
CPSC 304 Project Cover Page

Milestone #: 2

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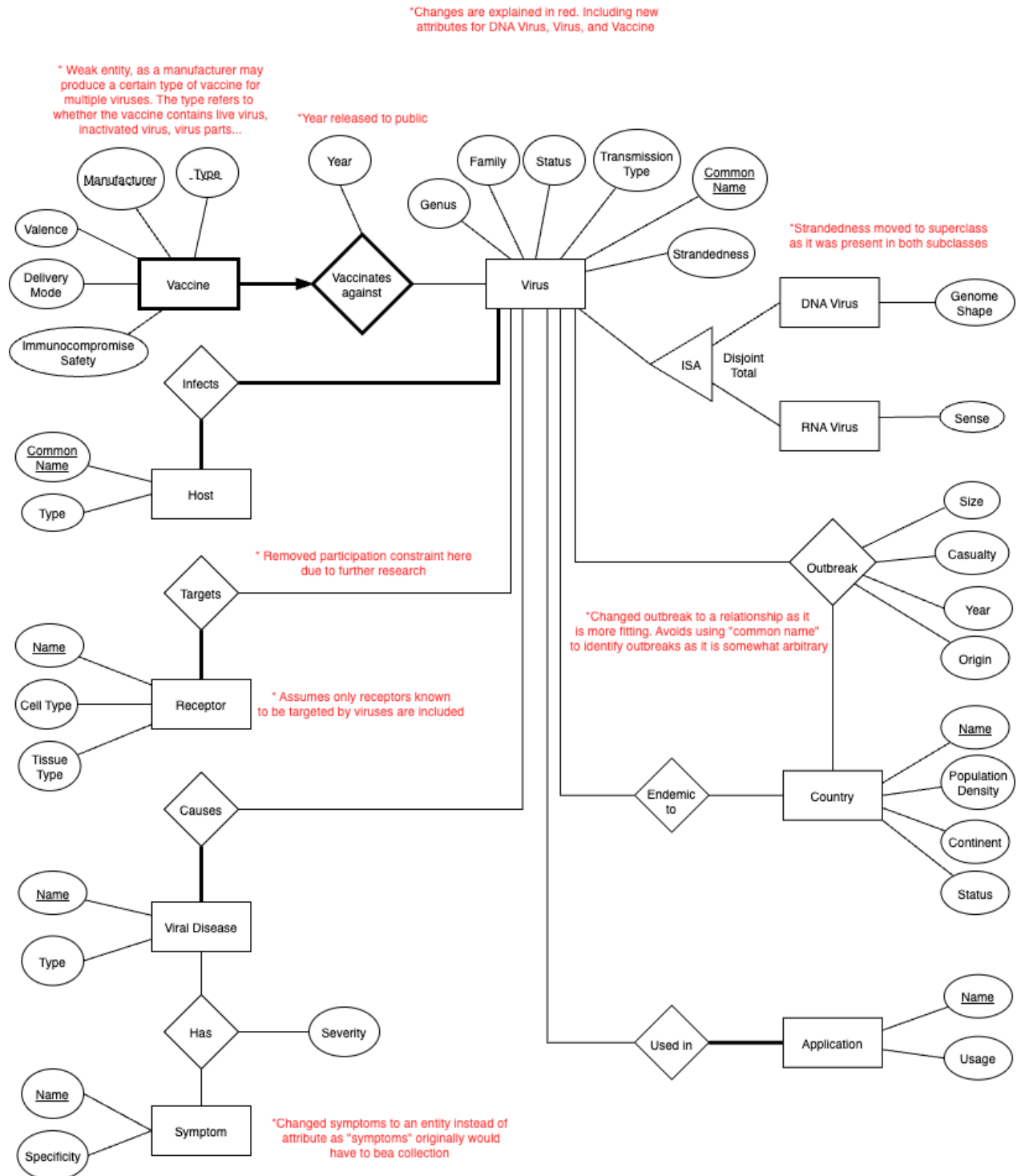
Group Number: 20

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By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

Modified ERD:



* Need assertions for participation constraints.

