Building the Data Engine that Makes the University's COVID-19 Saliva Testing Go

To be able to welcome students back to campus safely, the university needed to deploy a testing infrastructure that could process thousands of results a week.

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Testing thousands of students, faculty, and staff for coronavirus? Not an easy feat. Now imagine testing them every two weeks. Teams from across Washington University in St. Louis, including the Institute for Informatics, came together to build and

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scale up a system that has been processing thousands of samples and results since the start of the fall 2020 semester.

Not only was the data infrastructure put in place in a matter of weeks, but the test itself was a breakthrough. Developed by a team from the Department of Genetics and the McDonnell Genome Institute in collaboration with the biotechnology company Fluidigm, it uses saliva samples instead of uncomfortable nasal swabs, and it uses minimal reagents to do it.

The testing process is quick (most people are in and out in about six minutes), and it relies heavily on digital tools. “When students come to the testing center, they use their phones to scan a QR code,” says Albert Lai, PhD, deputy director for I^2. “From there, they log in to document any symptoms, and they get another barcode that’s scanned at the kiosk to ensure their sample is associated with them. They go off into a booth to collect their saliva sample, and then they’re automatically notified if their result is negative. If it’s positive, Student Health follows up with more information.”

The system is streamlined, efficient, and scalable. “The total cost of the physical infrastructure is low,” Lai says. “You just need a laptop and a barcode scanner.” In

fact, it's so successful that it's being used beyond campus. The St. Louis Blues, Maryville University, and the Missouri Department of Mental Health are among the organizations who have put it to use to slow the spread of COVID-19 in the region. The School of Medicine has also received a two-year, $5 million grant to implement and conduct testing at the six special education schools operated by the Special School District of St. Louis County.

'It Was a Big Crazy Hackathon'

Of course, this surveillance testing system didn't exist pre-pandemic. It had to be built and implemented quickly so that students, faculty, and staff could safely return to campus. The team developed the software on the fly with sometimes halfway defined requirements. "It was a big crazy hackathon," Lai says. "While some parts of the system utilize off-the-shelf software, other parts were developed by the team from scratch." Plus, there was the very real work of integrating these different systems so they talked to each other and the data could flow seamlessly to where it needed to be.

Reporting the test results is a big part of the institute's effort. Ian Lackey, senior software

engineer at I^2, worked on the reporting engine that allows reliably fast result notifications to be sent to those tested and Student and Occupation Health Services, and supports highly accurate sample-to-patient matching. “Reporting is something I’ve done most of my career, but not in this context — the context of a pandemic,” Lackey says. “We’re all suffering through this thing, but this was a chance to help. I think it’s important for people to know there are many people working hard to fight this virus in many different ways.”

As the process moved from the pilot program to primetime, the number of reports and the nuances of those reports grew exponentially. “It went from running one query to running 12 queries to now we need to run more than 60 unique reports using various techniques and technologies on differing schedules. So we built the reporting engine in a way that it can do pretty much any task you tell it to do on a scheduled basis.”

This configurable reporting engine is one aspect of the data infrastructure that may have lasting use once the pandemic is over. Another is the relationships that have been developed across the university. “We all came together to get this done — from basic science to pathology to I^2,” Lai says. “Many people I’ve worked with on this project have

felt that it was one of the most important projects they've ever worked on."

By the end of 2020, over 50,000 samples had been processed using the I^2-built software.

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