

Coronavirus: Are we underestimating how many people have had it? Sweden thinks so

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Many countries around the world are now facing the difficult decision of when and how to ease lockdown restrictions due to the novel coronavirus. In the absence of a vaccine, it is likely there will be new

waves of the epidemic, unless enough people have been infected to achieve herd immunity (assuming those who have contracted the virus retain enough protection and the virus does not mutate into a distinct strain) – estimated to be around 60%.

Unfortunately, government advisers in the UK, France and many other countries suggest [only a few percent of the population](#) have so far been infected. But does this add up? Like the proverbial "canary in the cage," Sweden, which is encouraging social distancing but has not fully locked down, could guide the world. Here, the authorities claim the country is rapidly approaching [herd immunity](#).

At face value, Sweden is not doing well. By April 22, its [mortality rates](#) from COVID-19 [were the tenth highest in the world](#), with 17.3 deaths per 100,000. By comparison, its neighbors Denmark, Norway and Finland ranked 17th, 22nd and 31st, with 6.4, 3.4 and 2.6 deaths per 100,000.

Protecting a population from becoming infected with aggressive containment is like protecting a forest in the path of wildfire—unless continuous fire fighting efforts are made, the forest will eventually burn. Aggressive contact tracing, testing, quarantine and lockdowns minimize contagion and have substantially reduced early fatalities from COVID-19.

But unless those who remain uninfected are protected until effective pharmacological interventions (vaccines, prophylactics and therapeutics) come online, the ultimate burden of deaths may be the same in countries who opt for lockdown as in those who adopted more liberal containment strategies.

How close Sweden is to herd immunity is unknown, because random seroprevalence testing, which requires testing for both the virus and

antibodies (to detect past infection), has not yet been undertaken nationwide, although plans are afoot. Nevertheless, the national public health agency, Folkhälsomyndigheten, and Swedish military sampled 738 Stockholmers and found that 2.5% [were infected](#) between March 26 and April 3 with SARS-CoV-2.

Mathematical models have also been performed to estimate the community spread of SARS-CoV-2. In analyses conducted by a leading UK group, 3.1% of the Swedish population [was estimated to be infected](#) by March 28. This contrasts with the much higher proportions estimated for Stockholm by [Tom Britton](#), a leading Swedish academic working with Folkhälsomyndigheten, who suggests up to [half of the capital's population will be infected](#) by the beginning of May—and the rest of the country may follow suit quickly.

But how can you get such different estimates? As pointed out elsewhere by Britton, many of the models' assumptions, particularly the case fatality rate (the proportion of those infected who die as a result), are uncertain. That's because testing has been focused on cases who are serious enough to end up in hospital and health care workers. But we don't know the number of people who suffer mild or no symptoms—these have to be estimated through simulations.

Because the community spread of SARS-CoV-2 is one of the major X-factors, attention is turning to how this can be measured rather than merely simulated.

Way forward

In the UK and US, the [COVID Symptom Tracker app](#) has provided the public health authorities with valuable data on symptoms and risk factors that provides early warnings of where COVID-19 is likely to hit next, as well as the overall spread of the virus. The app is in the process of being

launched in Sweden.

Combining nationwide self-reported data with directly assessed seroprevalence testing is likely to be a highly effective way of tracking the spread of SARS-CoV-2. One of the most aggressive efforts to achieve this has been underway in Iceland.

A recent report documented [0.6-0.8% of the population infected](#) by April 4, remaining constant during the 20-day screening period—consistent with an effective suppression strategy.

These findings correspond with a case fatality rate of ~0.36% (or about four deaths in every 1,000 infected). This number is remarkably close to the case fatality rate of 0.37% reported recently from a [seroprevalence study in Gangel, Germany](#), and [consistent with studies in Finland](#). It is much lower than the official case fatality rate [of about 13%](#) in the UK, Italy and France, which is well recognized to be a substantial overestimate owing to the very restrictive testing performed in most countries.

Assuming a case fatality rate of ~0.36% and combining this with confirmed COVID-19 deaths in Sweden (2,021 on April 23), one can very crudely estimate the [total number](#) infected through mid-April—by no means a surrogate for expert modeling or direct testing. Nevertheless, this equates to 561,389 infections nationwide (~5.5% of the total population).

Given [more than half the deaths](#) have so far occurred in Stockholm (1,128 as of April 23), yet only ~10% of the population lives there, about a third of the population in Sweden's capital may have been infected by mid-April. This is compatible with the early-May estimates reported for Stockholm by Folkhälsomyndigheten.

However, many deaths from COVID-19 go unnoticed, meaning the number of deaths may be much higher. This would in turn mean that the total number of infections is likely to be higher than estimated using the case fatality rate equation. In some countries, deaths from COVID-19 can be [reported as pneumonia deaths](#). And deaths that happen at home or in care homes, where there has been less testing, [are often not included](#) in official counts—or added much later.

There is also evidence suggesting that the virus started spreading much earlier than first thought. That means thousands of COVID-19 deaths would not have been attributed to COVID-19 (perhaps pneumonia instead). In the US, for example, an autopsy of a patient who died on February 6 confirmed that the virus hit the country [nearly a month earlier than registered](#). Similar evidence has been discovered in Italy.

Meanwhile, research published in *The Lancet* suggests that the true number of COVID-19 deaths in China [would have been four times higher](#) if the definition of a COVID-19 case that was later used had been applied from the outset.

Ultimately, these things matter when we try to estimate how many people have been infected from the number of people who have died. There has been much speculation about how close the UK is to herd immunity, with some arguing that as much as half the population [was infected by mid-March](#). Infection estimates using the case fatality rate equation, however, suggests it is a much lower proportion, but, like Stockholm, that London has shouldered the heaviest burden of infections so far.

It is impossible to know for sure how many people have had COVID-19—in Sweden and most other countries. But if the simulations conducted in Sweden are correct, and post-infection immunity is achieved in most people, we should soon expect infections and deaths in

Stockholm to drop substantially in the coming weeks.

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