Relational Schema & Functional Dependencies:

*Format: Primary Key, **Foreign Keys**

Virus(virusCommonName: String, Genus: String, Family: String, Status: String, TransmissionType: String, Strandedness: String)

Family \rightarrow Strandedness

Genus \rightarrow Family

virusCommonName \rightarrow Genus, Family, Status, TransmissionType, Strandedness

RNAVirus(**virusCommonName: String**, Sense: String)

virusCommonName \rightarrow Sense

DNAVirus(**virusCommonName: String**, GenomeShape: String)

virusCommonName \rightarrow GenomeShape

VaccinatesAgainst(**virusCommonName: String**, Manufacturer: String, Type: String, Valence: String, DeliveryMode: String, Year: Integer, ImmunocompromiseSafety: String)

Type \rightarrow ImmunocompromiseSafety

virusCommonName, Manufacturer, Type \rightarrow Valence, DeliveryMode, Year, ImmunocompromiseSafety

Host(hostCommonName: String, Type: String)

hostCommonName \rightarrow Type

Infects(**hostCommonName: String**, **virusCommonName: String**)

Receptor(receptorName: String, CellType: String, TissueType: String)

receptorName \rightarrow CellType, TissueType

Targets(**receptorName: String**, **virusCommonName: String**)

ViralDisease(**diseaseName: String**, Type: String)

diseaseName → Type

Causes(**diseaseName: String**, **virusCommonName: String**)

Symptom(**symptomName: String**, Specificity: String)

symptomName → Specificity

Has(**diseaseName: String**, **symptomName: String**, Severity: String)

diseaseName, symptomName → Severity

Country(**countryName: String**, PopulationDensity: Float, Continent: String, Status: String)

countryName → PopulationDensity, Continent, Status

Outbreak(**countryName: String**, **virusCommonName: String**, Size: String, Casualty: Integer, Year: Integer, Origin: String)

countryName, virusCommonName → Size, Casualty, Year, Origin

EndemicTo(**countryName: String**, **virusCommonName: String**)

Application(**applicationName: String**, Usage: String)

applicationName → Usage

UsedIn(**applicationName: String**, **virusCommonName: String**)

Normalization:

The tables that have 2 attributes: RNAVirus, DNAVirus, Host, Infects, Targets, ViralDisease, Cause, Symptom, Has, EndemicTo, Application and UsedIn are all in BCNF and 3NF.

The function dependencies of Receptor, Country, Outbreak are in the form of $X \rightarrow b$ where X is the primary keys from the tables. Hence they are all in BCNF and 3NF.

The two tables that violate BCNF are Virus and Vaccine Against.

Virus:

$\text{Genus}^+ = \{\text{Genus}, \text{Strandedness}, \text{Family}\}$

$\text{Family}^+ = \{\text{Family}, \text{Strandedness}\}$

$\text{virusCommonName}^+ = \{\text{virusCommonName}, \text{Genus}, \text{Family}, \text{Status}, \text{TransmissionType}, \text{Strandedness}\}$

Decompose:

Look at Family \rightarrow Strandedness. Family is not superkey.

VirusR1(Family, Strandedness),

VirusR2(VirusCommonName, Genus, Family, Status, TransmissionType)

Look at Genus \rightarrow Family. Genus is not superkey.

VirusR3(Genus, Family), VirusR4(VirusCommonName, Genus, Status, TransmissionType)

Result: VirusR1(Family, Strandedness), VirusR3(Genus, Family), VirusR4(VirusCommonName, Genus, Status, TransmissionType)

VaccineAgainst:

Type is not a super key \Rightarrow violate BCNF

Type⁺ = {Type, ImmunocompromiseSafety}

VirusCommonName, Manufacture, Type⁺ = {virusCommonName, Manufacturer, Type, Valence, DeliveryMode, Year, ImmunocompromiseSafety}

Decompose:

VaccineAgainst1(Type, ImmunocompromiseSafety)

VaccineAgainst2(Type, VirusCommonName, Manufacture, Valance, DeliveryMode, Year)

Result:

VaccineAgainst1(Type, ImmunocompromiseSafety)

VaccineAgainst2(Type, VirusCommonName, Manufacture, Valance, DeliveryMode, Year)

Post-normalization tables:

Virus1(Family: String, Strandedness: String)

Virus2(Genus: String, **Family: String**)

Virus3(virusCommonName: String, **Genus: String**, Status: String, TransmissionType: String)

RNAVirus(**virusCommonName: String**, Sense: String)

DNAVirus(**virusCommonName: String**, GenomeShape: String)

VaccineAgainst1(Type: String, ImmunocompromiseSafety: String)

VaccineAgainst2(**Type: String**, VirusCommonName: String, Manufacturer: String, Valence: String, DeliveryMode: String, Year: float)

Host(hostCommonName: String, Type: String)

Infects(**hostCommonName: String**, **virusCommonName: String**)

