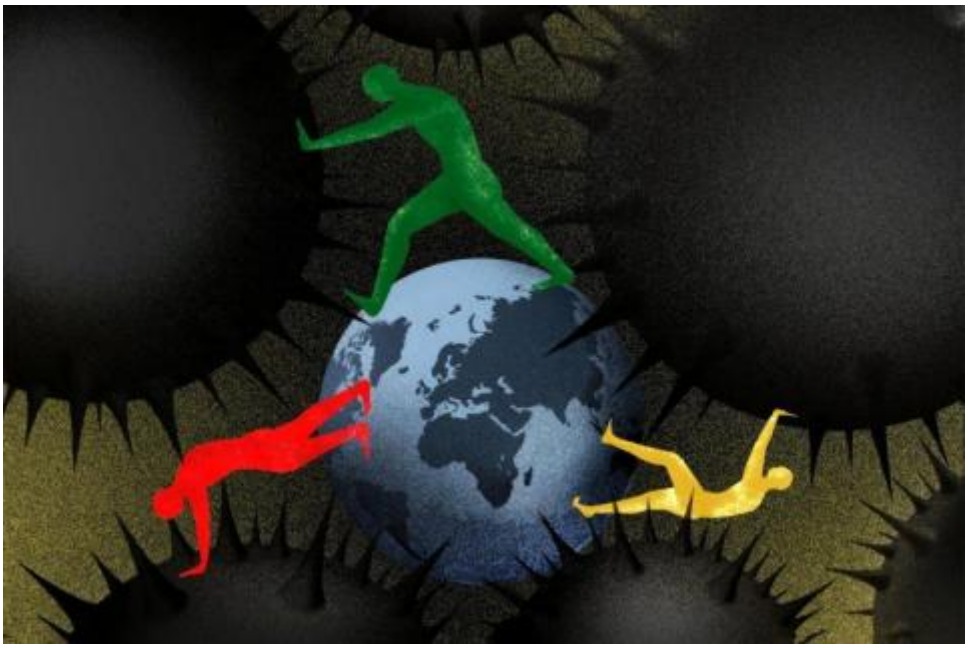
How Can We Thwart the Next Pandemic?



Leading scientists share some of the tools and strategies that could help us better confront and contain future outbreaks.

