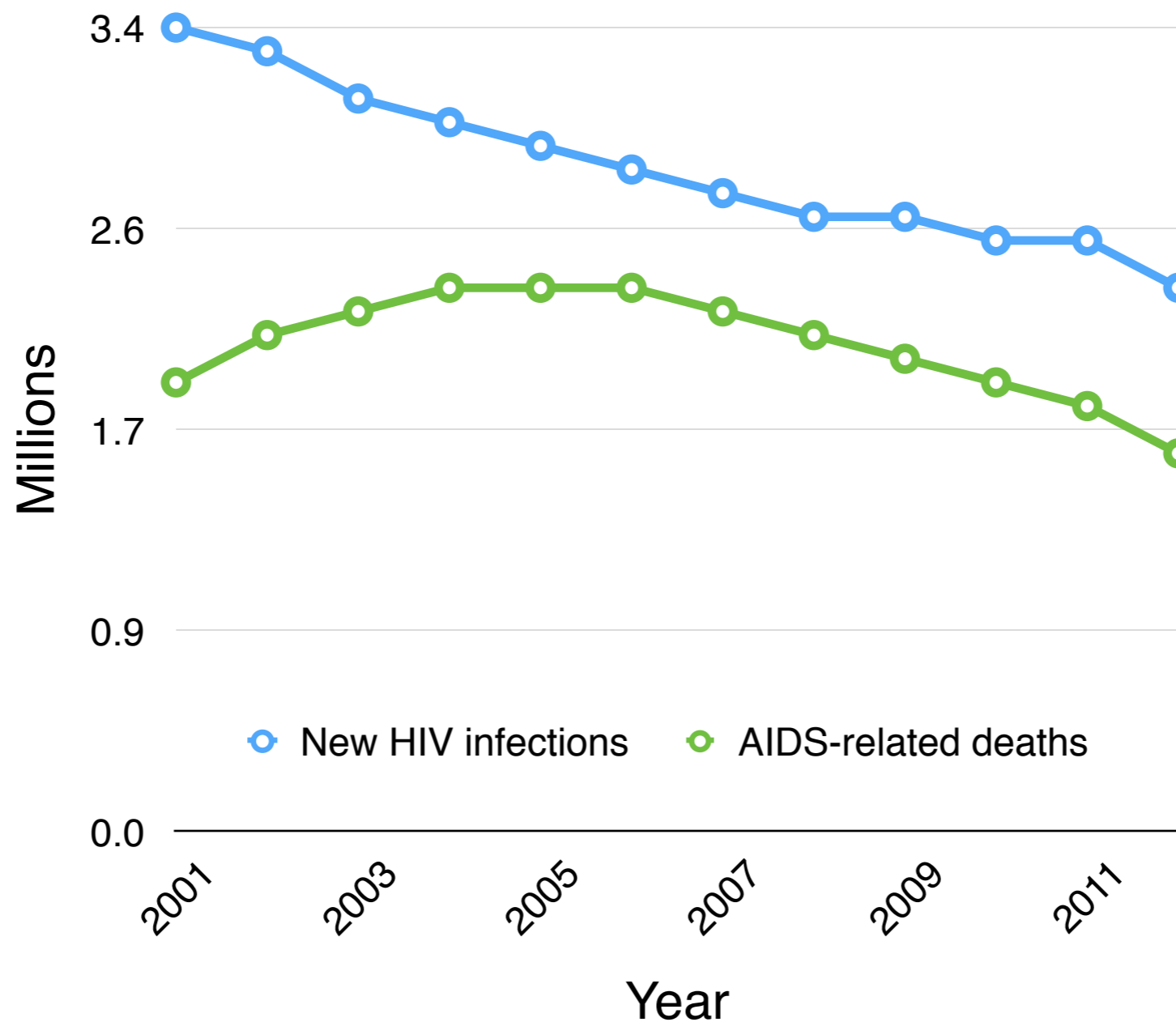


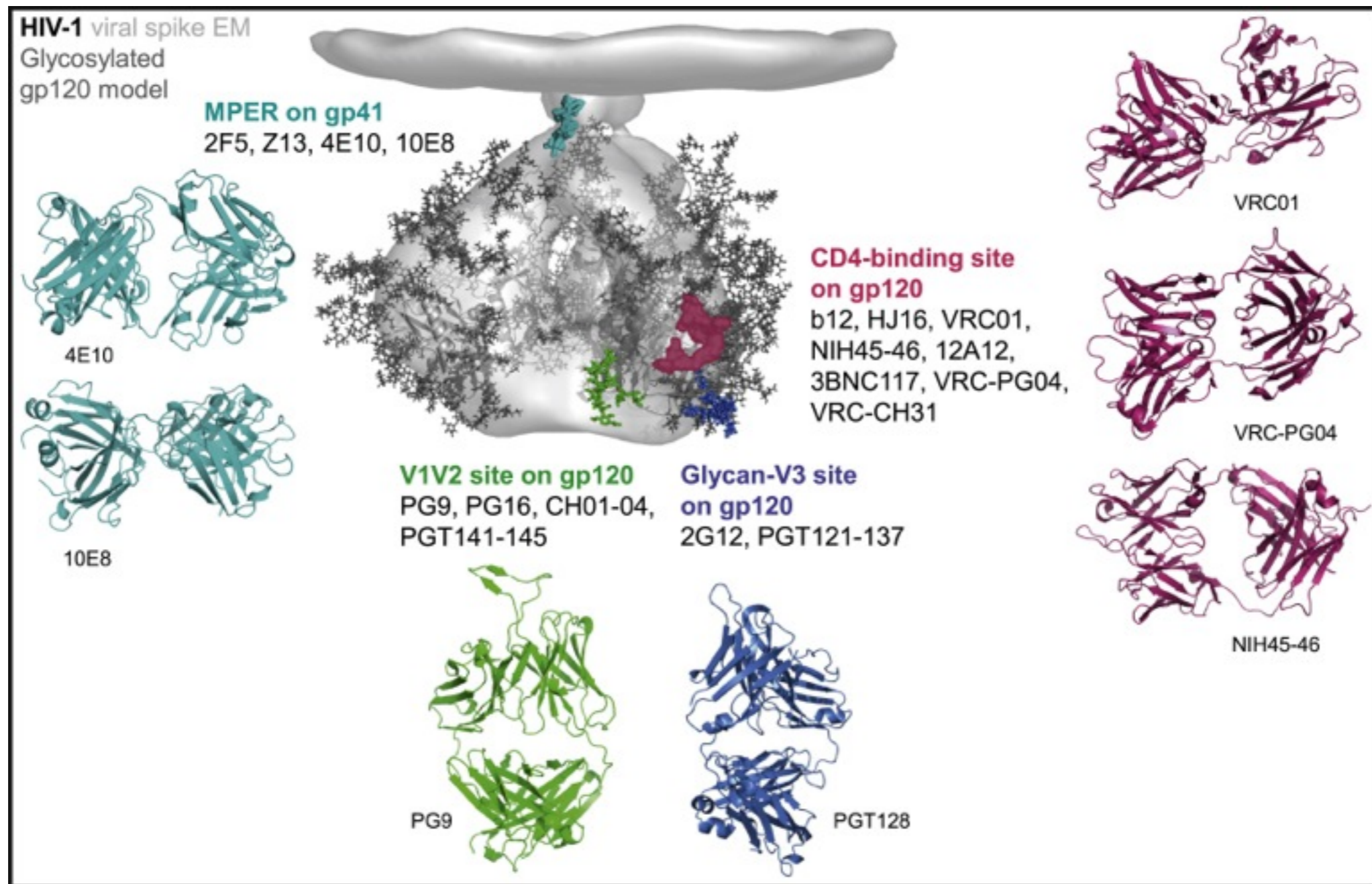
# The adaptive immune system as a learning algorithm

