Immune Epitope Database Overview

www.iedb.org

Presented by: Alessandro Sette, IEDB Principal Investigator

Our goals for this user workshop

We want your input to make the IEDB better:

- Learn about real-life applications for the IEDB
- Identify and prioritize problems with the user interface, documentation, functionality etc.

We want to enable you to get the most out of the IEDB:

- The primary IEDB success metric is usage
- Best compliment for our program is if IEDB data & tools help in your research (citations)

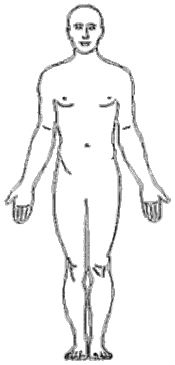
Immune Epitope Database

www.iedb.org

Database | Resource of experimentally-derived epitope information

- Allergens
- Infectious diseases
- Autoimmune diseases
- Transplantation / Alloantigens

… and more



Containing data on over **2.2 million unique structures** analyzed in over **6.6 million assays** from more than **24,000 curated references**.

Minimal Criteria for Epitope Inclusion

- Linear peptide <50 amino acids in length
- Tested as an immunogen or an antigen
- Discontinuous residues shown to be important in recognition
- Non-peptidic epitopes <5,000 Daltons
- Minimal information required (sequence, outcome, host, etc.)

Consistent data entry requires well defined data structure

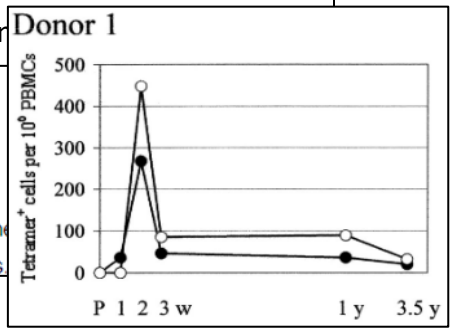
Quantitation of CD8+ T Cell Responses to Newly Identified HLA-A*0201–restricted T Cell Epitopes Conserved Among Vaccinia and Variola (Smallpox) Viruses

Masanori Terajima, John Cruz, Gregory Raines, Elizabeth D. Kilpatrick, Jeffrey S. Kenn
Francis A. Ennis

Materials And Methods

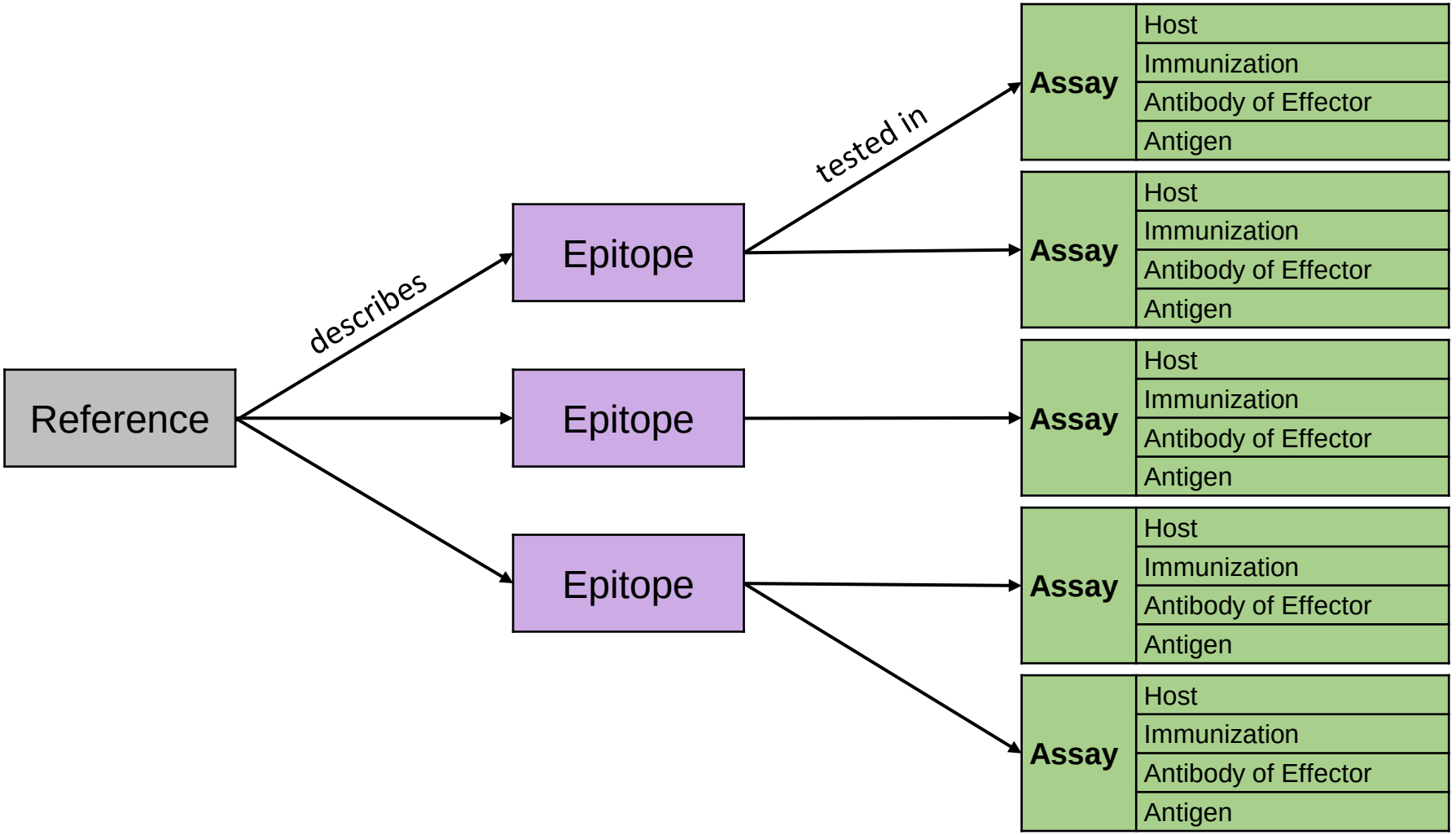
Donors.

Donors in this study were three HLA-A*0201–positive laboratory workers received primary immunization by scarification with the licensed smallpox vaccine, Dryvax®, as recommended by th
Centers for Disease Control and Prevention for laboratory pe el working with vaccinia viruses.



Epitope	**Structure**	Name	74A
		Chemical Type	Peptide / Protein
		Sequence	CLTEYILWV
		Domain / Region	Defined Epitope
	Source	Species	Vaccina Virus Ankara
		Strain	Ankara (MVA)
		Antigen	Putative 21.7k protein
		Antigen Accession	2772819
		Antigen Positions	79-87
Context	**Immunization**	Immunized Species	Homo sapiens
		Immunogen Type	Source species
		Administration	Scarification
	Assay	Antigen Type	Epitope
		Assay Type	ELISPOT
		Response Measured	Cytokine Release-IFN-g
		MHC Allele	HLA-A*0201

Data Structure: A Database of Experiments



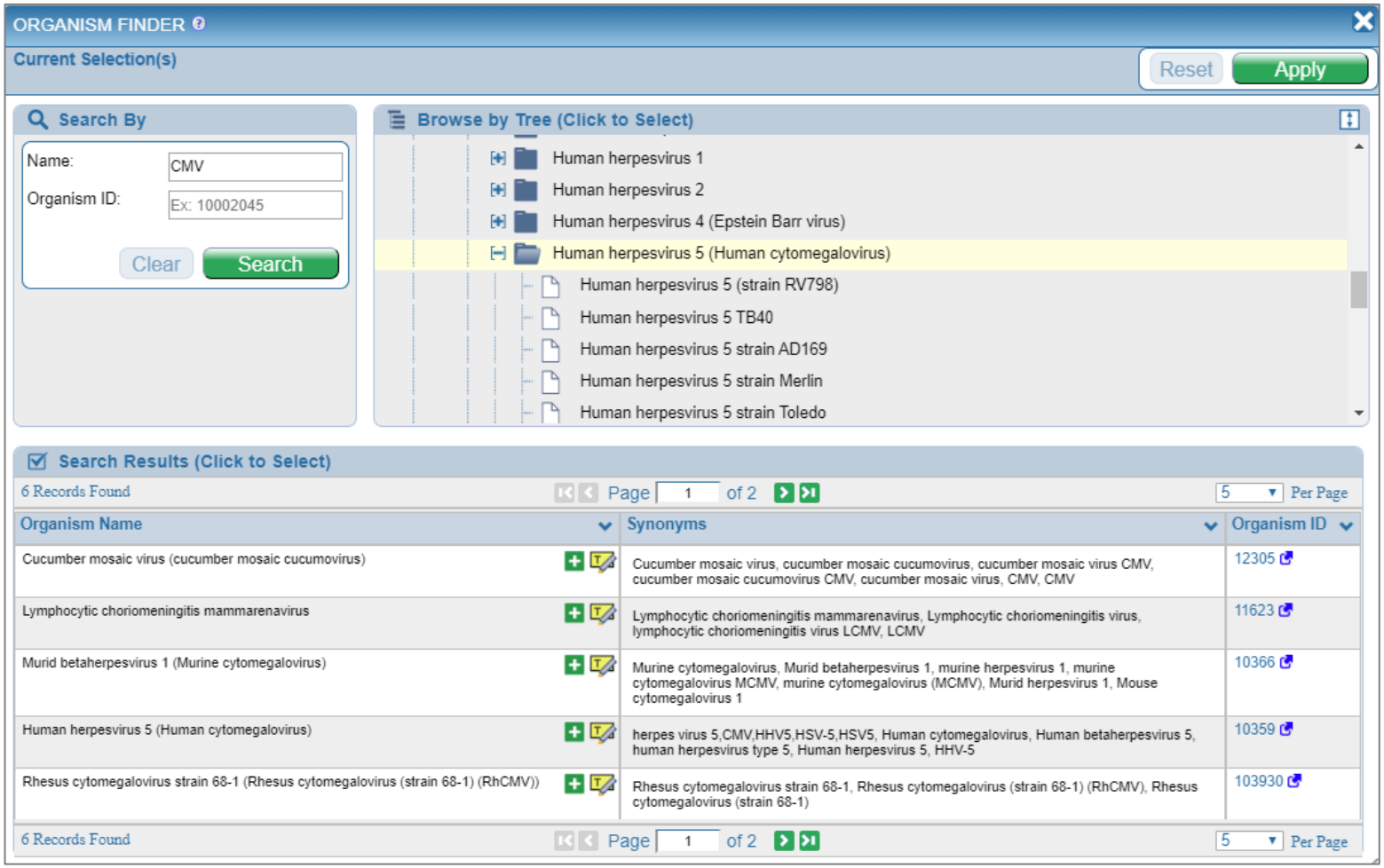
Collaborations with Ontologies

- Provides standardized nomenclature, definitions, synonyms, and hierarchical relationships
- Makes curation easier → Finders
- Enhances user experience → Finders
- Ensures consistency and accuracy
- Finds errors
- Facilitates interoperability

External Resources and Ontologies

Peptidic Epitope	Amino acid sequence
	Protein source
	Organism source

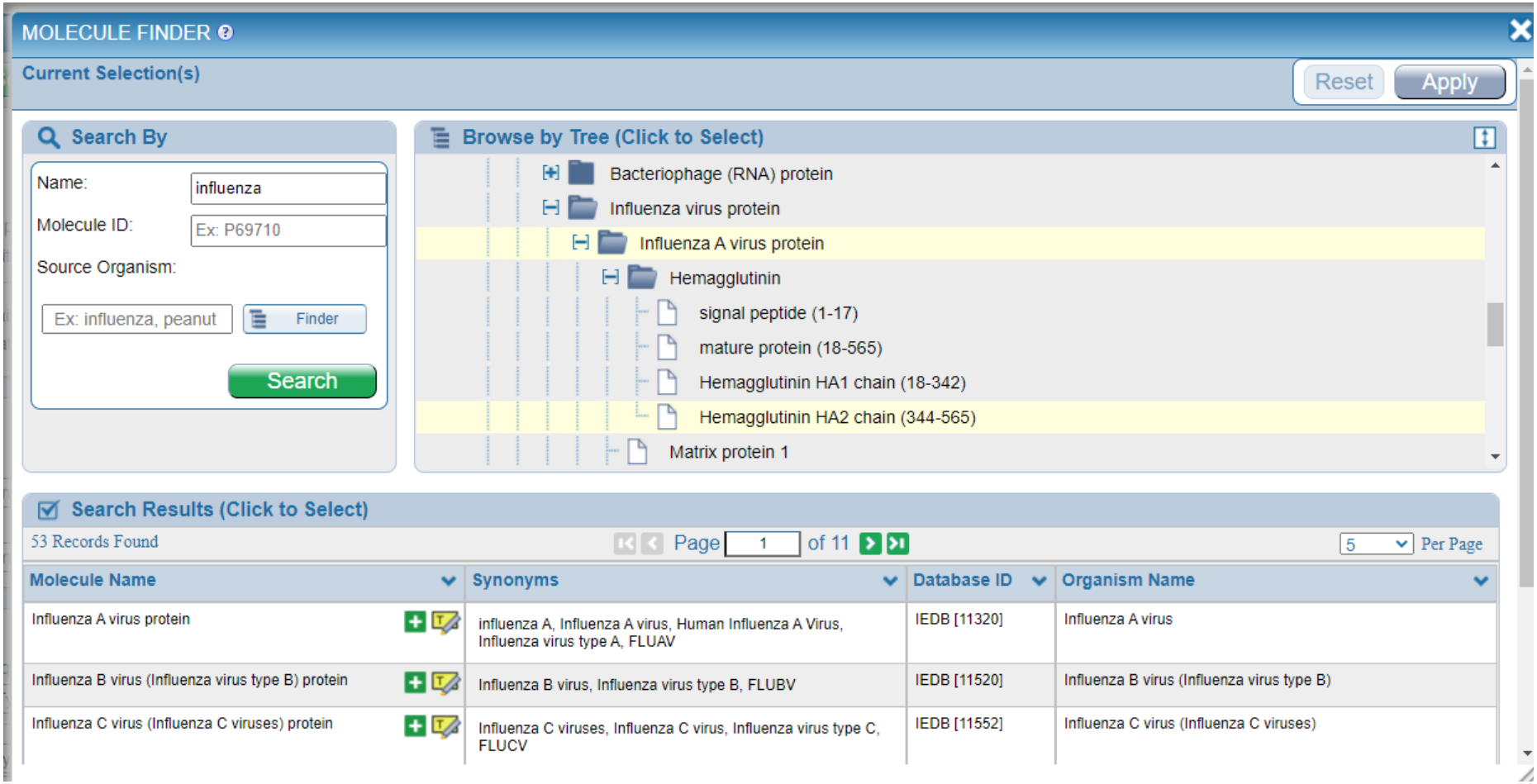
Human herpesvirus 5 (HHV-5)
NCBI
taxon:10359



