

THOUGHTS FROM THE STREET

COVID-19

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Testing, herd immunity and an eventual relaxation of mitigation efforts

After weeks of containment efforts, some governments dip their toes into the uncertain waters of re-opening parts of the economy. What needs to be in place in order to get back to a certain state of normalcy? And how does testing help in this endeavour?

In order to prevent and counter any epidemic, testing is important. It allows for surveillance, diagnosis, isolation, sizing and tracking of the problem. Without reliable and consistent data, fighting an epidemic in a targeted fashion is inherently difficult.

Unfortunately, however, whenever a novel virus makes the rounds, diagnostic tests first need to be developed and then manufactured and distributed at scale. This initial void of tests necessitates rather coarse measures to keep the epidemic at bay until wide-spread testing becomes available. Once testing capabilities catch up, a clearer picture of the epidemiological situation can be obtained and control measures can be assessed with respect to their effectiveness.

A tight testing regime is all the more important when it comes to relaxing control measures in order to monitor the effects of individual relaxation steps on the fragile balance. An early detection of flare ups and consequent isolation and contact tracing are needed to prevent a resurgence of the outbreak.

Testing

There are two basic parameters one can test for: the presence of the virus (so-called PCR tests) or the presence of antibodies against the virus as a result of a person's successful immune response (so-called serology or antibody tests). During acute infection, PCR tests allow for the identification and thus isolation of infected people. Speed and proximity of testing are key attributes in this setting in order to get results as quickly as possible. Otherwise, people will either be released back into society without knowing if they are infectious, or people need to be taken care of as if they had contracted the virus, thereby straining scarce resources in intensive care units (ICUs). Further, high-throughput solutions help to keep pace with the enormous amounts of tests required during the exponential growth phase of new infections. Companies such as Roche, Abbott, Thermo Fisher, Danaher (Cepheid), Becton Dickinson, Hologic, Biomérieux and DiaSorin offer testing solutions with varying throughput capacities and turnaround times. Once the exponential spreading of the virus tapers off and the epidemic reaches a more stable phase, serology tests help to assess the penetrance of infection in society. This is particularly relevant in the case of SARS-CoV-2 since many people might have contracted the virus without even noticing. Furthermore, people who display antibodies against the virus are likely immune to a re-infection for at least several months and can thus safely go back to work. These tests come in the form of lateral flow tests (cf. pregnancy test) or high-throughput systems for central laboratories. Companies developing serology tests include Danaher and DiaSorin, other established manufacturers are likely to follow.

Herd immunity

At this point, it might be useful to introduce the concept of herd immunity or more specifically, the reproduction number (R). R denotes how many people contract the virus from an infected person. Every pathogen has a different R value which is influenced by 1) the rate of contacts in a population, 2) the probability of transmitting an infection and 3) the duration of infectiousness. As long as R is above 1, a disease is spreading. An R below 1 means that the disease is retreating. Herd immunity results from the fact that once-infected people are immune and do not contribute to the spread anymore. Once the percentage of people who are immune reaches a certain threshold (herd immunity), the R falls below 1. Preliminary estimates suggest that SARS-CoV-2 has an R of 2 to 3 (for reference, influenza has an R of roughly 1.5). This means that we need an immunity of 50%-70% within the general population for the epidemic to end ($H = 1 - 1/R$). Vaccines are the most convenient way to achieve herd immunity. However, in the absence of a vaccine, one can try to force R below 1 by simply preventing 50%-70% of transmission chains through measures such as social distancing, increased hygiene and potentially masks (all so-called non-pharmaceutical interventions).

Relaxation of mitigation efforts

As soon as the number of new infections shows a steady decline (a sign that R is below 1) and the occupancy rate of ICU beds is within a manageable range, societies can start thinking about a step-wise re-opening of the economy. As already mentioned, it will be key to have a robust surveillance testing infrastructure in place. Further, social distancing and increased hygiene practices will still be needed, even during a relaxation, in order to keep R below 1. Wearing even simple masks might contribute to a decrease in the likelihood of transmission in public spaces. As time progresses, further relaxation steps can be taken, accompanied by a careful observation of their effects on the rate of new infections. It is thus foreseeable that we as individuals will have to continue to do our part by avoiding unnecessary physical contacts and keeping ourselves and others safe.

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