By Editorial Staff UCSF Magazine Summer 2021

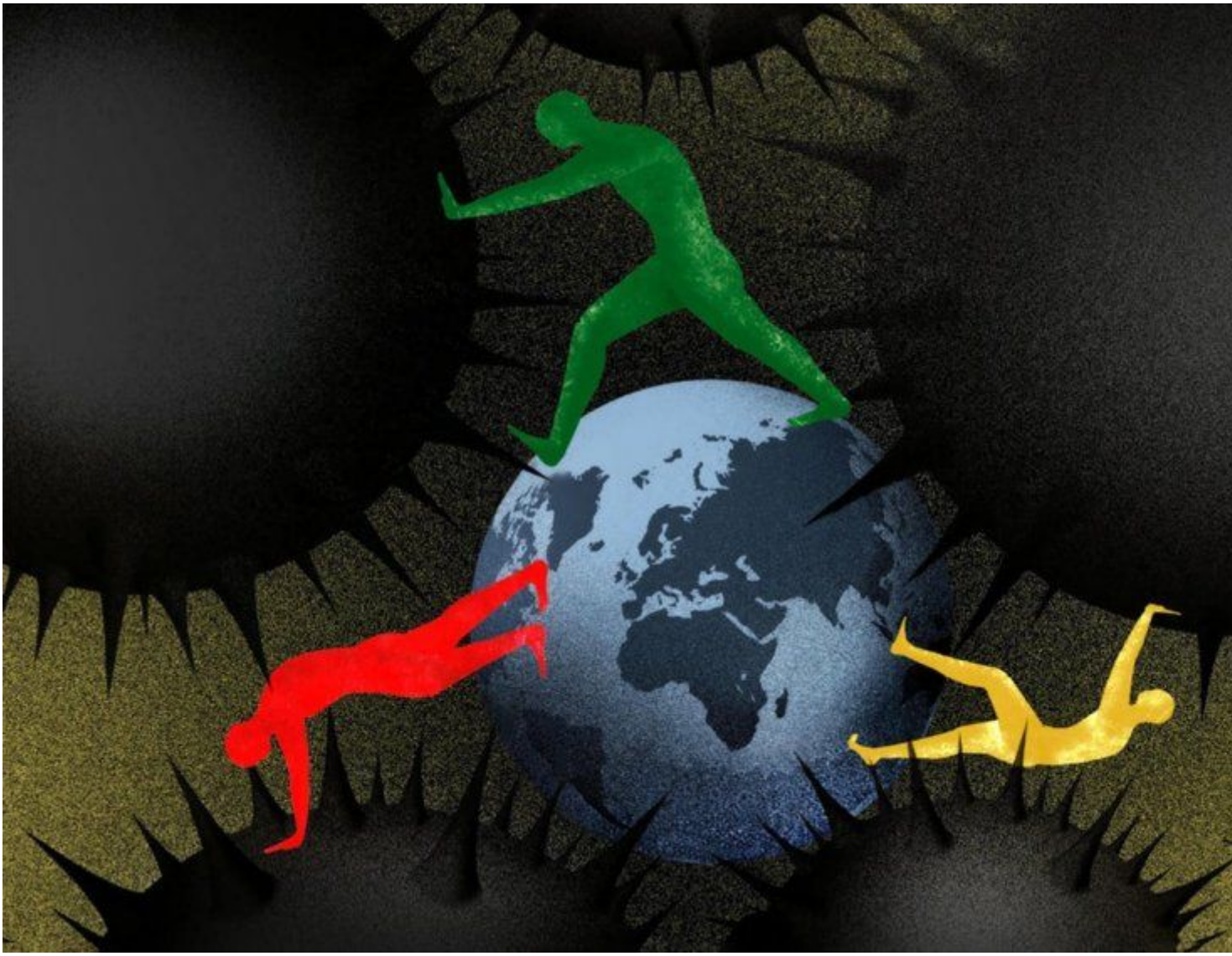


Illustration: Brian Stauffer

Harness the gene-editing tool CRISPR to develop rapid, inexpensive testing

One of the interesting things about CRISPR is that in nature, it works as a surveillance system. It?s a way that bacteria monitor themselves in their environment for viruses in real time and acquire new immunity. I think using CRISPR in a diagnostic capacity for human viruses is very exciting. We now have three different CRISPR-based chemistries that are supporting viral detection. The goal is to develop a simple saliva test that would allow people to monitor their own health ? for example, in their workplace or dormitory. That?s likely to happen.

JENNIFER DOUDNA, PHD

Professor of biochemistry and molecular biology at UC Berkeley, president of the UC Berkeley-UCSF Innovative Genomics Institute, and co-winner of the 2020 Nobel Prize in Chemistry

Keep an eye on coronaviruses

No one has a crystal ball to predict the next big threat, but we need to look back at history. Coronaviruses have been a red flag for some time. I worked on the first SARS pandemic, in 2003. That strongly hinted at the potential of coronaviruses to cause global pandemics, and that bats are a likely source. Then there was MERS, which only reinforced the pandemic potential of this family. Certainly the writing?s on the wall for coronaviruses.

JOE DERISI, PHD

Gordon M. Tomkins Professor and co-president of the Chan Zuckerberg Biohub

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Create early warnings for new viruses

It will be necessary to establish a network of gene sequencing stations around the world. They would report out on new and emerging viruses in real time, especially in low- and middle-income countries, so they can be analyzed by the scientific community as a whole and shared with global public health officials. This is totally within our grasp and is a concept we were working on at the Biohub even before COVID. The larger philosophical and practical question is whether the global community would be willing to pay for it.

