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)

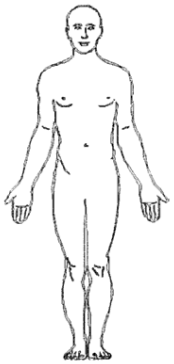
Immune Epitope Database

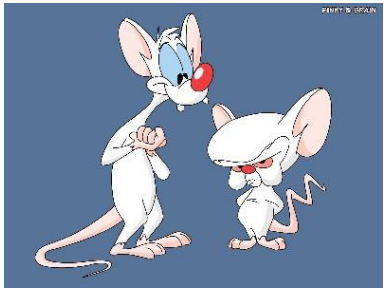
www.iedb.org

Database | Resource of experimentally-derived epitope information

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

… and more





Containing data on over **1.5 million unique structures** analyzed in over **4.7 million assays** from more than **22,300 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

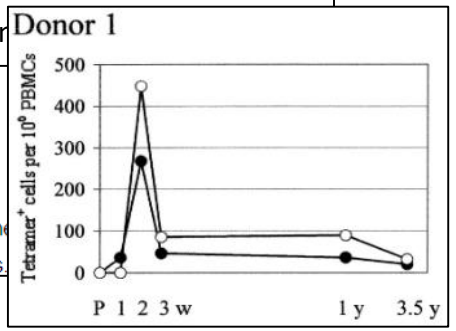
Quantitation of CD8+ T Cell Responses to Newly Identified HLA-A*0201–restricted T Cell Epitopes Conserved Among Vaccinia and Variola (Smallpox) Viruses

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

Materials And Methods

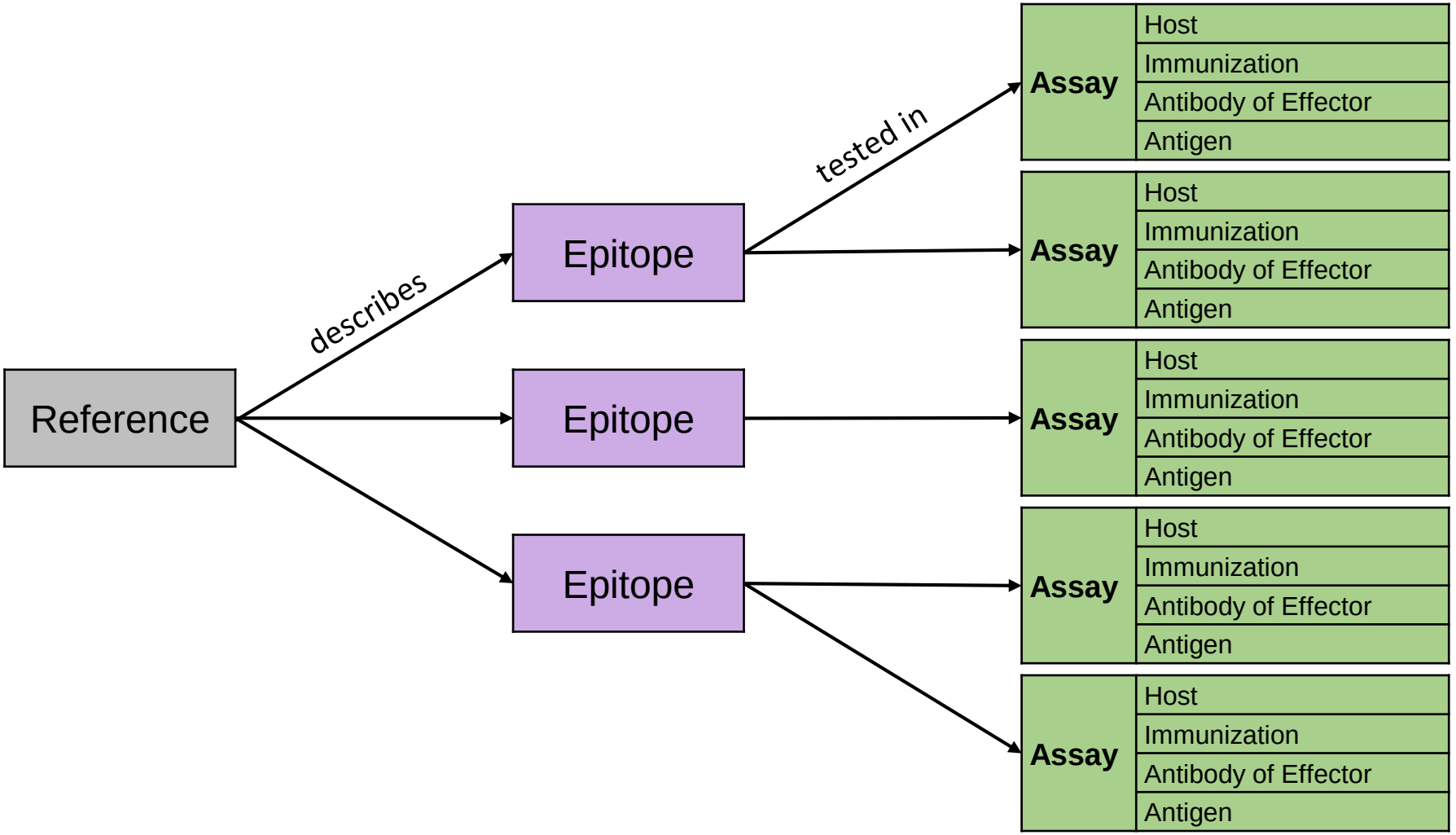
Donors.

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



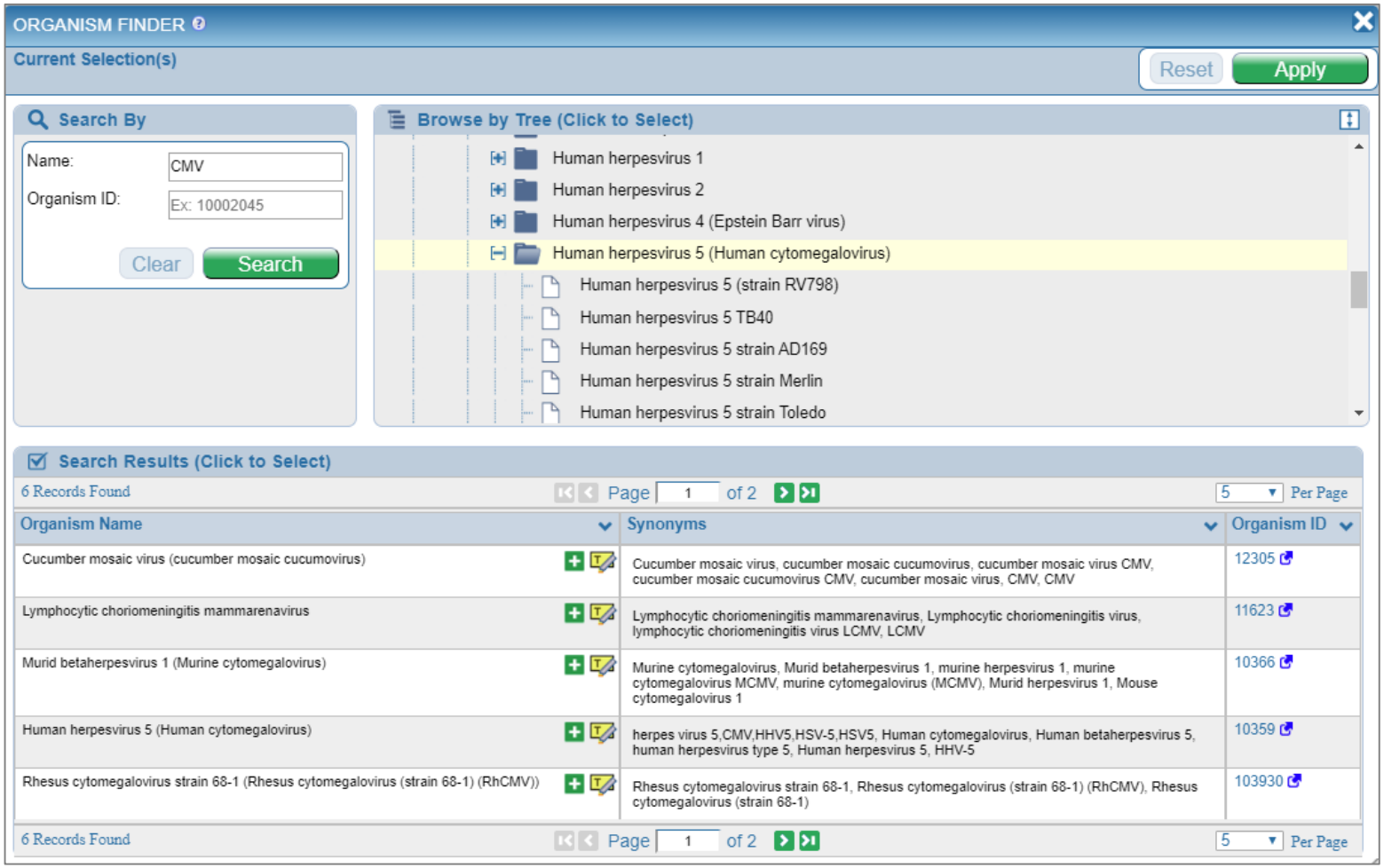
Collaborations with Ontologies

- 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

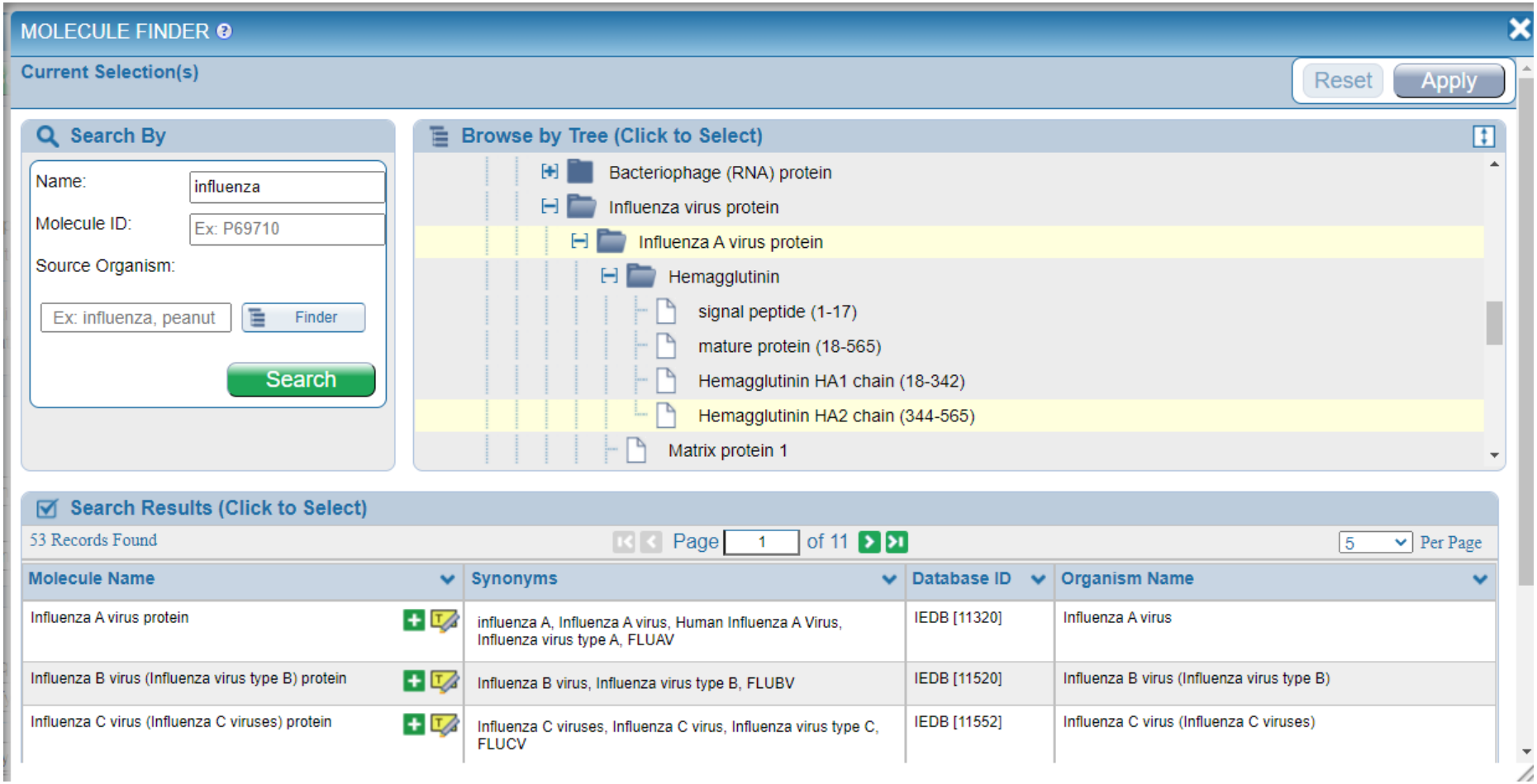
Human herpesvirus 5 (HHV-5)
NCBI
taxon:10359



