Making peace with saliva, pooled testing

Karen Titus

November 2020—Adam Barker, PhD, D(ABMM), was ready to call it quits.

For weeks, he had been working to bring saliva-based SARS-CoV-2 testing to ARUP Laboratories and the University of Utah. Dr. Barker, director of ARUP's COVID-19 rapid response lab, and his colleagues had done studies comparing saliva with nasopharyngeal swabs, which seemed to be following the flight of the passenger pigeon out of existence. They had wrestled with the FDA over emergency use authorization. They'd developed their own transport media, since that supply was also becoming extinct.

He had begun building kits for saliva collection and figured out what sample size worked best. Kits had been delivered to collection sites on campus, and staff were being trained in their use.

He was, in other words, creating a laboratory success story, one of the many that have been written since March.

He was not basking in this fact.

"I have to tell you: I lost so much sleep because of saliva," says Dr. Barker, who is also director, ARUP Institute for Clinical and Experimental Pathology, medical director of special microbiology and R&D special operations, and associate professor, Department of Pathology. Despite his lab's incredible investment and the fact that he was an early proponent, he'd had enough—a thought he did not keep to himself.

"I went to the powers that be at my hospital and said, 'Listen, I was the first person who loved saliva. I am working so hard to get this to work. How about we just go back to the old way?'" Dr. Barker recalls. The lab was seeing too many invalids on saliva samples and watching turnaround times increase—perturbing to any administrator. "I thought they would jump on it and say, *Yeah, let's stop*.

"They did the exact opposite."

Which is why Dr. Barker now finds himself running a large-scale, saliva-sample–based SARS-CoV-2 testing operation. The operation launched in early September. By mid-October, when he spoke to CAP TODAY, it was being used at drive-through collection centers throughout the university to test symptomatic patients or those who've been in contact with someone who has tested positive. They also do saliva-based screening for patients admitted to the hospital, as well as inpatients. As a large reference lab, ARUP is also providing kits to its numerous clients.

Dr. Barker's superiors had their reasons for wanting to stick with saliva, including ongoing PPE shortages and an easier collection process. They told him, *Patients like it better, we like it better. It's win-win. Keep going.*

Dr. Kathleen Beavis at the University of Chicago with Scott Matushek, MS, M(ASCP), laboratory manager, microbiology and immunology laboratories. “I really stood on my head to be transparent and mitigate risk,” Dr. Beavis says of the pooled testing that enabled UChicago to test broadly for SARS-CoV-2. [Photo: Jordan Porter-Woodruff]

And so laboratories go, continuing to pursue testing strategies they would have found unfathomable a year ago. Some, like ARUP, are turning to saliva. Others are handling outsized demands by pooling specimens. Choices are being shaped in part by maddening supply shortages outside the lab as well as in, by hospital executives, by media coverage and patient expectations.

The pressures within the lab are equally exhausting. At the University of Chicago, Kathleen Beavis, MD, has implemented pooling. It, too, appears to be a success story, but it’s impossible to ignore the tensions of deciding who needs to be tested and how, says Dr. Beavis, professor, Department of Pathology. When does one risk outweigh another? In a pandemic, with no real acme, can good enough actually be great?

In finding answers, labs will continue to devote hours to bringing up new tests—and, at least in Dr. Barker’s case, listening to leaders explain why sleep will remain elusive for the foreseeable future.

Dr. Barker and his colleagues started taking a more serious look at saliva samples in July, sparked by conversations with colleagues at other institutions as part of an American Board of Medical Microbiology consortium: If they ran out of swabs, everyone wondered, how would they keep testing going? Saliva seemed like a reasonable choice, especially with the promising work being done at Yale and Rutgers universities.

He and colleagues began their own study at Utah. “Supplies were still strained,” he says, “so we just went with what we had,” using empty 50-mL Falcon tubes at their drive-up sample collection sites. “That was basically our clinical trial. We wanted to get our head wrapped around what the numbers really looked like when we compared them to NP swabs.” The trial took about six weeks from start to finish. “Once we looked at the numbers we were quite happy with them,” he says. (Details of their work appeared in the *Journal of Clinical Microbiology*. Hanson KE, et al. 2020;58[11]:e01824-20.)

First of two parts. Next month: Journeys to alternative SARS-CoV-2 strategies

And yet they stopped the project—if only temporarily. Their contact at the FDA told them that if saliva concordance with NP swabs wasn't 95 percent or higher, the lab's EUA would be rejected. The lab's numbers fell just short: 94.6.

