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What if 'Herd Immunity' Is Closer Than Scientists Thought?

By Apoorva Mandavilli

14-18 minutes

In what may be the world's most important math puzzle, researchers are trying to figure out how many people in a community must be immune before the coronavirus fades.





Credit...Jonah Markowitz for The New York Times

- Published Aug. 17, 2020Updated Aug. 31, 2020

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We've known from the beginning how the end will arrive. Eventually, the coronavirus will be unable to find enough susceptible hosts to survive, fading out wherever it briefly emerges.

To achieve so-called herd immunity — the point at which the virus can no longer spread widely because there are not enough vulnerable humans — scientists have suggested that perhaps 70 percent of a given population must be immune, through vaccination or because they survived the infection.

Now some researchers are wrestling with a hopeful possibility. In interviews with The New York Times, more than a dozen scientists said that the threshold is likely to be much lower: just 50 percent, perhaps even less. If that's true, then it may be possible to turn back the coronavirus more quickly than once thought.

The new estimates result from complicated statistical modeling of the pandemic, and the models have all taken divergent approaches, yielding inconsistent estimates. It is not certain that any community in the world has enough residents now immune to the virus to resist a second wave.

But in parts of New York, London and Mumbai, for example, it is

not inconceivable that there is already substantial immunity to the coronavirus, scientists said.

"I'm quite prepared to believe that there are pockets in New York City and London which have substantial immunity," said Bill Hanage, an epidemiologist at the Harvard T.H. Chan School of Public Health. "What happens this winter will reflect that."

"The question of what it means for the population as a whole, however, is much more fraught," he added.

Herd immunity is calculated from the epidemic's so-called reproductive number, R_0 , an indicator of [how many people each infected person spreads the virus to](#).

The initial calculations for the herd immunity threshold assumed that each community member had the same susceptibility to the virus and mixed randomly with everyone else in the community.

"That doesn't happen in real life," said Dr. Saad Omer, director of the Yale Institute for Global Health. "Herd immunity could vary from group to group, and subpopulation to subpopulation," and even [by postal codes](#), he said.

For example, a neighborhood of older people may have little contact with others but succumb to the virus quickly when they encounter it, whereas teenagers may bequeath the virus to dozens of contacts and yet stay healthy themselves. The virus moves slowly in suburban and rural areas, where people live far apart, but zips through cities and households thick with people.

Once such real-world variations in density and demographics are accounted for, the estimates for herd immunity fall. Some researchers even suggested the figure may be in the range of 10 to 20 percent, but they were in the minority.

Assuming the virus ferrets out the most outgoing and most

susceptible in the first wave, immunity following a wave of infection is distributed more efficiently than with a vaccination campaign that seeks to protect everyone, said Tom Britton, a mathematician at Stockholm University.

His model puts the threshold for herd immunity [at 43 percent](#) — that is, the virus cannot hang on in a community after that percentage of residents has been infected and recovered.

Still, that means many residents of the community will have been sickened or have died, a high price to pay for herd immunity. And experts like Dr. Hanage cautioned that even a community that may have reached herd immunity cannot afford to be complacent.

The virus may still flare up here and there, even if its overall spread is stymied. It's also unclear how long someone who has recovered may be immune, and for how long.



Image





Credit...Atul Loke for The New York Times

Virus-Resistant Communities?

The coronavirus crashed this year's Purim celebrations in the Orthodox Jewish neighborhoods of New York City, tearing through the parades and masquerades in Brooklyn on March 9 and 10.

Schools and synagogues soon shut down to quell the spread, but it was too late. By April, thousands in the Brooklyn communities were infected, and [hundreds had died](#).

"It's like a black hole in my memory because of how traumatic it was," said Blimi Marcus, a nurse practitioner who lives in Borough Park, which was hit hard by the virus.

But all that has changed now, Ms. Marcus added: "The general feeling is one of complacency, that somehow we've all had it and we're safe."

Is it possible that [some of these communities have herd immunity](#)? In some clinics, up to 80 percent of people tested had antibodies to the virus. The highest prevalence was found among teenage boys.

