hokkaido/8/1980(H3N8))		6		6		
2642		387213	Influenza A virus (A/equine/Alaska/1/1991(H3N8))		1		1		
2643		387223	Influenza A virus (A/equine/Miami/1963(H3N8))	5		5			
2644		387239	Influenza A virus (A/gull/Delaware/475/1986(H2N2))		1		1		
2645		387243	Influenza A virus (A/herring gull/DE/677/1988(H2N8))		1		1		
2646		388041	Influenza A virus (A/bar-headed goose/Qinghai/1A/2005(H5N1))	1		1			

2647		388272	Pseudomonas aeruginosa PACS2		12		12		
2648		388634	Bombyx mandarina nuclear polyhedrosis virus		1		1		
2649		388799	HIV-1 group O	1		1			
2650		389259	Influenza A virus (A/Nagasaki/N03/2005(H3N2))		1		1		
2651	X	390157	Senecavirus A			8		8	
2652		390236	Borreliella afzelii PKo	2		2			
2653		391646	Hepatitis B virus ayw3	1		1			
2654		391647	Hepatitis B virus ayw2	8		8			
2655		391650	Hepatitis B virus ayw4	1		1			
2656		391896	Rickettsia bellii OSU 85-389		3		3		
2657		392021	Rickettsia rickettsii str. 'Sheila Smith'	1	9	1	9		
2658		392734	Terriglobus roseus		1		1		
2659		392809	Influenza A virus (A/Victoria/3/1975(H3N2))	45	9	45	13		4
2660		392810	Influenza A virus (A/chicken/Rostock/8/1934(H7N1))	2	4	2	4		
2661		392811	Influenza A virus (A/Udorn/8/1972(H3N2))	1		1			
2662		393011	Francisella tularensis subsp. holarctica OSU18		6		6		
2663		393115	Francisella tularensis subsp. tularensis FSC198		85		85		
2664		393117	Listeria monocytogenes FSL J1-194		2		2		
2665		393124	Listeria monocytogenes FSL N3-165		2		2		
2666		393125	Listeria monocytogenes FSL R2-503		1		1		
2667		393126	Listeria monocytogenes FSL R2-561		1		1		
2668		393128	Listeria monocytogenes F6900		1		1		
2669		393130	Listeria monocytogenes J0161		6		6		
2670		393133	Listeria monocytogenes 10403S		4		4		
2671		393305	Yersinia enterocolitica subsp. enterocolitica 8081		16		16		
2673		393548	Influenza A virus (A/chicken/Tula/Russia/Oct-5/2005(H5N1))		1		1		
2674		393557	Influenza A virus (A/Leningrad/1954/1(H1N1))		8		8		
2675		393697	Influenza A virus (A/Liaoning/25/2000(H1N1))		1		1		
2676		393902	Influenza A virus (A/Wisconsin/67/2005(H3N2))	1	5	1	5		
2677		395095	Mycobacterium tuberculosis str. Haarlem		127		127		
2678		395494	Gallionella capsiferriformans ES-2		1		1		
2679		395841	Influenza A virus (A/duck/Hokkaido/1130/01(H1N1))		1		1		
2680		395842	Influenza A virus (A/tern/Australia/1/04(H2N5))		1		1		
2681		397342	Horsepox virus		6		6		
2683		398031	Toxoplasma gondii type III		1		1		
2684		398812	TGEV virulent Purdue	4		4			
2686		399741	Serratia proteamaculans 568		1		1		
2687		400331	Influenza A virus (A/New South Wales/15/1999(H3N2))		1		1		
2688		400667	Acinetobacter baumannii ATCC 17978	10	13	10	13		

2689		400788	Influenza A virus (A/Indonesia/5/2005(H5N1))	1	3	1	3		
2690		400810	Influenza A virus (A/Indonesia/CDC594/2006(H5N1))	1		1			
2691		400828	Influenza A virus (A/Indonesia/CDC669/2006(H5N1))	5		5			
2692		400830	Influenza A virus (A/Indonesia/CDC699/2006(H5N1))	2		2			
2694		401650	Listeria monocytogenes HPB2262		3		3		
2695		401671	HIV-1 M:B_89.6		1		1		
2696		402194	Influenza A virus (A/Istanbul/CTF/10/2004(H3N2))		1		1		
2697		402464	Influenza A virus (A/gray teal/Australia/2/1979(H4N4))		1		1		
2698		402489	Influenza A virus (A/turkey/Minnesota/1200/1980(H7N3))		1		1		
2699		402518	Influenza A virus (A/Canada/rv504/2004(H7N3))	1		1			
2700		402527	Influenza A virus (A/chicken/Scotland/1959(H5N1))		1		1		
2701	X	402648	Streptomyces hainanensis				1		1
2702		402938	Influenza A virus (A/Michigan/2/2003(H1N2))	1		1			
2703		404137	Influenza A virus (A/chicken/Beijing/nl/2002(H9N2))		1		1		
2705		404150	Influenza A virus (A/chicken/Hubei/wk/1997(H5N1))		2		2		
2707		404155	Influenza A virus (A/chicken/Hunan/fg/2004(H5N1))		2		2		
2708		404163	Influenza A virus (A/chicken/Jilin/hg/2002(H5N1))		1		1		
2709		404330	Streptococcus pyogenes serotype M2	2		2			
2710		404331	Streptococcus pyogenes serotype M4	2		2			
2711		404408	Influenza A virus (A/chicken/Shanxi/2/2006(H5N1))	1		1			
2712		404573	Influenza A virus (A/chicken/Netherlands/03010132/03(H7N7))	1		1			
2713		404974	Vibrio cholerae AM-19226		1		1		
2714		405050	Influenza A virus (A/tern/Australia/1402/2004(H2N5))		1		1		
2715		405531	Bacillus cereus G9842		3		3		
2716		405532	Bacillus cereus B4264		1		1		
2717		405533	Bacillus cereus AH1134		3		3		
2718		405536	Bacillus anthracis str. Tsiankovskii-I		1		1		
2719		405917	Bacillus cereus W		1		1		
2720		405955	Escherichia coli APEC O1		8		8		
2721		406269	West Nile virus strain PTRoxo		12		12		
2722		407134	Yellow fever virus strain Ghana/Asibi/1927		5		5		
2723		407141	Yellow fever virus isolate Ethiopia/Couma/1961		2		2		
2724		407148	Campylobacter jejuni subsp. jejuni 81116		14		14		
2725		407418	Influenza A virus (A/chicken/Guiyang/2147/2005(H5N1))		1		1		
2726		408599	Human rotavirus G9P[8]	1		1			
2727		408685	Dengue virus 1 Brazil/97-11/1997		1058		1058		
2728		408686	Dengue virus 4 Philippines/H241/1956	4	947	4	947		

2729		408687	Dengue virus 4 Singapore/8976/1995		5		5		
2730		408688	Dengue virus 4 Thailand/0348/1991		15		15		
2731		408689	Dengue virus 4 Thailand/0476/1997		3		3		
2732		408690	Dengue virus 3 China/80-2/1980		84		84		
2733		408691	Dengue virus 3 Martinique/1243/1999		889		889		
2734		408692	Dengue virus 3 Sri Lanka/1266/2000		66		66		
2735		408693	Dengue virus 3 Singapore/8120/1995		69		69		
2736		408694	Dengue virus 2 Peru/IQT2913/1996		87		87		
2737		408870	Dengue virus 3 Philippines/H87/1956	8	13	8	13		
2738		408871	Dengue virus 4 Dominica/814669/1981	1	256	1	256		
2739		410069	Streptococcus pyogenes serotype M80	1		1			
2740		410072	Coprococcus comes	1		1			
2741		410078	Human respiratory syncytial virus S2	1		1			
2742		410289	Mycobacterium tuberculosis variant bovis BCG str. Pasteur 1173P2	1	229	1	230		1
2743		411157	Influenza A virus (A/Thailand/271/2005(H1N1))	1		1			
2744		411167	Influenza A virus (A/Queensland/11/2001(H3N2))		1		1		
2745		411662	Influenza A virus (A/Hanoi/TN405/2005(H3N2))		1		1		
2746		412022	Burkholderia mallei NCTC 10229		9		9		
2747		412419	Borrelia duttonii Ly	12		12			
2748		412420	Yersinia pestis CA88-4125		21		21		
2749		412614	Vibrio cholerae 2740-80		44		44		
2750		412694	Bacillus thuringiensis str. Al Hakam		8		8		
2751		412883	Vibrio cholerae MZO-3		1		1		
2752		412966	Vibrio cholerae 1587		3		3		
2753		412967	Vibrio cholerae MAK 757		9		9		
2754		413502	Cronobacter turicensis	1		1			
2755		413999	Clostridium botulinum A str. ATCC 3502		3		3		
2756		414044	Influenza A virus (A/Thailand/1(KAN-1A)/2004(H5N1))	1		1			
2757		415166	Influenza A virus(A/swine/Henan/2/2004(H9N2))		2		2		
2758		415167	Influenza A virus(A/swine/Henan/3/2004(H9N2))		1		1		
2759		415169	Influenza A virus(A/swine/Henan/5/2004(H9N2))		1		1		
2760		415172	Influenza A virus(A/swine/Henan/8/2004(H9N2))		2		2		
2761		415176	Influenza A virus(A/swine/Shandong/fNY/2003(H9N2))		3		3		
2762		415177	Influenza A virus(A/swine/Shandong/fZC/2003(H9N2))		7		7		
2763		416035	Norovirus Hu/GII.4/DenHaag89/2006/NL	1		1			
2764		416276	Rickettsia massiliae MTU5		2		2		
2765		416674	Influenza B virus (B/Yamagata/16/1988)	4	1	4	1		
2766		416730	Influenza A virus (A/Memphis/10/1996(H1N1))		1		1		
2767		417398	Vibrio cholerae MZO-2		2		2		

2768		417399	Vibrio cholerae NCTC 8457		1		1		
2769		417400	Vibrio cholerae B33		5		5		
2770		417758	Influenza A virus (A/quail/Shantou/1475/2004(H9N2))	1		1			
2771		418136	Francisella tularensis subsp. tularensis WY96-3418		2		2		
2772		418868	Influenza A virus (A/Egypt/14724-NAMRU3/2006(H5N1))	1		1			
2773		419109	Vibrio parahaemolyticus AQ3810		38		38		
2774	X	419612	Camelus ferus				1		1
2775		419947	Mycobacterium tuberculosis H37Ra		130		130		
2776		420174	Hepatitis C virus isolate HC-J4	23	163	23	163		
2777		420245	Leishmania braziliensis MHOM/BR/75/M2904	14	8	14	18		10
2778		420246	Geobacillus thermodenitrificans NG80-2	2		2			
2779		420521	Expression vector pNIC-NHT-CF	1		1			
2780		420662	Methylibium petroleiphilum PM1		1		1		
2781		421472	Influenza A virus (A/Indonesia/CDC1032N/2007(H5N1))	1		3		2	
2782		421877	Hepatitis C virus isolate HC-J1	3	26	3	26		
2783		421901	Influenza A virus (A/Egypt/0636-NAMRU3/2007(H5N1))	2	1	2	1		
2784		423368	Salmonella enterica subsp. enterica serovar Newport str. SL254		1		1		
2785	X	424362	Bat coronavirus HKU4-4				1		1
2786		424717	Shigella flexneri 3a	4		4			
2787		424718	Shigella flexneri 5a	2		2			
2788		424720	Shigella flexneri Y	8		8			
2789		425067	Burkholderia pseudomallei 305		2		2		
2790		425088	Tanganya virus		1		1		
2791		425551	Influenza A virus (A/AA/Huston/1945(H1N1))	1		1			
2792		425557	Influenza A virus (A/California/10/1978(H1N1))		1		1		
2793		426430	Staphylococcus aureus subsp. aureus str. Newman	7		7			
2794		426738	Influenza A virus (A/swine/Miyagi/5/2003(H1N2))		2		2		
2795		427773	Influenza A virus (A/Thailand/SP83/2004(H5N1))	1		1			
2796		427826	Influenza B virus (B/Hong Kong/8/1973)		1		1		
2797		427890	Influenza A virus (A/Viet Nam/JP4207/2005(H5N1))	1		1			
2799		430066	Brucella abortus S19		15		15		
2800		430417	Influenza A virus (A/Wyoming/3e5/2003(H3))	1		1			
2801		430511	Juquitiba virus		2		2		
2802		430557	Francisella tularensis subsp. tularensis FSC033		27		27		
2803		431944	Magnetospirillum gryphiswaldense MSR-1		1		1		
2804		431947	Porphyromonas gingivalis ATCC 33277	20	4	20	4		
2805		432070	Influenza A virus (A/Hong Kong/213/2003(H5N1))	1	4	1	4		
2806		432094	Influenza A virus (A/Wyoming/3/2003-X-147(H3N2))		1		1		

2807		432359	Toxoplasma gondii VEG	14		14			
2808		434922	Coxiella burnetii Dugway 5J108-111		8		8		
2809		434923	Coxiella burnetii CbuG_Q212		1		1		
2810		434924	Coxiella burnetii CbuK_Q154		1		1		
2811		435258	Leishmania infantum JPCM5	28	15	28	15		
2812		435359	Influenza A virus (A/chicken/Hebei/706/2005(H5N1))		2		2		
2813		436004	Influenza A virus (A/kunke/1/71(H3N2))		1		1		
2814		439184	Escherichia coli RS218	1		1			
2815	X	439220	Streptococcus caballi				1		1
2816		439235	Desulfatibacillum alkenivorans AK-01		1		1		
2817		439843	Salmonella enterica subsp. enterica serovar Schwarzengrund str. CVM19633		1		1		
2818		439847	Salmonella enterica subsp. enterica serovar Saintpaul str. SARA29		1		1		
2819		440534	Salmonella enterica subsp. enterica serovar 4,[5],12:i:- str. CVM23701		1		1		
2820		441158	Burkholderia pseudomallei 9		1		1		
2821		441159	Burkholderia pseudomallei 91		2		2		
2822		441160	Burkholderia pseudomallei 14		1		1		
2823		441769	Bacillus coahuilensis m4-4		1		1		
2824		441771	Clostridium botulinum A str. Hall	45		45			
2825		441962	Influenza A virus (A/duck/Mongolia/47/2001(H7N1))		3		3		
2826		443149	Mycobacterium tuberculosis CCDC5079		3		3		
2829		444178	Brucella ovis ATCC 25840		8		8		
2830		444185	Simian rotavirus A strain RRV	10	1	10	1		
2831		444186	Simian rotavirus A strain TUCH		5		5		
2832		444318	Influenza A virus (A/Texas/1/1977(H3N2))	1	15	1	15		
2833		444793	Influenza A virus (A/Auckland/590/2000(H1N1))		1		1		
2834		444922	Psychromonas ossibalaenae		1		1		
2835	X	445027	Influenza A virus (A/Beijing/01/2003(H5N1))			1		1	
2836		445335	Clostridium botulinum NCTC 2916		2		2		
2837		445338	Clostridium botulinum str. Iwanei E	6		6			
2838		445983	Borreliella burgdorferi 156a	1		1			
2839		445985	Borreliella burgdorferi ZS7	3	45	3	45		
2840		446023	Influenza A virus (A/Hong Kong/68(H3N2))	1		1			
2841	X	446679	Nostoc sphaeroides				1		1
2843		447095	Blastomyces dermatitidis ATCC 26199		1		1		
2844	X	447106	Leptospira licerasiae				1		1
2845		447133	Influenza A virus (A/chicken/Japan/1925(H7N7))	1		1			
2846		447188	Influenza A virus (A/duck/Tasmania/277/2007(H7N2))	1		1			
2847		448058	Influenza A virus (A/swine/Guangdong/01/2005(H3N2))		1		1		
2848		449278	West Nile virus SPU116/89		1		1		
2849		449656	Influenza A virus (A/chicken/Taiwan/2838V/00(H6N1))	15		15			

2850	X	451515	Staphylococcus aureus subsp. aureus USA300_FPR3757				1		1
2852		451707	Bacillus cereus NVH0597-99		7		7		
2853		451708	Bacillus cereus H3081.97		12		12		
2854		451709	Bacillus cereus 03BB108		8		8		
2855		451804	Aspergillus fumigatus A1163		13		13		
2856		452646	Neovison vison		1		1		
2857		452652	Kitasatospora setae KM-6054		1		1		
2858		452659	Rickettsia rickettsii str. Iowa		1		1		
2859		453057	Influenza A virus (A/Indonesia/CDC540/2006(H5N1))	1		1			
2860		453927	Juniperus formosana	1		1			
2861	X	456999	Rhizoctonia solani				1		1
2863		458234	Francisella tularensis subsp. holarctica FTNF002-00		1		1		
2864		458678	Hantaanvirus CGRn93P8		2		2		
2865		461739	Influenza B virus (B/Florida/4/2006)	1		1			
2866		461772	Influenza A virus (A/Wisconsin/43/2006(H3N2))	1		1			
2867		462695	Influenza A virus (A/Hiroshima/52/2005(H3))	2		2			
2869		463722	Murine norovirus GV/CR6/2005/USA		1		1		
2870		464314	Influenza A virus (A/Anhui/T2/2006(H5N1))	1		1			
2871		464417	Influenza B virus (B/Malaysia/2506/2004)	1		1			
2872		464622	Influenza A virus (A/Solomon Islands/3/2006 (Egg passage)(H1N1))	1		1			
2873		464623	Influenza A virus (A/Solomon Islands/3/2006(H1N1))	14		17		3	
2874		465541	Streptomyces sp. Mg1		1		1		
2875		467144	Modified Vaccinia Ankara virus		23		23		
2876		468968	Influenza A virus (A/Indonesia/560H/2006(H5N1))	1		1			
2877		470137	Brucella suis ATCC 23445	1	5	1	5		
2879		471223	Geobacillus sp. WCH70		2		2		
2880		471721	HIV-1 CRF01_AE	1		1			
2881		472511	Influenza A virus (A/Indonesia/TLL007/2006(H5N1))	1		1			
2882		475478	Influenza A virus (A/equine/New Market/1/1979(H3N8))	1		1			
2883		475493	Influenza A virus (A/equine/California/8560/2002(H3N8))		2		2		
2884		476176	Moraea pallida	1		1			
2886		476294	Influenza A virus (A/Brisbane/10/2007(H3N2))	5		5			
2887		476303	Influenza A virus (A/California/04/2007(H1N1))		1		1		
2888		478005	Escherichia coli O157:H7 str. EC4486		1		1		
2889		478006	Escherichia coli O157:H7 str. EC4501		2		2		
2890		478008	Escherichia coli O157:H7 str. EC869		13		13		
2891		479022	Influenza A virus (A/chicken/Korea/IS/2006(H5N1))	1		1			
2892	X	479935	Gluconobacter morbifer				1		1
2893		480019	Influenza A virus (A/Moscow/10/1999(H3N2))		2		2		

2894		480024	Influenza A virus (A/Wyoming/03/2003(H3N2))		8		8		
2895	X	480116	Hepatitis B virus adw2/Rutter/1979				1		1
2896		481805	Escherichia coli ATCC 8739		1		1		
2897		482134	Hepatitis B virus adw/Japan/Nishioka/1983		1		1		
2898		482628	Campylobacter jejuni subsp. jejuni BH-01-0142		1		1		
2899		482957	Burkholderia lata		2		2		
2900		483179	Brucella canis ATCC 23365		9		9		
2901		484021	Klebsiella pneumoniae subsp. pneumoniae NTUH-K2044		1		1		
2902		486280	Torque teno virus VT416		3		3		
2903		486619	Bacillus anthracis str. A0193		3		3		
2904		486620	Bacillus anthracis str. A0465		5		5		
2905		486621	Bacillus anthracis str. A0442		1		1		
2906		486623	Bacillus anthracis str. A0389		5		5		
2907		486624	Bacillus anthracis str. A0488		91		91		
2908		487067	Torque teno virus Human/Ghana/GH1/1996		3		3		
2909	X	487317	Aequorivita capsosiphonis				1		1
2910		487521	Mycobacterium intracellulare ATCC 13950	1		1			
2911		488233	Influenza A virus (A/Iran/1/1957(H2N2))		1		1		
2912		488241	Influenza A virus (A/Korea/426/1968(H2N2))		2		2		
2913		489455	hepatitis B virus genotype A	1		1			
2914		489460	HBV genotype B	1	5	1	10		5
2915		489466	HBV genotype C	10	21	10	28		7
2916		489469	Hepatitis B virus ayw/China/Tibet127/2002	1		1			
2917		489483	HBV genotype D	1	3	1	3		
2918		489821	Norovirus GII.4	2	11	2	16		5
2919		489822	Norovirus Hu/Houston/TCH186/2002/US	2		2			
2920		490039	Norovirus GII.2	1		1			
2921		490041	Norovirus GII.3	1		1			
2922		490133	Hepatitis B virus ayw/France/Tiollais/1979		4		4		
2923		493803	Merkel cell polyomavirus	2	12	2	30		18
2924		496036	Influenza A virus (A/duck/Vietnam/37/2007(H5N1))		1		1		
2925		497976	Salmonella enterica subsp. enterica serovar Typhi str. E00-7866		1		1		
2926		497977	Salmonella enterica subsp. enterica serovar Typhi str. 404ty		1		1		
2927		499191	Norovirus GII.1	1		1			
2928		499286	Influenza A virus (A/Hong Kong/CUHK13527/2003(H3N2))		2		2		
2929		502057	Vaccinia virus GLV-1h68		2		2		
2930		502780	Paracoccidioides brasiliensis Pb18	1	1	1	1		
2931		502790	Aeromonas diversa		1		1		
2932		503386	Influenza B virus (B/Kobe/3/2004)	1		1			
2933		504660	Influenza B virus (B/Kobe/67/2005)	1		1			

2934		504662	Influenza B virus (B/Kobe/39/2005)	1		1			
2935		504664	Influenza B virus (B/Kobe/113/2005)	1		1			
2936		504666	Influenza B virus (B/Kobe/115/2005-T1)	1		1			
2937		504697	Influenza A virus (A/Cygnus olor/Czech Republic/10732/07(H5N1))		1		1		
2938		504904	Influenza A virus (A/Brisbane/59/2007(H1N1))	26	14	26	14		
2939		504910	Influenza A virus (A/Wellington/75/2006(H1N1))		1		1		
2940		505184	HIV-1 M:A	9	1	9	1		
2941		505185	HIV-1 M:B	8	25	8	25		
2942		505186	HIV-1 M:C	11		11			
2943		505228	HIV-1 M:G	4		4			
2944		506282	Influenza A virus (A/unknown/New York/11646-5/2005(H7N2))	1		1			
2945		506350	Influenza A virus (A/Hong Kong/1/1968(H3N2))	22	3	22	3		
2947		506380	Influenza A virus (A/Hong Kong/1-4-MA21-1/1968(H3N2))	1		1			
2948		507601	Toxoplasma gondii GT1		205		205		
2950		508767	Clostridium botulinum E3 str. Alaska E43		1		1		
2951		508771	Toxoplasma gondii ME49	21	89	21	89		
2952		508775	Norovirus GII.9	1	1	1	1		
2953		509173	Acinetobacter baumannii AYE		1		1		
2954		509628	Hepatitis E virus type 3		1		1		
2955		510222	Influenza A virus (A/duck/Vietnam/NCVD-9/2007(H5N1))	1		1			
2956		510670	Hepatitis delta virus dTk6		1		1		
2957		511145	Escherichia coli str. K-12 substr. MG1655		31		31		
2958		511839	Influenza A virus (A/turkey/England/N28/1973(H5N2))	1		1			
2959	X	514118	Influenza A virus (A/BRISBANE/9/2006(H3N2))				1		1
2960		514193	Influenza A virus (A/CHU/2-524/2005(H3N2))		2		2		
2961		515581	Influenza A virus (A/swine/Ohio/24366/2007(H1N1))		2		2		
2963		515817	Amphioctopus fangsiao	1		1			
2964		518922	Influenza A virus (A/Beijing/262/1995(H1N1))	1		4		3	
2965		518968	Influenza A virus (A/X-31B(Puerto Rico/8/1934-Aichi/2/1968)(H3N2))	1		1			
2966		518987	Influenza B virus (B/Lee/1940)	5	3	5	3		
2967		519082	Influenza A virus (A/New York/107/2003(H7N2))	1		1			
2968	X	519424	Alkalihalobacillus trypoxylicola				1		1
2970		520450	Brucella abortus bv. 2 str. 86/8/59		1		1		
2971		520464	Brucella melitensis bv. 1 str. Rev.1	1		1			
2972		520963	Norovirus GII.11	1		1			
2973		520964	Norovirus GII.18	1		1			
2974		521004	Haemophilus influenzae 6P18H1		1		1		
2975		521005	Haemophilus influenzae 7P49H1		1		1		
2976		521007	Borreliella burgdorferi N40	4	3	4	3		

2977		522740	Influenza A virus (A/swine/Hannover/1/1981(H1N1))		12		12		
2978		524364	Norovirus Hu/1968/US	6	1	6	1		
2979		525281	Escherichia coli 83972		3		3		
2980		525368	Mycobacterium parascrofulaceum ATCC BAA-614		35		35		
2981		525374	Staphylococcus epidermidis BCM-HMP0060		1		1		
2982		526974	Bacillus cereus BDRD-ST24		1		1		
2983		526977	Bacillus cereus ATCC 4342		1		1		
2985		527024	Bacillus thuringiensis serovar tochigiensis BGSC 4Y1		1		1		
2986		527026	Bacillus thuringiensis serovar sotto str. T04001		1		1		
2988		528354	Neisseria gonorrhoeae MS11	8		8			
2989		529058	Influenza A virus (A/Uruguay/716/2007(H3N2))	1		1			
2990		529507	Proteus mirabilis HI4320	1		1			
2991		533026	Influenza A virus (A/turkey/Ohio/313053/2004(H3N2))	1	2	1	2		
2992		535026	Bacillus subtilis subsp. subtilis NCIB 3610 = ATCC 6051 = DSM 10		1		1		
2993		535852	Influenza A virus (A/California/06/2008(H1N1))		1		1		
2994		538555	Influenza A virus (A/swine/Korea/Hongsong2/2004(H1N2))		2		2		
2995		543153	Mycobacterium phage Predator		1		1		
2996		543824	Synechocystis aquatilis		2		2		
2997	X	545501	Oceanobacillus oncorhynchi				1		1
2998		546980	Norovirus Hu/GII-4/Saga1/2006/JP	1		1	1		1
2999		548470	Staphylococcus aureus subsp. aureus MN8	11		11			
3000		549169	Pseudogulbenkiania ferrooxidans		1		1		
3001		552536	Listeria monocytogenes HCC23		2		2		
3002		553345	Influenza A virus (A/Aichi/72/2007(H3N2))	1		1			
3003		553583	Staphylococcus aureus A9635	1		1			
3004		554290	Salmonella enterica subsp. enterica serovar Paratyphi A str. AKU_12601		3		3		
3005		556277	Influenza A virus (A/swine/Guangdong/02/2005(H3N2))	1		1			
3006		557433	Lactobacillus reuteri JCM 1112	3		3			
3007		557599	Mycobacterium kansasii ATCC 12478	1		1			
3008		558177	Influenza A virus (A/mallard/Bavaria/10/2007(H5N1))		1		1		
3009		559292	Saccharomyces cerevisiae S288C	16	2	16	2		
3010	X	559561	Aureobasidium namibiae				2		2
3011		560463	Influenza A virus (A/Taiwan/VGHYM0325-06/2002(H3N2))		1		1		
3014		562988	Influenza A virus (A/Egypt/2289-NAMRU3/2008(H5N1))	1		1			
3015		562992	Influenza A virus (A/Egypt/3300-NAMRU3/2008(H5N1))	1		1			
3016		563041	Helicobacter pylori G27	2		2			
3017	X	563466	Scedosporium apiospermum				1		1
3018		563773	Vibrio parahaemolyticus AN-5034		4		4		

3019		565995	Bundibugyo ebolavirus	15		15			
3021		566466	gamma proteobacterium NOR5-3		1		1		
3022		567106	Campylobacter jejuni subsp. jejuni IA3902		1		1		
3023		568206	Bacillus anthracis str. CDC 684		3		3		
3024		568819	Listeria monocytogenes serotype 4b str. CLIP 80459		6		6		
3025	X	568833	Influenza A virus (A/chicken/Jiangsu/7/2002(H9N2))				1		1
3026	X	568987	Candidatus Hamiltonella				1		1
3027		571800	Psychrobacter sp. G	1		1			
3028		572264	Bacillus cereus 03BB102		2		2		
3029		572307	Neospora caninum Liverpool		1		1		
3030		573729	Thermothelomyces thermophilus ATCC 42464	1		1			
3031		573797	Influenza A virus (A/England/654/2007(H1N1))		1		1		
3032		573977	Human bocavirus 2	4		4			
3033		574556	Anaplasma centrale str. Israel		2		2		
3034		575590	Bacteroidetes oral taxon 274 str. F0058	1		1			
3035		575591	Brucella abortus NCTC 8038		1		1		
3036		575788	Vibrio atlanticus LGP32		1		1		
3038		577543	Influenza A virus (A/Xinjiang/1/2006(H5N1))	4		4			
3039		578079	Influenza A virus (A/ferret/Maryland/P10-UMD/2008(H9N2))		1		1		
3041		580047	Chlamydia trachomatis A2497	3		3			
3042		585034	Escherichia coli IAI1	3		3			
3043		585544	Bacteroides sp. D22	1		1			
3044		586029	Fowl adenovirus 8b	2		2			
3045		587200	Variola virus human/India/Ind3/1967		4		4		
3046		587884	Influenza A virus (A/Sydney/5/1997(H3N2))	7		7			
3047		588533	Norovirus Hu/GII/GZ-1/2008/CHN	1		1			
3048	X	588596	Rhizophagus irregularis				1		1
3049		591020	Shigella flexneri 2002017		1		1		
3050		592021	Bacillus anthracis str. A0248		1		1		
3051		592313	Vibrio cholerae 12129(1)		1		1		
3053		595609	Recombinant Hepatitis C virus HK6a/JFH-1	3		8		5	
3054		598745	Giardia intestinalis ATCC 50581		7		7		
3055		604436	Influenza B virus (B/Brisbane/60/2008)	8		14		6	
3056		614035	Influenza A virus (A/swine/Belgium/1/1998(H1N1))	1		1			
3057		616922	Influenza A virus (A/chicken/Anhui/1/1998(H9N2))		1		1		
3058		617102	Yellow fever virus 17D/Tiantan	4	5	4	5		
3059		619693	Prevotella sp. oral taxon 472 str. F0295	1		1			
3061		627442	SARS coronavirus P2	1		1			
3062		627611	Vibrio parahaemolyticus K5030		22		22		
3063		630277	Tarsius lariang		1		1		

3064		632134	Influenza A virus (A/chicken/Pakistan/UDL-01/2008(H9N2))	7		7			
3065	X	632955	Acinetobacter rudis				1		1
3066		633557	Infectious bronchitis virus CK/CH/LHLJ/04V	1		1			
3067		634464	Chlamydia trachomatis Sweden2	1		1			
3068		637383	Helicobacter pylori NCTC 11639		8		8		
3069		638313	Human bocavirus 3	6		6			
3070		641140	Brucella abortus str. 2308 A		1		1		
3071		641501	Influenza A virus (A/California/04/2009(H1N1))	74	128	124	128	50	
3072		641809	Influenza A virus (A/California/07/2009(H1N1))	35	50	35	50		
3073		641812	Influenza A virus (A/Texas/05/2009(H1N1))	1		1			
3074		642261	Influenza A virus (A/California/08/2009(H1N1))	8		8			
3075		642794	Influenza A virus (A/Auckland/1/2009(H1N1))		1		1		
3076		643212	Influenza A virus (A/Netherlands/602/2009(H1N1))	2	14	2	14		
3077		643680	Saccharomyces cerevisiae EC1118		1		1		
3078		644289	Influenza A virus (A/Korea/01/2009(H1N1))	4		4			
3079		644788	Influenza A virus (A/Vietnam/1194/2004(H5N1))	14	9	14	10		1
3080		645463	Clostridioides difficile R20291	1		5		4	
3081		645724	Influenza A virus (A/Hong Kong/01/2009(H1N1))	3		3			
3082		645771	Influenza A virus (A/Catalonia/63/2009(H1N1))		1		1		
3083		647096	Influenza A virus (A/Beijing/01/2009(H1N1))		35		35		
3084	X	647343	Norovirus Hu/GII.4/Hiroshima/48/2004/JPN				1		1
3085		647514	Norovirus GI.1	1		1			
3086		647515	Norovirus GI.2	1		1			
3087		647516	Norovirus GI.3		1		1		
3088		647519	Norovirus GI.5	1		1			
3089		647521	Norovirus GI.7	1		1			
3090		647923	Influenza A virus (A/reassortant/NYMC X-179A(California/07/2009 x NYMC X-157)(H1N1))	16		16			
3091		648194	Neisseria meningitidis serogroup Y	3		3			
3092		648856	Influenza A virus (A/Beijing/501/2009(H1N1))	1		1			
3094		650131	Equine rhinitis B virus 1 strain P1436/71	6		6			
3095		652616	Mycobacterium tuberculosis str. Erdman = ATCC 35801	15	19	15	19		
3096		654811	Influenza A virus (A/Perth/16/2009(H3N2))	3		5		2	
3097		655288	Influenza A virus (A/mallard/Quebec/10969/2006(H2N3))		1		1		
3098		655827	Metarhizium acridum CQMa 102	1		1			
3099		655863	Grosmannia clavigera kw1407		1		1		
3100		657165	Influenza A virus (A/Hong Kong/213/03)	2	2	2	2		
3101		658578	Influenza A virus (A/duck/Beijing/MG0617/2005(H9N2))		1		1		

3102		658655	Lachnospiraceae bacterium 1_4_56FAA		1		1		
3103		658858	Giardia lamblia P15		1		1		
3104	X	660658	Norovirus Hu/GII.4/CHDC4108/1987/US				2		2
3106		661367	Legionella longbeachae NSW150		1		1		
3108		667015	Phocaeicola salanitronis DSM 18170		1		1		
3109		672161	Chlamydia trachomatis B/TZ1A828/OT	3		3			
3110		673446	Influenza A virus (A/reassortant/NYMC X-181(California/07/2009 x NYMC X-157)(H1N1))	1		1			
3111		679206	Escherichia coli MS 119-7		1		1		
3112		679716	Trypanosoma brucei gambiense DAL972		1		1		
3113		680689	Influenza A virus (A/England/AV877/1996(H7N7))		1		1		
3114		680690	Influenza A virus (A/Hong Kong/1074/1999(H9N2))	2	1	2	1		
3115		680692	Influenza A virus (A/Hong Kong/485/1997(H5N1))	1	1	1	1		
3116		680693	Influenza A virus (A/Netherlands/219/2003(H7N7))	1		1			
3117		680729	Influenza A virus (A/chicken/Italy/1067/1999(H7N1))		20		20		
3118		680739	Influenza A virus (A/chicken/Mexico/37821-771/1996(H5N2))		1		1		
3119		680767	Influenza A virus (A/duck/Hong Kong/140/1998(H5N1))		1		1		
3120		680785	Influenza A virus (A/environment/Hong Kong/156/1997(H5N1))	1		1			
3121		680789	Influenza A virus (A/environment/Viet Nam/1203/2004(H5N1))	1		1			
3122		680799	Influenza A virus (A/goose/Hong Kong/437-6/1999(H5N1))		1		1		
3123		680803	Influenza A virus (A/goose/Hong Kong/739.2/2002(H5N1))		1		1		
3125		682728	Influenza A virus (A/Quebec/144147/2009(H1N1))	10		10			
3126		683780	Influenza A virus (A/wild bird/Korea/A81/2009(H5N2))	1		1			
3127		687340	Torque teno virus 1		3		3		
3128		687341	Torque teno virus 2		4		4		
3129		687342	Torque teno virus 3		4		4		
3130		687343	Torque teno virus 4		6		6		
3131		687345	Torque teno virus 6		2		2		
3132		687346	Torque teno virus 7		3		3		
3133		687347	Torque teno virus 8		6		6		
3134		687350	Torque teno virus 11		1		1		
3135		687353	Torque teno virus 14		5		5		
3136		687354	Torque teno virus 15		3		3		
3137		687355	Torque teno virus 16		4		4		
3138		687358	Torque teno virus 19		5		5		
3139		687359	Torque teno virus 20		2		2		
3140		687360	Torque teno virus 21		2		2		
3141		687362	Torque teno virus 23		2		2		
3142		687363	Torque teno virus 24		3		3		

3143		687364	Torque teno virus 25		3		3		
3144		687365	Torque teno virus 26		5		5		
3145		687366	Torque teno virus 27		5		5		
3146		687367	Torque teno virus 28		3		3		
3147		687368	Torque teno virus 29		4		4		
3148		687369	Torque teno mini virus 1		1		1		
3149		687371	Torque teno mini virus 3		2		2		
3150		687375	Torque teno mini virus 7		2		2		
3151		687376	Torque teno mini virus 8		2		2		
3152		687382	Torque teno tamarin virus		2		2		
3153		687383	Torque teno douroucouli virus		5		5		
3154		687384	Torque teno felis virus		1		1		
3155		687385	Torque teno canis virus		1		1		
3156		687386	Torque teno sus virus 1a	12	1	12	1		
3157		689403	Human bocavirus 1	8		8			
3160	X	693999	Scotophilus bat coronavirus 512				1		1
3162	X	694008	Pipistrellus bat coronavirus HKU5				1		1
3163		694009	Severe acute respiratory syndrome-related coronavirus	171	505	179	507	8	2
3165		696871	Vaccinia virus Western Reserve		31		31		
3167		697610	Influenza A virus (A/India/GWMH05/2009(H1N1))		1		1		
3168		703352	Brucella melitensis M5-90	5	26	5	26		
3169	X	707424	Norovirus Hu/GII-4/Ehime4/2007/JP				1		1
3171	X	707488	Norovirus Hu/GII-4/Nagano3/2007/JP				4		4
3172	X	707882	Duck astrovirus 1			1		1	
3173	X	708187	Colletotrichum chlorophyti				1		1
3174		714978	Human adenovirus 55	4		4			
3175		715091	Influenza A virus (A/Roma/ISS1941/2009(H1N1))		1		1		
3176		715494	Influenza A virus (A/Hong Kong/33982/2009(H9N2))		3		3		
3177		722438	Mycoplasma pneumoniae FH	3		3			
3178		742305	Influenza A virus (A/slaty-backed gull/Japan/6KS0185/2006(H4N8))		1		1		
3179		742503	Tokudaia muenninki		1		1		
3180		743722	Sphingobacterium sp. 21	1		1			
3181		743973	Taylorella equigenitalis ATCC 35865	1		1			
3182		744533	Naegleria gruberi strain NEG-M	1		1			
3183		746128	Aspergillus fumigatus	127	87	136	88	9	1
3184		747305	Norovirus GII.10	7		7			
3185		754027	Treponema phagedenis F0421		1		1		
3186		754366	Influenza A virus (A/Ontario/309862/2009(H1N1))	1		1			
3187		754503	Mycoplasma hyopneumoniae 7422	1		1			
3188		759272	Chaetomium thermophilum var. thermophilum DSM 1495	1		1			
3189		759363	Chlamydia trachomatis D-EC	3		3			

3190	X	759851	Sporosarcina newyorkensis				1		1
3191		760591	Influenza A virus (A/Egypt/N03072/2010(H5N1))	1		1			
3192		761193	Runella slithyformis DSM 19594		1		1		
3193		761251	Influenza A virus (A/Mexico City/WR1704T/2009(H1N1))		1		1		
3194	X	762377	Influenza A virus (A/bar-headed goose/Qinghai/1-HVRI/2006(H5N1))				5		5
3195		762378	Influenza A virus (A/bar-headed goose/Qinghai/3/2005(H5N1))		1		1		
3197		763552	Mus musculus papillomavirus type 1		4		4		
3198		768646	Influenza A virus (A/chicken/Uchal/8293/2006(H9N2))		1		1		
3199		768647	Influenza A virus (A/chicken/Uchal/8286/2006(H9N2))		1		1		
3200		857099	Streptococcus mutans OMZ175	2	1	2	1		
3201		857571	Moraxella catarrhalis O35E	27		27			
3202		862909	Trichodysplasia spinulosa-associated polyomavirus	2		2			
3203	X	863370	Meiothermus granaticius				1		1
3204	X	866344	Helicobacter pylori F16			2		2	
3207		868597	Stenotrophomonas maltophilia JV3	1		1			
3208		870484	Nonlabens agnitus		1		1		
3209		871575	Ogataea parapolymorpha DL-1		1		1		
3210	X	874269	African swine fever virus Georgia 2007/1			15		15	
3211		875328	Mycolicibacter sinensis		10		10		
3213		885311	Entamoeba histolytica KU27		1		1		
3214		887118	Influenza A virus (A/Mexico/UASLP-012/2008(H3N2))		1		1		
3215		908203	Influenza A virus (A/Thailand/CU-H126/2009(H1N1))		1		1		
3216		909420	Neisseria meningitidis H44/76	2		2			
3217		913028	Yersinia enterocolitica W22703		1		1		
3218		914129	Streptococcus pneumoniae 2061376		1		1		
3219		915014	Influenza A virus (A/swine/Heilongjiang/44/2009(H1N1))	1		1			
3220		928301	Fowlpox virus strain NVSL		3		3		
3222		928313	Tacaribe virus strain Franze-Fernandez		6		6		
3223		929439	Leishmania mexicana MHOM/GT/2001/U1103		1		1		
3224		932622	Influenza A virus (A/chicken/Huadong/4/2008(H5N1))	1		1			
3225		935198	Clostridium botulinum B str. Eklund 17B (NRP)		1		1		
3226		936115	Influenza A virus (A/Netherlands/18/1994(H3N2))		1		1		
3227		940614	Granulicella mallensis		1		1		
3228		947939	Influenza A virus (A/aquatic bird/Korea/w44/2005(H7N3))		1		1		
3229		981087	Leishmania donovani BPK282A1		9		9		
3231		986174	Influenza A virus (A/swine/Korea/4382/2009(H1N2))		1		1		
3232		991335	Influenza A virus (A/swine/Hong Kong/71/2009(H1N1))		1		1		
3233		992121	Helicobacter pylori Hp M5	1		1			

