The Washington Post

Health

# Why outbreaks like coronavirus spread exponentially, and how to “flatten the curve”

By Harry Stevens March 14, 2020

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After the first case of covid-19, the disease caused by the new strain of coronavirus, was announced in the United States, reports of further infections trickled in slowly. Two months later, that trickle has turned into a steady current.

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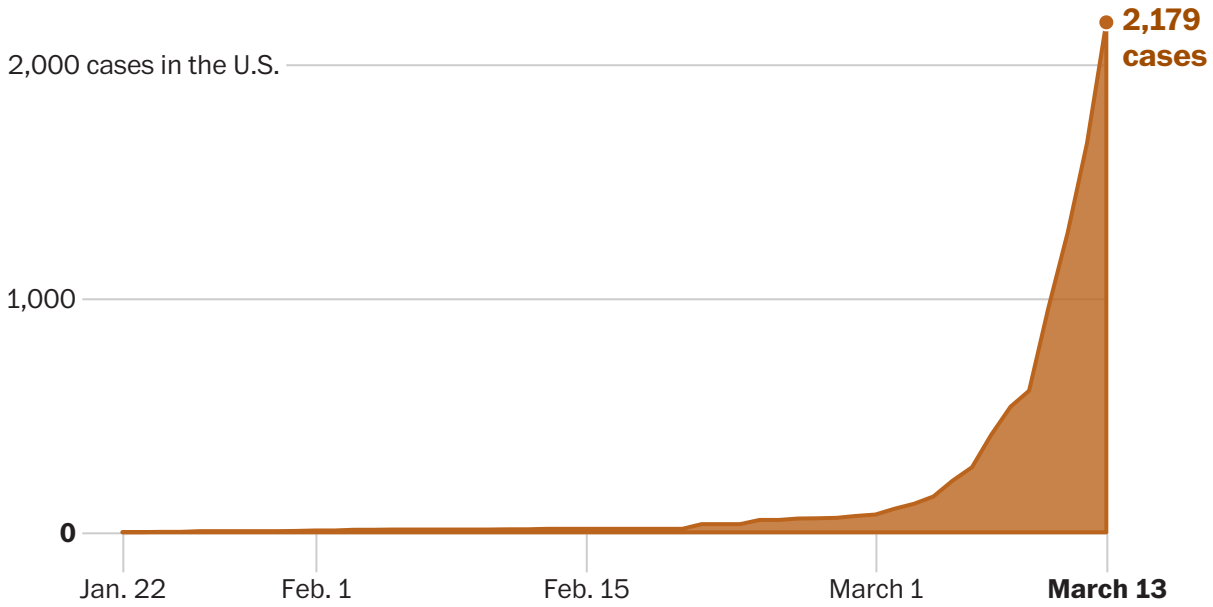



**Hover to explore the number of cases over time.**

This so-called **exponential curve** has experts worried. If the number of cases were to continue to double every three days, there would be about a hundred million cases in the United States by May.

*[Sign up for our Coronavirus Updates newsletter to track the outbreak. All stories linked within the newsletter are free to access.]*

That is math, not prophecy. The spread can be slowed, public health professionals say, if people practice "social distancing" by avoiding public spaces and generally limiting their movement.

Still, without any measures to slow it down, covid-19 will continue to spread exponentially for months. To understand why, it is instructive to simulate the spread of a fake disease through a population.

We will call our fake disease simulitis. It spreads even more easily than covid-19: whenever a **healthy person** comes into contact with a **sick person**, the healthy person becomes sick, too.

In a population of just five people, it did not take long for everyone to catch simulitis.

