



LAB MATTERS

analysis|answers|action

Spring 2023 Issue 1

The Need for LRN Modernization Through the Lens of an Outbreak

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The Association of Public Health Laboratories (APHL) works to strengthen laboratory systems serving the public's health in the US and globally. APHL's member laboratories protect the public's health by monitoring and detecting infectious and foodborne diseases, environmental contaminants, terrorist agents, genetic disorders in newborns and other diverse health threats.

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Provoking Total Transformation

In this edition of *Lab Matters*, we discuss the Laboratory Response Network as one aspect of how public health laboratories—and public health laboratory science—needs to modernize. But it is about a lot more than just improving infrastructure or having the technology necessary to innovate. It's about transforming and redefining the core function of public health laboratories.

During the COVID-19 pandemic, some of the confusion about public health laboratories arose when we were asked to serve as reference laboratories for high-volume testing for SARS-CoV-2. At that point, it was harder to differentiate between us, hospital laboratories and clinical laboratories. We were all working toward the same goal: provide actionable data to our partners and effect life-saving public health solutions for our communities. At least for Mississippi, that had not been our core function. But we found that, in doing that work, we did it well while keeping in compliance with regulations.

So we are now asking ourselves: who are we and what do we need to focus on? We do not just want to go back to what we were doing three years ago—we have realized that we really have a bigger role to play in the community in helping guide public health decisions moving forward. For example, a hospital in our region reported a new pathogen in patients that had no travel history. After diagnostic testing, additional characterization and collaborating with CDC, we were able to identify an endemic strain of *Burkholderia pseudomallei*. Without those established relationships with the hospital, we would have been much slower in identifying the pathogen and enabling the hospital to provide treatment.

In allowing our communities to guide us during this “transformation” process, we are realizing that we are not just laboratorians, but we are subject matter experts in each of our roles. We are educating ourselves within the laboratory about the technological advances and data modernization initiatives that have come out of the pandemic. We are providing a communications bridge between our federal and local partners. And providing that bridge is a responsibility for everyone in the laboratory—from the director to the administrative staff, we need to embrace what that will look like going forward.

Another component of this transformation is developing our workforce. We are going to have to approach workforce development a little differently and be much more hands-on than in the past. As I have talked about before, having APHL as a resource during the start of my career has been invaluable. Just having a network of colleagues to call on when times get challenging has been one of the greatest resources to me. If we were to all add an APHL component to our onboarding orientations and involve these new colleagues in determining those new or revised core functions of a public health laboratory, we can set the foundations for growth and positive change. Keeping our new staff wanting to learn and wanting to belong to a supportive, collaborative network will be critical.

Transformation happens in many ways—big, small, science-based, people-based. As we continue to find our footing after three years of pandemic response, it is a great opportunity to focus on how to use our new relationships, resources and momentum to change the world in our public health laboratory. ■

“In allowing our communities to guide us during this “transformation” process, we are realizing that we are not just laboratorians, but we are subject matter experts in each of our roles.”



Daphne Ware, PhD
President, APHL

Laying the Groundwork for the Future of APHL

As most of you know, I have been at APHL for a very long time. And the organization has changed a lot since I arrived in the 1990s. But I do not look at that as a weakness. In fact, part of APHL's greatest strength is its ability to change to fit the needs of our members. Our staff have a lot to do with that.

From the moment any new employee arrives, regardless of their position they are welcomed with two days of orientation about the association. And over their first three months, they meet with every senior staff member to learn a little bit more about not only their role in the association, but all the diverse work we do. Prior to the pandemic, we were an in-person office on a single floor in Silver Spring, MD and those orientations were face-to-face. In 2020, all that changed—we went from a few remote staff to all remote staff. We had to adapt our working style very quickly for the health and safety of all our staff. Now, we are an organization of 225 employees all over the world. And the rich perspectives that are brought during our all-staff meetings and conferences has really transformed the energy of our association. While we have always tried to foster a sense of belonging—both to members and staff—the pandemic really brought that to the forefront.

In late January and early February, I traveled to Atlanta for the in-person session of the Laboratory Leaders of Today orientation, then traveled to Cape Town, South Africa for APHL's international staff meeting. During the orientation in Atlanta, we were joined by CDC Director Dr. Rochelle Walensky, who told us, "Public health laboratories are the pointed edge of the spear in the nation's public health emergency responses." While that is a concept that is familiar to us within APHL, it may not be as easy to convey outside of the association. On

one hand, our member laboratories are continuing to do what they do so well; yet they also have so much potential to be change agents in their own communities. Public health laboratory practice is certainly not limited to analysis, surveillance or research. Likewise, as we saw during the pandemic, clinical laboratories have an important role in public health responses. It is going to be hard to fall back on previous behaviors, now that we all know what our colleagues and partners are capable of.

You may have been hearing some updates about the reorganization in CDC. Called CDC Moving Forward, the goal is to strengthen its structure to more swiftly respond to public health challenges facing the nation, while providing clear external communications. Many previously siloed activities are going to be consolidated, answering directly to the Director. APHL has had a seat at the table during those restructuring conversations, with APHL's Dr. Jill Taylor sitting on the Advisory Committee to the Director.

As APHL has transitioned to a "remote friendly" organization, we are also looking at better ways to provide collaborative spaces for our members to meet—not only as committee members coming to our headquarters office for a multi-day meeting, but also rethinking how our annual conferences are presented so they can reach the greatest audience. The energy in public health laboratories is shifting away from crisis response to taking a breath and decompressing—having the space to evaluate where we have been and where we are going is a gift. It's not always easy to rethink how you've been doing things, but now is the time to dust off the cobwebs and forge something new. ■

“It is going to be hard to fall back on previous behaviors, now that we all know what our colleagues and partners are capable of.”



Scott Becker, MS
Chief Executive Officer, APHL

Focus on Fellows: Megan Nelson

By Rudolph Nowak, MPH, senior specialist, Marketing & Communications



Megan Nelson

Megan Nelson read Richard Preston's *The Hot Zone* about the Ebola outbreak in Reston, VA in the late 1980s during her senior year in high school as required reading for her high school English class.

"I thought 'oh, this is a really cool career path'—the whole SIL level 4, being in a full hazmat suit for whatever reason was really enticing to me," Nelson said. She went on to the University of Wisconsin on a pre-med track but decided being patient-facing was not for her. She decided to pursue a bacteriology degree but was still unsure of what she wanted to do.

"I wanted to do something that had an actual impact ... I didn't just want to make money or sell products."

During her senior year of college, Nelson still was unsure of what she wanted to do with her degree. For her master's, she focused on programs that would give her more clinical opportunities. She found a master of science in Microbiology with an emphasis on Clinical Microbiology at the University of Wisconsin, La Crosse. A lot of the courses were cross listed with their Clinical Laboratory Services (CLS) program.

"I had never heard of CLS until I read about this program. I was like, 'what the heck? I could have been doing this the entire time?'"

Nelson went through three different rotations in her master's program: a

hospital clinical laboratory, a research laboratory and a public health laboratory. One of the projects for the public health rotation was duping a comparison study for culturing Carbapenem-resistant Enterobacteriaceae (CREs) from colonization screening swabs.

"The public health one drew me in. That was my first introduction to the Antibiotic Resistance (AR) Lab Network and that opened the world of AR for me."

The director of her graduate program got an email about the APHL-CDC Antibiotic Resistance Fellowship and sent it out to the students.

"This seemed like a really great opportunity, and I still really didn't know how I was going to break into the clinical world even having the master's because I didn't have the certification. I knew I was going to be competing with CLS students who had a year internship and a certification as part of their degree. I felt having a fellowship component would be more beneficial than just trying to break into a clinical setting."

She applied for the fellowship in August of 2019 and was matched to the **State Hygienic Laboratory at the University of Iowa**. The fellowship allowed Nelson the opportunity to break into the clinical setting she desired.

Fellowship During a Pandemic

The COVID-19 pandemic left an impression from her fellowship.

"I remember vividly sitting at my desk at the beginning of January (2020) and there was an article on CNN or something and it was about this virus. I looked at one of my colleagues across the office space and asked if they had read about this. He hadn't and I told him. Three months later we were told that it was the beginnings of a pandemic."

In early April 2020, Nelson's mentor, Microbiology Supervisor Ryan Jepson, was tapped to turn the training laboratory in the basement into a COVID-19 testing section. He asked Nelson to halt her fellowship projects and help with the testing section.

"It was a long, hard process but it was a really great experience. It was long days; there were a lot of validations. We did a 2,000+ sample validation in two weeks. Then we started testing. At the max we were testing like 6,000 samples a day."

In addition to the testing, instrument changes and procedures were constantly changing. Nelson was also handling the scheduling of the testing section and overseeing its accessioning, processing and extraction process.

"My laboratory director (Dr. Michael Pentella) pulled me aside one day in the thick of things and he was like 'I promise, it's not always like this. I promise it's not.'"

Nelson responded "I believe you. I feel like I have gotten 10 years of experience in three and a half."

A position opened in the Microbiology section near the end of Nelson's fellowship. She decided she wanted to stay in Iowa, so she applied for the position and was hired.

Nelson worked as an analyst for one year. Then the environmental microbiology manager retired, and the microbiology supervisor was hired for that position. So, Nelson applied for the microbiology supervisor position and was hired.