3234		996581	Influenza A virus (A/chicken/Shanghai/Q0808-1/2008(H9N2))		1		1		
3235		1003835	Severe fever with thrombocytopenia syndrome virus	1		1			
3236		1004253	Cyberlindnera mrakii	1	1	1	1		
3237		1005048	Collimonas fungivorans Ter331		2		2		
3238		1005962	Ogataea parapolymorpha		1		1		
3239		1006061	Duck hepatitis A virus 1	1		1			
3240		1006581	Mycoplasma gallisepticum S6	1		1			
3241		1009714	Pseudomonas aeruginosa PAK	7	3	7	3		
3242		1016852	Banana streak CA virus	5		5			
3243		1016853	Banana streak IM virus	10		10			
3244		1016998	Salmonella enterica subsp. enterica serovar Paratyphi B str. SPB7		11		11		
3245		1035514	Plasmodium vivax North Korean	1		1			
3246		1041522	Mycobacterium colombiense CECT 3035		20		20		
3247		1041990	Influenza A virus (A/Guangdong/15/2007(H3N2))	3		3			
3248		1045775	Paenibacillus catalpae	1		1			
3249	X	1046049	Norovirus Hu/GII.12/HS206/2010/USA				1		1
3250	X	1047168	Zymoseptoria brevis				1		1
3251		1050221	Chlamydia psittaci NJ1	10		10			
3252		1053141	Recombinant Hepatitis C virus J6/JFH1-J6	2		2			
3253		1055687	Trypanosoma vivax Y486	1		1			
3254		1068705	Influenza A virus (A/swine/Guangdong/221/2009(H1N1))		1		1		
3256	X	1071379	Tetrapisispora blattae				1		1
3257		1077587	Influenza B virus (B/Victoria/2/1987)	2	4	2	4		
3258		1081253	Influenza A virus (A/Indiana/08/2011(H3N2))		6		6		
3259		1082519	Influenza A virus (A/chicken/Taixing/10/2010(H9N2))	2		2			
3260		1086859	Influenza A virus (A/Bilthoven/4791/1981(H3N2))		3		3		
3261		1091045	Cutibacterium acnes subsp. defendens ATCC 11828	5		5			
3262		1093545	Influenza A virus (A/shorebird/Delaware Bay/277/2000(H9N7))		1		1		
3263		1112244	Chlamydia psittaci 06-1683	3		3			
3264		1112253	Chlamydia psittaci 02DC14	1		1			
3265		1112254	Chlamydia psittaci 02DC15	19		19			
3266		1112258	Chlamydia psittaci 02DC22	2		2			
3267		1112262	Chlamydia psittaci 03DC29	1		1			
3268		1112269	Chlamydia psittaci 09DC78	1		1			
3269		1117322	Glaesserella parasuis str. Nagasaki	1		1			
3270		1122279	Influenza A virus (A/equine/Guangxi/3/2011(H9N2))		1		1		
3271		1125722	Porphyromonas gingivalis W50		36		36		
3272		1126212	Macrophomina phaseolina MS6		1		1		

3273		1129345	Influenza A virus (A/little yellow-shouldered bat/Guatemala/153/2009(H17N10))		3		3		
3275	X	1133319	Bacteroides reticulotermitis				1		1
3276		1133363	Schmallenberg virus	6		6			
3277		1133968	Babesia microti strain RI	3		3			
3278	X	1136231	Candida orthopsilosis Co 90-125				1		1
3279		1144025	Influenza A virus (A/Shandong/9/1993(H3N2))	13		13			
3280		1146883	Blastococcus saxobsidens DD2		1		1		
3281		1156983	Norovirus Hu/GII.4/Minerva/CS1258/2006/USA	1		1			
3283		1163697	Influenza A virus (A/Oklahoma/309/2006(H3N2))	4	3	4	3		
3284		1169127	Clostridioides difficile genomovar ribotype_087	1		1			
3285		1171336	Influenza A virus (A/swine/Nebraska/A01116984/2011(H3N2))		1		1		
3286		1172206	Neisseria meningitidis NMB	1		1			
3288	X	1173701	Colletotrichum sublineola				1		1
3289		1176042	Influenza A virus (A/swine/Italy/1513-1/1998(H1N1))		1		1		
3290		1178016	Encephalitozoon romaleae SJ-2008		1		1		
3291	X	1179777	Mycoplasma feriruminatoris				1		1
3292		1182143	Norovirus Hu/GII.4/Farmington Hills/2004/USA	2		2			
3293		1182144	Norovirus Hu/GII.4/Minerva/2006/USA	2		2			
3294		1184252	Streptococcus suis S735	2		2			
3295	X	1184593	Influenza A virus (A/Victoria/210/2009(H3N2))			16		16	
3296		1186058	Trichosporon asahii var. asahii CBS 2479		1		1		
3297	X	1193095	Paucilactobacillus hokkaidonensis				1		1
3298	X	1193576	Staphylococcus aureus subsp. aureus CN1				3		3
3299		1197131	Escherichia coli F576	1		1			
3300		1198627	Mycobacteroides abscessus subsp. massiliense str. GO 06		1		1		
3301		1198676	Streptococcus mutans GS-5		14		14		
3302		1207470	Streptococcus pyogenes M1 476	1		1			
3303		1209523	Toxoplasma gondii type II		2		2		
3304		1209525	Toxoplasma gondii type I		2		2		
3305	X	1209926	Colletotrichum orchidophilum				1		1
3306		1214154	Streptococcus suis 2651	1		1			
3307		1214159	Streptococcus suis 13730	2		2			
3308		1214225	Acidocella sp. MX-AZ02	1		1			
3309		1218488	Torque teno sus virus k2	11		11			
3310		1219377	Human rhinovirus C3		52		52		
3311		1225860	Porcine torque teno virus 1	2		2			
3312		1229831	Chlamydia avium 10DC88	2		2			
3313	X	1235801	Lactobacillus murinus ASF361				2		2
3314	X	1235802	Eubacterium plexicaudatum ASF492				2		2

3316		1235996	Human betacoronavirus 2c EMC/2012	7	12	11	26	4	14
3317	X	1236180	Halopelagius longus				1		1
3318		1236978	Staphylococcus epidermidis JCM 2414	1		1			
3319		1239567	Mamastrovirus 3	2		2			
3320		1241973	Norovirus Hu/GII.4/Sydney/NSW0514/2012/AU	4		4	31		31
3321	X	1254407	Norovirus Hu/GII.4/N3/2008/HuZhou				1		1
3323		1263102	Prevotella copri CAG:164		1		1		
3324		1263720	Betacoronavirus England 1	10		11		1	
3325		1268303	Rhodococcus sp. AW25M09	1	1	1	1		
3326		1268360	Influenza A virus (A/Victoria/361/2011(H3N2))	5		5			
3327		1278073	Myxococcus stipitatus DSM 14675		1		1		
3328	X	1281454	Rodent hepacivirus				8		8
3329		1285028	Influenza A virus (A/American black duck/New Brunswick/00464/2010(H4N6))	1		1			
3330		1285600	Nile crocodilepox virus		2		2		
3331		1285902	Artificial vector pGEX-2T	1		1			
3332		1286616	Norovirus Hu/GII.3/693/425/2008/AU	6		6			
3333		1286635	Desulfotignum phosphitoxidans DSM 13687		1		1		
3334		1288825	Shigella flexneri 2b	2		2			
3335		1289562	Influenza A virus (A/swine/Spain/SF11131/2007(H1N1))		3		3		
3336		1291361	Leptospira interrogans serovar Naam str. Naam	1		1			
3337	X	1291821	Norovirus Hu/GII/20144/2009/VNM				1		1
3338	X	1291870	Norovirus Hu/GII/20457/2010/VNM				1		1
3339		1303514	Diaporthe toxica	1		1			
3340		1310532	Influenza A virus (A/chicken/West Java/Sbg-29/2007(H5N1))	7		7			
3342		1318439	Influenza A virus (A/Washington/05/2011(H1N1))	1		1			
3343		1318464	Bovine Schmallenberg virus BH80/Germany/2011	2		2			
3344		1321009	Influenza A virus (A/Texas/50/2012(H3N2))	2		2			
3345	X	1321999	Norovirus Hu/GII.6/Ehime120246/2012/JP			2		2	
3347		1330520	Enterovirus F	1		1			
3348		1332244	Influenza A virus (A/Shanghai/02/2013(H7N9))	11		66		55	
3349		1335626	Middle East respiratory syndrome-related coronavirus	11	21	11	25		4
3350		1337063	Puumala virus bank vole/CG1820/Russia/1984		1		1		
3351		1337393	Helicobacter pylori PZ5056	1		1			
3352		1342397	Influenza A virus (A/chicken/Hong Kong/TP38/2003(H9N2))		3		3		
3353		1342434	Influenza A virus (A/turkey/Minnesota/511/1978(H9N2))		1		1		
3354		1345266	HIV-1 M:CRF01_AE	1		1			
3355		1346336	Influenza A virus (A/Fort Monmouth/1-JY2/1947(H1N1))		1		1		
3356	X	1350216	Norovirus Hu/GII.12/Texas/E13842/USA/2000				1		1

3357		1352357	Helicobacter pylori SouthAfrica50	1		1			
3358		1355477	Bradyrhizobium diazoefficiens		1		1		
3359		1380386	Mycobacterium sp. URHB0044		1		1		
3361	X	1384672	Mumps virus genotype G				82		82
3362		1389959	Mycobacterium tuberculosis variant bovis AN5	9	28	9	28		
3363		1391655	Influenza A virus (A/Aichi/2-1/1968(H3N2))	1		1			
3364		1391998	Mycobacterium avium subsp. paratuberculosis 08-8281	1		1			
3365		1392869	Escherichia coli K1		1		1		
3367		1395982	Influenza A virus (A/tree sparrow/Shanghai/01/2013(H7N9))	1		1			
3368		1398154	Sporothrix brasiliensis 5110		4		4		
3369		1399582	Duck Tembusu virus	7		7			
3370		1401444	Avian leukosis virus ev/J	5		5			
3371		1403335	Porphyromonas gingivalis 381	71	55	71	55		
3372		1403514	Influenza A virus (A/chicken/Jiangsu/x1/2004(H9N2))	7		7			
3373		1405296	Chlamydia suis MD56	1		1			
3374		1406148	Norovirus Hu/GII.3/Jingzhou/2013402/CHN	2		2			
3375		1408475	Taylorella asinigenitalis ATCC 700933	1		1			
3376		1413188	Influenza A virus (A/Anhui/PA-1/2013(H7N9))	1	3	1	3		
3377		1416333	Trypanosoma cruzi Dm28c	2		2			
3378		1420840	Influenza A virus (A/Luxembourg/46/2009(H1N1))		1		1		
3379		1423732	Lactobacillus casei DSM 20011 = JCM 1134 = ATCC 393	2		2			
3380		1427371	Chlamydia pecorum VR629	5		5			
3381		1432052	Eisenbergiella tayi		3		3		
3382		1432555	Escherichia coli ISC7		1		1		
3383		1440122	Murid herpesvirus 68		2		2		
3384		1447813	Influenza A virus (A/Shanghai/5190T/2013(H7N9))		6		6		
3385		1451093	Influenza A virus (A/chicken/Taiwan/67/2013(H6N1))		5		5		
3386		1457141	Chlamydia avium	1		1			
3387		1457153	Chlamydia gallinacea	3		3			
3388		1458279	Staphylococcus aureus USA300-ISMMS1	1		1			
3390		1463841	Streptomyces sp. NRRL F-2580		1		1		
3391		1464048	Micromonospora parva		1		1		
3392		1470614	Influenza A virus (A/swine/Thailand/CU-S3673N/2012(H3N2))		1		1		
3393	X	1472713	Norovirus Hu/GII/Amsterdam/1994				1		1
3394		1476909	Banana streak MY virus	39		39			
3395		1481964	Influenza A virus (A/Anhui/1-DEWH730/2013(H7N9))	1	35	1	35		
3396		1481966	Influenza A virus (A/Anhui/1-JCVI1_RG2/2013(H7N9))	3		3			
3398		1498499	Legionella norrlandica		1		1		
3399	X	1498657	Norovirus Hu/GII.4/Chiba5/2010/JP				2		2

3400	X	1501332	Oribacterium asaccharolyticum				1		1
3401		1507381	Influenza A virus (A/Minnesota/11/2010(H3N2))	19		19			
3404	X	1562038	Norway rat hepacivirus 1				5		5
3406	X	1566201	Pseudomonas sp. NFACC45				2		2
3407		1566298	Paraiso Escondido virus		1		1		
3408		1570291	Ebola virus	3		3	142		142
3409		1581419	Amblyomma sculptum	1		1			
3410	X	1586324	Porcine deltacoronavirus			1		1	
3411	X	1590370	Betacoronavirus HKU24				3		3
3412	X	1631247	Mesorhizobium delmotii				1		1
3413		1634342	Norovirus Hu/GII/JP/2015/GII.P17_GII.17/Kawasaki 308	1		1			
3414		1663864	Influenza A virus (A/Anhui/1-YK_RG134/2013(H7N9))		1		1		
3415		1663934	Influenza A virus (A/Anhui/1-YK_RG64/2013(H7N9))		2		2		
3416		1663996	Influenza A virus (A/Anhui/1-YK_RG01/2013(H7N9))	1		1			
3417		1665645	Norovirus GI/Hu/NL/2012/GI.6/Groningen		1		1		
3418		1671798	Human papillomavirus type 54		1		1		
3419		1727172	Influenza A virus (A/duck/Bavaria/1/1977(H1N1))		2		2		
3420		1763596	Guertu virus	32		32			
3423		1835656	Rotavirus A RVA/Cow-tc/USA/B223/1983/G10P[11]	2		2			
3424		1855372	bacterium JGI 053		1		1		
3425	X	1868221	Porcine circovirus 3			4		4	
3427		1885248	Variegated squirrel bornavirus 1		1		1		
3428		1891187	Zaire ebolavirus Makona		57	48	57	48	
3429		1891729	Mesocricetus auratus polyomavirus 1	11		11			
3430		1891730	Mus musculus polyomavirus 1	4	30	4	30		
3431		1891762	Human polyomavirus 1	4	52	4	78		26
3432		1891767	Macaca mulatta polyomavirus 1	16	42	16	42		
3433		1898104	Bacteroidetes bacterium		1		1		
3434	X	1898112	Rhodospirillaceae bacterium				1		1
3435		1898203	Lachnospiraceae bacterium		1		1		
3436		1933300	Watermelon silver mottle tospovirus	3		3			
3437		1965067	Porcine reproductive and respiratory syndrome virus 2		41		41		
3438		1972699	Norovirus Hu/GII.3/3-34/2015/HNZZ/CHN	11		11			
3439	X	1978231	Acidobacteria bacterium				1		1
3440		1980442	Orthohantavirus		13		13		
3441		1980456	Andes orthohantavirus	2	79	2	79		
3442		1980459	Bayou orthohantavirus	1		1			
3443		1980463	Cano Delgadito orthohantavirus		1		1		
3444		1980467	Dobrava-Belgrade orthohantavirus		25		25		
3445		1980468	El Moro Canyon orthohantavirus		2		2		

3446		1980471	Hantaan orthohantavirus	2	60	2	60		
3447		1980475	Khabarovsk orthohantavirus		1		1		
3448		1980476	Laguna Negra orthohantavirus		12		12		
3449		1980481	Montano orthohantavirus	3		3			
3450		1980485	Prospect Hill orthohantavirus	1	2	1	2		
3451		1980486	Puumala orthohantavirus	32	20	32	20		
3452		1980489	Sangassou orthohantavirus		6		6		
3453		1980490	Seoul orthohantavirus		5		5		
3454		1980491	Sin Nombre orthohantavirus	1	35	1	35		
3455		1980494	Tula orthohantavirus	1	14	1	14		
3456		1980519	Crimean-Congo hemorrhagic fever orthonairovirus	82	18	95	18	13	
3461	X	2024894	Acidimicrobiaceae bacterium				1		1
3462	X	2026033	Influenza A virus (A/chicken/Hunan/S12753/2016(H7N9))			2		2	
3463		2029108	Bacillus sp. UMB0899	1		1			
3464		2043570	Zika virus ZIKV/H. sapiens/FrenchPolynesia/10087PF/2013	6	54	20	54	14	
3466	X	2066070	Mesorhizobium japonicum				1		1
3467		2070132	Influenza A virus (A/chicken/Jiangsu/W1-8/2015(H7N9))	6		6			
3468		2115988	Swine acute diarrhea syndrome related coronavirus	1		1			
3469		2116544	Synechococcus lacustris	1		1			
3470		2169971	Visna-maedi virus	5	7	5	7		
3471		2169986	Barley yellow dwarf virus PAV	1		1			
3472		2169991	Argentinian mammarenavirus	8	873	8	873		
3473		2169992	Brazilian mammarenavirus		879		879		
3474		2169993	Cali mammarenavirus		11		11		
3475		2169994	Paraguayan mammarenavirus		1		1		
3476		2169996	Serra do Navio mammarenavirus		3		3		
3477		2170197	Guenon simian foamy virus	1		1			
3478		2170200	Spider monkey simian foamy virus	1		1			
3479		2170201	Squirrel monkey simian foamy virus	1		1			
3480		2170206	Yellow-breasted capuchin simian foamy virus	1		1			
3481	X	2282107	Pyrrhoderma noxium				1		1
3482		2316109	Zika virus ZIKV/Human/Cambodia/FSS13025/2010		2		2		
3483	X	2478486	Holophagales bacterium				1		1
3484		2487134	Clostridium sp. E02		1		1		
3485	X	2492960	Bacillus yapensis				1		1
3486	X	2501420	Yak coronavirus				1		1
3487		2560319	Avian orthoavulavirus 1	21	5	21	5		
3488		2560525	Human orthorubulavirus 2	10		10			
3489		2560580	Mammalian orthorubulavirus 5	1	1	1	1		
3490		2560602	Mumps orthorubulavirus	3	1	3	2		1
3491		2560645	Porcine orthorubulavirus	3		3			

3492	X	2594813	Fusarium fasciculatum				1		1
3493	X	2630493	unclassified Granulicatella				1		1
3494		2678873	Trimerodytes annularis	1		1			
3495	X	2697049	Severe acute respiratory syndrome coronavirus 2			200	660	200	660
3496	X	2707005	Paenibacillus lutimineralis				1		1
3499		2758382	Bos taurus papillomavirus 2	15		15			
3500		10000000	Mus musculus BALB/c		3		3		
3501		10000055	Mus musculus DBA/2	1		1			
3502		10000067	Mus musculus C57BL/6				381		381
3503		10000187	Sus scrofa Landrace X Large White	1		1			
3504		10000291	Bacillus anthracis str. Sterne 34F2	1		1			
3505		10000293	Clostridium botulinum A 1	1		1			
3506		10000294	Clostridium botulinum A 2	2		2			
3507		10000295	Clostridium botulinum B 111	2		2			
3508		10000296	Clostridium botulinum D 1873	2		2			
3509		10000297	Clostridium botulinum C 92-13	5		5			
3510		10000299	Clostridium botulinum E Beluga	2		2			
3511		10000301	Clostridium botulinum A str. Hall hyper	3		3			
3512		10000302	Clostridium botulinum A Kyoto-F	1		1			
3513		10000303	Clostridium botulinum B Lammana	1		1			
3514		10000304	Clostridium botulinum F NCTC 10281	1		1			
3515		10000305	Clostridium botulinum B Okra	3		3			
3516		10000306	Clostridium botulinum C Stockholm	2		2			
3517		10000307	Clostridium difficile BART'S W1	1		1			
3518		10000308	Listeria monocytogenes ATCC 35967		1		1		
3519		10000309	Listeria monocytogenes ATCC 43251		3		3		
3520		10000313	Mycobacterium avium serovar 1	1		1			
3521		10000314	Mycobacterium avium serovar 2	1		1			
3522		10000316	Mycobacterium avium serovar 25	1		1			
3523		10000317	Mycobacterium avium serovar 26	1		1			
3524		10000318	Mycobacterium avium serovar 4	2		2			
3525		10000319	Mycobacterium avium serovar 8	1	1	1	1		
3526		10000320	Mycobacterium avium serovar 9	1		1			
3527		10000323	Mycobacterium bovis T/91/1378		6		6		
3528		10000328	Mycobacterium avium subsp. paratuberculosis Strain Ben		1		1		
3529		10000329	Mycobacterium tuberculosis 103	1		1			
3530		10000331	Mycobacterium gastri W471	1		1			
3531		10000335	Candida albicans A-9 (serotype B)	1		1			
3532		10000337	Candida albicans KIT 1113	1		1			
3533		10000339	Candida albicans serotype A	1		1			
3534		10000341	Leishmania donovani donovani 1S2D	1		1			
3535		10000345	Leishmania infantum LEM 75	14		14			

3536		10000348	Trypanosoma cruzi G	1		1			
3537		10000351	Trypanosoma cruzi Y	1		1			
3538		10000352	Entamoeba histolytica YS-27	1		1			
3539		10000353	Toxoplasma gondii 76K	5	5	5	5		
3540		10000354	Toxoplasma gondii BK	1	1	1	1		
3541		10000355	Toxoplasma gondii Prugniaud		1		1		
3542		10000356	Plasmodium berghei NK65	2	2	2	2		
3543		10000357	Plasmodium chabaudi adami DS	2	37	2	37		
3544		10000358	Plasmodium falciparum 366		1		1		
3548		10000363	Plasmodium falciparum Brazil-608	1	1	1	1		
3549		10000366	Plasmodium falciparum FCB-2	1		1			
3550		10000369	Plasmodium falciparum FVO		5		5		
3551		10000370	Plasmodium falciparum GAM5		1		1		
3552		10000371	Plasmodium falciparum Indochina I/CDC	32		32			
3553		10000373	Plasmodium falciparum ItG2G1		1		1		
3554		10000375	Plasmodium falciparum RO71	1	1	1	1		
3555		10000376	Plasmodium falciparum UF-5	2		2			
3556		10000378	Plasmodium vivax NK		2		2		
3557		10000381	Plasmodium yoelii yoelii YM	1	5	1	5		
3558		10000382	Babesia bovis Mexico	1	4	3	4	2	
3559		10000383	Babesia bovis Mexico Mo7	1	33	1	33		
3560		10000385	Schistosoma mansoni Puerto Rico	20	7	20	7		
3561		10000386	Monkeypox virus USA_2003_039		1		1		
3562		10000388	Vaccinia virus NYCBH - Dryvax		29		29		
3563		10000390	Variola major virus India-1967		1		1		
3564		10000391	Equid herpesvirus 2 ER32	1		1			
3565		10000394	Human herpesvirus 1 103/65	1		1			
3566		10000396	Human herpesvirus 1 McIntyre		1		1		
3567		10000398	Human herpesvirus 1 NS	1		1			
3568		10000404	Bovine herpesvirus 1 Lam	1		1			
3569		10000405	Equid herpesvirus 4 TH20	2		2			
3570		10000406	Human herpesvirus 3 H-551	26	15	26	15		
3571		10000408	Human herpesvirus 5 TB40		1		1		
3572		10000411	Murid herpesvirus 1 deltaMS94.5		2		2		
3573		10000412	Murid herpesvirus 1 Isolate G4		1		1		
3574		10000413	Murid herpesvirus 1 Isolate K6		1		1		
3576		10000420	Human herpesvirus 4 BL74		1		1		
3577		10000421	Human herpesvirus 4 CKL		10		10		
3578		10000424	Human herpesvirus 4 GD1	4	1	4	1		
3579		10000427	Human herpesvirus 4 type A		5		5		
3582		10000435	Hepatitis B virus genotype D		6		6		
3583		10000436	Hepatitis B virus subtype AY	7		7			
3584		10000437	Hepatitis B virus subtype AYR		1		1		

3585		10000438	Human parvovirus B19 genotype 1	1		1			
3586		10000439	Eastern equine encephalitis virus SV	8		8			
3587		10000440	Dengue virus type 1 Hawaii	29	22	29	22		
3588		10000442	Dengue virus type 3 CH53489		7		7		
3589		10000444	Japanese encephalitis virus CH2195LA	1		1			
3590		10000445	Japanese encephalitis virus JaOH0566	1		1			
3591		10000447	West Nile virus 3000.0259	2		2			
3592		10000449	Tick-borne encephalitis virus (WESTERN SUBTYPE) - Neudoerfl	10		10			
3593		10000451	Classical swine fever virus Shimen	16		16			
3594		10000453	Hepatitis C virus subtype 1a (isolate Gla)	5		5			
3595		10000455	Hepatitis C virus subtype 1a 1/910		18		18		
3596		10000456	Hepatitis C virus subtype 1b AD78	71		71			
3597		10000457	Hepatitis C virus subtype 1a Chiron Corp.	1	1	1	1		
3599		10000460	Hepatitis C virus subtype 1b JK1	13		13			
3600		10000462	Measles virus CAM/RB		1		1		
3601		10000463	Phocine distemper virus 2558/Han 88	5		5			
3602		10000465	Rinderpest virus LATC	2		2			
3603		10000467	Rabies virus CVS	14		14			
3604		10000470	Rabies virus Flury LEP		1		1		
3605		10000471	Rabies virus RC-HL	4		4			
3606		10000472	Bovine ephemeral fever virus BB7721	2		2			
3607		10000474	Influenza A virus H3N2 (A/Resvir-9 (H3N2))		10		10		
3608		10000477	H1N1 subtype Influenza A virus (A/Netherlands/306/00 (H1N1))		1		1		
3609		10000482	Rift Valley fever virus ZH501	2		2			
3610		10000483	Puumala virus CG18-20	4		4			
3611		10000484	Puumala virus Kazan	26	7	26	7		
3612		10000485	Puumala virus (STRAIN HALLNAS B1) Vranica/Hallnas	4		4			
3613		10000487	Lymphocytic choriomeningitis virus (strain Armstrong) (clone 4)	1		1			
3614		10000488	Lymphocytic choriomeningitis virus (strain Armstrong) (clone 53b)		61		61		
3615		10000490	Lymphocytic choriomeningitis virus A22.2b		1		1		
3616		10000491	Lymphocytic choriomeningitis virus Docile		2		2		
3617		10000494	Lymphocytic choriomeningitis virus (strain WE) variant 8.7		1		1		
3618		10000495	Lymphocytic choriomeningitis virus (strain WE) WE CL1.2		1		1		
3619		10000496	Lymphocytic choriomeningitis virus (strain Armstrong) (clone 3)		1		1		
3620		10000497	Lymphocytic choriomeningitis virus (strain Armstrong) (clone 5)	1		1			
3621		10000499	Equine infectious anemia virus PV		2		2		
3622		10000500	Human immunodeficiency virus 1 IIIB	1	2	1	2		
3623		10000501	Simian immunodeficiency virus - mac - mac 239	1	474	1	474		
3624		10000502	Simian immunodeficiency virus - mac - mac 32H		9		9		

3625		10000503	Simian immunodeficiency virus - mac - mac BK28		4		4		
3626		10000504	Simian immunodeficiency virus - mac - mac F965		2		2		
3628		10000506	Simian immunodeficiency virus - sm - sm PT573		3		3		
3629		10000507	Rabbit hemorrhagic disease virus Olot/89	1		1			
3630		10000513	Foot-and-mouth disease virus (strain O1) (O1 Kaufbeuren)	43	8	43	8		
3631		10000514	Foot-and-mouth disease virus (strain O1) (O1BFS 1860)	9		9			
3632		10000515	Foot-and-mouth disease virus (strain O1) (O1BFS)	5		5			
3633		10000516	Foot-and-mouth disease virus (strain O1) (O1 Campos)	18	19	18	19		
3634		10000518	Borna disease virus Giessen strain He/80	6		6			
3635		10000519	Hepatitis E virus China Xinjiang	1		1			
3636		10000520	Hepatitis E virus SAR-55	2	6	2	6		
3637		10000523	Hepatitis delta virus TW2667		5		5		
3638		10000524	Equid herpesvirus 2 691	1		1			
3639		10000525	Equid herpesvirus 2 16V	1		1			
3640		10000526	Equid herpesvirus 2 5FN	1		1			
3641		10000527	Equid herpesvirus 2 FIN60	1		1			
3642		10000528	Porcine respiratory and reproductive syndrome virus BJ-4	1		2		1	
3643		10000529	Porcine respiratory and reproductive syndrome virus CH-1a	7	1	7	1		
3644		10000530	Borrelia garinii IP90	3		3			
3645		10000535	Human herpesvirus 6B HST	1		1			
3646		10000536	Murid herpesvirus 4 G2.4		3		3		
3647		10000537	Murid herpesvirus 4 WUMS		19		19		
3648		10000542	Streptococcus pyogenes serotype M3 D58	4		4			
3649		10000544	Sin Nombre virus NM H10	4		4			
3650		10000547	Human enterovirus 71 Subgenogroup B5	12		12			
3651		10000548	Human enterovirus 71 Subgenogroup C2	19		19			
3652		10000549	Human enterovirus 71 Subgenogroup C4	11		11			
3653		10000550	Influenza A virus H3N2 (A/Netherlands/9/03 (H3N2))		1		1		
3654		10000553	Andes virus CHI-7913	53		53			
3655		10000554	Salmonella enterica subsp. enterica serovar Minnesota R595	2		2			
3656		10000555	Plasmodium yoelii yoelii 265BY		1		1		
3657		10000556	Foot-and-mouth disease virus (strain O1) Kaufbeuren	44	12	44	12		
3658		10000559	Chlamydophila abortus B-577	11		11			
3659		10000560	Norovirus genogroup 3 Bo/Jena/1980/DE	1		1			
3660		10000566	Paracoccidioides brasiliensis B339		8		8		
3661		10000567	Vibrio cholerae O1 serotype Inaba	1		1			
3662		10000568	Vibrio cholerae O1 serotype Ogawa	6		6			
3663		10000571	Cowpox virus (Brighton Red) White-pock		1		1		
3664		10000662	Rattus norvegicus Lewis		1		1		

3665		10000675	Borrelia burgdorferi CA12		6		6		
3666		10000679	Campylobacter jejuni subsp. jejuni 16971.94GSH (O:41)	2		2			
3667		10000718	Helicobacter pylori J223	2		2			
3668		10000720	Helicobacter pylori UA948	2		2			
3669		10000721	Helicobacter pylori UA955	1		1			
3670		10000723	Pseudomonas aeruginosa Immunotype 4	4		4			
3671		10000727	Escherichia coli 180/C3	1		1			
3672		10000728	Escherichia coli B B/r CM6		1		1		
3673		10000733	Escherichia coli O5:K4:H4	1		1			
3674		10000734	Escherichia coli O65:K-:H-	1		1			
3675		10000738	Salmonella typhimurium PL5 (O9,12)	1		1			
3676		10000739	Salmonella typhi 620Ty	1		1			
3677		10000740	Salmonella typhi Ty21a		6		6		
3678		10000742	Salmonella typhimurium SH 4809	4		4			
3679		10000743	Salmonella typhimurium SL3261		4		4		
3680		10000748	Shigella dysenteriae serotype 1	3		3			
3681		10000749	Shigella dysenteriae serotype 1 114Sd	1		1			
3682		10000752	Shigella flexneri 5b	1		1			
3683		10000754	Shigella flexneri X	1		1			
3684		10000756	Yersinia pestis KIM 5	21		21			
3685		10000757	Yersinia pestis 195/P	5		5			
3686		10000759	Pasteurella multocida X-73	2		2			
3687		10000760	Anaplasma marginale South Idaho		2		2		
3688		10000761	Orientia tsutsugamushi Karp	1		1			
3689		10000763	Chlamydia trachomatis Serovar C	16	1	16	1		
3690		10000764	Chlamydia trachomatis Serovar E	19	2	19	2		
3691		10000765	Chlamydia trachomatis Serovar H	7		7			
3692		10000766	Chlamydia trachomatis Serovar I	10		10			
3693		10000767	Chlamydia trachomatis serovar K	14		14			
3694		10000768	Chlamydia trachomatis Serovar L2	15	12	15	12		
3695		10000769	Chlamydia trachomatis Serovar L3	2		2			
3696		10000773	Streptococcus mutans MT 8148	40	12	40	12		
3697		10000775	Streptococcus pyogenes 156	1		1			
3698		10000776	Streptococcus pyogenes 88/25	1		1			
3699		10000777	Streptococcus pyogenes 88/30	1		1			
3700		10000778	Streptococcus pyogenes 88/544	1		1			
3701		10000779	Streptococcus pyogenes 90/85	1		1			
3702		10000780	Streptococcus pyogenes serotype M12 A374	1		1			
3703		10000781	Streptococcus pyogenes BSA10	3		3			
3704		10000782	Streptococcus pyogenes NS1	1		1			
3705		10000783	Streptococcus pyogenes NS14	1		1			
3706		10000784	Streptococcus pyogenes NS27	1		1			

3707		10000785	Streptococcus pyogenes NS5	1		1			
3708		10000786	Streptococcus pyogenes serotype M11	2		2			
3709		10000787	Streptococcus pyogenes serotype M13	1		1			
3710		10000788	Streptococcus pyogenes serotype M22	1		1			
3711		10000789	Streptococcus pyogenes serotype M24	6	2	6	2		
3712		10000790	Streptococcus pyogenes serotype M30	1		1			
3713		10000791	Streptococcus pyogenes serotype M41	1		1			
3714		10000792	Streptococcus pyogenes serotype M52	1		1			
3715		10000793	Streptococcus pyogenes serotype M54	1		1			
3716		10000794	Streptococcus pyogenes serotype M55	1		1			
3717		10000795	Streptococcus pyogenes serotype M57	1		1			
3718		10000796	Streptococcus pyogenes serotype M60	1		1			
3719		10000797	Streptococcus pyogenes serotype M75	1		1			
3720		10000798	Streptococcus pyogenes serotype M8	1		1			
3721		10000801	Foot-and-mouth disease virus - type O (O/SKR/2002)	1		1			
3722		10000802	Taenia crassiceps Strain ORF	3	3	3	3		
3723		10000804	Chlamydia trachomatis Serovar B	47	5	47	5		
3724		10000806	Foot-and-mouth disease virus (strain O1) (O1 Manisa)	6	1	6	1		
3725		10000807	Haemophilus influenzae NTHi UC19	2	2	2	2		
3726		10000809	Swine vesicular disease virus ITL/1/66	1		1			
3727		10000814	Leptospira interrogans serovar Lai str. HY-1	1		1			
3728		10000815	Pseudomonas aeruginosa PAO	2	2	2	2		
3729		10000816	Plasmodium falciparum T9/96	1	1	1	1		
3730		10000817	Pseudomonas aeruginosa KB7	2		2			
3731		10000818	Pseudomonas aeruginosa P1	1		1			
3732		10000820	Foot-and-mouth disease virus (strain O1) (O/Taiwan/1/97)	1		1			
3733		10000822	Pseudomonas aeruginosa Immunotype 3	1		1			
3734		10000824	Streptococcus pyogenes serotype M6 strain D471	4		4			
3735		10000825	Infectious bronchitis virus Avian strain D207	11		11			
3736		10000828	Ajellomyces dermatitidis ATCC 60636		2		2		
3737		10000829	Norovirus genogroup 2 Mexico type strain 36	3		3			
3738		10000832	Norovirus genogroup 2 Camberwell 1890	1		1			
3739		10000833	Haemophilus influenzae NTHi 1128	6		6			
3740		10000835	Equine rhinitis A virus 393/76	4		4			
3741		10000836	Foot-and-mouth disease virus C1 CS8	22	24	22	24		
3742		10000840	Foot-and-mouth disease virus C1 Brescia It/64	2		2			
3743		10000842	Swine vesicular disease virus NET/1/92	1		1			
3744		10000843	Neisseria meningitidis serogroup B H44/76	74	22	74	22		
3745		10000845	Chlamydia trachomatis Serovar F	3		3			
3746		10000848	Theileria sergenti Type B1		1		1		
3747		10000849	Theileria sergenti Type B2		2		2		

3748		10000850	Theileria sergenti Type C		5		5		
3749		10000851	Theileria sergenti Type I		1		1		
3750		10000852	Chlamydophila pneumoniae Kajaani 6		7		7		
3751		10000853	Chlamydia trachomatis Serovar L1	21	3	21	3		
3752		10000855	Theiler's murine encephalomyelitis virus (strain BeAn 8386) (variant M2)		1		1		
3753		10000856	Foot-and-mouth disease virus - type O isolate O/UKG/35/2001		14		14		
3755		10000858	Chlamydia trachomatis B/Jali-20/OT	2		2			
3756		10000859	Porcine respiratory and reproductive syndrome virus JA142	1		1			
3757		10000860	Haemophilus influenzae Serotype B	18	9	18	9		
3758		10000861	Haemophilus influenzae Variant d1	18		18			
3759		10000862	Plasmodium vivax VK247	1		1			
3760		10000863	Neisseria gonorrhoeae 4505	1		1			
3761		10000864	Porcine respiratory and reproductive syndrome virus MD-001	2		2			
3762		10000865	Influenza A virus H3N2 (A/Kiev/301/94)	3		3			
3763		10000888	Porcine respiratory and reproductive syndrome virus Olot/91	3	5	3	5		
3764		10000890	Porcine respiratory and reproductive syndrome virus SD92-23983		33		33		
3765		10000960	Human respiratory syncytial virus A Mon/3/88	6		6			
3766		10000961	Dengue virus type 1 strain 16007	15		15			
3767		10000964	Foot-and-mouth disease virus (strain O1) (O1 Brugge)	2		2			
3768		10000965	Dengue virus type 1 FGA/89	4		4			
3769		10000968	Hepatitis C virus subtype 1b isolate BE-11	3		3			
3770		10000969	Porcine respiratory and reproductive syndrome virus 111/92	9		9			
3771		10000971	West Nile virus NY-99	15	21	15	21		
3772		10000972	Neisseria meningitidis serogroup B Strain B16.B6	1		1			
3773		10000979	Neisseria meningitidis serogroup B Strain 8047	4		4			
3774		10000980	Arcanobacterium pyogenes Strain 42	4		4			
3775		10000986	Foot-and-mouth disease virus C1 CS30	1		1			
3776		10000987	Human rhinovirus 2 Vienna	5		5			
3777		10000989	Foot-and-mouth disease virus - type A (strain A22)	8	6	10	6	2	
3778		10000991	Foot-and-mouth disease virus - type A (strain A22 Iraq)	5	1	5	1		
3779		10000992	Foot-and-mouth disease virus - type SAT 1 (Strain Bot 1/68)	1		1			
3780		10000993	Foot-and-mouth disease virus - type SAT 2 (Strain Ken 3/57)	1		1			
3781		10000994	Foot-and-mouth disease virus - type SAT 3 (Strain Bec 1/65)	1		1			
3782		10000995	Foot-and-mouth disease virus - type Asia 1 Pakistan	1		1			
3783		10001000	Foot-and-mouth disease virus - type SAT 2 (strain Rho 1/48)	4		4			
3784		10001002	Swine vesicular disease virus SPA/1/93	16		16			
3785		10001003	Neisseria meningitidis serogroup B CU385	2		2			
3786		10001004	Human T-cell lymphotrophic virus type 1 (Caribbean isolate) (Strain HS35)	1		1			

3787		10001006	Proteus mirabilis CFT322	1		1			
3788		10001008	Chlamydia trachomatis Serovar J	6		6			
3789		10001019	Mus musculus B10.D2		1		1		
3790		10001020	Peste-des-petits-ruminants virus (strain Nigeria 75/1)		1		1		
3791		10001021	Treponema pallidum subsp. pallidum (strain Chicago)	19		19			
3792		10001025	Classical swine fever virus Glentorf		26		26		
3793		10001027	Vaccinia virus Connaught	1		1			
3794		10001028	Human poliovirus 2 (strain MEF-1)	1		1			
3795		10001032	Newcastle disease virus (strain La Sota)	17		17			
3796		10001039	Foot-and-mouth disease virus C3 (strain Resendne-Br/55)	1		1			
3797		10001040	Human poliovirus 2 (strain Sabin)	2	7	2	7		
3798		10001042	Haemophilus influenzae NTHi 1479	12	4	12	4		
3799		10001044	Neisseria meningitidis serogroup C MC51	1		1			
3800		10001047	West Nile virus strain 2741	32		32			
3801		10001049	Neisseria meningitidis serogroup B Strain S3446	1		1			
3802		10001050	Neisseria meningitidis serogroup B Strain 7967	1		1			
3803		10001051	Neisseria meningitidis serogroup A Strain 8659	1		1			
3804		10001053	Haemophilus influenzae MinnA	9		9			
3805		10001055	Haemophilus influenzae 6U	2		2			
3806		10001056	Haemophilus influenzae ATCC 9795	2		2			
3807		10001057	Pseudomonas aeruginosa CD4	1		1			
3808		10001058	Pseudomonas aeruginosa K122-4	1		1			
3809		10001077	Neisseria gonorrhoeae SU89	1		1			
3810		10001078	Neisseria gonorrhoeae SU96	3		3			
3811		10001081	Porphyromonas gingivalis HG66	2		2			
3812		10001085	Chlamydia trachomatis Serovar D	3		3			
3813		10001091	Borrelia burgdorferi BEP4	1		1			
3814		10001097	Sus scrofa Yorkshire	1		1			
3815		10001100	Plum pox virus (strain W)	6		6			
3816		10001102	Foot-and-mouth disease virus (strain O1) O/UKG/11/2001	1	1	1	2		1
3817		10001116	Norovirus genogroup 1 isolates 96-908	4		4			
3818		10001118	Foot-and-mouth disease virus - type O (strain HKN/14/82)	2		2			
3819		10001120	Cryptococcus neoformans var. neoformans Serotype D	1		1			
3820		10001121	Chlamydia trachomatis Serovar Da	1		1			
3821		10001130	Feline leukemia virus subtype A	2		2			
3822		10001132	Cryptococcus neoformans var. neoformans Serotype A	1		1			
3823		10001133	Rattus norvegicus DA		3		3		
3824		10001138	Newcastle disease virus (strain Eaves)	1		1			
3825		10001140	Newcastle disease virus (strain WA2116)	1		1			
3826		10001141	Chlamydia trachomatis Serovar A	22	8	22	8		