Receptor(receptorName: String, CellType: String, TissueType: String)

Targets(**receptorName: String**, **virusCommonName: String**)

ViralDisease(diseaseName: String, Type: String)

Causes(**diseaseName: String**, **virusCommonName: String**)

Symptom(symptomName: String, Specificity: String)

Has(**diseaseName: String**, **symptomName: String**, Severity: String)

Country(countryName: String, PopulationDensity: Float, Continent: String, Status: String)

Outbreak(**countryName: String**, **virusCommonName: String**, Size: String, Casualty: Integer, Year: Integer, Origin: String)

EndemicTo(**countryName: String**, **virusCommonName: String**)

Application(applicationName: String, Usage: String)

UsedIn(**applicationName: String**, **virusCommonName: String**)

SQL DDL Statements:

Note:

1. Although Oracle does not support ON UPDATE CASCADE, we will include it in SQL DDL statements.
2. Targets, Causes and Infects tables need insertions to ensure many-to-many and total participation constraints.

```
CREATE TABLE Virus1 (  
Family char PRIMARY KEY,  
Strandedness char);
```

```
CREATE TABLE Virus2 (  
Genus char PRIMARY KEY, Family char,  
FOREIGN KEY (Family) REFERENCES Virus1(Family) ON DELETE CASCADE ON UPDATE CASCADE);
```

```
CREATE TABLE Virus3 (  
virusCommonName char PRIMARY KEY, Genus char, Status char, TransmissionType char,  
FOREIGN KEY (Genus) REFERENCES Virus2(Genus) ON DELETE CASCADE ON UPDATE CASCADE);
```

```
CREATE TABLE RNAVirus (  
virusCommonName char PRIMARY KEY, Sense char,  
FOREIGN KEY (virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE  
CASCADE ON UPDATE CASCADE);
```

```
CREATE TABLE DNAVirus(  
virusCommonName char PRIMARY KEY, GenomeShape char,  
FOREIGN KEY (virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE  
CASCADE ON UPDATE CASCADE);
```

```
CREATE TABLE VaccineAgainst1(Type char PRIMARY KEY, ImmunocompromiseSafety char);
```

```
CREATE TABLE VaccineAgainst2(type char NOT NULL, virusCommonName char NOT NULL,  
Manufacture char NOT NULL, Valance char, DeliveryMode char, Year float,  
PRIMARY KEY (type, virusCommonName, Manufacture),  
FOREIGN KEY(type) REFERENCES VaccineAgainst1(type) ON DELETE CASCADE ON UPDATE  
CASCADE,  
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE  
CASCADE ON UPDATE CASCADE  
);
```

```
CREATE TABLE Host(hostCommonName char PRIMARY KEY, Type char);
```

```
CREATE TABLE Infects(hostCommonName char NOT NULL, virusCommonName char NOT NULL,  
PRIMARY KEY(hostCommonName, virusCommonName),  
FOREIGN KEY(hostCommonName) REFERENCES Host(hostCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE,
```



```
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE);  
/*assertion needed*/
```

```
CREATE TABLE Receptor(receptorName char PRIMARY KEY, CellType char, TissueType char);
```

```
CREATE TABLE Targets(  
receptorName char NOT NULL, virusCommonName char NOT NULL,  
PRIMARY KEY(receptorName,virusCommonName ),  
FOREIGN KEY(receptorName) REFERENCES Receptor ON DELETE NO ACTION ON UPDATE  
CASCADE,  
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE);  
/*assertion needed*/
```

```
CREATE TABLE ViralDisease(diseaseName char PRIMARY KEY, Type char);
```

```
CREATE TABLE Causes(  
diseaseName char NOT NULL, virusCommonName char,  
PRIMARY KEY (diseaseName, virusCommonName),  
FOREIGN KEY(diseaseName) REFERENCES ViralDisease(diseaseName) ON DELETE NO ACTION  
ON UPDATE CASCADE,  
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE  
);  
/*assertion needed*/
```

```
CREATE TABLE Symptom(symptomName char PRIMARY KEY, Specificity char);
```

```
CREATE TABLE Has(  
diseaseName char, symptomName char, Severity char,  
PRIMARY KEY(diseaseName, symptomName),  
FOREIGN KEY (diseaseName) REFERENCES ViralDisease(diseaseName) ON DELETE NO ACTION  
ON UPDATE CASCADE,  
FOREIGN KEY(symptomName) REFERENCES Symptom(symptomName) ON DELETE NO ACTION  
ON UPDATE CASCADE  
);
```

```
CREATE TABLE Country(countryName char PRIMARY KEY, PopulationDensity float, Continent  
char, Status char);
```

```
CREATE TABLE Outbreak(countryName char, virusCommonName char, Size char, Casualty int,  
Year int, Origin char,  
PRIMARY KEY(countryName, virusCommonName),  
FOREIGN KEY(countryName) REFERENCES Country(countryName) ON DELETE NO ACTION ON  
UPDATE CASCADE,  
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE  
);
```

```
CREATE TABLE EndemicTo(countryName char, virusCommonName,  
PRIMARY KEY(countryName, virusCommonName),  
FOREIGN KEY(countryName) REFERENCES Country(countryName) ON DELETE NO ACTION ON  
UPDATE CASCADE,  
FOREIGN KEY(virusCommonName) REFERENCES Virus3(virusCommonName) ON DELETE NO  
ACTION ON UPDATE CASCADE  
);
```

```
CREATE TABLE Application(applicationName char PRIMARY KEY, Usage char);
```

```
CREATE TABLE UsedIn(applicationName char NOT NULL, virusCommonName char,  
PRIMARY KEY(applicationName, virusCommonName),  
FOREIGN KEY (applicationName) REFERENCES Application ON DELETE NO ACTION ON UPDATE  
CASCADE,  
FOREIGN KEY (virusCommonName) REFERENCES Virus3 ON DELETE NO ACTION ON UPDATE NO  
ACTION  
);
```