Shishi Luo  
Simons Institute

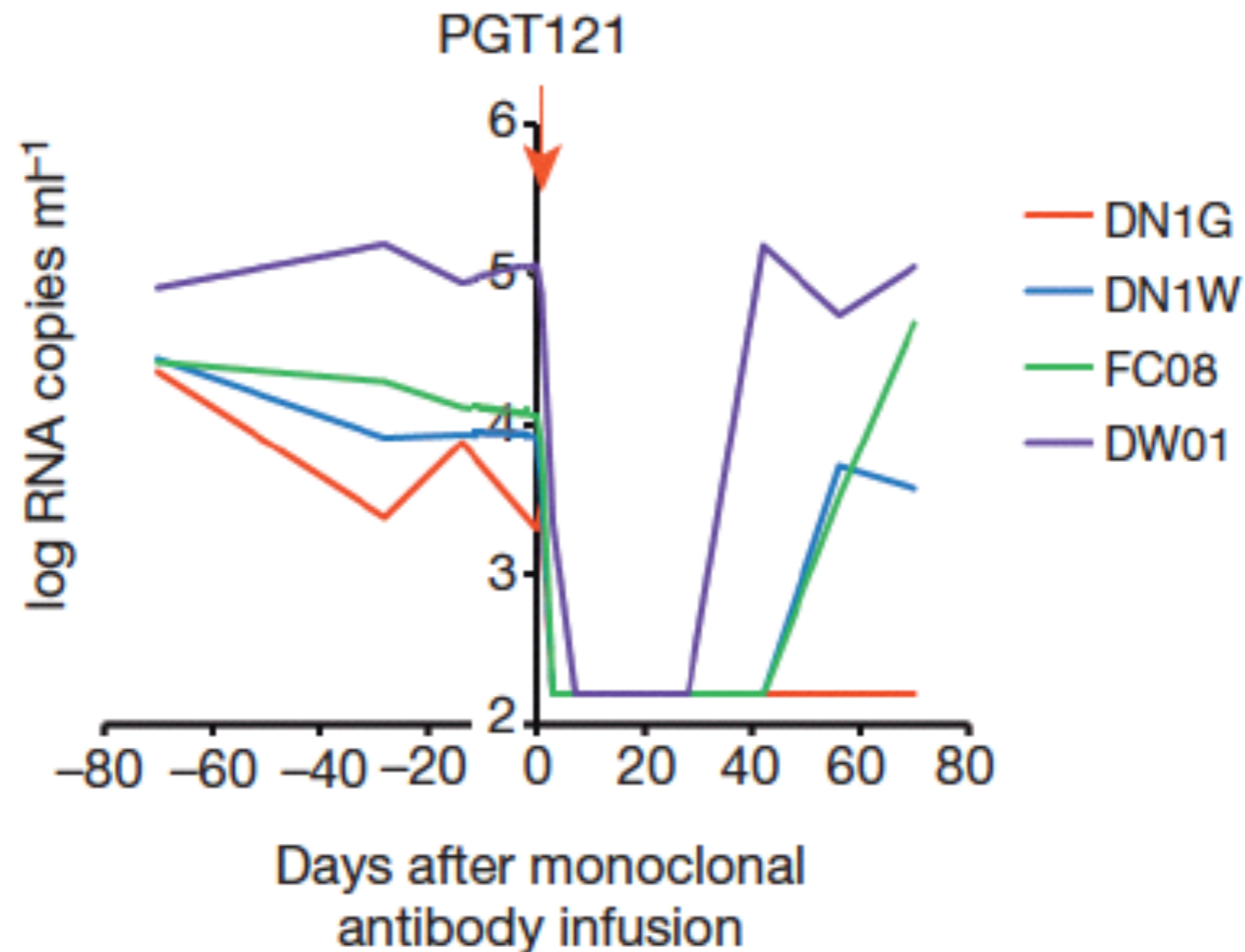
# Worldwide decline in HIV infection and related deaths