But people at clinics are more likely to be showing symptoms and therefore more likely to be infected, said Wan Yang, an epidemiologist at Columbia University's Mailman School of Public Health in New York. Random household surveys would probably find lower rates — but still well above the 21 percent average reported for New York City, she said.

Researchers in Mumbai conducted just such a [random household survey](#), knocking on every fourth door — or, if it was locked, the fifth — and took blood for antibody testing. They found a startling disparity between the city's poorest neighborhoods and its more affluent enclaves. Between 51 and 58 percent of residents in poor areas had antibodies, versus 11 to 17 percent elsewhere in the city.

The lowest-income residents are packed tightly together, share toilets, and have little access to masks. "These factors contributed to a silent infection spread," said Dr. Jayanthi Shastri, a microbiologist at Kasturba Hospital in Mumbai who led the work.

Most researchers are wary of concluding that the hardest-hit neighborhoods of Brooklyn, or even those in blighted areas of Mumbai, have reached herd immunity or will be spared future outbreaks.

But models like Dr. Britton's hint that it's not impossible. Other researchers have suggested, controversially, that herd immunity can be achieved at rates of immunity as low as 10 or 20 percent — and that entire countries may already have achieved that goal.

Criticism trailed Sunetra Gupta, a theoretical epidemiologist at Oxford University, after a [widely circulated interview](#) in which she said that London and New York may already have reached herd

immunity because of variability among people, combined with a theoretical [immunity to common cold coronaviruses](#) that may [protect against the new one](#).

“That could be the explanation for why you don’t see a resurgence in places like New York,” she said.

Most experts reject that notion. Several studies have shown that certain immune cells produced following infection with seasonal coronaviruses may also recognize the new coronavirus.

But “where is the evidence that it’s protective?” asked Natalie Dean, a biostatistician at the University of Florida.

[The Coronavirus Outbreak ›](#)

Frequently Asked Questions

Updated September 4, 2020

- **What are the symptoms of coronavirus?**
- In the beginning, the coronavirus [seemed like it was primarily a respiratory illness](#) — many patients had fever and chills, were weak and tired, and coughed a lot, though some people don’t show many symptoms at all. Those who seemed sickest had pneumonia or acute respiratory distress syndrome and received supplemental oxygen. By now, doctors have identified many more symptoms and syndromes. In April, [the C.D.C. added to the list of early signs](#) sore throat, fever, chills and muscle aches. Gastrointestinal upset, such as diarrhea and nausea, has also been observed. Another telltale sign of infection may be a sudden, profound diminution of one’s [sense of smell and taste](#). Teenagers and young adults in some cases have developed painful red and purple lesions on their fingers and

toes — nicknamed “Covid toe” — but few other serious symptoms.

- **Why is it safer to spend time together outside?**
- [Outdoor gatherings](#) lower risk because wind disperses viral droplets, and sunlight can kill some of the virus. Open spaces prevent the virus from building up in concentrated amounts and being inhaled, which can happen when infected people exhale in a confined space for long stretches of time, said Dr. Julian W. Tang, a virologist at the University of Leicester.
- **Why does standing six feet away from others help?**
- The coronavirus spreads primarily through droplets from your mouth and nose, especially when you cough or sneeze. The C.D.C., one of the organizations using that measure, [bases its recommendation of six feet](#) on the idea that most large droplets that people expel when they cough or sneeze will fall to the ground within six feet. But six feet has never been a magic number that guarantees complete protection. Sneezes, for instance, can launch droplets a lot farther than six feet, [according to a recent study](#). It's a rule of thumb: You should be safest standing six feet apart outside, especially when it's windy. But keep a mask on at all times, even when you think you're far enough apart.
- **I have antibodies. Am I now immune?**
- As of right now, [that seems likely, for at least several months](#). There have been frightening accounts of people suffering what seems to be a second bout of Covid-19. But experts say these patients may have a drawn-out course of

infection, with the virus taking a slow toll weeks to months after initial exposure. People infected with the coronavirus typically [produce](#) immune molecules called antibodies, which are [protective proteins made in response to an infection. These antibodies may](#) last in the body [only two to three months](#), which may seem worrisome, but that's perfectly normal after an acute infection subsides, said Dr. Michael Mina, an immunologist at Harvard University. It may be possible to get the coronavirus again, but it's highly unlikely that it would be possible in a short window of time from initial infection or make people sicker the second time.