"I know there are people who want to have an impact and public health isn't the most direct impact. It's not one patient, one problem. It is a whole community of problems," Nelson said. Her experience as a fellow influenced her to become a mentor.

"Don't be afraid to try it. [Mentoring is] a great way to recruit staff for a laboratory, and get projects and validations done without burning out staff. You get to be a direct, meaningful part of someone's story and watch them be successful. It is also an opportunity to bring new perspectives into the laboratory, which in turn creates opportunities for growth for yourself and your staff." ■



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The Association of Public Health Laboratories (APHL) and the Centers for Disease Control and Prevention (CDC) offer internship, fellowship and leadership programs for those interested in starting or furthering an exciting career in public health laboratory science. These programs offer real-world, hands-on experience while working collaboratively with industry leaders and developing professional networks.



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- APHL's Emerging Leader Program provides laboratory professionals with opportunities to acquire valuable leadership skills, preparing them to advance into managerial and supervisory positions.

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Preparing and Practicing for Chemical Threats in Florida

By **Lylah J. Seaton**, MPH, MLS(ASCP)CM, chemical threat laboratory manager, Florida Bureau of Public Health Laboratories-Jacksonville; **Angela Ren**, MS, chemical threat preparedness coordinator, Florida Bureau of Public Health Laboratories-Tampa; and **Michelle Latona**, MPA, MT, chemist/chemical threat coordinator, Florida Bureau of Public Health Laboratories-Jacksonville

The Florida Bureau of Public Health Laboratories Chemical Threat (CT) group annually hosts the statewide Chemical Threat Exposure Exercise (CTEE), which simulates a widespread chemical exposure event and tests the emergency response plans of Florida hospitals and their ability to receive and treat patients. As part of the exercise, hospitals have an opportunity to practice collecting and shipping specimens to the Jacksonville CT laboratory where they are evaluated by the staff using the Laboratory Response Network's Chemical Specimen Packaging and Shipping Exercise (SPaSE) criteria.

An Annual Undertaking

With the CTEE normally conducted during the last week of February or the first week of March, the initial planning starts in the fall. Participants get an overview of the planned exercise on an initial conference call, including the date of the exercise, location of the chemical release, numbers of patients affected, the chemical agent and the routes of exposure. The information gathered from the call is used for developing documents to be used in the exercise, including an exercise plan, controller-evaluator handbook, exercise evaluation guide, and participant feedback survey. These documents, generated using Homeland Security Exercise and Evaluation Program guidelines, are then emailed to the participants.

Participants meet two more times via conference call. After the second call, a list is compiled of the activities each facility wants to participate in during the exercise. Activities may include phone call drills to the Poison Information Center or testing a facility's incident command system or emergency department patient surge capacity. The facility can select as many activities as they wish to exercise and have the option to create some of their own. Hospitals participating in the SPaSE are sent

email attachments including manifest for specimens, collection flowchart, the "FL Just in Time Training Manual" and an example of the scoring/points for the activity. The final call serves to reiterate the exercise dates/times, make announcements or important reminders, provide a summary of activities occurring and review action items, such as feedback forms. This call will help answer questions the participants have regarding the overall exercise, and also remind everyone to take "action photos" that may be used in future trainings.

Many facilities participating in the specimen collection, packaging and shipping activity also express interest in attending a one-hour chemical threat outreach training that is offered by the Chemical Threat coordinators located in Jacksonville and Tampa. Hospitals and other facilities contact the coordinators to schedule on-site training for their group in order to best prepare for their CTEE SPaSE. This course briefly covers the history of chemical terrorism and details the different types of toxic agents that can be found during a chemical exposure. **APHL's Chemical Agents poster** and real-world examples from the news are used to describe potential threats for the first 30 minutes of the course. The second half is a hands-on demonstration, where the trainer acts as a facilitator, while participants work in groups and follow the manual to properly collect, package and ship both types of clinical specimens. Most of the trainings occur in January and February before the start of CTEE. The trainers also get requests for training throughout the year. For instance, if a facility onboards new staff or if the hospital lab director was not satisfied with their CTEE SPaSE score, they may request additional training.

Preparing to Respond to Mustard Gas

The 2022 CTEE scenario involved the accidental release of sulfur mustard gas when a canister was unearthed during an excavation in a densely populated area with an elementary school, shopping center and elder care facility nearby. In Florida, a cooling mist system is typically employed for the perimeter of a site to keep the construction area cool and reduce dust. In the scenario, this misting system aerosolized the liquid sulfur mustard, which affected a widespread area of the population.

Twenty-six hospitals, two county health departments and three poison information control centers—totaling almost 350 individuals—participated in the exercise. The Jacksonville CT laboratory received and evaluated 16 packages from participating facilities and each one received a scored SPaSE report so they could learn from this experience.

The creators of the CTEE purposely keep the scenario vague, so facilities can enhance their response to the exposure. For example, one hospital added a "shelter in place" component and another facility tested their continuity of operations plan based on the event by closing local roadways.

On the last day of the exercise, there was a conference call where participants shared what worked well and described any problems they experienced. The exercise was very well received with positive feedback from many of the participants. The 2023 CTEE runs February 28 through March 3 and Volatile Organic Compounds (VOC) is the selected chemical agent. The scenario involves jet fuel inhalation and direct skin/eye contact with a rapid onset of symptoms. Hundreds of patients of all ages will begin presenting to "your local hospital" with mild to severe symptoms. ■

Thallium Toxicity: A Case Study in Collaboration

By **Blake R. Elam, MS**, CT supervisor, Nevada State Public Health Laboratory

On the afternoon of June 10, 2022, the Chemical Threat (CT) Department of the **Nevada State Public Health Laboratory (NSPHL)** received a request to analyze specimens from patients suspected of suffering from acute Thallium toxicity. The patients, who reside in Las Vegas, had consumed sweets from India, and their symptoms included hair loss and peripheral nerve pain. After these samples were sent to Quest Diagnostics for analysis and were found by that laboratory to be positive for Thallium, the finding sparked a discussion that would lead to a collaborative effort between NSPHL, the **Southern Nevada Health District**, the **Agency for Toxic Substances and Disease Registry**, the Las Vegas Metropolitan Police Department All-Hazard Regional Multi-Agency Operations and Response Unit and the University of Nevada's Keck Museum. This team effort sought to identify the source of Thallium contamination. Factors of consideration included:

- Sample collection (location, type, technique)
- Chain of custody procedures
- Laboratory analysis of environmental swabs, food samples, teas, soil, plant material and pool water via inductively coupled mass spectrometry (ICP-MS).

The aim of NSPHL's CT group was to quantitatively analyze these samples to ensure the absence of environmental Thallium contamination and to elucidate the sources of patient poisoning.

Laboratory Testing

The NSPHL CT group prepared and analyzed 89 samples for Thallium testing. The matrices of these specimen were varied, and each sample type represented challenges that were overcome using variations of a nitric acid digestion and evaporation preparation method. These prepared samples were then subject to quantitative analysis via ICP-MS using a modified version of the Laboratory Response Network for Chemical Threats (LRN-C) Toxic Element Method. Control



"Barfi" imported sweets chemically tested for Thallium via ICP-MS. Photo: NSPHL

environmental swabs and of various minerals were procured from the Keck Museum. Control food samples were purchased at a local grocery store. All the prepared samples were analyzed in comparison to a prepared calibration curve and QCs on the Perkin Elmer Nexion 350D ICP-MS.

NSPHL also received four patient sample requisitions for Thallium analysis. The sealed package contained two urine samples and two blood samples. The urine samples were prepared and analyzed for Thallium content using the LRN-C standard toxic elements procedure. Since Thallium is cleared from blood very rapidly, the CT group designed a quantitative ICP-MS method that was successful in determining the amount of Thallium contained within the blood samples.

Result Interpretation and Reporting

Of all the food and environment samples received from the Southern Nevada Health District that were collected from inside and outside of the patient family home, only one contained clinically significant amounts of Thallium. The food product known as "Barfi" which had

been consumed by multiple members of the household were contaminated with amounts of Thallium ranging from 10–100 µg. The same Barfi samples were tested via X-ray fluorescence spectroscopy by a participating lab yielded negative analytical results for Thallium. To rule out any possible false positives and obtain a clearer understanding of the complexity of the Barfi matrix, the chemical terrorism group tested the top metallic frosted layer, the bottom unfrosted layer and vertical cross sections of multiple Barfi sweets. Interlaboratory verification of these results were executed by the Commonwealth of Virginia Department of General Services Division of Consolidated Laboratory Services in Richmond who performed a blind study of our samples via ICP-MS.

Final reports of all the testing were delivered to the Southern Nevada Health District and the Las Vegas Metropolitan Police Department. This case demonstrates that multi-agency cooperation and chemical testing by ICP-MS is crucial in the ascertainment of complex poisoning scenarios. ■

Biosurveillance Shows Fentanyl's Role in Rhode Island's Overdose Epidemic

By Louis Marchetti, PhD, TC(NRCC), chief of operations, Rhode Island State Health Laboratories

In 2019, the **Rhode Island Department of Health** (RIDOH) established a state-wide surveillance initiative to better understand the role of opioids in the ongoing overdose epidemic. Through collaborations with local hospital partners, the **Rhode Island State Health Laboratories** (RISHL) implemented biosurveillance as part of the public health surveillance for opioid overdoses. Initially, hospitals were required to submit residual urine specimens from all individuals who received treatment at a hospital emergency department and were believed to have experienced an opioid related overdose event. Urine specimens from 1,354 unique overdose encounters were received and tested by the RISHL over a two-year timeframe and the findings were published in *Addiction*.