# Potential for antibody-based HIV vaccine



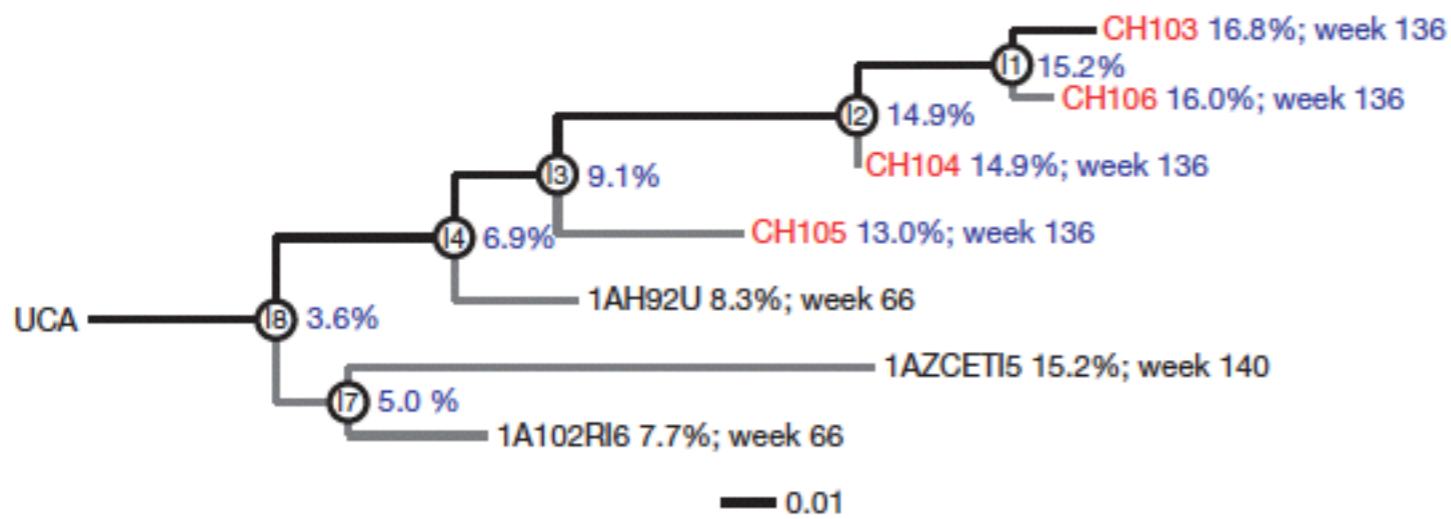
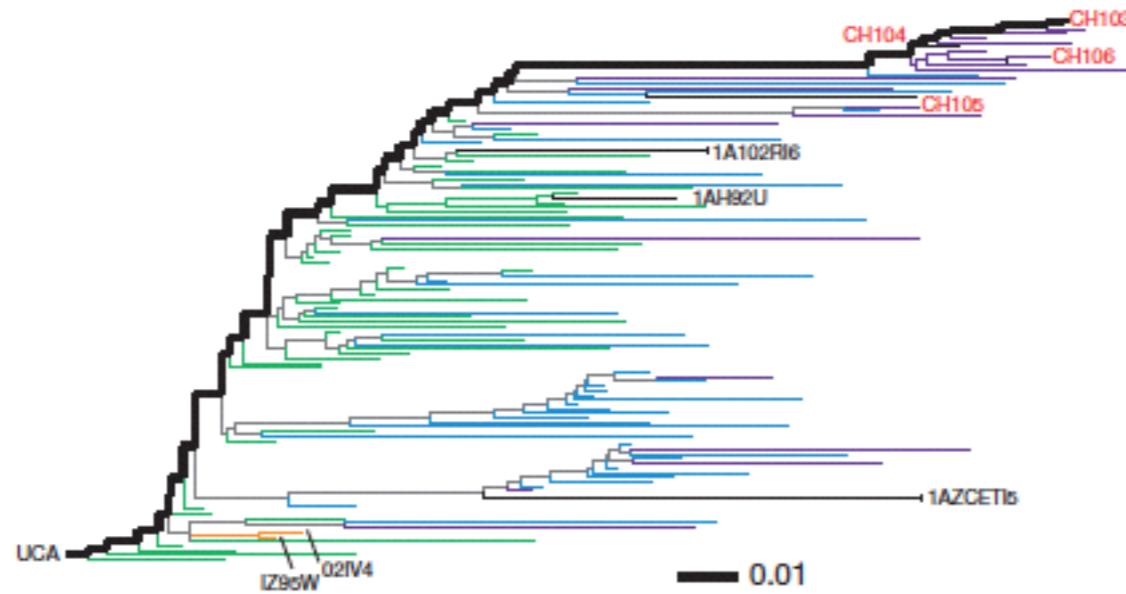
# Broad antibodies are effective therapy in non-human primates