- **What are my rights if I am worried about going back to work?**
- Employers have to provide [a safe workplace](#) with policies that protect everyone equally. [And if one of your co-workers tests positive for the coronavirus, the C.D.C.](#) has said that [employers should tell their employees](#) -- without giving you the sick employee's name -- that they may have been exposed to the virus.

These cities have not returned to pre-pandemic levels of activity, other experts noted.

"We are still nowhere near back to normal in our daily behavior," said Virginia Pitzer, a mathematical epidemiologist at the Yale School of Public Health. "To think that we can just stop doing all that and go back to normal and not see a rise in cases I think is wrong, is incorrect."

A second wave might also hit groups or neighborhoods that were spared by the first, and still wreak havoc, she said. Immunity is a patchwork quilt in New York, for instance:

Antibodies were present in 68 percent of people visiting a clinic in the Corona neighborhood of Queens, for instance, but in just 13 percent of those tested at a clinic in the Cobble Hill section of Brooklyn.

But another group, led by the mathematician Gabriela Gomes of the University of Strathclyde in Britain, [accounted for variations](#) within a society in its model and found that Belgium, England, Portugal and [Spain](#) have herd immunity thresholds [in the range of 10 to 20 percent](#).

“At least in countries we applied it to, we could never get any signal that herd immunity thresholds are higher,” Dr. Gomes said. “I think it’s good to have this horizon that it may be just a few more months of pandemic.”

Other experts urged caution, saying these models are flawed, as all models are, and that they oversimplify conditions on the ground.

Jeffrey Shaman, an epidemiologist at Columbia University, said it wasn’t clear to him that Dr. Gomes’s model offered only one possible solution. And he was suspicious of the big ranges among the four countries.

“I think we’d be playing with fire if we pretended we’re done with this,” Dr. Shaman said.

The new models offer food for thought, he and other experts said, but should not be used to set policy.

“Mathematically, it’s certainly possible to have herd immunity at these very, very low levels,” said Carl Bergstrom, an infectious disease expert at the University of Washington in Seattle.

“Those are just our best guesses for what the numbers should look like.”

“But,” he added, “they’re just exactly that, guesses.”



Image



Credit...Brittany Newman for The New York Times

Imperfect Immunity

But what about immunity at levels lower than those needed for herd immunity?

“Definitely the disease would not spread as well if it gets back into New York,” said Joel Miller, a mathematical modeler at La Trobe University in Australia. “The same level of behavior change will have more effect on the disease now than it did four months ago.”

Thinking of a city or country as composed of subgroups, demarcated by age, race and level of social activity, might also help governments protect those with the least immunity.

That perspective also might help put a renewed focus on groups who require the higher levels of immunity, because of greater exposure levels and other inequities, including Black and Latino residents, said Dr. Manoj Jain, an infectious disease expert at Emory University. “That’s where this info is very useful,” he said.

The models also suggest a vaccination strategy: Rather than uniformly vaccinate all groups, governments could identify and immunize those most likely to be exposed in “superspreader” events.

“Getting those people vaccinated first can lead to the greatest benefit,” said Dr. Michael Mina, an immunologist at Harvard University. “That alone could lead to herd immunity.”

Vaccination schemes for other pathogens have successfully exploited this approach. For example, when children were given the pneumococcal vaccine in the early 2000s, rates of [bacterial pneumonia in the elderly rapidly dropped](#) because of a “herd effect.”

Vaccines that offer just 50 percent protection are considered to be moderately effective, but at that efficiency, even a low herd immunity target would require that a large proportion of the population be immunized, Dr. Bergstrom noted.

If there are early reports of side effects that may scare away

some people, he said, “we’d do well to start thinking about all that now.”

Back in Brooklyn, fewer than 1 percent of people tested at neighborhood clinics over the past eight weeks were infected with the virus. But there are still handfuls of cases, Ms. Marcus said, adding that her 10-year-old niece was in quarantine because a counselor at her day camp had tested positive.

“Sometimes that’s all you need, right?” she said. “I’m still hoping we don’t see what we had in March and April, but I’m not so sure that we’ve seen the end of it.”