Urine specimens were initially chosen due to availability; however, while urine provides great insight into the patient's drug usage history, it is not the ideal specimen to elucidate the agents that gave rise to the overdose event that resulted in the hospital visit. In October 2021, RISHL rolled out the next phase of its biosurveillance efforts.

RISHL has expanded its scope beyond opioids to include stimulant and CNS depressant panels and altered its specimen submission guidance to require residual blood specimens, along with any available preliminary drug screening results, be submitted through this program. In addition to providing valuable insight into Rhode Island's overdose epidemic, these efforts also helped to inform APHL's **Opioid Biosurveillance Taskforce (OBTF)** model strategy.

Methodology

Since the program's inception, RISHL greatly expanded its capacity for confirmatory analyses by tandem mass spectrometry. Rhode Island's opioid panel consists of more than 40 opioids, opiates and metabolites in addition to

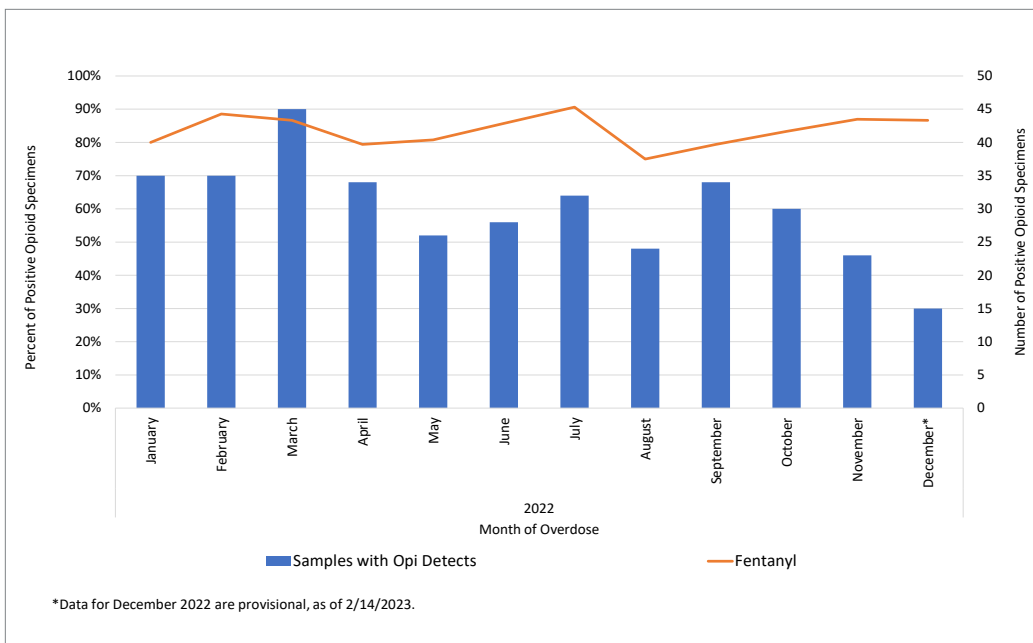


Figure 1: Rhode Island fentanyl trends and opioid positive specimens by month, January-December 2022.

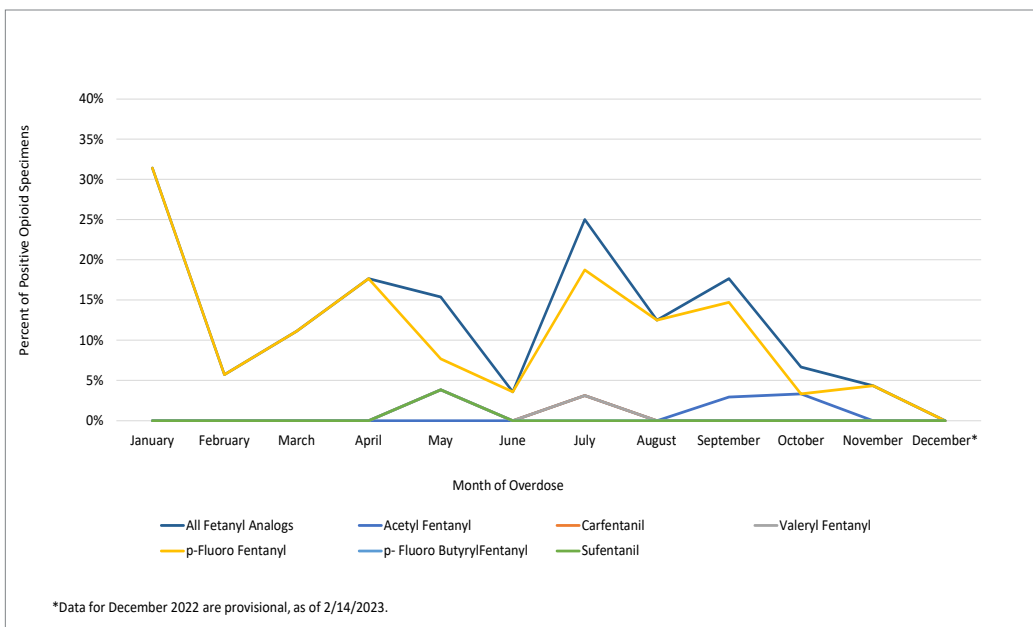


Figure 2: Rhode Island fentanyl analog trends by month, January-December 2022

This work was made possible by the Centers for Disease Control and Prevention through the Overdose Data to Action cooperative agreement. The author also wishes to acknowledge RIDOH Epidemiologist Kristen St. John for assisting in the data aggregation.

an extensive library of fentanyl analogs. Additional testing is directed by available screening data where CNS depressant and stimulant panels may also be leveraged to further elucidate the potential causative agents that gave rise to the overdose encounter.

Snapshot of Rhode Island's 2022 Opioid Analyses

From January to November 2022, RISHL received 469 specimens from suspected opioid-related overdoses representing ~25% of reported nonfatal overdoses statewide. Of these, 361 encounters (76%) were confirmed positive for an analyte within the opioid panel. Preliminary analysis of 2022 data sheds light on the continued contribution of fentanyl and fentanyl analogs in nonfatal overdose events. Of the 361 confirmed opioid related encounters, 272 (78%) were positive for fentanyl, its metabolite norfentanyl or a fentanyl analog (Figure

1). The data are expressed as a percentage derived from total monthly submissions ranging from a high of 89% in February to a low of 75% in August. During this same timeframe, p-fluorofentanyl, an analog first detected in Rhode Island in October 2021, was also observed in 43 (12%) confirmed opioid-related overdoses (Figure 2). Carfentanil, acetylfentanyl, valeryl fentanyl and sufentanil were also observed; however, a statistical breakdown is not described here in keeping with RIDOH's small number policy.

Ongoing Challenges

Since switching specimen types from urine to blood, RISHL has experienced a decrease in specimen submission. While the external impacts of COVID-19 on hospital infrastructure have certainly played a role, this decrease is mostly attributed to blood not being collected as routinely as urine in the hospital

emergency department in addition to hospital partners having a shorter specimen retention policy for blood. Outreach is often required to address submission shortfalls and bridge the loss of institutional knowledge resulting from staff turnover.

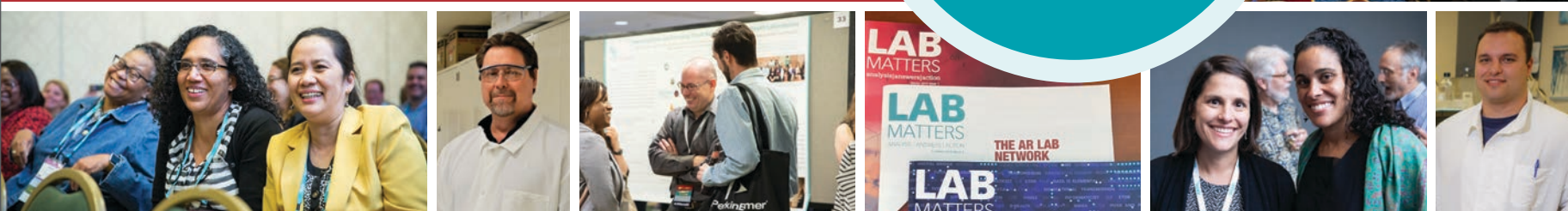
Conclusion

Laboratory-based surveillance of nonfatal overdoses continues to provide many public health and safety benefits. Timely and accurate data pertaining to the nature of circulating opioids have been used to provide the public with health advisories to empower harm reduction efforts and modify risk behaviors. This biomonitoring framework also paves the way for a potential reporting mechanism directly to the individual, which could further enable safe practices or act as a catalyst for seeking addiction treatment.