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

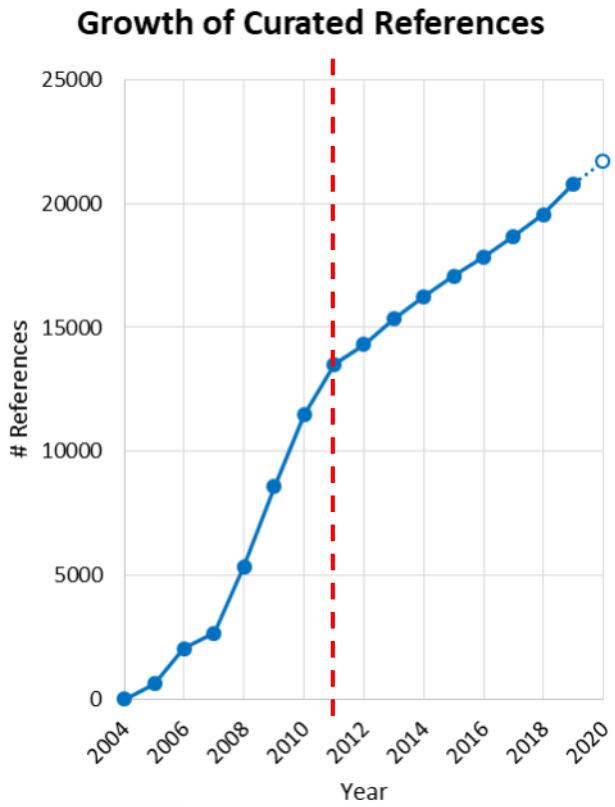
151K epitope related

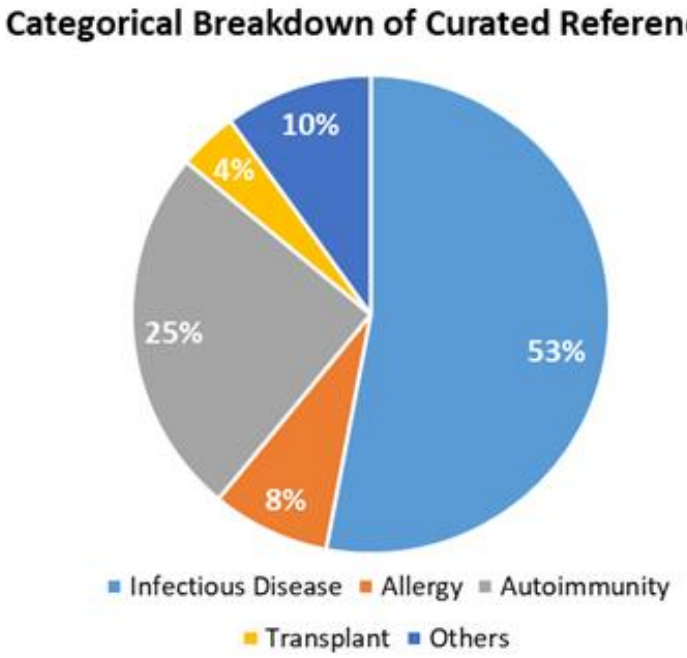
Abstract Review
- Manual scan
- Confirmation of classification

44K likely curatable

Manual Curation
- Assigned to curators
- Peer review

22K curated





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, 2021:

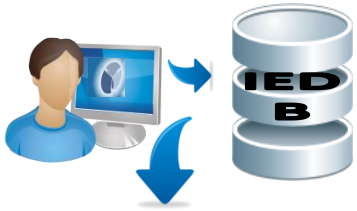
- Data from **319 submissions** is publicly available & **96 submissions** are in process or on-hold
- Submitted data comprises **23% of epitopes** available in the IEDB