Dr. Barker was frustrated and recalls plenty of back and forth with the agency. The other approved method currently in use—nasal swabs—was performing far worse (around 84 percent) compared with the NP swabs.

While he was trying to convince the FDA that saliva was viable, he was, as director of the reagent laboratory, looking into how to build kits. NP swabs weren't the only supply casualty; everyone was running out of media as well. So the lab developed ARUP Transport Media, or ATM.

Dr. Barker

He was also evaluating different collection kits for saliva, calling its use "inevitable" as he watched supplies vanishing. The goal was to find a kit that would not only be easy for clients to use but also simple to make and source, the lab equivalent of a wrap dress. He likewise was in contact with his vendors to determine what tubes might fit on automated systems.

At one point the lab tested 2-mL versus 1-mL tubes. The smaller size wasn't perfect, so they tried the larger tubes at one of the drive-through sites. The switch backfired, cutting the number of daily samples from 200 to 100. "People were taking forever to spit 2 mLs. So we went back and forth—what's the ideal situation," he says, given that nothing is ideal about having patients wait in their cars in long lines to spit into a tube.

Other numbers were much bigger. To maintain a steady stream of kit-making supplies requires about 7,000 funnels a day and 120,000 tubes a week. "And we have to make enough ATM to fill 50,000 tubes a week to keep up with demand."

Once he felt secure about his supply lines, the lab again contacted the FDA, whose own recent updates suggested to ARUP that they would not have to submit an EUA. When the FDA agreed, "That was the day we decided we're going to move forward with saliva."

At the start of September, the lab converted its numerous drive-through collection sites at the University of Utah and its Salt Lake Valley health clinics. The sites collect about 1,500 samples daily. On a Friday night, he says, the lab distributed some 20,000 kits it had made and taught staff how to use them.

Such a testbed "is important for labs to think about," he says, given that saliva is a hard matrix to work with. Indeed, the following day or two, after the lab started getting kits back from the university, "we saw a very high repeat rate that we didn't see in our study."

He blames a few things, mostly linked to the obdurate nature of the sample—saliva is as peevish as a Dickens shopkeeper. Patients were spitting more than the required allotment. "They were going way over the fill line," Dr. Barker says. "And they were not just drooling saliva in, but they were going deeper, almost like sputum." The protocol also asks patients not to eat or drink 30 minutes beforehand, but that wasn't being enforced. It wasn't, says Dr. Barker, a pretty picture. "All sorts of things that you can imagine with saliva."

That required them to dilute the samples according to their validation. The lab had planned for repeats, given the nature of saliva, but the high numbers took them by surprise. Their study suggested they'd encounter a three to

four percent repeat rate; in practice, the number was closer to 15 percent. At 9,000 to 10,000 samples, that high rate was problematic. More training ensued.

But that wasn't the end of the challenges. ARUP runs three platforms: Roche, Hologic, and Thermo Fisher. Each uses a different extraction method, which appears to have affected the repeat rates. Roche performed well, at three percent, so the lab began routing all its saliva samples to that platform. ARUP had that ability to maneuver, managing to add the Roche instrument fairly early; likewise, the newly formed rapid response laboratory is completely Thermo Fisher-based, "because it's really the only platform I could get en masse to get through our 15,000 samples a day."

If he were considering saliva-based testing and lacked these multiple options, "I would not do it," Dr. Barker says bluntly.

He's equally brief when he talks about the keys to managing saliva: "Teaching, dilution, and shuttling it to the right instrument," he says.

Once he had his come-to-Jesus moment with top administrators and realized there was no going back, he estimated that 20 to 30 percent of the kits they give to the university would be saliva. Instead, they've converted 95 percent from NP to saliva. TATs run about 30 hours. "I don't see saliva going away," he says. "I'm just trying to get our repeat rate down."

Dr. Barker has made his peace with saliva and now talks knowledgeably and with some degree of comfort about the matrix that he was once ready to jilt at the altar.

Despite its challenges, saliva has some cheering aspects. Though he's had no time to delve into the ever-changing numbers, he's drawn some early conclusions, based on ARUP's experience. "We think that saliva is very good," he says. "We also think it will capture some cases that NP will miss, and vice versa. But we think they're equivalent as far as sensitivities go."

