Science You Can Use

Jack K. Horner

Dear Science: My brother says that public orders requiring us to wear masks to help reduce the number of deaths from COVID-19 is based on a hoax. Is this true? -- Buck R.

Dear Buck: Here's a short answer to your question. The pandemic is not a hoax. There is good evidence that COVID-19 entered the US about 1 January 2020. Consider a scenario in which the pandemic continued from that time without any "interventions" (masking, social distancing, drugs, and vaccines) for 730 days (2 years). Let's then compare that "no-intervention" scenario with one in which everyone wears masks ("universal masking") for that same period without any other interventions. With no interventions, our current epidemiological data and models predict that approximately 600,000 people in the US would die from the disease. With universal masking starting 1 January 2020 and no other interventions, approximately 340,000 in the US would die from the disease. 260,000 lives would have been saved.

Here are some details. In what follows, I use a well-calibrated COVID-19 model (http://covidsim.eu/). This model requires, as input, specific values for the *infection rate* (a value which varies by scenario) and the following, which I will keep the same across all scenarios I analyze below

- individual recovery period after infection = 3 weeks (approximate current US average)
- recovered individuals are immune to re-infection
- start date = 1 January 2020 (the disease likely entered the US in late 2019)
- end date = 1 January 2022
- population on start date = 330 million (approximate population of the US)
- number of infected on start date = 1
- number of dead on start date = 0
- fraction of people infected who die = 0.03 (3%, current US data)
- no social distancing, drugs, or vaccines

or the equivalent of this information.

The first scenario, which I will call the "no-intervention" scenario, has no masking, social distancing, drugs, or vaccines. The second, which I will call the "early universal masking" scenario, assumes everyone wears masks beginning 1 January 2020 but has no other interventions.

For the "no-intervention" scenario, let's assume, based on data we have as of 25 October 2020, that the likely *actual* infection rate in the total population is about 0.01, and all other inputs have values noted above. In this scenario, the model above predicts that approximately 600,000 people would die from COVID-19.

Now let's look at the "early universal masking" scenario. For this scenario, assume that the infection rate in the total population is 0.006 (i.e., assume masks reduce the infection rate 40%;

see https://www.nature.com/articles/s41591-020-1132-9), beginning 1 January 2020, and all other inputs have the values noted above. For this scenario, the model above predicts that approximately 340,000 people would die from COVID-19.

In short, early universal masking would have saved approximately 260,000 lives compared to the no-intervention scenario.

The no-intervention scenario is an example of a "herd-immunity" scenario. Herd immunity is achieved when (1 – (1/R)) of the total population has achieved immunity to a disease (through prior infection and recovery, or through vaccination). R is the average number of individuals an infected an infected person infects. If there are no interventions, then immunity is achieved only by infection and recovery. As of 25 October 2020, in the US, R is about 3, so herd immunity would be achieved when about 70% (1 – (1/3) = 0.67) of the population has achieved immunity. When herd immunity is achieved, the virus will not be able to "find" enough non-immune (susceptible) individuals to infect to cause more than a tiny fraction of total deaths (from all causes). Even if we do nothing (the no-intervention scenario), the pandemic will "burn itself out" – but at a much greater loss of life than if we practice effective non-pharmaceutical interventions.

It is not too late to start universal masking. By best estimates, we can still save about 130,000 lives if universal masking were observed between 1 December 2020 and 1 March 2021.

What does all this tell us? Given the assumptions and model noted above, the timing of effective interventions like masking is everything. That said, public-health policy is almost never simply about minimizing the number of deaths. Various kinds of interventions – especially "lockdowns" -- can have severe effects on employment, educational access, and other values we have. There are tradeoffs among these values. To see this, consider some hypothetical scenarios. Would we tolerate, for example, eliminating 50% of the jobs in the US "overnight" and shutting down all schooling, for a year, just to minimize the number of deaths from a (hypothetical) pandemic disease? Almost surely not. What if had to lose just 5% of the jobs in the US, and had to shorten the school year by only three weeks, in order to minimize the number of deaths? We might tolerate that tradeoff.

For further information, see
https://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology .

Jack Horner is a systems engineer. Clancey Maloney and David Lambertson made valuable recommendations on an earlier draft of the column.