3827		10001145	Escherichia coli 1471	2		2			
3828		10001149	Haemophilus influenzae Subtype 1H	23		23			
3829		10001150	Haemophilus influenzae Strain Eagan	58		58			
3830		10001154	Transmissible gastroenteritis virus MAD88	8	1	8	1		
3831		10001155	Haemophilus influenzae strain 1479	2		2			
3832		10001156	Hepatitis B virus subtype AD	3	2	3	2		
3833		10001157	H3N2 subtype Influenza A virus (A/Hong Kong(H3N2))		15		15		
3834		10001161	Neisseria meningitidis serogroup B Strain 2996	1		1			
3835		10001162	Neisseria meningitidis serogroup B Strain M1239	4		4			
3836		10001207	Murine leukemia virus LP-BM5		1		1		
3837		10001209	Tobacco mosaic virus (strain PM5)	1		1			
3838		10001210	Tobacco mosaic virus (strain Ni568)	1		1			
3839		10001213	Human coxsackievirus B3 (strain RK)	1		1			
3840		10001215	Human rotavirus G9 WI61	1		1			
3841		10001216	Rotavirus G3 strain RV-3	1		1			
3842		10001223	Porphyromonas gingivalis OMZ 409	23		23			
3843		10001225	H1N1 subtype Influenza A/Oklahoma/7485/01		5		5		
3844		10001238	Puumala virus (strain Umea/hu)	1		1			
3845		10001239	Porcine circovirus strain ISU31	7		7			
3846		10001243	Theileria parva strain Marikebuni		1		1		
3847		10001307	Small ruminant lentivirus strain It-561	1		1			
3848		10001308	Small ruminant lentivirus strain It-Pi1	1		1			
3849		10001315	H1N1 swine influenza virus (A/swine/Korea/S10/2004(H1N1))		3		3		
3850		10001316	H1N1 swine influenza virus (A/swine/Korea/S175/2004(H1N1))		1		1		
3851		10001317	H9N2 subtype Influenza A virus (A/swine/Korea/S81/2004(H9N2))		1		1		
3852		10001318	H9N2 subtype Influenza A virus (A/swine/Korea/S83/2004(H9N2))		2		2		
3853		10001335	Japanese encephalitis virus Vellore P20778	1	1	1	1		
3854		10001392	Human adenovirus B strain Harbin04B	5		5			
3855		10001396	Murine cytomegalovirus (strain Smith) MW97.01		5		5		
3856		10001412	Rattus norvegicus Wistar-Furth		11		11		
3857		10001424	Brucella abortus W99	1		1			
3858		10001431	Infectious bronchitis virus CK/CH/LDL/97I	1		1			
3859		10001439	Streptococcus sanguinis strain BD113-20		6		6		
3860		10001456	Human respiratory syncytial virus A strain RGH	1		1			
3861		10001459	Babesia bovis Argentina R1A	4		4			
3862		10001484	Norovirus genogroup 1 GI.12	1		1			
3863		10001485	Norovirus genogroup 3 GIII.1	1		1			
3864		10001489	Proteus vulgaris Strain 5/43	1		1			
3865		10001490	Proteus mirabilis O24	1		1			
3866		10001491	Proteus mirabilis O29	1		1			

3867		10001492	Salmonella enterica subsp. enterica serovar Enteritidis SH1262	3		3			
3869		10001498	Proteus mirabilis O23	1		1			
3870		10001499	Proteus mirabilis O6	1		1			
3871		10001500	Proteus mirabilis O43	1		1			
3872		10001501	Proteus penneri ATCC 33519	1		1			
3873		10001502	Escherichia coli J-5	1		1			
3874		10001503	Acinetobacter lwoffii F78	1		1			
3875		10001504	Yokenella regensburgei PCM 2476	1		1			
3876		10001505	Yokenella regensburgei PCM 2477	1		1			
3877		10001511	Salmonella 'group A'	2		2			
3878		10001514	Providencia stuartii O33	1		1			
3879		10001519	Pseudomonas aeruginosa serotype O11	1		1			
3880		10001520	Haemophilus influenzae strain RM7004	1		1			
3881		10001523	Haemophilus influenzae strain I-69 Rd-/b+	4		4			
3882		10001524	Neisseria meningitidis strain 3006	1		1			
3883		10001526	Salmonella thompson C1 strain IS40	1		1			
3884		10001528	Escherichia coli F515	1		1			
3885		10001530	Acinetobacter haemolyticus strain 57	1		1			
3886		10001531	Acinetobacter haemolyticus strain 61	1		1			
3887		10001556	Moraxella catarrhalis 26404	1		1			
3888		10001558	Neisseria gonorrhoeae 15253	1		1			
3889		10001560	Neisseria meningitidis M982B	5		5			
3890		10001569	Salmonella enterica subsp. enterica serovar Gallinarum/pullorum str. 11	1		1			
3891		10001570	Salmonella enterica subsp. enterica serovar Gallinarum/pullorum str. 77	1		1			
3892		10001573	Anatid herpesvirus 1 Clone-03	1		1			
3893		10001578	Classical swine fever virus LPC/AHRI	4		4			
3894		10001581	Proteus penneri 8 (O67)	1		1			
3895		10001582	Dengue virus 1 Mochizuki	4		4			
3896		10001583	Dengue virus 2 New Guinea C	1	38	1	38		
3897		10001586	Porcine reproductive and respiratory syndrome virus 07V063	3		3			
3898		10001587	Porcine reproductive and respiratory syndrome virus 08V204	2		2			
3899		10001588	Providencia stuartii O4	1		1			
3901		10001606	Norovirus genogroup 2 Hu/NoV/Farmington Hills/2002/USA	1	2	1	2		
3902		10001614	Junin virus strain MC2		1		1		
3903		10001615	Machupo virus strain Carvallo		1		1		
3904		10001616	Guanarito virus strain INH-95551		1		1		
3905		10001617	Whitewater Arroyo virus strain AV9310135		1		1		
3906		10001618	Pichinde virus strain Munchique		1		1		
3907		10001619	Dengue virus 3 strain 16652	16		16			
3908		10001624	Feline infectious peritonitis virus (strain KU-2)	22	43	22	43		
3909		10001627	Human herpesvirus 5 (strain RV798)		6		6		

3910		10001628	Aggregatibacter actinomycetemcomitans serotype b str. Y4	1		1			
3911		10001633	Escherichia coli 055:B5	3		3			
3912		10001635	Dengue virus 2 PL046		7		7		
3913		10001636	Dengue virus 2 S221		42		42		
3914		10001638	Streptococcus pneumoniae type 27	2		2			
3915		10001641	Streptococcus dysgalactiae subsp. equisimilis D181	1		1			
3916		10001642	Foot-and-mouth disease virus - type O Wuppertal/FRG/82		1		1		
3917		10001644	Streptococcus pneumoniae CCUG 1378	1		1			
3918		10001645	Streptococcus pneumoniae CSR-SCS-2	1		1			
3919		10001646	Streptococcus pneumoniae type 37	2		2			
3920		10001648	Japanese encephalitis virus strain SA-14 -14-2	2		2			
3921		10001649	West Nile virus strain 956	1		1			
3922		10001651	Streptococcus pneumoniae type 14	19		25		6	
3923		10001652	Candida albicans NIH B-792 (serotype B)	1		1			
3924		10001659	Escherichia coli O125	1		1			
3925		10001662	Staphylococcus aureus Cowan 1	2		2			
3926		10001663	Streptococcus anginosus K214-2K	4		4			
3927		10001667	Helicobacter pylori 487	1		1			
3928		10001676	Streptococcus dysgalactiae subsp. equisimilis ATCC 12388	2		2			
3929		10001686	Streptococcus pneumoniae type 6A	2		2			
3930		10001687	Streptococcus pneumoniae type 6B	5		5			
3931		10001688	Pseudomonas syringae pv. atrofaciens str. IMV 7836	1		1			
3932		10001689	Pseudomonas syringae pv. atrofaciens str. IMV K-1025	1		1			
3933		10001690	Pseudomonas syringae pv. atrofaciens str. IMV 4394	1		1			
3934		10001693	Pseudomonas syringae pv. tagetis str. ICMP 6370	1		1			
3935		10001697	Pseudomonas syringae pv. phaseolicola str. IMV 120a	1		1			
3936		10001698	Pseudomonas syringae pv. morsprunorum str. GSPB 883	1		1			
3937		10001700	Pseudomonas syringae pv. morsprunorum str. CFBP 1650	1		1			
3938		10001705	Dengue virus 2 strain 43	2		2			
3939		10001713	Neisseria meningitidis serogroup W-135	1		1			
3940		10001722	Salmonella 'group D'	3		3			
3941		10001730	Streptococcus pneumoniae type 6C	1		1			
3942		10001731	Streptococcus pneumoniae type 2	8		8			
3944		10001740	Candida glabrata IFO 0622	1		1			
3945		10001747	Candida parapsilosis M1015	1		1			
3946		10001761	BK polyomavirus strain Dunlop		1		1		
3947		10001762	JC polyomavirus strain MAD1		1		1		
3948		10001763	Simian virus 40 strain 776		1		1		
3949		10001764	Classical swine fever virus Margarita (AJ704817)	4	1	4	1		

3950		10001768	Dengue virus 2 S-16803	1		1			
3951		10001771	Porcine reproductive and respiratory syndrome virus HuN4-F112	4	1	4	1		
3952		10001783	Neisseria meningitidis serogroup C strain C11	1	1	1	1		
3953		10001792	Streptococcus pneumoniae type 3	6		6			
3954		10001794	Helicobacter pylori B128 Gerbil-adapted variant 7.13	1		1			
3956		10001797	Neisseria meningitidis serogroup C strain MC19	1		1			
3957		10001798	Porcine transmissible gastroenteritis coronavirus strain Pur46-MAD	4		4			
3958		10001800	Porcine reproductive and respiratory syndrome virus HuN4	4	4	4	4		
3959		10001801	Streptococcus pneumoniae type 8	10		10			
3960		10001831	Moraxella catarrhalis serotype B	1		1			
3961	X	10001833	Streptococcus pneumoniae type 19F			1		1	
3962		10001835	Proteus penneri 7 (O61)	2		2			
3963		10001836	Proteus penneri 14 (O59)	2		2			
3964		10001837	Proteus penneri 15 (O52)	2		2			
3965		10001847	Clostridium difficile BI / NAP1/ 027	1		1			
3966		10001849	Moraxella catarrhalis serotype A	3		3			
3967		10001851	Moraxella catarrhalis serotype C	1		1			
3968		10001860	Neisseria meningitidis serogroup X	3		3			
3969		10001879	West Nile virus strain 68856	2		2			
3970		10001881	Porcine circovirus 2 -A	3		5		2	
3972		10001886	Brucella ovis 020	2		2			
3973		10001887	Brucella ovis Reo 198	1		1			
3974		10001888	Brucella ovis 63/290	1		1			
3976		10001895	Yersinia pseudotuberculosis str. 32777		1		1		
3977		10001900	Streptococcus agalactiae serogroup III M781	1	1	1	1		
3978		10001902	Human enterovirus 71 NUH0083/SIN/08	4		4			
3979		10001913	Lactobacillus johnsonii JCM 1022	3		3			
3980		10001918	Muscovy duck reovirus S12	4		4			
3981		10001929	Equine rhinitis B virus 2 strain 313/75	5		5			
3982		10001930	Equine rhinitis B virus 3 isolate 2225AS	5		5			
3983		10001934	Chikungunya virus Singapore/11/2008	3		8		5	
3984		10001943	Dengue virus 4 Burma/63632/1976	3		3			
3985		10001944	Dengue virus 3 Thailand/PaH881/1988	2		2			
3986		10001945	Dengue virus 1 PVP159	2		2			
3987		10001946	Foot-and-mouth disease virus - type Asia 1 YS/CHA/05	4		4			
3988		10001964	Porcine circovirus 1 strain 1/G	7		7			
3989		10001965	Avian leukosis virus strain NX0101	1		1			
3990		10001967	Avian leukosis virus isolate CAUHM01	1		1			
3991		10001973	Vaccinia virus Acambis 2000	8		8			
3992		10001975	Streptococcus salivarius JCM 5707	1		1			
3993		10001997	Chikungunya virus strain LR2006_OPY1 IMT/Reunion Island/2006	1		1			

3994		10001999	Reticuloendotheliosis virus strain HLJ07I	1		1			
3995		10002000	Porcine epidemic diarrhea virus CH/SHH/06	1		1			
3996		10002003	Campylobacter jejuni subsp. jejuni serotype HS:15	1		1			
3997		10002006	Bluetongue virus 16 BN96/16	2		2			
3998		10002007	Plasmodium falciparum isolate UAS22	4		4			
3999		10002008	Plasmodium falciparum isolate UAS31	1		1			
4000		10002009	Plasmodium falciparum isolate UAS29	2		2			
4001		10002010	Dengue virus 2 D2/SG/05K4155DK1/2005		49		49		
4002		10002011	Plasmodium falciparum R29/IT4	1		1			
4003		10002015	Human coxsackievirus A16 shzh05-1	92		92			
4004		10002018	Bovine coronavirus Kakegawa	1		1			
4005		10002020	Foot-and-mouth disease virus - type Asia 1 Nepal 29/97	4		4			
4006		10002022	Escherichia coli O6 O6:K15:H31		1		1		
4007		10002026	Murine norovirus 1 Mu/NoV/GV/MNV1/2002/USA		1		1		
4008		10002027	Bluetongue virus 16 Kumamoto/1985	2		2			
4009		10002028	Bluetongue virus 16 Beatrice Hill/1987	2		2			
4010		10002034	Fish	4		4			
4011		10002052	Toxoplasma gondii Gansu Jingtai	27		27			
4012		10002056	Enterovirus A71 TW/2086/98	1		1			
4013		10002069	Bordetella pertussis 509		7		7		
4014		10002079	Clostridium difficile VPI 10463	2		2			
4015		10002082	Rhesus rotavirus MMU 18006		3		3		
4016		10002089	Porcine reproductive and respiratory syndrome virus SY0608	17		17			
4017		10002090	Influenza A virus (A/swine/Denmark/101310-1/2011(H1N1))		7		7		
4018		10002111	Dengue virus 4 TVP-376	1		1			
4019		10002112	Dengue virus 4 1036	1		1			
4020		10002121	Staphylococcus aureus Reynolds	2		2			
4021		10002122	Staphylococcus aureus Becker	2		2			
4022		10002123	Peste-des-petits-ruminants virus China/Tibet/Geg/07-30	53		53			
4023		10002127	Escherichia coli O86:B7	1		1			
4024		10002129	Staphylococcus aureus RN4850	1		1			
4025		10002132	Duck hepatitis A virus 1 HP-1	2		2			
4026	X	10002144	Chikungunya virus CHIKV/SL/2006 SL15649				26		26
4027		10002148	Dengue virus 4 Mexico/BC287/1997	1		1			
4028		10002151	Duck hepatitis A virus 1 LY0801	1		1			
4029		10002152	Duck hepatitis A virus 3 SD1201	1		1			
4030		10002161	Streptococcus pneumoniae type 1	5		5			
4031		10002165	Avian infectious bronchitis virus (strain CHINA/Sczy3/09)	2		2			
4032		10002169	Avian infectious bronchitis virus (strain Holte)		2		2		

4034		10002183	ZIKV/H. sapiens/French Polynesia/PF13/2013	4		4			
4035		10002188	ZIKV/H. sapiens/PRI/PRVABC59/2015		5		12		7
4036		10002190	ZIKV/H. sapiens/Uganda/MR-766/1947	4		5	1	1	1
4037		10002192	Streptococcus suis 1178027	2		2			
4039		10002196	Hepatitis E virus type 4 JAK-Sai	1		1			
4040		10002197	Chikungunya virus MY/08/065	15		15			
4042		10002238	Influenza A virus (A/swan/Poland/305-135V08/2006(H5N1))	1		1			
4044		10002272	Streptococcus pneumoniae 7F	5		5			
4045		10002273	Influenza A virus (A/Hong Kong/4801/2014(H3N2))		1		1		
4046		10002285	Yellow fever virus CNYF01/2016	1		1			
4047		10002287	Salmonella enterica subsp. enterica serovar Typhi str. Quailes		1		1		
4048		10002289	Enterobacteria phage PRD1	2		2			
4050	X	10002308	West Nile virus goshawk/Austria/2008				61		61
4051	X	10002309	Andes orthohantavirus CHI-9717869			11		11	
4052	X	10002310	Canine Distemper Virus strain PS			2		2	
4053	X	10002313	Porcine epidemic diarrhea virus strain HeB/TS/2016/325b			1		1	
4054	X	10002314	Streptococcus pneumoniae type 10A			1		1	
4056	X	10002317	ZIKV/H. sapiens/Brazil/BEH823339/2015			1		1	
4058	X	10002329	Severe acute respiratory syndrome coronavirus 2 USA-WA1/2020				27		27
4059		10002337	Anogeissus	1		1			
4060	X	10002345	Influenza B virus (B/Phuket/3073/2013)			2		2	

2 Website Features

In 2020, the IEDB continued the agile, continuous deployment methodology, whereby weekly, iterative updates were deployed to the IEDB external website (3.10). Changes of note include:

- Added ‘Include Related Structures’ search option to the homepage, which allows searching of epitope-related objects.
- Added ‘Deleted Assay’ information for retracted references to the Assay and Reference Detail pages.
- Added new multi-file MHC Ligand CSV export to Database Export page since the original file format is too large to load in Excel.
- Removed all adoptive transfer fields from the external site, except for adoptive transfer comments.
- Added auto syncing of new diseases into disease table during external build.
- Removed ImmunomeBrowser icon from Advanced Searches.
- Added additional build information to all external databases for better version tracking of releases.
- Revised homepage to include coronavirus banner and links to download analysis document.
- Revised receptor export to display MHC allele data.
- Added new alternate identifiers information to ‘Reference Details’ page.

In addition to feature updates and improvements, many outstanding bugs and defects were also addressed throughout the contract year.

In addition, there were two major releases (Releases 2.23 and 2.24) of the Analysis Resource since the 2019 Annual Compendium plus numerous smaller updates made throughout the year. Changes of note include:

- All Python 2 code was ported to Python 3, including standalone packages (Python 3.6 or higher is required).
- The 'IEDB recommended' method for MHC Class I binding predictions has changed to NetMHCpan EL 4.0 based on the benchmark results. 'IEDB recommended 2.22' is still available, and the link can be found in older page versions.
- The tool "DeepSeqPa" was added to MHC Class I Automated Server Benchmarks.
- Warning/error messages were clarified for MHC Class I, MHC-NP, SCEptRe, and the Cluster tool
- NetMHCpan 4.1 (EL and BA) incorporated into MHC Class I binding web, API, and standalone tools
- NetMHCIIpan 4.0 (EL and BA) incorporated into MHC Class II binding web, API, and standalone tools

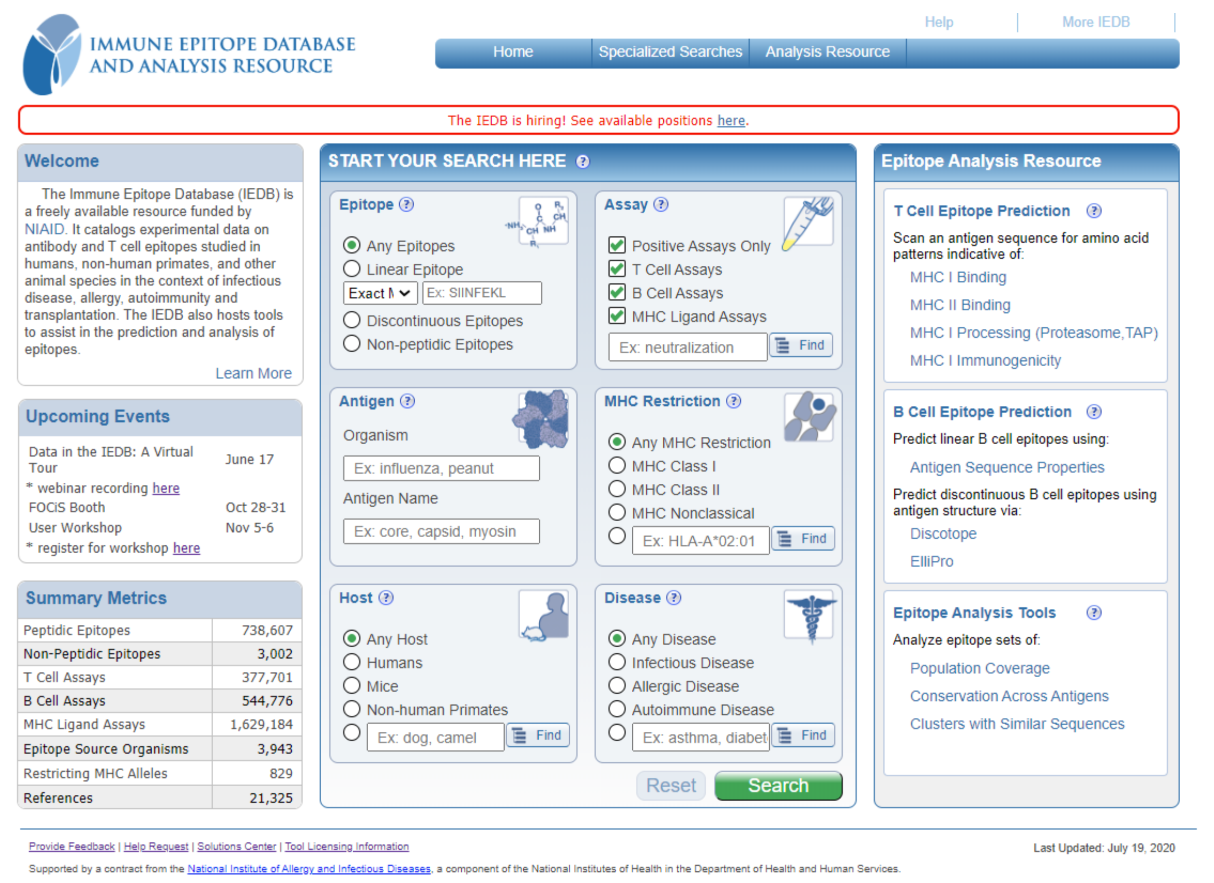
The IEDB website functionality can be divided into five categories– Home Page (Section 2.1), Specialized Searches (Section 2.2.2), Analysis Resource (Section 2.3), Help (Section 2.4), and More IEDB (Section 2.5), which largely correspond to the pull-down menus at the top of the home page. The subsections that follow describe the website features within these categories.

The reader will find it helpful to keep in mind how data are stored in the IEDB. Each item contained in the IEDB consists of a reference (article or submission) containing information about one or more epitopes and associated binding or response information. The same epitope can exist in multiple references.

2.1 Home Page

The IEDB Home Page (www.iedb.org) is the default screen displayed when users enter the IEDB system. Besides providing a general description of the IEDB project, the home page displays system level status and notification of scheduled updates or maintenance. As one can see in Figure 2.1, the page is divided into three columns that contain introductory information, Summary Metrics of the data, a basic data search capability, and links to the epitope prediction and analysis tools in the Analysis Resource. As users browse the IEDB system, they can return to the home page anytime by clicking *Home* on the far left of the main menu bar or by clicking on the IEDB logo in the upper left-hand corner of the page.

The top box in the left column contains a welcome statement that briefly describes the content of the database. It also has a "Learn More" link that brings the user to a web page containing more information about the support and user help features available, about the data itself, and about the IEDB program. This page is described in detail in Section 2.6. The Summary Metrics are displayed in the bottom box of this column. These numbers are intended to be a gauge of the volume of data available in the system. The Summary Metrics provide the number of epitopes (peptidic and non-peptidic), assays (T cell, B cell, and MHC ligand assays), epitope source organisms, restricting MHC alleles, and references. A middle box may appear (as shown in Figure 2.1) when there are special messages to convey to users. The text will appear in red. The middle column contains the initial search interface that is described in detail in Section 2.2.1. This section includes several finders on the search interface, thus enabling more complete queries without the need for further filtering of the results. The rightmost column has links to the most frequently used tools in the Analysis Resource.



The IEDB is hiring! See available positions here.

The Immune Epitope Database (IEDB) is a freely available resource funded by NIAID. It catalogs experimental data on antibody and T cell epitopes studied in humans, non-human primates, and other animal species in the context of infectious disease, allergy, autoimmunity and transplantation. The IEDB also hosts tools to assist in the prediction and analysis of epitopes.

Data in the IEDB: A Virtual Tour	June 17
* webinar recording here	
FOCiS Booth	Oct 28-31
User Workshop	Nov 5-6
* register for workshop here	

Peptidic Epitopes	738,607
Non-Peptidic Epitopes	3,002
T Cell Assays	377,701
B Cell Assays	544,776
MHC Ligand Assays	1,629,184
Epitope Source Organisms	3,943
Restricting MHC Alleles	829
References	21,325

Scan an antigen sequence for amino acid patterns indicative of:

Predict linear B cell epitopes using:

Predict discontinuous B cell epitopes using antigen structure via:

Analyze epitope sets of:

Last Updated: July 19, 2020

Supported by a contract from the National Institute of Allergy and Infectious Diseases, a component of the National Institutes of Health in the Department of Health and Human Services.

Figure 2.1 IEDB 3.10 Home page

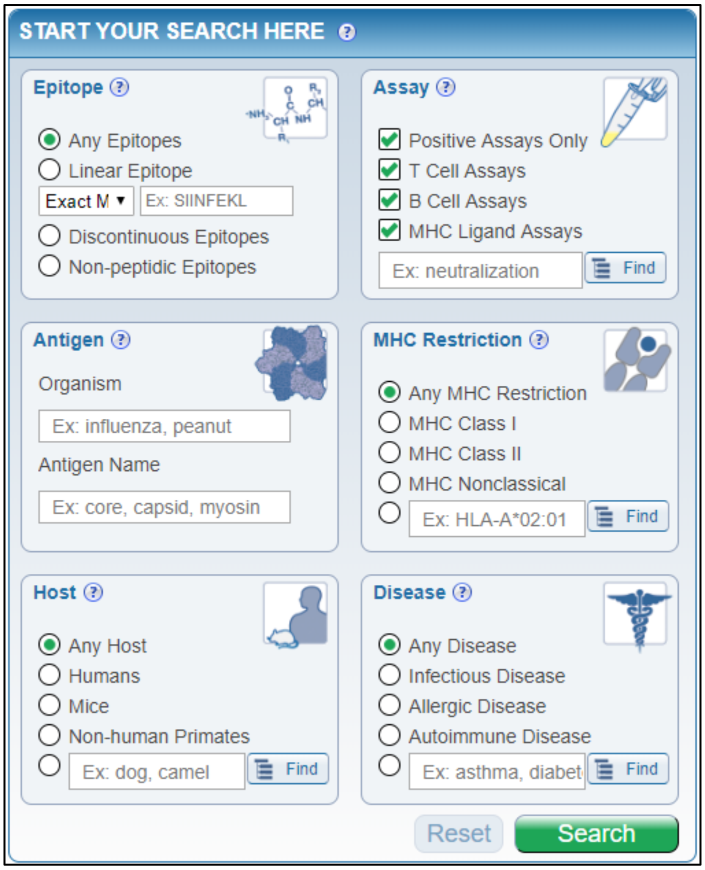
2.2 Query

There are several ways users can find information in the IEDB. A simplified search that is especially designed for the needs of most immunologists appears on the home page. This document will refer to this particular query as the Simple Search or Home Page Search. A family of advanced query-by-example searches can be accessed on the Search pull-down menu and consist of “Epitope Details”, “T Cell Assay Details”, “B Cell Assay Details”, “MHC Assay Details”, “Identifier Search”, and “Browse by 3D Structure”. This group of queries are referred to as Specialized Searches. All of these methods return results in a common format, as described in Section 2.2.3. These methods are elaborated in the subsections below.

2.2.1 Perform a Home Page Search

The home page search feature available in the center of the home page (Figure 2.2) is designed to simplify the search process for many commonly asked queries by immunologists. It is the most frequently used query mode. The approach it takes is analogous to many travel and shopping websites. IEDB users can start their search by specifying a number of fundamental and common search parameters on the home page. On the subsequent results page, users can then apply additional and more specific filters. The epitope structure choices include linear epitopes, discontinuous epitopes, and non-peptidic epitopes. For the linear epitope search, the user can prescribe the type of search desired - an exact match to the entered sequence, a substring search (described below), or a homologous peptide sequence at identity levels of 70%, 80%, or 90% as determined by BLAST. The IEDB categorizes all assays as T cell, B cell, or MHC ligand. The MHC ligand includes binding and elution assays. Users can also select the MHC restriction for non-B cell searches. Finally, users can select the host species and the disease.

The results of the query are displayed in five tabs – Epitopes, Antigens, Assays, Receptors, and References. The Epitopes tab lists the epitope description, such as the amino acid sequence for linear epitopes, its associated antigen and source organism, the number of references in which it appears, and the number of assays in which it is used. The Antigen tab lists the antigen, its source organism, and the number of related epitopes, assays, and references. The Assays tab contains three tabs, one each for T cell, B cell, and MHC ligand assays. The Receptors tab details the receptor types alongside the sequences of each chain component, and is divided into two separate tabs for T Cell Receptors (TCRs) and B Cell Receptors (BCRs). The References tab lists the IEDB-specific reference identifier, the authors, title, abstract, and year of publication or submission. A user can cross-query specific criteria from any of these five tabs; for example, filtering on a specific assay would refresh the results to display data across all tabs which is only relevant to that assay. Additionally, a user can click on the IEDB-specific identifier link to drill down to get additional information about the epitope, assay, receptor or reference.


START YOUR SEARCH HERE

Epitope
● Any Epitopes
○ Linear Epitope
Exact M ▾ Ex: SIINFEKL
○ Discontinuous Epitopes
○ Non-peptidic Epitopes

Assay
☑ Positive Assays Only
☑ T Cell Assays
☑ B Cell Assays
☑ MHC Ligand Assays
Ex: neutralization Find

Antigen
Organism
Ex: influenza, peanut
Antigen Name
Ex: core, capsid, myosin

MHC Restriction
● Any MHC Restriction
○ MHC Class I
○ MHC Class II
○ MHC Nonclassical
○ Ex: HLA-A*02:01 Find

Host
● Any Host
○ Humans
○ Mice
○ Non-human Primates
○ Ex: dog, camel Find

Disease
● Any Disease
○ Infectious Disease
○ Allergic Disease
○ Autoimmune Disease
○ Ex: asthma, diabet Find

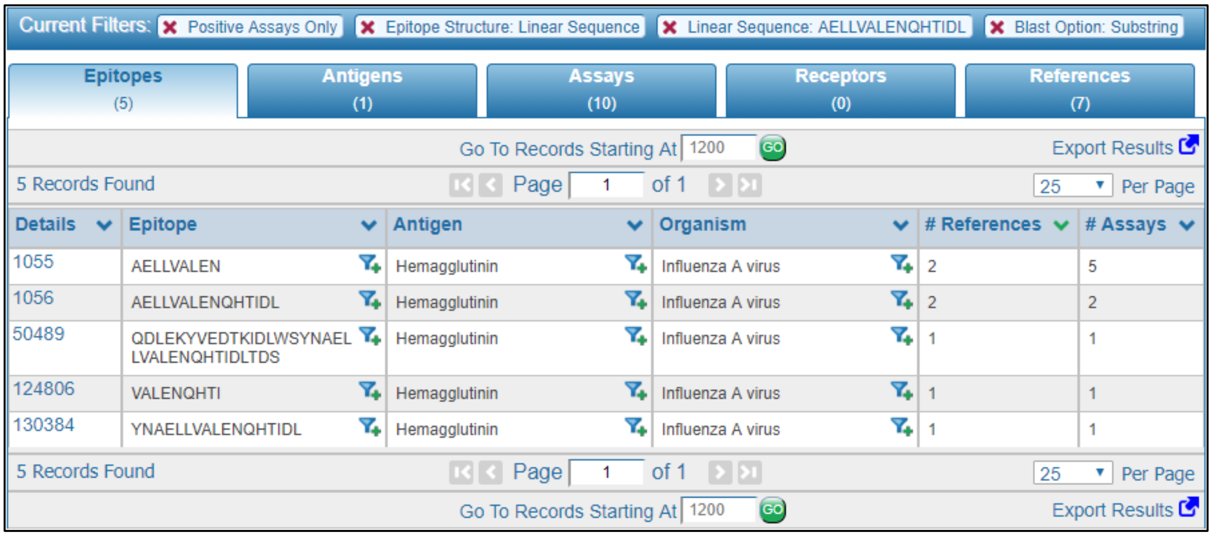
Figure 2.2 Home page simple search

Once the initial results are generated, the user can filter the results using additional filtering criteria. Auto-complete fields and associated hierarchical tree views reveal the available parameter choices. In this way, users can narrow their query to specific non-peptidic epitopes, assay types, MHC alleles, hosts, or diseases. Users can also specify article type (journal article and/or submission), the author, title, PubMed ID, and year. All filters that are applied are displayed at the top of the page. Results on most pages can be downloaded as comma separated value (CSV) files that can be read using a text editor or spreadsheet application. Users also have the ability to map positive and negative results to reference proteomes as a means of visualizing immunogenic regions using the Immunome Browser (Section 2.2.3.2).

An autocomplete feature is available for many of the fields on the left-hand side of the results page that contain additional filter criteria. This includes the non-peptidic epitope field in the Epitope box, the organism and antigen name fields in the Antigen box, the T cell, B cell, and MHC ligand assay fields in the Assay box, the specific MHC restriction field in the MHC Restriction box, the specific host field in the Host box, and the specific disease field in the Disease box. For example, as one types "hep" in the organism field in the Antigen box, several choices start to appear in a list below the text field, including "hepatitis C virus". The user can click on a selection from the list or can continue typing to further narrow down choices. Likewise, a user may type "human" or "homo" to select "homo sapiens" in the Organism field. The list of matches includes scientific names and synonyms. These actions enable users to quickly specify their search parameters without using the finders. Use of the autocomplete circumvents the need to directly use the finders.

If the user decides not to use the autocomplete feature for a search field, they will need to use the finders. The epitope source can be prescribed for the source organism and source antigen by using the organism finder (Section 2.2.4.5) and molecule finder (Section 2.2.4.4), respectively. The user can decide whether to include B cell responses, T cell responses, and/or MHC ligand results in the search (at least one must be checked). The host organism, the MHC restriction, and the MHC class can also be specified with the help of the organism finder and the allele finder (Section 2.2.4.1). The fields using finders will allow multiple selections as search criteria. In these cases, the selections are treated as a set. Records will be considered a match if they include at least one of the selected values in the set. The search is executed by clicking the Search button and the query results can be viewed on the updated results page described in Section 2.2.3.

In addition to finding peptides in the database that contain the specified amino acid sequence, the substring search also finds epitopes within the input sequence itself. For example, when the sequence AELLVALENQHTIDL is submitted for a substring search, the query results, shown in Figure 2.3, yields five peptide sequences. Three of them (the second, third, and fifth) contain the input sequence. The two others (the first and fourth) are substrings of the input sequence that are also epitopes contained in the IEDB.



Current Filters: ✖ Positive Assays Only ✖ Epitope Structure: Linear Sequence ✖ Linear Sequence: AELLVALENQHTIDL ✖ Blast Option: Substring

Epitopes (5) | Antigens (1) | Assays (10) | Receptors (0) | References (7)

Go To Records Starting At 1200 GO — Export Results

5 Records Found — Page 1 of 1 — 25 Per Page

Details	Epitope	Antigen	Organism	# References	# Assays
1055	AELLVALEN	Hemagglutinin	Influenza A virus	2	5
1056	AELLVALENQHTIDL	Hemagglutinin	Influenza A virus	2	2
50489	QDLEKYVEDTKIDLWSYNAELLVALENQHTIDLTDS	Hemagglutinin	Influenza A virus	1	1
124806	VALENQHTI	Hemagglutinin	Influenza A virus	1	1
130384	YNAELLVALENQHTIDL	Hemagglutinin	Influenza A virus	1	1

5 Records Found — Page 1 of 1 — 25 Per Page

Go To Records Starting At 1200 GO — Export Results

Figure 2.3 Query results for a substring search performed on the input sequence AELLVALENQHTIDL

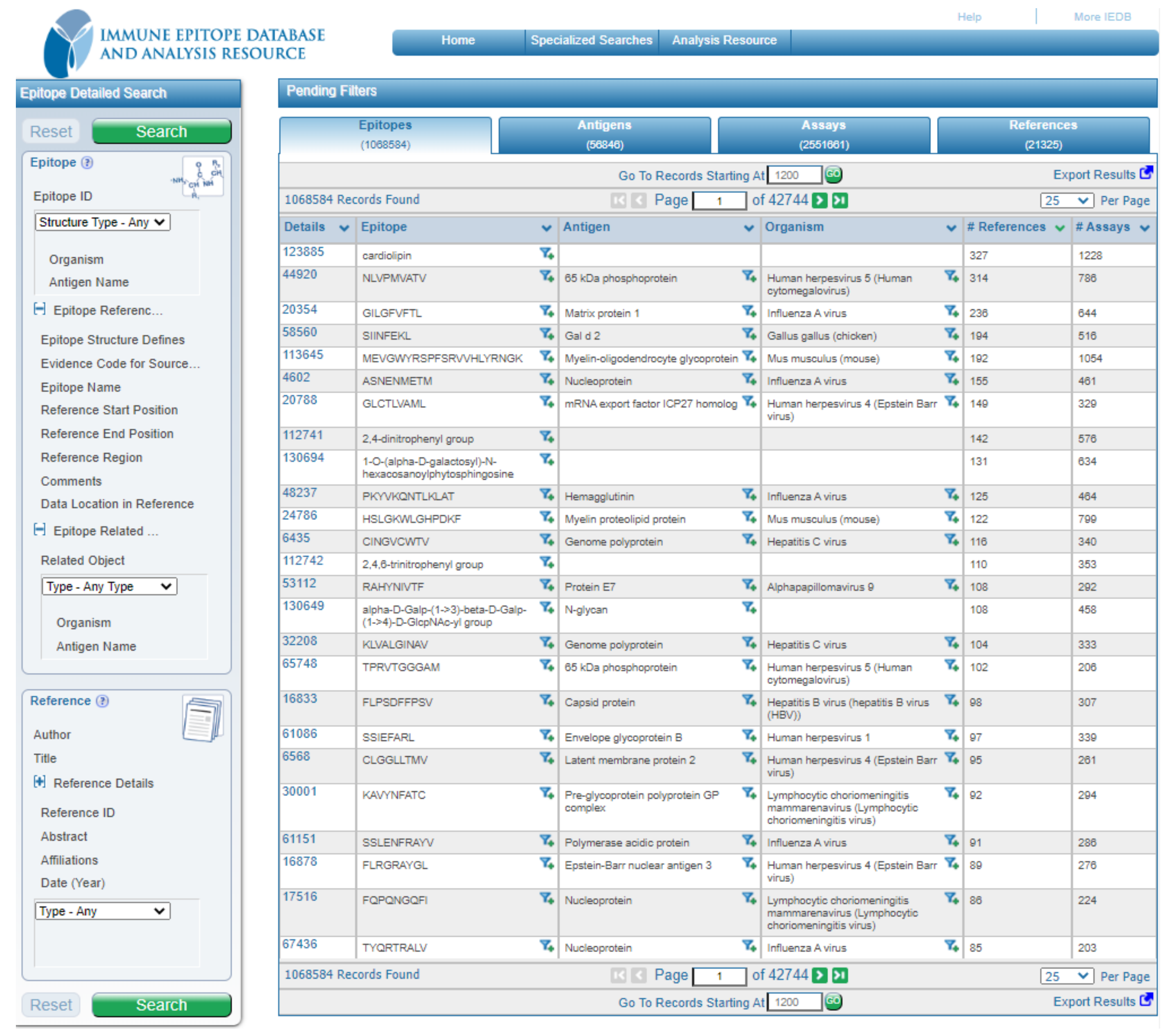
2.2.2 Specialized Searches

The Specialized queries are based on a standard Query by Example (QBE) approach, which is a method of forming queries where a user can enter conditions for each data field they want included in the query. The Specialized queries allow users to define example criteria for each field in the system. As there are over 300 fields, the Specialized Search queries are both powerful and comprehensive.

The fully expanded input screen for the Epitope Details Search is shown in Figure 2.4. The user can specify criteria in the left-hand panels for Epitope and Reference. These sections expand to the right to expose more detailed criteria for the search, including autocomplete fields and finders. An example of the expanded Epitope box is found in Figure 2.5. Users can specify search criteria for the epitope, such as epitope type (e.g. peptide from protein, carbohydrate), source molecule and organism, and various reference details. Further explanation of the search terms can be found in the Curation Manual. Using the bottom Reference section, the user can search on several reference criteria, such as author name, article title, the IEDB Reference ID, keywords in the reference abstract, year, author affiliation, and reference type. References are either published literature articles that have been curated by the IEDB curation staff or data submitted directly by researchers.

Auto-complete functionality is available for all the finder fields, as exemplified by the Simple Search and denoted by the greyed text that provide example inputs. The "?" provides a brief explanation and a "Learn More" link that connects to the appropriate help page in the IEDB Solutions Center. Finders are described in further detail in Section 2.2.4.

Figure 2.5 shows the fields when "Structure Type - Any" is selected in the Epitope filter. The fields for the other epitope type selections are shown in Figure 2.6 (linear epitopes), Figure 2.7 (Discontinuous epitopes), Figure 2.8 (Discontinuous peptides on Multichain), and Figure 2.9 (Non-peptidic epitopes).