If the repeat rates can be kept low, he continues, saliva "would be superior for many reasons. It makes automation much easier. I don't have to worry about swabs." At current count, ARUP is receiving 35 different kits, he says. "We're talking every swab known to mankind, in every media." With that overwhelming variety, "It's weird to say, but saliva's the most consistent" element he now works with. "I see spit in the tube, and that's what it is. We know they've collected enough, because they can see the volume. From a lab point of view, that makes it more trustworthy."

The initial collection problems have largely disappeared, Dr. Barker reports. Three weeks into the launch, and with two weeks of clients sending in the saliva samples, things were falling into place. He credits the drop in repeats to the considerable training the lab did, including videos and photos.

His lab's own study confirmed what other studies have shown, he says—that both saliva and the virus are stable. "We saw no degradation at room temperature for five days" with neat saliva, he says.

Nor did they see any degradation when ATM was added. "We did that study because we knew we'd be diluting the patient sample right off the bat," he says. The tubes contain 1 mL of solution, diluting the saliva sample 1:1. Dr. Barker calls that ratio the sweet spot for sensitivity.

Moreover, "We wanted to make sure we didn't see any degradation in the RNA virus," he says. "That sounds like a simple thing, but it isn't."

That was, in fact, the stumbling block to his initial plan—just buy saliva collection kits, which might have gained him back some of those lost hours of sleep. "We were going to," he says. "To be honest with you, we wanted the easy way out—just buy a kit and send it to our clients."

They found, however, that many of the supposed DNA virus-protecting kits on the market contained a detergent,

usually SDS, which degraded the virus. “If I had time to do my science work,” he says, in a familiar pandemic lament, “it’s more than likely that the detergent is ripping apart the lipid wall of the virus and exposing the RNA.” The lab would need to build its own kits, Dr. Barker reluctantly concluded.

The DIY model continues to evolve. The kit uses a funnel adapter to make it easier for patients to deposit their specimen, and early on Dr. Barker was able to secure that supply line. “But at the same time I commissioned a group in California to make a mold for me,” so ARUP could manufacture its own funnels. He anticipated it being ready in October.

Dr. Barker has in a sense taken on the understudy role of manufacturer. His motivation is self-evident: “I don’t trust the supply lines anymore,” he says. With ARUP owning its supply line, “Those molds give us about 150,000 funnels a week. And we won’t have to deal with companies that might run short.”

Contemplating the scene, he continues: “That’s what COVID does. When we get a nice supply line in from a company for one week, the following week it will be wiped out. That’s why we moved off on our own—making our own kits is the only reliable way I can make sure I get about 50,000 to 60,000 of them a week.”

Dr. Barker took his first steps toward saliva in March, when he saw on the news that northern Italy was shutting down. Knowing that Copan’s manufacturing plant was located in the region, “I remember turning to my wife and saying, ‘That’s where we get—where the whole world gets—swabs and media for viruses.’

“And the next day Copan called all of us and said, ‘What you have is all you’re going to get,’” he continues. ARUP’s clients—from all 50 states—started calling soon afterward, asking the lab to send everything it had in turn. The lab keeps about 1 million various kits on hand in its warehouse, which seemed sufficient at first. “But within a week we realized we weren’t going to make it through the month,” Dr. Barker says.

That forced the lab to don its Apollo 11 hats, making the most of what they had. ARUP turned its attention to R&D and diluting its universal transport media supply. “We divided everything by two,” Dr. Barker says. “Within another week we realized that wasn’t going to give us a month—it was probably going to give us two weeks.”

The reagent lab swung into action. “Now I have 45 people who all they do is make kits,” says Dr. Barker, who estimates he’s spent about $2.5 million on hardware and instrumentation, everything from baggers to autofillers to label makers, “just to get our clients enough kits.” Last year the lab made 1.3 million kits, he says; as of mid-October, it had made about 2.5 million. “All that excess is COVID.”

He talks about starting slowly with saliva, but as with everything pandemic related, that’s a relative term. When the executive leaders realized the lab wasn’t keeping up with demand early on, “They turned to me and said, ‘OK, get another 10,000 samples a day in here.’” To get the saliva samples up and running required building that entire lab, doing so in about six weeks. “Which is unheard of,” he says. “We’re hiring 12 to 15 people a week and training them. It’s nonstop.”

It’s a success story, but one Dr. Barker wishes he didn’t have to tell. Such tales can make the testing landscape sound like a high-tech Gilligan’s Island, the medical equivalent of building necessities out of bamboo and parts salvaged from the SS Minnow. Echoing others who’ve called for a national testing strategy, he says, “If we had had a place where we could go and get centralized anything, it would have been better than what we’ve had.” ARUP clients include a number of large universities and hospital systems, “so we realized very quickly that we were competing with our own clients.” The mismatch between supplies and those who could provide testing closer to the patient, with quicker TATs, “failed miserably,” Dr. Barker says.