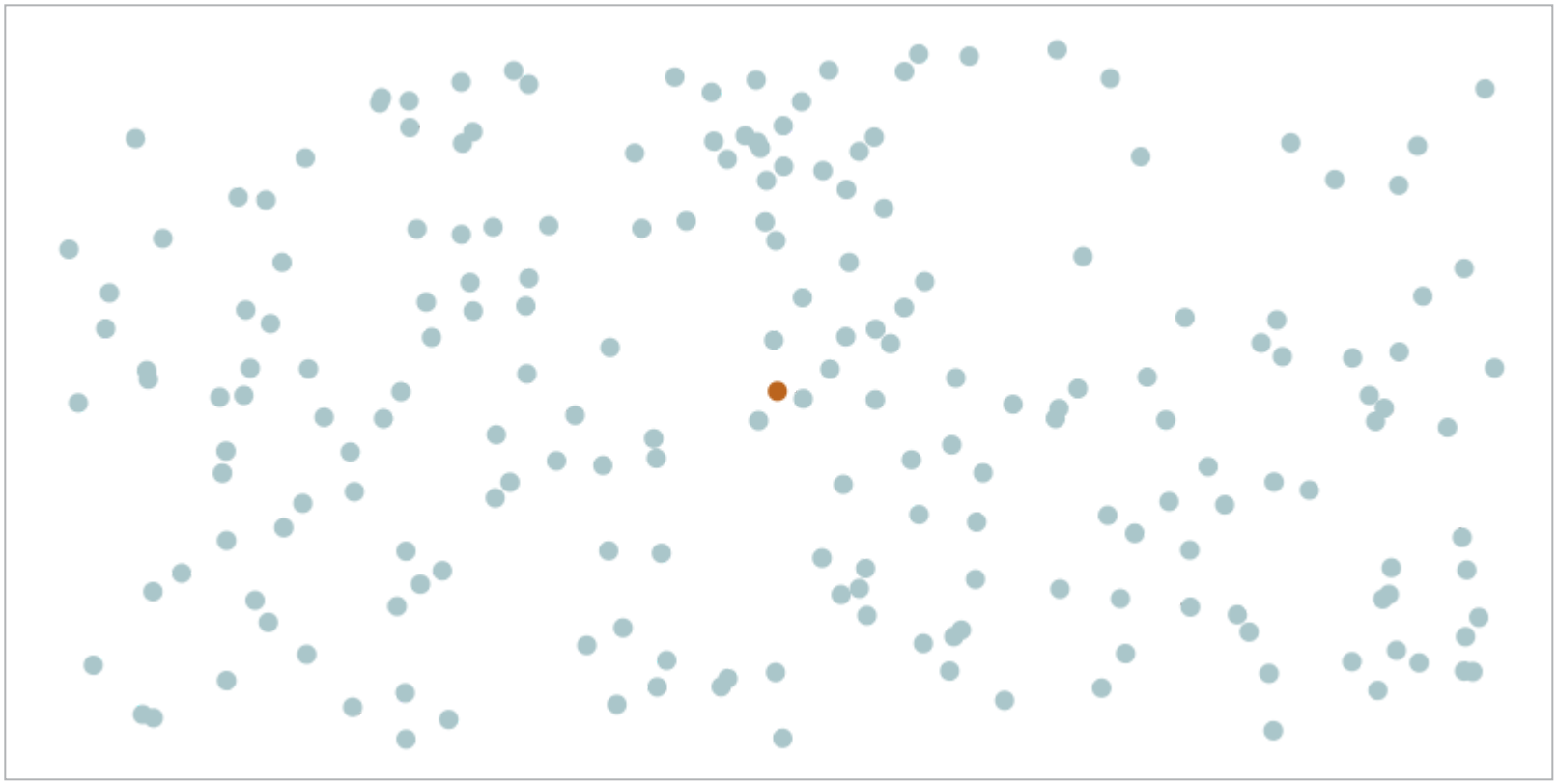
In real life, of course, people eventually recover. A **recovered person** can neither transmit simulitis to a healthy person nor become sick again after coming in contact with a sick person.

Let's see what happens when simulitis spreads in a town of 200 people. We will start everyone in town at a random position, moving at a random angle, and we will make one person **sick**.

Notice how the slope of the red curve, which represents the number of sick people, rises rapidly as the disease spreads and then tapers off as people recover.