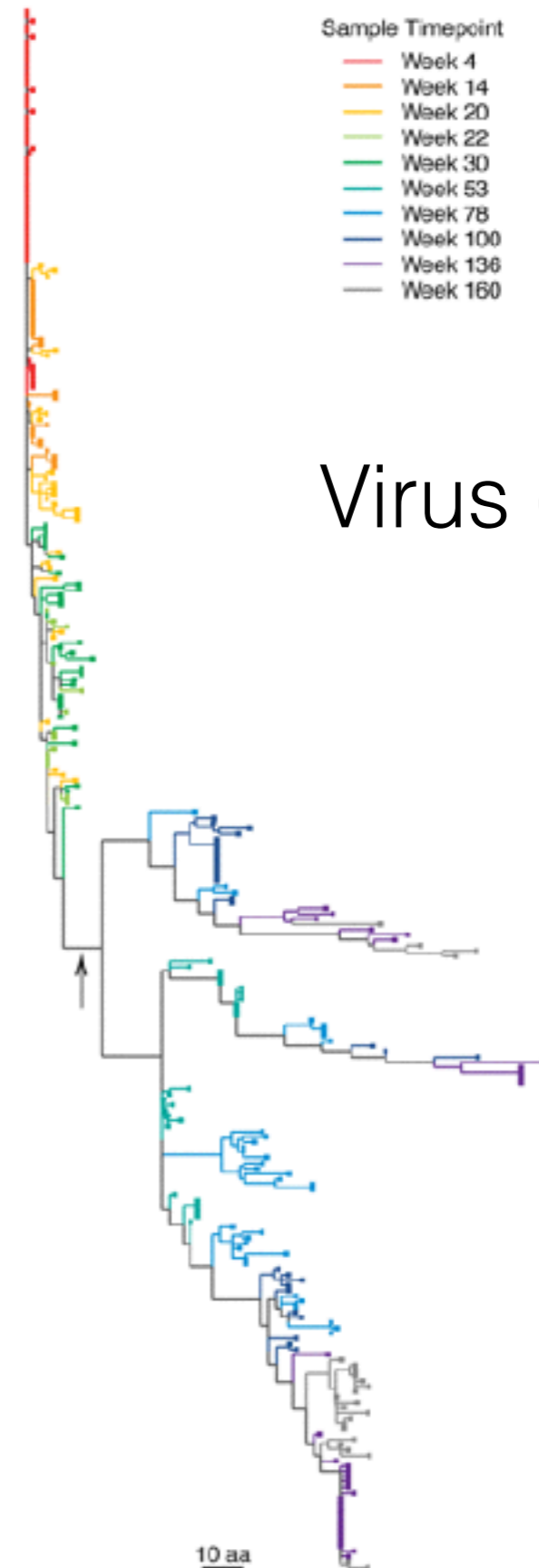
# Unclear how to elicit broad antibodies

- typically found late in infection (>two years)
- not found in all infected individuals
- comprise ~0.1% of sampled B cell population
- highly mutated
- typically not reactive with transmitted/founder strain