He now plans to refine the funnel that channels the sample into the collection tube. The saliva tends to cling to the side, he says, and when the funnel is removed, too much sample has been deposited.

He suspects he’s not the only one encountering this problem. So he’s working with an engineering team from the university to study viscosity, with the hopes they can suggest a better funnel or tube that he can then make. He’s also asking them to ponder a design that could strain the saliva as it’s being deposited, to create a faster

throughput in the laboratory. How, he asks, might they better handle cases when people overspit, or when they provide "chunky" saliva (which could be the name of his grunge band should he ever find time to start one). Is there a way to run the test even if the patient has eaten beforehand?

He falls silent for a moment, considering what his job now entails. In these postdiluvian times, all tasks seem different. His background is in mass spec and infectious diseases, specifically TB. "I've given that all up. I never thought I'd be meeting with the engineering department. But I am."

One hiccup—the meeting was delayed by the vice presidential debate that happened on campus, an apt metaphor for how politics and the pandemic have often crossed paths.

For all the success and exhaustion, Dr. Barker has his eye on another target: pooling specimens. He's begun working on protocols, knowing it would be a way to reduce costs. It's critical, he says. The need hits not only close to home, but *in* his home—the day he spoke with CAP TODAY, he was working from home because his daughter's classroom had shut down for COVID-19-related reasons. Not only is there insufficient testing to help keep schools open, he says, but the schools he's spoken with (and likely those he hasn't, he says) lack the money to get testing done.

"This is where the whole field needs to move to," he says. "How do we get more tests for a very low cost?" Up until this point, he says, labs—for all their heroics—have barely been able to keep up with demands. "Actually, we haven't been able to keep up. And we've been reactive up to this point. We need to be on the attack."

Though pooling is considered optimum where prevalence rates are low, Utah's was 13.7 percent when Dr. Barker spoke with CAP TODAY; at the University of Utah, the figure had risen to 18 percent. With higher positivity rates an indication of undertesting, "We're just at the beginning now," he says. His words turned out to be prescient. By the last week in October, positivity rates in the state were still rising, hitting 20 percent one day.

With the increased testing and rise in positive cases in Utah, physicians have been clear in their weekly meetings with the lab, he says: *Yes, we want to stick with saliva—don't switch it out.* That's being driven in part, he says, by concerns about PPE, not to mention the approaching winter—no one relishes the idea of extensive outdoor collection times.

The pandemic has forced labs to move testing well beyond the normal boundaries. Drive-through collection sites have the appearance of the least-fun tailgates ever—parking lots, lines of cars, lots of spitting, but (mostly) without the burgers and beer. "Normally we wouldn't be doing what we're doing," says Dr. Barker, a sentence that every laboratory professional has likely uttered this year.

With the pandemic, "Everything gets called into question," he says. Are the kits worthwhile? Is the media worthwhile? With traditional kits and swabs unavailable, the question becomes, How are we going to get kits back into the laboratory?

That question is the crux of saliva, Dr. Barker says. When he and others began, it was with the assumption that its value lay in the relative ease of automation and collection. "The reality is, our use of saliva is based on nothing more than the fact that the country's labs went through not having kits or swabs." Patient ease was a byproduct, albeit a welcome one. Yes, labs needed (and still need) instruments, reagents, transport media, and pipette tips. But the stark, basic fact facing labs this year has also been this: "We needed samples," Dr. Barker says.

"The lab did what we do and said, *OK, how do we get samples in the lab?* And saliva was what we thought about," he says. "Whether we're right or wrong is going to be debatable." But like a military battle, that's for historians to decide. "Right now, we can live with it."

The ever-present past continues to define, if not downright haunt, the pandemic, as each lab battles—in the face of burnout and fatigue—to solve problems that have dragged on since March.

The past certainly has shaped the responses of Dr. Beavis as she launched a pooled testing program in Chicago,

though her past runs a little longer and extends to China. Dr. Beavis, who is also medical director of the microbiology and immunology laboratories, says her first COVID-19-related email dates to Christmas 2019. A news report she had seen about the disease in Wuhan caught her eye because she had taught in that city five years earlier.

She reached out to her former microbiology colleagues there and heard the sobering facts. “We started preparing my lab January 6,” she says.