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APHL eUPDATE

colLABorate

Four Ways to Design Wellness into Public Health Laboratories

By **Mike Mottet**, principal laboratory planner, HDR and **Warren Hendrickson**, public health director, Education & Science, HDR

A laboratorian takes a phone call in stairwell, as it is likely the only quiet, solitary place in the building. A colleague stays at work after hours because inefficiencies in the aging facility are impacting productivity. These are not atypical scenes, particularly in public health laboratories. As employee health and wellness continues to be a priority for the workplace, designers and facility managers of public health laboratories are examining these new expectations and norms to reimagine a healthy, welcoming and productive work environment for staff.

Rethink Old Paradigms

In the past, break rooms were uninviting and utilitarian spaces with hard floors, the hum of the refrigerator and chatter of coworkers providing limited options for how laboratory staff could take a break and recharge. However, recently, design discussions increasingly include conversations about improved space for employees outside of the laboratory environment. Accommodating simple needs such as hoteling workstations and quiet spaces to be alone and relax, or even open wi-fi in designated areas of the building where security requirements allow for it.

Break Up the Break Spaces

Laboratorians benefit from spaces that offer moments of peace in comfortable, quiet areas with warmer lighting and good acoustics. Along with the traditional spaces for employees to collaborate and gather, designs now include spaces for staff to be alone, eat lunch or read a book on their breaks. Design teams have also incorporated fitness spaces, covered and uncovered outdoor spaces and walking paths to increase access to exercise and nature.

In the Maryland Public Health Laboratory designed by HDR, each floor has its own “recharge” area. Though not necessarily a designated break room, these are welcoming, comfortable areas for



Alabama Department of Public Health State Public Health Laboratory in Prattville, Alabama. Photo: HDR

employees to step away from an intense laboratory environment. With recharge areas on each floor, employees can take a quick moment to make a call or read a book before going back to work.

Prioritize Laboratory Efficiency

Inefficient laboratory flow can have a detrimental effect on productivity and, as a result, employee health and wellness. Given the task-oriented nature of their work, creating open, flexible environments that allow laboratory staff to optimize workflow can also create a more productive and enjoyable working day. In touring the Alabama Public Health Laboratory post-completion, HDR’s design team noticed tables uniquely grouped together in an open laboratory. To an outsider, it may have looked chaotic, but staff thrived in the flexible setup because it could be augmented to meet their specific needs and increase their workflow productivity.

Incorporate Visualization Into the Design Process

Design discussions with project partners welcome staff to envision how spaces can, should and could be used. For

example, a conference room for meeting can also host a retirement party, or a huddle area for two to four staffers to collaborate can also be used by one person to make a phone call. HDR takes programmatic needs for spaces and allows users to dream about what else the space could be used for well before construction begins. When staff begins to move into the new facility, they have already visualized how they can use the space in support of their health, wellness and fun.

As sponsors of the APHL Healthiest Laboratory Award, HDR is committed to supporting the health and wellness for public health laboratories. We encourage further discussion about wellness in laboratories, and how vibrant and efficient work and relaxation environments for employees spur discovery and improve testing outcomes for the people of the state. ■

HDR is an APHL Platinum Level Sustaining Member.

Meeting the Challenge for Measuring Trace Levels of PFAS in Water

By **Jenifer Lewis**, senior market development manager, Environmental Markets, Waters

Per- and polyfluorinated alkyl substances (PFAS) are currently one of the most discussed and researched environmental contaminants. Labeled as “forever chemicals,” they are manufactured organic compounds that have been used in a variety of common consumer products, like non-stick cookware, food packaging, stain resistant carpets, waterproof fabrics and very effective firefighting foams. Their widespread use has resulted in deposition into the environment, where they have eventually found their way into public drinking water and food supplies.

Studies of water supplies in the United States have confirmed that PFAS are present in drinking water across the nation and are present in the blood of people and animals all over the world. Current research has linked exposure to PFAS to a range of health effects including an increased risk of certain cancers (prostate, kidney and testicular), suppression of the body's immune system and reduced vaccine response, and reproductive and developmental effects.

In 2022, the **US Environmental Protection Agency (US EPA)** updated their PFAS Health Advisory Limits (HALs) in response to new toxicity research studies. US EPA describes health advisory limits as “concentrations of such drinking water contaminants at which adverse health effects are not anticipated to occur over specific exposure durations, such as one-day, 10-days or a lifetime.” The more toxic chemicals of perfluorooctanic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) have limits set at ultra-low values of 0.004 and 0.02 parts per trillion (ppt) respectively. Considering that 1 ppt is equivalent to 1 drop of water spread out in 20 Olympic size swimming pools, measuring these trace level concentrations can present an analytical challenge.

Liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS), is the ideal analytical solution for delivering high sensitivity and analyte



Waters ACQUITY™ Premier UPLC™ coupled to Xevo™ TQ-Absolute. Photo: Waters

specificity for PFAS. The Waters Xevo™ TQ-Absolute utilizes a new detector technology designed specifically to enhanced sensitivity for challenging negative ionizing compounds, like PFAS. The ACQUITY PREMIER liquid chromatograph incorporates MaxPeak™ surface technology, which provides pre-conditioned fluid paths to reduce analyte to metal interactions, and improve sensitivity and reproducibility.

Sample enrichment using solid phase extraction (SPE) is another tool that can be utilized to enhance the sensitivity of water testing methods like US EPA 537.1 and 533 prior to sample injection. Typically, a 250-fold concentration is achieved by loading a 250 ml sample aliquot onto an extraction cartridge, eluting compounds of interest with solvent, and concentrating to 1 ml or less just prior to analysis.

Background PFAS contamination from routine materials in laboratories must be controlled to meet sub-ppt limits of detection. PFAS are frequently

found at trace levels as impurities in commonly used laboratory items, like polytetrafluoroethylene products (PTFE), solvent lines, aluminum foil, sharpies and methanol.

The combination of the enhanced sensitivity of the Xevo™ TQ Absolute, with SPE sample enrichment techniques, can provide a path for meeting the demand for detection of PFAS at increasingly lower concentrations. LC-MS/MS is an uncomplicated platform that is easy to operate and designed for demanding, trace level, quantitative applications.

To learn more about comprehensive analytical workflow solutions please visit [Waters.com/PFAS](https://www.waters.com/PFAS). To learn more about PFAS reference materials and proficiency testing support please visit [ERAQC.com/PFAS](https://www.eraqc.com/PFAS). ■

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Mpox virus. Photo: istockphoto

The Need for LRN Modernization Through the Lens of an Outbreak

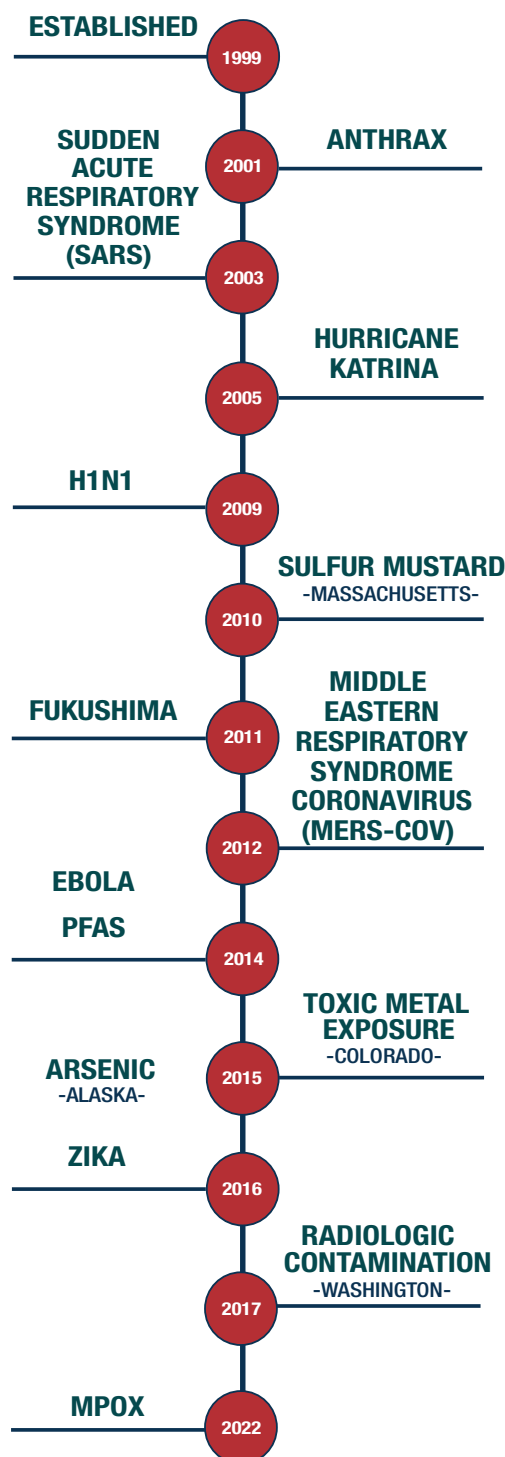
by Melanie Padgett Powers, writer

Jocelyn R. Hauser, PhD, D(ABMM), laboratory director at the **District of Columbia Public Health Laboratory**, was checking email on her phone in her Cleveland hotel room before heading out for the final day of the APHL 2022 Annual Conference. An email caught her attention: an alert from the **US Centers for Disease Control and Prevention (CDC)** about monkeypox, later renamed **mpox**. It was May 20, 2022.