External Resources and Ontologies

Peptidic Epitope	Amino acid sequence
	Protein source
	Organism source

PKYVKQNTLKLAT
hemagglutinin HA1
GenBank/UniProt
GI:AAL62329.1—UniProt:Q8V285



Literature Curation

PubMed / PDB
- Complex query
- Bi-weekly

240K retrieved

Classifier
- Content based categories
- Retrained annually

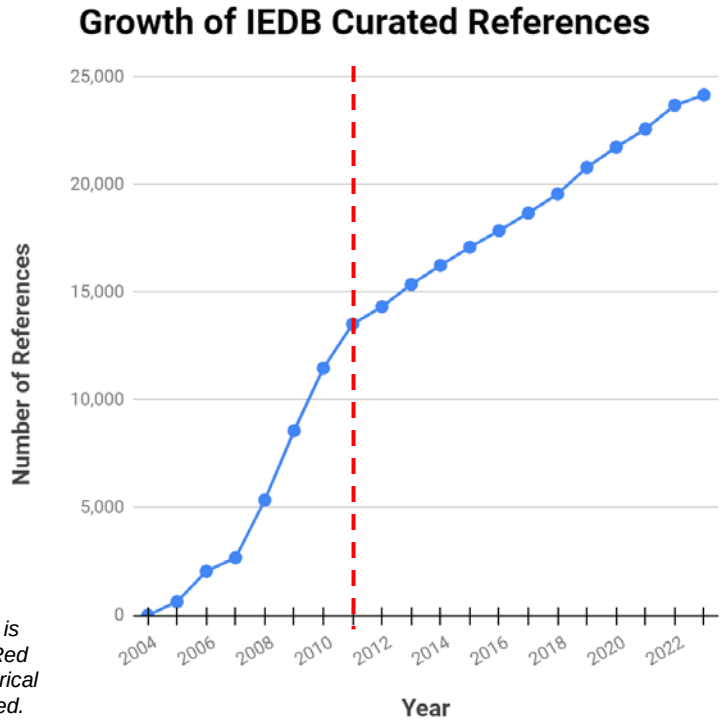
151K epitope related

Abstract Review
- Manual scan
- Confirmation of classification

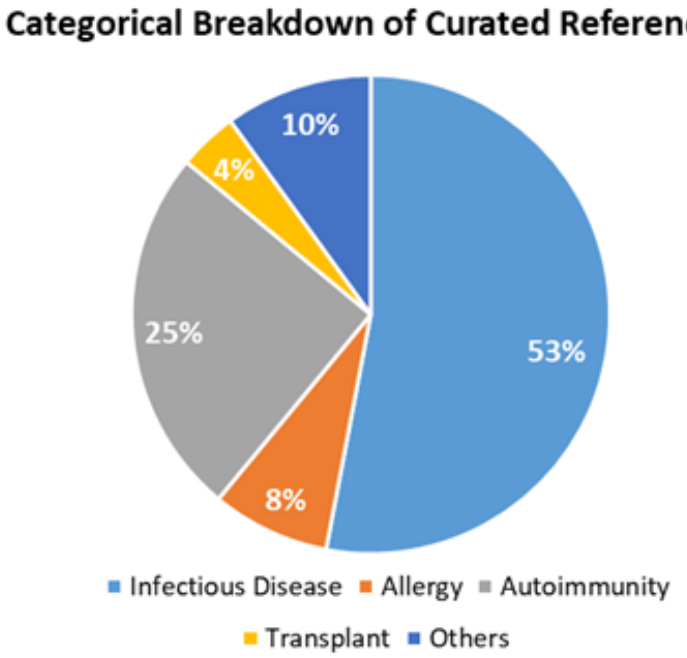
44K likely curatable

Manual Curation
- Assigned to curators
- Peer review

24K curated



***Note**: 2023 data is based on Q1-3. Red line indicates historical curation completed.*



Consistency and Quality Control Measures

- Manually curated by a team of PhD-level scientists with specific expertise
- Formal curation guidelines and peer review
  Curation Manual: http://curationwiki.iedb.org/wiki/index.php/Main_Page
- External immunological experts
- Built in validation in the curation application

Data Submissions

- Primarily sourced through NIAID Epitope Discovery contracts
- Data deposition is open to the general research community on a case-by-case basis

As of October, 2022:

- Data from **340 submissions** are publicly available & **90 submissions** are in process or on-hold
- Submitted data comprises ~**20% of epitopes** available in the IEDB

Inquire by contacting: nblazeska@lji.org or submissionsupport@iedb.org!

Direct Submission Process

Submission

- Investigators submit files via IEDB data submission tool

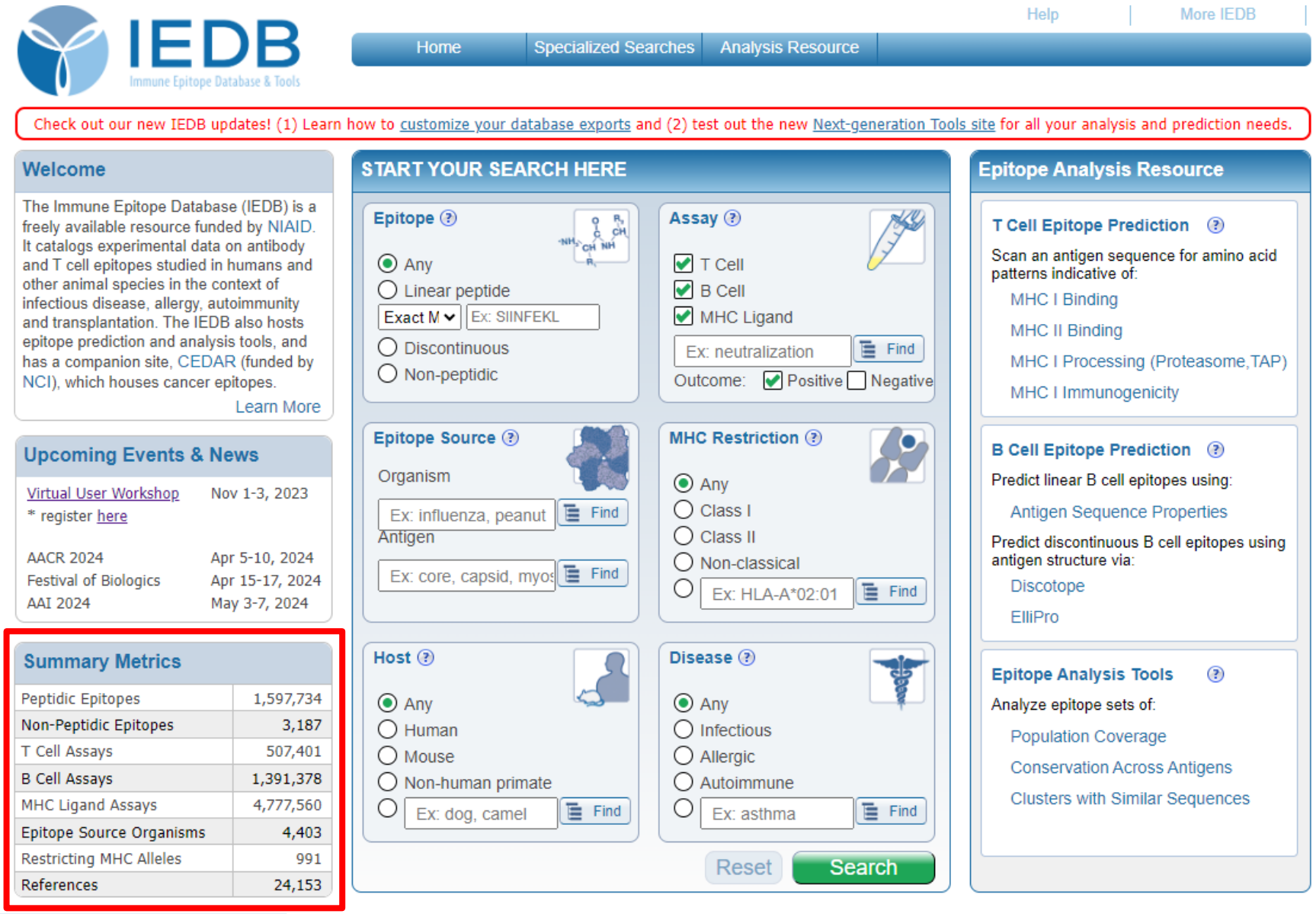
Review

- Automated validation and manual curator review check data consistency
- Submitter confirms final approval