Earlier brushes with MERS and SARS had primed her as well, along with the types of training that were more common decades ago. “I went to lots of workshops and seminars about working safely with bioagents in the ’90s,” Dr. Beavis says, “and safety and preparedness training for emerging pathogens really ramped up after 9/11.”

In January and February she worked to reconfigure biosafety cabinets in the laboratory. “We also, back in January, ordered a ton of supplies, anticipating there was going to be a run on them weeks or months later.” Still, she says, “I felt I was pushing the rock up the hill to try to bring attention to this.”

Pooling came to mind early on. She was already familiar with it from her days at the John H. Stroger Jr. Hospital of Cook County, in Chicago, where she performed pooled PCR testing of HIV specimens. “This worked beautifully for HIV,” she says, given the low prevalence rates. “And because we were looking for very high viral loads that are seen in acute infections, we could pool in groups of 16,” with no loss of sensitivity.

Pooled testing for SARS-CoV-2 is less obviously beneficial, given its higher prevalence rates. And because the tests are trying to detect virus that can be present in low amounts, there is a loss of sensitivity.

At UChicago, she uses pools of five, aiming to pool populations with a prevalence of less than two percent. Once the prevalence rises to four percent, she notes, 18 percent of the pools will be positive—and the retesting of the pool’s individual members is labor-intensive and delays reporting. Any institution that uses pooling to expand testing, she says, must discuss risk mitigation and appropriate patient populations.

Risk mitigation might also come into play on a more personal level. Says Dr. Beavis: “I don’t like to miss a diagnosis on anyone. But this summer we were between a rock and a hard place.” (As October drew to a close, that rock and hard place were re-emerging, with infection rates in Chicago and Illinois starting to match the high levels seen in spring.) “Do we limit testing based on symptoms and risk factors? Or do we try to test as many as possible and mitigate the risk of a false-negative?”

Among the many troubles set loose by the pandemic, one has been a sort of mini-existential crisis for laboratories. “If we think about it”—and Dr. Beavis clearly has—“when we limit testing based on symptoms and risk factors, that’s what we’re supposed to be doing as pathologists. But for COVID-19, it just doesn’t make sense.” Because many asymptomatic people without obvious risk factors have the disease and might transmit it, broader testing is needed.

Dr. Beavis’ approach to the pandemic’s push-pull is one she says has served her well over the years. “I look at many challenging situations with the question, *What mistake would I rather make?* Would I rather turn away all patients because I ran out of reagents, or would I rather miss some diagnoses in patients from low-prevalence populations with minimal virus?”

The reagent shortage is what launched UChicago into the pool, so to speak. “But there are costs to pooling, too,” Dr. Beavis says, that need to be balanced within the testing equations. “Even at a two percent positive rate, you’re using tech time to pool the specimens, manage the specimens, and retest the ‘singlets’ if a pool is positive.”

When she began ramping up for SARS-CoV-2 in March, she says, she tried to anticipate the staffing and logistical challenges of doing large-scale testing. “I started to voice my needs loudly and often,” she says with a laugh. “I knew that we could handle the analytical part of testing, but we would not be able to handle the pre- and postanalytical parts without additional assistance.” Specimens would need to be accessioned, tested, and reported to public health authorities—both positive and negative results in this case.

Also on the postanalytical side, Dr. Beavis was told the computer system was capable of reporting individual results from pooled samples into both the electronic medical records and then to the public health department. She stops, laughs, and then utters an oft-repeated pandemic idiom. “This was not true.”

That sent her techs from the microbiology lab scrambling to devise a procedure using barcode scanners and Excel spreadsheets to report individual results from pooled specimens.

Redundancy has also been fraught. Planning for when a system goes down has always been a constant on lab to-do lists, but, says Dr. Beavis, “Pooling makes this an even bigger challenge.” If pooling allows a lab to increase testing on one platform from 200 specimens a day to 1,000, “What’s your backup? If you’re thinking about implementing pooling, you have to talk about backup systems,” she cautions.

One way for her to manage that revolves around TATs. As with online dating, it’s best to keep expectations low. “We promise 48 hours for routine testing, just to be safe,” she says. (Rapid testing is done in three hours; urgent testing, one.) “But in all honesty, our routine testing is coming in at less than 24 hours,” she says, a success that has made managing expectations more difficult. “Our physicians now unfortunately have started to expect same-day results, making us less able to absorb hiccups. When we’ve had problems with our high-throughput instrument, we still met the 48-hour turnaround time, but people had gotten so used to our same-day results, they perceived a 48-hour TAT as a problem. So that’s something we’re still trying to navigate.”