That CDC Health Alert Network advisory reported a confirmed case of mpox in Massachusetts and asked clinicians to be vigilant to the mpox rash.

“Immediately when they sent that out, I was emailing back and forth with my team: Where are we? Do we have all the reagents in case we get something? Do we have the trained people? Just trying to gear up just in case,” Hauser says.

LRN RESPONSE TIMELINE



A week later, Hauser was on a Zoom call with **CDC's Laboratory Response Network (LRN)** when her state epidemiologist emailed her that DC had a suspected mpox case. Another one came in later that night, a few days before Memorial Day.

"It was essentially the holiday weekend that jump-started our response," Hauser says. "From there, it became like a snowball of getting requests and having positive samples within the next two weeks. And then it kept snowballing with more samples."

When mpox hit the United States last year, CDC activated the LRN, allowing for a coordinated response, standardized testing and information-sharing among laboratories. The mpox experience across the US highlighted the power of the LRN, but it also showcased its weaknesses—offering lessons in ways the network must modernize.

"The LRN is an underutilized resource that needs to be reimaged in terms of the world of today—and the world of today is that we're going to have more frequent introductions to infectious diseases," says Jill Taylor, PhD, APHL senior advisor for scientific affairs.

The Creation and Benefits of the LRN

The LRN was established in 1999 by APHL, CDC and the Federal Bureau of Investigation as a network of laboratories that could prepare for and respond to bioterrorism. Today's LRN has two components: the LRN for Chemical Threats Preparedness (LRN-C) and the LRN for Biological Threats Preparedness (LRN-B). The LRN-B uses a tiered structure of thousands of clinical laboratories that serve as sentinels, ruling out and referring threats to reference laboratories. There are approximately 120 reference laboratory members, representing all 50 state public health laboratories plus some local public health, military, veterinary, agriculture, food, water and international laboratories. These reference laboratories detect and characterize biological threats such as anthrax and mpox.

Another tier of the LRN-B is comprised of national laboratories such as those at CDC and Department of Defense. These laboratories perform additional characterization as well as assay development.

The LRN was also created in a world before the 9/11 terrorist attacks, a world without social media and a world with a blossoming internet that ordinary people were still discovering. In 1999, information did not travel so fast—and so widely—as it does in 2023. There have been massive advancements in technology over the past 20 years, along with new epidemics and emerging diseases that stress laboratories' capabilities. The LRN finds itself stretched at times and is ripe for modernization, experts say. But CDC will need to push for and lead that modernization, and it will likely need more money to do so.

The LRN partnership "is paramount to the current response and to future responses," says Scott Hughes, PhD, assistant commissioner and laboratory director of the **New York City Department of Health and Mental Hygiene Public Health Laboratory**. But funding is always an issue, he says.

"Funding spikes with an outbreak and then it goes away," Hughes says. "That's always something that is foremost in our minds—preparing for the next outbreak when there isn't an outbreak. It's very hard to justify that from a funding point of view, but it needs to be done. You need to have a response-ready team."

During the 2022 mpox outbreak, being a part of the LRN meant laboratories could access assays and reagents from CDC and be a part of a constant communication network about how to respond to the outbreak. While mpox is not designated as a Select Agent, it is on the LRN list of tests, mostly to differentiate it from its cousin, the more dangerous and (almost) eradicated smallpox.

"We had the assay already available, and the LRN supplied us with our reagents to do the testing," says Nicole M. Green, PhD, D(ABMM), director of public health laboratories at the **Los Angeles County**



People check in to get a vaccination at a walk-up mpox vaccination site at Barnsdall Art Park in Hollywood, CA. Photo: Brian van der Brug / Los Angeles Times via Getty Images

Department of Public Health. “Then we had a lot of communication with both CDC and APHL almost on a weekly basis in the very beginning, where the network would host these calls and people could call in to ask questions.”

Those LRN meetings with the CDC and other laboratory directors facilitated discussion on how to make testing more efficient, increase capacity and speed up turnaround times. When the outbreak happened, mpox already had an approved test ready for use. However, the test was manual, which slowed down testing especially as suspected cases increased.

“It’s fine when you have one sample, but when you’ve got hundreds of samples ... It was taking our team, for 10 to 20 samples, between an hour and an hour and a half to just put in the results and the data for each sample.”

Jocelyn R. Hauser, PhD, D(ABMM)

“With input from public health laboratories, APHL worked with CDC to look at additional extraction platforms, specifically automated extraction platforms,” says Chris Mangal, MPH, APHL’s director of Public Health Preparedness and Response. “We saw an acceleration in how CDC evaluated automated extraction platforms, submitted performance data to the **US Food and Drug Administration (FDA)** and secured approval for laboratories to use automated extraction. The addition of automated extraction platforms was an important aspect of the mpox response to help laboratories handle testing surge.”

CDC also engaged commercial laboratories that had higher throughput testing, thereby increasing testing capacity.

How the LRN Should Modernize

The connectivity of the LRN helped bring about changes to the mpox outbreak as public health laboratories continued to learn what worked best and shared that information with each other, with CDC and APHL input. But it also illuminated

cracks in the system that experts say need to be addressed for future outbreaks.

Mpox was a known pathogen and already had an approved test in place, albeit a manual one. While initially it had to be tested in a biosafety level-3 (BSL-3) suite—based on how contagious and deadly smallpox is—that was later changed to BSL-2, which opened up testing and personnel capacity. But how will the LRN respond to a larger outbreak, a more contagious and deadlier pathogen or an unknown pathogen? Or now, a very familiar one: **SARS-CoV-2**, the coronavirus that causes COVID-19, which has killed more than 6 million people globally.

One of the first tests of the LRN was the 2001 anthrax attacks, where laboratories not only had to respond initially but had to surge up as they were inundated with samples of all types of white powder that people feared were anthrax. In 2003, the LRN responded to a small outbreak of mpox, then SARS. Later there were ricin and tularemia scares, followed by H1N1 flu in 2009. The LRN was activated in all these outbreaks. Yet the LRN was never activated during the COVID-19 pandemic.



Residents wait in line at a DC Health location administering the mpox vaccine in Washington, DC. The US government declared the mpox outbreak a public health emergency in order to bring awareness and resources to combat the spreading of the virus. Photo: Alex Wong/Getty Images

Mangal says it's difficult to tease out why CDC never activated the LRN during COVID-19, but she points to the bioterrorism aspect of LRN's conception.

"One of the things that we have to keep in mind is with mpox CDC had tests for a broad range of viruses to quickly rule out smallpox viruses so the network was prepared to respond. There are other instances where the LRN has been utilized to respond to emerging infectious diseases that don't fit the profile for biological warfare. We'd like to say that the LRN is utilized for emerging infectious diseases outside of the bioterrorism space, but in reality, it hasn't fully caught up to that expectation."

Taylor adds, "The question becomes, 'What is the LRN's mission?' The LRN was not used during the COVID-19 pandemic in any way. At the individual public health laboratories, LRN staff were used to add surge capability, but they didn't use an LRN test. It wasn't done in LRN laboratories, as such.

"SARS-CoV-2 as a new emerging pathogen was certainly not on the list of tests to

develop," Taylor continues, "but given the capability of the LRN laboratory at CDC to develop tests, one would have thought that they would do it."

The LRN tests also need to be updated, experts agree. Tests need to be automated and available for a variety of high-throughput machines, not from only one or two vendors. Tests should also be multi-targeted. Taylor points out how helpful it would have been to have had one test last fall that could differentiate between SARS-CoV-2, influenza and respiratory syncytial virus.

"But ultimately, we need to be pathogen agnostic, meaning that we have to have a test that will detect an unknown," Taylor says. "And the way to do that at the moment is metagenomic sequencing. Metagenomic sequencing is beyond a research test, but you need quite a bit of capability and informatics capability in laboratories to be able to do it. That needs to become a gold standard test rather than something that's done in a very high capability laboratory."

Last year, as the mpox cases and number of samples increased, CDC brought in commercial laboratories, which had BSL-2 capability. "The mpox outbreak that we just had spread incredibly quickly. The first identification was in Massachusetts, and then all of a sudden it was all over the country, and so high-throughput was needed," Taylor says.

"If public health laboratories had had a test that did have more high-throughput capability, then the public health laboratory could have controlled the level of testing required," Taylor continues. "So the LRN system worked, but it didn't work as effectively as it ought to in this day and age."

One challenge with using the commercial laboratories rather than improving capacity in the public health laboratories was that once the commercial laboratories took on much of the testing, it was difficult to collect public health information.

"There needs to be clarity on how the data coming out of the commercial laboratory is shared back to the public

“I still consider the LRN a jewel in CDC’s crown, but it’s an old jewel, and it has not adapted to the world we live in now. It simply needs to be reset for today and the future.”

Jill Taylor, PhD

health world—and how those specimens are shared with the public health world,” Hughes says. The commercial laboratories may not be keeping specimens and are not necessarily giving the samples to the public health laboratories or CDC to learn more about the disease outbreak through sample culturing or sequencing.

“There is a risk to relying solely on commercial labs for public health-related testing,” Hughes says.

Another LRN bottleneck during the mpox outbreak was the CDC’s LRN Results Messenger (RM) system, which required laboratory staff to manually type in a lot of patient demographic data and a case history in order to report a mpox test result.