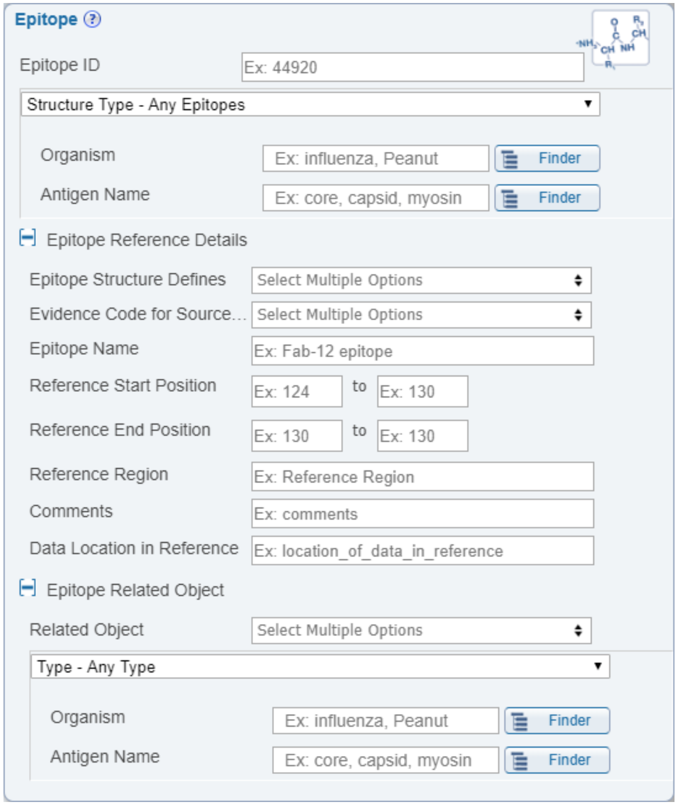


1068584 Records Found

Details	Epitope	Antigen	Organism	# References	# Assays
123885	cardiolipin			327	1228
44920	NLVPMVATV	65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	314	786
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	236	644
58560	SIINFEKL	Gal d 2	Gallus gallus (chicken)	194	516
113645	MEVGWYRSPFSRVVHLYRNGK	Myelin-oligodendrocyte glycoprotein	Mus musculus (mouse)	192	1054
4602	ASNENMETM	Nucleoprotein	Influenza A virus	155	461
20788	GLCTLVAML	mRNA export factor ICP27 homolog	Human herpesvirus 4 (Epstein Barr virus)	149	329
112741	2,4-dinitrophenyl group			142	576
130694	1-O-(alpha-D-galactosyl)-N-hexacosanoylphytosphingosine			131	634
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	125	464
24786	HSLGKWLGHPDKF	Myelin proteolipid protein	Mus musculus (mouse)	122	799
6435	CINGVCWTV	Genome polyprotein	Hepatitis C virus	116	340
112742	2,4,6-trinitrophenyl group			110	353
53112	RAHYNIVTF	Protein E7	Alphapapillomavirus 9	108	292
130649	alpha-D-Galp-(1->3)-beta-D-Galp-(1->4)-D-GlcpNAc-yl group	N-glycan		108	458
32208	KLVALGINAV	Genome polyprotein	Hepatitis C virus	104	333
65748	TPRVTGGGAM	65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	102	206
16833	FLPSDFFPSV	Capsid protein	Hepatitis B virus (hepatitis B virus (HBV))	98	307
61086	SSIEFARL	Envelope glycoprotein B	Human herpesvirus 1	97	339
6568	CLGGLLTMV	Latent membrane protein 2	Human herpesvirus 4 (Epstein Barr virus)	95	261
30001	KAVYNFATC	Pre-glycoprotein polyprotein GP complex	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	92	294
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	91	286
16878	FLRGRAYGL	Epstein-Barr nuclear antigen 3	Human herpesvirus 4 (Epstein Barr virus)	89	276
17516	FQPQNGQFI	Nucleoprotein	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	86	224
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	85	203

1068584 Records Found

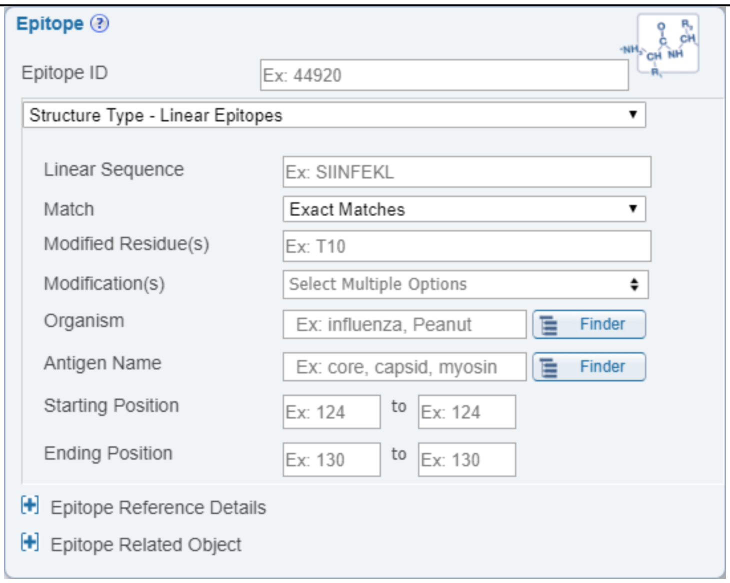
Figure 2.4 Epitope Specialized Search input screen



Structure Type - Any Epitopes

Type - Any Type

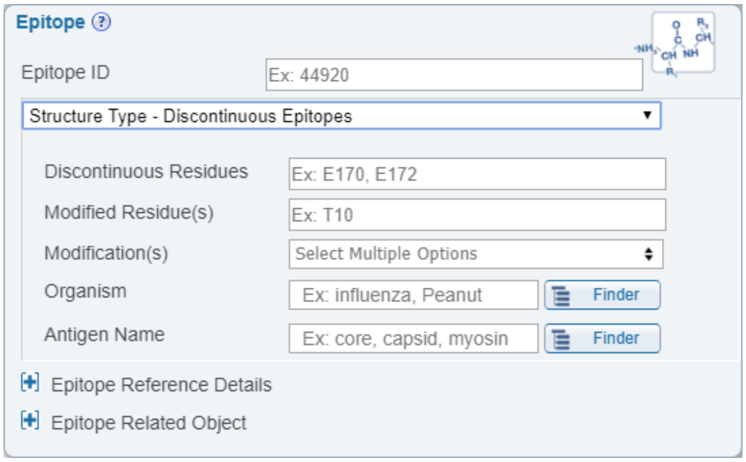
Figure 2.5 Epitope panel on the Specialized Search page expanded to show input fields



Structure Type - Linear Epitopes

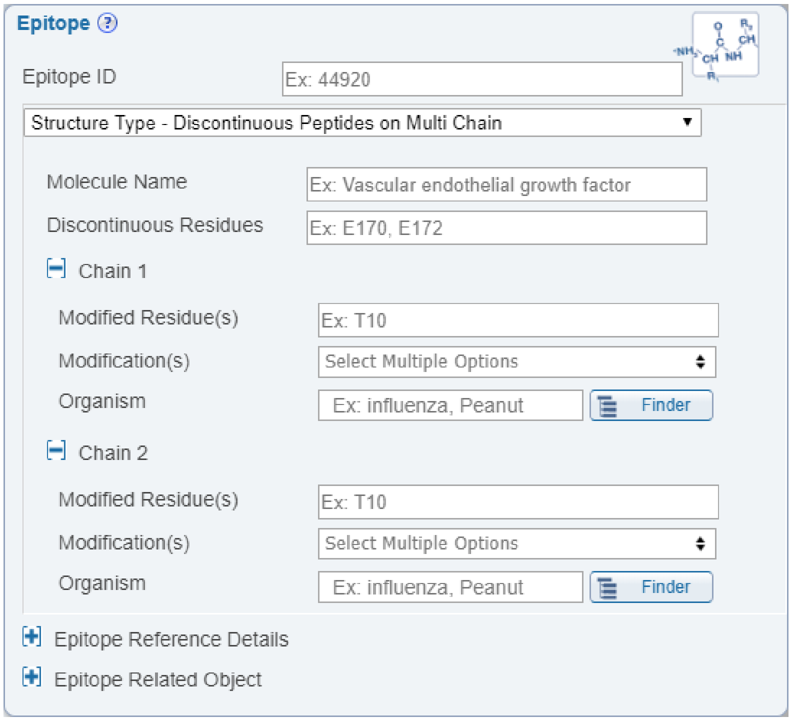
Match: Exact Matches

Figure 2.6 Epitope query fields in the Advanced Search for Linear peptide epitopes



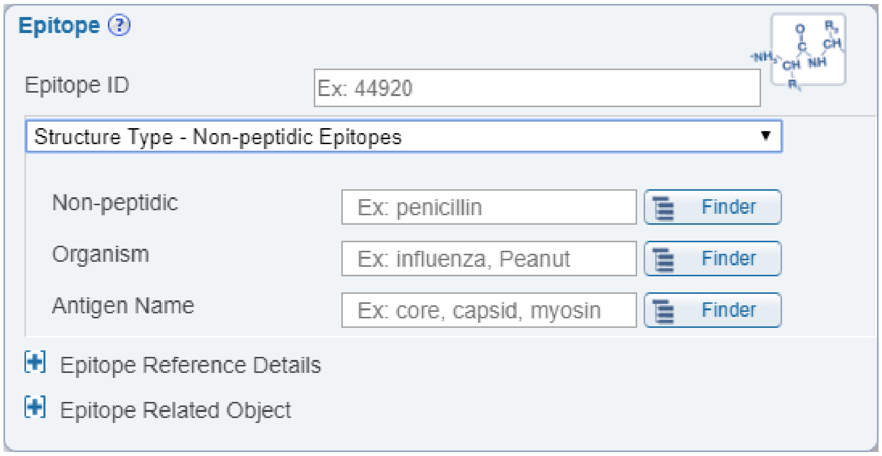
Structure Type - Discontinuous Epitopes

Figure 2.7 Epitope query fields in the Advanced Search for Discontinuous peptide epitopes



Structure Type - Discontinuous Peptides on Multi Chain

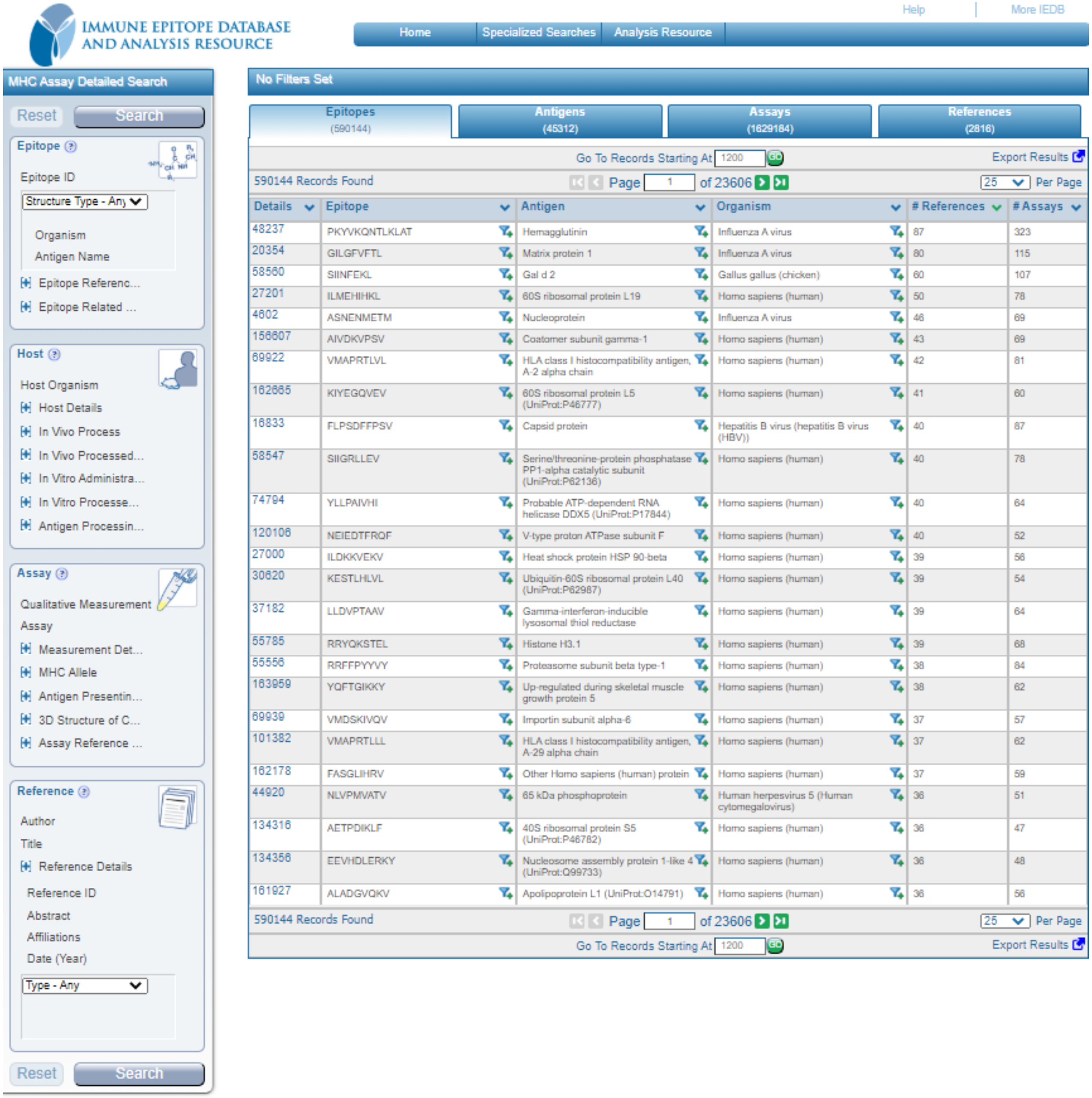
Figure 2.8 Epitope query fields in the Advanced Search for Discontinuous peptide on multi-chain epitopes



Structure Type - Non-peptidic Epitopes

Figure 2.9 Epitope query fields in the Advanced Search for Non-peptidic epitopes

There are five other Specialized Search queries that can be used to select search criteria for references, epitopes, and assays. These are T Cell Assay Details, B Cell Assay Details, MHC Assay Details, Identifier Search, and Browse by 3D Structure. As an example, the MHC Assay Detailed Search page is shown in Figure 2.10. As is the case for all three assay search pages, the Epitope and Reference criteria fields are listed first and last, respectively, with the other relevant filter criteria specific for each assay type listed between them.



590144 Records Found

Details	Epitope	Antigen	Organism	# References	# Assays
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	87	323
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	80	115
58560	SIINFEKL	Gal d 2	Gallus gallus (chicken)	60	107
27201	ILMEHIHKL	60S ribosomal protein L19	Homo sapiens (human)	50	78
4602	ASNENMETM	Nucleoprotein	Influenza A virus	46	69
156607	AIVDKVPSV	Coatomer subunit gamma-1	Homo sapiens (human)	43	69
69922	VMAPRTLVL	HLA class I histocompatibility antigen, A-2 alpha chain	Homo sapiens (human)	42	81
162665	KIYEGQVEV	60S ribosomal protein L5 (UniProt:P46777)	Homo sapiens (human)	41	60
16833	FLPSDFFPSV	Capsid protein	Hepatitis B virus (hepatitis B virus (HBV))	40	87
58547	SIIGRLLEV	Serine/threonine-protein phosphatase PP1-alpha catalytic subunit (UniProt:P62136)	Homo sapiens (human)	40	78
74794	YLLPAIVHI	Probable ATP-dependent RNA helicase DDX5 (UniProt:P17844)	Homo sapiens (human)	40	64
120106	NEIEDTFRQF	V-type proton ATPase subunit F	Homo sapiens (human)	40	52
27000	ILDKKVEKV	Heat shock protein HSP 90-beta	Homo sapiens (human)	39	56
30620	KESTLHLVL	Ubiquitin-60S ribosomal protein L40 (UniProt:P62987)	Homo sapiens (human)	39	54
37182	LLDVPTAAV	Gamma-interferon-inducible lysosomal thiol reductase	Homo sapiens (human)	39	64
55785	RRYQKSTEL	Histone H3.1	Homo sapiens (human)	39	68
55556	RRFFPYYVY	Proteasome subunit beta type-1	Homo sapiens (human)	38	84
163959	YQFTGIKKY	Up-regulated during skeletal muscle growth protein 5	Homo sapiens (human)	38	62
69939	VMDSKIVQV	Importin subunit alpha-6	Homo sapiens (human)	37	57
101382	VMAPRTLLL	HLA class I histocompatibility antigen, A-29 alpha chain	Homo sapiens (human)	37	62
162178	FASGLIHRV	Other Homo sapiens (human) protein	Homo sapiens (human)	37	59
44920	NLVPMVATV	65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	36	51
134316	AETPDIKLF	40S ribosomal protein S5 (UniProt:P46782)	Homo sapiens (human)	36	47
134356	EEVHDLERKY	Nucleosome assembly protein 1-like 4 (UniProt:Q99733)	Homo sapiens (human)	36	48
161927	ALADGVQKV	Apolipoprotein L1 (UniProt:O14791)	Homo sapiens (human)	36	56

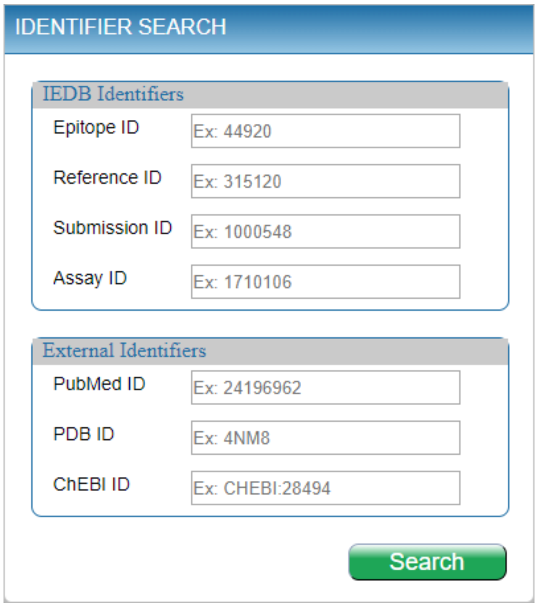
590144 Records Found

Figure 2.10 MHC Assay Detailed Search web page

The B cell response assay category captures B cell-mediated immunity information and describes antibody responses related to the epitope/antigen. In a B cell response, B lymphocytes (a type of white blood cell) produce proteins called antibodies that bind to antigens. Antibodies are present on the surface on B lymphocytes and are also secreted. Once an antibody binds an antigen, the bound antigen molecule can be engulfed by phagocytes and broken into fragments.

The T Cell Response assay category captures T cell-mediated immunity information where the MHC molecule/antigen complex is recognized by T cells in the context of presentation by an antigen presenting cell.

The MHC Ligand assay category combines assays that were previously in the MHC Binding and MHC Ligand Elution assay categories. As such, the MHC Ligand category captures details relating to the in vitro interaction of the epitope with specific MHC molecules along with available Epitope-MHC complex structure details, that is the epitope's binding capacity to the MHC molecule. It also captures data related to epitopes that are naturally processed and presented on the surface of an antigen presenting cell. The MHC Ligand Elution subcategory differs from the MHC Binding subcategory in that for the former, antigen bound to the MHC molecule on the cell surface has been taken up and processed internally for presentation by the antigen presenting cell, whilst for the latter, antigen in solution is bound to MHC molecules on the surface of the antigen presenting cells.


IDENTIFIER SEARCH

IEDB Identifiers

Epitope ID	Ex: 44920
Reference ID	Ex: 315120
Submission ID	Ex: 1000548
Assay ID	Ex: 1710106

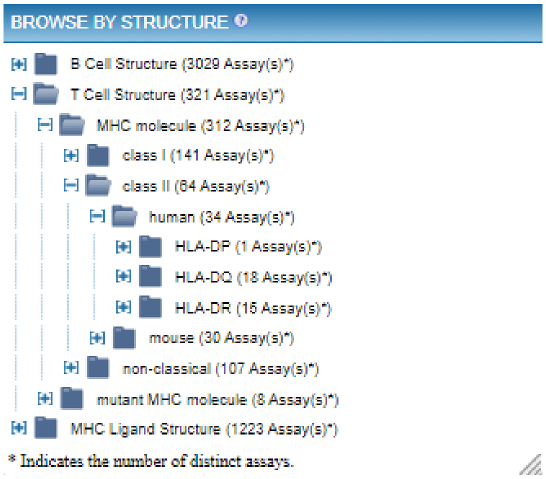
External Identifiers

PubMed ID	Ex: 24196962
PDB ID	Ex: 4NM8
ChEBI ID	Ex: CHEBI:28494

Figure 2.11 Identifier Search input screen

The Identifier Search input screen is shown in Figure 2.11. If users know the epitope, reference, submission, or assay identifier they are seeking, they can enter that information into one of the four IEDB Identifiers fields.

The Browse by 3D Structure selection screen in shown in Figure 2.12. Users can select 3D structure of interest to them based on available structures within the database.


BROWSE BY STRUCTURE

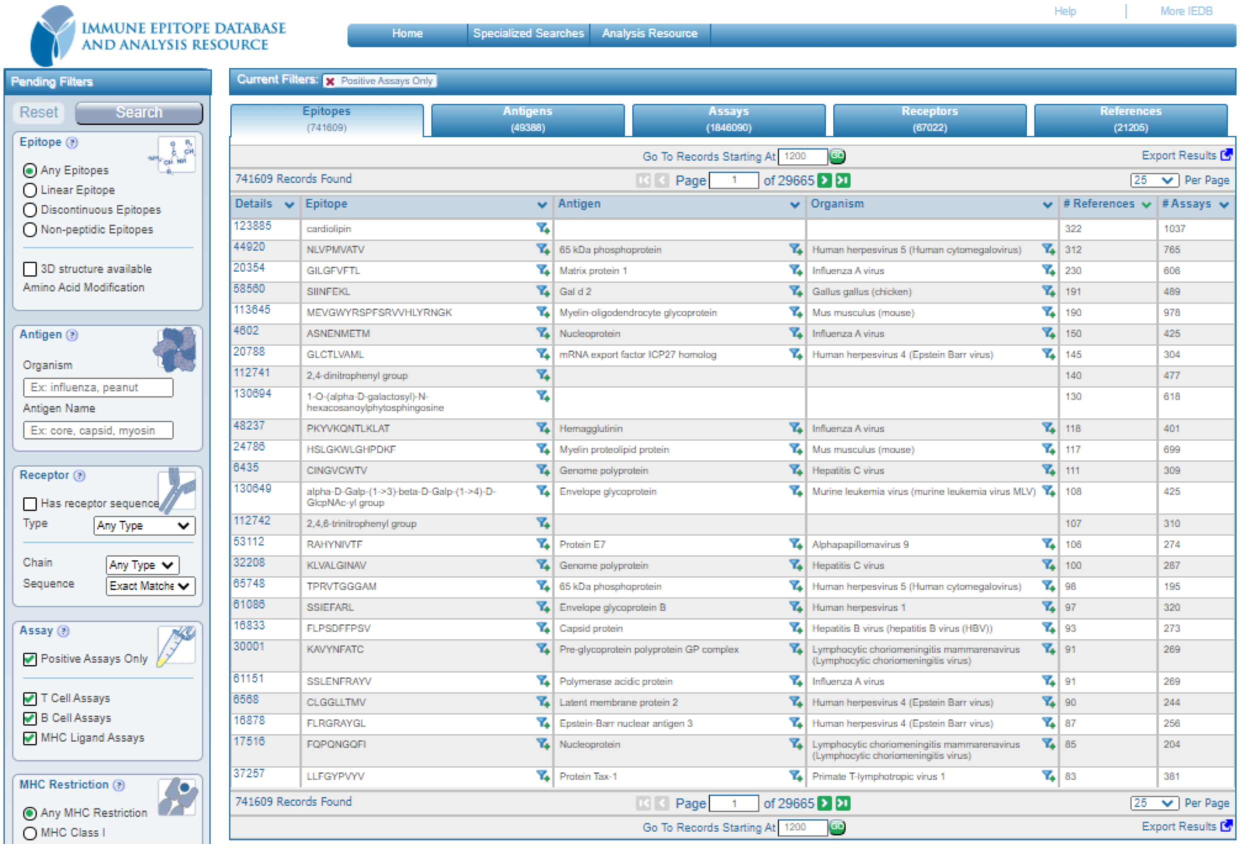
- ⊞ B Cell Structure (3029 Assay(s)*)
- ⊟ T Cell Structure (321 Assay(s)*)
  - ⊟ MHC molecule (312 Assay(s)*)
    - ⊞ class I (141 Assay(s)*)
    - ⊟ class II (64 Assay(s)*)
      - ⊟ human (34 Assay(s)*)
        - ⊞ HLA-DP (1 Assay(s)*)
        - ⊞ HLA-DQ (18 Assay(s)*)
        - ⊞ HLA-DR (15 Assay(s)*)
      - ⊞ mouse (30 Assay(s)*)
    - ⊞ non-classical (107 Assay(s)*)
  - ⊞ mutant MHC molecule (8 Assay(s)*)
- ⊞ MHC Ligand Structure (1223 Assay(s)*)

* Indicates the number of distinct assays.

Figure 2.12 Browse by 3D Structure search

2.2.3 Search Results Page

The results of a search or query appear on the Results page. An example is shown in Figure 2.12. The search criteria are listed in the Current Filters section above the results table. There are five tabs for the results. Figure 2.12 displays the Epitopes tab. Results are initially sorted by the number of assays, but the user can click on the column header to change the sort order. A second click will reverse the sort order of the selected column. The table includes the epitope structure description, the corresponding antigen, source organism, the number of references in which the epitope appears, and the number of assays (positive and negative) that reside in the database. Clicking on the Epitope ID number in the far-left column will take the user to a Distinct Epitope Detail page, as seen in Figure 2.13. The bottom section of the figure contains links to relevant tools in the Analysis Resource. Links can also appear to the Bioinformatics Resource Centers (BRC), such as the Influenza Research Database (IRD). The user can also refine the search results by clicking on the filter icon in the epitope, antigen, and organism fields.



Current Filters: Positive Assays Only

Epitope
● Any Epitopes
○ Linear Epitope
○ Discontinuous Epitopes
○ Non-peptidic Epitopes
☐ 3D structure available
Amino Acid Modification

Antigen
Organism: Ex: influenza, peanut
Antigen Name: Ex: core, capsid, myosin

Receptor
☐ Has receptor sequence
Type: Any Type
Chain: Any Type
Sequence: Exact Matches

Assay
☑ Positive Assays Only
☑ T Cell Assays
☑ B Cell Assays
☑ MHC Ligand Assays

MHC Restriction
● Any MHC Restriction
○ MHC Class I

Go To Records Starting At 1200

741609 Records Found Page 1 of 29665 25 Per Page

Details	Epitope	Antigen	Organism	# References	# Assays
123885	cardiolipin			322	1037
44920	NLVPMVATV	65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	312	765
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	230	606
58560	SIINFEKL	Gal d 2	Gallus gallus (chicken)	191	489
113645	MEVGWYRSPFSRVVHLYRNGK	Myelin-oligodendrocyte glycoprotein	Mus musculus (mouse)	190	978
4602	ASNENMETM	Nucleoprotein	Influenza A virus	150	425
20788	GLCTLVAML	mRNA export factor ICP27 homolog	Human herpesvirus 4 (Epstein Barr virus)	145	304
112741	2,4-dinitrophenyl group			140	477
130694	1-O-(alpha-D-galactosyl)-N-hexacosanoylphytosphingosine			130	618
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	118	401
24786	HSLGKWLGHPDKF	Myelin proteolipid protein	Mus musculus (mouse)	117	699
6435	CINGVCWTV	Genome polyprotein	Hepatitis C virus	111	309
130649	alpha-D-Galp-(1->3)-beta-D-Galp-(1->4)-D-GlcpNAc-yl group	Envelope glycoprotein	Murine leukemia virus (murine leukemia virus MLV)	108	425
112742	2,4,6-trinitrophenyl group			107	310
53112	RAHYNIVTF	Protein E7	Alphapapillomavirus 9	106	274
32208	KLVALGINAV	Genome polyprotein	Hepatitis C virus	100	287
65748	TPRVTGGGAM	65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	98	195
61086	SSIEFARL	Envelope glycoprotein B	Human herpesvirus 1	97	320
16833	FLPSDFFPSV	Capsid protein	Hepatitis B virus (hepatitis B virus (HBV))	93	273
30001	KAVYNFATC	Pre-glycoprotein polyprotein GP complex	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	91	269
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	91	269
6568	CLGGLLTMV	Latent membrane protein 2	Human herpesvirus 4 (Epstein Barr virus)	90	244
16878	FLRGRAYGL	Epstein-Barr nuclear antigen 3	Human herpesvirus 4 (Epstein Barr virus)	87	256
17516	FQPQNGQFI	Nucleoprotein	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	85	204
37257	LLFGYPVYV	Protein Tax-1	Primate T-lymphotropic virus 1	83	381

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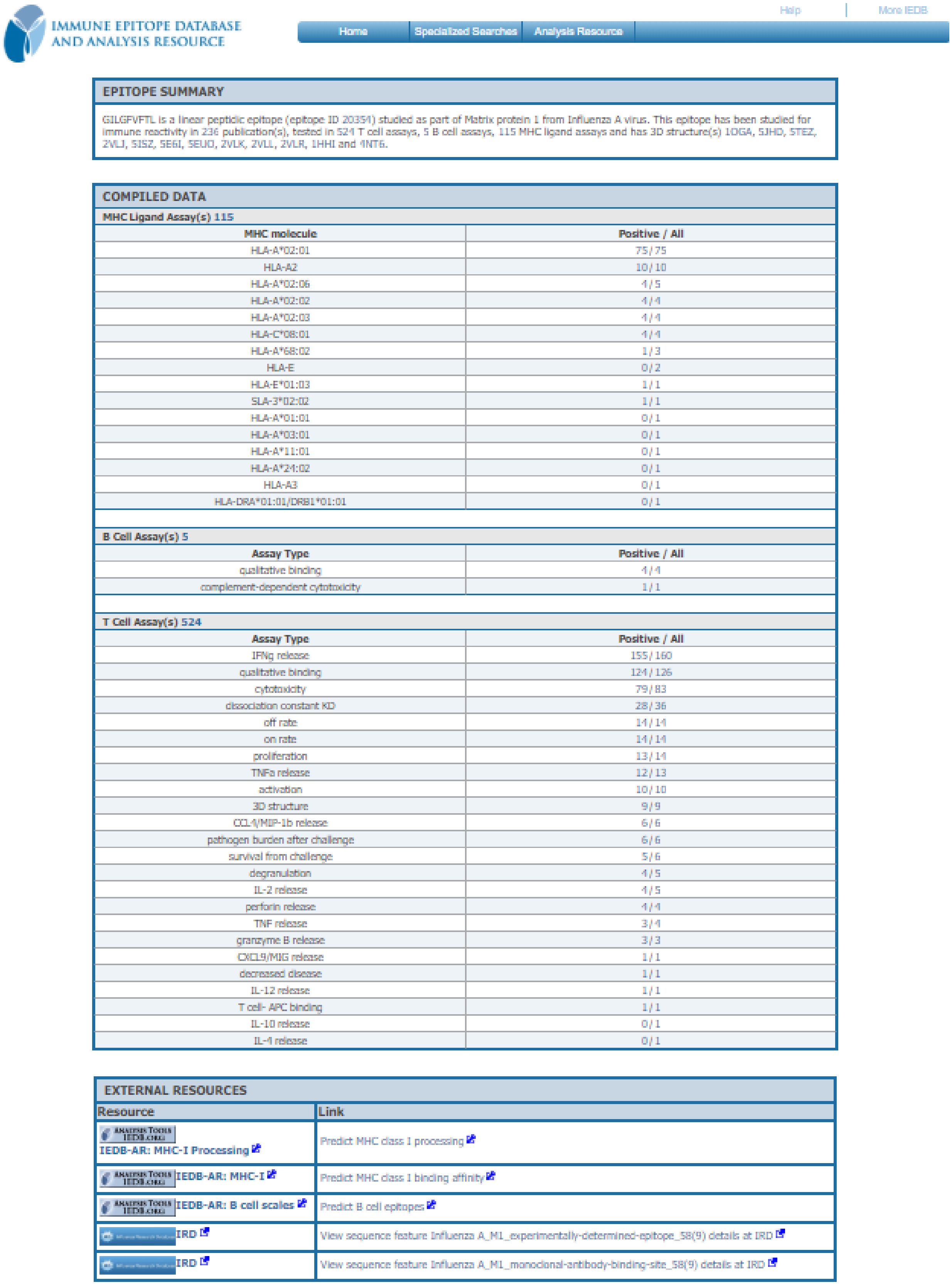
Go To Records Starting At 1200

Figure 2.13 The Epitope tab of the search results page



EPITOPE SUMMARY

GILGFVFTL is a linear peptidic epitope (epitope ID 20354) studied as part of Matrix protein 1 from Influenza A virus. This epitope has been studied for immune reactivity in 236 publication(s), tested in 524 T cell assays, 5 B cell assays, 115 MHC ligand assays and has 3D structure(s) 1OGA, 5JHD, 5TEZ, 2VLJ, 5ISZ, 5E6I, 5EUO, 2VLK, 2VLL, 2VLR, 1HHI and 4NT6.

COMPILED DATA

MHC Ligand Assay(s) 115

MHC molecule	Positive / All
HLA-A*02:01	75 / 75
HLA-A2	10 / 10
HLA-A*02:06	4 / 5
HLA-A*02:02	4 / 4
HLA-A*02:03	4 / 4
HLA-C*08:01	4 / 4
HLA-A*68:02	1 / 3
HLA-E	0 / 2
HLA-E*01:03	1 / 1
SLA-3*02:02	1 / 1
HLA-A*01:01	0 / 1
HLA-A*03:01	0 / 1
HLA-A*11:01	0 / 1
HLA-A*24:02	0 / 1
HLA-A3	0 / 1
HLA-DRA*01:01/DRB1*01:01	0 / 1

B Cell Assay(s) 5

Assay Type	Positive / All
qualitative binding	4 / 4
complement-dependent cytotoxicity	1 / 1

T Cell Assay(s) 524

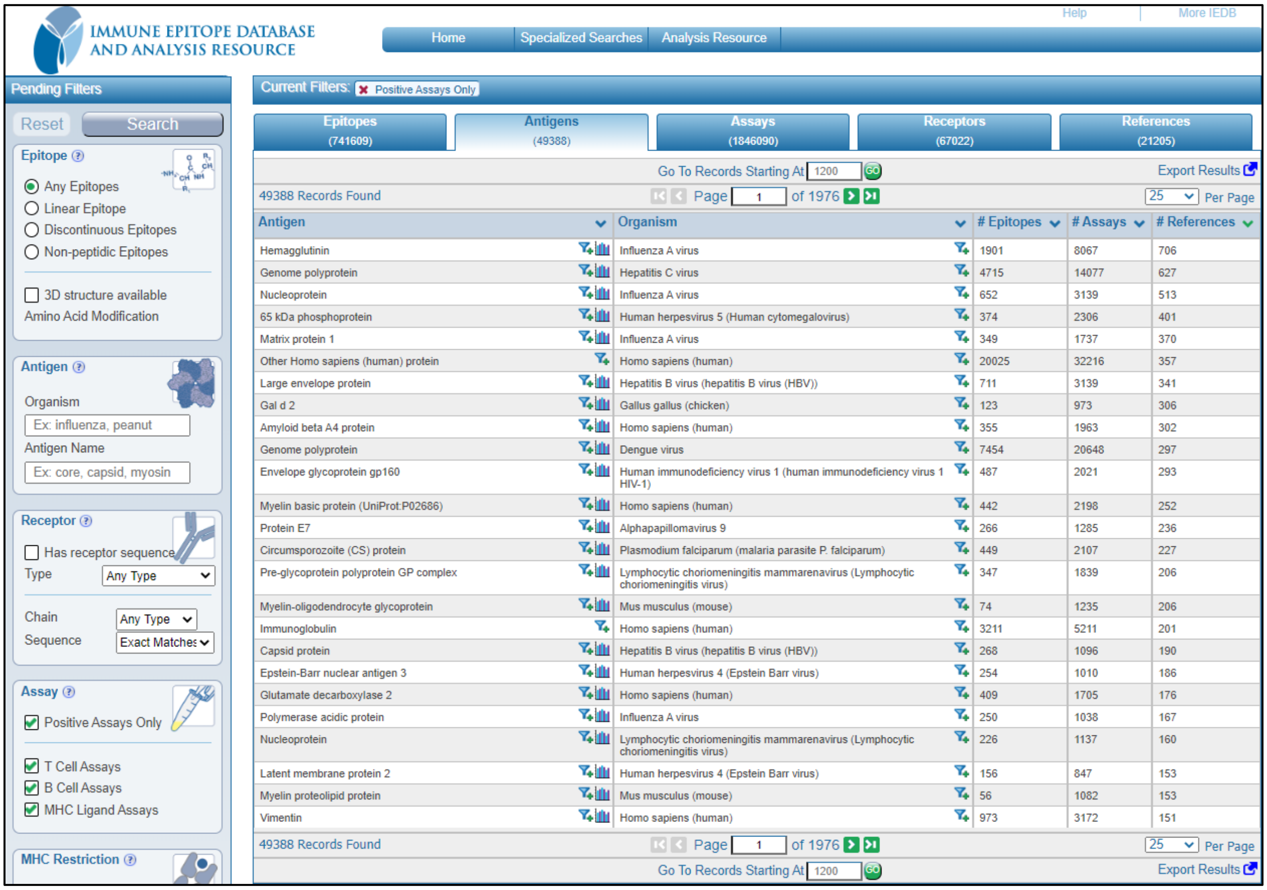
Assay Type	Positive / All
IFNg release	155 / 160
qualitative binding	124 / 126
cytotoxicity	79 / 83
dissociation constant KD	28 / 36
off rate	14 / 14
on rate	14 / 14
proliferation	13 / 14
TNFa release	12 / 13
activation	10 / 10
3D structure	9 / 9
CCL4/MIP-1b release	6 / 6
pathogen burden after challenge	6 / 6
survival from challenge	5 / 6
degranulation	4 / 5
IL-2 release	4 / 5
perforin release	4 / 4
TNF release	3 / 4
granzyme B release	3 / 3
CXCL9/MIG release	1 / 1
decreased disease	1 / 1
IL-12 release	1 / 1
T cell- APC binding	1 / 1
IL-10 release	0 / 1
IL-4 release	0 / 1

EXTERNAL RESOURCES

Resource	Link
IEDB-AR: MHC-I Processing	Predict MHC class I processing
IEDB-AR: MHC-I	Predict MHC class I binding affinity
IEDB-AR: B cell scales	Predict B cell epitopes
IRD	View sequence feature Influenza A_M1_experimentally-determined-epitope_58(9) details at IRD
IRD	View sequence feature Influenza A_M1_monoclonal-antibody-binding-site_58(9) details at IRD

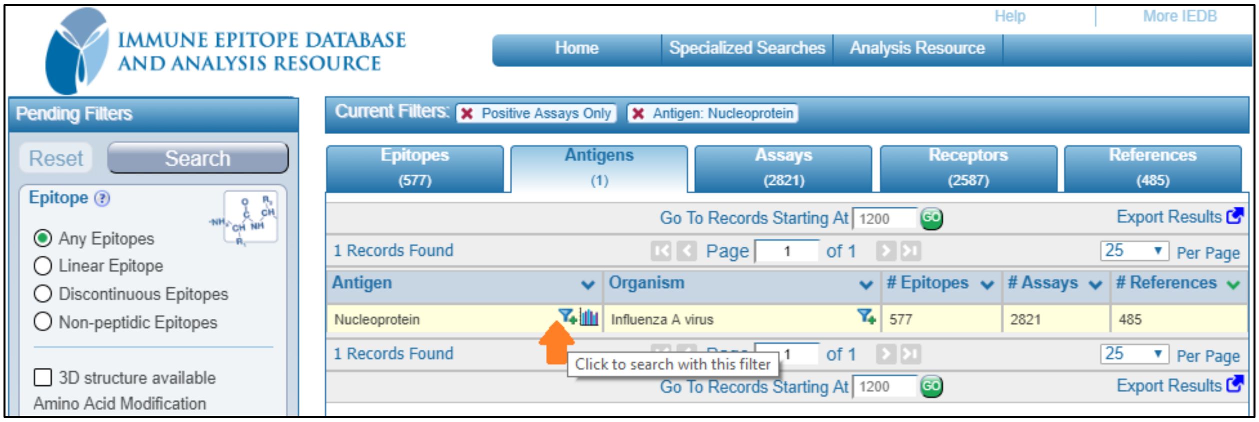
Figure 2.14 An example of the epitope detail page

The second tab on the results page is the Antigens tab (Figure 2.14). Results are initially sorted by the number of assays, but the user can click on the column header to change the sort order. The table includes the antigen name, the corresponding source organism, the number of associated antigen epitopes in the IEDB, and the number of assays (positive and negative) that reside in the database. The user can explore the data related to a particular antigen by clicking on the funnel icon in the righthand side of the Antigen column. The data in the other three tabs will change accordingly as seen in Figure 2.15.



Antigen	Organism	# Epitopes	# Assays	# References
Hemagglutinin	Influenza A virus	1901	8067	706
Genome polyprotein	Hepatitis C virus	4715	14077	627
Nucleoprotein	Influenza A virus	652	3139	513
65 kDa phosphoprotein	Human herpesvirus 5 (Human cytomegalovirus)	374	2306	401
Matrix protein 1	Influenza A virus	349	1737	370
Other Homo sapiens (human) protein	Homo sapiens (human)	20025	32216	357
Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	711	3139	341
Gal d 2	Gallus gallus (chicken)	123	973	306
Amyloid beta A4 protein	Homo sapiens (human)	355	1963	302
Genome polyprotein	Dengue virus	7454	20648	297
Envelope glycoprotein gp160	Human immunodeficiency virus 1 (human immunodeficiency virus 1 HIV-1)	487	2021	293
Myelin basic protein (UniProt:P02686)	Homo sapiens (human)	442	2198	252
Protein E7	Alphapapillomavirus 9	266	1285	236
Circumsporozoite (CS) protein	Plasmodium falciparum (malaria parasite P. falciparum)	449	2107	227
Pre-glycoprotein polyprotein GP complex	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	347	1839	206
Myelin-oligodendrocyte glycoprotein	Mus musculus (mouse)	74	1235	206
Immunoglobulin	Homo sapiens (human)	3211	5211	201
Capsid protein	Hepatitis B virus (hepatitis B virus (HBV))	268	1096	190
Epstein-Barr nuclear antigen 3	Human herpesvirus 4 (Epstein Barr virus)	254	1010	186
Glutamate decarboxylase 2	Homo sapiens (human)	409	1705	176
Polymerase acidic protein	Influenza A virus	250	1038	167
Nucleoprotein	Lymphocytic choriomeningitis mammarenavirus (Lymphocytic choriomeningitis virus)	226	1137	160
Latent membrane protein 2	Human herpesvirus 4 (Epstein Barr virus)	156	847	153
Myelin proteolipid protein	Mus musculus (mouse)	56	1082	153
Vimentin	Homo sapiens (human)	973	3172	151

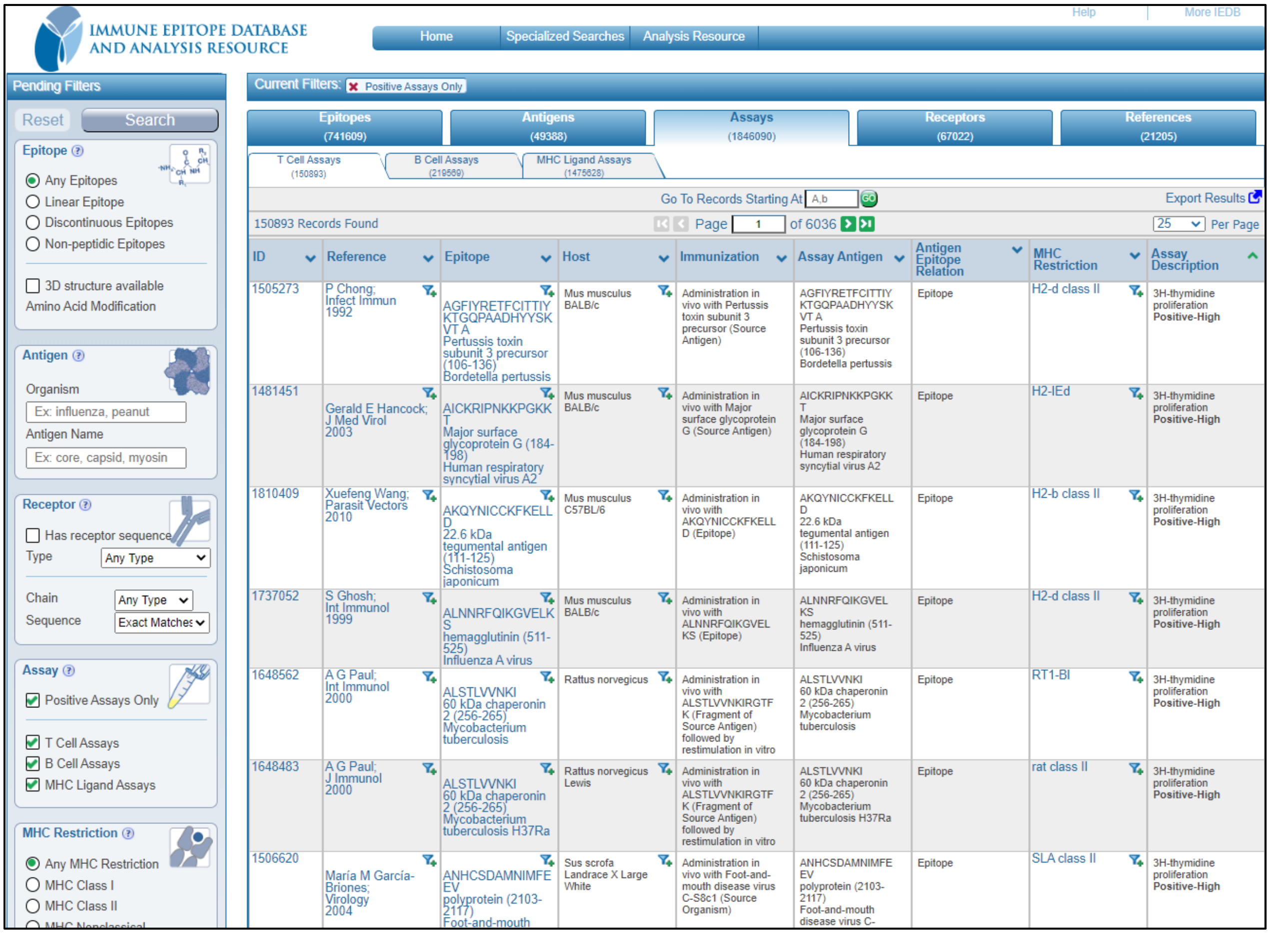
Figure 2.15 The Antigens tab of the search results page



Antigen	Organism	# Epitopes	# Assays	# References
Nucleoprotein	Influenza A virus	577	2821	485

Figure 2.16 The Results filtered by the Nucleoprotein of the Influenza A virus. This was achieved by clicking on the filter icon in the antigen column. The content of the other tabs contain data specific to this antigen.