Sample Data:

Virus1	
<u>Family</u>	Strandedness
Coronaviridae	Single
Poxviridae	Double
Retroviridae	Single
Orthomyxoviridae	Single
Picornaviridae	Single
Secoviridae	Single
Herpesviridae	Double
Microviridae	Single
Filoviridae	Single
Paramyxoviridae	Single
Hepadnaviridae	Double
Papillomaviridae	Double

Virus2	
<u>Genus</u>	<u>Family</u>
Betacoronavirus	Coronaviridae
Orthopoxvirus	Poxviridae
Lentivirus	Retroviridae
Alphainfluenzavirus	Orthomyxoviridae
Enterovirus	Picornaviridae
Comovirus	Secoviridae
Simplexvirus	Herpesviridae
Sinsheimervirus	Microviridae
Ebolavirus	Filoviridae
Morbillivirus	Paramyxoviridae
Orthohepadnavirus	Hepadnaviridae
Chipapillomavirus	Papillomaviridae

Virus3			
<u>virusCommonName</u>	<u>Genus</u>	Status	Transmission
SARS-CoV	Betacoronavirus	Active	Respiratory Droplets
Variola Virus	Orthopoxvirus	Eradicated	Airborne Particles
Human Immunodeficiency virus	Lentivirus	Active	Bodily Fluids
Monkeypox Virus	Orthopoxvirus	Active	Direct Contact
Influenza A Virus	Alphainfluenzavirus	Active	Respiratory Droplets
Poliovirus	Enterovirus	Active	Fecal-oral

Vaccinia Virus	Orthopoxvirus	Active	Direct Contact
Cowpea Mosaic Virus	Comovirus	Active	Insects
Herpes Simplex Virus	Simplexvirus	Active	Bodily Fluids
Phi X 174	Sinsheimervirus	Active	Bacterial
Zaire Ebolavirus	Ebolavirus	Active	Bodily Fluids
Rinderpest morbillivirus	Morbillivirus	Eradicated	Direct Contact
Hepatitis B Virus	Orthohepadnavirus	Active	Bodily Fluids
Human Papillomavirus	Chipapillomavirus	Active	Direct Contact

RNA Virus	
<u>virusCommonName</u>	Sense
SARS-CoV	Positive
Human Immunodeficiency virus	Positive
Influenza A Virus	Negative
Poliovirus	Positive
Cowpea Mosaic Virus	Positive
Zaire Ebolavirus	Negative
Rinderpest morbillivirus	Negative

DNA Virus	
<u>virusCommonName</u>	Genome Shape
Variola Virus	Linear
Monkeypox Virus	Linear
Vaccinia Virus	Linear
Herpes Simplex Virus	Linear
Phi X 174	Circular

Hepatitis B Virus	Linear
Human Papillomavirus	Circular

VaccineAgainst1	
Type	Immunocompromised Safety
Attenuated	Unsafe
Inactivated	Safe
Subunit	Safe
mRNA	Safe
Viral Vector	Safe