| Count | |
|---|---|
| Recovered | 0 |
| Healthy | 199 |
| Sick | 1 |

**Change over time**

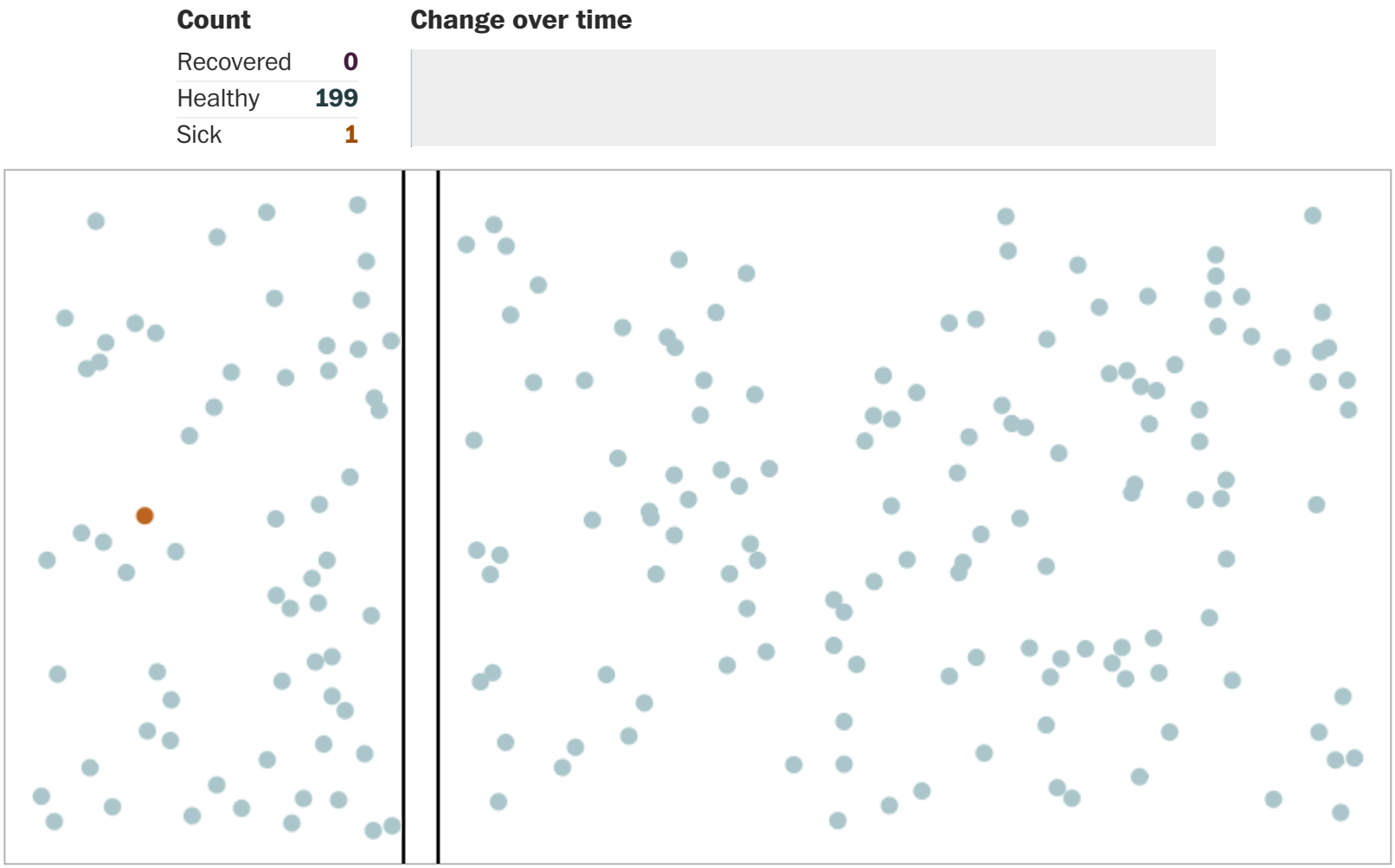


Our simulation town is small — about the size of Whittier, Alaska — so simulitis was able to spread quickly across the entire population. In a country like the United States, with its 330 million people, the curve could steepen for a long time before it started to slow.

*[Mapping the spread of the coronavirus in the U.S. and worldwide]*

When it comes to the real covid-19, we would prefer to slow the spread of the virus before it infects a large portion of the U.S. population. To slow

simulitis, let's try to create a **| | forced quarantine**, such as the one the Chinese government imposed on Hubei province, covid-19's ground zero.




Whoops! As health experts would expect, it proved impossible to completely seal off the sick population from the healthy.

Leana Wen, the former health commissioner for the city of Baltimore, explained the impracticalities of forced quarantines to The Washington Post in January. “Many people work in the city and live in neighboring counties, and vice versa,“ Wen said. “Would people be separated from their families? How would every road be blocked? How would supplies reach residents?”

As Lawrence O. Gostin, a professor of global health law at Georgetown University, put it: “The truth is those kinds of lockdowns are very rare and never effective.”