The third tab on the results page is the Assays tab (Figure 2.16). Results are initially sorted by the Assay Description, but the user can click on the column header to change the sort order. The table contains three additional tabs, one each for the three assay categories – T cell, B cell, and MHC Ligand. The table for the T cell assays includes the assay ID, the reference, epitope, host organism, immunization, assay antigen, antigen epitope relation, MHC restriction, and assay description. The content of the B cell assay tab is the same except it omits the MHC restriction column. The MHC ligand assay tab contains fields for assay ID, reference, epitope, antigen processing, MHC restriction, assay description, and quantitative measure. Clicking on the Assay ID in the far-left lane will take the user to an Assay Detail page. An example is given in Figure 2.17. The actual page contains additional fields below what is shown in the figure, including sections for Epitope Reference Details, Immunization, Host Details, 1st In Vivo Process, Administration Details, 1st Immunogen, Immunogen Details, Immunization Comments, T Cell Assay, Effector Cells, Antigen Presenting Cells, MHC Allele, Antigen, Antigen Details, and Assay Reference Details. The user can also refine the results further by clicking on the filter icon that is available in several of the fields, such as reference, epitope, and host.



Current Filters: Positive Assays Only

● Any Epitopes
○ Linear Epitope
○ Discontinuous Epitopes
○ Non-peptidic Epitopes
☐ 3D structure available
Amino Acid Modification

Organism: Ex: influenza, peanut
Antigen Name: Ex: core, capsid, myosin

☐ Has receptor sequence
Type: Any Type
Chain: Any Type
Sequence: Exact Matches

☑ Positive Assays Only
☑ T Cell Assays
☑ B Cell Assays
☑ MHC Ligand Assays

● Any MHC Restriction
○ MHC Class I
○ MHC Class II
○ MHC Nonclassical

Go To Records Starting At: A,b

150893 Records Found

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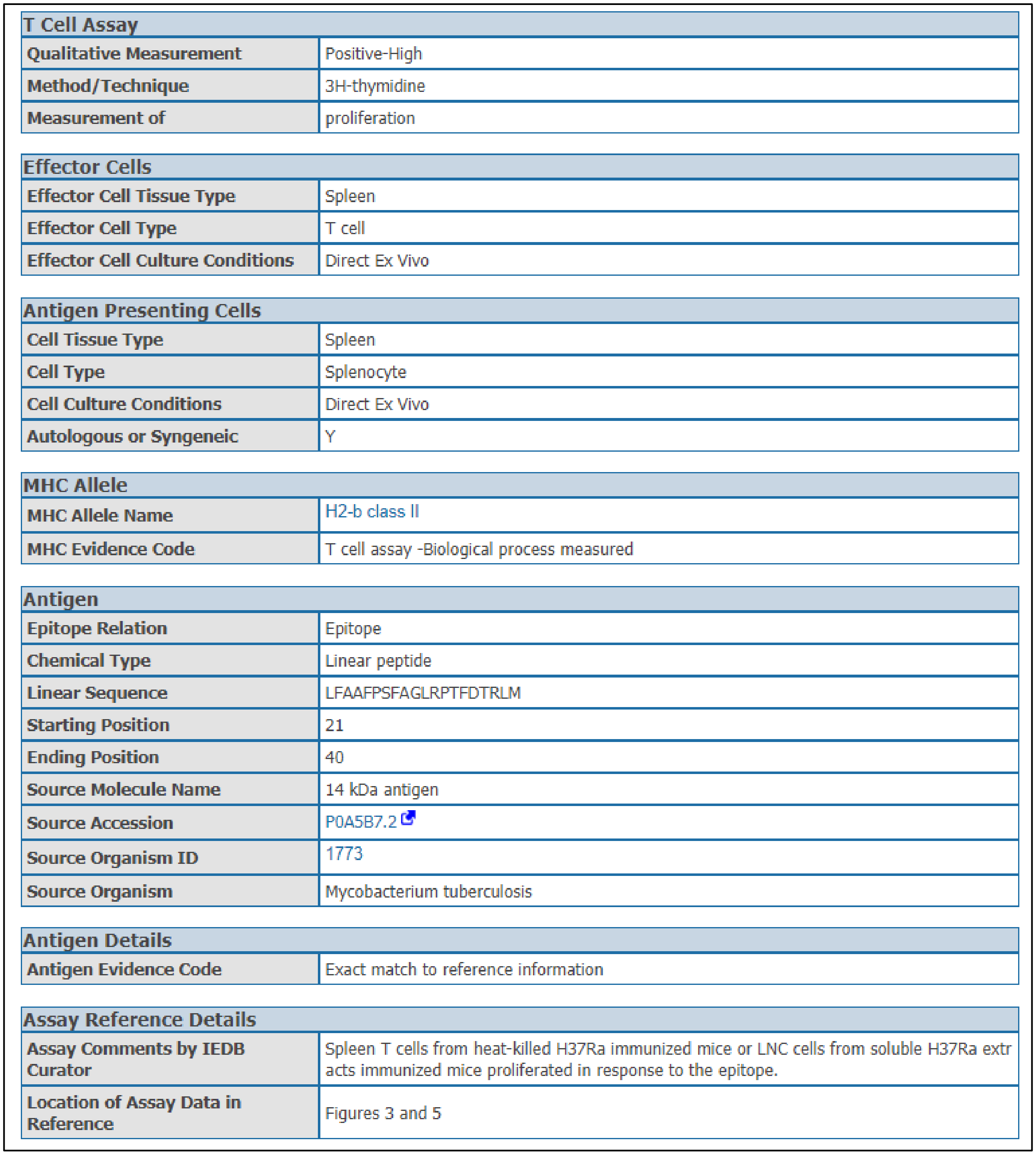
ID	Reference	Epitope	Host	Immunization	Assay Antigen	Antigen Epitope Relation	MHC Restriction	Assay Description
1505273	P Chong; Infect Immun 1992	AGFIYRETFCITTIYKTGQPAADHYYSKVT A Pertussis toxin subunit 3 precursor (106-136) Bordetella pertussis	Mus musculus BALB/c	Administration in vivo with Pertussis toxin subunit 3 precursor (Source Antigen)	AGFIYRETFCITTIYKTGQPAADHYYSKVT A Pertussis toxin subunit 3 precursor (106-136) Bordetella pertussis	Epitope	H2-d class II	3H-thymidine proliferation **Positive-High**
1481451	Gerald E Hancock; J Med Virol 2003	AICKRIPNKKPGKKT Major surface glycoprotein G (184-198) Human respiratory syncytial virus A2	Mus musculus BALB/c	Administration in vivo with Major surface glycoprotein G (Source Antigen)	AICKRIPNKKPGKKT Major surface glycoprotein G (184-198) Human respiratory syncytial virus A2	Epitope	H2-IEd	3H-thymidine proliferation **Positive-High**
1810409	Xuefeng Wang; Parasit Vectors 2010	AKQYNICCKFKELLD 22.6 kDa tegumental antigen (111-125) Schistosoma japonicum	Mus musculus C57BL/6	Administration in vivo with AKQYNICCKFKELLD (Epitope)	AKQYNICCKFKELLD 22.6 kDa tegumental antigen (111-125) Schistosoma japonicum	Epitope	H2-b class II	3H-thymidine proliferation **Positive-High**
1737052	S Ghosh; Int Immunol 1999	ALNNRFQIKGVELKS hemagglutinin (511-525) Influenza A virus	Mus musculus BALB/c	Administration in vivo with ALNNRFQIKGVELKS (Epitope)	ALNNRFQIKGVELKS hemagglutinin (511-525) Influenza A virus	Epitope	H2-d class II	3H-thymidine proliferation **Positive-High**
1648562	A G Paul; Int Immunol 2000	ALSTLVVNKI 60 kDa chaperonin 2 (256-265) Mycobacterium tuberculosis	Rattus norvegicus	Administration in vivo with ALSTLVVNKIRGTFK (Fragment of Source Antigen) followed by restimulation in vitro	ALSTLVVNKI 60 kDa chaperonin 2 (256-265) Mycobacterium tuberculosis	Epitope	RT1-Bl	3H-thymidine proliferation **Positive-High**
1648483	A G Paul; J Immunol 2000	ALSTLVVNKI 60 kDa chaperonin 2 (256-265) Mycobacterium tuberculosis H37Ra	Rattus norvegicus Lewis	Administration in vivo with ALSTLVVNKIRGTFK (Fragment of Source Antigen) followed by restimulation in vitro	ALSTLVVNKI 60 kDa chaperonin 2 (256-265) Mycobacterium tuberculosis H37Ra	Epitope	rat class II	3H-thymidine proliferation **Positive-High**
1506620	María M García-Briones; Virology 2004	ANHCSDAMNIMFEEV polyprotein (2103-2117) Foot-and-mouth	Sus scrofa Landrace X Large White	Administration in vivo with Foot-and-mouth disease virus C-S8c1 (Source Organism)	ANHCSDAMNIMFEEV polyprotein (2103-2117) Foot-and-mouth disease virus C-	Epitope	SLA class II	3H-thymidine proliferation **Positive-High**

Figure 2.17 The Assays tab of the search results page. The page contains three additional tabs for T Cell, B Cell, and MHC Ligand Assays



T Cell Assay	
Qualitative Measurement	Positive-High
Method/Technique	3H-thymidine
Measurement of	proliferation

Effector Cells	
Effector Cell Tissue Type	Spleen
Effector Cell Type	T cell
Effector Cell Culture Conditions	Direct Ex Vivo

Antigen Presenting Cells	
Cell Tissue Type	Spleen
Cell Type	Splenocyte
Cell Culture Conditions	Direct Ex Vivo
Autologous or Syngeneic	Y

MHC Allele	
MHC Allele Name	H2-b class II
MHC Evidence Code	T cell assay -Biological process measured

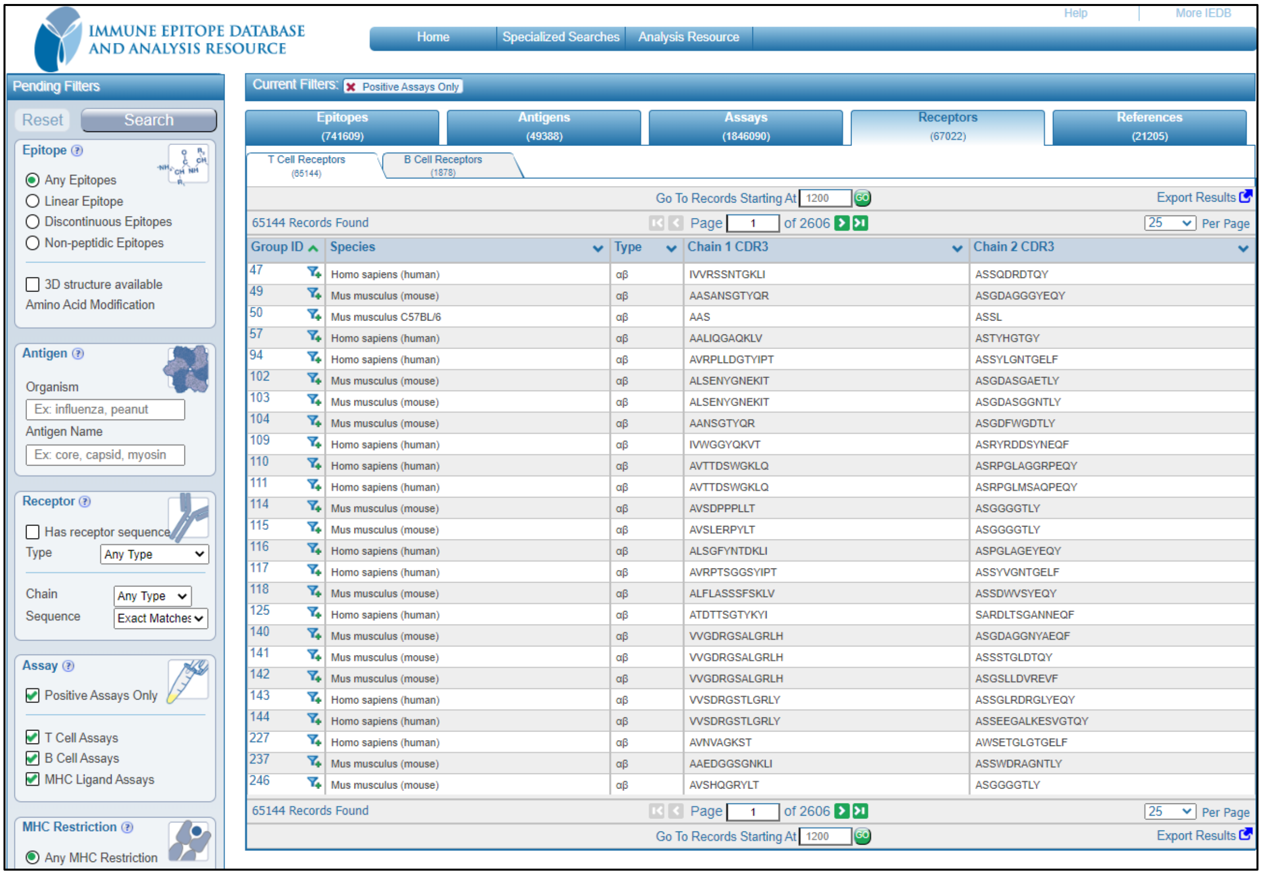
Antigen	
Epitope Relation	Epitope
Chemical Type	Linear peptide
Linear Sequence	LFAAFPSFAGLRPTFDTRLM
Starting Position	21
Ending Position	40
Source Molecule Name	14 kDa antigen
Source Accession	P0A5B7.2
Source Organism ID	1773
Source Organism	Mycobacterium tuberculosis

Antigen Details	
Antigen Evidence Code	Exact match to reference information

Assay Reference Details	
Assay Comments by IEDB Curator	Spleen T cells from heat-killed H37Ra immunized mice or LNC cells from soluble H37Ra extracts immunized mice proliferated in response to the epitope.
Location of Assay Data in Reference	Figures 3 and 5

Figure 2.18 The top three sections of a sample T cell assay detail page.

The fourth tab on the results page is the Receptors tab (Figure 2.19). The Receptors tab indicates the distinct receptor group, the species, and the receptor types alongside the sequences of each chain component. The display is subdivided into two separate tabs for TCRs and BCRs. Clicking on the Group ID links brings the user to a receptor specific details page.



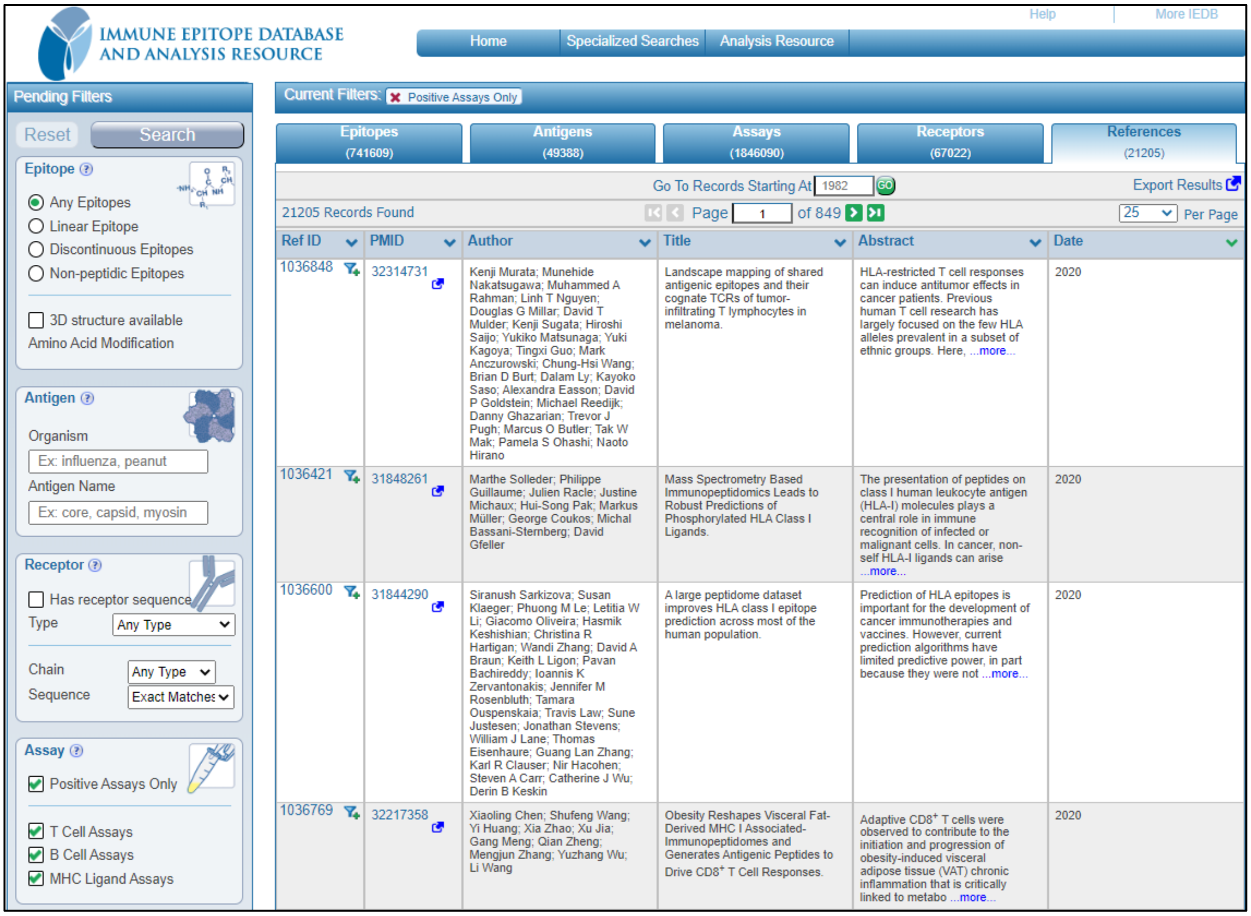
65144 Records Found

Group ID	Species	Type	Chain 1 CDR3	Chain 2 CDR3
47	Homo sapiens (human)	αβ	IVVRSSNTGKLI	ASSQDRDTQY
49	Mus musculus (mouse)	αβ	AASANSGTYQR	ASGDAGGGYEQY
50	Mus musculus C57BL/6	αβ	AAS	ASSL
57	Homo sapiens (human)	αβ	AALIQGAQKLV	ASTYHGTGY
94	Homo sapiens (human)	αβ	AVRPLLDGTYIPT	ASSYLGNTGELF
102	Mus musculus (mouse)	αβ	ALSENYGNEKIT	ASGDASGAETLY
103	Mus musculus (mouse)	αβ	ALSENYGNEKIT	ASGDASGGNTLY
104	Mus musculus (mouse)	αβ	AANSGTYQR	ASGDFWGDTLY
109	Homo sapiens (human)	αβ	IVWGGYQKVT	ASRYRDDSYNEQF
110	Homo sapiens (human)	αβ	AVTTDSWGKLQ	ASRPGLAGGRPEQY
111	Homo sapiens (human)	αβ	AVTTDSWGKLQ	ASRPGLMSAQPEQY
114	Mus musculus (mouse)	αβ	AVSDPPPLLT	ASGGGGTLY
115	Mus musculus (mouse)	αβ	AVSLERPYLT	ASGGGGTLY
116	Homo sapiens (human)	αβ	ALSGFYNTDKLI	ASPGLAGEYEQY
117	Homo sapiens (human)	αβ	AVRPTSGGSYIPT	ASSYVGNTGELF
118	Mus musculus (mouse)	αβ	ALFLASSSFSKLV	ASSDWVSYEQY
125	Homo sapiens (human)	αβ	ATDTTSGTYKYI	SARDLTSGANNEQF
140	Mus musculus (mouse)	αβ	VVGDRGSALGRLH	ASGDAGGNYAEQF
141	Mus musculus (mouse)	αβ	VVGDRGSALGRLH	ASSSTGLDTQY
142	Mus musculus (mouse)	αβ	VVGDRGSALGRLH	ASGSLLDVREVF
143	Homo sapiens (human)	αβ	VVSDRGSTLGRLY	ASSGLRDRGLYEQY
144	Homo sapiens (human)	αβ	VVSDRGSTLGRLY	ASSEEGALKESVGTQY
227	Homo sapiens (human)	αβ	AVNVAGKST	AWSETGLGTGELF
237	Mus musculus (mouse)	αβ	AAEDGGSGNKLI	ASSWDRAGNTLY
246	Mus musculus (mouse)	αβ	AVSHQGRYLT	ASGGGGTLY

65144 Records Found

Figure 2.19 The Receptors tab of the search results page

The fifth tab on the results page is the References tab (Figure 2.20). Results are initially sorted by the year of publication or submission, the most recent references first. Again, the user can click on the column header to change the sort order. The table includes the IEDB-assigned reference ID, the PubMed ID, authors, article title, abstract, and the date. For journal articles, the information is downloaded directly from PubMed. Clicking on the Ref ID in the far-left lane will take the user to a Reference Detail page. An example is given in Figure 2.21.



Current Filters: ✖ Positive Assays Only

● Any Epitopes
○ Linear Epitope
○ Discontinuous Epitopes
○ Non-peptidic Epitopes

☐ 3D structure available
Amino Acid Modification

☐ Has receptor sequence
Type: Any Type
Chain: Any Type
Sequence: Exact Matches

☑ Positive Assays Only

☑ T Cell Assays
☑ B Cell Assays
☑ MHC Ligand Assays

Go To Records Starting At 1982

21205 Records Found

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Ref ID	PMID	Author	Title	Abstract	Date
1036848	32314731	Kenji Murata; Munehide Nakatsugawa; Muhammed A Rahman; Linh T Nguyen; Douglas G Millar; David T Mulder; Kenji Sugata; Hiroshi Saijo; Yukiko Matsunaga; Yuki Kagoya; Tingxi Guo; Mark Anczurowski; Chung-Hsi Wang; Brian D Burt; Dalam Ly; Kayoko Saso; Alexandra Easson; David P Goldstein; Michael Reedijk; Danny Ghazarian; Trevor J Pugh; Marcus O Butler; Tak W Mak; Pamela S Ohashi; Naoto Hirano	Landscape mapping of shared antigenic epitopes and their cognate TCRs of tumor-infiltrating T lymphocytes in melanoma.	HLA-restricted T cell responses can induce antitumor effects in cancer patients. Previous human T cell research has largely focused on the few HLA alleles prevalent in a subset of ethnic groups. Here, ...more...	2020
1036421	31848261	Marthe Solleder; Philippe Guillaume; Julien Racle; Justine Michaux; Hui-Song Pak; Markus Müller; George Coukos; Michal Bassani-Sternberg; David Gfeller	Mass Spectrometry Based Immunopeptidomics Leads to Robust Predictions of Phosphorylated HLA Class I Ligands.	The presentation of peptides on class I human leukocyte antigen (HLA-I) molecules plays a central role in immune recognition of infected or malignant cells. In cancer, non-self HLA-I ligands can arise ...more...	2020
1036600	31844290	Siranush Sarkizova; Susan Klaeger; Phuong M Le; Letitia W Li; Giacomo Oliveira; Hasmik Keshishian; Christina R Hartigan; Wandi Zhang; David A Braun; Keith L Ligon; Pavan Bachireddy; Ioannis K Zervantonakis; Jennifer M Rosenbluth; Tamara Ouspenskaia; Travis Law; Sune Justesen; Jonathan Stevens; William J Lane; Thomas Eisenhaure; Guang Lan Zhang; Karl R Clauser; Nir Hacohen; Steven A Carr; Catherine J Wu; Derin B Keskin	A large peptidome dataset improves HLA class I epitope prediction across most of the human population.	Prediction of HLA epitopes is important for the development of cancer immunotherapies and vaccines. However, current prediction algorithms have limited predictive power, in part because they were not ...more...	2020
1036769	32217358	Xiaoling Chen; Shufeng Wang; Yi Huang; Xia Zhao; Xu Jia; Gang Meng; Qian Zheng; Mengjun Zhang; Yuzhang Wu; Li Wang	Obesity Reshapes Visceral Fat-Derived MHC I Associated-Immunopeptidomes and Generates Antigenic Peptides to Drive CD8$^+$ T Cell Responses.	Adaptive CD8$^+$ T cells were observed to contribute to the initiation and progression of obesity-induced visceral adipose tissue (VAT) chronic inflammation that is critically linked to metabo ...more...	2020

Figure 2.20 The References tab of the search results page

Reference	
Article Authors	Shira Yair-Sabag; Valentina Tedeschi; Carolina Vitulano; Eilon Barnea; Fabian Glaser; Dganit Melamed Kadosh; Joel D Taurog; Maria Teresa Fiorillo; Rosa Sorrentino; Arie Admon
Article Title	The Peptide Repertoire of HLA-B27 may include Ligands with Lysine at P2 Anchor Position.

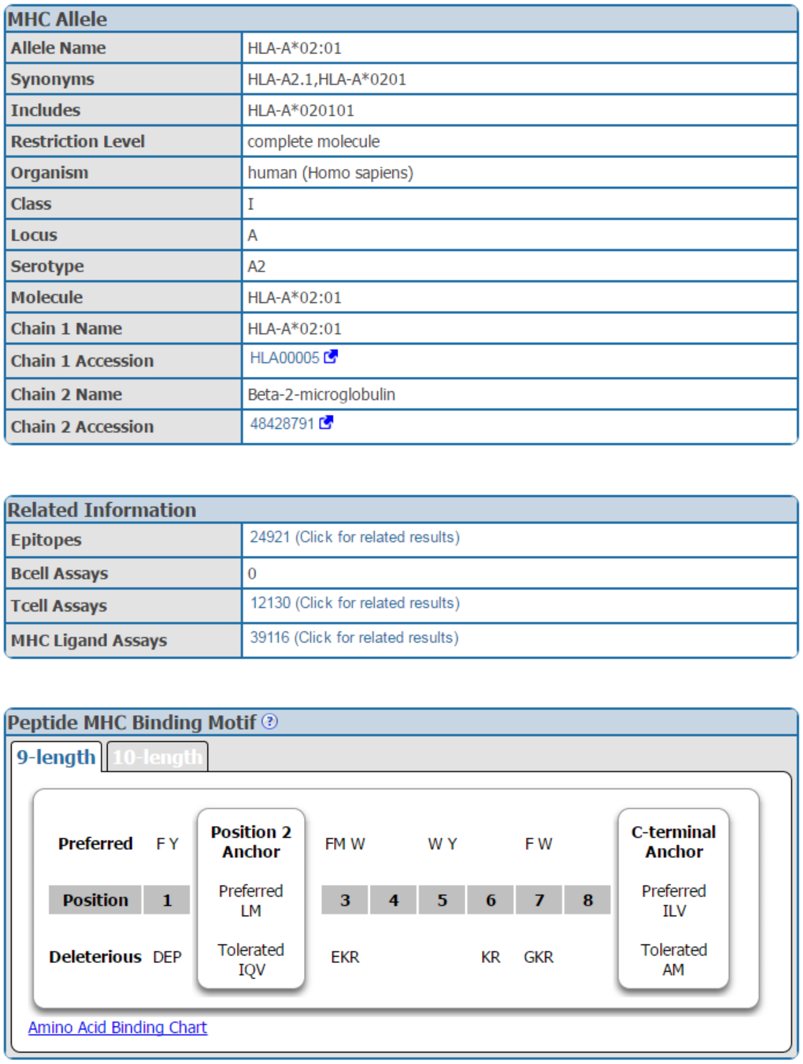
Reference Detail	
Reference ID	1033511
Abstract	The HLA-B*27 peptidome has drawn significant attention due to the genetic association between some of the HLA-B*27 alleles and the inflammatory rheumatic disease ankylosing spondylitis (AS), for which a comprehensive biological explanation is still lacking. This study aims to expand the known limits of the HLA-B*27 peptidome to facilitate selection and testing of new peptides, possibly involved in the disease. The HLA peptidomes of HeLa and C1R cell lines stably transfected with the AS-associated HLA-B*27:05 allele, the nonassociated HLA-B*27:09 allele, or their cysteine 67 to serine mutants (C67S), are analyzed on a very large scale. In addition, the peptidomes of HLA-B*27:05 and HLA-B*27:05-C67S are analyzed from the spleens of rats transgenic for these alleles. The results indicate that C67S mutation increases the percentage of peptides with glutamine or lysine at their P2 position (P2-Lys), in both HLA-B*27:05 and HLA-B*27:09. Furthermore, a small fraction of HLA-B*27 peptides contains lysine at their second position (P2), in addition to the more commonly found peptides with arginine (P2-Arg) or the less common glutamine (P2-Gln) located at this anchor position. Overall these data indicate that peptides with P2-Lys should be considered as real ligands of HLA-B*27 molecules and taken into account while looking for putative peptides implicated in the AS.
Affiliations	Department of Biology, Technion-Israel Institute of Technology, Haifa, Israel; Department of Biology and Biotechnology "C. Darwin", Sapienza University of Rome, Rome, Italy; Bioinformatics Knowledge Unit, The Lorry I. Lokey Interdisciplinary Center for Life Sciences and Engineering, Technion-Israel Institute of Technology, Haifa, Israel; Department of Internal Medicine, University of Texas Southwestern Medical Center, Dallas, USA.
Date	2018
Reference Type	Literature
PubMed ID	29393594
Journal	Proteomics
Journal Volume	18
Article Pages	e1700249
Journal ISSN	1615-9861
Curation Last Updated	2019-01-03 23:39:42

Related Information	
Epitopes	34798 (Click for related results)
Bcell Assays	0
Tcell Assays	0
MHC Ligand Assays	42431 (Click for related results)

Figure 2.21 An example of the Reference detail page

2.2.3.1 Peptide MHC Binding Motif Displays

A display of peptide MHC binding motif diagrams and amino acid binding charts for a subset of MHC allele records appears on the MHC Allele Details page. Clicking on the allele name in the MHC Restriction column on the Assays tab for T Cells and MHC Ligand will bring the user to an MHC Allele Details page (Figure 2.22). As can be seen by the tabs in the binding motif display, the Peptide MHC Binding Motif diagrams on MHC Allele Information pages support diagrams for multiple lengths.



MHC Allele	
Allele Name	HLA-A*02:01
Synonyms	HLA-A2.1,HLA-A*0201
Includes	HLA-A*020101
Restriction Level	complete molecule
Organism	human (Homo sapiens)
Class	I
Locus	A
Serotype	A2
Molecule	HLA-A*02:01
Chain 1 Name	HLA-A*02:01
Chain 1 Accession	HLA00005
Chain 2 Name	Beta-2-microglobulin
Chain 2 Accession	48428791

Related Information	
Epitopes	24921 (Click for related results)
Bcell Assays	0
Tcell Assays	12130 (Click for related results)
MHC Ligand Assays	39116 (Click for related results)

Peptide MHC Binding Motif

Position	1	Position 2 Anchor	3	4	5	6	7	8	C-terminal Anchor
Preferred	F Y	Preferred LM	FM W		W Y		F W		Preferred ILV
Deleterious	DEP	Tolerated IQV	EKR			KR	GKR		Tolerated AM

Figure 2.22 Sample MHC Allele Details page with Peptide MHC Binding Motif diagram for HLA-A*02:01. Note the link to the corresponding Amino Acid Binding Chart on the bottom left of the diagram

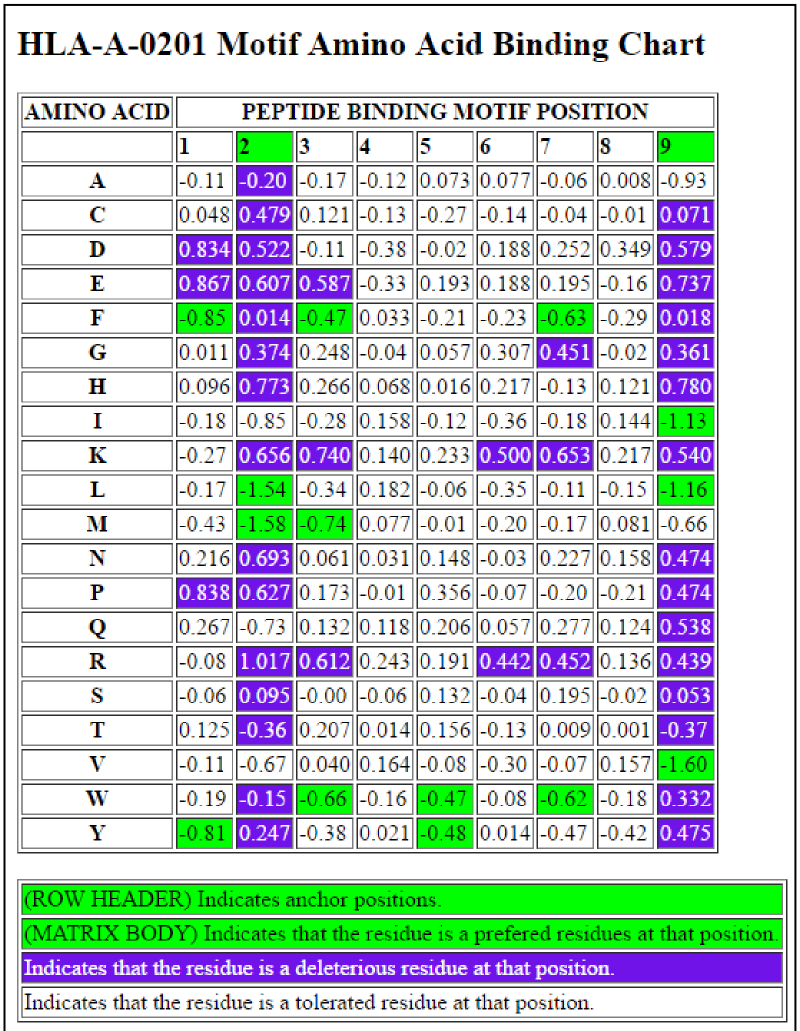
The Peptide MHC Binding Motif diagram summarizes the results of the amino acid binding for each position, which is shown in Figure 2.23. The amino acids are color-coded for each position, where green indicates the residue is preferred for binding, purple indicates it is deleterious for binding, and white indicates the residue is tolerated at that position. The motif diagram shows which residues are preferred and tolerated at the anchor positions, and which residues are preferred and deleterious at the non-anchor positions.

The residue preference is calculated from the SMM prediction matrix, which is described in Section 2.3.1.1. The following steps are taken in determining the residue preference at each position:

For anchor position:

1. determine the best value of this position from corresponding column of the SMM matrix
2. if a residue's value in this column of the SMM matrix is within 3-fold of the best value, designate this residue as preferred

3. if a residue's value in this column of the SMM matrix is within 10-fold of the best value, designate this residue as tolerated
4. The remaining residues are designated as deleterious



HLA-A-0201 Motif Amino Acid Binding Chart

AMINO ACID	PEPTIDE BINDING MOTIF POSITION								
	1	2	3	4	5	6	7	8	9
A	-0.11	-0.20	-0.17	-0.12	0.073	0.077	-0.06	0.008	-0.93
C	0.048	0.479	0.121	-0.13	-0.27	-0.14	-0.04	-0.01	0.071
D	0.834	0.522	-0.11	-0.38	-0.02	0.188	0.252	0.349	0.579
E	0.867	0.607	0.587	-0.33	0.193	0.188	0.195	-0.16	0.737
F	-0.85	0.014	-0.47	0.033	-0.21	-0.23	-0.63	-0.29	0.018
G	0.011	0.374	0.248	-0.04	0.057	0.307	0.451	-0.02	0.361
H	0.096	0.773	0.266	0.068	0.016	0.217	-0.13	0.121	0.780
I	-0.18	-0.85	-0.28	0.158	-0.12	-0.36	-0.18	0.144	-1.13
K	-0.27	0.656	0.740	0.140	0.233	0.500	0.653	0.217	0.540
L	-0.17	-1.54	-0.34	0.182	-0.06	-0.35	-0.11	-0.15	-1.16
M	-0.43	-1.58	-0.74	0.077	-0.01	-0.20	-0.17	0.081	-0.66
N	0.216	0.693	0.061	0.031	0.148	-0.03	0.227	0.158	0.474
P	0.838	0.627	0.173	-0.01	0.356	-0.07	-0.20	-0.21	0.474
Q	0.267	-0.73	0.132	0.118	0.206	0.057	0.277	0.124	0.538
R	-0.08	1.017	0.612	0.243	0.191	0.442	0.452	0.136	0.439
S	-0.06	0.095	-0.00	-0.06	0.132	-0.04	0.195	-0.02	0.053
T	0.125	-0.36	0.207	0.014	0.156	-0.13	0.009	0.001	-0.37
V	-0.11	-0.67	0.040	0.164	-0.08	-0.30	-0.07	0.157	-1.60
W	-0.19	-0.15	-0.66	-0.16	-0.47	-0.08	-0.62	-0.18	0.332
Y	-0.81	0.247	-0.38	0.021	-0.48	0.014	-0.47	-0.42	0.475

(ROW HEADER) Indicates anchor positions.

(MATRIX BODY) Indicates that the residue is a prefered residues at that position.

Indicates that the residue is a deleterious residue at that position.

Indicates that the residue is a tolerated residue at that position.

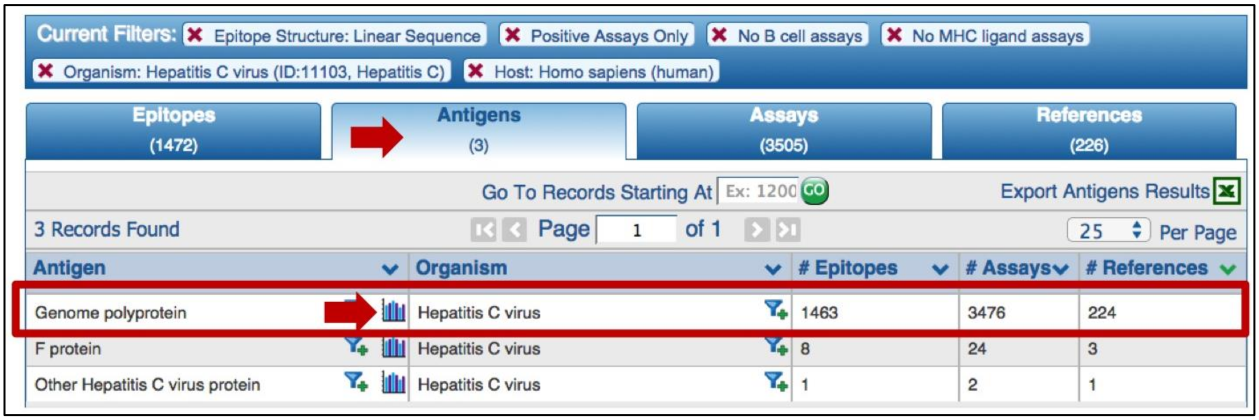
Figure 2.23 Amino acid binding matrix for MHC allele HLA-A*02:01

For non-anchor position:

1. determine the median value of this position from corresponding column of the SMM matrix
2. if a residue's value in this column of the SMM matrix is within 3-fold of the median value, designate this residue as tolerated
3. if a residue's value in this column of the SMM matrix is above 3-fold of the median value, designate this residue as preferred
4. if a residue's value in this column of the SMM matrix is below 3-fold of the median value, designate this residue as deleterious

2.2.3.2 Immunome Browser

The Immunome Browser is a feature integrated into the IEDB to more efficiently display large sets of immune epitope data. The purpose of the tool is to allow users to explore how often each protein region has been studied in immune assays and in how many assays the immune response was positive or negative. The Immunome Browser “maps” query results from the IEDB onto a reference proteome. A reference proteome is used because (1) epitopes reported in IEDB were identified for different strains and protein isoforms – mapping to the reference protein allows to visualize and study such epitopes as they would have the same antigen; (2) different mutant variants of the same epitope were tested and reported; and (3) immune response varies among studies and assays due to heterogeneity of samples and complexity of immune response. The Immunome Browser presents the mapped data along with calculated 'epitope prominence scores' that rank known epitopes based on how frequently subjects responded to each epitope, allowing identification of immunodominance. Both linear and discontinuous linear peptide epitopes with T cell or B cell responses are supported for viewing using the Immunome Browser. It is accessible via the Immunome Browser icon on the Antigen tab on the results page, as seen in Figure 2.24.