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

Direct Submission Process

Submission

- Investigators submit files via IEDB data submission tool



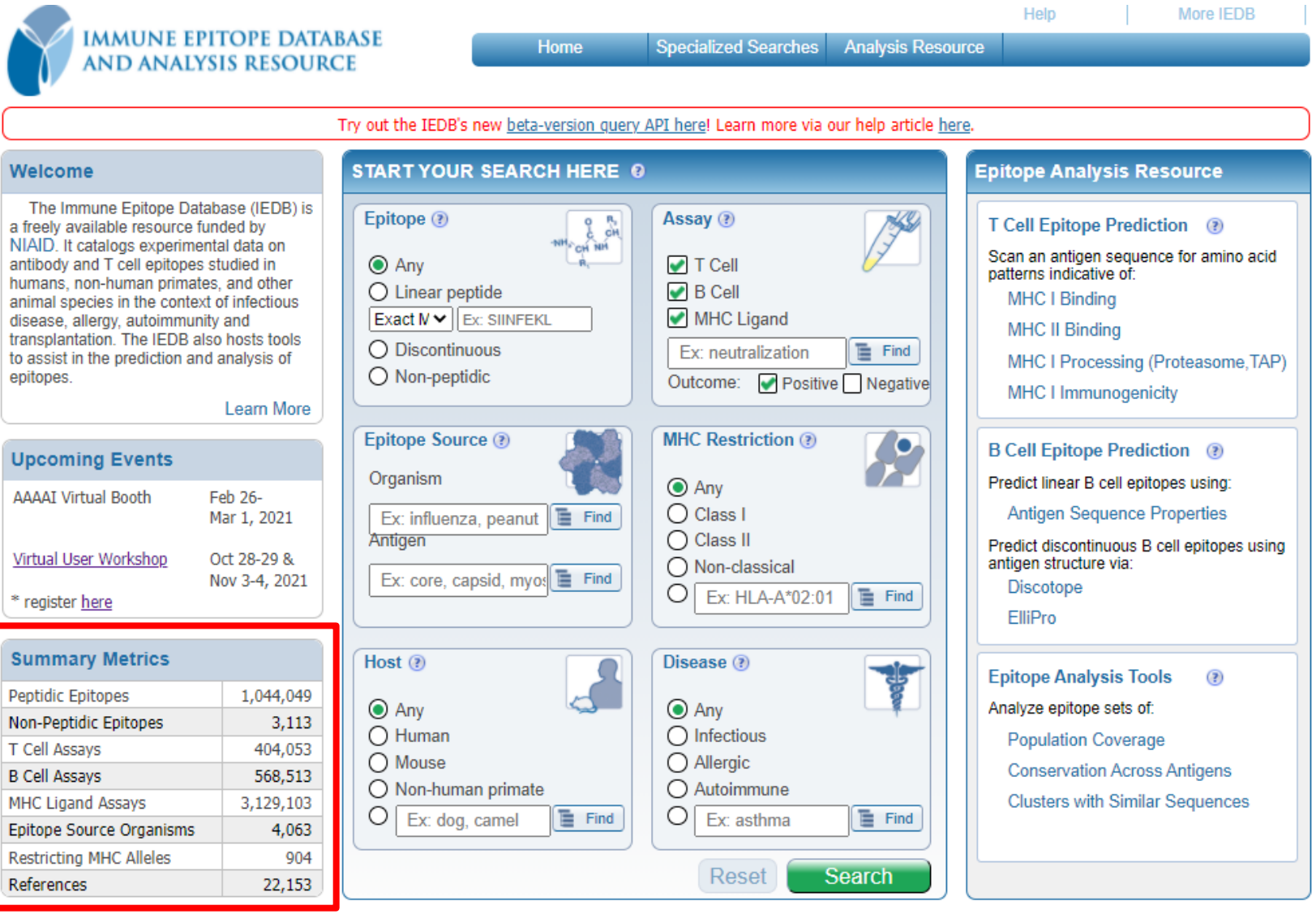
Review

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

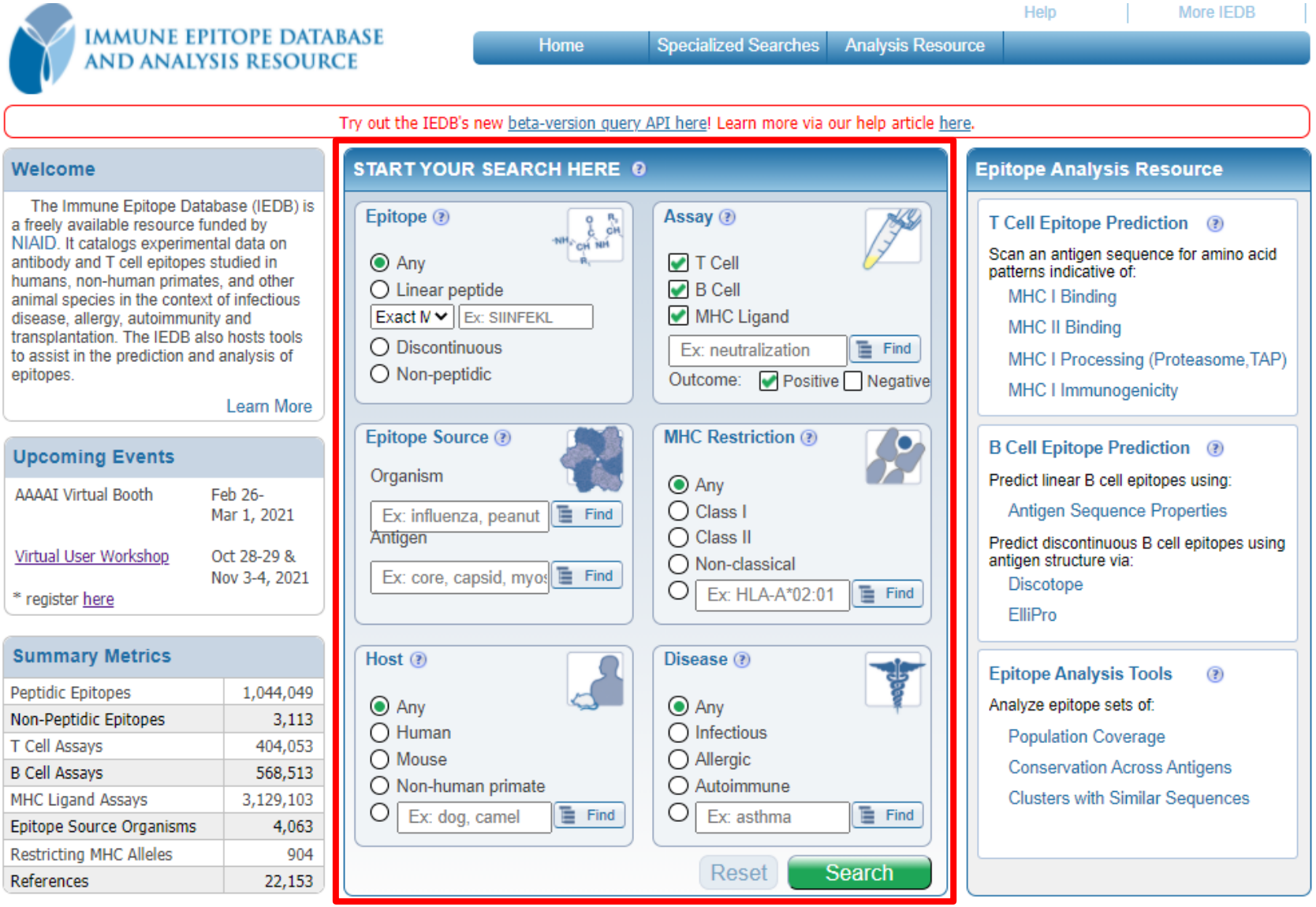
Release

- Public release date set by submitter

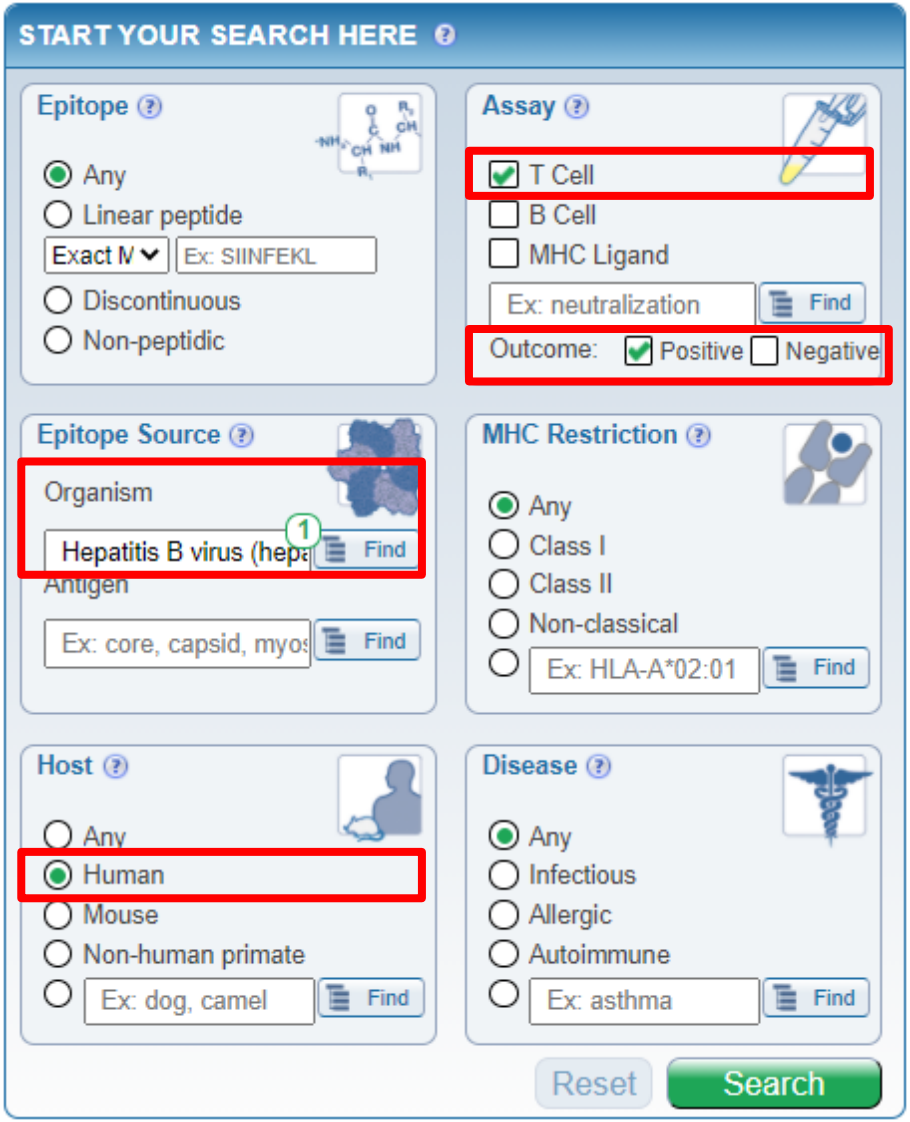
IEDB.org: Homepage & Cumulative Data



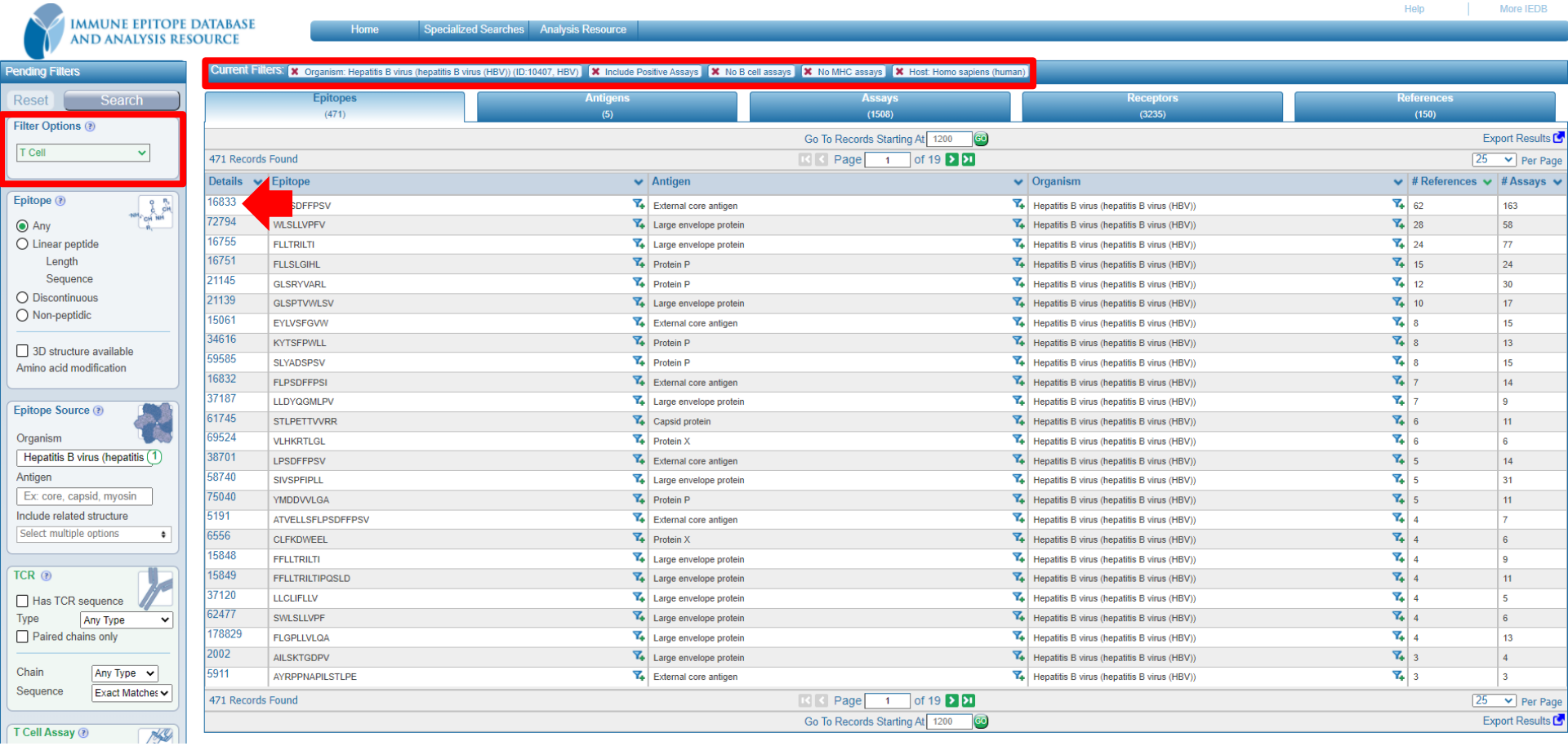
IEDB.org: Homepage & Search Interface



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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Go To Records Starting At 1200
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