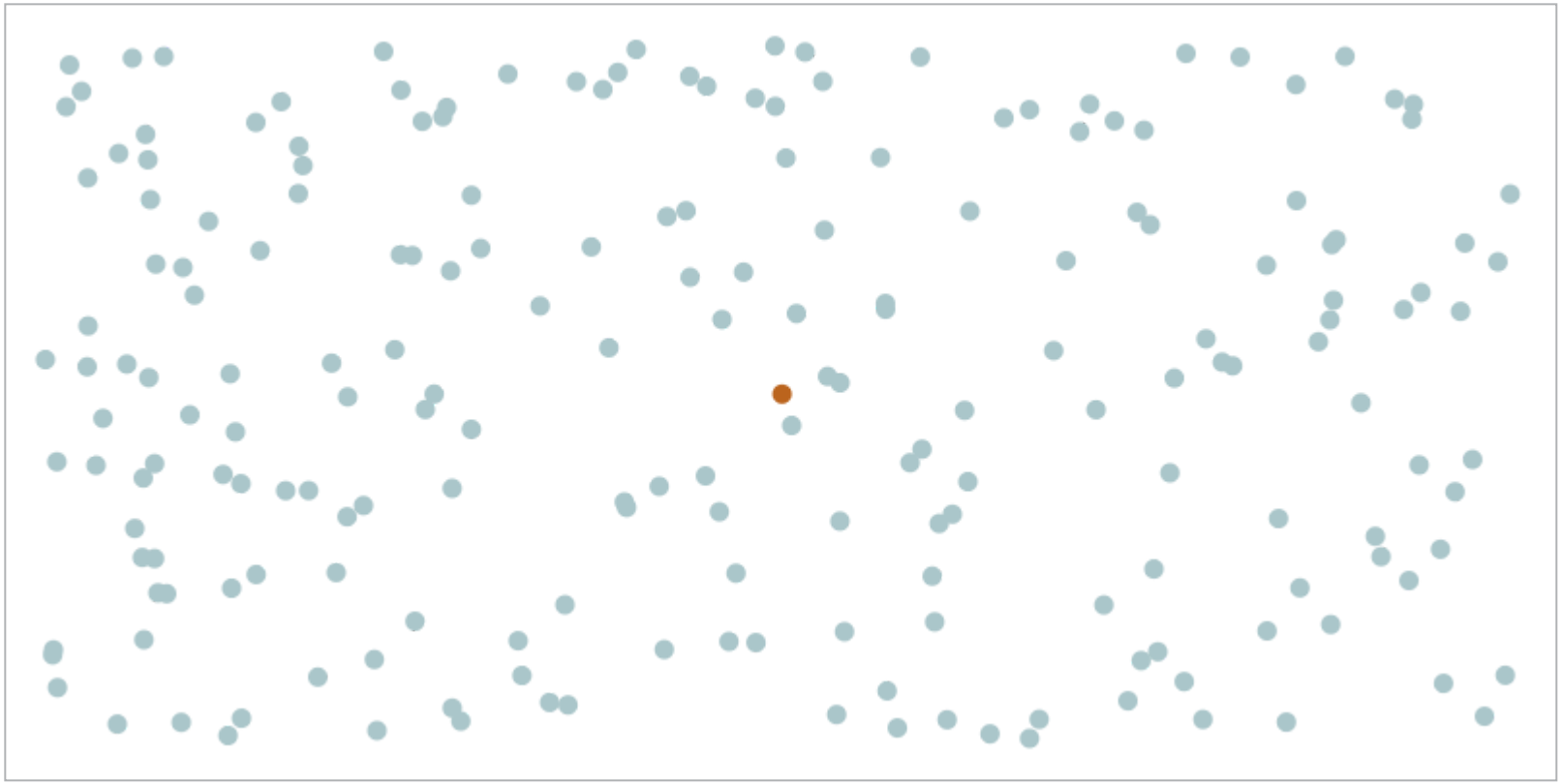
Fortunately, there are other ways to slow an outbreak. Above all, health officials have encouraged people to avoid public gatherings, to stay home more often and to keep their distance from others. If people are less mobile and interact with each other less, the virus has fewer opportunities to spread.

Some people will still go out. Maybe they cannot stay home because of their work or other obligations, or maybe they simply refuse to heed public health warnings. Those people are not only more likely to get sick themselves, they are more likely to spread simulitis, too.