Current Filters: ✖ Epitope Structure: Linear Sequence ✖ Positive Assays Only ✖ No B cell assays ✖ No MHC ligand assays ✖ Organism: Hepatitis C virus (ID:11103, Hepatitis C) ✖ Host: Homo sapiens (human)

Epitopes (1472) | Antigens (3) | Assays (3505) | References (226)

Go To Records Starting At Ex: 1200 GO

Export Antigens Results

3 Records Found

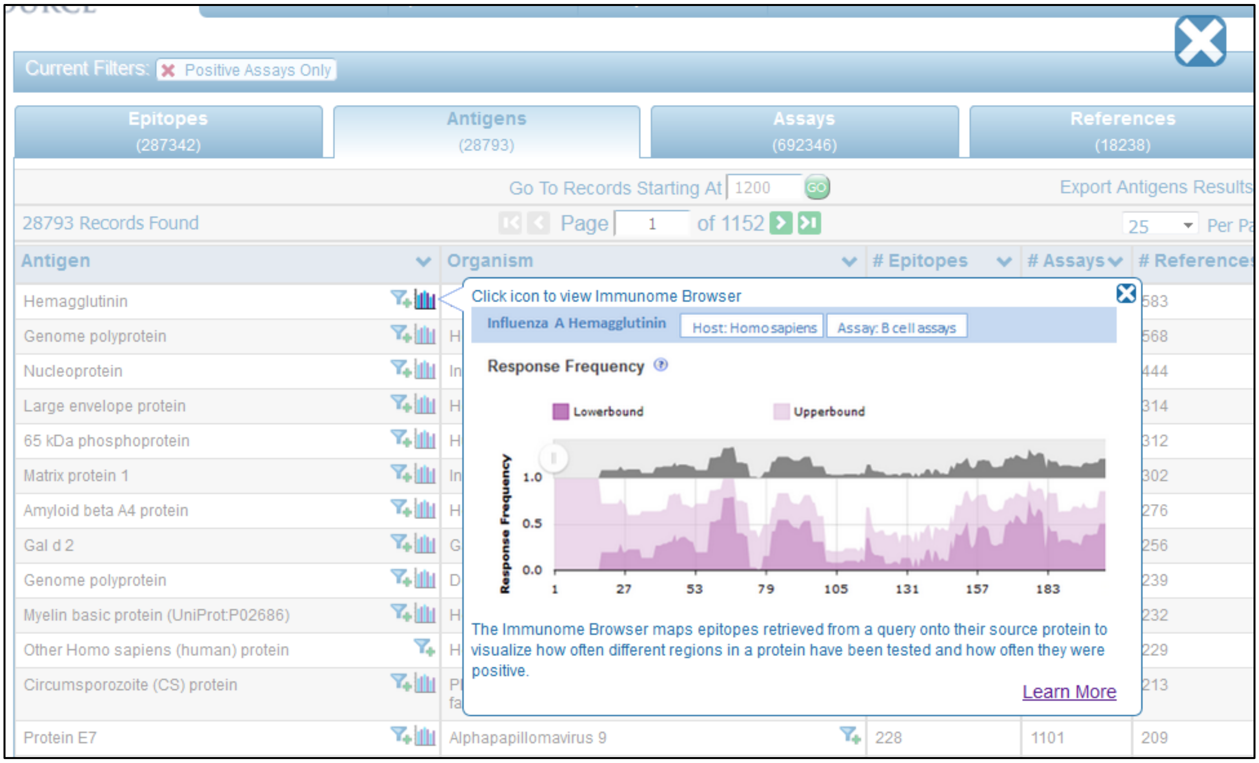
Page 1 of 1

25 Per Page

Antigen	Organism	# Epitopes	# Assays	# References
Genome polyprotein	Hepatitis C virus	1463	3476	224
F protein	Hepatitis C virus	8	24	3
Other Hepatitis C virus protein	Hepatitis C virus	1	2	1

Figure 2.24 The Immunome Browser is accessed by clicking on the icon shown on the Antigen tab on the results page of a query

In order to make the Immunome Browser capability more prominent, a pop-up window was added that appears the first time a user goes to the Antigen tab after making a search, as seen in Figure 2.25. It can be easily dismissed by clicking on the large X in the upper right-hand corner or clicking anywhere else on the window.



28793 Records Found

Antigen	Organism	# Epitopes	# Assays	# Reference
Hemagglutinin				583
Genome polyprotein	H			568
Nucleoprotein	In			444
Large envelope protein	H			314
65 kDa phosphoprotein	H			312
Matrix protein 1	In			302
Amyloid beta A4 protein	H			276
Gal d 2	G			256
Genome polyprotein	D			239
Myelin basic protein (UniProt:P02686)	H			232
Other Homo sapiens (human) protein	H			229
Circumsporozoite (CS) protein	Pl fa			213
Protein E7	Alphapapillomavirus 9	228	1101	209

Click icon to view Immunome Browser

Influenza A Hemagglutinin | Host: Homo sapiens | Assay: B cell assays

The Immunome Browser maps epitopes retrieved from a query onto their source protein to visualize how often different regions in a protein have been tested and how often they were positive.

Figure 2.25 A pop-up window appears each time the user clicks on the Antigen tab on the Results page. It highlights the Immunome Browser icon and briefly explains the Immunome Browser's functionality.

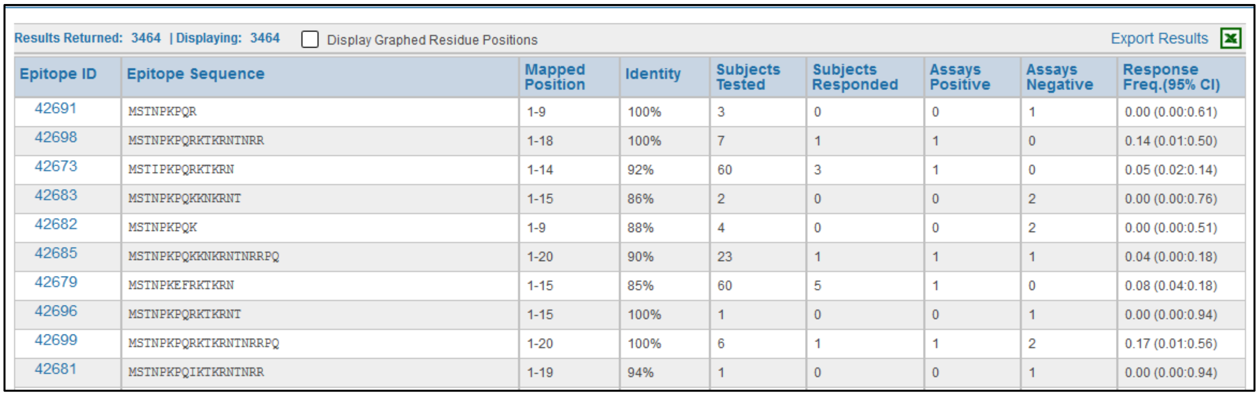
In the Immunome Browser, each selected antigen is considered to be a target protein, and the tool by default maps and visualizes all epitopes in the query result that are from the source antigen, which is the target protein or any of its taxonomic child. The mapping is done using the alignment between the source antigen and the target protein, and matching the epitope positions in the source antigen with the residue positions in the target protein. By default, epitopes that were tested as negative for the correspondent query will be mapped as well, even if the user queried only for positive assays. Also, the epitopes that failed to satisfy the default mapping criteria won't be mapped and visualized. The Immunome Browser output for query criteria of T cell assays, linear epitopes, Hepatitis C virus, and human host is shown in Figure 2.26.

Pending Filters: Positive Assays Only; Epitope Structure: Linear Sequence; Organism: Hepatitis C virus (ID:11103, Hepatitis C); No B cell assays; No MHC ligand assays; Host: Homo sapiens (human)

Residue Position Start 1 End 3011

Figure 2.26 Immunome Browser graphical output displaying assay results mapped onto a reference proteome by residue position

Two graphs are generated in the Immunome Browser. The upper plot titled "Response Frequency" renders the lower (dark color) and upper (light color) bounds of the 95% confidence interval (CI) of the response frequency (RF) for each position target protein position, averaged over all epitopes mapped to that position. RF is calculated as the number of positively responded subjects (or individuals in this case) relative to the total number of those tested summed up by mapped epitopes. The graph, however, displays only the upper and lower bounds of the 95% confidence interval (CI) for the RF score and not the RF score itself. The lower plot, titled "Epitope Assay Counts," indicates the number of positive and negative assays for each residue position.


Results Returned: 3464 | Displaying: 3464 ☐ Display Graphed Residue Positions Export Results

Epitope ID	Epitope Sequence	Mapped Position	Identity	Subjects Tested	Subjects Responded	Assays Positive	Assays Negative	Response Freq.(95% CI)
42691	MSTNPKPQR	1-9	100%	3	0	0	1	0.00 (0.00:0.61)
42698	MSTNPKPQRKTKRNTNRR	1-18	100%	7	1	1	0	0.14 (0.01:0.50)
42673	MSTIPKPQRKTKRN	1-14	92%	60	3	1	0	0.05 (0.02:0.14)
42683	MSTNPKPQKKNKRNT	1-15	86%	2	0	0	2	0.00 (0.00:0.76)
42682	MSTNPKPQK	1-9	88%	4	0	0	2	0.00 (0.00:0.51)
42685	MSTNPKPQKKNKRNTNRRPQ	1-20	90%	23	1	1	1	0.04 (0.00:0.18)
42679	MSTNPKEFRKTKRN	1-15	85%	60	5	1	0	0.08 (0.04:0.18)
42696	MSTNPKPQRKTKRNT	1-15	100%	1	0	0	1	0.00 (0.00:0.94)
42699	MSTNPKPQRKTKRNTNRRPQ	1-20	100%	6	1	1	2	0.17 (0.01:0.56)
42681	MSTNPKPQIKTKRNTNRR	1-19	94%	1	0	0	1	0.00 (0.00:0.94)

Figure 2.27 Immunome Browser tabular output.

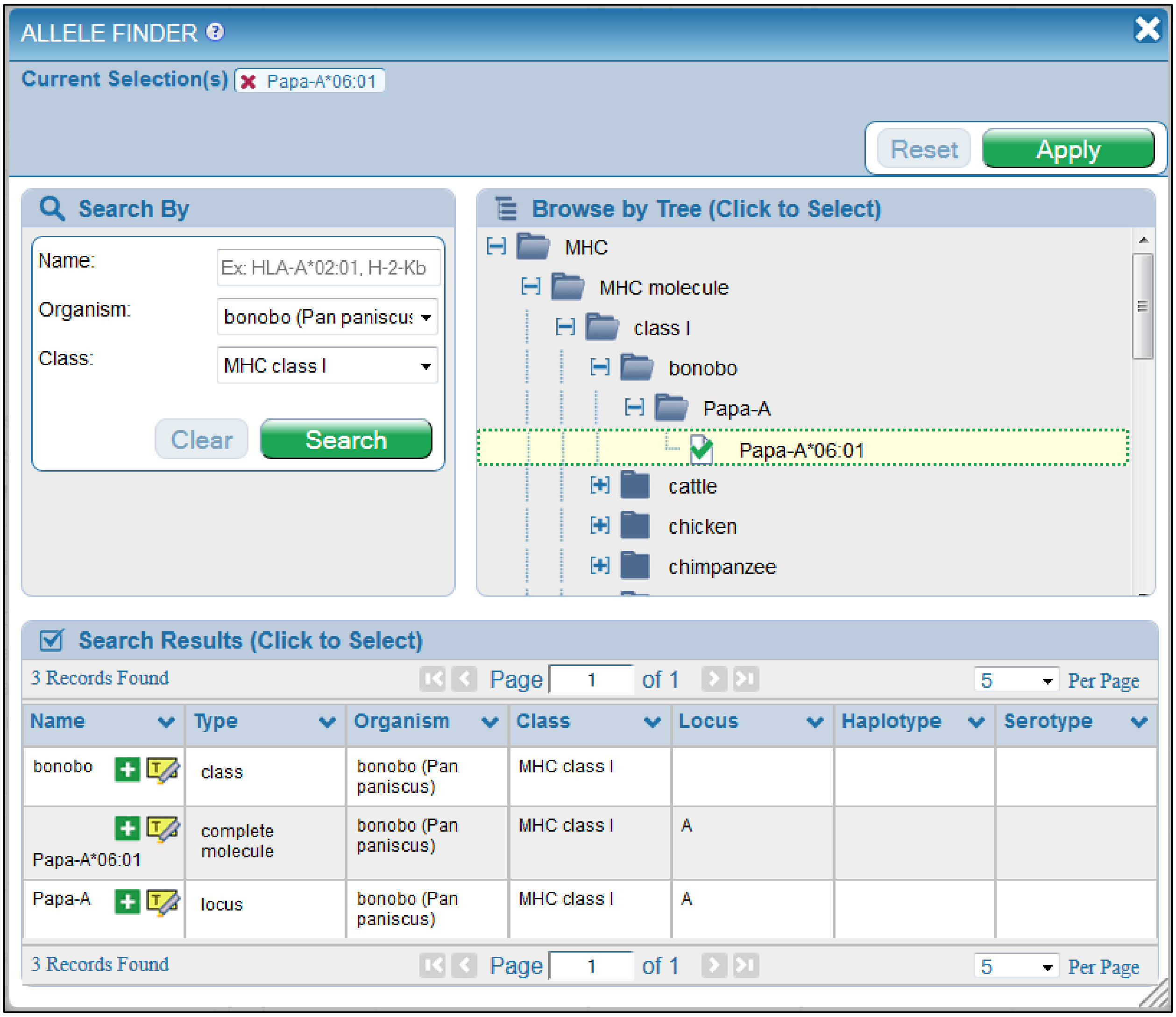
In addition to the plots, a table is generated that displays the epitope ID, sequence, position, and identity, as well as the number of subjects tested, the number who responded, and number of positive and negative assays, and the response frequency (Figure 2.27). The user can interactively zoom in and out on the plots to a specific protein region and, if the check box for the table to correspond the plots is selected, the table is automatically updated to show only epitope from the selected region. Alternatively, the user can specify the residue start and end positions at the bottom of plots and click Update Display.

2.2.4 Finders Overview

Several finders (Allele, Assay, Disease, Molecule, Geolocation, and Organism) are available to help facilitate selections and control vocabulary usage, thus improving query results. At times the potential list of selections can be quite extensive, and the finders help users make selections from large lists. The finders can be utilized when performing all queries. Multiple selections can be made when utilizing finders during a query.

2.2.4.1 Allele Finder

The MHC Allele Finder facilitates the selection of one or more MHC alleles. The finder consists of four sections as shown in Figure 2.28. The top section lists the alleles that the user selects. The selections can be removed by clicking on the red X of an allele name or by clicking on the Reset button to delete all selected alleles. When the user has completed the selection process, the user needs to click the green Apply button. The middle left section of the finder contains the “Search By” panel. Users can search by allele name, source organism, and/or class (I, II, or non-classical). After the user supplies their search criteria and clicks the Search button, the system will filter the list of MHC alleles using the organism, class, and allele provided. The allele finder uses wild card characters by default on both ends of criteria entered into the allele field. The system then returns in the bottom “Search Results” panel a list of any alleles that contain the value in the name field and match the class selected. Users can click on the green “+” icon to select an allele. Users can also click on the yellow highlighter icon to highlight the allele in the allele tree in the middle right section of the finder. Alternatively, a user can browse the hierarchical allele tree. Clicking on a node in this tree will add the allele to the Current Selections section of the finder.



Current Selection(s) Papa-A*06:01

Name: Ex: HLA-A*02:01, H-2-Kb

Organism: bonobo (Pan paniscus

Class: MHC class I

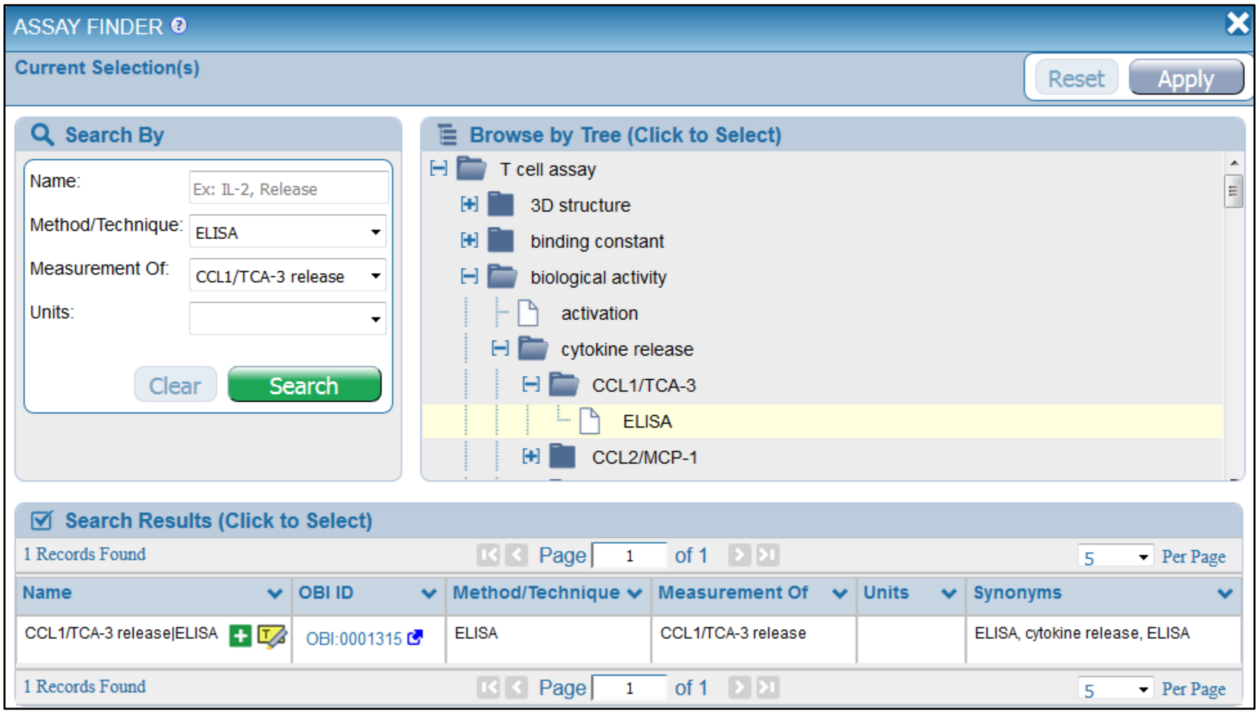
Name	Type	Organism	Class	Locus	Haplotype	Serotype
bonobo	class	bonobo (Pan paniscus)	MHC class I			
Papa-A*06:01	complete molecule	bonobo (Pan paniscus)	MHC class I	A		
Papa-A	locus	bonobo (Pan paniscus)	MHC class I	A		

Figure 2.28 Allele Finder. Alleles are displayed in a tree structure and users can search by allele name, source organism, and MHC class (I, II, or non-classical)

2.2.4.2 Assay Finder

The IEDB contains experimental data characterizing antibody and T cell epitopes studied in humans, non-human primates, and other animal species. Search results may easily be narrowed to include only the specific assay categories of T Cell Assays, B Cell Assays, and MHC Ligand Assays. Additionally, one may further narrow search results to very specific experimental methods using the Assay Finder.

The Assay Finder is used to facilitate the selection of one or more assay types and lists all assay types in the selected assay category. The Assay Finder for T Cell, B cell, and MHC Ligand assays can be found in the Assay section on the home page search interface, the left-hand side of the Results page, and on their respective Specialized Search pages. These versions of the Assay Finder organize and display assays in a tree structure, as seen in Figure 2.29 for the T Cell assays. Users can also search for assays by their method/technique and by the characters within the assay's name. The figure shows the results for ELISA type assays for "CCL1/TCA-3 release". Users can click on the green "+" icon to select an assay. Users can also click on the yellow highlighter icon to highlight the assay in the assay tree in the middle right section of the finder, as is shown in the figure. Alternatively, a user can browse the hierarchical assay tree. Clicking on a node in this tree will add the assay to the Current Selections section of the finder.



Name: Ex: IL-2, Release
Method/Technique: ELISA
Measurement Of: CCL1/TCA-3 release
Units:

Name	OBI ID	Method/Technique	Measurement Of	Units	Synonyms
CCL1/TCA-3 release|ELISA	OBI:0001315	ELISA	CCL1/TCA-3 release		ELISA, cytokine release, ELISA

Figure 2.29 Assay Finder on the T Cell Advanced Search page. Assays are displayed in a tree structure and users can find displays by their method/technique and by the characters with which the assay name starts

2.2.4.3 Disease Finder

This query feature allows users to select a disease association based on the host disease state or status as captured in curation. Diseases are organized into a browsable tree structure. Upon the selection of host disease state/status, the system provides the user with a hierarchical *Disease Tree* that organizes the data at the highest level according to the five disease categories (Allergy, Autoimmunity, Infectious Disease, Additional Diseases by category, and Transplant-related Disease and Allo-reactivity) and then by the anatomical location of the disease (e.g. respiratory tract, gastrointestinal tract). In this way the user can either type in the disease name or synonym of interest, or navigate the Disease Tree by disease manifestation and physical location to see what is available. A node for healthy subjects is also included. The Disease Finder is fully functional for only Autoimmunity. The finder will be revised with an updated disease ontology and hierarchical tree during 2017 based on the Disease Ontology that will make it functional for the other disease categories. Infectious disease searches are best accommodated using the Organism Finder to specify the antigen.

Figure 2.30 shows the Disease Tree with diabetes highlighted. DOID refers to the Disease Ontology identifier. The DTREE designates an IEDB-specific identifier that will be updated later with a DOID number when the Disease Ontology incorporates the terms.

Current Selection(s) ✗ diabetes mellitus

Disease Name: diabetes

Disease ID: Ex: 9415

ID Source:

4 Records Found Page 1 of 1 5 Per Page

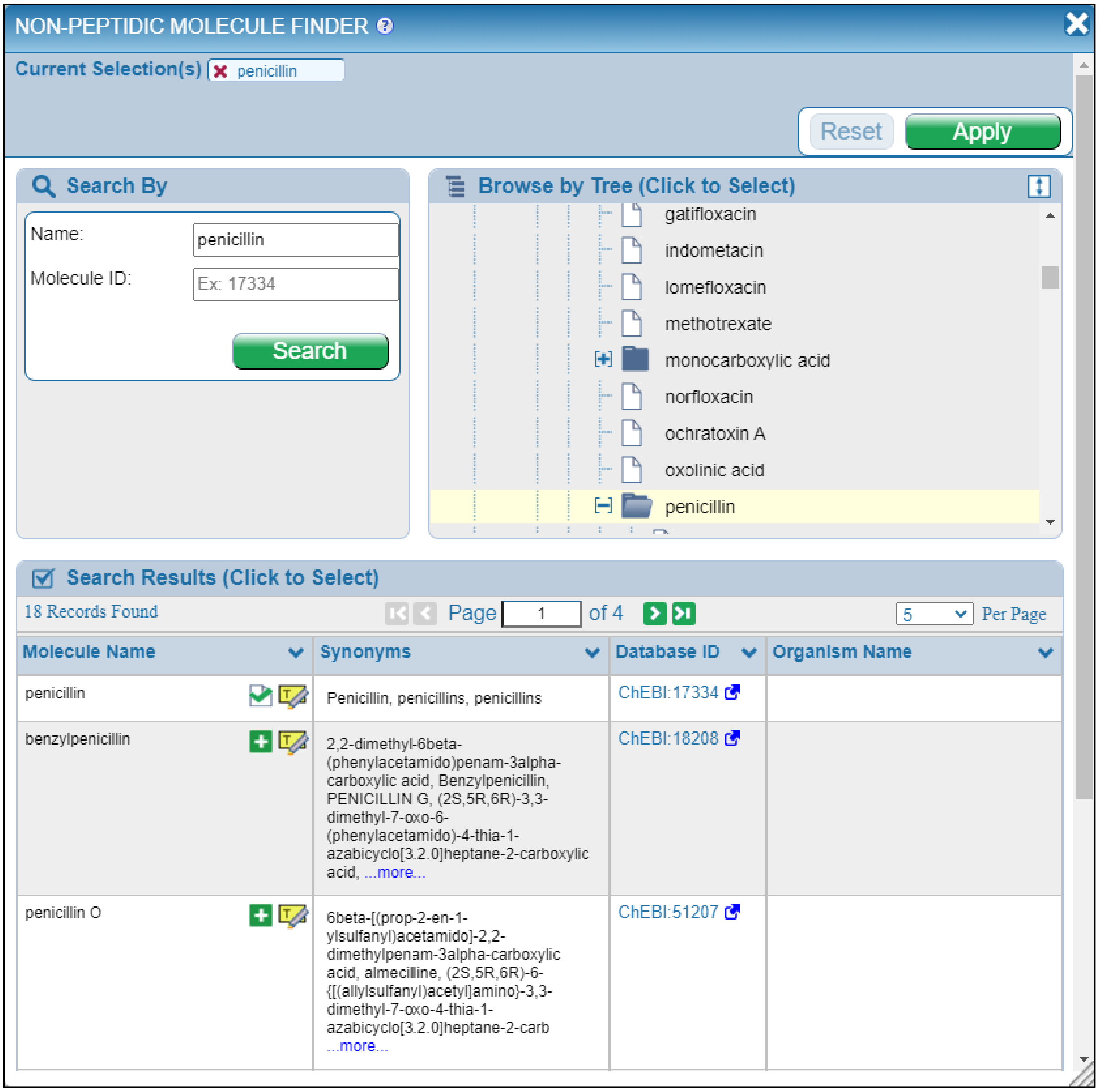
Disease Name	Synonyms	Disease ID
diabetes mellitus		DOID [DOID:9351]
prediabetes syndrome	prediabetic state, Prediabetes	DOID [DOID:11716]
type 1 diabetes mellitus	type I diabetes mellitus, insulin-dependent diabetes mellitus, IDDM	DOID [DOID:9744]
type 2 diabetes mellitus	type 2 diabetes, non-insulin-dependent diabetes mellitus, type II diabetes mellitus, NIDDM	DOID [DOID:9352]

4 Records Found Page 1 of 1 5 Per Page

Figure 2.30 The disease finder is particularly helpful in specifying epitopes related to autoimmune diseases. In the example shown, diabetes is highlighted and selected.

2.2.4.4 Molecule Finder

The Molecule Finder is used to facilitate the selection of source antigens, immunogens, and epitopes. There are two versions of the Molecule Finder – one specifically for non-peptidic molecules found in the Epitope box in the results page, and another that includes peptidic and non-peptidic branches, found in the Antigen box in the results page. The former contains the structures curated by the Chemical Entities of Biological Interest (ChEBI) database. An example of the non-peptidic finder is shown in Figure 2.31.



Current Selection(s) ☒ penicillin

Name: penicillin

Molecule ID: Ex: 17334

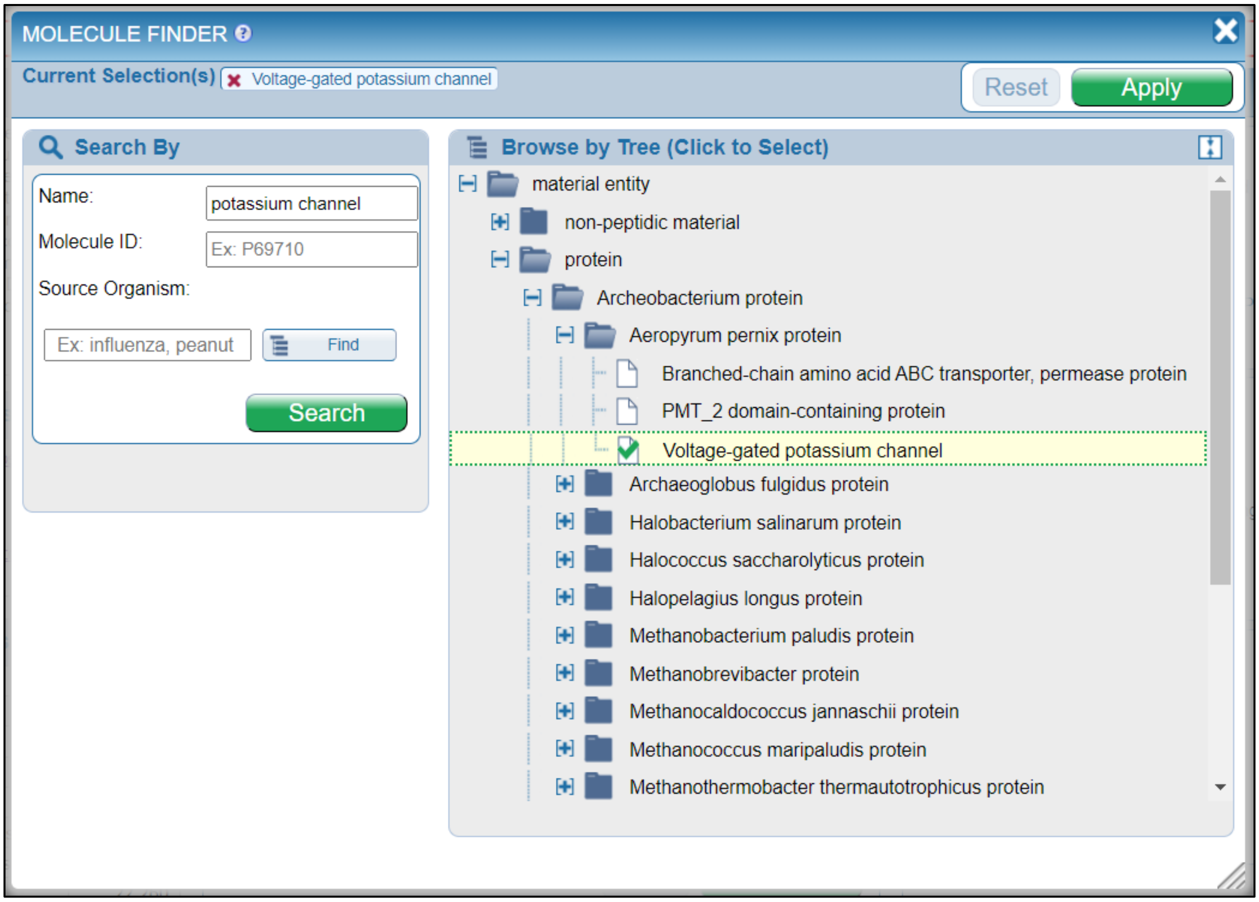
gatifloxacin
indometacin
lomefloxacin
methotrexate
monocarboxylic acid
norfloxacin
ochratoxin A
oxolinic acid
penicillin

18 Records Found — Page 1 of 4 — 5 Per Page

Molecule Name	Synonyms	Database ID	Organism Name
penicillin	Penicillin, penicillins, penicillins	ChEBI:17334	
benzylpenicillin	2,2-dimethyl-6beta-(phenylacetamido)penam-3alpha-carboxylic acid, Benzylpenicillin, PENICILLIN G, (2S,5R,6R)-3,3-dimethyl-7-oxo-6-(phenylacetamido)-4-thia-1-azabicyclo[3.2.0]heptane-2-carboxylic acid, ...more...	ChEBI:18208	
penicillin O	6beta-[(prop-2-en-1-ylsulfanyl)acetamido]-2,2-dimethylpenam-3alpha-carboxylic acid, almecilline, (2S,5R,6R)-6-{[(allylsulfanyl)acetyl]amino}-3,3-dimethyl-7-oxo-4-thia-1-azabicyclo[3.2.0]heptane-2-carb ...more...	ChEBI:51207	

Figure 2.31 The non-peptidic version of the Molecule Finder. This finder is accessed in the Epitope filter on the search results page.

With regard to the protein or peptidic branch of the Molecule Finder, individual GenPept proteins utilized by IEDB data are assigned to parent proteins from reference proteomes by sequence homology.



Current Selection(s) Voltage-gated potassium channel

Name: potassium channel

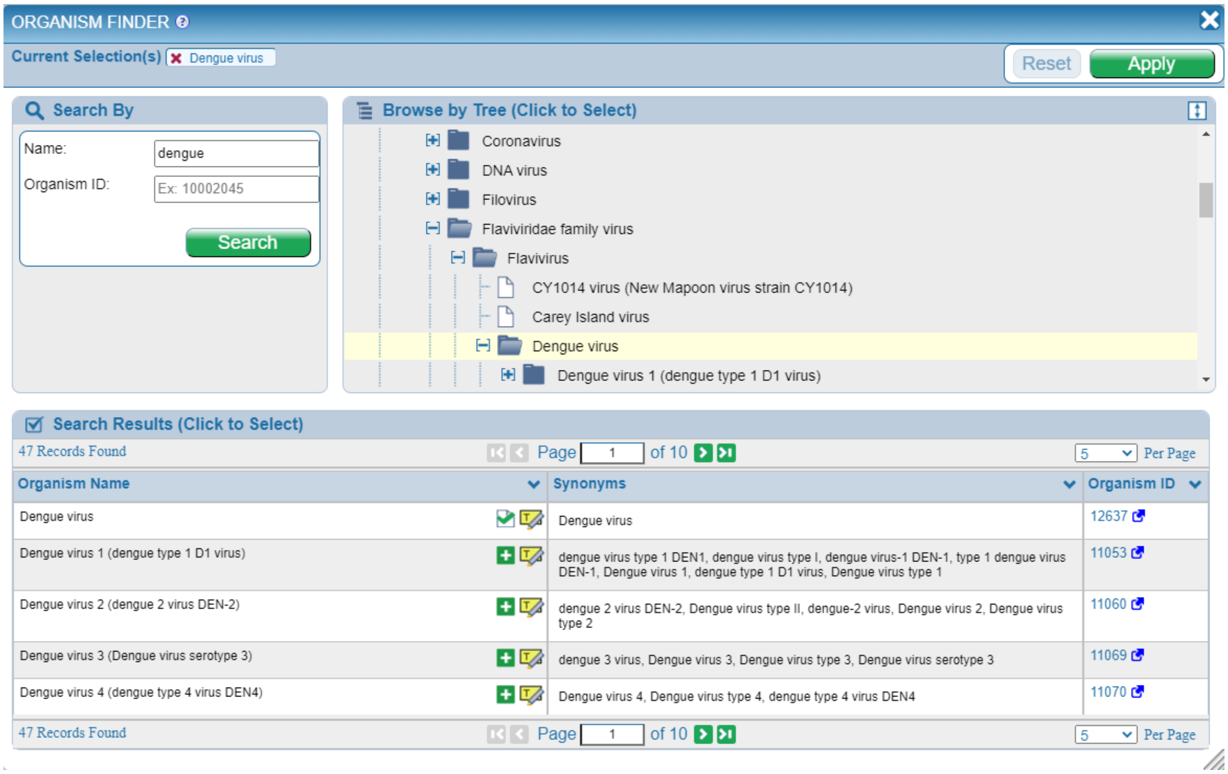
Figure 2.32 An example of the protein branch of the Molecule Finder

As one can see in Figure 2.32, a user can search the molecule tree by entering text, including synonyms, in the Name field in the upper left-hand corner of the finder. The user can also specify the source organism of the molecule of interest using the autocomplete field or the organism finder. For example, this can facilitate the specification of a hemagglutinin is a particular strain of Influenza.

2.2.4.5 Organism Finder

The organism finder is used to facilitate the selection of a species or strain from the NCBI Taxonomy Database. The Organism finder allows the user to find species using their name, synonyms, or taxonomy identifier (assigned by NCBI). When the user performs a search, the system will display a tree structure. The user can search for a name or Organism ID in the "Search By" panel in the upper left-hand portion of the Finder. In the example shown in

Figure 2.33, a search for "dengue" is performed, which results in 47 items being found. The user can select one or more of the items by clicking on the green "+" icon or clicking a branch in the tree. The user can also choose to highlight the item in the tree, as shown in the figure, by clicking the corresponding yellow highlighter icon. Synonyms for a selection are listed next to the organism name column in the search results table. When the Organism Finder is adjacent to a Host Organism field, only the source organisms for which data exist in the IEDB are displayed in the tree structure.



Current Selection(s): Dengue virus

Name: dengue
Organism ID: Ex: 10002045

Coronavirus
DNA virus
Filovirus
Flaviviridae family virus
Flavivirus
CY1014 virus (New Mapoon virus strain CY1014)
Carey Island virus
Dengue virus
Dengue virus 1 (dengue type 1 D1 virus)

47 Records Found — Page 1 of 10 — 5 Per Page

Organism Name	Synonyms	Organism ID
Dengue virus	Dengue virus	12637
Dengue virus 1 (dengue type 1 D1 virus)	dengue virus type 1 DEN1, dengue virus type I, dengue virus-1 DEN-1, type 1 dengue virus DEN-1, Dengue virus 1, dengue type 1 D1 virus, Dengue virus type 1	11053
Dengue virus 2 (dengue 2 virus DEN-2)	dengue 2 virus DEN-2, Dengue virus type II, dengue-2 virus, Dengue virus 2, Dengue virus type 2	11060
Dengue virus 3 (Dengue virus serotype 3)	dengue 3 virus, Dengue virus 3, Dengue virus type 3, Dengue virus serotype 3	11069
Dengue virus 4 (dengue type 4 virus DEN4)	Dengue virus 4, Dengue virus type 4, dengue type 4 virus DEN4	11070

47 Records Found — Page 1 of 10 — 5 Per Page

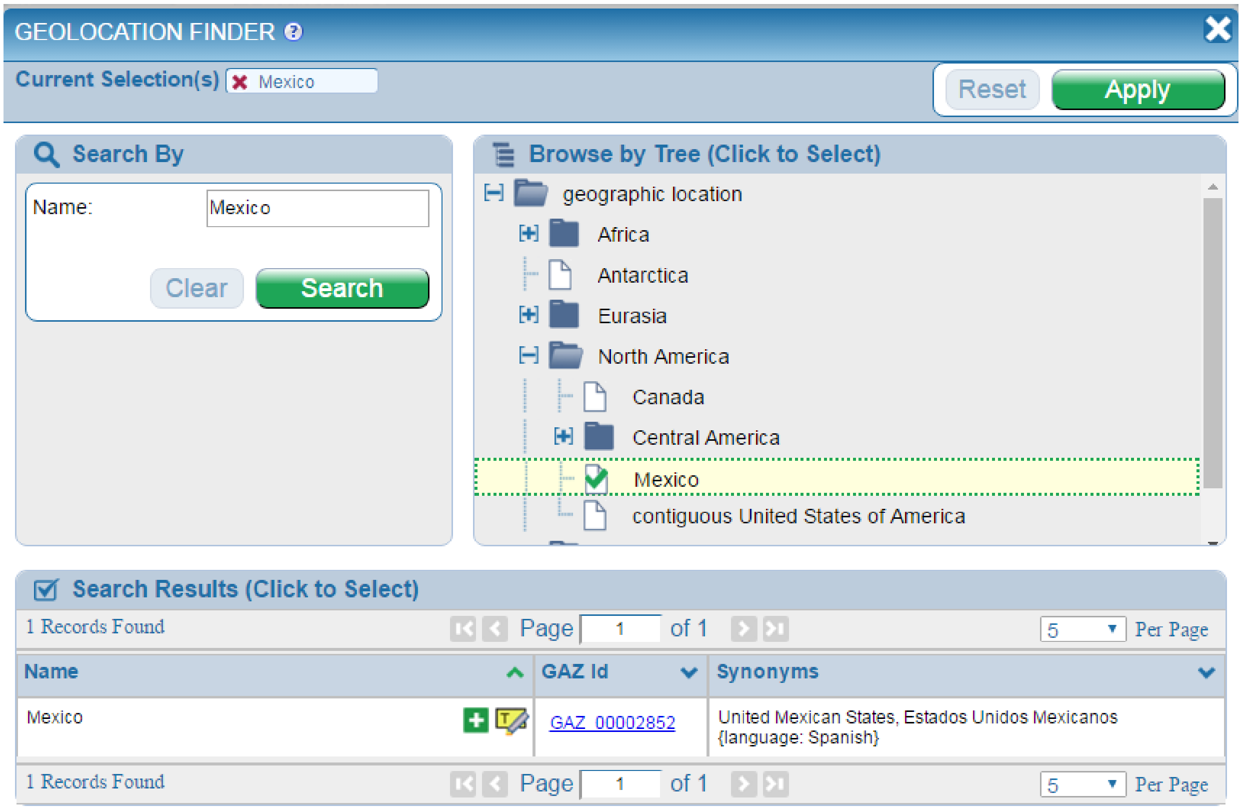
Figure 2.33 Organism Finder showing a search for dengue with dengue highlighted in the tree

2.2.4.6 Geolocation Finder

This feature combines the locations where study subjects were studied and the external ontology known as Gazetteer (http://bioportal.bioontology.org/ontologies/1397). It can be found on the B Cell Search, T Cell Search, and MHC Ligand Specialized search pages under the Host Details subsection within the Immunization section. Gazetteer represents geographic locations in a formal ontological hierarchy. The IEDB's Geographic Location Finder was created by taking the geographic locations mentioned in the manuscripts containing data curated by the IEDB and presenting them in the formal ontological hierarchy of Gazetteer. Thus, every geographic location in the Finder links out to a GAZ ID, where additional information provided by Gazetteer such as definitions and synonyms can be found.

To use the Finder, simply navigate the tree by clicking open the continent of choice to find the country(ies) where study subjects were exposed to the immunogen tested in the immune epitope assays. Alternatively, one may use the "Search By" feature and type free text to search the tree. The Search By feature accepts synonyms as search criteria. Its use is shown in Figure 2.34 for the term “Mexico”.

It must be noted that curators only capture geographic location information when authors explicitly state that subjects were recruited in a specific country. The location of authors' affiliations is not used to populate this field.



Current Selection(s): Mexico

Name: Mexico

1 Records Found   Page 1 of 1   5 Per Page

Name	GAZ Id	Synonyms
Mexico	GAZ_00002852	United Mexican States, Estados Unidos Mexicanos {language: Spanish}

1 Records Found   Page 1 of 1   5 Per Page

Figure 2.34 Geolocation finder. This example shows the tree structure by continent, region, and country. A search was made for Mexico within the tree using the Search By box on the left, which produced one result. This was then highlighted in the tree, as shown. Clicking on "Mexico" in the tree populated the Current Selection field in the upper left corner of the finder.

2.3 Tools

The Analysis Resource pull-down menu at www.iedb.org accesses the IEDB Analysis Resource and has five items – Analysis Resource Overview, T Cell Epitope Prediction, B Cell Epitope Prediction, Epitope Analysis Tools, and Tool Licensing Information. The purpose of the Analysis Resource of the IEDB is to provide computational tools that enhance the value of the IEDB database to the user. Providing access to tools in one centralized location helps make users aware of available solutions to their problems. All of the information contained within the Analysis Resource, including analysis tools and algorithms developed by the IEDB staff, are freely available to the scientific community. For commercial entities that wish to access the tools in-house, licensing information for the tools can be accessed from the pull-down menu. The Analysis Resource can also be accessed via the rightmost panel on the IEDB home page, although only the most frequently used tools are listed.