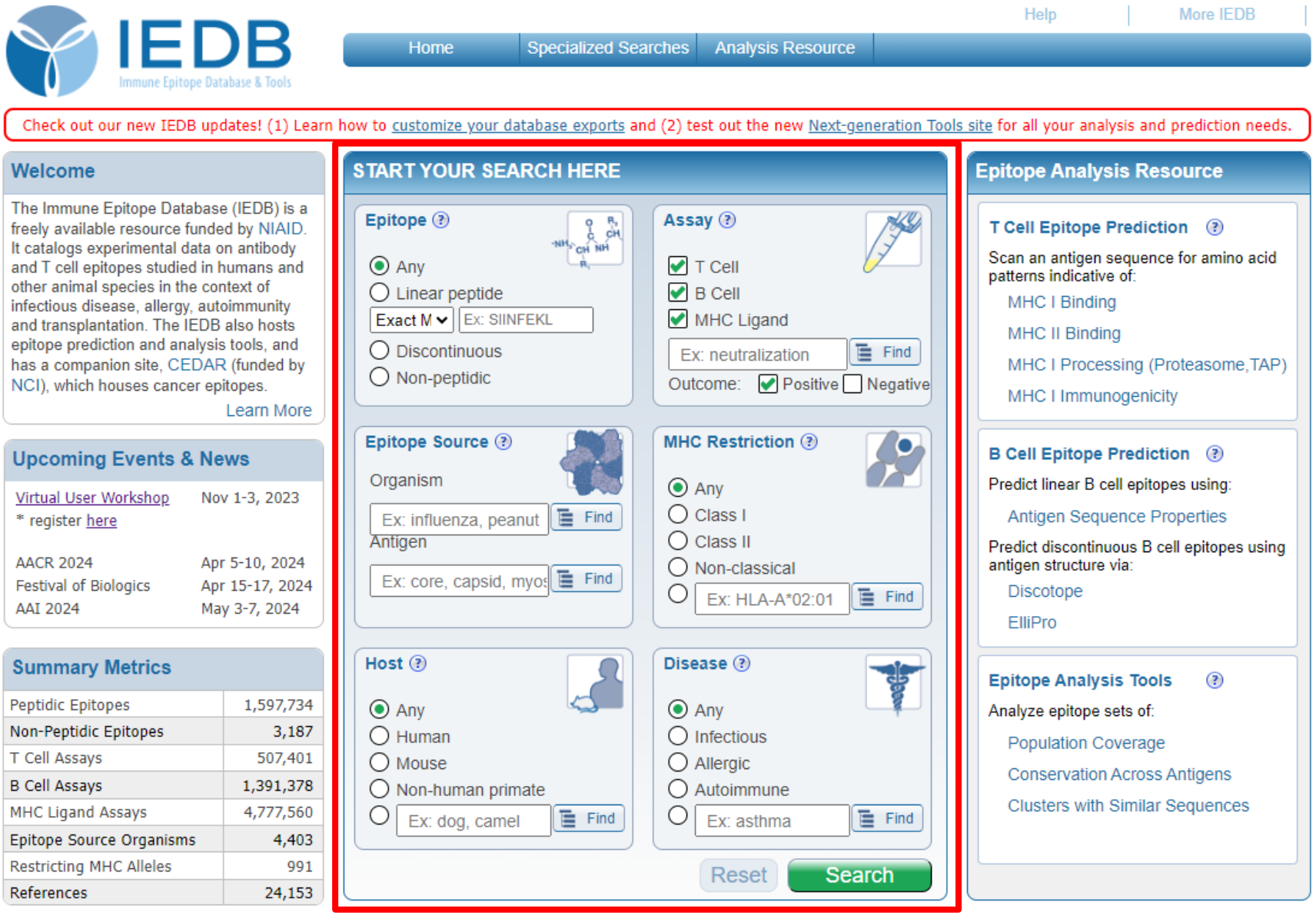
Release

- Public release date set by submitter

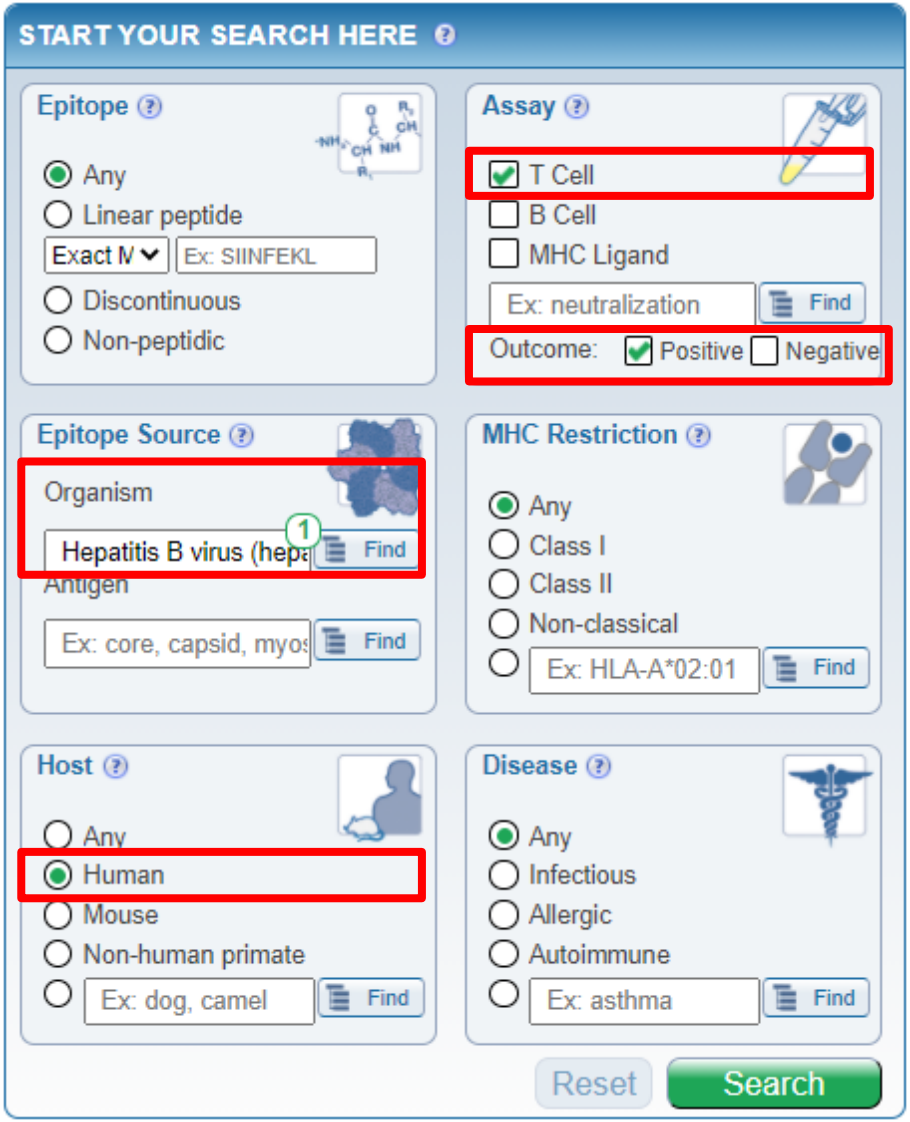
IEDB.org: Homepage & Cumulative Data



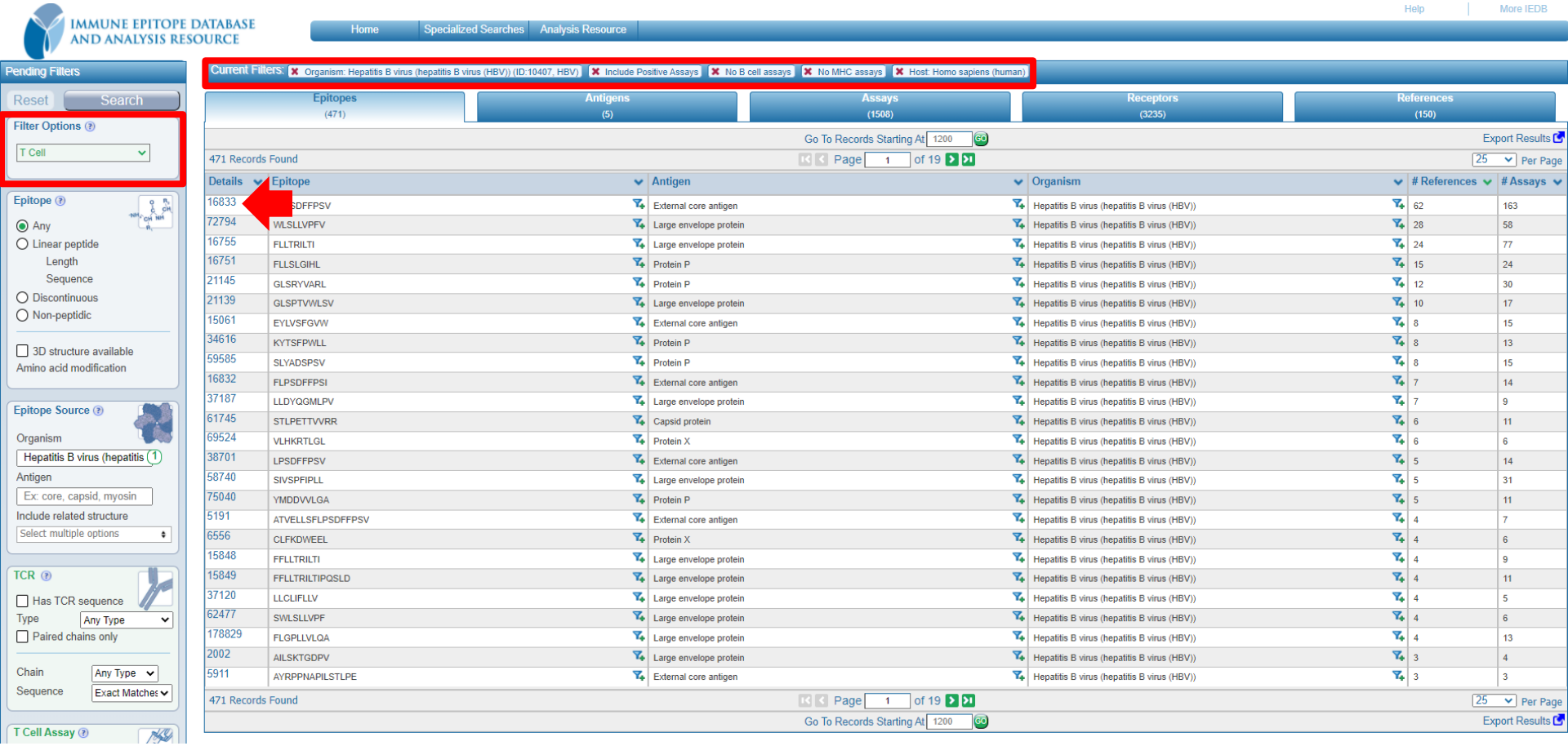
IEDB.org: Homepage & Search Interface



Example Query: HBV T Cell Epitopes in Humans



Results Summarized in Tables



Details	Epitope	Antigen	Organism	# References	# Assays
16833	SDFFPSV	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	62	163
72794	WLSLLVPFV	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	28	58
16755	FLLTRILTI	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	24	77
16751	FLLSLGIHL	Protein P	Hepatitis B virus (hepatitis B virus (HBV))	15	24
21145	GLSRYVARL	Protein P	Hepatitis B virus (hepatitis B virus (HBV))	12	30
21139	GLSPTVWLSV	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	10	17
15061	EYLVSFGVW	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	8	15
34616	KYTSFPWLL	Protein P	Hepatitis B virus (hepatitis B virus (HBV))	8	13
59585	SLYADSPSV	Protein P	Hepatitis B virus (hepatitis B virus (HBV))	8	15
16832	FLPSDFFPSI	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	7	14
37187	LLDYQGMLPV	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	7	9
61745	STLPETTVVRR	Capsid protein	Hepatitis B virus (hepatitis B virus (HBV))	6	11
69524	VLHKRTLGL	Protein X	Hepatitis B virus (hepatitis B virus (HBV))	6	6
38701	LPSDFFPSV	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	5	14
58740	SIVSPFIPLL	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	5	31
75040	YMDDVVLGA	Protein P	Hepatitis B virus (hepatitis B virus (HBV))	5	11
5191	ATVELLSFLPSDFFPSV	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	4	7
6556	CLFKDWEEL	Protein X	Hepatitis B virus (hepatitis B virus (HBV))	4	6
15848	FFLLTRILTI	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	4	9
15849	FFLLTRILTIPQSLD	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	4	11
37120	LLCLIFLLV	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	4	5
62477	SWLSLLVPF	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	4	6
178829	FLGPLLVLQA	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	4	13
2002	AILSKTGDPV	Large envelope protein	Hepatitis B virus (hepatitis B virus (HBV))	3	4
5911	AYRPPNAPILSTLPE	External core antigen	Hepatitis B virus (hepatitis B virus (HBV))	3	3

471 Records Found
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Export Results

Detail Pages Summarize Relevant Information

Details Pages:

- Epitope Summary
- Compiled Data
  - MHC Ligand Assay(s)
  - B Cell Assay(s)
  - T Cell Assay(s)
- External Resources

Also available for:

- Assays
- Receptors
- References

EPITOPE SUMMARY

FLPSDFFPSV is a linear peptidic epitope (epitope ID 16833) studied as part of External core antigen from Hepatitis B virus (hepatitis B virus (HBV)) and Capsid protein from Hepatitis B virus (hepatitis B virus (HBV)). This epitope has been studied for immune reactivity in 101 publication(s), tested in 215 T cell assays, 8 B cell assays, 88 MHC ligand assays and has 3D structure(s) 3OXR, 3OXS, 1HHH and 3OX8.

COMPILED DATA

MHC Ligand Assay(s) 88

MHC molecule	Positive / All
HLA-A*02:01	35/35
HLA-A*02:03	8/8
HLA-A*02:06	8/8
HLA-A*02:02	6/6
HLA-A*02:07	4/4
HLA-A*68:02	4/4
HLA-A*03:01	0/3
HLA-A*11:01	0/3
HLA-A*02:05	2/2
HLA-A*01:01	0/2
HLA-B*07:02	0/2
HLA-B*15:02	0/2
HLA-A*02:04	1/1
HLA-A*02:11	1/1
HLA-A2	1/1
HLA-B44	1/1
H2-Kd	0/1
HLA-A*24:02	0/1
HLA-A*31:01	0/1
HLA-A*68:01	0/1
Mamu-A1*001:01	0/1

B Cell Assay(s) 8

Assay Type	Positive / All
qualitative binding	7/7
dissociation constant KD	1/1

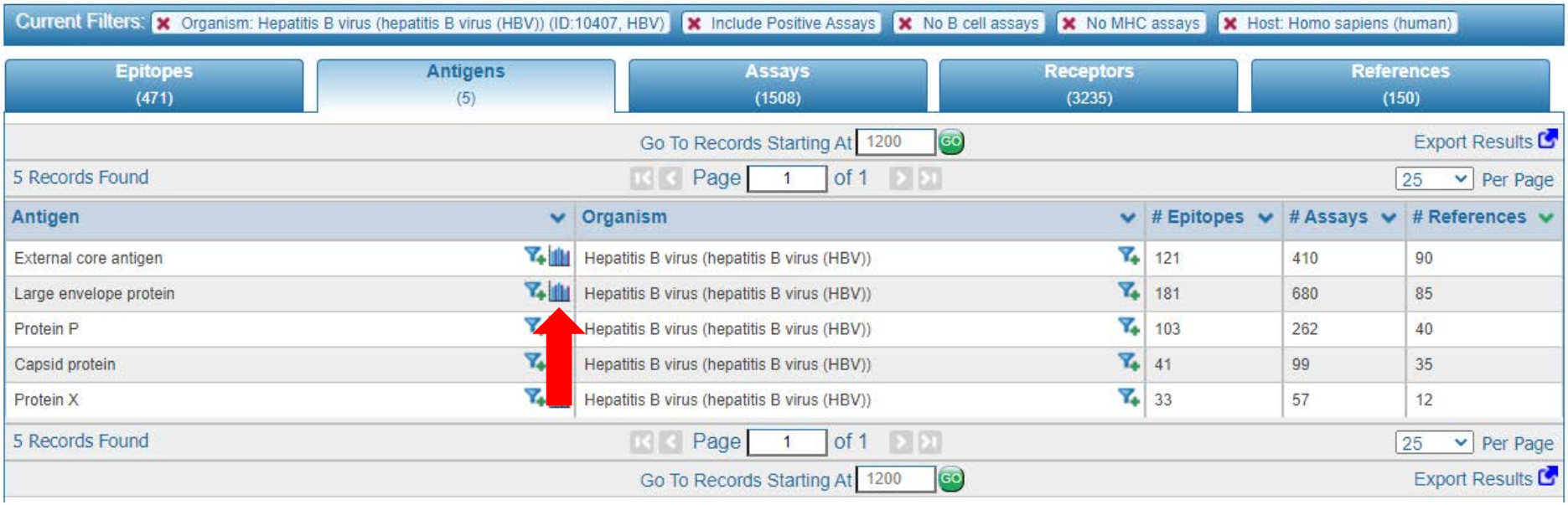
T Cell Assay(s) 215

Assay Type	Positive / All
cytotoxicity	63/74
IFNg release	65/66
qualitative binding	45/50
TNFa release	7/8
IL-2 release	4/4
proliferation	4/4
IL-4 release	2/2
TNF release	2/2
activation	1/1