“It’s fine when you have one sample, but when you’ve got hundreds of samples ... It was taking our team, for 10 to 20 samples, between an hour and an hour and a half to just put in the results and the data for each sample,” Hauser says.

Her team worked with CDC, which eventually allowed the laboratory to bulk-upload a spreadsheet of all the results, she says. Later, the CDC data team helped the laboratory switch over to electronic messaging and skip the RM portion.

“But for a really long time we were doing both,” Hauser says. “So, I think it’s worth spending the time and the resources to be able to get electronic reporting for these and be able to collect all the information that they would get from RM.”

The reason CDC asks for so much information is valid, Taylor says, allowing the agency to develop case reports, learn more about the disease and put out recommendations. “But in reality,” she says, “it’s more efficient to get the patient

tested, and then when you get a positive result, the epidemiologists follow up with that individual and get the information for a case report.”

Also, she points out, when testing was switched to the commercial laboratories, those facilities were not required to provide as much data with the results.

Use of Whole Genome Sequencing

Los Angeles County began whole genome sequencing (WGS) in July 2022 to learn more about the mpox clade, but when the commercial entities took over, it also had trouble getting samples, Green says.

“The same thing happened with COVID-19—we were the only place in town to get the COVID-19 test and then it went off to the commercial laboratories,” Green says. “And now, because our role has changed ... we don’t have anything to sequence. So now, we have to get the samples back from these laboratories.”

She compares it to a merry-go-round: “It seems kind of inefficient, that’s all.”

As Los Angeles County considered doing WGS on the mpox virus, Green’s staff heard about a laboratory at the Yale University School of Public Health that had developed a sequencing assay but had no samples to test it on. So, Los Angeles County reached out, and the two teams formed a partnership: Yale provided the laboratory with the test—and reagent initially—to evaluate their method with the county’s samples. It worked.

Sequencing in-house meant the laboratory could provide data about the virus to their epidemiologists faster, Green says. The laboratory learned several things from WGS. The team continued to

confirm that the strain in the outbreak was the West African clade, not the deadlier Congo Basin clade. Furthermore, the laboratory detected genome deletions that could affect the accuracy of diagnostic tests.

“What we realized was that the parts of the genome that were missing potentially were areas that certain diagnostic tests were using as targets, meaning that if you had a patient that had a strain that had this deletion, it may not be detected,” she says.

Through WGS, the laboratory also identified mutations in samples that could make those patients resistant to tecovirimat, or TPOXX, which is approved to treat smallpox and is being used to treat mpox under an investigational new drug protocol. Green’s laboratory shared their data with CDC, the National Center for Biotechnology Information and with databases such as GISAID.

The Future of the LRN

While experts agree the LRN needs to be updated, modernization will likely require a different perspective—perhaps a reframing. Mangal believes the LRN needs elevation at the CDC, that more divisions need to consider it as the go-to laboratory response arm.

Taylor agrees: “It’s a preexisting network with highly trained people, with funding that goes up and down (which is a problem), and instead it needs to be the frontline of the response.

“I still consider the LRN a jewel in CDC’s crown,” Taylor continues, “but it’s an old jewel, and it has not adapted to the world we live in now. It simply needs to be reset for today and the future.” ■

APHL and the Laboratory Response Network

By Tyler Wolford, manager, Emergency Preparedness and Response

A robust laboratory network is critical to effectively respond to known and emerging public health threats. To address this need within the United States, the **Laboratory Response Network (LRN)** was founded in 1999 through a collaboration between the **US Centers for Disease Control and Prevention (CDC)**, the **Federal Bureau of Investigation (FBI)** and APHL. Its primary objective was to create a system for responding to biological threats, but today it has expanded to form a network of state and local public health, federal, military and international laboratories capable of responding to biological, chemical, radiological and other public health threats such as emerging infectious diseases. Over the years, the Department of Defense (DoD) has become a key partner in oversight of the LRN. As a founding partner of the LRN, APHL continues to support and advance the LRN through training, quality improvement initiatives, surge capacity and exercise planning, policy development and fostering of partnerships.

Leading Strategy and Communication

Twice a year, APHL facilitates meetings of the LRN Joint Leadership Committee (JLC) to discuss key planning and policy issues surrounding LRN. Established in 2005 as a working group under the APHL Public Health Preparedness and Response (PHPR) Committee, LRN JLC is comprised of leadership from CDC, FBI, APHL and DoD. It provides input and guidance to the LRN on operational and policy issues and assists LRN leadership in developing relevant policy recommendations. In addition, the Committee can advocate for national LRN support and can facilitate compliance of LRN policies. The LRN JLC is vital in leading the LRN and executing strategic priorities for the future of the network.

APHL also serves as a gatekeeper for the **LRN for Biological Threats Preparedness (LRN-B)**, communicating with laboratories regarding membership and routine operations. APHL's responsibilities include monitoring laboratory membership in the network and adherence to membership policies, assisting members with registration and individual access to the LRN secure information hub, communicating with new laboratory directors on laboratory roles and responsibilities, monitoring select agent permits and providing technical support. APHL, in coordination with CDC LRN program staff, offers rapid support through these communication channels to meet the operational needs of the network.

To further support communication, strategy and partnership building, APHL plans and convenes the biennial LRN National Meeting to provide LRN partners with current information on preparedness collaborations and emerging technologies, share model practices, discuss solutions to ongoing challenges, address training needs and explore the future of the LRN.

Advancing Science and Technology

In 2007, APHL established the LRN Operational Workgroup (OPWG), a subcommittee of the PHPR Committee, to improve the quality of products, services and guidance provided by the CDC LRN Program Office to network members of the LRN-B. OPWG provides feedback and makes recommendations to **CDC's Division of Preparedness and Emerging Infections (DPEI)** Laboratory Preparedness and Response Branch (LPRB). These quality improvement initiatives include, but are not limited to:

- Protocol and algorithm revisions
- Assessment of reagents

- Evaluation and onboarding of new assays and technologies
- Challenge panel implementation
- Enhancements to electronic data messaging
- Evaluation of trainings and LRN member satisfaction levels.

OPWG meets virtually on a monthly basis and in-person biannually and serves as an agent of representation, delivering proposals and recommendations as the voice of LRN member laboratories to CDC.

A cornerstone of the LRN-B is its ability to detect biological threat agents rapidly and accurately. To that end, the network is continuously seeking current, most efficient and reliable technologies and assays for its testing needs. APHL, in collaboration with CDC, facilitates method and technology evaluations to verify performance in LRN laboratories, to demonstrate reproducibility and to generate data necessary for assay development studies. This also ensures repeatability of results when systems and test kits are distributed and used within the LRN. As the technology progresses, APHL and CDC continue to collaborate with LRN-B member laboratories on multi-center evaluation studies, training courses and developing guidance for these detection technologies. ■

Texas Laboratory Response Network Members Meet In Person

By Rana Rahmat, specialist, Laboratory Response Network



The Texas Laboratory Response Network meeting in Bandera, TX.

A peaceful ranch in Bandera, Texas, the self-proclaimed “Cowboy Capital of the World,” is not where one expects to attend a scientific meeting. The Mayan Ranch is exactly where state and local public health laboratorians from the Texas network of **Laboratory Response Network (LRN)** laboratories meet on an annual basis. Texas is unique in that it is one of the few states with multiple LRN laboratories. The meeting, organized by the **Texas Department of State Health Services (DSHS)** laboratory in Austin, offers a forum for laboratories to provide updates on current activities, discuss new methods and technologies, network with colleagues, and troubleshoot issues impacting laboratory testing.

The three-day event in December 2022 presented a chance for laboratory personnel to gather in person for the first time since the COVID-19 pandemic began. Participants included LRN laboratory staff from the 10 state and local public health LRN laboratories and partners from

organizations such as the **US Centers for Disease Control and Prevention (CDC)**, **Federal Bureau of Investigation** and **APHL**.

The meeting began with a closed session for Texas LRN laboratory personnel to introduce themselves and to report on activities, trainings and challenges faced during the previous year. The subsequent two days were open sessions that included other partners such as the local Civil Support Team (CST) and APHL. Topics during the open sessions included laboratory renovations at the Texas DSHS, work performed by the **Texas A&M Veterinary Medical Diagnostic Laboratory**, and notable chemical threat cases that occurred during the year. Attendees also had a chance to hear about APHL’s activities in support of the LRN, including a discussion on the future of the LRN and laboratory needs moving forward. The final morning consisted of case studies and lessons learned, as well as an APHL overview of biosafety activities, resources and training opportunities.

Presentations were followed by in-depth discussions among colleagues and included a chance to ask questions about how specific cases were handled, successes, challenges and what could be improved in future responses, and an exchanging of ideas for how laboratories can improve their systems and communications for future responses.