VaccineAgainst2					
virusCommonName	Type	Manufacturer	Valence	Delivery Mode	Year
Zaire Ebolavirus	Viral Vector	Merck & Co.	1	Injection	2014
SARS-CoV	mRNA	Pfizer	2	Injection	2021
Hepatitis B Virus	Subunit	Merk & Co.	5	Injection	2019
SARS-CoV	Inactivated	Sinovac Biotech	1	Injection	2021
Poliovirus	Attenuated	Cantacuzino Institute of Bucharest	1	Oral	1961
Human Papillomavirus	Subunit	Merk & Co.	9	Injection	2014

Host	
hostCommonName	Type
Human	Mammal

E. coli	Bacteria
Cowpea	Plant
Deer	Mammal
Buffalo	Mammal

Infects	
<u>hostCommonName</u>	<u>virusCommonName</u>
Human	SARS-CoV
Human	Variola Virus
Human	Human Immunodeficiency virus
Human	Monkeypox Virus
Human	Influenza A Virus
Human	Poliovirus
Human	Vaccinia Virus
Cowpea	Cowpea Mosaic Virus
Human	Herpes Simplex Virus
E. coli	Phi X 174
Human	Zaire Ebolavirus
Buffalo	Rinderpest morbillivirus
Deer	Rinderpest morbillivirus
Human	Hepatitis B Virus
Human	Human Papillomavirus

Receptor		
<u>receptorName</u>	Cell Type	Tissue Type
ACE2	Enterocytes	Epithelia
MARCO	Keratinocytes	Epidermis

CCR5	Immune Cells	All
GAG	Keratinocytes	Epidermis
Sialic Acid	All	All
CD155	Immune Cells	All

Targets	
<u>receptorName</u>	<u>virusCommonName</u>
ACE2	SARS-CoV
MARCO	Variola Virus
CCR5	Human Immunodeficiency virus
GAG	Monkeypox Virus
Sialic Acid	Influenza A Virus
CD155	Poliovirus
GAG	Vaccinia Virus

Viral Disease	
<u>diseaseName</u>	Type
Smallpox	Acute
AIDS	Chronic
Hepatitis	Acute
Herpes Labialis	Dormant
Influenza	Acute

Causes	
<u>diseaseName</u>	<u>virusCommonName</u>
Smallpox	Variola Virus
AIDS	Human Immunodeficiency Virus

Hepatitis	Hepatitis B Virus
Herpes Labialis	Herpes Simplex Virus
Influenza	Influenza A Virus

Symptom	
<u>symptomName</u>	Specificity
Blisters	Non-specific
Vomit	Non-specific
Diarrhea	Non-specific
Lymphadenopathy	Specific
Macules	Specific

Has		
<u>diseaseName</u>	<u>symptomName</u>	Severity
Herpes Labialis	Blisters	Mild
Hepatitis	Vomit	Mild
Hepatitis	Diarrhea	Mild
AIDS	Lymphadenopathy	Severe
Smallpox	Macules	Severe

Country			
<u>countryName</u>	PopulationDensity	Continent	Status
United States	36	North America	Developed
China	153	Asia	Developing
Mexico	66	North America	Developing
Japan	338.2	Asia	Developed
Congo	16	Africa	Underdeveloped

Canada	4	North America	Developed
South Africa	25	Africa	Developed

Outbreak					
<u>countryName</u>	<u>virusCommonName</u>	Size	Casualty	Year	Origin
United States	Influenza A Virus	Pandemic	100 million	1346	Spain
China	SARS-CoV	Pandemic	25 million	2019	China
Mexico	Variola Virus	Epidemic	8 million	1519	Mexico
Japan	Variola Virus	Epidemic	2 million	735	Japan
Congo	Ebola Virus	Epidemic	55	2020	Congo

*Casualty is supposed to be integer, using “million” here for ease

EndemicTo	
<u>countryName</u>	<u>virusCommonName</u>
United States	Influenza A
China	Influenza A
South Africa	Human Immunodeficiency Virus
Canada	Hepatitis B Virus
Congo	Human Immunodeficiency Virus

Application	
<u>applicationName</u>	Usage
Weapon	Biological Warfare
Synthetic Virus	Research
Nanotechnology	Research
Virotherapy	Medicine
Vaccine	Medicine

UsedIn	
<u>applicationName</u>	<u>virusCommonName</u>
Weapon	Vaccinia Virus
Synthetic Virus	Poliovirus
Nanotechnology	Cowpea Mosaic Virus
Virotherapy	Herpes Simplex Virus
Vaccine	Poliovirus