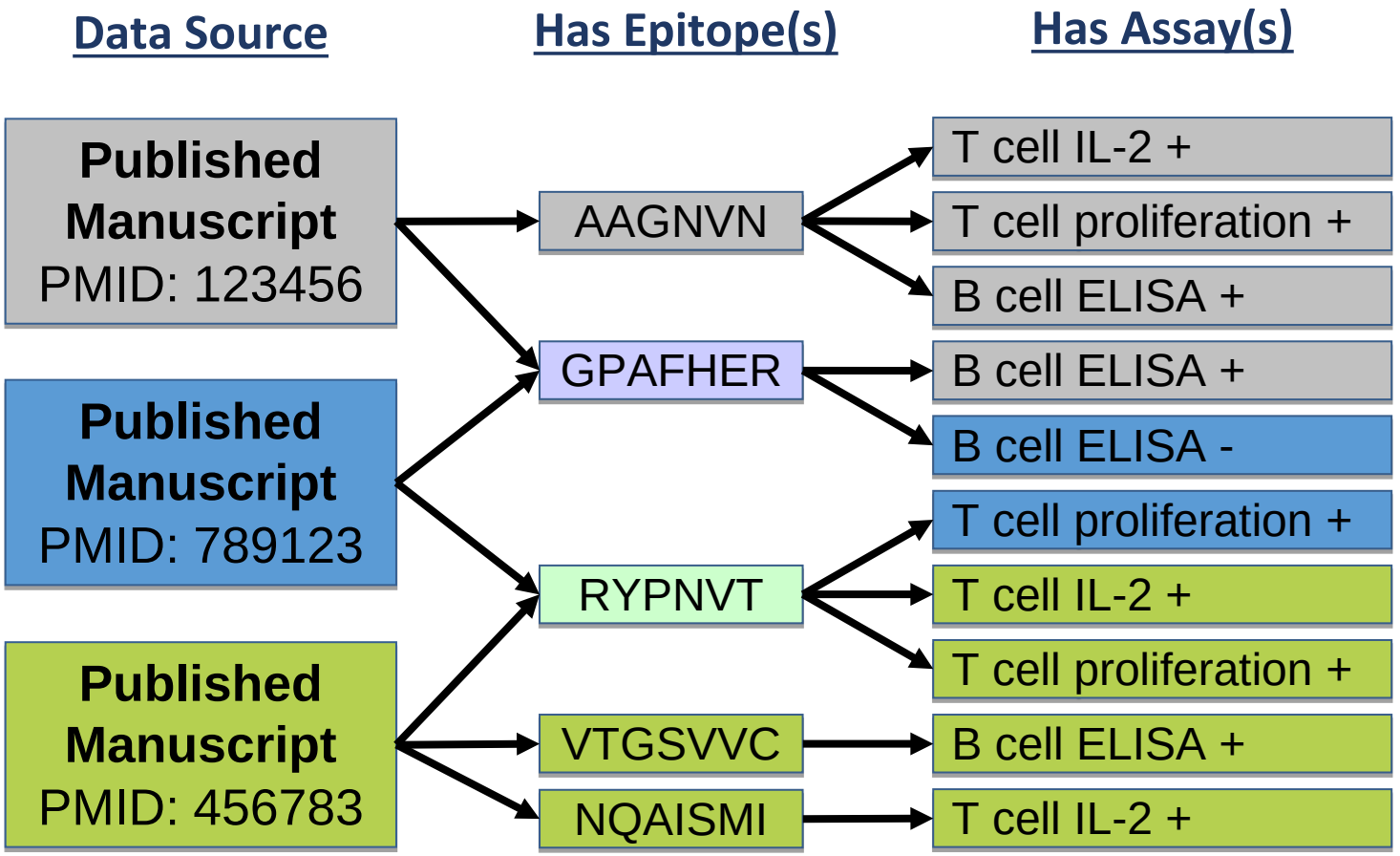
EXTERNAL RESOURCES

Resource	Link
ANALYSIS TOOLS IEDB.ORG IEDB-AR: MHC-I Processing	Predict MHC class I processing
ANALYSIS TOOLS IEDB.ORG IEDB-AR: MHC-I	Predict MHC class I binding affinity
ANALYSIS TOOLS IEDB.ORG IEDB-AR: B cell scales	Predict B cell epitopes

Antigens: Identifying Protein Source of Epitopes



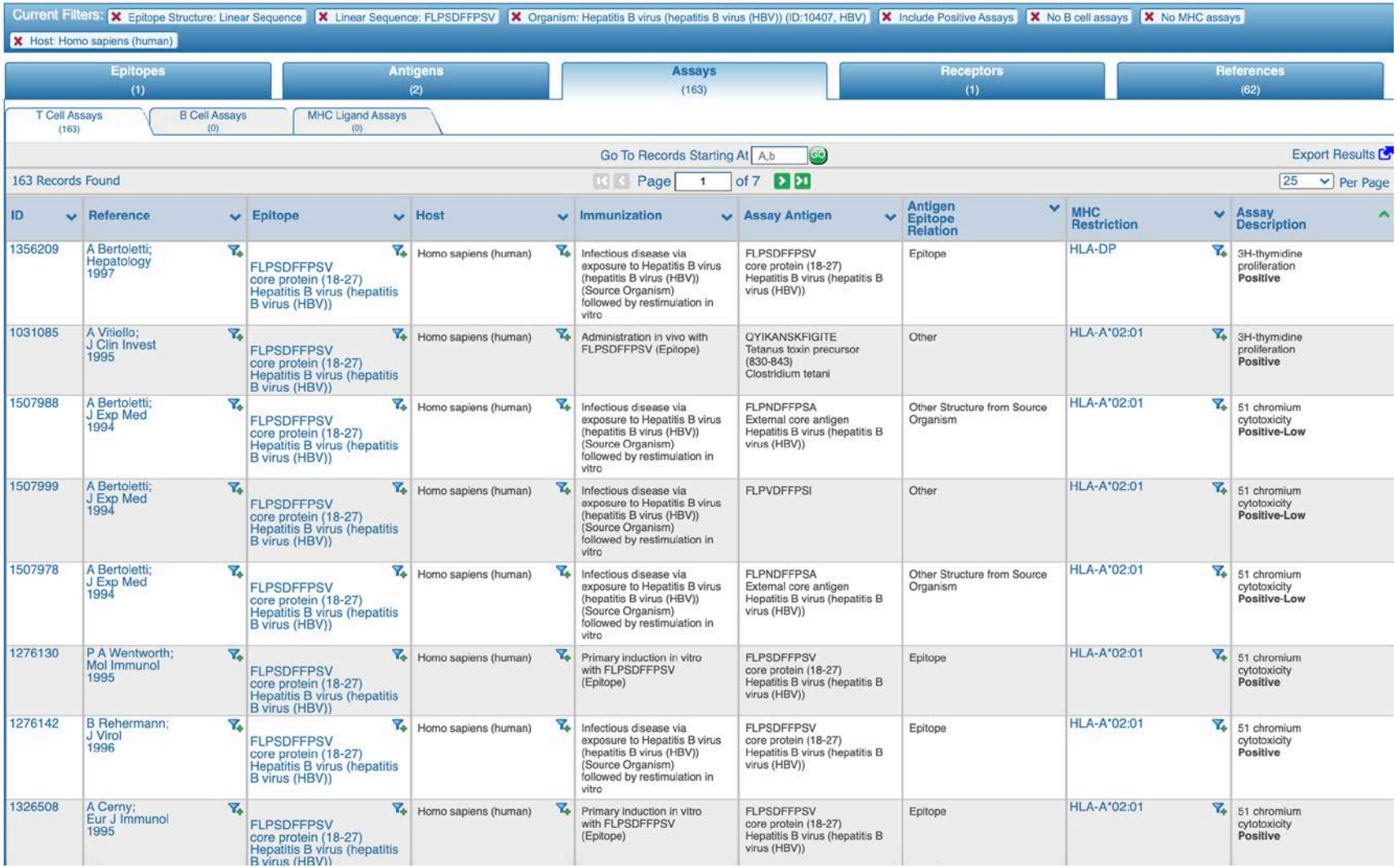
Data Aggregation



ImmunomeBrowser: Visualization on Reference Proteins

Also available as a standalone tool on AR!

Assays: Experiments in which epitopes were tested



Current Filters: Epitope Structure: Linear Sequence | Linear Sequence: FLPSDFFPSV | Organism: Hepatitis B virus (hepatitis B virus (HBV)) (ID:10407, HBV) | Include Positive Assays | No B cell assays | No MHC assays | Host: Homo sapiens (human)

Epitopes (1) | Antigens (2) | Assays (163) | Receptors (1) | References (62)

T Cell Assays (163) | B Cell Assays (0) | MHC Ligand Assays (0)

Go To Records Starting At A,b GO | Export Results

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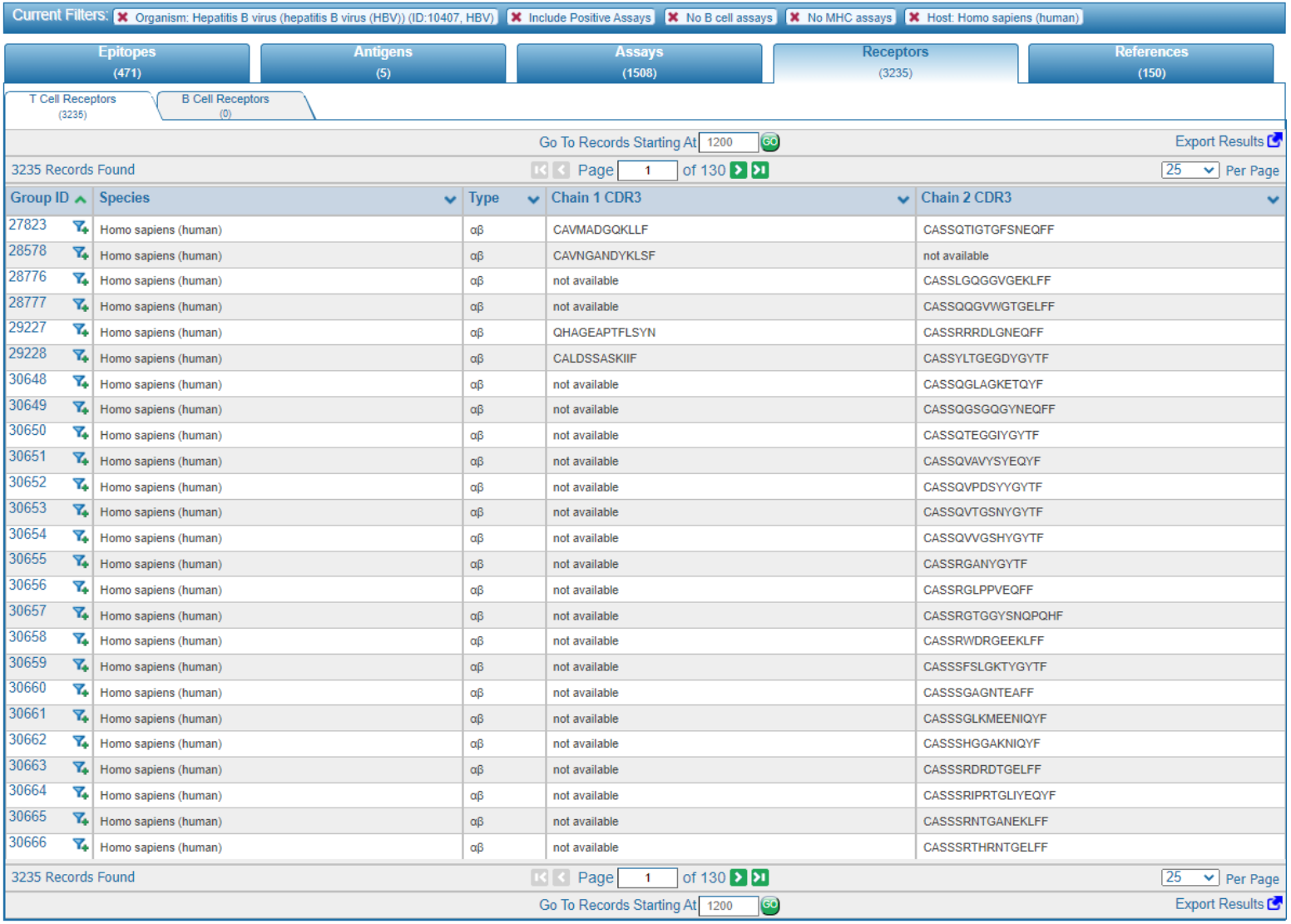
ID	Reference	Epitope	Host	Immunization	Assay Antigen	Antigen Epitope Relation	MHC Restriction	Assay Description
1356209	A Bertoletti; Hepatology 1997	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Infectious disease via exposure to Hepatitis B virus (hepatitis B virus (HBV)) (Source Organism) followed by restimulation in vitro	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Epitope	HLA-DP	3H-thymidine proliferation **Positive**
1031085	A Vitiello; J Clin Invest 1995	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Administration in vivo with FLPSDFFPSV (Epitope)	QYIKANSKFIGITE Tetanus toxin precursor (830-843) Clostridium tetani	Other	HLA-A*02:01	3H-thymidine proliferation **Positive**
1507988	A Bertoletti; J Exp Med 1994	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Infectious disease via exposure to Hepatitis B virus (hepatitis B virus (HBV)) (Source Organism) followed by restimulation in vitro	FLPNDFFPSA External core antigen Hepatitis B virus (hepatitis B virus (HBV))	Other Structure from Source Organism	HLA-A*02:01	51 chromium cytotoxicity **Positive-Low**
1507999	A Bertoletti; J Exp Med 1994	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Infectious disease via exposure to Hepatitis B virus (hepatitis B virus (HBV)) (Source Organism) followed by restimulation in vitro	FLPVDFFPSI	Other	HLA-A*02:01	51 chromium cytotoxicity **Positive-Low**
1507978	A Bertoletti; J Exp Med 1994	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Infectious disease via exposure to Hepatitis B virus (hepatitis B virus (HBV)) (Source Organism) followed by restimulation in vitro	FLPNDFFPSA External core antigen Hepatitis B virus (hepatitis B virus (HBV))	Other Structure from Source Organism	HLA-A*02:01	51 chromium cytotoxicity **Positive-Low**
1276130	P A Wentworth; Mol Immunol 1995	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Primary induction in vitro with FLPSDFFPSV (Epitope)	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Epitope	HLA-A*02:01	51 chromium cytotoxicity **Positive**
1276142	B Rehermann; J Virol 1996	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Infectious disease via exposure to Hepatitis B virus (hepatitis B virus (HBV)) (Source Organism) followed by restimulation in vitro	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Epitope	HLA-A*02:01	51 chromium cytotoxicity **Positive**
1326508	A Cerny; Eur J Immunol 1995	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Homo sapiens (human)	Primary induction in vitro with FLPSDFFPSV (Epitope)	FLPSDFFPSV core protein (18-27) Hepatitis B virus (hepatitis B virus (HBV))	Epitope	HLA-A*02:01	51 chromium cytotoxicity **Positive**

