Aging and Adaptation in Infectious Diseases III

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Immunity to antigenically variable pathogens arises from an individual's history of exposures to multiple strains. The success of a new strain in turn depends on how strongly it is recognized by immune responses generated against previous strains. Traditionally, cross-reactivity between two strains is thought to depend on the similarity between their antigenic structures. Antigenic maps are a widely used visualization tool in which the distance between strains (represented as points in Euclidean space) provides a measure of their antigenic similarity, and potential for cross-reactivity.

However, the concept of a fixed antigenic distance between two strains implies that all hosts, regardless of their age and exposure history, would gain the same degree of cross-protection against strain B, given exposure to or vaccination with strain A. This contradicts a growing body of experimental and epidemiological evidence, showing that individuals with different exposure histories can exhibit vastly different levels of cross-protection against the same viral challenge.

We are developing an individual-based model which we will use to explore how differences in individual exposure history can cause hosts to perceive different antigenic distances between strains. We will use this model to explore how history-specific differences in immunity arise, and to what extent they cause immunity to differ from the predictions of existing maps, which assume a fixed distance between strains.