

The beginning of a pandemic is a deluge of numbers. Numbers for our cities, our countries, our world.

It can feel like everyone is looking at the same numbers and reading different stories.

Understanding all these numbers during an outbreak is important because it tells us what preventive strategies we need to use.

But where do all these numbers even come from? Does more testing lead to more cases? What does the positivity rate mean?

Let's take a step back.

With any infectious disease, an *outbreak* is a sudden increase in cases beyond what's expected in a population for a certain area.

For a brand-new virus, that did not exist anywhere before, an outbreak occurs when *any* cases are detected.

But who counts as a case isn't always clear and consistent. At the beginning of a novel virus outbreak, someone may only count as a *case* if they are infected, symptomatic, and have access to a test, even though there are likely people that are sick that don't get tested, as well as some that are infected but don't experience any symptoms.

We likely miss cases at this point because doctors aren't looking for them, may not even know what to look for, and may not have access to testing supplies.

As we learn more about the virus, public health experts expand the case definition to include people diagnosed by clinicians based on symptoms, including those experiencing symptoms but without access to an official lab test. This makes the number of reported cases rise.

Just by widening the case definition, the case number jumps seemingly overnight because all of the people who had symptoms but hadn't been lab-tested are now considered cases.

Expanding the case definition helps us quickly get a better idea of how many people are infected while testing is still limited.

But official lab tests are still crucial for catching those who are infected but not experiencing symptoms. Testing tells us more accurately where the virus is, and how quickly it's spreading.

Who gets a lab test affects another number we see a lot, the positivity rate.

The positivity rate is the percentage of all tests conducted that come back positive. At first, we only test the people who are very likely to have the virus, so most tests come back positive and the positivity rate is high.

Ideally, we then expand testing efforts so we have a better idea of how many people are truly infected in the population.

At the same time, populations take substantial measures – such as social distancing and contact tracing - to contain the spread of disease.

If these measures are effective, the number of cases decrease over time, even though they may initially appear to increase because more people are being tested. Eventually, since the spread is being contained and because people who are not symptomatic are also tested, the positivity rate comes down as well.

A target positivity rate may be set to indicate whether or not we are testing enough to catch most cases. Reaching this target lets us know the spread is being contained.

If new infections are not prevented as testing expands, the case number increases and the positivity rate does not reach the established threshold because the spread is not being contained.

If an epidemic continues to spread quickly and there isn't enough testing, the number of cases can appear to decrease. But this is not because fewer people are infected- it's just that we aren't identifying them. In this case, the positivity rate is usually very high.

Most importantly, more testing is never to blame for more infections. Testing lets us know who to isolate in order to stop the disease from spreading to anyone else. Without testing, we don't know who to isolate, increasing the likelihood that infected people are interacting with non-infected people and spreading the disease.

Testing is a necessary tool to slow transmission until a cure is found. But it must be combined with isolation, quarantine, and contact tracing to be effective.