Epitope-specific B Cell and T Cell Receptors



Current Filters: Organism: Hepatitis B virus (hepatitis B virus (HBV)) (ID:10407, HBV) | Include Positive Assays | No B cell assays | No MHC assays | Host: Homo sapiens (human)

Epitopes (471) | Antigens (5) | Assays (1508) | Receptors (3235) | References (150)

T Cell Receptors (3235) | B Cell Receptors (0)

Go To Records Starting At 1200 GO — Export Results

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Group ID	Species	Type	Chain 1 CDR3	Chain 2 CDR3
27823	Homo sapiens (human)	αβ	CAVMADGQKLLF	CASSQTIGTGFSNEQFF
28578	Homo sapiens (human)	αβ	CAVNGANDYKLSF	not available
28776	Homo sapiens (human)	αβ	not available	CASSLGQGGVGEKLFF
28777	Homo sapiens (human)	αβ	not available	CASSQQGVWGTGELFF
29227	Homo sapiens (human)	αβ	QHAGEAPTFLSYN	CASSRRRDLGNEQFF
29228	Homo sapiens (human)	αβ	CALDSSASKIIF	CASSYLTGEGDYGYTF
30648	Homo sapiens (human)	αβ	not available	CASSQGLAGKETQYF
30649	Homo sapiens (human)	αβ	not available	CASSQGSGQGYNEQFF
30650	Homo sapiens (human)	αβ	not available	CASSQTEGGIYGYTF
30651	Homo sapiens (human)	αβ	not available	CASSQVAVYSYEQYF
30652	Homo sapiens (human)	αβ	not available	CASSQVPDSYYGYTF
30653	Homo sapiens (human)	αβ	not available	CASSQVTGSNYGYTF
30654	Homo sapiens (human)	αβ	not available	CASSQVVGSHYGYTF
30655	Homo sapiens (human)	αβ	not available	CASSRGANYGYTF
30656	Homo sapiens (human)	αβ	not available	CASSRGLPPVEQFF
30657	Homo sapiens (human)	αβ	not available	CASSRGTGGYSNQPQHF
30658	Homo sapiens (human)	αβ	not available	CASSRWDRGEEKLFF
30659	Homo sapiens (human)	αβ	not available	CASSSFSLGKTYGYTF
30660	Homo sapiens (human)	αβ	not available	CASSSGAGNTEAFF
30661	Homo sapiens (human)	αβ	not available	CASSSGLKMEENIQYF
30662	Homo sapiens (human)	αβ	not available	CASSSHGGAKNIQYF
30663	Homo sapiens (human)	αβ	not available	CASSSRDRDTGELFF
30664	Homo sapiens (human)	αβ	not available	CASSSRIPRTGLIYEQYF
30665	Homo sapiens (human)	αβ	not available	CASSSRNTGANEKLFF
30666	Homo sapiens (human)	αβ	not available	CASSSRTHRNTGELFF

3235 Records Found — Page 1 of 130 — 25 Per Page
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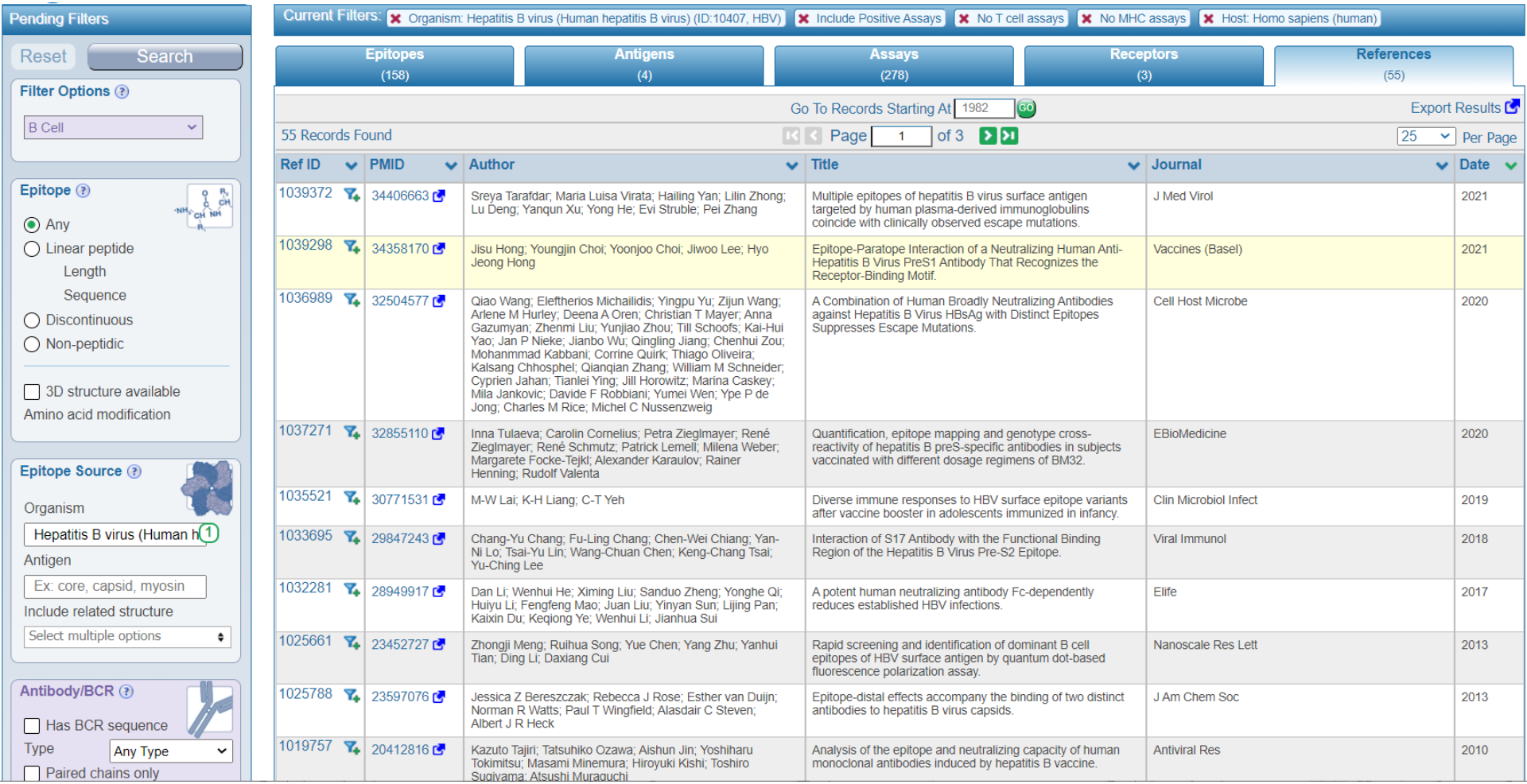
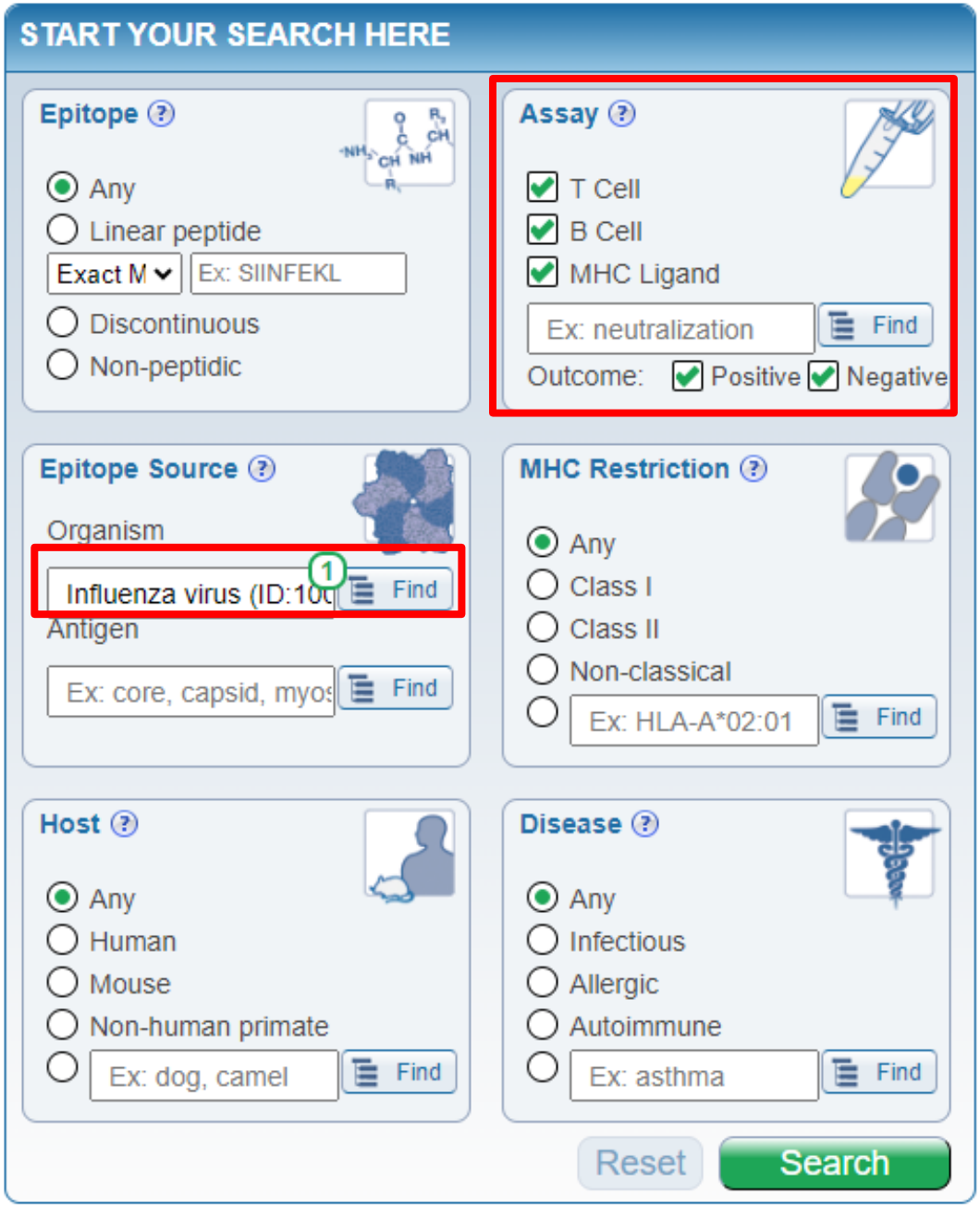
References: Source of Information



