Individual variation in susceptibility or exposure to SARS-CoV-2 lowers the herd immunity threshold

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Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in China in late 2019 and spread worldwide causing the ongoing pandemic of coronavirus disease (COVID-19). Scientists throughout the world have engaged with governments, health agencies, and with each other, to address this emergency. Mathematical models have been central to important decisions concerning contact tracing, quarantine, and social distancing, to mitigate or suppress the initial pandemic spread. Successful suppression, however, leaves populations at risk to resurgent waves due to insufficient acquisition of immunity. Models have thus also addressed longer term SARS-CoV-2 transmission scenarios and the requirements for continued adequate response as the disease becomes endemic. I will describe how individual variation in susceptibility or exposure accelerates the acquisition of immunity in populations due to selection by the force of infection facilitating the transition from pandemic to endemic seasonal dynamics [1, 2, 3, 4, 5].

As severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) spreads, the susceptible subpopulation is depleted causing the incidence of new cases to decline. Variation in individual susceptibility or exposure to infection exacerbates this effect. Individuals that are more susceptible or more exposed tend to be infected earlier, depleting the susceptible subpopulation of those who are at higher risk of infection. This selective depletion of susceptibles intensifies the deceleration in incidence. Eventually, susceptible numbers become low enough to prevent epidemic growth or, in other words, the herd immunity threshold (HIT) is reached. Although estimates vary, simple calculations suggest that herd immunity to SARS-CoV-2 requires 60-70% of the population to be immune. By fitting epidemiologi-

cal models that allow for heterogeneity to SARS-CoV-2 outbreaks across the globe, we show that variation in susceptibility or exposure to infection reduces these estimates. Accurate measurements of heterogeneity are therefore of paramount importance in controlling the COVID-19 pandemic.

References

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