Impact Stories

Preventing the Next Pandemic

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How Rutgers' coordinated response to COVID-19 is informing preparation for future pandemics

The total number of global deaths linked to COVID-19 recently surpassed 4 million, with the United States experiencing the most (15 percent) of any country. While these numbers are staggering, to put them into further context, an estimated 1.5 million children around the world now have lost a parent, grandparent, or other caregiver to a virus they never saw coming. Of course, coronavirus molecules are so small they couldn't see them if they tried.

The devastating toll of COVID-19 has left an indelible mark on everyone, but it has also raised our collective awareness of the many other pandemic dangers lurking beyond the horizon. "The challenge that we, as humans, are facing in the 21st century are novel and persistent infectious diseases that are rising and spreading at alarming rates," says William Gause, director of the Institute for Infectious and Inflammatory Disease. "This is in part because our increased mobility allows the rapid spread of these diseases around the world as we travel by airplane and other means. It is also due to our huge and dense populations that can host new pathogens in large numbers, providing a critical mass for their rapid evolution into even more dangerous variants." Case in point, the past two decades have born witness to a series of large-scale viral breakouts: SARS in 2003, swine flu in 2009, Ebola in 2014, Zika in 2016, and COVID-19 in 2019.

Rutgers' strengths in infectious and inflammatory disease research allowed the university to establish itself at the forefront of the COVID-19 pandemic response. Within months of the first reported COVID-19 case, Rutgers researchers produced several groundbreaking tests for the virus, exponentially accelerating the disease's detection. Working across disciplines, Rutgers researchers developed models to better understand SARS-CoV-2, the novel coronavirus that

causes COVID-19, while university medical school partnerships with pharmaceutical companies helped spur the development of vaccines.

Informed by Rutgers' experience addressing COVID-19, David Alland, director of the new **Center for COVID-19 Response and Pandemic Preparedness** (CCRP2), sees a future in which university scientists can proactively respond to viral outbreaks instead of being reactive. That's partly why the center has developed open-source diagnostic tests for Covid-19. "We created these tests as an open-source project because we want to get them out there to detect variants and to develop a flexible system that can be used worldwide," says Alland.

Recognizing that it would be impossible to address the vast array of potential microbial threats individually, the center is formulating strategies to evaluate and respond to outbreaks of all kinds. "It's about what we can learn from responding to this pandemic so we can be better prepared for the next one," Alland says.

Optimizing immune response

One major focus of the CCRP2 involves fundamental research into understanding how a new pathogen interacts with the host immune system for the purpose of developing more effective treatments and vaccines. From there the center leverages clinical and other trial resources to determine the efficacy of novel vaccines and therapeutics. "Developing models for COVID allows us to do immunological studies to better understand how the body fights off this disease and how we can help it better control its immune response to the disease," Alland says.

These models have helped advance novel treatments to control viral replication and harmful inflammation, a core contributor to the lung injury and dysfunction associated with COVID-19. "New treatments for COVID can also provide insights into new treatments for the next virus or bacteria or even fungus that might cause a pandemic," says Gause.

"One of the holy grails of immunology," says Gause, "is coming up with ways of modulating the COVID-19 immune response without compromising the components that lead to resistance and host protection." Of the millions who have already had COVID-19, an estimated 26 percent suffer long-term effects that range from cognitive to cardiovascular disorders. "As with many infectious diseases, a major cause of these disorders is our own immune system malfunctioning. In the response to COVID, our immune systems can become hyperactivated, resulting in damage to our own tissues and organs that lasts long after the virus has been irradicated. New treatments are needed to modulate the immune response so we can control the harmful inflammation without impairing our body's ability to mount an immune response that can destroy the virus."

Working with live viruses

Charged with a mandate to predict and prepare for the emergence of the next deadly virus, the CCRP2 is also developing rapid-response preparedness capabilities to address a broad range of emerging and re-emerging pathogens. "We are fortunate at Rutgers to have four large biocontainment laboratories that can work with the highest threat pathogens," Alland says. "These facilities are quite rare around the world, especially ones of this size, and they allow us to work with dangerous live viruses like SARS-CoV-2, tuberculosis, anthrax, and the plague."

Alland is quick to note that the center has developed a core of experts in Biosafety Level 3 (BSL-3) practices, who can not only work with live viruses but also conduct experiments for other scientists in the biocontainment laboratories. "These experts can help with virology studies, high-threat pathogen research, immunological and diagnostic testing [as well as working] on the actual genetics of viruses and helping with next generation sequencing studies to look at different variants."

In the long term, they can develop models for observational and epidemiological studies to help the center better understand the natural history and transmission of SARS-CoV-2. Significant investment in infrastructure upgrades to the biocontainment laboratories and recruitment of premier faculty with BSL-3 training and expertise in viral pathogenesis and inflammation will increase the center's capacity to finally end the COVID-19 epidemic and prepare for the next one.

Preparing for the next pandemic

“Rutgers has always had a strong focus on infectious disease dating back to Selman Waksman’s discovery of streptomycin,” says Alland. “This has put us in a place where we have the kind of breadth and diversity in our research capabilities that other biomedical universities just don’t have.” And the university’s strengths in medical research means that the CCRP2 team can do testing and conduct therapeutic trials.

This is important, Alland notes, because there are many researchers working on drugs that attack the virus, but only a few are looking at drugs and compounds that can help a human host respond better to COVID-19 and other pathogens. “We don’t like doing things that everyone else does,” says Alland. “We don’t mind doing things that are a little more out there but can have a huge impact on human health.”

Case in point: CCRP2 recently released new diagnostic tests capable of rapidly detecting the new COVID-19 variants. This project is open source, because being able to test on a larger, faster scale will make all the difference when it comes time to face the next viral outbreak.

With the critical mass of outstanding scientists actively engaged in immunology and infectious disease research and incredible resources for conducting that research, the Rutgers CCRP2 team is well positioned to pivot to preventing the next pandemic. “We have a lot of exciting treatments coming up right now in which we’re able to manipulate particular molecules and modulate them to control information,” says Gause. “We’re just at the tip of the iceberg.”