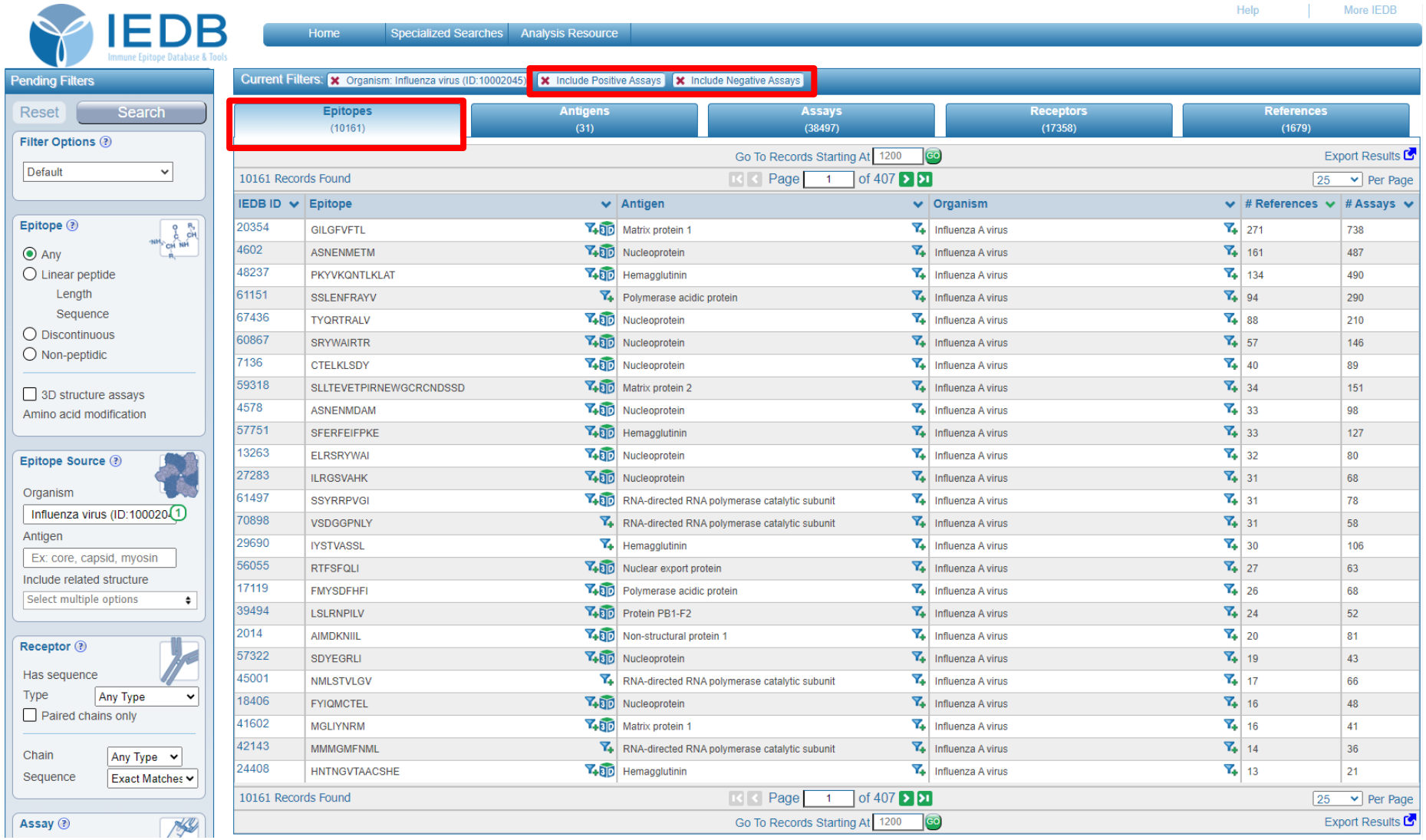
Ref ID	PMID	Author	Title	Journal	Date
1039372	34406663	Sreya Tarafdar; Maria Luisa Virata; Hailing Yan; Lilin Zhong; Lu Deng; Yanqun Xu; Yong He; Evi Struble; Pei Zhang	Multiple epitopes of hepatitis B virus surface antigen targeted by human plasma-derived immunoglobulins coincide with clinically observed escape mutations.	J Med Virol	2021
1039298	34358170	Jisu Hong; Youngjin Choi; Yoonjoo Choi; Jiwoo Lee; Hyo Jeong Hong	Epitope-Paratope Interaction of a Neutralizing Human Anti-Hepatitis B Virus PreS1 Antibody That Recognizes the Receptor-Binding Motif.	Vaccines (Basel)	2021
1036989	32504577	Qiao Wang; Eleftherios Michailidis; Yingpu Yu; Zijun Wang; Arlene M Hurley; Deena A Oren; Christian T Mayer; Anna Gazumyan; Zhenmi Liu; Yunjiao Zhou; Till Schoofs; Kai-Hui Yao; Jan P Nieke; Jianbo Wu; Qingling Jiang; Chenhui Zou; Mohanmmad Kabbani; Corrine Quirk; Thiago Oliveira; Kalsang Chhosphel; Qianqian Zhang; William M Schneider; Cyprien Jahan; Tianlei Ying; Jill Horowitz; Marina Caskey; Mila Jankovic; Davide F Robbiani; Yumei Wen; Ype P de Jong; Charles M Rice; Michel C Nussenzweig	A Combination of Human Broadly Neutralizing Antibodies against Hepatitis B Virus HBsAg with Distinct Epitopes Suppresses Escape Mutations.	Cell Host Microbe	2020
1037271	32855110	Inna Tulaeva; Carolin Cornelius; Petra Zieglmayer; René Zieglmayer; René Schmutz; Patrick Lemell; Milena Weber; Margarete Focke-Tejkl; Alexander Karaulov; Rainer Henning; Rudolf Valenta	Quantification, epitope mapping and genotype cross-reactivity of hepatitis B preS-specific antibodies in subjects vaccinated with different dosage regimens of BM32.	EBioMedicine	2020
1035521	30771531	M-W Lai; K-H Liang; C-T Yeh	Diverse immune responses to HBV surface epitope variants after vaccine booster in adolescents immunized in infancy.	Clin Microbiol Infect	2019
1033695	29847243	Chang-Yu Chang; Fu-Ling Chang; Chen-Wei Chiang; Yan-Ni Lo; Tsai-Yu Lin; Wang-Chuan Chen; Keng-Chang Tsai; Yu-Ching Lee	Interaction of S17 Antibody with the Functional Binding Region of the Hepatitis B Virus Pre-S2 Epitope.	Viral Immunol	2018
1032281	28949917	Dan Li; Wenhui He; Ximing Liu; Sanduo Zheng; Yonghe Qi; Huiyu Li; Fengfeng Mao; Juan Liu; Yinyan Sun; Lijing Pan; Kaixin Du; Keqiong Ye; Wenhui Li; Jianhua Sui	A potent human neutralizing antibody Fc-dependently reduces established HBV infections.	Elife	2017
1025661	23452727	Zhongji Meng; Ruihua Song; Yue Chen; Yang Zhu; Yanhui Tian; Ding Li; Daxiang Cui	Rapid screening and identification of dominant B cell epitopes of HBV surface antigen by quantum dot-based fluorescence polarization assay.	Nanoscale Res Lett	2013
1025788	23597076	Jessica Z Bereszczak; Rebecca J Rose; Esther van Duijn; Norman R Watts; Paul T Wingfield; Alasdair C Steven; Albert J R Heck	Epitope-distal effects accompany the binding of two distinct antibodies to hepatitis B virus capsids.	J Am Chem Soc	2013
1019757	20412816	Kazuto Tajiri; Tatsuhiko Ozawa; Aishun Jin; Yoshiharu Tokimitsu; Masami Minemura; Hiroyuki Kishi; Toshiro Sugiyama; Atsushi Muraguchi	Analysis of the epitope and neutralizing capacity of human monoclonal antibodies induced by hepatitis B vaccine.	Antiviral Res	2010

Example Query II: Influenza Virus Epitopes



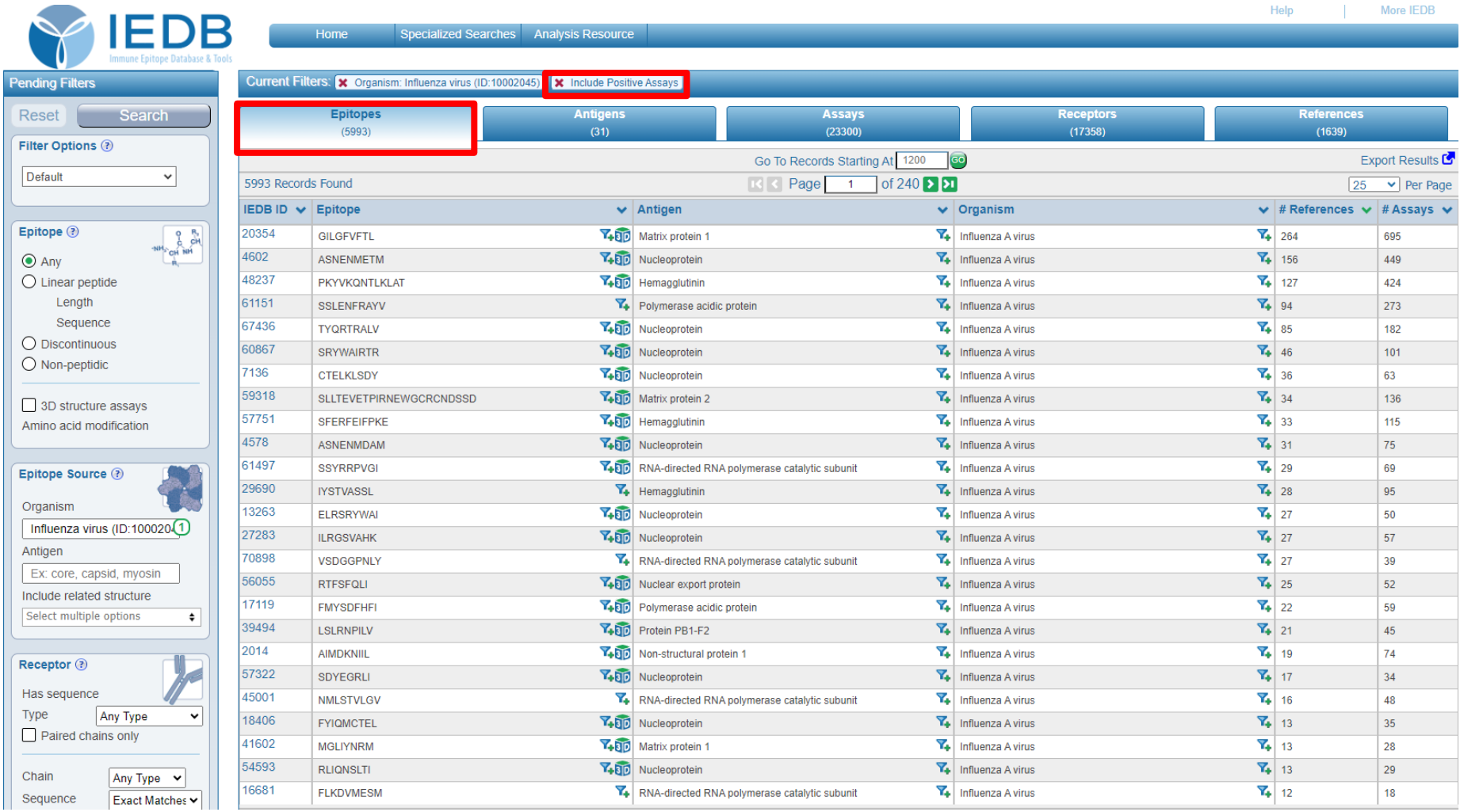
Results: All influenza virus epitopes

Both positive and negative assay outcomes



Results: Positive influenza virus epitopes

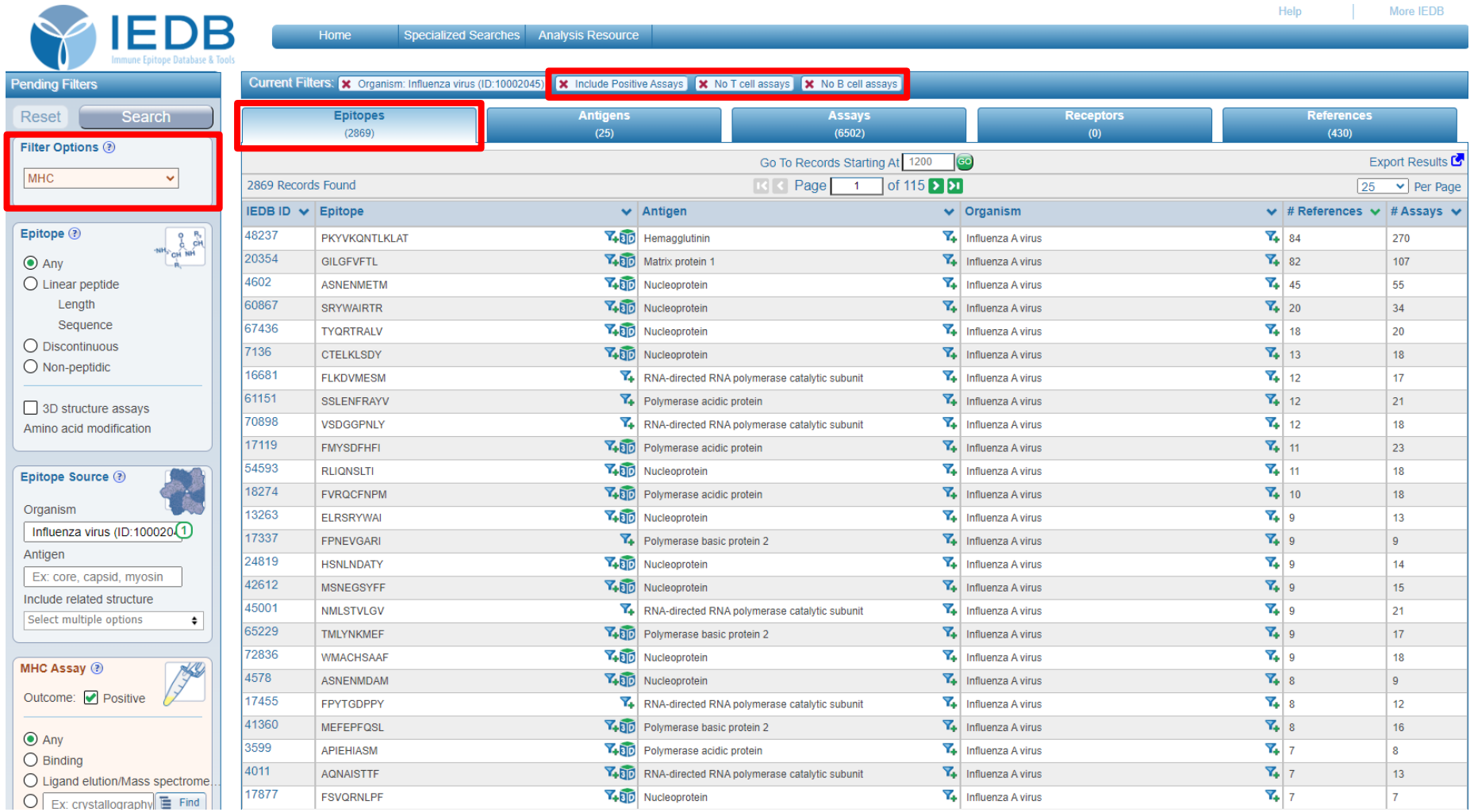
Positive assay outcomes



IEDB ID	Epitope	Antigen	Organism	# References	# Assays
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	264	695
4602	ASNENMETM	Nucleoprotein	Influenza A virus	156	449
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	127	424
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	94	273
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	85	182
60867	SRYWAIRTR	Nucleoprotein	Influenza A virus	46	101
7136	CTELKLSDY	Nucleoprotein	Influenza A virus	36	63
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	34	136
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	33	115
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	31	75
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	29	69
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	28	95
13263	ELRSRYWAI	Nucleoprotein	Influenza A virus	27	50
27283	ILRGSVAHK	Nucleoprotein	Influenza A virus	27	57
70898	VSDGGPNLY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	27	39
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	25	52
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	22	59
39494	LSLRNPILV	Protein PB1-F2	Influenza A virus	21	45
2014	AIMDKNIIL	Non-structural protein 1	Influenza A virus	19	74
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	17	34
45001	NMLSTVLGV	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	16	48
18406	FYIQMCTEL	Nucleoprotein	Influenza A virus	13	35
41602	MGLIYNRM	Matrix protein 1	Influenza A virus	13	28
54593	RLIQNSLTI	Nucleoprotein	Influenza A virus	13	29
16681	FLKDVMESM	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	12	18