The conference room was not the only place where great discussions took place. Frequent breaks allowed for ample networking opportunities as well as the chance to partake in extracurricular activities such as horseback riding or visiting the many animals that call the ranch home. And good company, great food and a cozy atmosphere in the main building of the ranch allowed attendees to wind down for the day, exchanging stories and forging new relationships. ■

Supporting Polio and Mpox Population Surveillance Through Wastewater Testing

By **Meghan Fuschino**, MS, Viral Diseases director of operations and associate director of Virology, New York State Department of Health; **Mohammed A. Alazawi**, PhD, program research specialist and manager, Wastewater Surveillance Program, New York State Department of Health; **Alejandro Godínez**, MPH, program research specialist, New York State Department of Health; **Daniel C. Lang**, MS, PG, deputy director, Center for Environmental Health, New York State Department of Health; **Milagros Neyra**, MPH, project director, Syracuse University; **Kirsten St. George**, PhD, chief of Viral Diseases and director of Virology, State University of New York at Albany; **Jeff Lahti**, environmental microbiology supervisor, Washington State Department of Health Public Health Laboratories; and **Erin Morin**, MHS, specialist, Environmental Health

Wastewater surveillance proved to be a successful early-warning, population-level, trend detection system during the COVID-19 pandemic. Now, it is developing into a versatile tool for public health as laboratories start to use this testing to monitor for other pathogens of concern.

New York State Department of Health

In July 2022, the **New York State Department of Health (NYSDOH)** and the **Rockland County Department of Health (RCDOH)** were alerted to a confirmed poliomyelitis case in Rockland County.^{1,2} Stored extracts from **SARS-CoV-2** samples collected from March-July 2022 in the treatment plants within neighboring counties of concern were processed and analyzed collaboratively by the **US Centers for Disease Control and Prevention (CDC)**, the **Wadsworth Center** and **Quadrant Biosciences** for poliovirus. Assays were standard enterovirus surveillance real time reverse transcription polymerase chain reaction (RT-PCR) assays, followed by VP1 region sequencing. Among these stored extracts, 24 samples from Rockland, Orange, Kings, Richmond and Sullivan counties tested positive for poliovirus, with 17 samples from Rockland, Orange and Sullivan counties genetically linked to the poliomyelitis case.

These positives justified expanding poliovirus surveillance efforts to each participating site within the counties surrounding Rockland County. NYSDOH and RCDOH also worked together to identify sampling points upstream from select treatment plants and deployed portable autosamplers to locate affected communities within Rockland County.



RCDOH and NYSDOH personnel coordinating the deployment of a portable autosampler for upstream sampling in Rockland County in August 2022. Photo: RCDOH

The public was alerted to the presence of polio in their wastewater and informed about the importance of polio vaccinations.^{3,4} Strategies were then developed to increase polio vaccinations in the communities with persistent poliovirus detection in wastewater, low vaccination rates and increased risk for possible paralytic disease.⁵ Going forward, wastewater monitoring for polio will continue in the aforementioned communities and those with high international travel traffic. Travel paths are not often evident, and some countries use oral polio vaccine, which, although rare, can cause poliomyelitis. As a typically seasonal disease,⁶ detections are expected to decrease significantly during the winter but preparedness for the following spring and summer is

considered an important public health precaution.

Washington State Public Health Laboratories

In October 2022, **Washington State Department of Health (DOH) Public Health Laboratories (PHL)** expanded its SARS-CoV-2 wastewater sampling and testing infrastructure to test for mpox as part of the **Washington Wastewater-Based Epidemiology (WAWBE)** program and DOH mpox response. Under the COVID-19 response, DOH PHL and WAWBE grew a sampling and analysis network of 15 wastewater treatment plants collecting samples twice weekly for SARS-CoV-2 analysis. Using this foundation, DOH leadership and the mpox response team identified wastewater surveillance as a priority mpox surveillance tool in Washington state. DOH PHL used a **Stanford University presence/absence assay** to identify mpox in wastewater. The **KingFisher™ Flex** and **Nanotrap® Microbiome A** particles are used to concentrate the samples and DNA is extracted using the **MagMax™ Viral/Pathogen Nucleic Acid Isolation Kit**. This assay was quickly developed and validated with help from Washington's Laboratory Response Network for Biological Threats (LRN-B) section and by using internal emergency use validation guidelines. The LRN-B section provided access to known positive material to ensure the primers and probes would be able to detect mpox and for use as spiking material for the validation study. A few challenges included a short validation timeline leading to only presence/absence testing and the inability to create a SARS-CoV-2 multiplex. Low

limit of detection levels also forced the laboratory to use contrived samples for validation.

While DOH PHL was developing its testing assay, DOH worked with clinical epidemiologists, health officials, community organizations and CDC to develop communication and vaccination resources to slow mpox's spread. Thanks to those efforts, mpox cases drastically decreased around the same time DOH PHL's presence/absence testing was available. As a result, mpox was not detected in any wastewater samples tested. DOH PHL is continuing to work on developing an assay to quantify mpox and is analyzing stored samples from the peak case-rates to refine mpox wastewater testing sensitivity. Wastewater testing remains a long-term strategy to monitor potential mpox outbreaks and resurgences in Washington state. ■

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Water Reuse in the United States: A Growing Practice with Public Health Implications

By **Hunter Adams**, environmental laboratory supervisor, City of Wichita Falls and **Sarah Wright**, manager, Environmental Laboratories

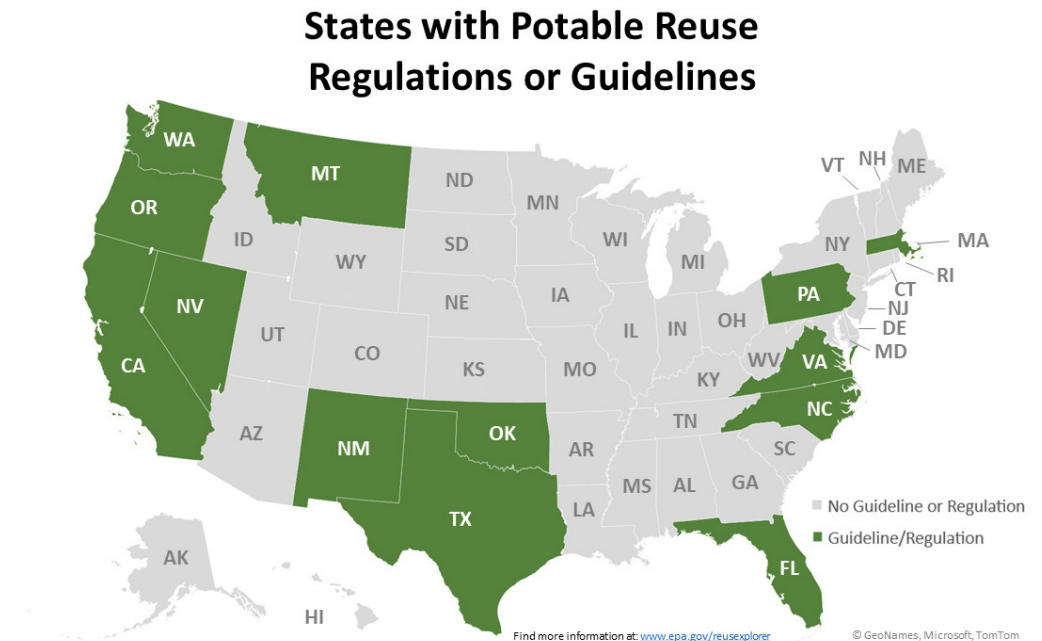
Water reuse can take many forms, including direct potable reuse (DPR, from wastewater straight to drinking water); indirect potable reuse (IPR, from wastewater to surface/groundwater to drinking water) and non-potable reuse (water reused directly from treated wastewater for agricultural and industrial purposes). In contrast to the more traditional process of wastewater effluent being discharged into a waterbody and eventually being treated at a downstream site, IPR is usually more of a closed loop system and the water is reused by the same drinking water/wastewater jurisdiction.

In an effort to combat rising drought conditions and shrinking natural water supplies across the United States, the **US Environmental Protection Agency** (US EPA) developed a **National Water Reuse Action Plan (WRAP)** in 2020. WRAP focuses innovation, funding and research on the nation's water supply with the goal to improve water resilience, security and sustainability through collaboration. In October 2022, a delegation of 42 water reuse experts traveled to Israel to examine their centralized water reuse systems.

A Desert Solution

Existential threats of water scarcity, rising sea levels and climate change have driven Israel's water reuse policies. Since water is one of its most precious resources, every drop of water—even rooftop runoff—is regulated by the Ministry of Environmental Protection with all water rights belonging to the government. Because of this centralized approach, Israel produces nearly 80% of the nation's drinking water supply by desalination, and reuses 85% of their treated wastewater effluent primarily for irrigation and some industrial uses.

The US has currently taken a very different regulatory approach to water



reuse, with US EPA establishing guidance and a support framework through WRAP and states having primacy when it comes to establishing drinking water and wastewater regulations equal to or more protective than SDWA and CWA. But as reuse practices progress, these decentralized state requirements will develop according to regional needs and create a patchwork of regulations. This means that while public health laboratories will not have a clear-cut template for reuse, they can prepare for potential monitoring needs to protect public health.

Planning and Looking Ahead

At a minimum, DPR will continue to follow the Safe Drinking Water Act (SDWA) regulatory framework. Designated **state primacy agencies** enforce SDWA compliance and may add any additional monitoring requirements that they see fit. IPR will follow the Clean Water Act (CWA) regulatory framework, because wastewater effluent intended for reuse enters an environmental buffer (e.g.,

receiving stream or reservoir) before its final use. Once sourced for drinking water, that water will need to comply with SDWA regulations.