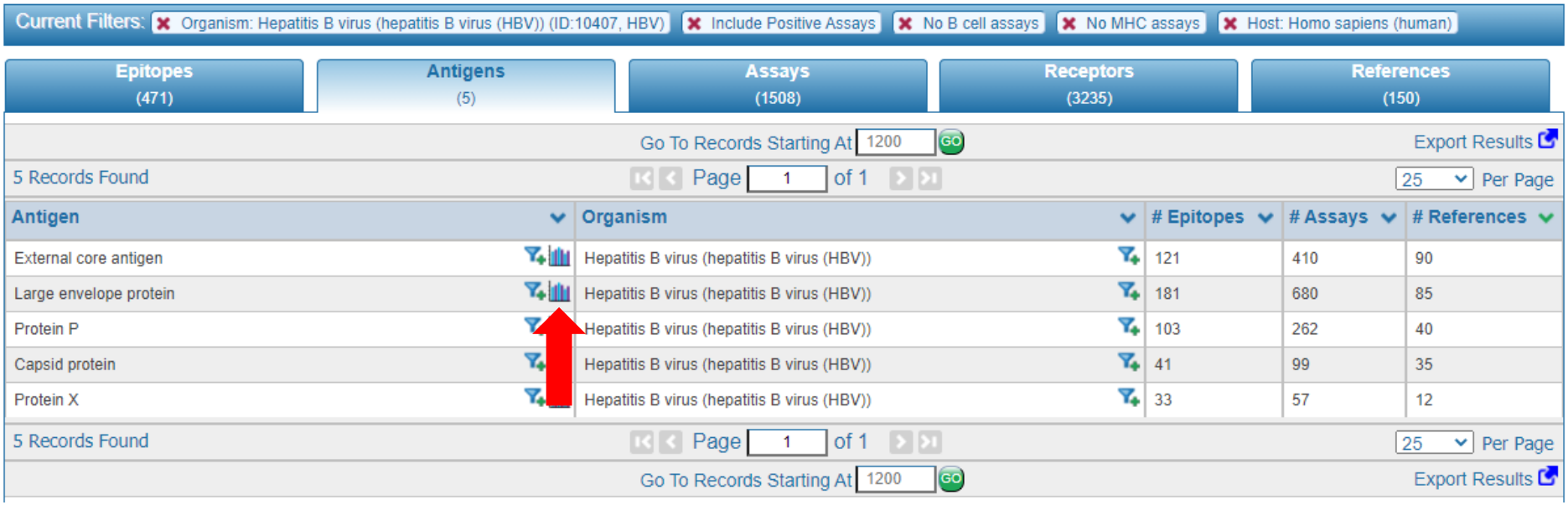
T Cell Assay(s) 215

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

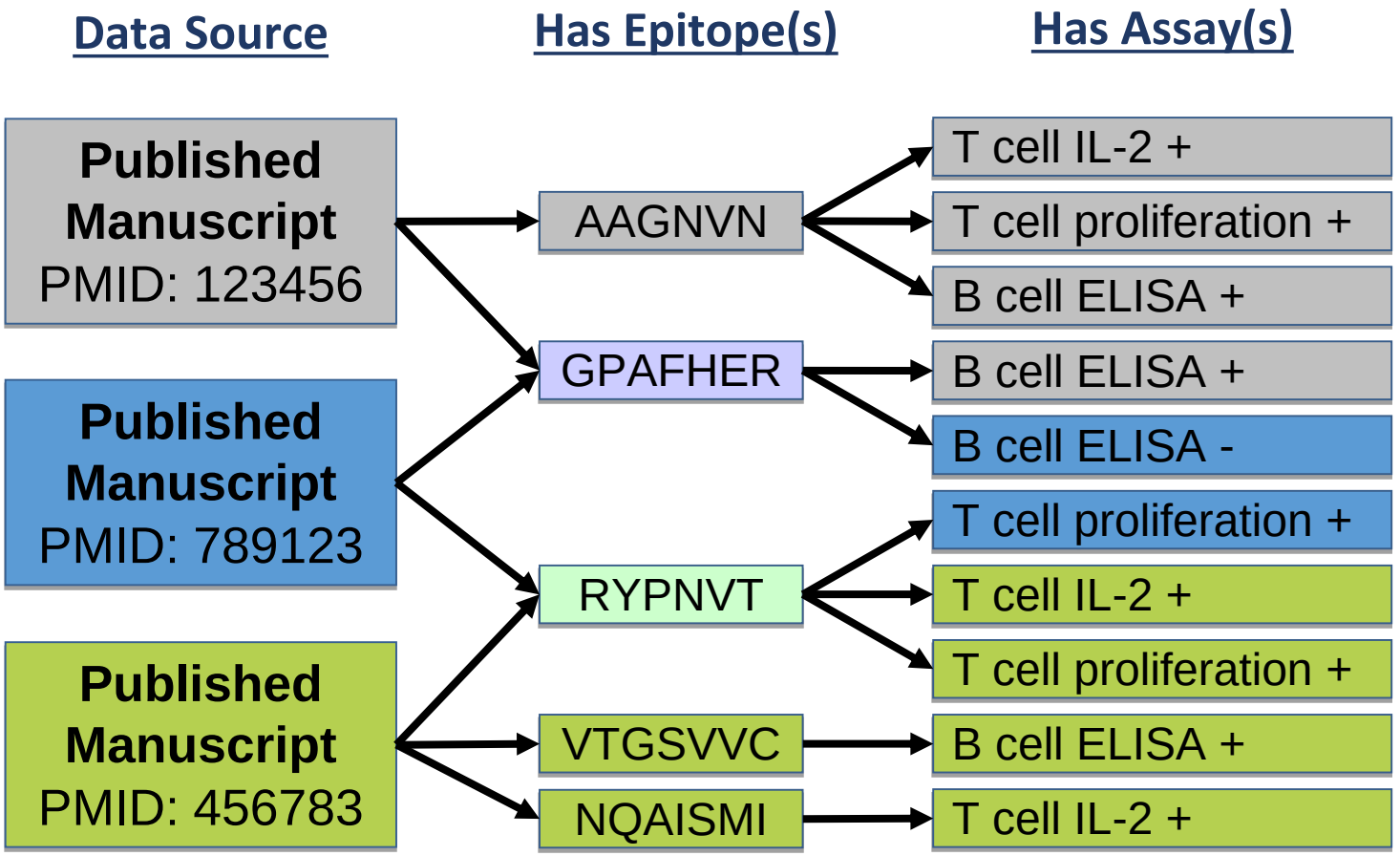
EXTERNAL RESOURCES

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)

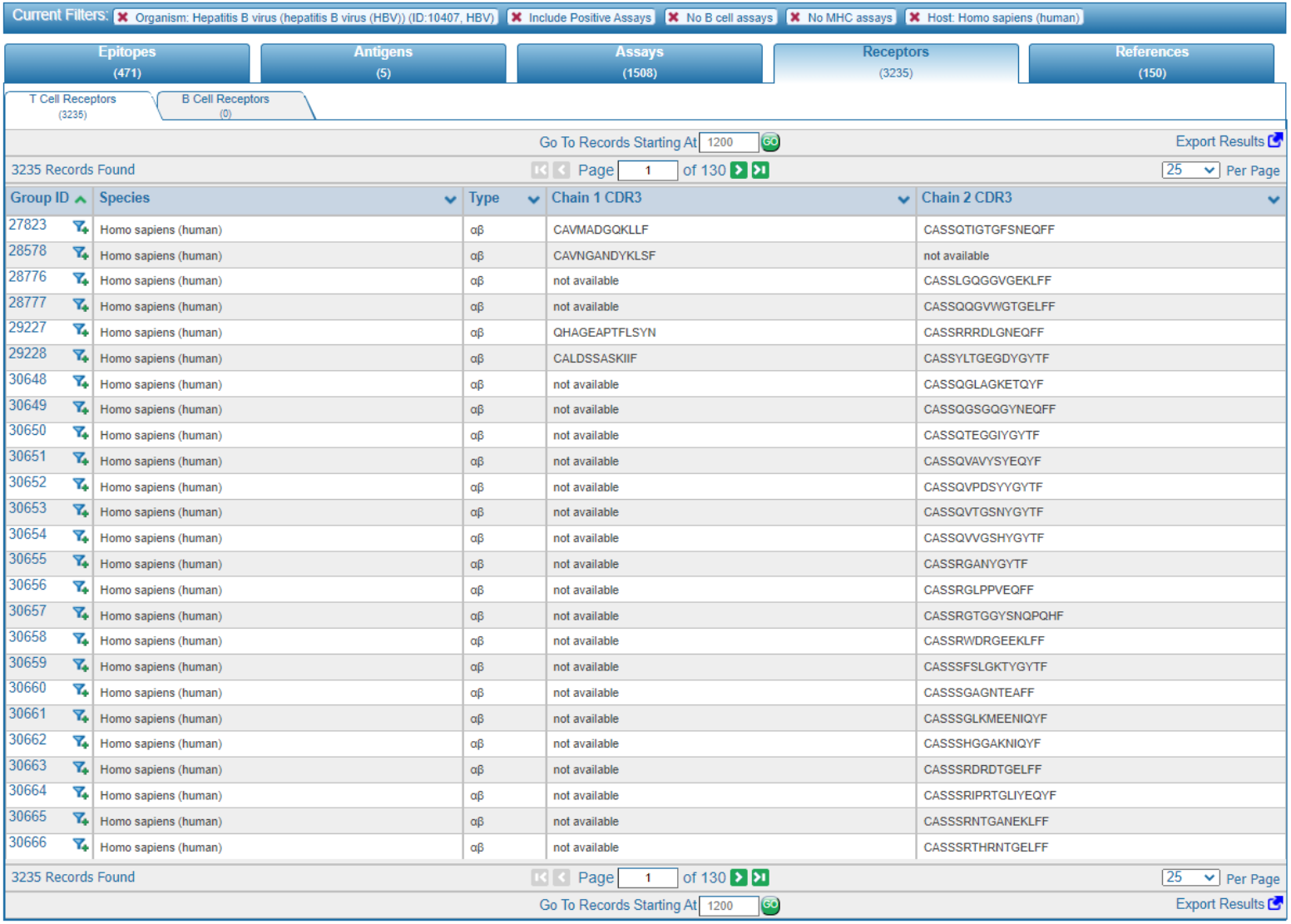
T Cell Assays (163) | B Cell Assays (0) | MHC Ligand Assays (0)

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

163 Records Found | Page 1 of 7 | 25 Per Page

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)

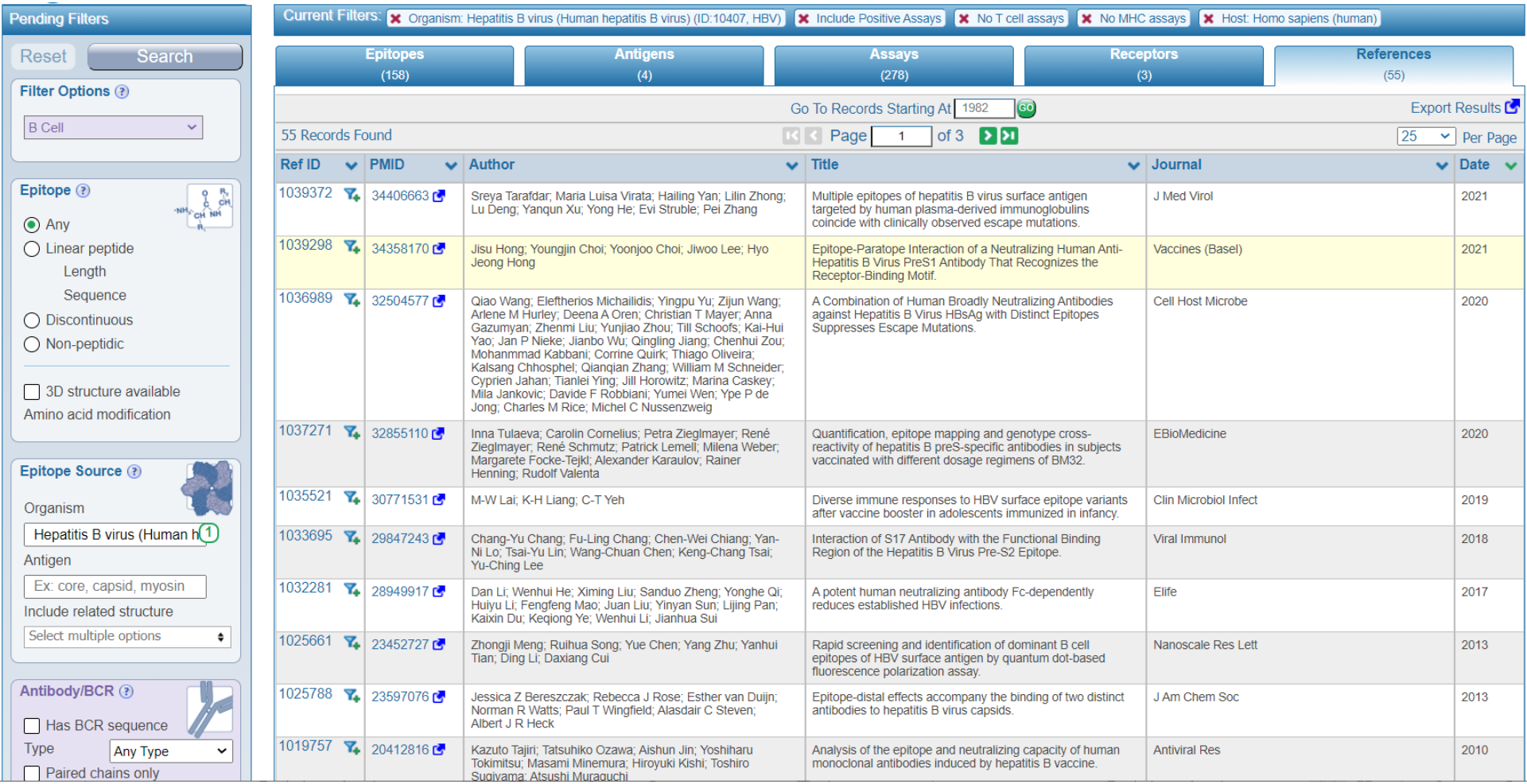
Go To Records Starting At 1200 GO — Export Results

