

U.S. Leadership for a Pandemic-Free Future

Technologies to end biological threats

Both [economically](#) and in lives lost, Covid-19 was the worst thing to happen to the United States since the 1918 Flu pandemic, [easily](#) exceeding the death tolls of [World War II](#) and all other [wars](#). And yet, in some ways we were lucky with Covid-19; its close relative [MERS](#) has [over ten times](#) the case fatality rate. It is not a matter of if, but when the next pandemic will occur - either naturally occurring or deliberately caused.

For military technology and materiel, the United States has best-in-the-world R&D, large reserves, and domestic supply chains. But with the 2020 pandemic, we were as flat-footed as we were in 1918. It does not have to be this way. By investing in specific, known technology innovations, the U.S. can regain its claim to international leadership in science and technology, innovation, public health, and national security. Economic competitiveness, resiliency and U.S. based growth will be an inevitable result.

Most importantly, we must ensure this never happens again.

What do we need to do?

Covid-19 will cost the United States over ten *trillion* dollars. For a fraction of that, the U.S. government can invest now in the following game-changing technologies that virtually ensure nothing like it, or worse, will ever happen again. Specific investments across the pandemic prevention, detection, protection, and response architecture will ensure the U.S. changes the pandemic paradigm forever.

The U.S. government should invest now in these game-changing technology priorities

Prevent Outbreaks

- Technologies that deter and prevent bad actors - Advances in machine learning and physical characterization increasingly make it possible to distinguish between natural and engineered DNA. This can facilitate attribution and deter biological weapon development and deployment.
- Comprehensive laboratory biosafety - Continuous innovation in lab safety, as with automobile and airplane safety, will further decrease the probability of catastrophic accidents or malicious exfiltration.

Identify Threats Early

- Ubiquitous (metagenomic) sequencing - Existing technologies, nudged along to develop faster, or along certain pathways, could ensure the cheap, rapid sequencing of all

genetic material collected in a sample. This would allow for the detection of never-before-seen pathogens even in under-resourced locations. If widely deployed, potential pandemic pathogens would be unlikely to take hold in the human population because infections would be identified and isolated early. They would also further provide us with a head start needed to develop countermeasures once something is detected.

- Digital pathogen surveillance - With advances in machine learning it becomes possible to use the filtering of electronic data streams to detect pathogens in the population and in livestock. Early prototypes of these systems have worked well and warrant scaling.
- National pathogen surveillance and forecasting center - If ubiquitous sequencing and digital pathogen surveillance constitute the nervous system, this center would be the brain. It would develop and use models and forecasting techniques to identify threats, and allow us to deploy and prioritize resources and develop countermeasures, all in real time.

Detect Infections Faster

- Point-of-person diagnostics - These are tests that can identify an infection on-the-spot without needing to be sent to a lab. These can provide rapid results allowing for faster isolation and treatment of those infected.
- Non-invasive detection - Technologies are maturing that can non-invasively detect if someone is infected with a pathogen. These would potentially be broad and pathogen-agnostic while identifying asymptomatic individuals.
- Pan-pathogen detection - Most current tests are specific to one pathogen and not useful in the case of a novel pandemic. Tests have been developed that can detect many known pathogens and certain novel pathogens. These will become broader, more effective, and cheaper with investment.

Protect People Better

- Next generation personal protective equipment (PPE) - Barriers and filters are the foundation for protecting against biological threats, especially for frontline researchers and health care professionals. We must invest in more protective and more usable PPE as well as in domestic manufacturing capacity that can scale rapidly.
- Pathogen-proof structures and transport- We are skilled at engineering to mitigate fires and earthquakes, but we have not yet invested in the sterilization and filtration technology to make our buildings pandemic-resistant. This is especially vital in hospitals, nursing homes, and other high-risk spaces.
- Vaccine candidates for prototype pathogens - There are only 25 viruses known to infect humans. Producing vaccines for at least one pathogen in each of these 25 families

would give us a head start the next time a member of one of their families mutates to become a potential pandemic pathogen. Bringing similar vaccines through approvals builds confidence, know-how and regulator precedence for much faster approval. In fact the only way we were able to make SARS-CoV-2 vaccines so quickly is that efforts had been underway to make coronavirus vaccines before the pandemic hit.

Save Lives

- Multi-pathogen therapeutic drugs - Broad-spectrum antivirals developed in advance would be ready to save lives whenever a novel threat emerges (in addition to potentially helping treat endemic infectious disease). In particular, small molecule antivirals are both promising and have lower dual use potential than other possible approaches.
- Flexible and scalable manufacturing of pharmaceuticals - Certain platform technologies can enable faster surge production of vaccines and therapeutics. Research into formulations that would reduce dependence on cold chains for distribution and apply these technologies to the delivery of therapeutics would make them more viable for pandemic response as well as everyday commercial use.
- Needle free methods for drug and vaccine administration - Patches, nasal sprays, and orally delivered vaccines and medical countermeasures can be self-administered and received through the mail. This makes them faster and easier to distribute (including to anywhere on the planet), cheaper, less dangerous (since people will not be congregating for shots), and more agreeable, especially to people who fear needles. In addition, these methods might allow us to better control dosage.