Results: Influenza virus epitopes that bind

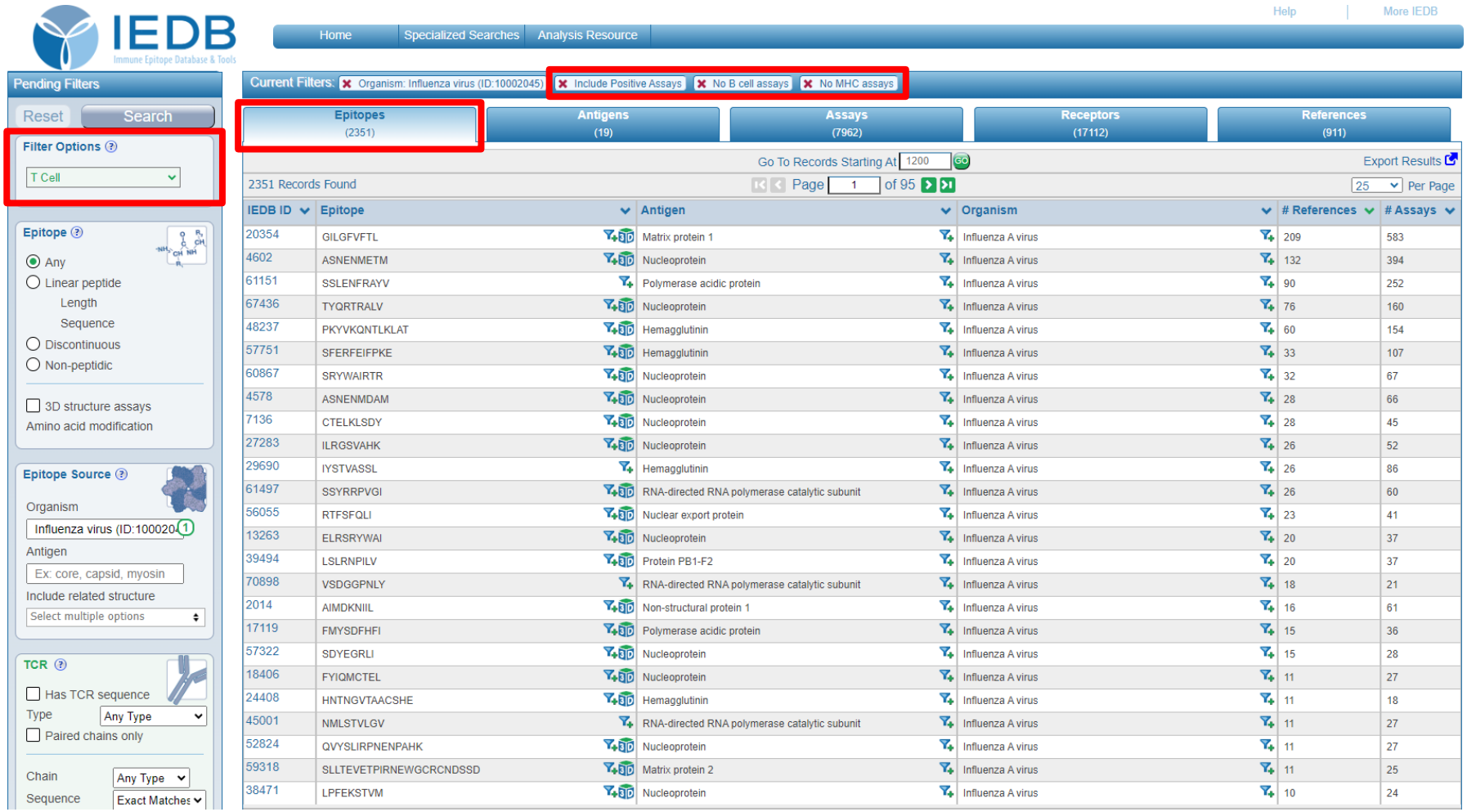
Positive assay outcomes for MHC assays



IEDB ID	Epitope	Antigen	Organism	# References	# Assays
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	84	270
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	82	107
4602	ASNENMETM	Nucleoprotein	Influenza A virus	45	55
60867	SRYWAIRTR	Nucleoprotein	Influenza A virus	20	34
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	18	20
7136	CTELKLSDY	Nucleoprotein	Influenza A virus	13	18
16681	FLKDVMESM	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	12	17
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	12	21
70898	VSDGGPNLY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	12	18
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	11	23
54593	RLIQNSLTI	Nucleoprotein	Influenza A virus	11	18
18274	FVRQCFNPM	Polymerase acidic protein	Influenza A virus	10	18
13263	ELRSRYWAI	Nucleoprotein	Influenza A virus	9	13
17337	FPNEVGARI	Polymerase basic protein 2	Influenza A virus	9	9
24819	HSNLNDATY	Nucleoprotein	Influenza A virus	9	14
42612	MSNEGSYFF	Nucleoprotein	Influenza A virus	9	15
45001	NMLSTVLGV	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	9	21
65229	TMLYNKMEF	Polymerase basic protein 2	Influenza A virus	9	17
72836	WMACHSAAF	Nucleoprotein	Influenza A virus	9	18
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	8	9
17455	FPYTGDPPY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	8	12
41360	MEFEPFQSL	Polymerase basic protein 2	Influenza A virus	8	16
3599	APIEHIASM	Polymerase acidic protein	Influenza A virus	7	8
4011	AQNAISTTF	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	7	13
17877	FSVQRNLPF	Nucleoprotein	Influenza A virus	7	7

Results: Influenza virus epitopes that are immunogenic

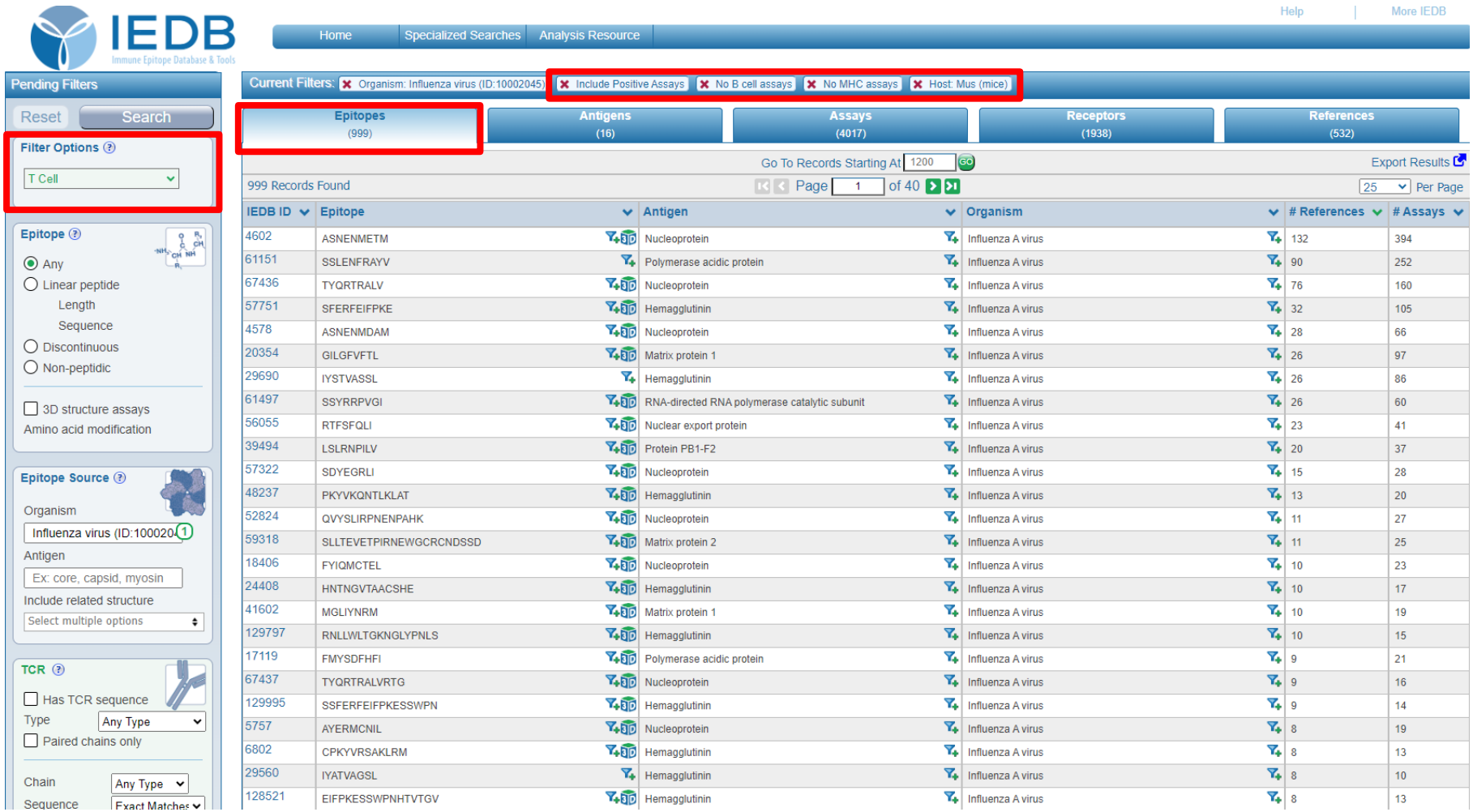
Positive assay outcomes for T cell assays



IEDB ID	Epitope	Antigen	Organism	# References	# Assays
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	209	583
4602	ASNENMETM	Nucleoprotein	Influenza A virus	132	394
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	90	252
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	76	160
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	60	154
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	33	107
60867	SRYWAIRTR	Nucleoprotein	Influenza A virus	32	67
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	28	66
7136	CTELKLSDY	Nucleoprotein	Influenza A virus	28	45
27283	ILRGSVAHK	Nucleoprotein	Influenza A virus	26	52
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	26	86
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	26	60
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	23	41
13263	ELRSRYWAI	Nucleoprotein	Influenza A virus	20	37
39494	LSLRNPILV	Protein PB1-F2	Influenza A virus	20	37
70898	VSDGGPNLY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	18	21
2014	AIMDKNIIL	Non-structural protein 1	Influenza A virus	16	61
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	15	36
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	15	28
18406	FYIQMCTEL	Nucleoprotein	Influenza A virus	11	27
24408	HNTNGVTAACSHE	Hemagglutinin	Influenza A virus	11	18
45001	NMLSTVLGV	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	11	27
52824	QVYSLIRPNENPAHK	Nucleoprotein	Influenza A virus	11	27
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	11	25
38471	LPFEKSTVM	Nucleoprotein	Influenza A virus	10	24

Results: Influenza virus mouse epitopes that are immunogenic

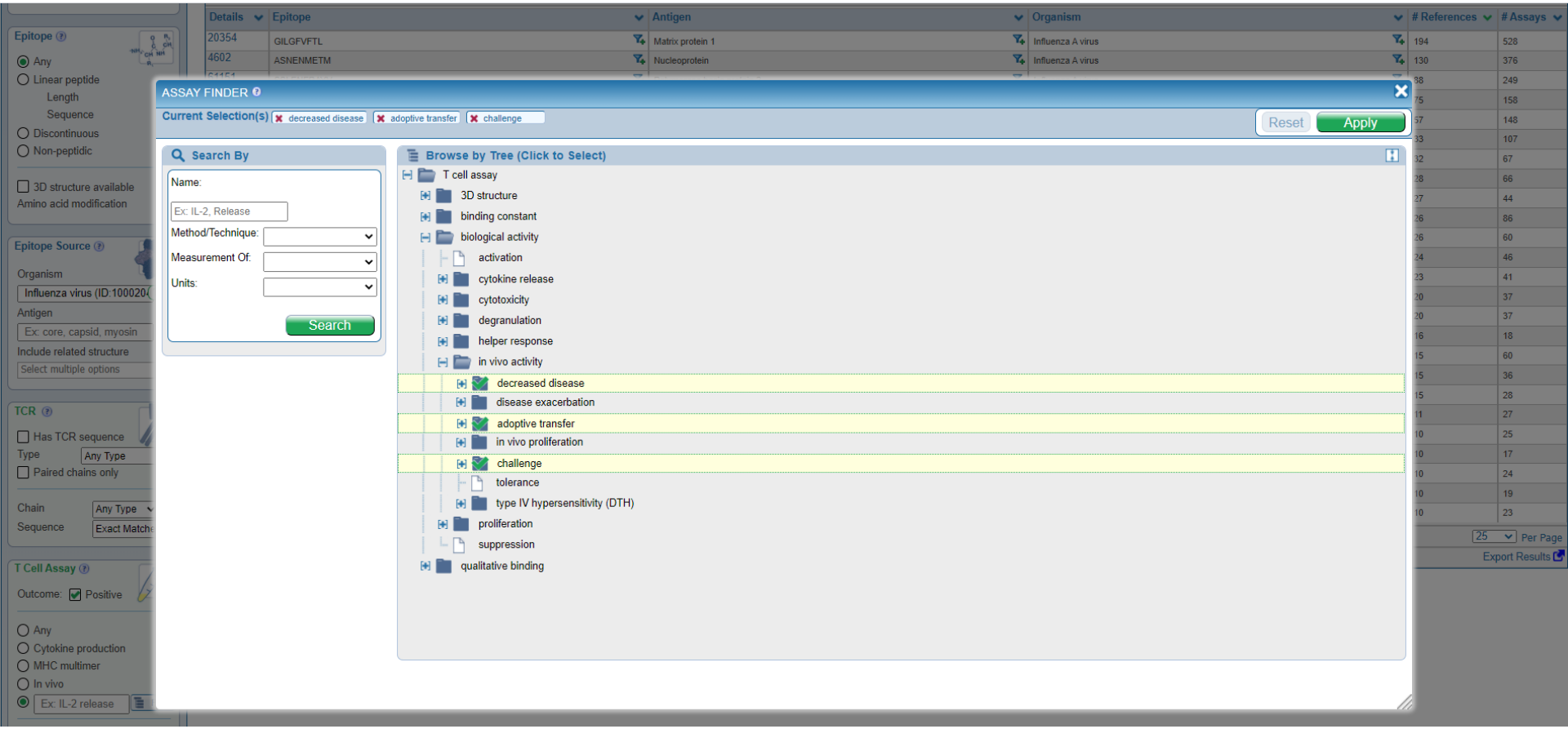
Positive assay outcomes for T cell assays in a mouse host



