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Steering antibody evolution to combat rapidly mutating pathogens SHENSHEN WANG, JORDI MATA-FINK, MIT, DENNIS BURTON, The Scripps Research Institute, DANE WITTRUP, MEHRAN KARDAR, ARUP CHAKRABORTY, MIT — The adaptive immune system houses amazingly efficient evolutionary processes coordinated across multiple length and time scales to protect higher organisms from diverse infectious pathogens. The optimization problem to be solved is often intricately constrained and highly dynamical. Failure of solving the problem timely leads to loss of protection. One such devastating situation is posed by rapidly mutating viruses (e.g. HIV which infects the immune system itself). One major challenge of designing an effective vaccine is to contain a diversifying mixture of antigen variants from evading recognition by antibodies. To confront this challenge, we develop a multi-scale computational model to simulate the stochastic evolutionary process of antibody affinity maturation against time varying antigen. By introducing dynamics into the design principle, we identify the optimal vaccination strategy which has been shown in mouse experiment to be very effective in focusing antibody response to the vulnerable part of the virus.

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