3235 Records Found — Page 1 of 130 — 25 Per Page

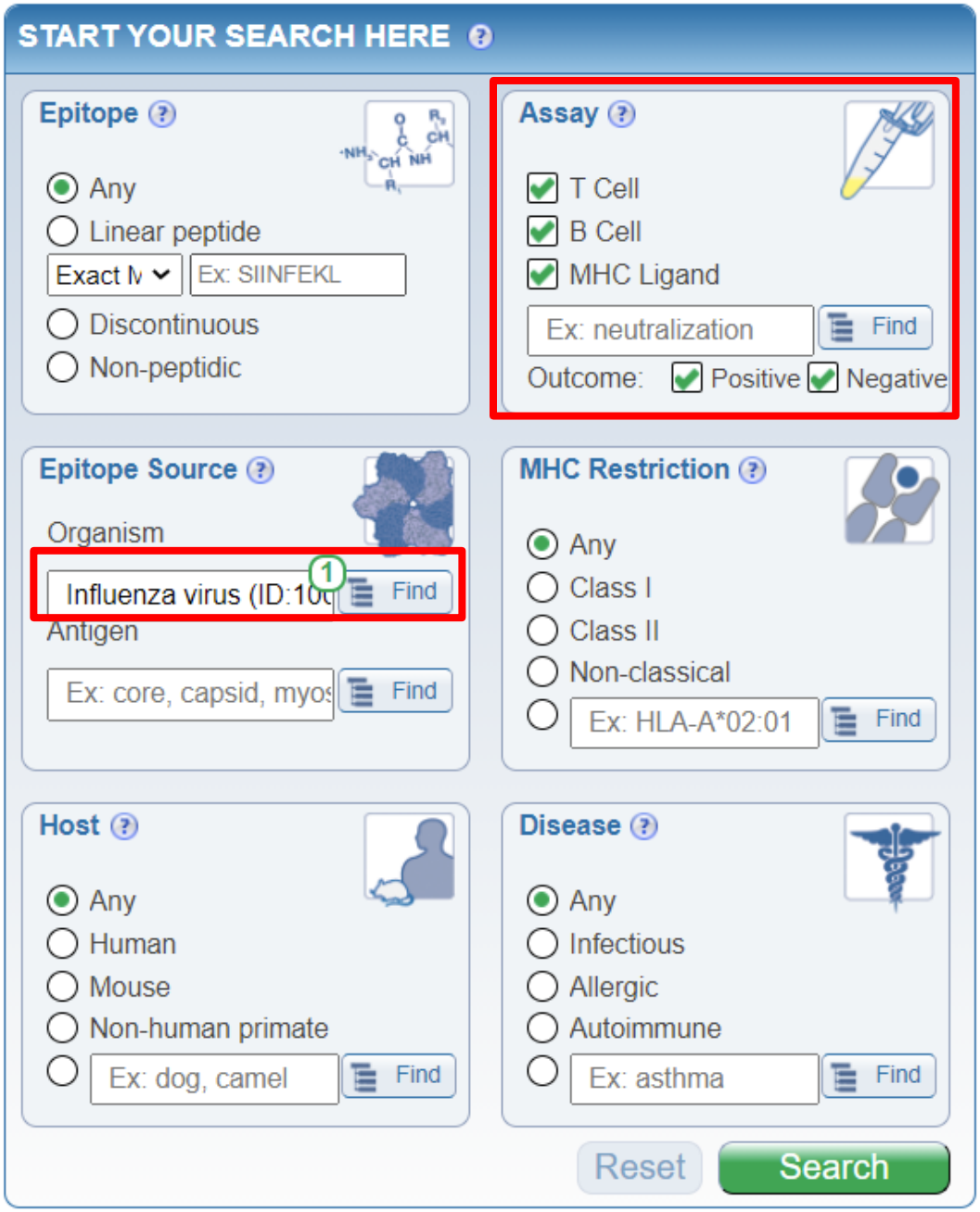
Group ID	Species	Type	Chain 1 CDR3	Chain 2 CDR3
27823	Homo sapiens (human)	αβ	CAVMADGQKLLF	CASSQTIGTGFSNEQFF
28578	Homo sapiens (human)	αβ	CAVNGANDYKLSF	not available
28776	Homo sapiens (human)	αβ	not available	CASSLGQGGVGEKLFF
28777	Homo sapiens (human)	αβ	not available	CASSQQGVWGTGELFF
29227	Homo sapiens (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
Go To Records Starting At 1200 GO — Export Results

References: Source of Information

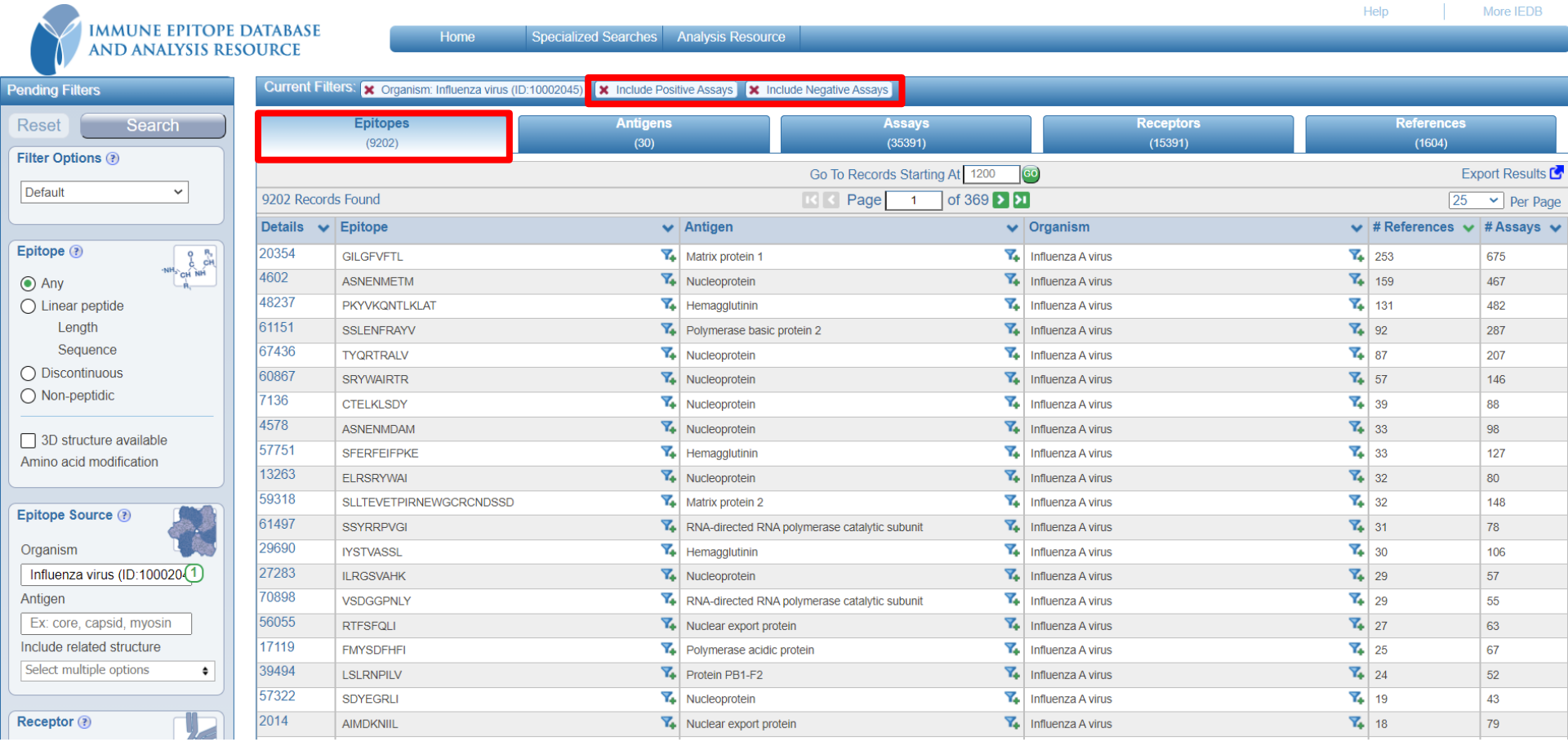


Example Query II: Influenza Virus Epitopes



Results: All influenza virus epitopes

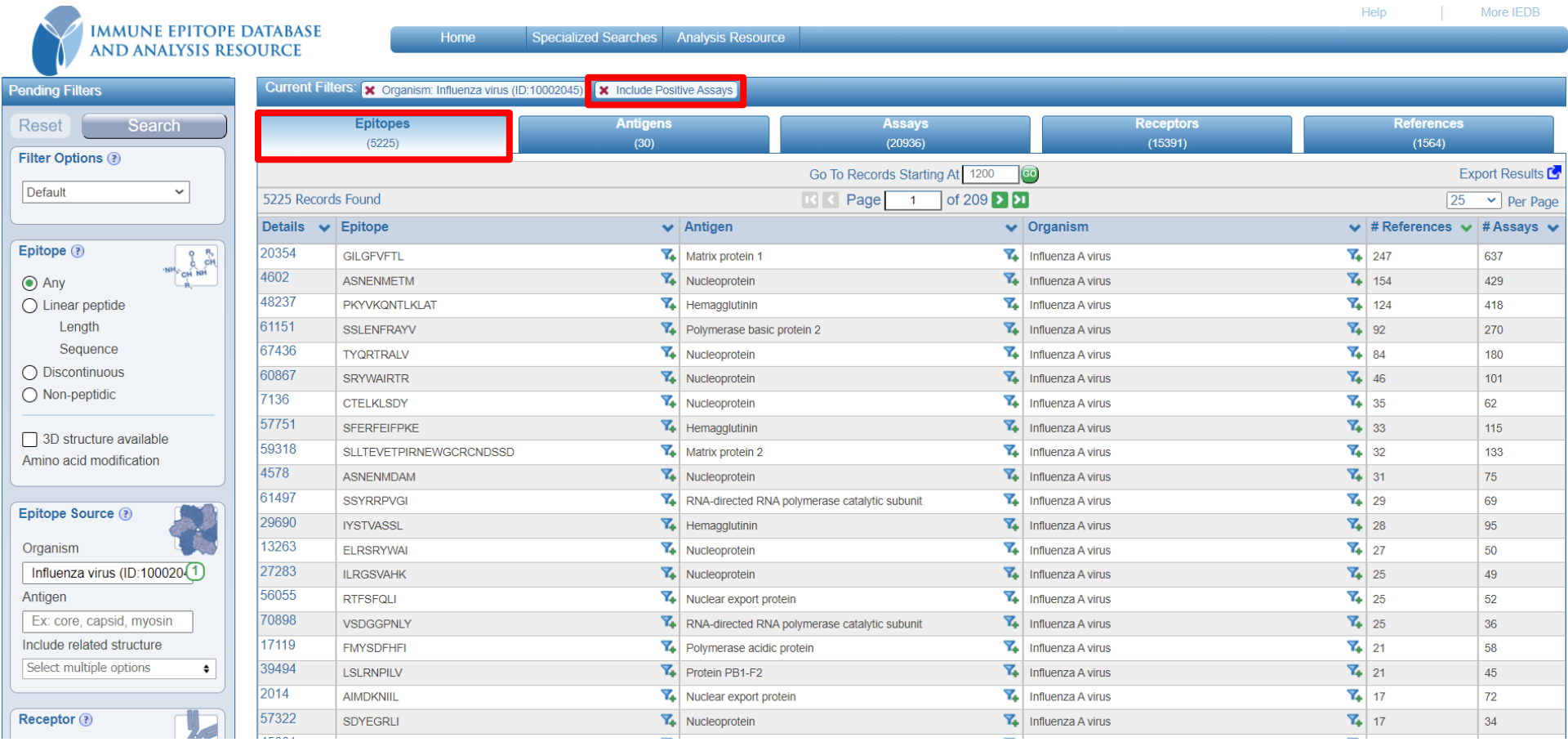
Both positive and negative assay outcomes



