Leading the way forward in the era of Covid-19: A white paper from MIT Forefront

In September 2020, six months into the Covid-19 pandemic's devastating impact on the United States, MIT launched a live, online discussion series, MIT Forefront, aimed at finding solutions to urgent global problems. The inaugural session, "Disrupting the Inequalities of Covid-19 in Work and Health Care," included business and policy leaders as well as MIT experts in economics and medicine.

The goal was to bring together leaders from different fields, sparking productive discussions among experts who might not otherwise have the opportunity to talk directly. Together, they examined the inequities in the worlds of work and health care that have been exacerbated by the pandemic and offered ideas and possible solutions.

This first session culminated in a call to action by moderator Eric Schmidt, former CEO and chairman of Google, a Visiting Innovation Fellow at MIT, and cofounder of Schmidt Futures. Praising MIT's carefully planned reopening of campus as an excellent model, he said, "My fervent hope is that MIT will now establish the principles of best practice and do everything possible to get these adopted throughout the nation."

With this white paper, MIT is answering that call. Part I makes the case for government support of low-cost, accurate Covid-19 testing; all involved in MIT Forefront's September session agreed that it must be a national priority. Part II examines strategies and priorities for getting people safely back to work and relieving some of the economic pain suffered by lower-wage workers. Part III highlights several best practices in halting the exponential growth of Covid-19, and in Part IV, we look to the future, asking how we must prepare for the next pandemic, even as we grapple with this one.

Rapid, low-cost Covid-19 testing: a national priority

Schmidt has been vocal about the need for the government to support rapid testing initiatives as the cornerstone of the plan to reopen businesses and schools. Bruce Walker, MD, founding director of the Ragon Institute of MGH, MIT and Harvard, professor of the practice of medicine at MIT, professor of medicine at Harvard Medical School, and a Howard Hughes Medical Institute Investigator, agreed: "MIT needs to call for Operation Warp Speed for testing."

The Institute is able to test students, faculty, and staff regularly through a partnership with the Broad Institute of MIT and Harvard, which is conducting Covid-19 tests for more than 100 colleges. MIT, along with several other colleges requiring rigorous testing protocols, has reopened without generating a corresponding spike in Covid-19 cases.

Early in the planning for MIT'S reopening, it became clear that space and innovation would be needed to safely conduct frequent, on-campus testing. With a typical MIT approach to problem solving, a team of engineers, architects, medical workers, and facilities experts built a 60-foot trailer that is now the main testing site on campus. Later, MIT converted the Johnson Athletics Center to serve as a self-swab testing site. At the same, time MIT's Information Systems & Technology team was put to the task

of developing a ["Covid Pass" application](#) for smartphones in collaboration with the Institute's academic, research, and administrative organizations, providing rapid notification of test results and reprogramming building access to link to the required testing schedule to enhance compliance of students, faculty and staff.

Testing is expensive, however, and panelists were cognizant that not all institutions can afford such a system at the current cost. As of fall 2020, MIT is conducting thousands of tests a week, and although the Broad Institute processes the tests for colleges and universities for $25 per sample, compared to $100 to $150 per test charged by some private labs, it still represents a huge expense for any institution.

The panel applauded the early response by MIT researchers in recognizing and addressing these testing challenges and then integrating science and engineering to develop innovative technology solutions to major problems. They noted [a promising CRISPR-based diagnostic for Covid-19](#) that can produce results in 30 to 60 minutes with similar accuracy as the standard PCR diagnostics now being used. The new test, known as STOPCovid, has the potential to be made cheaply enough that people could test themselves every day. In [a study appearing in the *New England Journal of Medicine*](#), researchers showed that STOPCovid detected 93% of the positive Covid-19 cases that had been identified by the PCR test.

Walker, who is recognized as an international leader in the study of immune control and evasion in HIV infection, believes that a home setting for testing will be available relatively soon. Speaking at an MIT [Town Hall](#) early in the pandemic, he spoke about the development of at-home tests similar to a pregnancy test that will deliver results in less than half an hour. "There are some extraordinary advances being made at MIT," said Walker. "It's within the foreseeable future that you can get up in the morning and brush your teeth … take a Q-tip and swirl it around your nares [nostrils], stick it in a tube, and have it turn color if you're infected and not turn color if you're not."

Panelists were in agreement that government support is needed to drastically increase testing capacity and speed throughout the United States, and that MIT should take a lead in promoting this. "We are behind other countries on low-cost testing and access," said Anantha P. Chandrakasan, dean of MIT's School of Engineering. "It has to be a national priority—if this continues another year or two, some jobs will disappear for good." Here again, technology solutions were seen as key.