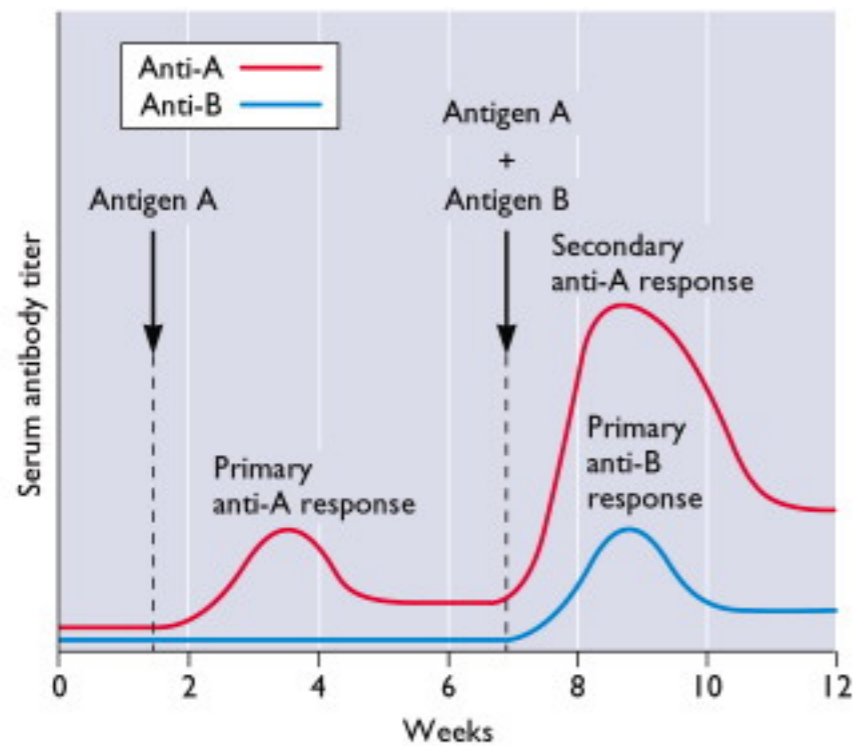
# Antibody (VH)



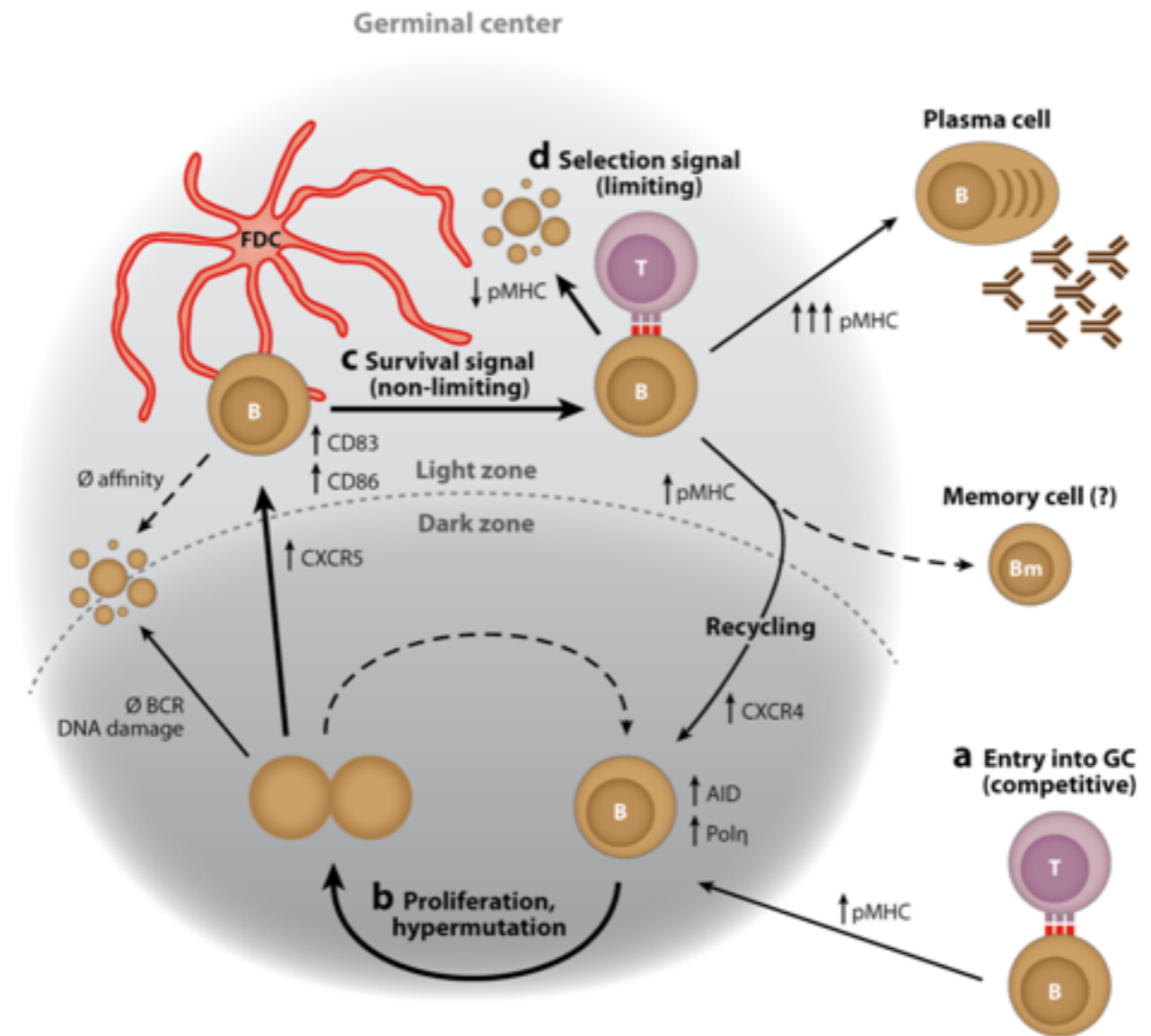
# Virus (*env*)