Details	Epitope	Antigen	Organism	# References	# Assays
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	253	675
4602	ASNENMETM	Nucleoprotein	Influenza A virus	159	467
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	131	482
61151	SSLENFRAYV	Polymerase basic protein 2	Influenza A virus	92	287
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	87	207
60867	SRYWAIRTR	Nucleoprotein	Influenza A virus	57	146
7136	CTELKLSDY	Nucleoprotein	Influenza A virus	39	88
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	33	98
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	33	127
13263	ELRSRYWAI	Nucleoprotein	Influenza A virus	32	80
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	32	148
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	31	78
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	30	106
27283	ILRGSVAHK	Nucleoprotein	Influenza A virus	29	57
70898	VSDGGPNLY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	29	55
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	27	63
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	25	67
39494	LSLRNPILV	Protein PB1-F2	Influenza A virus	24	52
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	19	43
2014	AIMDKNIIL	Nuclear export protein	Influenza A virus	18	79

Results: Positive influenza virus epitopes

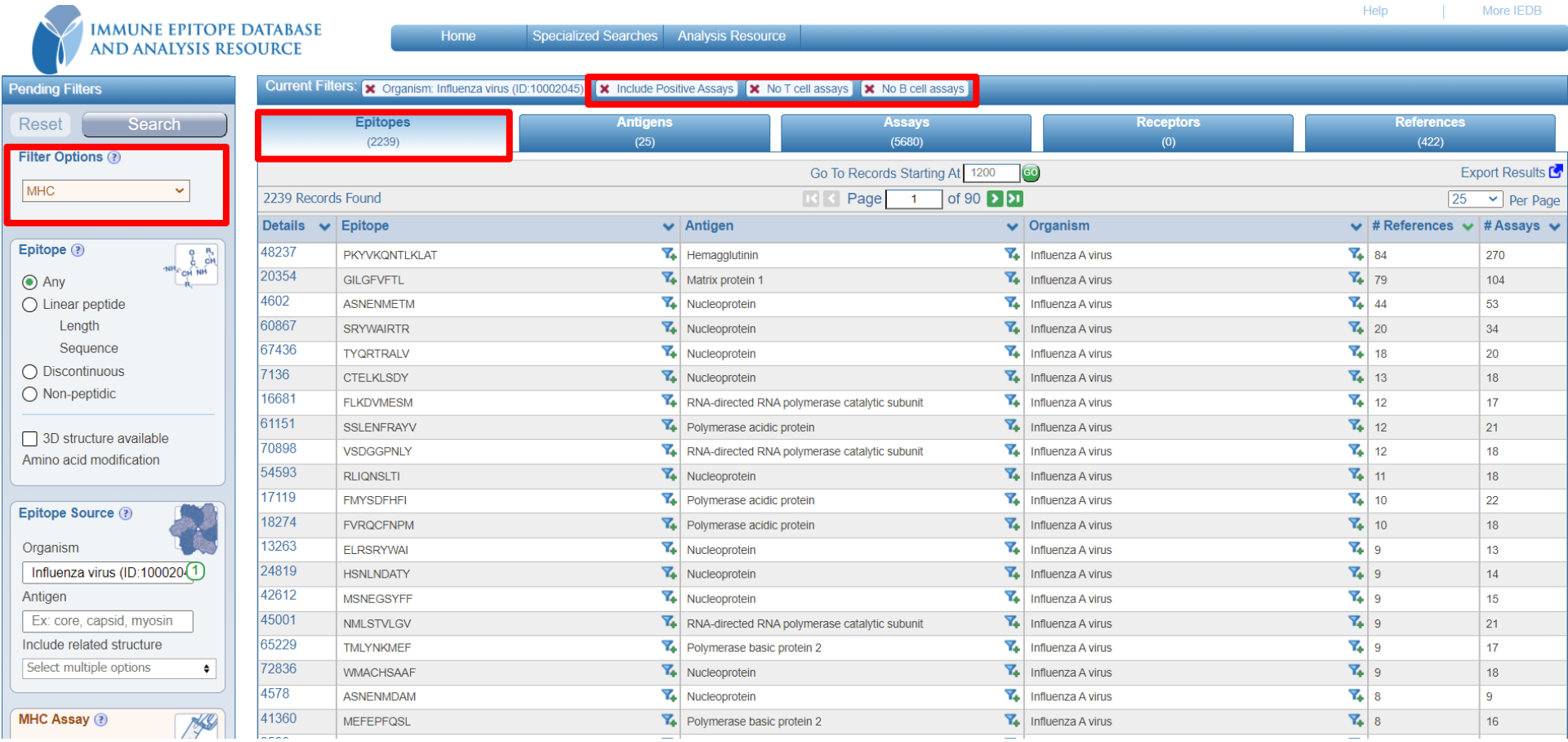
Positive assay outcomes



Details	Epitope	Antigen	Organism	# References	# Assays
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	247	637
4602	ASNENMETM	Nucleoprotein	Influenza A virus	154	429
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	124	418
61151	SSLENFRAYV	Polymerase basic protein 2	Influenza A virus	92	270
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	84	180
60867	SRYWAIRTR	Nucleoprotein	Influenza A virus	46	101
7136	CTELKLSDY	Nucleoprotein	Influenza A virus	35	62
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	33	115
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	32	133
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	25	49
56055	RTFSFQLI	Nuclear export protein	Influenza A virus	25	52
70898	VSDGGPNLY	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	25	36
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	21	58
39494	LSLRNPILV	Protein PB1-F2	Influenza A virus	21	45
2014	AIMDKNIIL	Nuclear export protein	Influenza A virus	17	72
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	17	34

Results: Influenza virus epitopes that bind

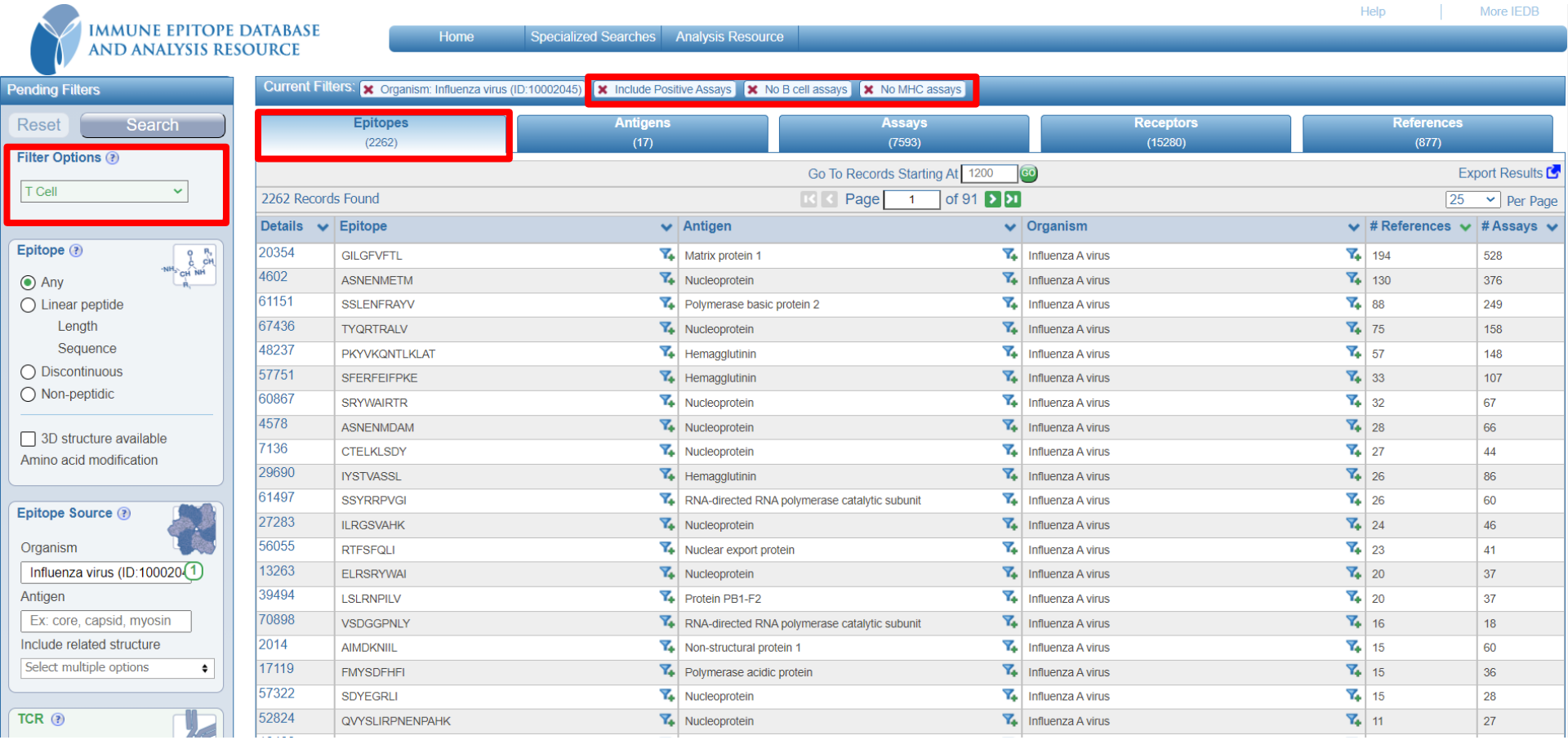
Positive assay outcomes for MHC assays



Details	Epitope	Antigen	Organism	# References	# Assays
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	84	270
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	79	104
4602	ASNENMETM	Nucleoprotein	Influenza A virus	44	53
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
54593	RLIQNSLTI	Nucleoprotein	Influenza A virus	11	18
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	10	22
18274	FVRQCFNPM	Polymerase acidic protein	Influenza A virus	10	18
13263	ELRSRYWAI	Nucleoprotein	Influenza A virus	9	13
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
41360	MEFEPFQSL	Polymerase basic protein 2	Influenza A virus	8	16

Results: Influenza virus epitopes that are immunogenic

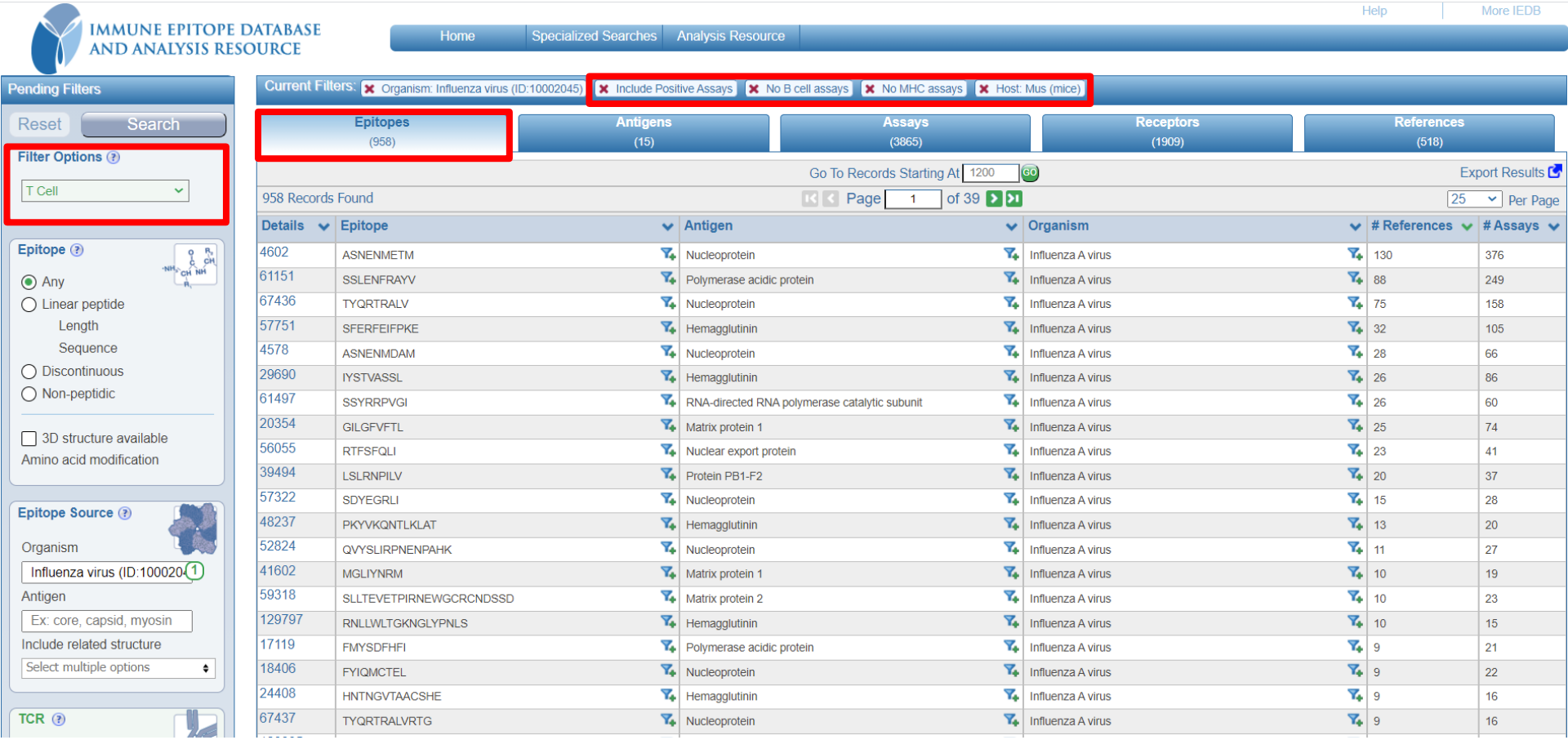
Positive assay outcomes for T cell assays



