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MY CRISPR STORY

Building a COVID-19 Pop-Up Testing Lab

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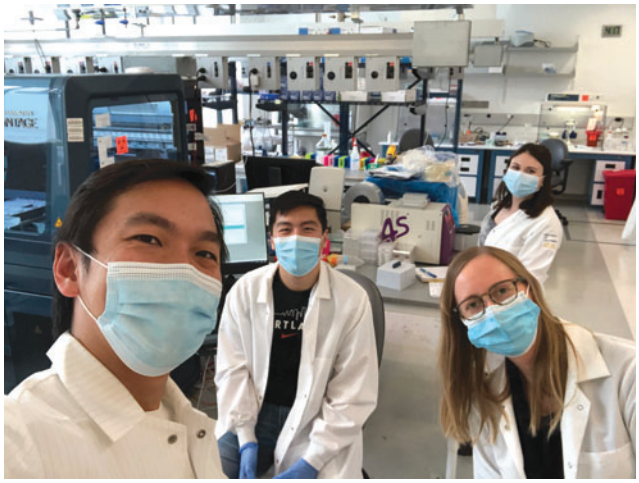

Fig. 1. Selfie of the core technical development team, all members of the Doudna lab. (From left to right): Enrique Lin Shiao, Connor Tsuchida, Abby Stahl, and Jennifer Hamilton. This photo was was taken on a day when no clinical samples were being processed, hence the relaxed PPE. (Credit: E. Lin Shiao)

Two years ago, I joined Jennifer Doudna's laboratory at University of California Berkeley (UCB) as a postdoc with the goal of advancing CRISPR-based gene-editing therapeutics. Having done my PhD training in virology with Peter Palese at Mount Sinai, I was really interested in adapting viral strategies to more effectively deliver CRISPR-Cas9 tools to disease-relevant cells. Midway through my fellowship, however, it turned out my virology background would be needed for an entirely different challenge: setting up a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) diagnostic testing laboratory on the Berkeley campus.

On-campus research in the Doudna laboratory largely ceased on March 17, when the coronavirus disease 2019 (COVID-19) crisis prompted a shelter-in-place order for the Bay Area. Like so many other laboratories across the United States and elsewhere, we shut down experiments, froze our cells in liquid nitrogen, and hoped we would be able to return to our projects before too long.

At that time, only five Berkeley residents had laboratory test-confirmed SARS-CoV-2 infections. The low number was not terribly reassuring, as only 116 people had been tested. During that final week in the lab, I was even wary of touching elevator buttons. The pandemic felt so immediate because we lacked the data to know the true extent of the viral spread, not just in our lab, but in our entire community.

The Innovative Genomics Institute (IGI), a collection of UC San Francisco and UCB laboratories generally focused on advancing the field of genome engineering, was also troubled by the lack of testing in the Bay Area. The same day that the shelter-in-place went into effect, Jennifer invited me to lead the technical development of the IGI's SARS-CoV-2 ''pop-up'' testing laboratory along with my fellow postdoc Enrique Lin Shiao. It felt just like a call to arms; I simply had to say yes.

Along with Doudna laboratory colleagues Connor Tsuchida and Abby Stahl, Enrique and I spent 3 intense weeks optimizing RNA extraction and qPCR to ensure our assay would reliably detect the presence of viral RNA. While we waited for delivery of various ordered reagents and consumables, we would go on late-night scavenger hunts through shuttered research labs, trying to procure the needed assay plates or multichannel pipettes.

In parallel, many other volunteers worked on myriad other requirements necessary for converting a former genomics sequencing core facility into a clinical laboratory—a unique challenge, as UCB lacks a medical school. All of these combined efforts culminated in us being able to process our first clinical COVID-19 specimens in the first week of April.

Filling the Void

At first, our pop-up laboratory filled a testing void that was not being met either on our campus or in the wider community. By partnering with the on-campus University Health Services, we are now providing free testing

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Fig. 2. Scenes from a pop-up laboratory. Doudna postdocs Jennifer Hamilton and Enrique Lin Shiao are co-technical leads of the Innovative Genomics Institute testing lab. (Credit: Max & Jules Photography)

for all symptomatic UCB students and staff with a rapid 24-hour turnaround time to quickly identify and notify positive individuals.

But our campus community does not exist in a bubble. We have also been offering free testing to city of Berkeley and East Bay residents since our first week of operation. Initially, the tests were for first responders, essential workers, and homeless individuals. As our capacity increased, we extended testing to all symptomatic people living in Berkeley.

Recently, we have implemented a fully robotic sample processing pipeline, which increases our capacity to more than 1,000 samples per day. Our goal is not only to get our lab and the university back up and running; we also want to continue prioritizing community partnerships where we can do the most good, and that includes testing as many people as possible. To that end, we've also posted a preprint describing our methods[1] so that other labs around the country can follow or adapt the same playbook.

Our testing laboratory is entirely staffed by volunteer postdoctoral fellows and graduate students. We selected about 30 volunteers from labs across the UCB campus based on their technical experience with RNA extraction, qPCR analysis, and biosafety level 2 training. Like everyone, I feel frustrated to have to put my own research on hold during the pandemic, but we all accept that this is currently the safest option for our research community until we can robustly implement surveillance testing and contact tracing.

If there is an upside to this situation, I would say it's the wonderful camaraderie has blossomed between testing team members—this isn't the science we chose, but we all realize we're using our skills for the good of our community. Returning coronavirus test results to clinicians brings a sense of immediate usefulness and validation that contrasts somewhat from obtaining a nice experimental result in the research laboratory.

When we eventually return to our labs, the testing team volunteers will likely approach our research projects with fresh eyes and the support of new collaborators. While it's ironic that IGI's diagnostic lab is not currently using CRISPR-based detection for SARS-CoV-2—using qPCR allowed us to scale up as quickly as possible—my colleagues are already working toward applying these cutting-edge tools to combat the COVID-19 pandemic. We now know the immense progress a focused and resolute group of scientists can achieve in a short amount of time.

References

1. Innovative Genomics Institute SARS-CoV-2 Testing Consortium, Doudna J. Blueprint for a Pop-up SARS-CoV-2 Testing Lab. *medRxiv*. 2020 April 24. DOI: https://doi.org/10.1101/2020.04.11.20061424.