Let's see what happens when a quarter of our population continues to move around while the other three quarters adopt a strategy of what health experts call "social distancing."

| Count | |
|---|---|
| Recovered | 0 |
| Healthy | 199 |
| Sick | 1 |

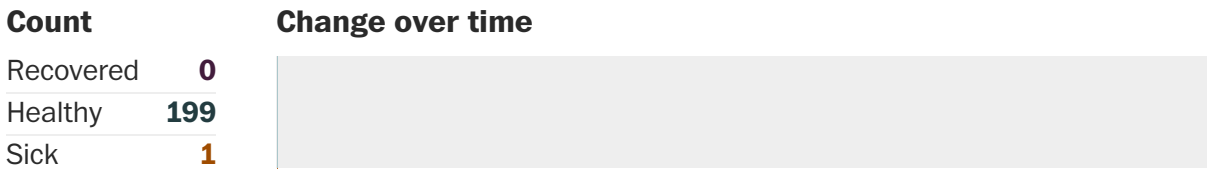
**Change over time**

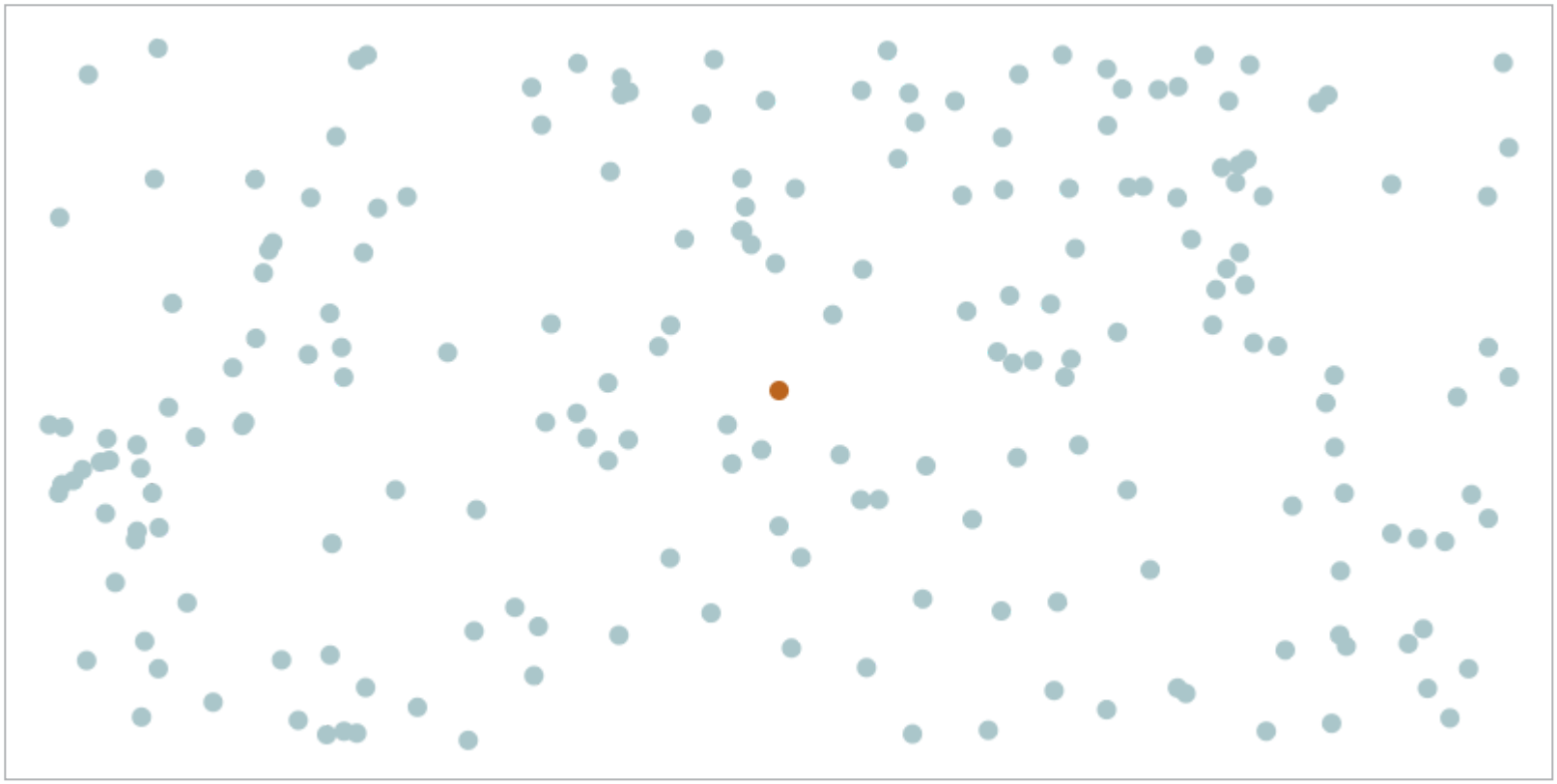


More social distancing keeps even more people healthy, and people can be nudged away from public places by removing their allure.