The tools provided in the analysis resource fall into two categories – prediction tools and analysis tools. Prediction tools extrapolate beyond data held in the database. They can be used to predict epitopes in protein sequences or predict properties of known epitopes, such as their MHC binding affinity. Analysis tools help extract and interpret data contained in the database.

For prediction tools, it is important to differentiate between the **tool** making predictions, and the **method** used to generate that tool, given a set of training data. For example, the artificial neural network (ANN) method or approach, when trained on a particular data set, will yield a prediction tool. As the ANN method is trained on different data sets, different corresponding prediction tools will result. In this way, the ANN method can be used to develop an MHC class I prediction tool and a separate MHC class II prediction tool. These tools can be refined as more data are available for training. One benefit of the IEDB is that it allows implementing methods to automatically generate new prediction tools as the database grows.

The AR Labs concept was introduced in early 2016. Tools under AR Labs are experimental and are considered to be beta versions, not quite ready for production yet. They are intended for further research, updates and testing. This means they are functional, but the team is still actively developing on improving them and more substantial changes are expected in upcoming releases.

The next subsections will describe each prediction and analytical tool in more detail.

2.3.1 T Cell and B Cell Prediction Tools

Prediction tools can be subdivided into categories by what they predict. The current tools fall into the subcategories listed below:

- T cell epitopes – MHC class I and II binding prediction
- T cell epitopes – Processing prediction
- T cell epitopes – Immunogenicity prediction
- B cell epitope prediction
- Structure tools

2.3.1.1 T Cell Epitopes - MHC binding prediction

The Analysis Resource provides tools for predicting peptide binding to MHC class I and II molecules. For class I binding predictions, users can select predictions performed with tools derived from ten different methods – IEDB Recommended, artificial neural network (ANN), stabilized matrix method (SMM), SMM with a peptide:MHC binding energy covariance matrix (SMMPMBEC), Scoring matrices derived from combinatorial peptide libraries (Comblib_Sidney2008), Consensus, NetMHCpan, PickPocket, NetMHCcons, and NetMHCstabpan. The Consensus method is derived from the ANN, SMM, and CombLib methods. For class II binding predictions, users can select IEDB Recommended, the Combinatorial Library method, the NN_align, the SMM_align method, a method devised by Sturniolo et al. and used in TEPITOPE, NetMHCIIpan, and a consensus method derived from the NN-align, SMM_align, Sturniolo methods, and the Combinatorial Library. Tutorials and example data are available for both the class I and II tools.

A RESTful interface is available for the MHC class I and class II prediction tools. This allows users to perform predictions on the IEDB server in batch mode without having to install any software on their own systems. Additionally, users will always be assured that they are using the latest version of the tools. More information is available in Section 2.3.5. These tools are also available in standalone form on the Download tab and can be downloaded at http://tools.iedb.org/main/download/.

2.3.1.1.1 Peptide Binding to MHC Class I Molecules

Users can select from ten different methods for predicting class I epitopes – ANN, SMM, SMMPMBEC, Comblib_Sidney2008, Consensus, NetMHCpan, NetMHCcons, PickPocket, NetMHCstabpan, and IEDB recommended, which are described further below. A check box can be used to show only frequently occurring alleles. This allows the selection of only those alleles that occur in at least 1% of the human population or allele frequency of 1% or higher. However, un-checking the check-box will allow selection of all the alleles and corresponding peptide lengths for a particular species. Users can also upload an allele file instead of entering allele on the page one at a time.

Artificial Neural Network
Artificial neural networks (ANN) are computer algorithms modeled after the brain. They consist of many simple processing units which are wired together in a communication network. Each unit is a simplified model of a neuron which sends off a new signal if it receives a sufficiently strong input signal from the other units to which it is connected. The strength of these connections can be varied in order for the network to perform a desired pattern of node signal activity, which is learned from a set of input training data.

ANNs have been trained for 81 different Human MHC alleles including HLA-A, -B, -C and -E. Furthermore, predictions for 41 animal (Monkey, Cattle, Pig, and Mouse) alleles are available. The current version of ANN is based on NetMHC 4.0. The method is described in Nielsen et al. (Protein Science, 2003) and Andreatta and Nielsen (Bionformatics, 2016).

Stabilized Matrix Method (SMM)
The Stabilized Matrix Method (SMM) described by Peters and Sette (BMC Bioinformatics, 2005) can be applied to calculate matrices from quantitative affinity data of peptides binding to MHC molecules. The advantage of this method is that it suppresses the noise present in the training data, caused by the inevitable experimental error as well as the limited number of data points.

Stabilized matrix Method with a Peptide:MHC Binding Energy Covariance matrix (SMMPMBEC)
SMMPMBEC is an improved version of SMM. It is different from SMM in that it addresses sparseness of peptide sequence coverage that is often found in binding data sets by using Peptide:MHC Binding Energy Covariance (PMBEC). The PMBEC matrix was derived from experimentally determined binding affinity measurements using combinatorial peptide libraries. SMMPMBEC is described in Kim et al. BMC Bioinformatics 2009.

Scoring matrices derived from combinatorial peptide libraries (Comblib_Sidney2008)
Comblib_Sidney2008 refers to a set of predictors (i.e. scoring matrices) that were derived from binding affinity measurements of combinatorial peptide libraries against a panel of MHC alleles. This work is

described in Sidney et al. (Immunome Res. 2008). This class of predictors is unique in that average binding energy contribution of a given residue at a position is directly measured, without worrying about limited peptide sequence coverage.

Consensus

The Consensus predictor was motivated by an idea that predictions made by consulting "consensus" of individual predictions from multiple predictors may result in improved performance over that of any individual ones. For MHC-I, a work describing an early implementation can be found in Moutaftsi et al. (Nat Biotech 2006). The methods used for Consensus are ANN, SMM, and CombLib_Sidney2008. The Consensus method uses as many of these three component methods as possible, depending on their applicability for the chosen allele and length.

NetMHCpan

NetMHCpan version 4.0 predicts binding of peptides to any MHC class I molecule of known sequence using artificial neural networks (ANNs). The method is trained on binding affinity and eluted ligand data leveraging the information from both data types as described in Jurtz et al. (J Immunol, 2017). To train this method, data on all class I MHC ligand elution assays available in IEDB database were collected including the ligand sequence, details of the source protein, position of the ligand in the source protein and the restricting allele of the ligand. There were 160,527 distinct assays in total and the length of the ligands ranged from 4–37. All lengths with a count of ligands at least 0.5% of total ligands were selected for further analysis which included lengths 8–15 and comprised of 99% of the assay entries. After refinement described in Jurtz et al. (J Immunol, 2017), the final training data set had 85,217 entries in total with ligand length ranging from 8 to 15. The ligands originated from 14,797 source antigens and were restricted by 55 unique HLA molecules. Random artificial negatives were generated for each MHC molecule covered by eluted ligand data by sampling randomly 10*N peptides of each length 8–15 amino acids from the antigen source protein sequences, where N is the number of 9mer ligands for the given MHC molecule.

In 2020, NetMHCpan was updated to version 4.1, as described in Reynisson et al. (Nucleic Acids Res, 2020). The updated version of NetMHCpan differs from its predecessor in two critical aspects: the training data and the machine-learning modeling framework. The training data have been vastly extended by accumulating MHC BA and EL data from the public domain. In particular, EL data were extended to include MA data. The combined dataset used for training of NetMHCpan-4.1 consists of 13,245,212 data points covering 250 distinct MHC class I molecules. The machine learning framework was updated from NNAlign to NNAlign_MA to allow for effective handling of these MA data. In short, the NNAlign framework is a single-allele framework permitting the integration of mixed data types (BA and EL) in the model training, which allows information to be leveraged across the different data types, resulting in a boosted predictive power. NNAlign_MA extends this training framework to allow for the incorporation of EL MA data. This is achieved by iteratively annotating the best single-allele to the MA data during the model training, effectively deconvoluting the MA binding motifs. In 2020, NetMHCpan EL 4.1 became the 'IEDB recommended' method based on benchmarking results.

PickPocket

PickPocket predicts binding of peptides to any known MHC molecule using position specific weight matrices. The method is trained on more than 150,000 quantitative binding data covering more than 150 different MHC molecules. Predictions can be made for HLA-A, B, C, E and G alleles, as well as for non-human primates, mouse, cattle, and pig. Version 1.1 has been retrained on extensive data sets, including 10 prevalent HLA-C and 7 prevalent BoLA MHC-I molecules. The matrices of pocket-library are generated using the SMM_pmbec method described in Kim et al. (BMC Bioinformatics, 2009). Predictions can be made for 8 – 12mer peptides. All non-9mer predictions are made using approximations. The prediction values are given in nM IC50 values. The algorithm is described in Zhang et al. (Bioinformatics, 2009).

NetMHCcons

NetMHCcons predicts binding of peptides to any known MHC class I molecule. This is a consensus method for MHC class I predictions integrating three state-of-the-art methods, NetMHC, NetMHCpan, and PickPocket, to give the most accurate predictions. NetMHC is an artificial neural network-based (ANN) allele-specific method which has been trained using 94 MHC class I alleles. Version 3.4 is used as part of NetMHCcons-1.1. NetMHCpan is a pan-specific ANN method trained on more than 115,000 quantitative binding data covering more than 120 different MHC molecules. Version 2.8 is used as part of NetMHCcons-1.1. PickPocket Version 1.1 is described above. NetMHCcons can generate predictions for peptides of 8 – 15 residues in length. The prediction values are given in nM IC50 values. The method is described in detail in Karosiene et al. (Immunogenetics, 2012).

NetMHCstabpan

NetMHCstabpan was introduced in 2016. It predicts binding stability of peptides to any known MHC molecule using artificial neural networks (ANNs). The method is trained on more than 25,000 quantitative stability data covering 75 different HLA molecules. The user can upload full length MHC protein sequences, and have the server predict MHC restricted peptides from any given protein of interest. Predictions can be made for 8-14 mer peptides, although all non 9mer predictions are made using approximations. Most HLA molecules have a strong preference for binding 9mers. The prediction values are given in half life time in hours values and as %-Rank to a set of 200,000 random natural peptides. The method is described in Rasmussen et al. (Journal of Immunology, 2016).

IEDB Recommended

IEDB recommended is the default prediction method selection. Prior to 2020, IEDB recommended considered all alleles and their corresponding peptide lengths for a particular species. For each allele-length combination, consensus method was used, which includes ANN, SMM, and CombLib. However, as of 2020, NetMHCpan EL 4.1 became the 'IEDB recommended' method based on benchmarking results.

2.3.1.1.2 Peptide Binding to MHC Class II Molecules

Users can select from seven different methods for predicting class II epitopes – IEDB recommended, SMM-align, Sturniolo, Combinatorial Library, Consensus, NN-align, and NetMHCIIpan. By default, the overall best method (IEDB recommended) is selected. However, not all methods can currently make predictions for all alleles, so only the alleles available will be displayed. The seven methods are described further below.

SMM-align

The MHC class II binding groove is open at both ends making the correct alignment of a peptide in the binding groove a crucial part of identifying the core of an MHC class II binding motif. The stabilization matrix alignment method, SMM-align, allows for direct prediction of peptide:MHC binding affinities. The method uses amino terminal peptide flanking residues (PFR) to get a consistent gain in predictive performance by favoring binding registers with a minimum PFR length of two amino acids. The method predicts quantitative peptide:MHC binding affinity values. The method has been trained and evaluated on a data set that covers the nine HLA-DR supertypes suggested and three mouse H2-IA allele. The method is described by Nielsen et al. (BMC Bioinformatics, 2007).

Sturniolo

This matrix-based approach is used in the TEPITOPE class II epitope prediction program. It is described in Sturniolo et al. (Nat. Biotechnol., 1999).

Combinatorial Library

The positional scanning combinatorial libraries approach utilized a pool of random peptide libraries to systematically measure the contribution to MHC binding from each amino acid at each of the nine positions at the binding peptide. Each pool in the library contains 9-mer peptides with one fixed residue at a single position. With each of the 20 naturally occurring residues represented at each position along the 9-mer backbone, the entire library consisted of 180 peptide mixtures. Competitive binding assays were then carried out to determine the IC50 values for each pool. IC50 values for each mixture were standardized as a ratio to the geometric mean IC50 value of the entire set of 180 mixtures, and then normalized at each position so that the value associated with the optimal value at each position corresponds to 1. For each position, an average (geometric) relative binding affinity (ARB) was calculated, and then the ratio of the ARB for the entire library to the ARB for each position was derived. The final results are a set of 9 by 20 scoring matrices which could predict the binding of novel peptides to MHC molecules.

The methodology is the same as that used for the MHC class I combinatorial library tool as described in Sidney et al. Immunome Res. 2008. A description of the ARB method is contained in Bui et al., Immunogenetics, 2005.

Consensus

The consensus method was developed by the IEDB team by exploiting features of three aforementioned methods. The Consensus method uses NN-align, SMM-align, and the combinatorial peptide scanning library. When the scanning library is not available for an allele, the Sturniolo method is used instead. A paper describing the original method was published by Wang et al. (PLoS Comput Biol, 2008), and a subsequent paper was published by Wang et al. (BMC Bioinformatics, 2010). The datasets used in assessing the performance of the NN-align, SMM-align, and Sturniolo methods and in developing the Consensus method, as described in Wang et al. (2010), can be found at http://tools.iedb.org/main/datasets/.

NN-align

NN-align is an artificial neural network-based alignment algorithm for MHC class II peptide binding prediction. It simultaneously identifies the MHC class II binding core and binding affinity. The method is trained using an algorithm that corrects bias in the training data caused by redundancy in binding core representation. Prediction accuracy has been shown to improve significantly when information about the residues flanking the peptide-binding core is considered. A 2009 paper in BMC Bioinformatics by Nielsen and Lund describes the method in detail (PMID: 19765293).

NetMHCIIpan

NetMHCIIpan predicts binding of peptides for all three human MHC class II isotypes- HLA-DR, HLA-DP, and HLA-DQ, in addition to mouse H-2-I molecules. A paper describing the method was published by Nielsen et al. in PLoS Computational Biology, 2008, and a paper describing the latest version 3.1 was published by Andreatta et al. in Immunogenetics, 2015.

In 2020, NetMHCIIpan was updated to version 4.0, as described in Reynisson et al. (Nucleic Acids Res, 2020). The updated version of NetMHCIIpan differs from its predecessor in two critical aspects: the training data and the machine-learning modeling framework. The training data have been vastly extended by accumulating MHC BA and EL data from the public domain. In particular, EL data were extended to include MA data. The combined dataset used for training of NetMHCIIpan-4.0 consists of 4 086 230 data points covering a total of 116 distinct MHC class II molecules. The machine learning framework was updated from NNAlign to NNAlign_MA to allow for effective handling of these MA data. In short, the NNAlign framework is a single-allele framework permitting the integration of mixed data types (BA and EL) in the model training, which allows information to be leveraged across the different data types, resulting in a boosted predictive power. NNAlign_MA extends this training framework to allow for the incorporation of EL MA data. This is achieved by iteratively annotating the best single-allele to the MA data during the model training, effectively deconvoluting the MA binding motifs.

IEDB Recommended
IEDB recommended 2.22 is the default prediction method selection. It considers all alleles and their corresponding peptide lengths for a particular species. For each allele-length combination, consensus method is used, as described above. If none of these methods are available for the allele, NetMHCIIpan is used.

2.3.1.1.3 Tepitool

The tool is designed as a wizard for the prediction of T cell epitope candidates from a given set of amino acid sequences, based on predicted peptide binding to MHC class I and class II molecules, where the user is led through a series of well-defined steps to complete the task. In contrast to the independent methods described above, Tepitool guides the user step-by-step as a client-side web form that takes user input data that is in turn processed at the server-side when the user submits the entire form. All fields except sequences and alleles are filled with default recommended settings for prediction and selection of optimum peptides. The input parameters can be adjusted as per the user's specific needs, and the user can go back to previous steps to change the selection before final submission of the job. The TepiTool has six steps:

(i) Provide sequence data.
(ii) Select the host species and MHC allele class.
(iii) Select the alleles for binding prediction.
(iv) Select peptides to be included in prediction.
(v) Select preferred methods for binding prediction and peptide selection and cutoff values.
(vi) Review selections, enter job details and submit data.

The tool is described in Paul et al. (Curr. Protoc. Immunol., 2016).

2.3.1.2 T Cell Epitopes – MHC Processing Prediction

2.3.1.2.1 Proteasomal cleavage/TAP transport/MHC class I combined predictor

For the prediction of antigen processing through the MHC class I antigen presentation pathway, we incorporated predictions of proteasomal cleavage and TAP transport similar to the MHCPathway website described in (Tenzer et al, CMLS, 2005). The predictions are based on in vitro experiments characterizing the sequence specificity of proteasomal cleavage and TAP transport. The goal of the prediction is to identify MHC-I ligands (peptides that are naturally processed from their source proteins and presented by MHC class I molecules).

The proteasomal cleavage predictions evaluate how efficiently a peptide or its N-terminally prolonged precursors can be liberated from its source protein. The TAP transport predictions evaluate how efficiently a peptide or its N-terminal prolonged precursors are transported into the ER by TAP (Peters et al., Immunol, 2003). When this information is taken together and combined with MHC class I binding predictions, the tool yields a prediction of the efficiency with which a peptide is presented on the cell surface. The methods available are ANN, SMM, SMMPMBEC, Comblib_Sidney2008, NetMHCpan, PickPocket, NetMHCcons, and IEDB Recommended, which are described in Section 2.3.1.1.1.

A check box can be used to show only frequently occurring alleles. This allows the selection of only those alleles that occur in at least 1% of the human population or allele frequency of 1% or higher. However, un-checking the check-box will allow selection of all the alleles and corresponding peptide lengths for a particular species. Users can also upload an allele file instead of entering allele on the page one at a time.

2.3.1.2.2 Neural network-based prediction of proteasomal cleavage sites (NetChop) and T cell epitopes (NetCTL/NetCTLpan)

NetChop produces neural network predictions for cleavage sites of the human proteasome (Kesmir et al., 2002). NetChop considers the characteristics of the structurally modified proteasomes found in cells stimulated by gamma-interferon under physiological conditions. The NetChop algorithm was trained on in vitro data and MHC Class I ligand data. The use of this training set, combined with the artificial neural network methodology, makes the prediction of cleavage sites more accurate. NetChop has been trained only on human data, but since the proteasome structure is quite conserved, the algorithm developers believe that the tool is capable of making reliable predictions for at least the other mammalian proteasomes.

NetCTL predicts CTL epitopes in protein sequences integrating prediction of peptide MHC binding, proteasomal C terminal cleavage and TAP transport efficiency. The method is described in detail in Larsen et al. (Eur J Immunol., 2005). NetCTLpan is an update to the original NetCTL server that allows for prediction of CTL epitope with restriction to any MHC molecules of known protein sequence (Stranzl et al., Immunogenetics, 2010). This tool is also available in a standalone form on the Download tab and can be downloaded at http://tools.iedb.org/main/download/.

2.3.1.2.3 MHC-NP: Prediction of peptides naturally processed by the MHC

MHC-NP is a tool for predicting peptides naturally processed by the MHC pathway and was introduced to the Analysis Resource in 2013. MHC-NP employs data obtained from MHC elution experiments in order to assess the probability that a given peptide is naturally processed and binds to a given MHC molecule. This tool was the winner of the 2nd Machine Learning Competition in Immunology, where it yielded state-of-the-art accuracy for the prediction of peptides eluted from human HLA-A*02:01, HLA-B*07:02, HLA-B*35:01, HLA-B*44:03, HLA-B*53:01, HLA-B*57:01 and mouse H2-D(b) and H2-K(b) MHC molecules. The method is described in Giguère et al. (J Immunol Methods, 2013). Because the tool was developed by researchers external to the IEDB team, it is not included in the virtual machine image.

2.3.1.2.4 MHC-II-NP: Prediction of peptides naturally processed by the MHC

Although algorithms for the prediction of peptide binding affinity to MHC II molecules exist, there is a lack of methods that predict the ligands resulting from natural antigen processing. To address this gap MHC-II-NP was developed.

The training ligand dataset, obtained through IEDB database query, contained more than 14,000 naturally processed ligands identified by MS of peptides eluted from MHC class II-expressing cells (from approximately 2,600 unique protein sequences). Analysis into sequence signatures which liberate peptides from their source antigens revealed preferred amino acids surrounding both N- and C- ligand terminuses. These cleavage motifs were used to develop this method for predicting naturally processed MHC II ligands as described in Paul et al. (Front. Immunol., 2018).

2.3.1.3 T Cell Class I pMHC Immunogenicity Predictor

An MHC class I immunogenicity tool was introduced in 2013. T-cells have to recognize peptides presented on MHC molecules to be activated and elicit their effector functions. Several studies have demonstrated that some peptides are more immunogenic than others and therefore more likely to be T-cell epitopes. This tool is based on an analysis of a large set of data describing the immunogenicity of peptides presented on various MHC-I molecules.

Two main conclusions could be drawn from this analysis. First, in line with previous observations, the developers showed that positions P4-6 of a presented peptide are more important for immunogenicity. Second, some amino acids, especially those with large and aromatic side chains, are associated with immunogenicity. This information was combined into a simple model that was used to demonstrate that immunogenicity is, to a certain extent, predictable. This model was validated with data from two independent epitope discovery studies. This model indicated that T-cells are equipped to better recognize viral than human (self) peptides. The method is described in Calis et al. (PLoS Comput Biol., 2013). This tool is also available in a standalone form on the Download tab and can be downloaded at http://tools.iedb.org/main/download/.

2.3.1.4 Deimmunization

The deimmunization tool is attempt to identify immunodominant regions in a given therapeutically important protein, and suggest amino-acid substitutions that create non-immunogenic versions of the proteins. Therefore, we have opted for a two steps process; 1) In the first step, the deimmunization tool will list all the immunogenic regions or peptides based on selected threshold. These peptides will be generated from the protein with 15mer window size and 10mer overlap. 2) In the second step, the user can select one or more peptides listed in the results and final result window will display the non-immunogenic substitution of each selected peptides. The default threshold is 8.5 (which is difference in the median of percentile rank from 26 reference alleles set for MHC class II). In the final result window, the tools will also take care of the fact that non-immunogenic substitution in the immunogenic peptides, should not create new immunogenic site in the neighboring peptides. Therefore, the result window will also display the effect of substitution on the neighboring peptides.

This tool is described in Dhanda et al. (Immunology, 2018).

2.3.1.5 CD4 T cell immunogenicity

The server is developed to predict the allele independent CD4 T cell immunogenicity at population level, overcoming complications related to the high level of variability of HLA molecules, potential other factors beyond HLA as well as a frequent lack of HLA typing data. With this tool, users can predict the T cell immunogenicity using 7-allele method (Paul et. al. 2015), immunogenicity method and combined method (IEDB recommended). The combined method predicts the final score that combines the predictions from 7-allele method and immunogenicity method.

This tool is described in Dhanda et al. (Front Immunol, 2018).

2.3.2 B Cell Epitope Prediction

2.3.2.1 Prediction of linear epitopes from protein sequence

Six different tools are provided that predict antibody epitope candidates from amino acid sequences. Five are based on amino acid property scales and a sixth method uses a Hidden Markov Model. Parameters such as hydrophilicity, flexibility, accessibility, and antigenic propensity of polypeptides chains have been correlated with the location of continuous epitopes in a few well-characterized proteins. Based on these observations, amino acid property scales have been developed to predict antigenic determinants. Each scale consists of 20 values assigned to each of the amino acid residues on the basis of their relative propensity to possess the property described by the scale. The following amino acid property scales have been selected and implemented based on their popularity and coverage of different categories.

- Secondary structure - Chou and Fasman beta turn prediction
- Surface exposure - Emini surface accessibility prediction
- Flexibility - Karplus and Schulz flexibility prediction
- Antigenicity - Kolaskar and Tongaonkar antigenicity prediction
- Hydrophobicity/hydrophilicity - Parker hydrophilicity prediction

BepiPred combines the predictions of a hidden Markov model and the propensity scale of Parker et al. (Biochemistry, 1986). It is described in Larsen et al. (Immunome Research, 2006). The linear B cell epitope predictor is also available as a standalone tool. In 2017, BepiPred 2.0 was developed and published (Nucleic Acids Res, 2017), PMID: 28472356. BepiPred-2.0 uses structural predictions, such as surface accessibility and secondary structure as part of the feature space. Using a Random Forest machine-learning algorithm trained on structural epitopes obtained from 160 3D-structures, they improved the performance significantly compared to the prior version and other state-of-the-art prediction tools.

2.3.2.2 DiscoTope - Prediction of epitopes from protein structure

DiscoTope was augmented in 2013 to include version 2.0 as well as version 1.1. DiscoTope is designed specifically to predict discontinuous epitopes. It uses protein three-dimensional structural data in addition sequence data. The method is based on amino acid statistics, spatial information, and surface accessibility in a compiled data set of discontinuous epitopes determined by X-ray crystallography of antibody/antigen protein complexes. DiscoTope 2.0 works with a novel definition of the spatial neighborhood used to sum propensity scores and half-sphere exposure as a surface measure. The results are more accurate than version 1.1 but involve more complex calculations that increase run times by a factor of approximately 30.

DiscoTope 1.1 is described in Haste Andersen et al. (Protein Sci., 2006), and DiscoTope 2.0 is described in Kringelum et al. (PLoS Comp. Bio, 2012).

2.3.2.3 ElliPro - Epitope prediction based upon structural protrusion

ElliPro predicts linear and discontinuous antibody epitopes based on a protein antigen's 3D structure. ElliPro accepts either a protein structure (preferred) or a protein sequence as an input. If a protein sequence is used, ElliPro will predict its 3D structure by homology modeling. Its use if described in the Tutorial tab of the ElliPro section of the Analysis Resource. The method is described in Julia Ponomarenko et al. (BMC Bioinformatics, 2008). It is also available as a standalone tool.

2.3.2.4 Methods for modeling and docking of antibody and protein 3D structures

This web page provides information on methods for modeling and docking of antibody and protein 3D structures. The methods are available as web servers and are hosted outside the IEDB except one method, LYRA, described above. One of the approaches at B-cell epitope prediction involves antibody-antigen docking, or 3D modeling of an antibody-antigen complex, for known 3D structures of both antibody and antigen. When the structures of either antibody or protein or both are unknown (that is, not available in PDB) but sequences are known, the user can attempt to obtain the 3D structural models of the antibody and the antigen, following the chart displayed on the web page and using the described web servers. Links are provided to these servers for the user’s convenience.

2.3.3 Structure Tools

2.3.3.1 LYmphocyte Receptor Automated modeling (LYRA)

The LYRA web server implements a complete and automated method for building of B- and T-cell receptor structural models starting from their amino acid sequence alone. The webserver is freely available and easy to use for non-specialists. Upon submission, LYRA automatically generates alignments using ad hoc profiles, predicts the structural class of each hypervariable loop, selects the best templates in an automatic fashion, and provides within minutes a complete 3D model that can be downloaded or inspected online. Experienced users can manually select or exclude template structures according to case specific information. LYRA is based on the canonical structure method, that in the last 30 years has been successfully used to generate antibody models of high accuracy, and in our benchmarks this approach proves to achieve similarly good results on TCR modeling, with a benchmarked average RMSD accuracy of 1.29 and 1.48 Å for B- and T-cell receptors, respectively. The tool is described in detail by Klausen et al. (Nucleic Acids Research, 2015).

2.3.3.2 Structural Complexes of Epitope Receptor (SCEptRe)

SCEptRe provides weekly updated, non-redundant, user customized benchmark datasets with information on the immune receptor features for receptor-specific epitope predictions. This tool extracts weekly updated 3D complexes of antibody-antigen, TCR-pMHC and MHC-ligand from the Immune Epitope Database (IEDB) and clusters them based on antigens, receptors and epitopes to generate benchmark datasets. Users can customize structural quality and clustering parameters (e.g., resolution, R free factors, antigen or epitope sequence identity) to generate these datasets based on their need. The tool is described in detail by Mahajan et al. (BMC Bioinformatics, 2019).

2.3.3.3 Docktope

Docktope is a web-based tool, based on the D1-EM-D2 approach, intended to allow the pMHC-I modeling. Some applications allowed from the pMHC-I construction include the study of the pMHC-I tridimensional structure, epitope-MHC-I interaction patterns, cross-reactivity assessment and molecular dynamics studies. The tool allows the user to construct pMHC-I structures for the following alleles: HLA-A*02:01 (9-mer epitopes), HLA-B*27:05 (9-mer epitopes), H2-Db (9-mer/10-mer epitopes) and H2-Kb (8-mer epitopes). The tool is described in detail by Rigo et al. (Scientific Reports, 2015).

2.3.4 Epitope Analysis Tools

2.3.4.1 Population Coverage

T cells recognize a complex between a specific MHC type and a particular pathogen-derived epitope and thus a given epitope will elicit a response only in individuals that express an MHC molecule capable of binding that particular epitope. MHC molecules are extremely polymorphic (over a thousand different variants are known in humans). Therefore, selecting multiple peptides with different MHC binding specificities will afford increased coverage of the patient population targeted as vaccine recipients. The issue of population coverage in relation to MHC polymorphism is further complicated by the fact that different MHC types are expressed at dramatically different frequencies in different ethnicities. Thus, without careful consideration, a vaccine with ethnically biased population coverage could result. To address this issue, the actual/predicted binding capacity of potential epitopes to as many different MHC molecules possible (and when available, also restriction data of T cell responses recognizing the epitope) can be used to project the population coverage in different ethnicities of different vaccine candidates or epitope sets. Accordingly, epitope-based vaccines or diagnostics can be designed to maximize population coverage, while minimizing complexity (that is, the number of different epitopes included in the diagnostic or vaccine), and also minimizing the variability of coverage obtained or projected in different ethnic groups.

An important consideration in the process of epitope selection is that the patient population coverage afforded by a given set is not simply corresponding to the sum of the coverage of its individual components. Thus, to calculate the coverage afforded by a given mixture of epitopes, a more comprehensive approach and a suitable algorithm has been developed for this specific purpose (Bui et al. BMC Bioinformatics 2006). This method calculates the fraction of individuals predicted to respond to a given epitope set on the basis of HLA genotypic frequencies, assuming non-linkage disequilibrium between HLA loci, and on the basis of MHC binding and/or T cell restriction data. The algorithm is briefly explained here. First, genotypic frequencies of various MHC are tabulated. Each time a peptide binds to a given MHC, a "hit" is recorded for that MHC. The process is repeated for all peptides. Then the hits for MHC are tallied. Next, the frequency of each possible diploid MHC combination (phenotype) is calculated. For n MHC types, this corresponds to an $n \times n$ tabulation of the frequency at which each specific pair of MHCs will be found in the population from which the MHC frequencies are derived. A similar table is generated to contain the number of hits per each of the MHC combinations by adding the number of hits associated with each of the two alleles of MHC in the combination (a simple exception is the case of homozygous combinations, where the number of hits is simply the number of hits of the given MHC). From these two tables, a frequency distribution is assembled, tabulating the genotypic frequency of all MHC combinations associated with a certain number of hits. The result of the analysis is displayed as a frequency distribution histogram and a cumulative frequency plot.

HLA allele genotypic frequencies were obtained from Allele Frequency Net Database (http://www.allelefrequencies.net/). At present, Allele Frequency Net Database (Gonzalez-Galarza FF et al., Nucleic Acids Res. 2015) provides allele frequencies for 115 countries and 20 different ethnicities grouped into 16 different geographical areas. In addition, the program also accepts custom populations with allele frequencies defined by users. Multiple population coverages can be simultaneously calculated and an average population coverage is generated. Since MHC class I and MHC class II restricted T cell epitopes elicit immune responses from two different T cell populations (CTL and HTL, respectively), the program provides three calculation options to accommodate different coverage modes: (1) class I separate, (2) class II separate, and (3) class I and class II combined. For each population coverage, the tool computes the following: (1) projected population coverage, (2) average number of epitope hits / HLA combinations recognized by the population, and (3) minimum number of epitope hits / HLA combinations recognized by 90% of the population (PC90).

2.3.4.2 Epitope Conservancy

In a diagnostic or epitope-based vaccine setting, focusing on conserved epitopes allows for targeting responses around pathogen variability, whether it exists prior to infection, or develops in the natural course of disease. The use of conserved epitopes would be expected to focus the immune response on sequences crucial for retaining biological function of the pathogen proteins, and thus with intrinsically lower variability, even under immune pressure. The epitope conservancy analysis tools implemented here aims to address the issue of variability (or conservation) of epitopes, and to assist in the selection of epitopes with the desired pattern of conservation. The algorithm has been implemented to calculate the degree of conservancy of an epitope within a given protein sequence set at different degree of identities. The degree of conservation is defined as the number of protein sequences that contain the epitope at a given identity level, divided by the total number of protein sequences found in the dataset analyzed (Bui et al. BMC Bioinformatics 2007).

Users can now also indicate whether they want duplicated protein sequences removed from the results set by checking a box in the “Specify calculation options” section of the input page. Previously redundant results were removed. For users wanting to study different populations, keeping redundant sequences can be very informative.

2.3.4.3 Epitope Cluster Analysis

Version 2.0 of the Epitope Cluster Analysis tool (Dhanda et al., Immunology. 2018) was released in 2018. This new version expanded tool functionality to include graphical representation, to provide connectivity within a cluster, to generate epitope clusters based on representative or consensus sequences, and to calculate overhang sequence identity. The base functionality of the tool remained the same.

The tool groups epitopes into clusters based on sequence identity. A cluster is defined as a group of sequences that has a sequence similarity greater than the minimum sequence identity threshold specified. Epitope sequences can be either directly entered in the text area or uploaded from a file. Two acceptable sequence formats are PLAIN and FASTA. The user can select the sequence identity threshold at which they want to calculate epitope clusters. Clusters are displayed in a table format where clusters are indicated by table rows which have the same color.

2.3.4.4 Computational Methods for Mapping Mimotopes to Protein Antigens

A web page devised by Dr. Julia Ponomarenko was added to the Analysis Tools section in 2014 that provides guidelines for mapping mimotopes to protein antigens. Mimotopes are molecules, often peptides, which are recognized by antibodies or T cells that were primed to recognize a different epitope. For antibody epitope mapping, peptide mimotopes can be selected from a combinatorial library (usually peptides from a specific protein antigen) on binding to a specific monoclonal antibody with high affinity. They are commonly obtained using phage display. Experimental data on mimotopes can be found in the IEDB, MimoDB (http://immunet.cn/mimodb/index.html), and journal publications. Mimotopes can mimic essential features of genuine epitopes and therefore their mapping to the antigen is a logical and essential step of the mimotope analysis. This web page provides information on available methods for mimotope mapping, how to search the IEDB for mimotopes, and an example of a mimotope dataset and the results of its mapping, using the available web servers hosted outside the IEDB.

Methods available as web servers and operational as of July 2014 (they all require the user submitting an antigen protein 3D structure, providing either PDB ID of the structure or the pdb file) are as follows:

- **MIMOX** (http://immunet.cn/mimox/)
- **Pepitope server** (http://pepitope.tau.ac.il/) provides three algorithms: Mapitope, PepSurf, or combined
- **EpiSearch** (http://curie.utmb.edu/episearch.html)

The web page also lists other published methods that are unavailable as web servers. They include the following:

- **PepMapper** (http://www.ncbi.nlm.nih.gov/pubmed/22701536) (2012) - provided URL didn't respond
- **MimoPro** (http://www.ncbi.nlm.nih.gov/pubmed/21609501) (2011) - provided URL didn't respond
- **Pep-3D-Search** (http://www.ncbi.nlm.nih.gov/pubmed/19087303) (2008) - available for download at http://kyc.nenu.edu.cn/Pep3DSearch/
- **MEPS** (http://www.ncbi.nlm.nih.gov/pubmed/17430573) (2007)
- **MIMOP** (http://www.ncbi.nlm.nih.gov/pubmed/16434442) (2006)
- **3D-Epitope-Explorer (3DEX)** (http://www.ncbi.nlm.nih.gov/pubmed/15834923) (2005) - available for download at http://www.schreiber-abc.com/3dex/
- **Enshell-Seijffers et al.** (http://www.ncbi.nlm.nih.gov/pubmed/14596802) (2003)
- **FINDMAP** (http://www.ncbi.nlm.nih.gov/pubmed/12935344) (2003)
- **SiteLight** (http://www.ncbi.nlm.nih.gov/pubmed/12824481) (2003)

The webpage also contains instructions on how to search for mimotopes in the IEDB.

2.3.4.5 Restrictor Analysis Tool for Epitopes (RATE)

RATE is an automated method that can infer HLA restriction for a set of given epitopes from large datasets of T cell responses in HLA typed subjects. The tool takes two data files, one containing the alleles expressed by the subjects and the other containing the response of the peptides in the subjects. The tool calculates the odds ratio and estimates its significance using Fisher's exact test. It also calculates a parameter called relative frequency similar to odds ratio. The tool was developed with a focus on class II alleles but can also be applied to class I alleles. A description of the tool can be found in Paul et al. (Journal of Immunology, 2015).

In 2017, RATE was validated using experimentally defined restriction data from a set of 191 tuberculosis-derived epitopes and 63 healthy individuals with MTB infection from the Western Cape Region of South Africa. Additionally, the parameters used by the RATE tool to infer restriction were optimized. New HLA restrictions were identified using the optimized RATE tool. A description of this study can be found in Paul et al. (BMC Immunol, 2017).

2.3.4.6 ImmunomeBrowser

This tool aggregates all data relevant to the user query and allows one to visualize the known immune response to a specific antigen, as well as illustrating knowledge gaps in a reference protein. It provides the immune reactivity in terms of response frequency (RF) and the number of subjects tested/responded and/or number of independent assays performed along the length of reference protein. The tool was originally implemented in the results page of the database section of the IEDB. To further extend the usability to predicted epitopes and propriety epitopes or non-IEDB data, a stand-alone version of the tool was developed in 2018 (Dhanda et. al., Bioinformatics 2018). The standalone version maps user provided peptide sets and associated response data to a user-provided protein reference sequence. This now allows the user to analyze and visualize immunodominant regions within their own dataset. The results are presented both as a user interactive JavaScript based web interface and a tabular format in a selected reference sequence.

2.3.5 IEDB Analysis Resource Labs

The AR Labs concept was introduced in early 2016. Tools designated as within AR Labs are experimental and are considered to be beta versions, not quite ready for production yet. They are intended for further research, updates and testing. This means they are functional, but the team is still actively developing on improving them and more substantial changes are expected in upcoming releases. Therefore, users are asked not to expect the same level of stability for these tools as for other tools in the IEDB analysis resource. Users are welcome to send bug reports and suggestions for improvements for these tools via the help desk.

Of the tools described above, 8 tools are currently available under the Labs designation:

Prediction LABS Tools	Analysis LABS Tools
MHCII-NP	RATE
Deimmunization	ImmunomeBrowser
CD4 T Cell Immunogenicity	
LYRA	
SCEptRe	
Docktope	

2.3.6 Benchmark References and Data Sets

The “Datasets” tab contains data sets and references related to benchmarking results of the IEDB’s epitope prediction tools. There are three accordion sliders that can be expanded to reveal details. The three are for MHC class I binding prediction, MHC class II binding prediction, and B cell epitope prediction. In each case, the journal article title, authors, journal name, and year are listed along with a description of the data set, the date of its generation, details on the data set generation, the data format, and where the data set is available.

For the MHC class I binding predictions, the references are:

- Reynisson B, Alvarez B, Paul S, Peters B, Nielsen M. NetMHCpan-4.1 and NetMHCIIpan-4.0: improved predictions of MHC antigen presentation by concurrent motif deconvolution and integration of MS MHC eluted ligand data. Nucleic Acids Res. 2020 Jul 2;48(W1):W449-W454. doi: 10.1093/nar/gkaa379. PMID: 32406916; PMCID: PMC7319546.

- Jurtz V, Paul S, Andreatta M, Marcatili P, Peters B, Nielsen M. NetMHCpan-4.0: Improved Peptide-MHC Class I Interaction Predictions Integrating Eluted Ligand and Peptide Binding Affinity Data. J Immunol. 2017 Nov 1;199(9):3360-3368. doi: 10.4049/jimmunol.1700893. Epub 2017 Oct 4. PMID: 28978689; PMCID: PMC5679736.
- Trolle T, Metushi IG, Greenbaum JA, Kim Y, Sidney J, Lund O, Sette A, Peters B, Nielsen M. Automated benchmarking of peptide-MHC class I binding predictions. Bioinformatics. 2015 Jul 1;31(13):2174-81. doi: 10.1093/bioinformatics/btv123. Epub 2015 Feb 25. PMID: 25717196; PMCID: PMC4481849
- Kim Y, Sidney J, Buus S, Sette A, Nielsen M, Peters B. Dataset size and composition impact the reliability of performance benchmarks for peptide-MHC binding predictions. BMC Bioinformatics. 2014 Jul 14;15:241. doi: 10.1186/1471-2105-15-241. PMID: 25017736; PMCID: PMC4111843.
- Kim Y, Sidney J, Pinilla C, Sette A, Peters B. Derivation of an amino acid similarity matrix for peptide: MHC binding and its application as a Bayesian prior. BMC Bioinformatics. 2009 Nov 30;10:394. PMID: 19948066.
- Peters B, Bui HH, Frankild S, Nielson M, Lundegaard C, Kostem E, Basch D, Lamberth K, Harndahl M, Fleri W, Wilson SS, Sidney J, Lund O, Buus S, Sette A., A community resource benchmarking predictions of peptide binding to MHC-I molecules, PLoS Comput Biol. 2006 Jun 9;2(6):e65. Epub 2006 Jun 9. PMID: 16789818

For the MHC class II binding predictions, the references are:

- Reynisson B, Alvarez B, Paul S, Peters B, Nielsen M. NetMHCpan-4.1 and NetMHCIIpan-4.0: improved predictions of MHC antigen presentation by concurrent motif deconvolution and integration of MS MHC eluted ligand data. Nucleic Acids Res. 2020 Jul 2;48(W1):W449-W454. doi: 10.1093/nar/gkaa379. PMID: 32406916; PMCID: PMC7319546.
- Andreatta M, Trolle T, Yan Z, Greenbaum JA, Peters B, Nielsen M. An automated benchmarking platform for MHC class II binding prediction methods. Bioinformatics. 2018 May 1;34(9):1522-1528. doi: 10.1093/bioinformatics/btx820. PMID: 29281002; PMCID: PMC5925780.
- Jensen KK, Andreatta M, Marcatili P, Buus S, Greenbaum JA, Yan Z, Sette A, Peters B, Nielsen M. Improved methods for predicting peptide binding affinity to MHC class II molecules. Immunology. 2018 Jul;154(3):394-406. doi: 10.1111/imm.12889. Epub 2018 Feb 6. PMID: 29315598; PMCID: PMC6002223.
- Wang P, Sidney J, Kim Y, Sette A, Lund O, Nielsen M, Peters B. Peptide binding predictions for HLA DR, DP and DQ molecules. BMC Bioinformatics. 2010 Nov 22;11:568. PMID: 21092157; PMCID: PMC2998531.
- Wang, P., J. Sidney, C. Dow, B. Mothe, A. Sette, B. Peters. (2008). A Systematic Assessment of MHC Class II Peptide Binding Predictions and Evaluation of a Consensus Approach. PLoS Computational Biology 4(4). PMID: 18389056

For the B cell predictions, the references are:

- Kringelum JV, Nielsen M, Padkjær SB, Lund O. Structural analysis of B-cell epitopes in antibody:protein complexes. Mol Immunol. 2013 Jan;53(1-2):24-34. doi: 10.1016/j.molimm.2012.06.001. Epub 2012 Jul 10. PMID: 22784991; PMCID: PMC3461403
- Kringelum JV, Lundegaard C, Lund O, Nielsen M. Reliable B cell epitope predictions: impacts of method development and improved benchmarking. PLoS Comput Biol. 2012;8(12):e1002829. doi: 10.1371/journal.pcbi.1002829. Epub 2012 Dec 27. PMID: 23300419; PMCID: PMC3531324.