JOE DERISI

Hone a vaccine strategy

Vaccines and the immune response are pretty specific. We need to develop a vaccine strategy that can be implemented quickly, but probably not too far in advance. It could be tightly coupled with a surveillance system. Let?s say we see a signal coming from a gene sequencing station somewhere, and we see there?s community spread of this pathogen, probably by respiratory transmission. That should trigger a series of well-planned events so that a vaccine can be designed and implemented even more quickly than it was for SARS-CoV-2.

JOEL ERNST, MD

Professor of medicine and chief of the Division of Experimental Medicine

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Expect airborne transmission

We don?t know what the next viral outbreak is going to be, but we can predict how it?s going to travel: by the airborne route. SARS-CoV-2 is massively successful because it is so readily transmitted. SARS1 and MERS aren?t that efficiently transmitted between human beings. An infection that?s transmitted by the respiratory route is the best way for a pathogen to get

around the world rapidly.

JOEL ERNST

Consider pandemics a security threat

COVID?s threat to society and the economy is on the level of a terrorist or security threat. It?s one that goes across the societal touchstones. Security threats also prompt a different management approach in the White House and the State Department. A decision to put pandemics in a security context brings an entirely different group of people to each meeting. You have the ability to have the military understand and be part of your deployment cache. Designating pandemics a security threat also bumps up the budget and the rapid response capability.

ERIC GOOSBY, MD ?78

Professor of medicine, MacArthur Foundation Professor of Global Health Sciences, and UN Special Envoy on Tuberculosis

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Ditch a one-size-fits-all approach to treating viruses

We learned from COVID that where people are in the disease stage should inform how we treat them. If you want an antiviral to work best, for example, you?ve got to give it to patients as soon as possible after infection and diagnosis. Antivirals may help later in disease, but it is clear they are most impactful when given early. We also need oral antivirals that would facilitate rapid treatment and a true test-and-treat approach, potentially breaking the cycle of transmission. On the flip side, when people become more seriously ill from COVID and require oxygen, this is when they benefit from systemic anti-inflammatories like steroids. If we give these to people who don?t need oxygen, they may cause harm. We had to recognize this isn?t a one-size-fits-all situation.

ANNIE LUETKEMEYER, MD

Professor of medicine and of infectious diseases

Think beyond vaccines

Instead of targeting the virus, what if we could target the machines in our body that the virus hijacks to cause infections? There?s been a large effort both here at UCSF and at many other institutions to map out how SARS-CoV-2 or other viruses commandeer human cells to replicate and cause disease. If there are common systems in our body that many viruses hijack, you could target those systems specifically in an infection. Those would be good solutions for SARS-CoV-2 but also for other viruses. We could have them stockpiled and ready to go for a new pandemic.

One other broad idea is to use laboratory-produced antibodies that neutralize many types of viruses, which we could give to people to target infections. This approach could be effective with the very early stages of infection, or perhaps even as preventives.

AASHISH MANGLIK, MD, PHD

Assistant professor of pharmaceutical chemistry

PLUS: Five Pandemic Silver Linings

Telehealth can be surprisingly intimate

It?s like a home visit, where you can see baby and mom and grandmother, all at the same time. That has helped us build resilience.

DAYNA LONG, MD

Co-director of community health and engagement, UCSF Benioff Children?s Hospitals

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Clinical trials can be launched and run quickly

We?ve seen barriers fall that we?d been trying to break down for years. I don?t think any of it has been shortcutting safety or good science.

JENNIFER DOUDNA

Silicon Valley better understands telehealth

Companies now get that we need digital health devices that you don?t have to be an internet genius to use.

ROBERT WACHTER, MD

Holly Smith Distinguished Professor of Science and Medicine, Lynne and Marc Benioff Professor of Hospital Medicine, and chair of the Department of Medicines

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Technology from the past decade is paying off

It took years to figure out that HIV caused AIDS. With today?s genomic technology, we can sequence and identify the genomes of viruses, even those that are totally novel, in a matter of days.

JOE DERISI

Some intractable diseases could finally fall

Now may be the time to think about applying new vaccine design technologies, like mRNA, to diseases like malaria, tuberculosis, Chagas, syphilis, and many others that have lacked vaccines for so long.

JOE DERISI

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