



Building the Supply Chain for Large-Scale Covid-19 Testing

Widespread Covid-19 testing will be a fact of life for years to come. Scaling up the supply chain requires governments to answer five key questions.

Scaling up access to Covid-19 testing is one of the most serious challenges that the global healthcare supply chain has ever faced. And it is not going away anytime soon.

Testing shortages in many countries were a major contributing factor to the botched early response to the pandemic. **Without an effective vaccine**, proactive and robust testing is the one of the most effective measures for stamping out burgeoning clusters before infection becomes widespread. **According to most predictions**, however, the need for testing is likely to remain high for a long time even after a successful vaccine becomes available. As we head into the winter season in the northern hemisphere, the demand for COVID-19 tests is likely to increase even further. Flu and other respiratory illnesses common in winter produce symptoms similar to Covid and many such suspected cases will also have to be tested.

Low and Middle Income countries (LMIC) stand to be the hardest hit from shortages of testing equipment and supplies. Already, we see that Africa, with over 1.2 billion people, **lags behind** Europe and most of North America in testing capacity. Latin America, facing severe testing shortfalls of its own, was declared the **new epicentre of the global pandemic** over the summer. In June, I co-wrote^[1] a technical note for

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Center for Global Development titled “**India’s Covid-19 Testing Capacity Must Grow by a Factor of 10**”. In the months since, India has experienced **the world’s worst surge in cases** and while testing capacity has **increased considerably**, it is still short of what is needed to reduce the spread of infections and gradually reopen the economy.

What would it take to bring adequate Covid-19 testing to the entire world? It would require much more than greatly increasing production of test kits. There are also five key strategic questions each national government must answer based on the needs and particularities of its own population.

What is the right mix of testing?

There are three distinct types of tests that can be deployed in various combinations: the molecular or PCR (polymerase chain reaction) test, the rapid antigen test (both of which can be performed using a nasal swab or saliva sample), as well as the antibody test (using a finger stick or blood sample).

The PCR test and rapid antigen test are designed to detect active infection – but produce results at very different rates. While the latter is usually completed in a matter of minutes, in its current form the former can take up to a week due to the multi-stage laboratory process and the limited amount of testing

equipment. Naturally, the labour-intensive PCR test translates into a much higher cost compared to the rapid antigen test. But what the PCR test lacks in efficiency and affordability, it makes up for in accuracy. The accuracy of the rapid antigen test, by contrast, has been called into question.

Antibody tests are used to determine whether someone has recently recovered from Covid-19 and may therefore have immunity from further infection for a time. They can also give a general sense of the virus's prevalence in the community which is useful for formulating and evaluating the public health response.

Government agencies, especially in developing countries, must devise the right combination of testing types for their populace, keeping in mind the following factors:

Portfolio diversification: A common narrative we hear is that “We have the testing technology. We simply need to increase our capacity”. This misses the nuance that it is not merely about scaling up one type of testing. Basic portfolio diversification theory tells us that spreading investments around, thereby limiting exposure to any one type of asset, helps mitigate the overall risk. By the same token, diversification is the best lever for managing the different objectives testing programmes must achieve: controlling disease spread; maximising scale, affordability and efficiency of testing; managing individual preferences; and controlling supply chain uncertainty, thereby preventing shortages. Admittedly, diversification creates a supply coordination problem where different types of swabs, reagents and other necessary supplies have to be available synchronously. But with the right information flow and appropriate incentives, this problem could be minor compared to the risks of overly focusing on one type of test.

Accuracy vs. speed: Holding out for the most accurate results (via the PCR test) could backfire horribly if, in the interim, people go about their business and unknowingly infect others. An ideal test is one which can detect the virus as early as possible during infection with extremely high precision (i.e. a miniscule number of false negatives or false positives). However, as we wait for such tests to be available, we face trade-offs between speed and accuracy of tests. **Faster tests with slightly lower precision** make it possible to test large groups of people frequently, including those without any symptoms. Such tests may be extremely useful for essential workers who need to return to their jobs and must be tested frequently. More accurate tests would be required for individuals who are getting tested due to clinical symptoms and may require treatment, or for those planning to travel overseas for work or tourism.

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Each individual's use case (e.g. for return to work screening or clinical diagnosis), payer (employer, government, insurance or self-pay) and geographical location (urban vs. rural) will determine which type of test they seek.

Barring a future technological breakthrough which improves both speed and accuracy while maintaining affordability, policymakers need to focus their efforts on managing a testing market with a variety of tests for different use cases.

Does it pay to invest in pooled testing?

The need to handle and treat samples individually is a large part of what makes Covid-19 testing so challenging. It would be so much simpler if big groups of samples could be analysed at once. It turns out that's not so farfetched: Rwanda, India and a few other countries have begun using a technique called **pooled testing** (routinely used for blood donation screening), which combines samples and tests them together, distinguishing between them only when a positive result is found. The Covid-free majority can thus be passed over quickly, reducing testing time and costs.

The efficiency of pooled testing is believed to decline as positivity rates climb above 10 percent. Nonetheless, we are now discovering that when combined with algorithmic risk assessments that remove randomness from the process, **the right kind of pooled testing** may yet retain advantages even for the more badly affected communities. As the science continues to advance, the potential value of pooled testing will probably grow even further.

Which metric is most important?

Throughout the crisis, the most common measure of quality for national testing regimes has been the testing rate – that is, how many people are tested as a percentage of the population. However, the sample collection is only half the challenge. The other half is delivering timely results. We have seen a vast divergence in waiting times, even between regions or states within the same country.

Looking only at testing rates does not register the often-desperate situation in diagnostic labs, where samples can sit untouched for days waiting for one of too-few testing machines to become free. Adopting average turnaround time (TAT) for receiving results as a key metric provides a more complete picture of a locality's ability to test effectively. The testing rate and TAT should be used as the joint barometer of success.

Do you know your asset and supply inventory?

Currently, many labs run automated or semi-

automated testing platforms which simplify the tasks in PCR analysis and increase safety, quality and reliability. But this also means that the testing kits are not plug-and-play; the test kits, reagents, and/or cartridges must be used in conjunction with a machine from the same manufacturer. There is the potential for supply mismatch, then, if kits are ordered without first considering the composition and distribution of machines already installed. Yet, the agencies responsible for overseeing the procurement of test supplies often do not have complete and systematic information about what machines are in place in various district laboratories. The lack of such information leads to delays in orders of test kits to different manufacturers. This points to the need for asset and supply inventory tracking solutions which are not just for lab companies (i.e. at the firm level) but comprehensively cover national testing assets. Combined with stock and flow information for reagents, kits and supplies, asset and supply tracking would avoid mismatches and ensure that any potential shortages are identified and addressed quickly.

How will the public and private sector work together?

National and regional governments must decide upon an optimal division of labour with private-sector actors. For example, in the technical note on India, we called for the Indian Council for Medical Research to maintain its centralised role in procurement, quality control and strategy-making, but to let private logistics firms manage the ordering and distribution and include more private labs as part of the national testing network. Less public-sector micromanagement would provide both large laboratory chains and emerging-market entrepreneurs more latitude in finding frugal yet innovative ways to sustainably scale up testing.

For the private sector to invest in building additional capacity for testing, new risk sharing and contracting models have to be explored instead of paying private labs on a per test basis. Bringing science and business innovation together gives us the greatest chance of solving the monumental healthcare challenges created by Covid-19.

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[1] Co-authors were Abha Mehndiratta, Kalipso Chalkidou, Sidharth Rupani and Krishna Reddy.

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