Details	Epitope	Antigen	Organism	# References	# Assays
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	194	528
4602	ASNENMETM	Nucleoprotein	Influenza A virus	130	376
61151	SSLENFRAYV	Polymerase basic protein 2	Influenza A virus	88	249
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	75	158
48237	PKYVKQNTLKLAT	Hemagglutinin	Influenza A virus	57	148
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	27	44
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	26	86
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	26	60
27283	ILRGSVAHK	Nucleoprotein	Influenza A virus	24	46
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	16	18
2014	AIMDKNIIL	Non-structural protein 1	Influenza A virus	15	60
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	15	36
57322	SDYEGRLI	Nucleoprotein	Influenza A virus	15	28
52824	QVYSLIRPNENPAHK	Nucleoprotein	Influenza A virus	11	27

Results: Influenza virus mouse epitopes that are immunogenic

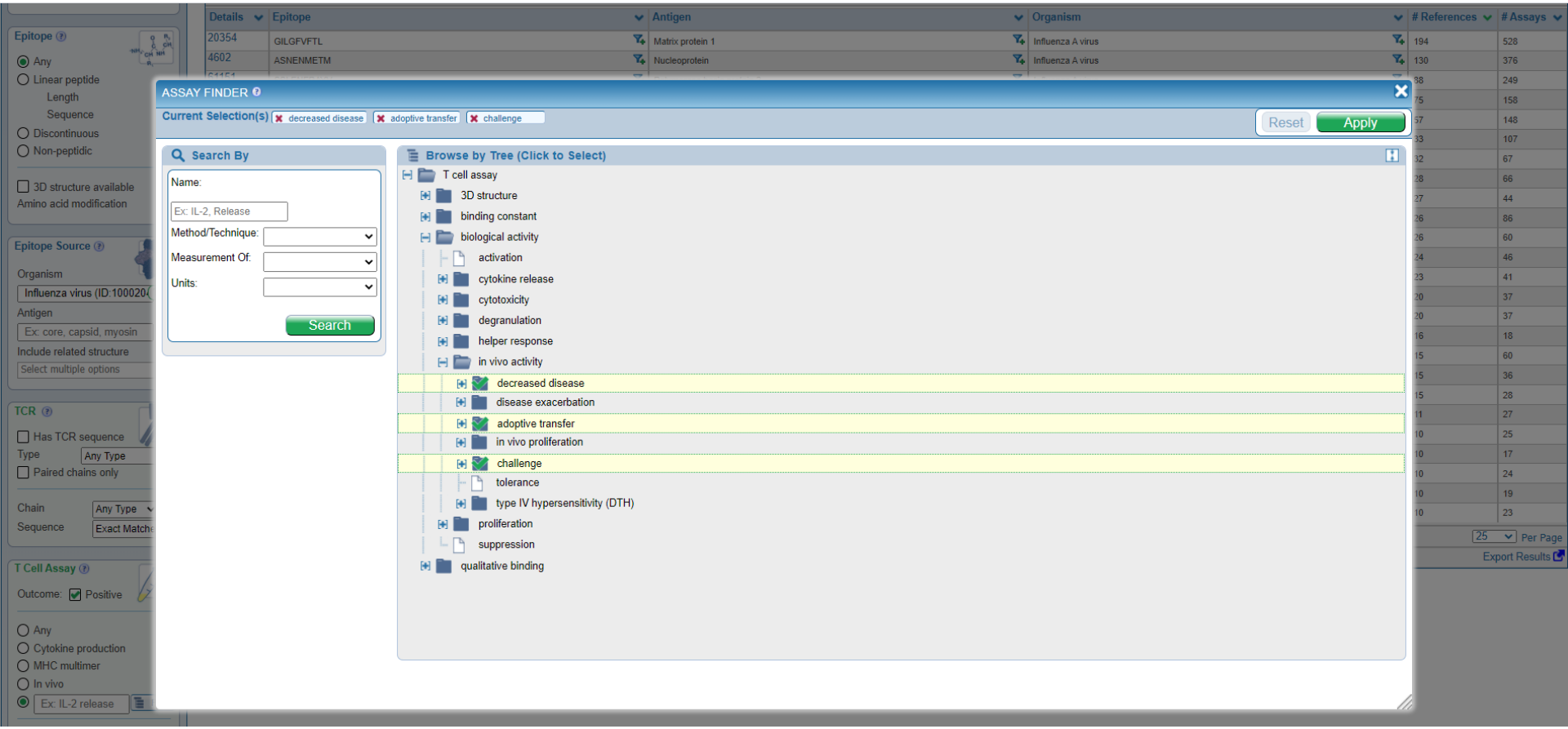
Positive assay outcomes for T cell assays in a mouse host



Details	Epitope	Antigen	Organism	# References	# Assays
4602	ASNENMETM	Nucleoprotein	Influenza A virus	130	376
61151	SSLENFRAYV	Polymerase acidic protein	Influenza A virus	88	249
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	75	158
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	32	105
4578	ASNENMDAM	Nucleoprotein	Influenza A virus	28	66
29690	IYSTVASSL	Hemagglutinin	Influenza A virus	26	86
61497	SSYRRPVGI	RNA-directed RNA polymerase catalytic subunit	Influenza A virus	26	60
20354	GILGFVFTL	Matrix protein 1	Influenza A virus	25	74
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
41602	MGLIYNRM	Matrix protein 1	Influenza A virus	10	19
59318	SLLTEVETPIRNEWGCRCNDSSD	Matrix protein 2	Influenza A virus	10	23
129797	RNLLWLTGKNGLYPNLS	Hemagglutinin	Influenza A virus	10	15
17119	FMYSDFHFI	Polymerase acidic protein	Influenza A virus	9	21
18406	FYIQMCTEL	Nucleoprotein	Influenza A virus	9	22
24408	HNTNGVTAACSHE	Hemagglutinin	Influenza A virus	9	16
67437	TYQRTRALVRTG	Nucleoprotein	Influenza A virus	9	16

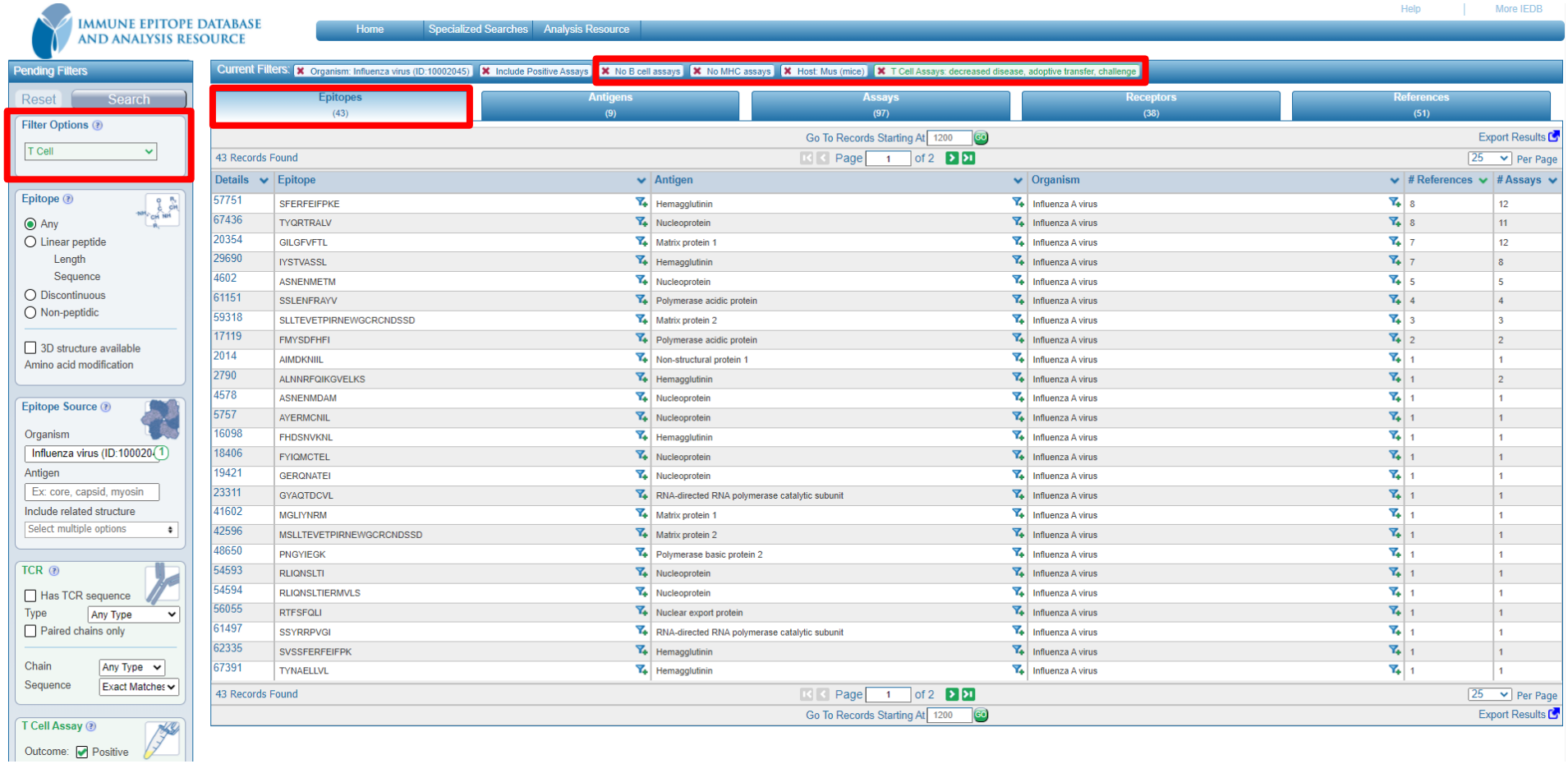
Results: Influenza virus epitopes that offer protection from disease

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



Details	Epitope	Antigen	Organism	# References	# Assays
57751	SFERFEIFPKE	Hemagglutinin	Influenza A virus	8	12
67436	TYQRTRALV	Nucleoprotein	Influenza A virus	8	11
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
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
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
62335	SVSSFERFEIFPK	Hemagglutinin	Influenza A virus	1	1
67391	TYNAELLVL	Hemagglutinin	Influenza A virus	1	1

