



The 2020 Pandemic

SARS-CoV-2 Immunity: What Have You Herd?

Steven L. Shafer, MD

Herd immunity has been bandied about since the start of the COVID-19 pandemic. Previously, herd immunity was mostly used to describe the efficacy of vaccines when a small fraction of the population remains unvaccinated. In the last year, herd immunity has been suggested as a strategy to end the pandemic. Let's not do that.

Much of the noise about herd immunity reflects misunderstanding of the meaning and implications of the term. The Centers for Disease Control and Prevention defines herd immunity as “a situation in which a sufficient proportion of a population is immune to an infectious disease (through vaccination and/or prior illness) to make its spread from person to person unlikely. Even individuals not vaccinated (such as newborns and those with chronic illnesses) are offered some protection because the disease has little opportunity to spread within the community” (asamonitor.pub/3kBNAf4). In a recent publication in *Nature Reviews*, Fontanet and Cauchemez offer a more precise definition of herd immunity: “when one infected person in a population generates less than one secondary case on average” (*Nat Rev Immunol* 2020;20:583-4).

Herd immunity is not immunity.

As explained by the CDC, and by Fontanet and Cauchemez, herd immunity means that enough people are immune to make it more probable than not that a single infected individual will not spread the disease to another person. Of course, if the person does infect another person, then the new case still has COVID-19, with the same risks of organ injury, long-term disability, and death.

In the absence of non-pharmaceutical interventions, the percent of the population required to reach herd immunity can be calculated from R_0 , the number of secondary infections caused by each infected individual at the start of the pandemic: herd immunity threshold = $1 - 1/R_0$. Estimates of R_0 for SARS-CoV-2 range from 2.5 to 4, so the fraction of the population required to reach herd immunity ranges from 60% to 75%. However, that assumes we are behaving like gas molecules, randomly bumping into each other at constant rates. Herd immunity might kick in



closer to 40% when the model accounts for different mixing rates among society (*Science* 2020;369:846-9). However, as noted by Fontanet and Cauchemez, “there is little evidence to suggest that the spread of SARS-CoV-2 might stop naturally before at least 50% of the population has become immune.”

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There have been several natural experiments with herd immunity. In July, SARS-CoV-2 tore through San Quentin prison in California, infecting 2,240 (asamonitor.pub/35xgb0O) prisoners out of a population 3,462 (asamonitor.pub/2H5apdh) (65%), resulting in 28 deaths (asamonitor.pub/35xgb0O). SARS-CoV-2 similarly

surged in Manaus, Brazil, in March and April, infecting 66% of the population (*medRxiv* September 2020).

Multiple seroprevalence studies suggest we are nowhere close to 50%-65% of the population required for herd immunity (*Nature* November 2020). Recent papers documented that fraction of the population with immunity at the end of the first wave (March through June) was 1% in Scotland (*Euro Surveill* 2020;25), 5% in Spain (*Lancet* 2020;396:535-44), 6% in The Netherlands (*Nat Commun* 2020;11:5744), 5% in France (*J Clin Med* 2020;9:E3569), 11% in Geneva (*Lancet* 2020;396:313-19), and 20% in New York City (*Nature* November 2020). Reaching herd immunity would add about 10-fold additional cases and deaths. Additionally, deaths continue to rise in San Quentin prison, and Manaus, Brazil is currently seeing a second surge in cases.

Nevertheless, herd immunity has been proposed as strategy by advisors to Boris Johnson (asamonitor.pub/2H4KulY), President Trump (asamonitor.pub/35AG9k0), and Anders Tegnell, the Swedish epidemiologist who opposes stringent public health mandates (asamonitor.pub/3kzvL0g). Deaths are currently surging in the U.K., the U.S., and Sweden. Most recently, the Great Barrington Declaration proposed allowing COVID-19 to spread unrestricted in young, healthy



Steven L. Shafer, MD

Editor-in-Chief, *ASA Monitor*, and Professor-Med Ctr Line, Department of Anesthesia, Stanford University School of Medicine, Stanford, California.

individuals “to minimize mortality and social harm until we reach herd immunity” (asamonitor.pub/3ny57H1).

There are several problems with adopting herd immunity as a strategy to end the COVID-19 pandemic:

- COVID-19 is lethal in vulnerable populations and can cause long-term disability and death in lower-risk populations. It is currently the third-leading cause of death in the U.S. This isn't influenza.
- There are zero demonstrations that at-risk populations can be protected while disease spreads freely in everyone else.
- Immunity may not be durable. Reinfection with the four endemic coronaviruses occurs every six to 36 months (*Nat Med* September 2020), and reinfection has been documented with SARS-CoV-2 (*medRxiv* September 2020; *Lancet Infect Dis* 2020;S1473-3099:30764-7; *Clin Infect Dis* September 2020).
- Public health measures buy precious time during which novel and highly effective treatments (see “The evolving Armamentarium of COVID-19 Therapeutics” on page 32) and even vaccines(!) (see “COVID-19 Vaccine Update” on page 1) can be developed, potentially saving millions of lives (see “Let Us Go Then ...” on page 4).

Tom Frieden, the former head of the CDC, wrote that “The route to herd immunity would run through graveyards filled with Americans who did not have to die” (asamonitor.pub/38IDSPo).

William Haseltine, one of the most prominent investigators in the U.S., is particularly blunt: “We are wasting time talking about herd immunity” (asamonitor.pub/38S11VV). Haseltine concludes:

Every American has a role to play and an opportunity to stamp out this disease. By wearing masks, practicing safe social distancing and choosing the inconvenience of self-isolation when we fear we've been exposed to infection, we can stop this outbreak dead in its tracks. ■