Text S2. Ordinary differential equations describing the single epitope version (n=1) of the model.

Equations 1-2 describe how the number of resistant hosts in the population changes over time. Equations 3-6 describe how the number of hosts in each of the four susceptible host categories change over time. Equations 7-14 describe how the number of hosts in each of the eight infected host categories change over time. For these equations the force of infection for the wildtype and escape mutant strains is given by 
\[ \lambda_0 = \left( \beta c(Y^0_0 + Y^0_0 + \tilde{Y}^0_0) + \beta e \tilde{Y}^1_0 \right)/N \]
and 
\[ \lambda_i = \beta c(Y^1_0 + Y^1_0 + \tilde{Y}^1_0 + \tilde{Y}^1_0)/N, \]
respectively, where \( N \) represents the total population size,
\[ N = \sum_{h=0,1} \left( R^h + X^h + \tilde{X}^h + \sum_{v=0,1} \left( Y^h_v + \tilde{Y}^h_v \right) \right). \]

Resistant, vaccinated, HLA+
\[ \frac{dR^i}{dt} = B p y r - \mu R^i \]  
(1)

Resistant, vaccinated, HLA-
\[ \frac{dR^0}{dt} = B (1 - p) y r - \mu R^0 \]  
(2)

Susceptible, unvaccinated, HLA+
\[ \frac{dX^1}{dt} = B p (1 - \gamma) - (\lambda_o + \lambda_i + \mu) X^1 \]  
(3)

Susceptible, unvaccinated, HLA-
\[ \frac{dX^0}{dt} = B (1 - p) (1 - \gamma) - (\lambda_o + \lambda_i + \mu) X^0 \]  
(4)

Susceptible, vaccinated, HLA+
\[ \frac{d\tilde{X}^1}{dt} = B p y (1 - r) - (\lambda_o + \lambda_i + \mu) \tilde{X}^1 \]  
(5)

Susceptible, vaccinated, HLA-
\[ \frac{d\tilde{X}^0}{dt} = B (1 - p) \gamma (1 - r) - (\lambda_o + \lambda_i + \mu) \tilde{X}^0 \]  
(6)

Infected (WT), unvaccinated, HLA+
\[ \frac{dY^0_0}{dt} = \lambda_0 X^1 - \phi Y^0_0 - (\mu + \alpha) Y^0_0 \]  
(7)

Infected (escape), unvaccinated, HLA+
\[ \frac{dY^1_0}{dt} = \lambda_i X^1 + \phi Y^0_0 - (\mu + \alpha) Y^1_0 \]  
(8)

Infected (WT), unvaccinated, HLA-
\[ \frac{dY^0_0}{dt} = \lambda_0 X^0 + \psi Y^0_0 - (\mu + \alpha) Y^0_0 \]  
(9)

Infected (escape), unvaccinated, HLA-
\[ \frac{dY^0_1}{dt} = \lambda_i X^0 - \psi Y^0_1 - (\mu + \alpha) Y^1_0 \]  
(10)

Infected (WT), vaccinated, HLA+
\[ \frac{d\tilde{Y}^0_0}{dt} = \lambda_0 \tilde{X}^1 - \tilde{\phi} \tilde{Y}^0_0 - (\mu + \lambda) \tilde{Y}^0_0 \]  
(11)

Infected (escape), vaccinated, HLA+
\[ \frac{d\tilde{Y}^0_1}{dt} = \lambda_i \tilde{X}^1 + \tilde{\phi} \tilde{Y}^0_1 - (\mu + \lambda) \tilde{Y}^1_0 \]  
(12)

Infected (WT), vaccinated, HLA-
\[ \frac{d\tilde{Y}^0_0}{dt} = \lambda_0 \tilde{X}^0 + \psi Y^0_1 - (\mu + \alpha) \tilde{Y}^0_0 \]  
(13)

Infected (escape), vaccinated, HLA-
\[ \frac{d\tilde{Y}^0_1}{dt} = \lambda_i \tilde{X}^0 - \psi Y^0_1 - (\mu + \alpha) \tilde{Y}^1_0 \]  
(14)