UChicago runs four platforms. Its Thermo Fisher instrument was set to handle pooling for UChicago students and faculty. (“I’ll be honest—I am so glad that University of Chicago doesn’t start fall semester until the beginning of October. That gave us an extra two months to learn from the experiences of others and work out internal kinks,” she says. Just over a week later, the *Chicago Tribune* reported on an outbreak at the university’s business school, which sent more than 100 students into quarantine.) The Roche Cobas 6800 runs high-throughput pooling for all other sites. Rapid testing is done on the BioFire and Cepheid platforms.

Dr. Beavis recommends two other guardrails for pooling: Be transparent and check results reporting.

Dr. Beavis’ lab places a comment on results from pooled samples, stating the decreased sensitivity and the possible need for retesting. It’s also important, she says, to check reports not only in the hospital information system but in the patient portals, to ensure the comments are transferring. She’d rather let people proactively know their results have been pooled, rather than risk having testing somehow appear to be compromised.

She also insisted on clarity during validation. “We approached this very rigorously,” she says. It was important to quantify the risk, “determining how many low-prevalence infections we would miss. That then allowed us to be transparent with physicians ordering the test and patients reviewing results. It also gave us confidence our risk mitigation strategies were appropriate.”

The FDA does not now require labs to attach comments about decreased sensitivity to results, and Dr. Beavis says not all her UChicago colleagues considered it necessary, either. “Questions were raised. But again, I kept arguing for transparency.” The lab also notifies patients whose specimens were pooled to get a repeat test if their symptoms persist or worsen, and makes it clear that a repeat test will not be pooled. “I really stood on my head to be transparent and mitigate risk,” Dr. Beavis says. “It so goes against our grain as pathologists to perform testing with lowered sensitivity.”

Reporting results to the public health department has brought yet another about-face in the lab as well as IT challenges. Most patients’ results are reported through Sunquest and then to Epic, and the information flows automatically to public health. Some outlying clients require an interface, however, which needs to be built for each site. Moreover, public health reporting usually entails providing a list of people who’ve tested positive for, say, an STD. “I’m *not* giving them a list of who’s been tested for STDs,” Dr. Beavis says. But for SARS-CoV-2, “They want a list of the positives and negatives.” That required another reconfiguration.

Patients who need rapid results obviously are not candidates for pooled testing. UChicago is pooling only

outpatients, and ED patients who are unlikely to be admitted. The institution has also expanded testing in conjunction with community partners in the city's South and West side neighborhoods, whose residents previously lacked access to testing. As with its other sites in the city and suburbs, the lab keeps close tabs on prevalence rates.

One way to identify higher-prevalence populations is to focus on asymptomatic versus symptomatic patients, but that's not a simple task, at least at UChicago. "It's a challenge to the computer system, it's a challenge to document—and the micro lab doesn't have control over that," Dr. Beavis says. "We rely on our colleagues collecting specimens to indicate if the specimen is from an asymptomatic patient."

It was easy, however, for the microbiology lab to identify where positive pools were coming from. "So we're also relying on the geographic source of the specimen rather than a patient characteristic."

For all the hurdles successfully leaped, Dr. Beavis' work is far from done. "Right now we can pool because we're testing only for [SARS-CoV-2]," she says. But if influenza prevalence is high, will they still be able to do that if they have to use one test for SARS-CoV-2 as well as flu A/B and possibly RSV? Some manufacturers were discontinuing production of respiratory panels that don't include SARS-CoV-2, she notes. While pooling has enabled UChicago to test broadly for several months, that could be upended during flu season.

If Dr. Beavis knew plenty about pooling before, thanks to her earlier HIV experiences, she knows even more now, she says. "We quickly published our comparison of assays and our experience with serology," she says (Moran A, et al. *J Clin Microbiol.* 2020;58[8]:e00772-20. Beavis KG, et al. *J Clin Virol.* 2020;129:104468). Writing about pooling is taking a little longer, she says, noting that a resident and fellow are writing up the experience. But even a brief pause to consider the lab's progress, she says, "makes me realize how much we've learned since July."

Both she and Dr. Barker consider their forays into saliva and pooling success stories born of another shambolic story that has been unfolding throughout the year. Labs are making do, and doing well at it, until there's time to figure out better, long-term answers. "Creativity has been the story of the last eight months," Dr. Beavis says. But as the year starts coming to a close, telling that story has begun to feel more like wading through a novel.

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