

Text S1. An illustration of how it is determined whether a host is successfully vaccinated or not. This demonstrates the use of the notation F to describe the set of host and virus types that are successfully vaccinated.

Consider a vaccine that contains 5 epitopes ($n=5$) restricted by 5 different HLA types:

Epitope number	1	2	3	4	5
HLA class I restriction	A1	A13	B51	B27	B7

An individual with HLA type A1, A2, B27, B8 would be host type $\mathbf{h}_a = (1, 0, 0, 1, 0)$.

An individual with HLA type A1, A13, B51, B27 would be host type $\mathbf{h}_b = (1, 1, 1, 1, 0)$.

A virus with no escape mutations in any of the 5 epitopes would be virus type $\mathbf{v}_a = (0, 0, 0, 0, 0)$.

A virus with escape in the A1 and B27 epitopes would be virus type $\mathbf{v}_b = (1, 0, 0, 1, 0)$.

The set F contains $(\mathbf{h}_a, \mathbf{v}_a)$, $(\mathbf{h}_b, \mathbf{v}_a)$ and $(\mathbf{h}_b, \mathbf{v}_b)$ but not $(\mathbf{h}_a, \mathbf{v}_b)$.

Host type Virus type	$\mathbf{h}_a = (1, 0, 0, 1, 0)$ $\mathbf{v}_a = (0, 0, 0, 0, 0)$	$\mathbf{h}_a = (1, 0, 0, 1, 0)$ $\mathbf{v}_b = (1, 0, 0, 1, 0)$	$\mathbf{h}_b = (1, 1, 1, 1, 0)$ $\mathbf{v}_a = (0, 0, 0, 0, 0)$	$\mathbf{h}_b = (1, 1, 1, 1, 0)$ $\mathbf{v}_b = (1, 0, 0, 1, 0)$
Ticks and crosses representing the epitopes that do and don't provide protection	(√, ×, ×, √, ×)	(×, ×, ×, ×, ×)	(√, √, √, √, ×)	(×, √, √, ×, ×)
In F ? Hosts are protected if they have protection from at least one epitope.	Yes	No	Yes	Yes

Notice that we assume no difference in the survivorship or infectiousness of an \mathbf{h}_b host whether infected with a \mathbf{v}_a virus or a \mathbf{v}_b virus. Provided one non-escaped epitope is restricted, the host is successfully vaccinated.