- Rubinstein ND, Mayrose I, Martz E, Pupko T. Epitopia: a web-server for predicting B-cell epitopes. BMC Bioinformatics. 2009 Sep 14;10:287. doi: 10.1186/1471-2105-10-287. PMID: 19751513; PMCID: PMC2751785.
- Liang S, Zheng D, Standley DM, Yao B, Zacharias M, Zhang C. EPSVR and EPMeta: prediction of antigenic epitopes using support vector regression and multiple server results. BMC Bioinformatics. 2010 Jul 16;11:381. doi: 10.1186/1471-2105-11-381. PMID: 20637083; PMCID: PMC2910724.
- Ponomarenko JV, Bourne PE., Antibody-protein interactions: benchmark datasets and prediction tools evaluation. BMC Struct Biol. 2007 Oct 2;7(1):64. PMID: 17910770

2.3.7 Other Ways to Access Tools

There are several ways that users can access many of the tools in the Analysis Resource in addition to using the tools directly on the Analysis Resource website. On the Analysis Resource home page (http://tools.iedb.org), there are tabs for Tools-API and Download. The former takes the user to information about the RESTful interface. The RESTful (Representational State Transfer) web service is available for the MHC class I and II binding predictions, MHC class I processing predictions, and MHC-NP for T cell epitopes, and linear epitope prediction methods for B cells. The service sends POST request to the tool’s server, and relies on user supplied parameters. The Tools-API web page contains examples for accessing the service using the 'curl' program, although any program that sends POST requests to the server will work just as well (including a web browser). This feature allows users to perform predictions on the IEDB server in batch mode without having to install any software on their own systems. Additionally, users will always be assured that they are using the latest version of the tools.

The Download tab takes the user to the IEDB Tools Download web page. For users from non-commercial organizations with batch processing needs, the MHC class I and II binding prediction tools, linear B cell epitope prediction tool, ElliPro, the epitope cluster analysis tool, the MHC class I immunogencity tool, and proteasomal cleavage prediction tool (added in 2016) are available as standalone scripts for download. These command line tools are kept in sync with the web tools and should therefore produce the same results as clicking through the web interface. They are freely available to non-profit/academic users through an open source license.

For commercial users that would like to run the analysis resource locally, licenses for a virtual machine image file or standalone downloads are available upon request for a modest annual fee. For the virtual machine, all tools are included except MHC-NP which was not developed by the IEDB team. The virtual machine image is kept in sync with the current version of the IEDB Analysis Resource and is updated approximately every six months. Commercial licenses are also available. Requests for either license can be sent to license@iedb.org.

2.4 Help Overview

The Help pull-down menu contains items that aid the user to understand and utilize the features of the website. Users can access relevant documentation, request help, and provide feedback.

2.4.1 Support

The IEDB Solutions Center is the primary resource for information on using the website's features. The user can submit help requests, check on the status of requests, browse and search the knowledge base and forums, and link to help documentation, such as the Curation Manual. In order to submit a help request via the Solutions Center, users must provide an email address, a subject line, and a description of the issue password. The Solutions Center can also be accessed by a link at the bottom of each web page.

The Solutions Center has extensive documentation organized in forums that address a variety of topics, including the epitope analysis and prediction tools, submitting data to the IEDB, querying the database, and general announcements and updates. The Solutions Center is also the repository for the Annual Compendia, the list of papers published by the IEDB team, release notes for the main website and the Analysis Resource, and the News and Noteworthy forum. In addition, written and video tutorials, including the presentations from the annual IEDB User Workshops can be found there.

2.4.2 Help Request

Users can submit help requests in two ways. At the bottom of most pages is a "Help request" link. This will initiate a submission to the IEDB Solutions Center. The second method also utilizes the IEDB Solutions Center. The top menu bar on the IEDB Solutions Center web page has a "Help Request" link. Selecting this link brings the user to a "Submit a request" web page. The user must fill in their email address, the subject line, and a description of the help request. All help requests are forwarded to the same help desk.

Help requests should consist of problems that users have with the application, such as a certain function of the system not working. Questions on how to use features of the application should be covered in the online help available in the Solutions Center. After submitting a help request, a confirmation e-mail will be sent to the user's e-mail address, which will include the help request number. When the help request issue has been resolved, an e-mail will be sent to notify the user that the help request has been satisfied.

Help requests are generally responded to within one business day and solved within five business days. Requests that are actually bug reports by users are answered initially to inform the requestor that their issue is being forwarded to the appropriate developers and they will be notified when a fix is released. Requests involving the curation or re-curation of articles will typically take longer to resolve.

2.4.3 Provide Feedback

All users are able to submit feedback, which will transmit an email message to the IEDB team. Feedback is intended for questions, input, and suggestions, such as new features they would like to see added in the future. Feedback helps the IEDB team update the system to provide users with the best possible experience. If users need help using the system or handling an unexpected result, a Help Request is more appropriate. The feedback feature can be accessed with the Support pull-down menu and the "Provide Feedback" at the bottom of each web page. Both initiate a submission to the IEDB Solutions Center.

2.4.4 Video Tutorials

There is a link to the IEDB video tutorials and information articles under the Help menu at the top of each web page. This link takes the user to the "How-to Videos" article in the Solutions Center in the Tutorials and Reference Materials folder. Most of the videos are edited versions of live presentations made at the annual IEDB User Workshops. The videos from the 2019 and 2020 events are currently posted for user viewing. An overview of the resource and information regarding the data structure and curation are presented first. The next category addresses the query and reporting features. Videos for all the tools in the Analysis Resource are listed next. Videos for the legacy website have been removed because the legacy site has been retired and can no longer be accessed by users.

2.5 More IEDB

The "More IEDB" pull-down menu contains links to other relevant information that may be of interest to users. Its component links are described below.

2.5.1 Database Export

The contents of the Immune Epitope Database are exported weekly to files in XML format. The database export page (Figure 2.35) contains a complete database export in XML format along with exports of the various records that are referenced in the complete database export. The complete dataset export is provided as a ZIP archive (iedb_export.zip) containing one XML file for each reference contained in the database. The export also contains ZIP archives of XML files that provide users with the full record for the various identifiers that are referenced in the full database export, such as the IEDB source organism accession identifier list, the MHC allele name list, and the organism list. The supporting XML files only contain full records when the record is not otherwise available from the original source.

The database export page also provides the relevant XML Schema Definition (XSD) files for each of the XML files provided. The XSD file(s) for a particular XML file are located in the IEDB Schema box in the export table. In the case of the complete database export, multiple schemas are provided, with the primary schema being listed first, followed by any supporting schemas.

In addition to the XML export, the contents of the IEDB are exported weekly as a MySQL Structure Query Language (SQL) database. The database export page contains the complete database export in two formats, a single SQL script (iedb_public.sql.gz), and a TAR archive of MyISAM binary tables (iedb_public.tar.gz). Both export formats are generated from a 5.5.52-MariaDB database server. The database export page also provides an entity-relationship diagram (ERD) for the MySQL database.

Archives of the data as they appeared in IEDB 1.0, 2.0, 2.1, and 2.3 are available by clicking on the *Archived Versions*. For each version, there is a compressed file that contains an XML for each reference. The corresponding XSD files are also available for download.

Select compilations of data are available for download from the Database Export web page in CSV format in the section titled CSV Metric Exports. Users can download these files to conveniently obtain all the information in the IEDB for specific categories. Files are available for all epitopes, antigens, T cell assays, B cell assays, MHC ligand assays, and references. In addition, an export for antibody and T cell receptors was added in 2016. In addition to the files available on the Database Export web page, comma separated values (CSV) file exports are available on-demand from all list pages and list tabs throughout the site.

2.5.2 Meta-Analyses

The IEDB team has conducted a variety of analyses that examine data in the IEDB for several disease conditions and have been published in scientific journals. Over 20 papers have been published covering topics ranging from allergies, diabetes, and multiple sclerosis, to influenza, tuberculosis, malaria. When a user selects this menu item, they are directed to the Meta-analyses folder in the Knowledgebase and Forums section of the IEDB Solutions Center. The forum is updated as new meta-analyses are published. Users who subscribe to the folder will be automatically informed when content is added.

2.5.3 Citing the IEDB

Data and tools within the IEDB are presented as a public resource. Users are requested to consider citing the IEDB when they present information obtained from the IEDB or use tools contained in the Analysis Resource. It is expected that the authors of an entry as well as the IEDB are properly cited whenever their work is referred to:

1. The IEDB website should be cited using the URL: http://www.iedb.org

2. The journal reference for the IEDB was updated in 2018; and should be cited as:

   Vita R, Mahajan S, Overton JA, Dhanda SK, Martini S, Cantrell JR, Wheeler DK, Sette A, Peters B. The Immune Epitope Database (IEDB): 2018 update. Nucleic Acids Res. 2018 Oct 24. doi: 10.1093/nar/gky1006. [Epub ahead of print] PubMed PMID: 30357391.

2.5.4 Release Notes

Release notes are provided whenever a new release of the main website or the Analysis Resource is deployed to the public. When a user selects this menu item, they are directed to the Release Notes folder in the Knowledgebase and Forums section of the IEDB Solutions Center. The forum is updated as new releases are deployed. Users who subscribe to the folder will be automatically informed when content is added.

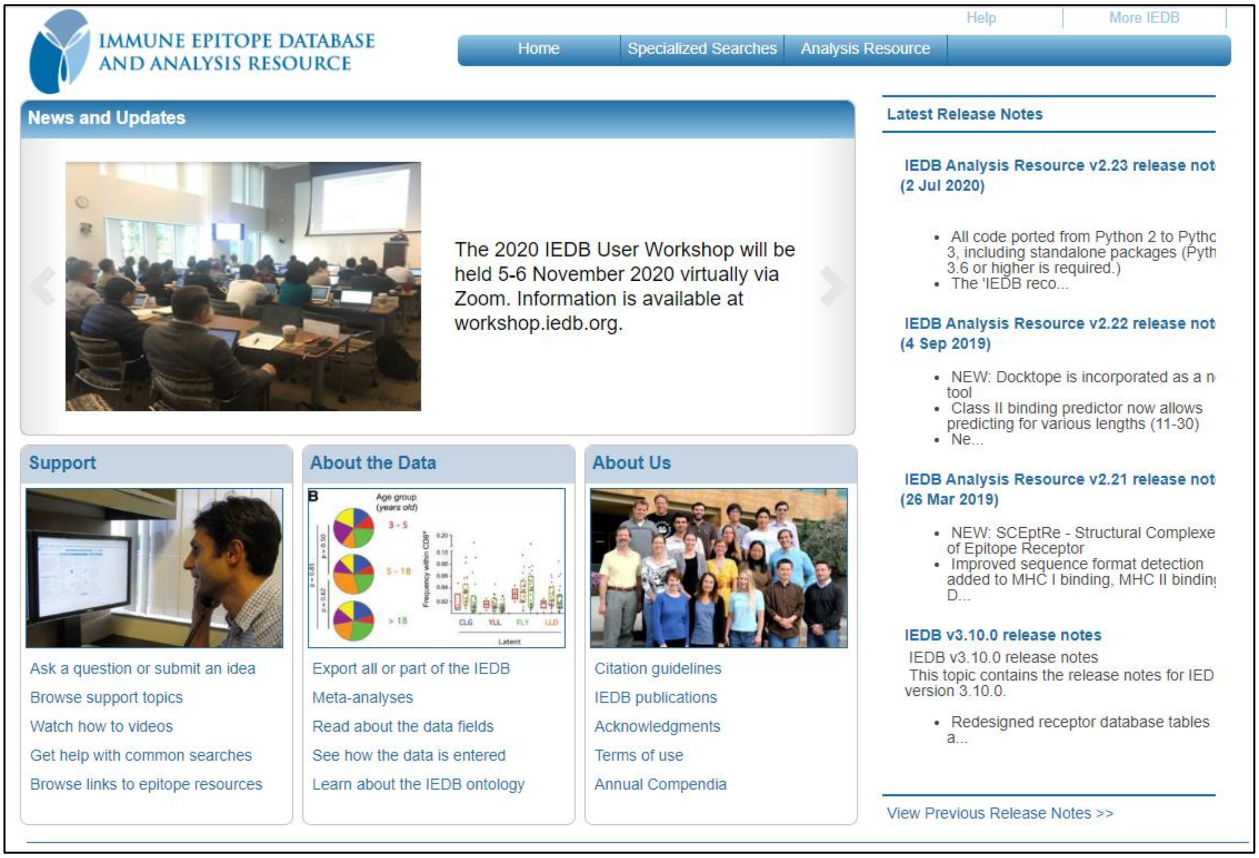
2.5.5 Links to External Sources

The IEDB system provides a list of links to external resources solely for the convenience of Immune Epitope Database visitors. The Immune Epitope Database has no interest in, responsibility for, or control over the linked-site. The Immune Epitope Database makes no promises or warranties of any kind, express or implied, including those of fitness for any particular purpose, as to the content of the linked-site. To view the links available, select the Links menu item. The hyperlinks on the links page are grouped by category:

- Public Databases, Prediction Algorithms, and Other Tools
- Antibody Related Links
- Bioinformatics Resource Centers
- MHC and TCR Related Links
- Protein Related Links
- Laboratory Resources
- Biodefense Resources

2.6 Learn More

The Learn More web page can be accessed from the link at the bottom of the Welcome box in the upper left-hand corner of the IEDB home page. The Learn More page has five major sections, as seen in Figure 2.36. The upper left section has a carousel of content from the New and Noteworthy forum in the Solutions Center. A graphic is usually included in the forum article that is displayed in the left-hand portion of the section. Below this section are three other sections titled Support, About the Data, and About Us. The Support section has links to submit a help request or feedback. The right-hand panel of the page lists the release notes for the most recent versions of the main website and the Analysis Resource.



The 2020 IEDB User Workshop will be held 5-6 November 2020 virtually via Zoom. Information is available at workshop.iedb.org.

IEDB Analysis Resource v2.23 release not
(2 Jul 2020)

- All code ported from Python 2 to Pythc 3, including standalone packages (Pyth 3.6 or higher is required.)
- The 'IEDB reco...

IEDB Analysis Resource v2.22 release not
(4 Sep 2019)

- NEW: Docktope is incorporated as a n tool
- Class II binding predictor now allows predicting for various lengths (11-30)
- Ne...

IEDB Analysis Resource v2.21 release not
(26 Mar 2019)

- NEW: SCEptRe - Structural Complexe of Epitope Receptor
- Improved sequence format detection added to MHC I binding, MHC II binding D...

IEDB v3.10.0 release notes

IEDB v3.10.0 release notes

This topic contains the release notes for IED version 3.10.0.

- Redesigned receptor database tables a...

Figure 2.35 The Learn More page, accessed from the Welcome message in the upper left corner of the IEDB home page

2.6.1 Support

Each link is briefly described below.

Ask a question or submit an idea

This link allows the user to submit a help request or suggestion via the IEDB Solutions Center. The user must specify their email address, the subject of their request, and description of the problem or suggestion. Users can also attach relevant files.

Browse support topics

The IEDB Solutions Center home page has a variety of user help, including several resources for getting started with the IEDB, recent Release Notes, and timely articles.

Get help with common searches
There is a category in the Solutions Center that contains a list of common queries and questions. These queries have been designed to parallel the IEDB meta-analysis efforts. Meta-analyses are performed at intervals to query the database for all data relating to subjects of interest (ex. Influenza, Malaria, Tuberculosis). These queries represent a simplified version of such analysis.

Browse links to epitope resources
The IEDB system provides a list of links to external resources solely for the convenience of Immune Epitope Database visitors as described in Section 2.5.5.

2.6.2 About the Data

Each link is briefly described below.

Export all or part of the IEDB
Clicking on this link will bring the user to the Database Export page that is described in Section 2.5.1.

Meta-analyses
The meta-analyses conducted by the IEDB team are described in Section 2.5.2.

Read about the data fields
This link gives the user access to a subset of the Curation Manual hosted in a Wiki that describes and defines the various data fields. Using the Find function of their web browser, users can search for the data field name of interest in order to gain a fuller understanding of the field definition and the possible values.

See how the data is entered
Users can access the full IEDB Curation Manual. The rules for curating all data fields are described in this Wiki.

Learn about the IEDB ontology
Selecting IEDB Ontology takes the user to http://ontology.iedb.org, the home page for the Ontology of Immune Epitopes (ONTIE). The IEDB ontology is available to download in a format that can be viewed with the Protégé OWL editor. The file ONTIE.owl contains the classes and relations used in the IEDB export. IEDB-export.owl is the ONTIE-annotated export of the IEDB T cell epitope data. Smaller versions of the file are available for download. The ONTIE home page also lists related ontologies that are used in constructing ONTIE.

2.6.3 About Us

Citation Guidelines
This link brings the user to the “Citing the IEDB” web page described in Section 2.5.3.

IEDB Publications
A list of publications relevant to the IEDB can be found on the Publications page. They have been grouped into four categories – General IEDB, Epitope Meta-analyses, Analysis Resource, and Curation. This list is updated with each new release of the main website. A list of IEDB related publications can also be found in the Publications folder in the IEDB Solutions Center.

Acknowledgements
A host of talented individuals have worked hard to make the Immune Epitope Database a reality. A roster of the current team members can be viewed on this page.

Terms of Use

The Terms of Use page is a collection of statements that outline the conditions related to using the IEDB system. The Terms of use includes our privacy notice, copyright information, and various disclaimers. The IEDB privacy policy describes what user information is collected, the circumstances for collecting it, and how it is used. Personal information about users is not collected unless the users choose to provide it.

Annual Compendia

An archive of the IEDB Annual Compendia can be found at this link to the IEDB Solutions Center. The list includes all Annual Compendia going back to 2005.

3 Scientific Publications

This section lists the scientific publications for which the IEDB played a contributory role. The first section lists publications authored by the IEDB contractor team over the past 18 years. The second section lists references that cited the IEDB. This list was compiled by using Google Scholar and the ISI Web of Knowledge to find citations for each one of the IEDB team authored papers.

3.1 IEDB Sponsored Publications

Scientific articles written by the IEDB team members that are relevant to the IEDB are listed below (organized by year of publication) through 2020. This publication list was re-evaluated in December 2020 to ensure that the list was accurate and up to date. As a result of this review, the publication list now contains 172 IEDB sponsored publications (including book chapters) between program inception in 2003 and 31 December 2020.

Year	Type	Paper	PMID	Journal
2020	General	HLA Class I Binding of Mutant EGFR Peptides in NSCLC Is Associated With Improved Survival	32927123	Journal of Thoracic Oncology
		A Sequence Homology and Bioinformatic Approach Can Predict Candidate Targets for Immune Responses to SARS-CoV-2.	32183941	Cell Host Microbe
		A behind the scenes tour of the IEDB curation process: an optimized process empirically integrating automation and human curation efforts	32615639	Immunology
		Epitope prediction and identification- adaptive T cell responses in humans	33131981	Seminars in Immunology
	Tools	Benchmarking predictions of MHC class I restricted T cell epitopes in a comprehensively studied model system	32453790	PLOS Computational Biology
		T Cell Epitope Predictions	32045313	Annual Review of Immunology Vol. 38
		NetMHCpan-4.1 and NetMHCIIpan-4.0, improved prediction of MHC antigen presentation by concurrent motif deconvolution and integration of MS MHC eluted ligand data	32406916	Nucleic Acids Research
		Improved prediction of MHC II antigen presentation through integration and motif deconvolution of Mass spectrometry MHC eluted ligand data	32308001	Nature Biotechnology
		Major Histocompatibility Complex.Binding, Eluted Ligands, and Immunogenicity: Benchmark Testing and Predictions.	32117208	Frontiers in Immunology
		Comparison of HLA ligand elution data and binding predictions reveals varying prediction performance for the multiple motifs recognized by HLA-DQ2.5	33064841	Immunology
		A structured model for immune exposures	32283555	Database
		Impact of Cysteine Residues on MHC Binding Predictions and Recognition by Tumor-Reactive T Cells	32571843	J Immunology
		Immunoinformatics: Predicting Peptide–MHC Binding	N/A	Annual Review of Biomedical Data Science

		Immunopeptidomic data integration to artificial neural networks enhances protein-drug immunogenicity prediction	32655572	Frontiers in Immunology
2019	General	Comprehensive Review of Human Plasmodium falciparum-Specific CD8+ T Cell Epitopes	30949162	Frontiers in Immunology
		Human T Cell Response to Dengue Virus Infection	31552052	Frontiers in Immunology
		A survey of known immune epitopes in the enteroviruses associated with acute flaccid myelitis	31451291	Human Immunology
		Benchmark datasets of immune receptor-epitope structural complexes	31601176	BMC Bioinformatics
		The Immune Epitope Database and Analysis Resource program 2003-2019 reflections and outlook	31761977	Immunogenetics
	Tools	Antibody specific B-cell epitope predictions: leveraging information from antibody-antigen protein complexes	30863406	Frontiers in Immunology
		Immune Epitope Database - Analysis Resource (IEDB-AR) in 2019	31114900	Nucleic Acids Research
		TCRpMHCmodels: Structural modelling of TCR-pMHC class I complexes.	31601838	Scientific Reports
		Book Chapter: Prediction of B and T cell epitopes in proteins	N/A	Immunotechnology and Its Applications
		NNAlign_MA; MHC Peptidome Deconvolution for Accurate MHC Binding Motif Characterization and Improved T-cell Epitope Predictions	31578220	Molecular & Cellular Proteomics
2018	General	Investigation of outbreak-specific nonsynonymous mutations on Ebolavirus GP in the context of known immune reactivity	30581874	Journal of Immunology Research
		FAIR principles and the IEDB: Short-term improvements and a Long-term vision of OBO-Foundry mediated machine-actionable interoperability	29688354	Database
		A Review on T Cell Epitopes Identified Using Prediction and Cell-Mediated Immune Models for Mycobacterium tuberculosis and Bordetella pertussis	30555469	Frontiers in Immunology
		Identification of Errors in the IEDB Using Ontologies	29688357	Database
		Epitope Specific Antibodies and T Cell Receptors in the Immune Epitope Database	30515166	Frontiers in Immunology
		The Immune Epitope Database (IEDB): 2018 update	30357391	Nucleic Acids Research
	Tools	An automated benchmarking platform for MHC class II binding prediction methods	29281002	Bioinformatics
		Bioinformatics Tools for the Prediction of T-Cell Epitopes.	29714025	Methods Mol Biol
		Development of a novel clustering tool for linear peptide sequences	30014462	Immunology
		Predicting HLA CD4 immunogenicity in human populations	29963059	Frontiers in Immunology
		Footprints of antigen processing boost MHC class II natural ligand binding predictions	30446001	Genome Medicine

		Computational Tools for the Identification and Interpretation of Sequence Motifs in Immunopeptidomes	29327813	Proteomics
		ImmunomeBrowser: A tool to aggregate and visualize complex and heterogeneous epitopes in reference protein	29878047	Bioinformatics
		Improved methods for predicting peptide binding affinity to MHC class II molecules	29315598	Immunology
		Determination of a Predictive Cleavage Motif for Eluted Major Histocompatibility Complex Class II Ligands	30127785	Frontiers in Immunology
		Microbiota epitope similarity either dampens or enhances the immunogenicity of disease-associated antigenic epitopes	29734356	PLoS One
2017	General	Deciphering the MHC-associated peptidome: a review of naturally processed ligand data	28756714	Expert Rev Proteomics
		Unconventional peptide Presentation by Major Histocompatibility Complex (MHC) Class I Allele HLA-A*02:01: Breaking Confinement	28179428	J Biol Chem
		The Immune Epitope Database: How Data Are Entered and Retrieved	28634590	J Immunol Res
		Better living through ontologies at the Immune Epitope Database	28365732	Database (Oxford)
		The SysteMHC Atlas project	28985418	Nucleic Acids Res
		The Immune Epitope Database and Analysis Resource in Epitope Discovery and Synthetic Vaccine Design	28352270	Front Immunol
	Tools	Experimental validation of the RATE tool for inferring HLA restrictions of T cell epitopes	28681704	BMC Immunology
		Citrullination only infrequently impacts peptide binding to HLA class II MHC	28481943	PLoS One
		Machine learning reveals a non-canonical mode of peptide binding to MHC class II molecules	28542831	Immunology
		NNAlign: a platform to construct and evaluate artificial neural network models of receptor-ligand interactions	28407117	Nucleic Acids Res
		BepiPred-2.0: improving sequence-based B-cell epitope predictions using conformational epitopes	28472356	Nucleic Acids Res
		GibbsCluster: unsupervised clustering and alignment of peptide sequences	28407089	Nucleic Acids Res
		An introduction to Deep learning on biological sequence data - Examples and solutions	28961695	Bioinformatics
		Development of a strategy and computational application to select candidate protein analogues with reduced HLA binding and immunogenicity	28833085	Immunology
		NetMHCpan 4.0: Improved peptide-MHC class I interaction predictions integrating eluted ligand and peptide binding affinity data	28978689	J Immunol
2016	General	Ebola: an analysis of immunity at the molecular level	N/A	IEEE Xplore Digital Library
		Identifying candidate targets of immune responses in Zika virus based on homology to epitopes in other Flavivirus species	28018746	PLoS Curr

		Immune Epitope Database and Analysis Resource (IEDB)	N/A	Encyclopedia of Bioimmunology
		An Ontology for Major Histocompatibility Restriction	26759709	J Biomed Semantics
		The Ontology for Biomedical Investigations	27128319	PLoS One
		Reproducibility and Conflicts in Immune Epitope Data	26678806	Immunology
	Tools	The Length Distribution of Class I-Restricted T Cell Epitopes Is Determined by Both Peptide Supply and MHC Allele-Specific Binding Preference	26783342	J Immunol
		NetMHCpan-3.0; improved prediction of binding to MHC class I molecules integrating information from multiple receptor and peptide length data sets	27029192	Genome Med
		T-cell recognition is shaped by epitope sequence conservation in the host proteome and microbiome	26789414	Immunology
		TepiTool: A pipeline for computational prediction of T cell epitope candidates	27479659	Current Protocols in Immunology
		Toxoplasma gondii peptide ligands open the gate of the HLA class I binding groove	26824387	Elife
		Gapped sequence alignment using artificial neural networks: application to the MHC class I system	26515819	Bioinformatics
		Pan-Specific Prediction of Peptide-MHC Class I Complex Stability, a Correlate of T Cell Immunogenicity	27402703	J Immunol
2015	General	Analysis of Human RSV immunity at the molecular level: learning from the past and present	26001197	PLoS One
		The Use of the Immune Epitope Database (IEDB) to Study Autoimmune Epitope Data related to Alopecia Areata	26551944	Journal of Investigative Dermatology
		The immune epitope database (IEDB) 3.0	25300482	Nucleic Acids Res
		Consequences of periodic α-to-β(3) residue replacement for immunological recognition of peptide epitopes	25559929	ACS Chem Biol
	Tools	Automated benchmarking of peptide-MHC class I binding predictions	25717196	Bioinformatics
		Development and validation of a broad scheme for prediction of HLA class II restricted T cell epitopes	25862607	J Immunol Methods
		Automatic generation of validated specific epitope sets	26568965	J Immunol Res
		Antibody specific epitope prediction - emergence of a new paradigm	25837466	Curr Opin Virol
		A population response analysis approach to assign class II HLA-epitope restrictions	25948811	J Immunol
		LYRA, a webserver for lymphocyte receptor structural modeling	26007650	Nucleic Acids Res
		Accurate pan-specific prediction of peptide-MHC class II binding affinity with improved binding core identification	26416257	Immunogenetics
2014	General	Substantial gaps in knowledge of Bordetella pertussis antibody and T cell epitopes relevant for natural immunity and vaccine efficacy	24530743	Human Immunology

		Conservancy of mAb epitopes in Ebolavirus glycoproteins of previous and 2014 outbreaks	25642381	PLoS Curr
		A molecular view of multiple sclerosis and experimental autoimmune encephalitis: What can we learn from the epitope data?	24365494	J Neuroimmunol
	Tools	Dataset size and composition impact the reliability of performance benchmarks for peptide-MHC binding predictions	25017736	BMC Bioinformatics
		NetTepi: an integrated method for the prediction of T-cell epitopes	24863339	Immunogenetics
		NetMHCstab - predicting stability of peptide:MHC-I complexes; impacts for CTL epitope discovery	23927693	Immunology
		Characterization of binding specificities of bovine leucocyte class I molecules: impacts for rational epitope discovery	25186069	Immunogenetics
2013	General	Navigating diabetes-related immune epitope data: resources and tools provided by the Immune Epitope Database (IEDB)	25140192	Immunome Res
		Query Enhancement through the Practical Application of Ontology: The IEDB and OBI	23734660	J Biomed Semantics
		Positional Bias of MHC Class I Restricted T-Cell Epitopes in Viral Antigens is likely due to a Bias in Conservation	23357871	PLoS Comput Biol
	Tools	Evaluating the immunogenicity of protein drugs by applying in vitro MHC binding data and the immune epitope database and analysis resource	24222776	Clin Dev Immunol
		Properties of MHC class I presented peptides that enhance immunogenicity	24204222	PLoS Comp Biol
		NetMHCIIpan-3.0, a common pan-specific MHC class II prediction method including all three human MHC class II isotypes, HLA-DR, HLA-DP and HLA-DQ	23900783	Immunogenetics
		SigniSite: Identification of residue-level genotype-phenotype correlations in protein multiple sequence alignments	23761454	Nucleic Acids Res
		Evaluation of peptide selection approaches for epitope-based vaccine design	24461003	Tissue Antigens
		HLA Class I Alleles Are Associated with Peptide-Binding Repertoires of Different Size, Affinity, and Immunogenicity	24190657	J Immunol
		Structural analysis of B-cell epitopes in antibody:protein complexes	22784991	Mol Immunol
2012	General	A meta-analysis of the existing knowledge of immunoreactivity against hepatitis C virus (HCV)	22675428	PLoS One
		The immune epitope database: a historical retrospective of the first decade	22681406	Immunology
		Strategies to query and display allergy-derived epitope data from the Immune Epitope Database (IEDB)	23172234	Int Arch Allergy Immunol
		A Comparison of Epitope Repertoires Associated with Myasthenia Gravis in Humans and Nonhuman Hosts	23243503	Autoimmune Dis
	Tools	Immune epitope database analysis resource	22610854	Nucleic Acids Res

		Predictions versus high-throughput experiments in T-cell epitope discovery: competition or synergy?	22149708	Expert Rev Vaccines
		NetMHCcons: a consensus method for the major histocompatibility complex class I predictions.	22009319	Immunogenetics
2011	General	Cost sensitive hierarchical document classification to triage PubMed abstracts for manual curation	22182279	BMC Bioinformatics
		A Model for Collaborative Curation, The IEDB and ChEBI Curation of Non-peptidic Epitopes	21897450	Immunome Res
		IEDB-3D: structural data within the immune epitope database	21030437	Nucleic Acids Res
	Tools	Applications for T-cell epitope queries and tools in the Immune Epitope Database and Analysis Resource	21047510	J Immunol Methods
		Prediction of epitopes using neural network based methods	21047511	J Immunol Methods
		A computational pipeline to generate MHC binding motifs	28747991	Immunome Res
2010	General	Towards defining molecular determinants recognized by adaptive immunity in allergic disease: an inventory of the available data	21403821	J Allergy (Cairo)
		OBI consortium. Modeling biomedical experimental processes with OBI	20626927	J Biomed Semantics
		Design and utilization of epitope-based databases and predictive tools	20213141	Immunogenetics
		Meta-analysis of all immune epitope data in the Flavivirus genus: inventory of current immune epitope data status in the context of virus immunity and immunopathology	20565291	Viral Immunol
		The Immune Epitope Database 2.0	19906713	Nucleic Acids Res
		Molecular determinants of T cell epitope recognition to the common Timothy grass allergen	20554959	J Immunol
		Divergent motifs but overlapping binding repertoires of six HLA-DQ molecules frequently expressed in the worldwide human population.	20810981	J Immunol
		Five HLA-DP molecules frequently expressed in the worldwide human population share a common HLA supertypic binding specificity	20139279	J Immunol
		Uncovering the interplay between CD8, CD4 and antibody responses to complex pathogens.	20143946	Future Microbiol
	Tools	MHC class II epitope predictive algorithms	20408898	Immunology
		Peptide binding predictions for HLA DR, DP and DQ molecules	21092157	BMC Bioinformatics
		Limitations of Ab initio predictions of peptide binding to MHC class II molecules	20174654	PLoS One
		NetCTLpan: pan-specific MHC class I pathway epitope predictions	20379710	Immunogenetics
		The MHC motif viewer: a visualization tool for MHC binding motifs.	20143317	Curr Protoc Immunol
2009	General	Classification of the universe of immune epitope literature: representation and knowledge gaps	19774228	PLoS One

		Pre-existing immunity against swine-origin H1N1 influenza viruses in the general human population	19918065	Proc Natl Acad Sci
		Meta-analysis of immune epitope data for all Plasmodia: overview and applications for malarial immunobiology and vaccine-related issues	19149776	Parasite Immunol
		Two MHC class I molecules associated with elite control of immunodeficiency virus replication, Mamu-B*08 and HLA-B*2705, bind peptides with sequence similarity.	19494300	J Immunol
		Diverse recognition of conserved orthopoxvirus CD8+ T cell epitopes in vaccinated rhesus macaques.	19531389	Vaccine
		Definition of epitopes and antigens recognized by vaccinia specific immune responses: their conservation in variola virus sequences, and use as a model system to study complex pathogens	20006135	Vaccine
	Tools	NetMHCpan, a method for MHC class I binding prediction beyond humans	19002680	Immunogenetics
		Derivation of an amino acid similarity matrix for peptide: MHC binding and its application as a Bayesian prior	19948066	BMC Bioinformatics
		The PickPocket method for predicting binding specificities for receptors based on receptor pocket similarities: Application to MHC-peptide binding	19297351	Bioinformatics
		Pan-specific MHC class I predictors: a benchmark of HLA class I pan-specific prediction methods	18996943	Bioinformatics
2008	General	The Curation Guidelines of the Immune Epitope Database and Analysis Resource	18688821	Cytometry A
		Analysis of epitope information related to Bacillus anthracis and Clostridium botulinum	18251694	Expert Rev Vaccines
		Quantitative peptide binding motifs for 19 human and mouse MHC class I molecules derived using positional scanning combinatorial peptide libraries	18221540	Immunome Res
		HLA class I supertypes: a revised and updated classification	18211710	BMC Immunol
		Immunodominant epitopes in herpes simplex virus type 2 glycoprotein D are recognized by CD4 lymphocytes from both HSV-1 and HSV-2 seropositive subjects	18941251	J Immunol
	Tools	NetMHC-3.0: accurate web accessible predictions of human, mouse and monkey MHC class I affinities for peptides of length 8-11	18463140	Nucleic Acids Res
		Quantitative Predictions of Peptide Binding to Any HLA-DR Molecule of Known Sequence: NetMHCIIpan	18604266	PLoS Computational Biology
		B-cell epitope prediction		Structural Bioinformatics
		ElliPro: a new structure-based tool for the prediction of antibody epitopes	19055730	BMC Bioinformatics
		A Systematic Assessment of MHC Class II Peptide Binding Predictions and Evaluation of a Consensus Approach	18389056	PLoS Computational Biology
		Immune epitope database analysis resource (IEDB-AR)	18515843	Nucleic Acids Res

2007	General	An analysis of the epitope knowledge related to Mycobacteria	18081934	Immunome Res
		Ab and T cell epitopes of influenza A virus, knowledge and opportunities	17200302	Proc Natl Acad Sci
		Meeting Report: NIH Workshop on the Tuberculosis Immune Epitope Database	18068490	Tuberculosis (Edinb)
		Integrating epitope data into the emerging web of biomedical knowledge resources	17479127	Nat Rev Immunol
		Immune epitope mapping in the post-genomic era: lessons for vaccine development	17113275	Curr Opin Immunol
		Automating document classification for the Immune Epitope Database	17655769	BMC Bioinformatics
		Characterization of the peptide-binding specificity of the chimpanzee class I alleles A 0301 and A 0401 using a combinatorial peptide library	17701407	Immunogenetics
	Tools	Antibody-protein interactions: benchmark datasets and prediction tools evaluation.	17910770	BMC Struct Biol
		EpitopeViewer: a Java application for the visualization and analysis of immune epitopes in the Immune Epitope Database and Analysis Resource (IEDB)	17313688	Immunome Res
		Development of an epitope conservancy analysis tool to facilitate the design of epitope-based diagnostics and vaccines	17897458	BMC Bioinformatics
		Towards a consensus on datasets and evaluation metrics for developing B-cell epitope prediction tools	17205610	J Mol Recognit
		Modeling the adaptive immune system: predictions and simulations	18045832	Bioinformatics
		NetMHCpan, a method for quantitative predictions of peptide binding to any HLA-A and -B locus protein of known sequence	17726526	PLoS One
2006	General	The biocurator: connecting and enhancing scientific data	17069454	PLoS Comput Biol
		The Immune Epitope Database and Analysis Resource	N/A	Conference Proceedings
		Curation of complex, context-dependent immunological data	16836764	BMC Bioinformatics
	Tools	Predicting population coverage of T-cell epitope-based diagnostics and vaccines	16545123	BMC Bioinformatics
		A community resource benchmarking predictions of peptide binding to MHC-I molecules	16789818	PLoS Comput Biol
2005	General	The design and implementation of the immune epitope database and analysis resource	15895191	Immunogenetics
		The Immune Epitope Database and Analysis Resource: From Vision to Blueprint	15760272	PLoS Biology
		An ontology for immune epitopes: application to the design of a broad scope database of immune reactivities	16305755	Immunome Res
		A Roadmap for the Immunomics of Category A–C Pathogens	15773067	Immunity
		Characterization of the peptide-binding specificity of Mamu-A*11 results in the identification of SIV-derived epitopes and interspecies cross-reactivity	15747117	Immunogenetics

	Tools	Generating quantitative models describing the sequence specificity of biological processes with the stabilized matrix method	15927070	BMC Bioinformatics
		A computational resource for the prediction of peptide binding to Indian rhesus macaque MHC class I molecules.	16137805	Vaccine
2004	General	The immune epitope database and analysis resource: from vision to blueprint	16312048	Genome Inform
		Identification of seventeen new simian immunodeficiency virus-derived CD8+ T cell epitopes restricted by the high frequency molecule, Mamu-A*02, and potential escape from CTL recognition	15470050	J Immunol
2003	General	In silico prediction of peptides binding to multiple HLA-DR molecules accurately identifies immunodominant epitopes from gp43 of Paracoccidioides brasiliensis frequently recognized in primary peripheral blood mononuclear cell responses from sensitized individuals	15208742	Mol Med

3.2 Publications Citing the IEDB in 2020

In 2020, the IEDB or Analysis Resource received a total of 3,970 individual citations (3,506 total citations for IEDB publications and 464 additional inline citations). This represents an increase of 1,294 citations over 2,676 from the previous year (2019). In 2020, the IEDB received 464 in-text citations that did not cite a specific reference, representing a decrease of 133 over 597 from 2019. However, given the significant increase in overall citations from 2020 over 2019, this decrease in in-text citations is not an indication of declining relevance.

The citation list includes 1,996 references that formally cited one or more of the 167 papers written by the IEDB team over the past eighteen years, or cited the IEDB without specifying a reference. This represents an increase of 476 references from the 1,520 references that cited the IEDB in 2019. Of note, this total may increase over time since these databases may not include references published late in 2020.

The formal citation list was compiled by using Google Scholar and the ISI Web of Knowledge to find citations for each one of the 167 papers and excludes self-citations. In contrast, often scientific reports quote the IEDB not as a formal citation, but by simply stating in the text that the IEDB was used or listing the website address. Here we developed and implemented a plan to address in-text citations (informal mentions of the IEDB, rather than a direct citation). For this purpose, we utilized Publish or Perish, a software program that retrieves citations from Crossref, Google Scholar, Microsoft Academic, Scopus, and Web of Science, and returns output that can easily be converted to an excel file. The tool can capture citations that the document specialist's citation analysis, which includes Google Scholar and Web or Science, may have missed, and can capture references that cite the IEDB in text but do not cite a specific IEDB-related publication.

The papers have been categorized by the type of IEDB paper they cited – General IEDB (G) or Analysis Resource (AR). By reference, the General IEDB (G) papers received 1,088 citations in 2020 and the Analysis Resource (AR) papers received 2,418 citations. Additionally, there were 464 inline citations, which, in total, sums to the expected 3,970 citations for 2020. All papers listed below denote their category or categories with these abbreviations since a paper can cite several IEDB papers that belong in different categories. For example, a paper that cites an analysis resource paper may also cite the primary IEDB Nucleic Acids Res (2018) paper, and thus is listed under General IEDB and has an [AR, G] to indicate the Analysis Resource citation. Any paper that has "General" as one of its categories has been listed in the General category below.

3.2.1 References Formally Citing IEDB Publications

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6. Abduljaleel, Z. and Al-Allaf, F.A. (2020). "Synthetic Monoclonal Antibody Designed for Novel SARS-nCoV-2 Spike-S1 Protein Antigenic Targeted Epitope of Receptor Binding Domain Inhibit to Prevent Viral Entry." **[AR]**

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9. Abella, J.R., Antunes, D., Jackson, K., Lizee, G., Clementi, C., and Kavraki, L.E. (2020). "Markov state modeling reveals alternative unbinding pathways for peptide-MHC complexes." Proceedings of the National Academy of Sciences of the United States of America 117(48): 30610-30618. **[G]**

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