IEDB ID	Epitope	Antigen	Organism	# References	# Assays
4602	ASNENMETM	Nucleoprotein	Influenza A virus	132	394
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	90	252
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	76	160
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	32	105
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	28	66
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	26	97
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	26	86
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	26	60
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	23	41
39494	LSLRNPILV	Protein PB1-F2	Influenza A virus	20	37
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	15	28
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	13	20
52824	QVYSLIRPNENPAHK	Nucleoprotein	Influenza A virus	11	27
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	11	25
18406	FYIQMCTEL	Nucleoprotein	Influenza A virus	10	23
24408	HNTNGVTAACSHE	Hemagglutinin	Influenza A virus	10	17
41602	MGLIYNRM	Matrix protein 1	Influenza A virus	10	19
129797	RNLLWLTGKNGLYPNLS	Hemagglutinin	Influenza A virus	10	15
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	9	21
67437	TYQRTRALVRTG	Nucleoprotein	Influenza A virus	9	16
129995	SSFERFEIFPKESSWPN	Hemagglutinin	Influenza A virus	9	14
5757	AYERMCNIL	Nucleoprotein	Influenza A virus	8	19
6802	CPKYVRSAKLRM	Hemagglutinin	Influenza A virus	8	13
29560	IYATVAGSL	Hemagglutinin	Influenza A virus	8	10
128521	EIFPKESSWPNHTVTGV	Hemagglutinin	Influenza A virus	8	13

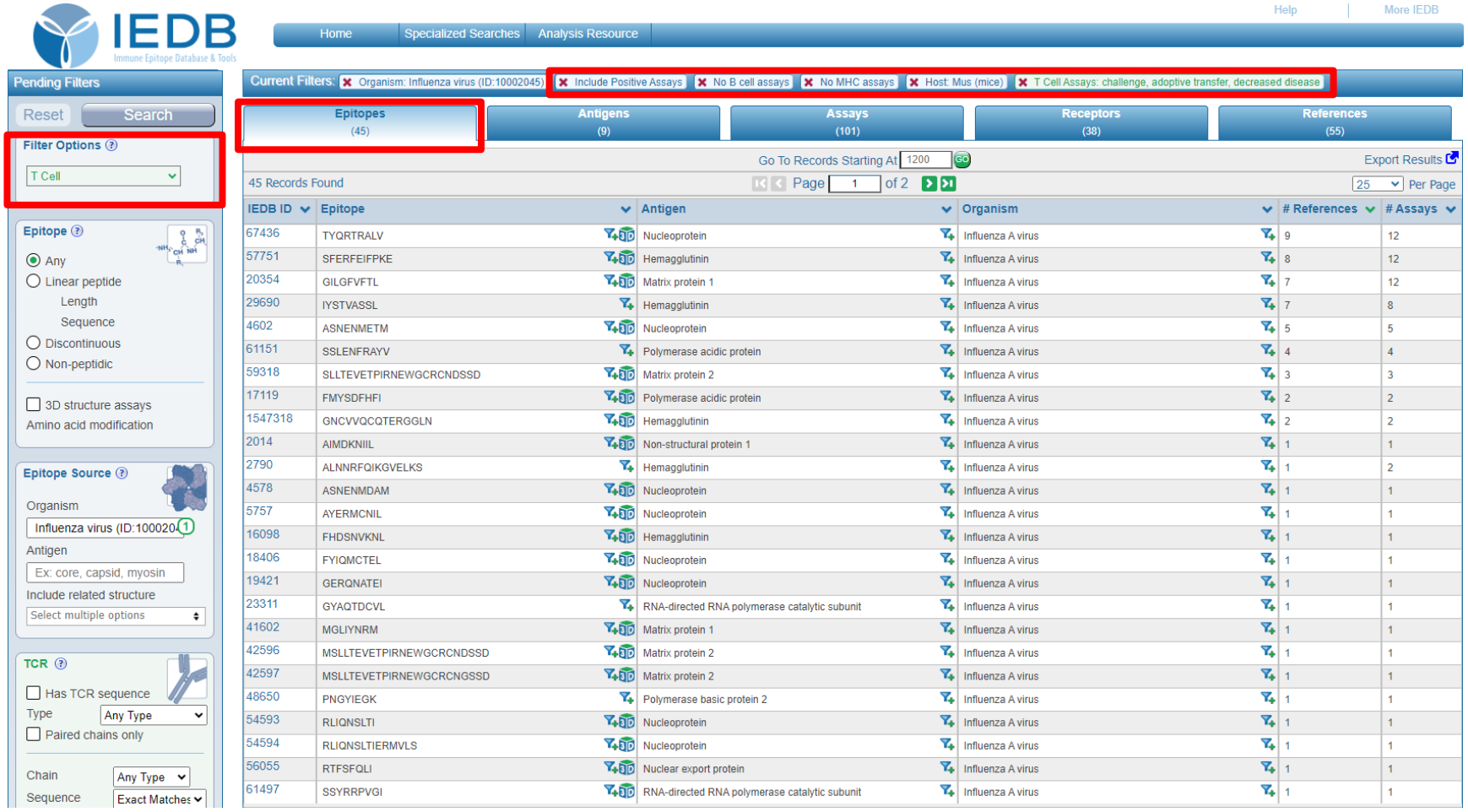
Results: Influenza virus epitopes that offer protection from disease

Positive assay outcomes for T cell assays (decreased disease, adoptive transfer, challenge) in a mouse host



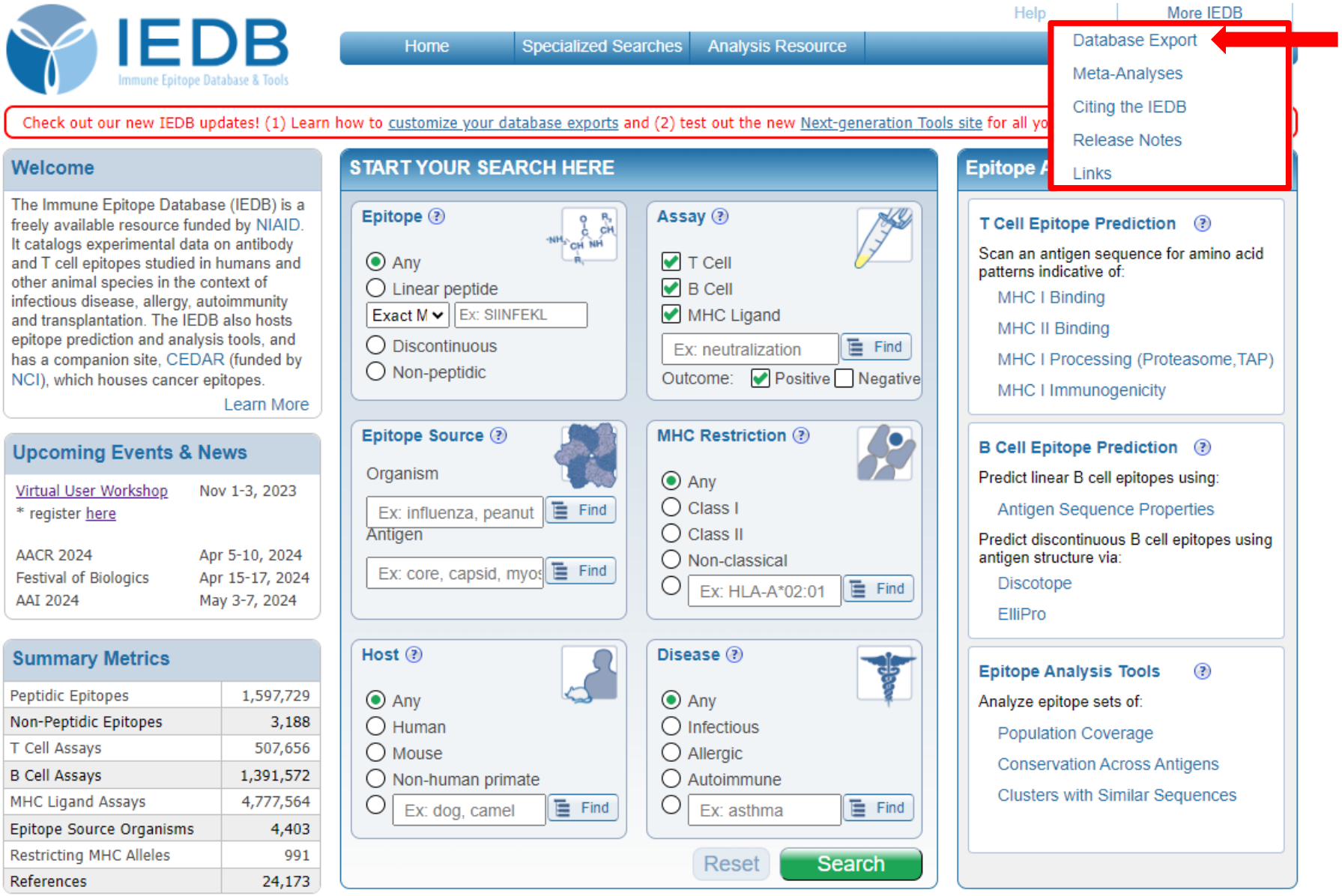
Results: Influenza virus epitopes that offer protection from disease

Positive assay outcomes for T cell assays (decreased disease, adoptive transfer, challenge) in a mouse host



IEDB ID	Epitope	Antigen	Organism	# References	# Assays
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	9	12
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	8	12
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	7	12
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	7	8
4602	ASNENMETM	Nucleoprotein	Influenza A virus	5	5
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	4	4
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	3	3
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	2	2
1547318	GNCVVQCQTERGGLN	Hemagglutinin	Influenza A virus	2	2
2014	AIMDKNIIL	Non-structural protein 1	Influenza A virus	1	1
2790	ALNNRFQIKGVELKS	Hemagglutinin	Influenza A virus	1	2
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	1	1
5757	AYERMCNIL	Nucleoprotein	Influenza A virus	1	1
16098	FHDSNVKNL	Hemagglutinin	Influenza A virus	1	1
18406	FYIQMCTEL	Nucleoprotein	Influenza A virus	1	1
19421	GERQNATEI	Nucleoprotein	Influenza A virus	1	1
23311	GYAQTDCVL	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	1	1
41602	MGLIYNRM	Matrix protein 1	Influenza A virus	1	1
42596	MSLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	1	1
42597	MSLLTEVETPIRNEWGCRCNGSSD	Matrix protein 2	Influenza A virus	1	1
48650	PNGYIEGK	Polymerase basic protein 2	Influenza A virus	1	1
54593	RLIQNSLTI	Nucleoprotein	Influenza A virus	1	1
54594	RLIQNSLTIERMVLS	Nucleoprotein	Influenza A virus	1	1
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	1	1
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	1	1

More Exports



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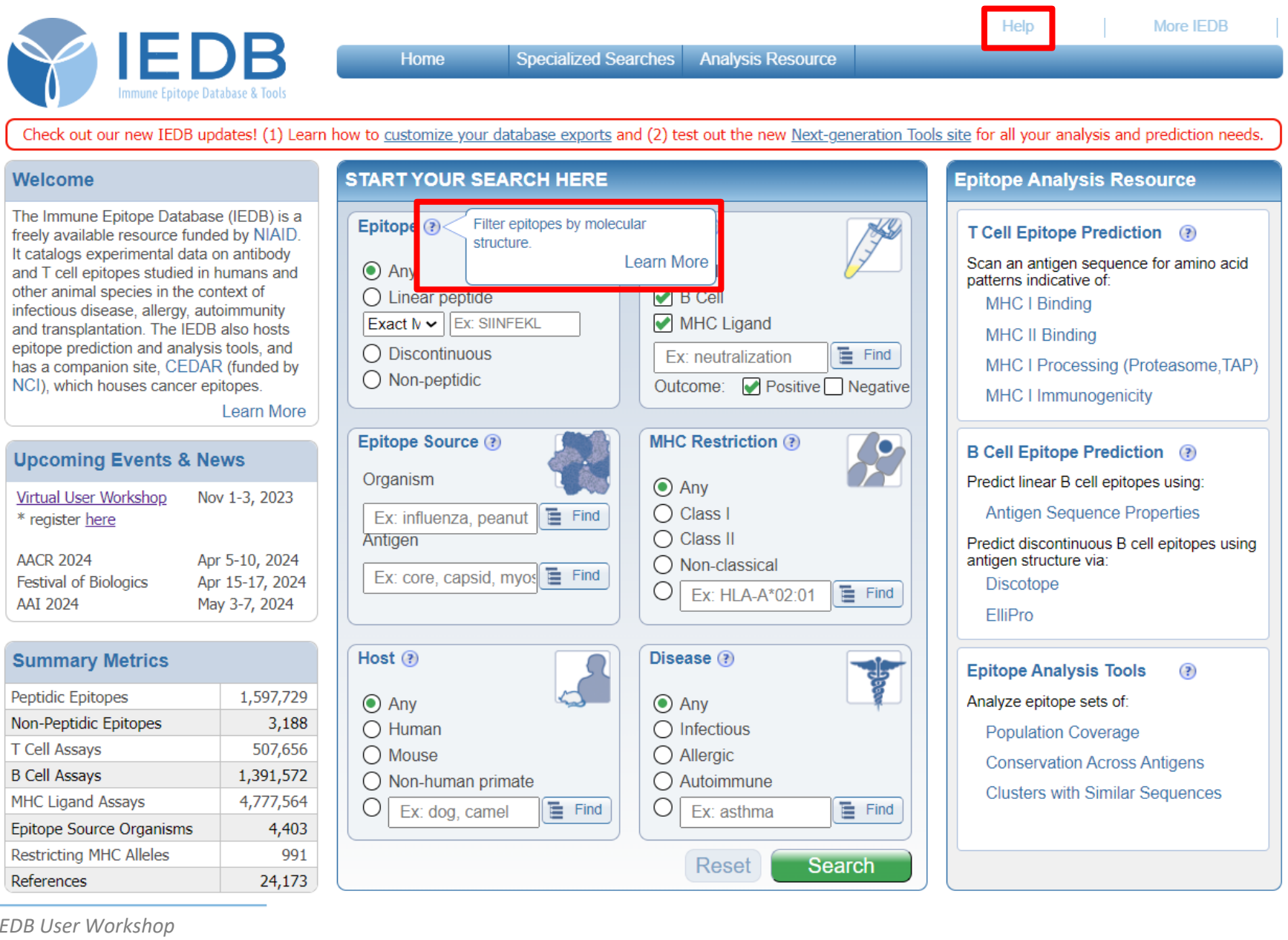


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