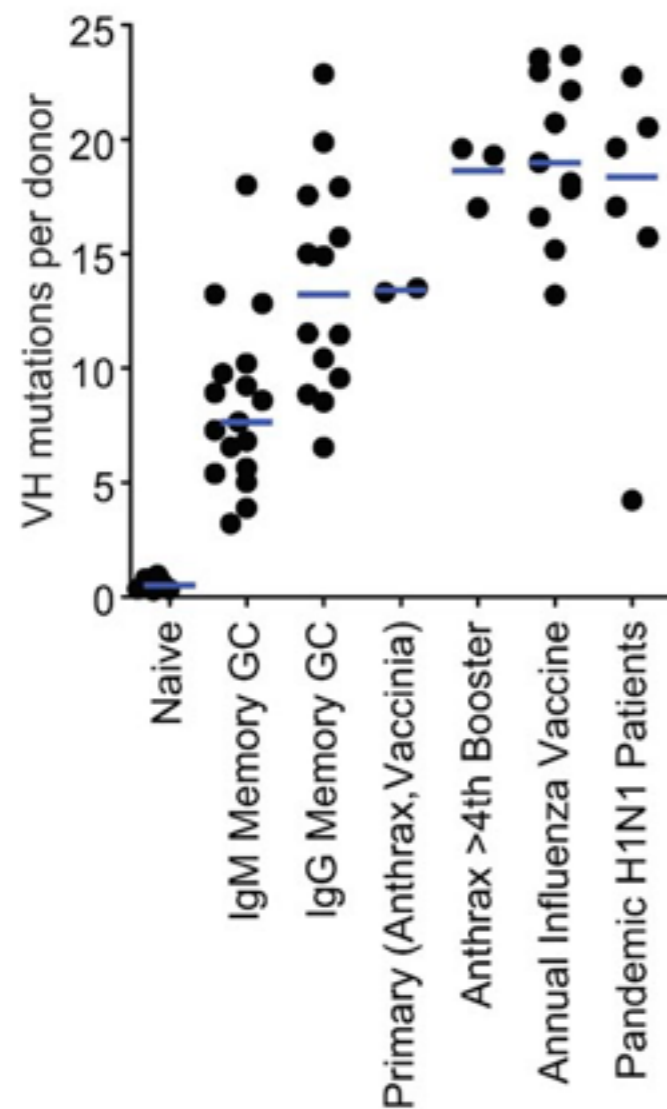
# Clonal selection and affinity maturation



virology.ws



# Some B cell numbers



Wrammert et al, *J Exp Med* 2011

- $\sim 10^{11}$  B cells in human body,  $10^9$  in peripheral blood
- $\sim 10^{-5}$  of B cells respond to given molecule
- theoretical germline BCR sequence diversity is  $\sim 10^{13}$  amino acid sequences
- mutation rate  $\sim 10^{-3}$  per base per generation



