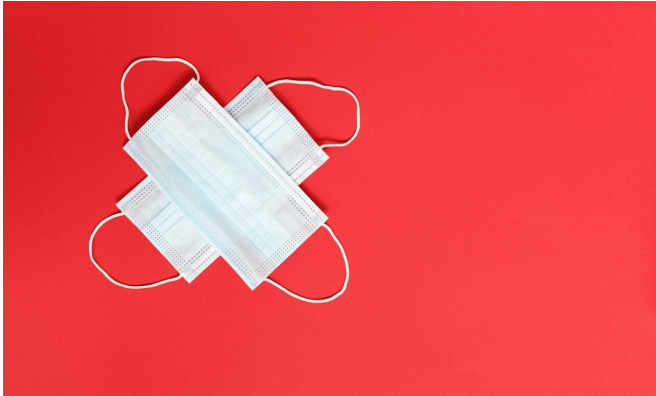


Frequent, rapid testing could cripple COVID within weeks, study shows

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Testing half the population weekly with inexpensive, rapid-turnaround COVID-19 tests would drive the virus toward elimination within weeks— even if those tests are significantly less sensitive than gold-standard clinical tests, according to a new study published today by University of Colorado Boulder and Harvard University researchers.

Such a strategy could lead to "personalized stay-at-home orders" without shutting down restaurants, bars, retail stores and schools, the authors said.

"Our big picture finding is that, when it comes to public health, it's better to have a less sensitive [test](#) with results today than a more sensitive one with results tomorrow," said lead author Daniel Larremore, an assistant professor of computer science at CU Boulder. "Rather than telling everyone to stay home so you can be sure that one person who is sick doesn't spread it, we could give only the contagious people stay-at-home orders so everyone else can go about their lives."

For the study, published in the journal *Science Advances*, Larremore teamed up with collaborators

at CU's BioFrontiers Institute and the Harvard T.H. Chan School of Public Health to explore whether test sensitivity, frequency, or turnaround time is most important to curb the spread of COVID-19.

The researchers scoured available literature on how viral load climbs and falls inside the body during infection, when people tend to experience symptoms, and when they become contagious.

They then used mathematical modeling to forecast the impact of screening with different kinds of tests on three hypothetical scenarios: in 10,000 individuals; in a university-type setting of 20,000 people; and in a city of 8.4 million.

When it came to curbing spread, they found that frequency and turnaround time are much more important than test sensitivity.

For instance, in one scenario in a large city, widespread twice-weekly testing with a rapid but less sensitive test reduced the degree of infectiousness, or R_0 ("R naught"), of the virus by 80%. But twice-weekly testing with a more sensitive PCR (polymerase chain reaction) test, which takes up to 48 hours to return results, reduced infectiousness by only 58%. When the amount of testing was the same, the rapid test always reduced infectiousness better than the slower, more sensitive PCR test.

That's because about two-thirds of infected people have no symptoms and as they await their results, they continue to spread the virus.

"This paper is one of the first to show we should worry less about test sensitivity and, when it comes to [public health](#), prioritize frequency and turnaround," said senior co-author Roy Parker, director of the BioFrontiers Institute and a Howard Hughes Medical Institute investigator.

The study also demonstrates the power of frequent

testing in shortening the pandemic and saving lives. minutes. Some PCR tests can take several days.

In one scenario, in which 4% of individuals in a city were already infected, rapid testing three out of four people every three days reduced the number ultimately infected by 88% and was "sufficient to drive the epidemic toward extinction within six weeks."

The study comes as companies and academic research centers are developing low-cost, rapid turnaround tests that could be deployed in large public settings or commercialized for do-it-yourself use.

Sensitivity levels vary widely. Antigen tests require a relatively high viral load—about 1,000 times as much virus compared to the PCR test—to detect an infection. Another test, known as RT-lamp (reverse transcription loop-mediated isothermal amplification), can detect the virus at around 100 times as much virus compared to the PCR. The benchmark PCR test requires as little as 5,000 to 10,000 viral RNA copies per milliliter of sample, meaning it can catch the virus very early or very late.

In the past, federal regulators and the public have been reluctant to embrace rapid tests out of concern that they may miss cases early in infection. But, in reality, an infected person can go from 5,000 particles to 1 million viral RNA copies in 18 to 24 hours, said Parker.

"There is a very short window, early in infection, in which the PCR will detect the virus but something like an antigen or LAMP test won't," Parker said.

And during that time, the person often isn't contagious, he said.

"These rapid tests are contagiousness tests," said senior co-author Dr. Michael Mina, an assistant professor of epidemiology at the Harvard T.H. Chan School of Public Health. "They are extremely effective in detecting COVID-19 when people are contagious."

They are also affordable, he added. The rapid tests can cost as little as \$1 each and return results in 15

minutes. Some PCR tests can take several days. Mina envisions a day when the government sends simple, cheap DIY tests to every home. Even if half of Americans tested themselves weekly and self-isolated if positive, the result would be profound, he said.

"Within a few weeks we could see this outbreak going from huge numbers of cases to very manageable levels," Mina said.

Rapid testing could also be the key to breathing life back into former super spreader threats like football stadiums, concert venues and airports, with patrons testing themselves on the way in and still wearing masks as a precautionary measure, Larremore said.

"Less than .1% of the current cost of this virus would enable frequent testing for the whole of the U.S. population for a year," said Mina, referencing a recent Harvard economic analysis.

The authors say they are heartened to see that several countries have already begun testing all of their citizens, and hopeful that the new U.S. administration has named rapid testing as a priority.

"It's time to shift the mentality around testing from thinking of a COVID test as something you get when you think you are sick to thinking of it as a vital tool to break transmission chains and keep the economy open," Larremore said.

More information: Test sensitivity is secondary to frequency and turnaround time for COVID-19 screening, *Science Advances* (2020). DOI: [10.1126/sciadv.abd5393](https://doi.org/10.1126/sciadv.abd5393), advances.sciencemag.org/content/11/20/sciadv.abd5393

Provided by University of Colorado at Boulder

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