## Figure 3— source data 1. Parameters used in the simulations.

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| **Parameters** | **Definitions** | **Value** | **Note** |
| Individual Immune responses |
| $$μ\_{l}$$ | Mean log titers of long-term (i.e., broad range) boosting to an infected strain. | 2.02 | Ref ((*4*)) |
| $$μ\_{s}$$ | Mean log titers of short-term (i.e., narrow range) boosting to an infected strain. | 2.69 | Ref ((*4*)) |
| $$σ\_{l}$$ | Duration in years to determine the decrease of cross-reactions for long-term (i.e., broad range) boosting. | 1/0.130 | Ref ((*4*)) |
| $$σ\_{s}$$ | Duration in years to determine the decrease of cross-reactions for short-term (i.e., narrow range) boosting. | 1/0.031 | Ref ((*4*)) |
| $$ω$$ | Duration in years for the decay of short-term (i.e., narrow range) boosting. | 1/0.79 | Ref ((*4*)) |
| $$τ$$ | Parameter to determine the antigenic seniority. | 0 | Assumption |
| $$ρ$$ | Rate of changes in antigenic distance per year. | 0.778 | Ref ((*3*)). |
| Immunity-dependent protection |
| $$β$$ | Scale parameter of the titer-dependent protection. | 2.1 | Ref ((*37*)) |
| $$μ\_{50}$$ | Log titer with 50% probability of protection from infection. | 3 | Ref ((*37*)) |
| Population-level circulation |
| $$λ\_{t}$$ | A(H3N2) activity in year t. | a) a constant of 0.2; b) random, Uniform (0, 0.2); c) cyclic with a 5-year periodicity and maximum activity of 0.2 | Assumption.Equation 11 |