



Letter from the Director



In 1995, Lincoln Laboratory introduced into its portfolio several programs that applied our expertise in sensors and signal processing to the detection and identification of chemical and biological agents in the environment. Since then, our biology-related efforts have expanded into projects involving systems that not only help protect the environment but also enhance human health and performance. This issue of the *Lincoln Laboratory Journal* highlights recent and ongoing biotechnology work, representing research and development ranging from the creation of systems that sense individuals' physiological and neurological status to the investigation of innovative synthetic biology. These articles represent some of our more mature biotechnology projects; we continue to explore new applications.

As this special issue of the *Lincoln Laboratory Journal* goes to press, many parts of the United States and the world are emerging from stay-at-home guidance that has been one of the first steps to bringing the coronavirus pandemic under control. Reflecting on the human and economic impacts of the pandemic to the nation, we see research and development in biology, biotechnology, and human systems as a critically important part of national and global security. This issue provides a view of our commitment to an area of research and development that is growing in importance to improving the human condition on many fronts.

For the past decade, the infectious disease and public health community has warned the world of an increased risk of pandemics as a result of the growing human population and its encroachment on natural habitats, the interconnectedness of global travel and economies, and climate change expanding new disease vectors. The world is now experiencing the worst pandemic in a hundred years for all these and many other reasons. As we are in the midst of this crisis, we see that advanced technology is playing a key role in the response, from new molecular diagnostics and sophisticated computer modeling to rapid design and development of vaccines. It is clear that many gaps remain in pandemic preparedness and response. New technologies could enable an integrated system that will improve the ability of our nation and the world to effectively respond to potentially more dire future pandemics.

An effective, integrated pandemic response system would focus on four main objectives: surveillance, containment, mitigation, and eradication of the disease. The system's overall goal is to minimize the number of infected people while causing the least amount of disruption to society. This goal is easiest to reach when we can stay ahead of an outbreak, and a system that meets this goal requires several components:



- An improved global early-warning system that finds and characterizes new pathogens,
- Widespread, simple, and affordable diagnostic tests that enable the public health community to find and contain outbreaks,
- Efficient and effective contact tracing,
- Rapid drug repurposing to treat a new disease,
- Rapid new therapeutic and vaccine design, development, testing, manufacturing, and distribution,
- Improved health care system situational awareness that enables efficient resource allocation and patient care,
- Improved epidemiological and economic modeling to predict the costs and benefits of intervention policy options,
- Methods of understanding and predicting human behavior under various policy scenarios.

To advance the research and development in many of these areas, the Laboratory is planning to establish a new Biotechnology and Human Systems Division in the next couple of months. The Laboratory's long-standing expertise in systems analysis, sensing, and signal processing, and its more recent experience in biotechnology and artificial intelligence (AI) can provide significant contributions to all of the needed components. We have already begun new programs in some of these areas, leveraging AI for rapid drug discovery, automating contact tracing, and improving analysis of the medical system needs. As we look forward to transitioning new technologies to commercial companies and national health protection centers, we hope to support the nation with capabilities to better anticipate and respond to the next pandemic.

A handwritten signature in blue ink that reads "Eric D. Evans".

Eric D. Evans
Director, MIT Lincoln Laboratory