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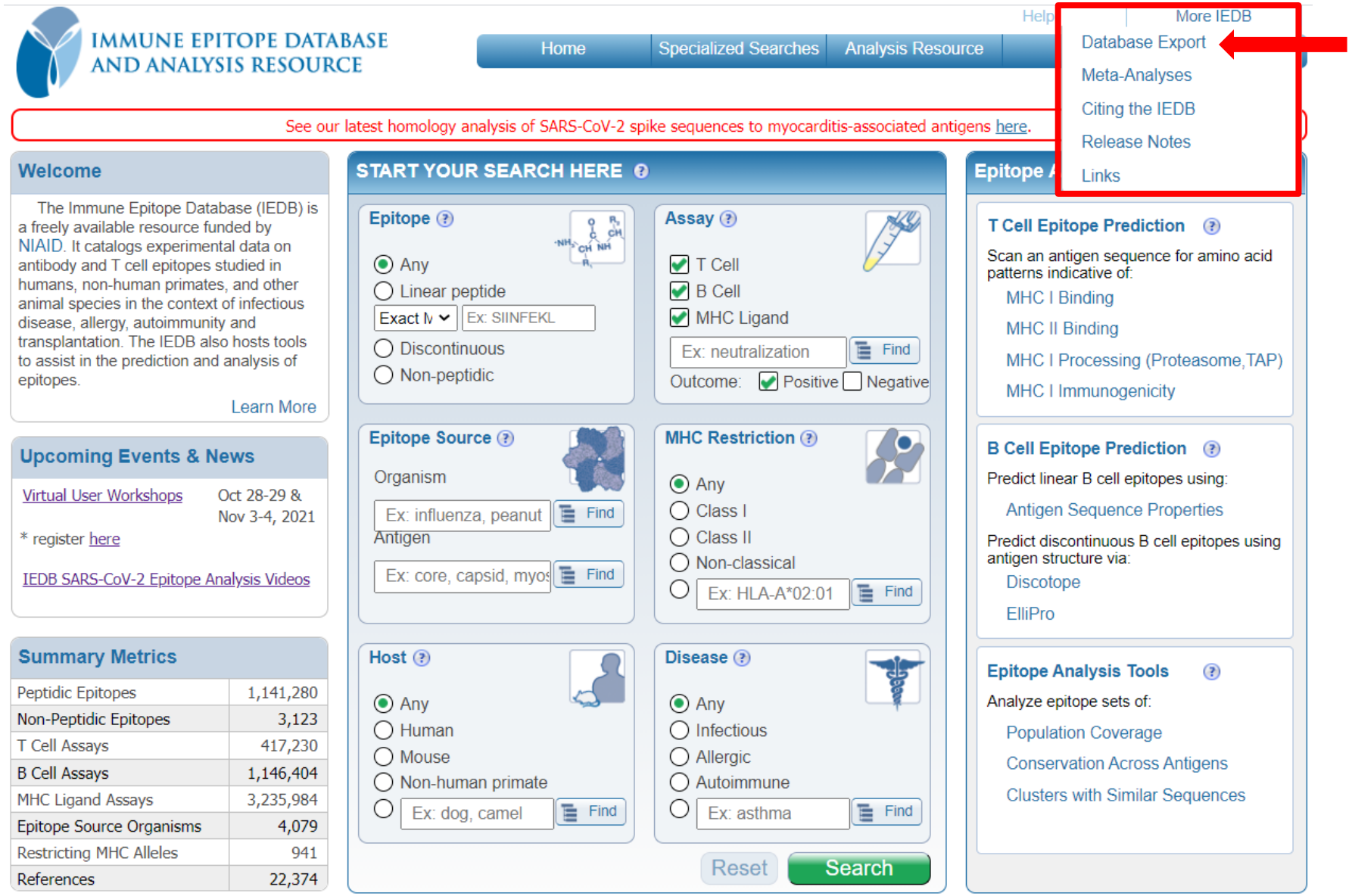

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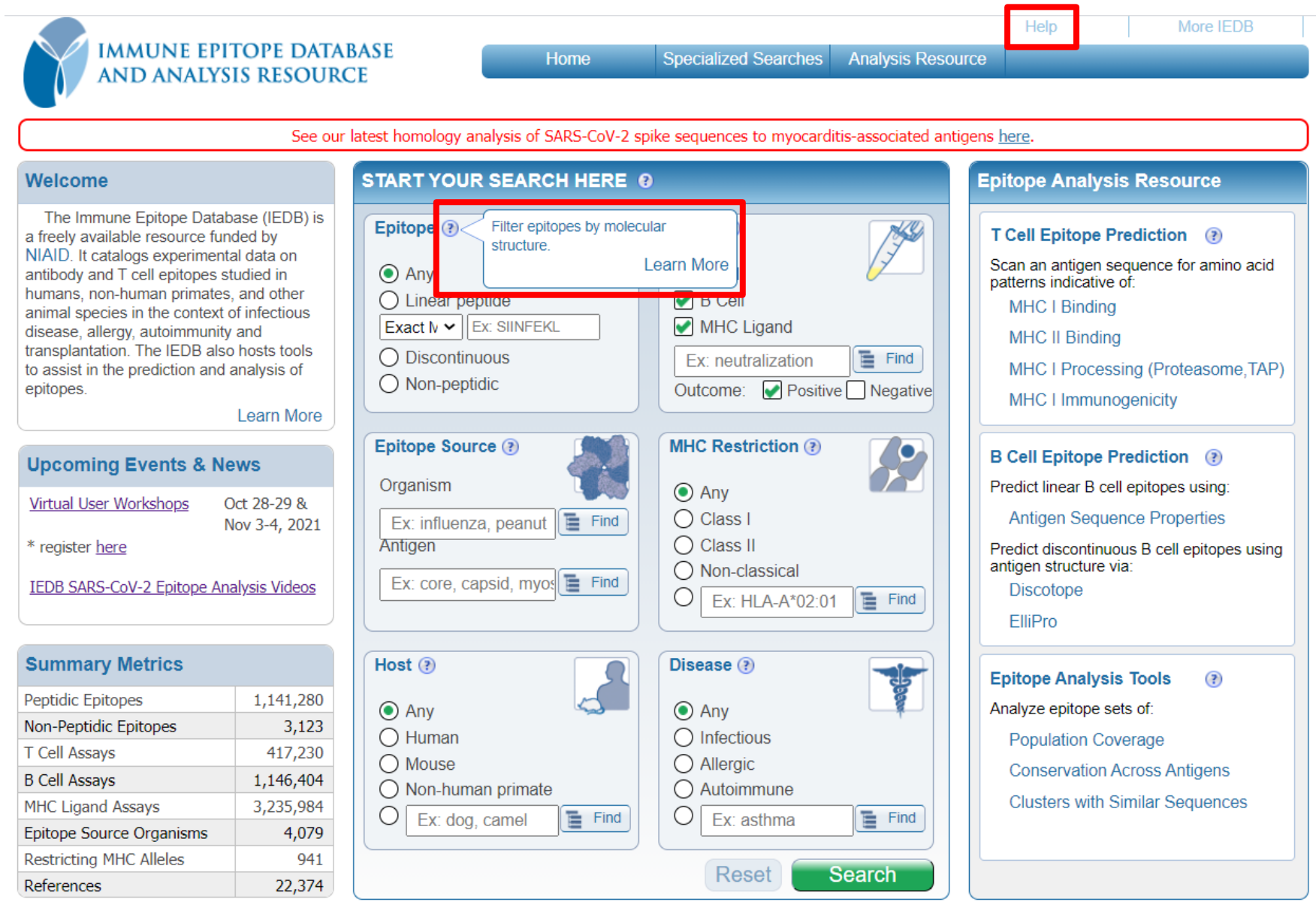

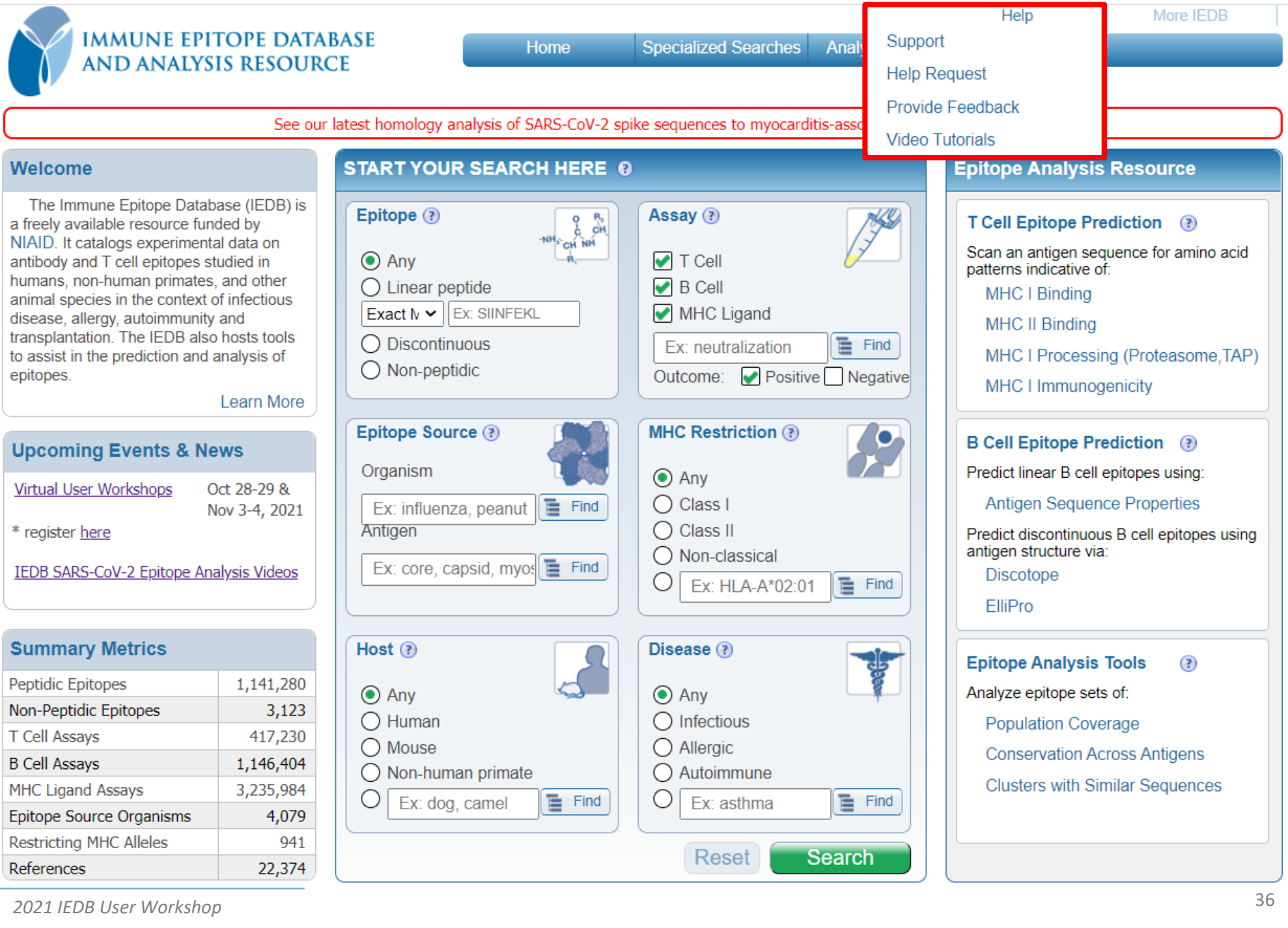
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