Reopening the economy before a vaccine is widely available

MIT Forefront panelists examined the devastating impact of the pandemic on low-wage workers in the United States, a disproportionate number of whom are women and people of color. While there is a constant stream of media reports about the choices of white-collar employees who are now untethered from offices, James Manyika, senior partner at McKinsey & Company and chairperson and director of McKinsey Global Institute, pointed out that remote work is a privilege not available to the majority. "We need to remember that, at most, only a third of us can work from home," said Manyika, who serves on California Governor Gavin Newsom's Task Force on Business and Jobs Recovery. "The other two thirds have to physically show up somewhere to actually do work. So we shouldn't get carried away with the work-from-home idea …. We have to find a way to open up and do it safely."

Ursula Burns, senior advisor of Teneo Ltd., retired chairperson and CEO of both VEON Ltd. and the Xerox Corporation, and a member of the MIT Corporation, advocated for more corporate responsibility. "We have a massive dislocation of employees that companies are not taking

responsibility for," she said. "Businesses in this time have to be more like government and take care of their workers in ways they haven't before. Shareholders will say this isn't what companies are supposed to do. But we're in a situation now where people have no safety net."

The panel discussed the need for workplace and social policies to provide additional or strengthened support, during this challenging time and beyond, such as increased support for childcare and paid family leave. In addition, sending employees safely back to work will require mask wearing, social distancing, frequent testing, contact tracing, and immediate quarantining of those who test positive or exhibit symptoms. Closing businesses and keeping children out of school until a vaccine is widely available is not a solution, the panel agreed, discussing the economic and emotional harm inflicted by public health decisions that were necessary but painful.

"There's got to be a realistic perspective given to people that there's going to be this dialing between lives and livelihoods," said panelist Indra Nooyi, former chairperson and CEO of PepsiCo, co-chair of the Reopen Connecticut Advisory Group, and a member of the MIT Corporation. "It's not lives *or* livelihoods. It's lives *and* livelihoods."

Critical to opening workplaces and easing the economic impact on workers, all agreed once again, will be broad access to low-cost, accurate testing.

Breaking the exponential growth of Covid-19

"Viruses and pandemics are damaging when they become exponential," said MIT Institute Professor and economist Daron Acemoglu. "Infected people infect others. Surveillance, rapid testing, and behavioral responses break that exponential chain; infected people don't pass the infection. There's a best practice here with a behavioral aspect, a mathematical aspect, and an epidemiological aspect." The best practices demonstrated by MIT's recent experience, according to Walker, are "a combination of really robust surveillance with testing and getting everybody to buy into wearing masks and adhering to distancing."

MIT's meticulously planned reopening required [mandatory and frequent testing](#) of everyone on campus, isolation of those who test positive, mandates for mask wearing and social distancing, and detailed [contact tracing](#). Thus far, the reopening has been [very successful](#), with a very low number of Covid-19 cases identified and successful prevention of community spread. Several other universities with similar reopening strategies have also had good outcomes.

Preparing for the next pandemic: MIT's role

MIT is uniquely equipped to play a valuable role in a global pandemic. According to Walker, pandemic preparedness requires:

- Involvement of multiple disciplines to address policy, technology, and medical issues;
- Use of nanotechnology to develop better, more rapid vaccines;
- Global surveillance to identify new pathogens as they evolve and technologies that screen for them; and
- On-site, rapid testing that will almost immediately identify an infected individual.

Additionally, [efforts are already underway](#) to prevent future shortages of personal protective equipment like those experienced in early 2020. Walker recalled that when Covid-19 first hit the United States, regulatory issues slowed down consortia formation by Boston hospitals and universities seeking to join forces in their response. MIT should advocate for regulatory changes that will facilitate such collaboration more quickly in future pandemics.

At the state level, MIT is playing a key role in the [Massachusetts Consortium on Pathogen Readiness](#) (MassCPR), a multi-institutional research collaboration seeking to respond to the current pandemic and better prepare for future outbreaks. MassCPR has engaged hundreds of scientists across 20 Boston-area universities, medical schools, research institutes, and teaching hospitals to elucidate the basic biology of the SARS-CoV-2 virus, develop new diagnostic tools, vaccines, and antiviral therapies, create modeling systems, and provide expertise in disease epidemiology and clinical care.

More broadly, MIT is building a multidisciplinary coalition of the world's leading experts on immunology, epidemiology, infectious diseases, public health, medical supply chain management, public health policy and economics, big data analytics and artificial intelligence, and health care regulation. The group will focus on individual and population immunology, seeking to address the many facets of effective prediction and mitigation of infectious disease spread.

The Institute is uniquely positioned to help build a more pandemic-resilient world through an integrated system of technologies. Technology is key to early diagnosis and ongoing surveillance, development of vaccines and antiviral therapeutics for highly pathogenic viruses, establishment of flexible manufacturing methods to enable rapid, large-scale manufacturing of vaccines and therapies following successful clinical trials, and the design and retrofitting of housing, workplaces, and hospital environments to minimize virus transmission.

Conclusion

At a time like no other in MIT's history, the Covid-19 pandemic has highlighted the unique resources the Institute brings to bear in a world health crisis. "We will get out of this predicament because of science, engineering, and technology," said Walker. "I think that MIT is the ideal place to really lead this effort."