“We control the desire to be in public spaces by closing down public spaces. Italy is closing all of its restaurants. China is closing everything, and we are closing things now, too,” said Drew Harris, a population health researcher and assistant professor at The Thomas Jefferson University College of Public Health. “Reducing the opportunities for gathering helps folks social distance.”

To simulate more social distancing, instead of allowing a quarter of the population to move, we will see what happens when we let just one of every eight people move.





The four simulations you just watched — a free-for-all, an attempted quarantine, moderate social distancing and extensive social distancing — were random. That means the results of each one were unique to your reading of this article; if you scroll up and rerun the simulations, or if you revisit this page later, your results will change.

Even with different results, moderate social distancing will usually outperform the attempted quarantine, and extensive social distancing usually works best of all. Below is a comparison of your results.

Simulitis is not covid-19, and these simulations vastly oversimplify the complexity of real life. Yet just as simulitis spread through the networks of bouncing balls on your screen, covid-19 is spreading through our human networks — through our countries, our towns, our workplaces, our families. And, like a ball bouncing across the screen, a single person's behavior can cause ripple effects that touch faraway people.

*[What you need to know about coronavirus]*

In one crucial respect, though, these simulations are nothing like reality: Unlike simulitis, covid-19 can kill. Though the fatality rate is not precisely known, it is clear that the elderly members of our community are most at risk of dying from covid-19.

"If you want this to be more realistic," Harris said after seeing a preview of this story, "some of the dots should disappear."

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**Harry Stevens**
Harry Stevens joined The Washington Post as a graphics reporter in 2019.

**About this story**

The data for the chart at the top of this story showing the number of reported cases in the United States was collected by the Johns Hopkins University Center for Systems Science and Engineering and is available for download on GitHub. The likely number of actual cases in the U.S. is likely far higher because of problems with the coronavirus test and because many cases are so mild that those infected do not visit a doctor or hospital.

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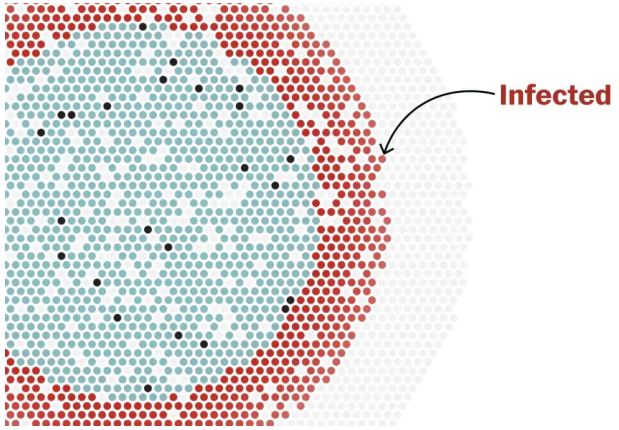
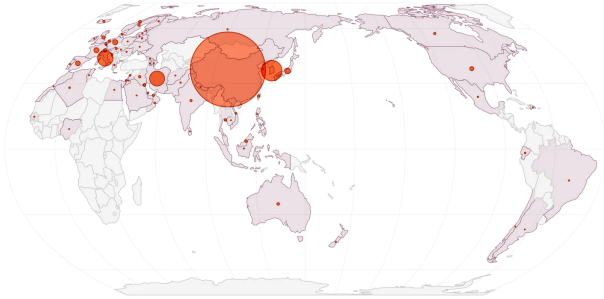



## Mapping the spread of the coronavirus in the U.S. and worldwide

Since the coronavirus outbreak began in China, new cases have been confirmed in more than 100 countries, with thousands of cases reported in South Korea, Italy and Iran and hundreds in the United States.



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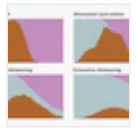

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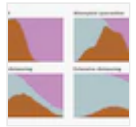

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