However, because reused water has not been acknowledged as a traditional potable water source in the US, there have not been long-term studies conducted on the composition of that water, specifically with contaminants of concern. It is not clear whether reused water, particularly DPR, will have higher or lower concentrations of unregulated contaminants such as per- and polyfluoroalkyl substances (PFAS) and microplastics. A jurisdiction will need to determine if their wastewater and/or their environmental water sources in general have concerning levels of unregulated contaminants to decide whether water reuse can be equally protective of public health.

Monitoring needs could include routine unregulated contaminant testing in drinking water and wastewater. In wastewater, a jurisdiction may benefit from increased testing frequency of

nutrients (e.g., nitrogen and phosphorus) to better predict conditions favorable for harmful algal bloom formation, and inorganics like total dissolved solids to ensure drinking water taste will not be affected. Wastewater process control testing may also increase to ensure quality data, when it is understood that wastewater effluent is now source water for reuse systems..

States are starting to draft policies to help clarify what will be needed to protect public health within their jurisdiction. For example, in Texas, [Senate Bill 905](#) was passed in 2021 to require the Texas Commission on Environmental Quality (TCEQ) to “develop and make available to the public a regulatory guidance manual to explain the TCEQ rules that

apply to direct potable reuse.” This bill passed both chambers without a single dissenting vote. And in 2022, the Colorado Water Quality Control Commission also took unanimous action to add DPR to [Regulation 11](#) of the Colorado Primary Drinking Water Regulations. The Colorado Department of Public Health and the Environment is now creating draft water reuse policies that will have monitoring recommendations.

As the US addresses the growing issue of water scarcity, water reuse will become more widespread and play an important role in national security and stability. If water reuse is being considered in your jurisdiction, public health laboratories have an opportunity to help inform and

develop water reuse testing and practices to ensure public health protection.

If you have questions, please contact Hunter Adams (hunter.adams@wichitafallstx.gov) or Sarah Wright (sarah.wright@aphl.org). ■

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Building Collaboration in Asia Through PulseNet International

By Kristy Kubota, manager, PulseNet

Antimicrobial resistance (AR) accounts for a large proportion of morbidity and mortality worldwide. Global initiatives have been developed to support surveillance and identify emerging drug-resistant strains circulating within regions and globally. Use of genomic tools such as whole genome sequencing (WGS) provides opportunities to conduct surveillance of AR bacteria by detecting emerging strains at the population level, which can impact clinical treatment and contribute to the understanding of how resistance spreads throughout the human, animal and environmental ecosystems.

In 2021, PulseNet International became part of a larger **US Centers for Disease Control and Prevention (CDC)** initiative—the **Global Antimicrobial Resistance Laboratory and Response Network**—focusing on building laboratory capacity for detecting AR within regions encompassing PulseNet International. APHL is one of 26 organizations that received funding to develop systems to respond to the threats posed by the spread of resistant bacteria. As part of this work, APHL received funding in its first year to support PulseNet Asia Pacific with developing capacity for PulseNet WGS workflows, data analysis and data sharing in the region.

New PulseNet Asia Pacific Coordinators

In 2021, Professor Ben Howden's team at the Peter Doherty Institute for Infection and Immunity at the University of Melbourne in Australia became the new PulseNet regional coordinators for the Asia Pacific region due to the retirement of Dr. Kai-Man Kam from the Chinese University of Hong Kong. Professor Howden is the Director of the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL) at the Doherty Institute for Applied Microbial Genomics and Head of the Howden Research Group. Their research interests include translational microbial genomics

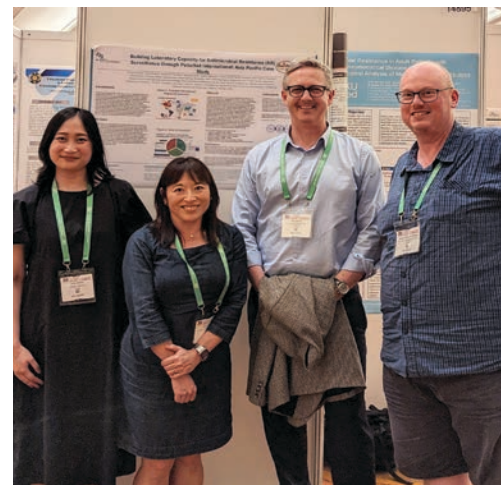
for clinical and public health practice. Additionally, the Centre for Pathogen Genomics at the Doherty Institute was established to support new collaborative opportunities for translational research, genomics-informed infectious disease surveillance and capacity building and training. The Centre's program is focused on four key themes: infectious diseases surveillance and response, antimicrobial resistance, One Health and pandemic preparedness and response. Leveraging the expertise of the applied public health research and surveillance activities at MDU PHL, this new collaboration will provide opportunities to grow PulseNet Asia Pacific activities within the region.

Implementing a New Network

APHL utilized funding through the Global Antimicrobial Resistance Laboratory and Response Network to support PulseNet Asia Pacific laboratories in developing capacity in the region for PulseNet WGS workflows, data analysis and data sharing. APHL launched a feasibility study with public health laboratories within the region to demonstrate PulseNet's surveillance system for both enteric foodborne cluster detection and emerging antimicrobial resistance monitoring. The five public health laboratories selected to participate include:

- Centers for Disease Control, Taiwan
- Research Institute for Tropical Medicine (RITM), Philippines
- Institute for Medical Research (IMR), Malaysia
- National Institute of Health, Thailand
- Centers for Disease Control and Prevention, Thailand
- Institute of Environmental Science and Research (IESR), New Zealand

APHL partnered with Theiagen Genomics to develop a Terra workspace, a web-based application that enables users to access open source bioinformatic workflows through cloud computing



From l to r: MDU PHL Manager Tuyet Hoang, Kristy Kubota, MDU PHL director Professor Ben Howden and MDU PHL Associate Professor Torsten Seemann at the 7th World One Health Congress meeting in Singapore, November 2022

resources. Developed by the Broad Institute at MIT and Harvard University, Terra has been widely implemented by public health laboratories for **SARS-CoV-2** sequence analysis. Bioinformatic workflows were developed in Terra for analysis of enteric bacteria and training was conducted during fall 2022 with the study sites. In-person wet-bench training is planned at the University of Melbourne in February 2023.

Following training, participating laboratories plan to sequence and analyze 100 enteric bacterial isolates as part of this study throughout 2023. It is hoped that this study will demonstrate the utility of WGS methods and use of bioinformatic tools for the identification of AR resistance genes in enteric bacteria. Through data sharing in Terra, laboratories within the Asia Pacific region will be able to collectively monitor and identify AR pathogens circulating within the region. APHL hopes to expand laboratory capacity to other PulseNet International regions including Africa and elsewhere in future years. ■

Liberia Accredits Four Biosafety Cabinet Certifiers

By Palmira Mangae, MPH, senior specialist, Global Health

In 2019, APHL and the **US Center for Disease Control and Prevention's (CDC's) National Public Health Institute Program (NPHI)** focused efforts on establishing a national biosafety cabinet (BSC) certification program for the National Public Health Institute of Liberia (NPHIL). This program was conducted in partnership with Eagleson Institute to provide necessary training and mentorship with the aim of accrediting the participants as BSC Certifiers through the NSF International BSC Field Certifier Basic Accreditation Program.

Four biomedical engineers were selected based on their aptitude for math and mechanical skills. The students participated in formal training courses and mentoring sessions, along with a significant amount of time practicing their newly acquired skills between classes. These courses were a mixture of extensive didactic and practical training between 2019 and 2022 and included:

- Phase I: introduction to BSC certification and correct use of BSCs with a focus on Class II A1 cabinets.
- Phase II: BSC decontamination, repair and troubleshooting.
- Phase III: Phase II Refresher training and validation of the testing equipment.
- Phase IV: Refresher of the entire BSC training phase and accreditation examination preparation.

As part of the training program, APHL purchased testing equipment for the engineers as well as necessary supplies for cabinet testing, repair and decontamination at various stages of the training.

Impact

There is a great need for indigenous, accredited BSC certifiers in Sub-Saharan Africa to handle the growing need for safe operation of BSCs within the



From l to r: Alieu Barry, Amos Tellewoyen, Jame Kollie and Comfort Zowulu work to illustrate understanding on BSC decontamination, repair and troubleshooting

continent. According to the Africa Centers for Disease Control and Prevention's Biosafety & Biosecurity Initiative 2021-2-25 Strategic Plan, certification of BSCs are a major priority area and the training and certification of biosafety and biosecurity experts is a medium-term goal for the African Union states.

As a result of this initiative undertaken by CDC and APHL, in September 2022, all four biomedical engineers took the NSF Basic Accreditation Examination and passed to become fully accredited by NSF to certify BSCs. For Liberia, this is an amazing accomplishment and puts them ahead of the curve with respect to the Africa CDC's strategic plan to address biosafety and biosecurity needs on the continent. Consequently, the accreditation of these engineers can provide Liberia with the needed capacity to test, repair and certify BSCs which can

improve safety and operations in their laboratories nationally.

Challenges

Over the course of the program implementation, there were various logistical and administrative challenges including navigating the impact of the COVID-19 pandemic on the engineer's ability to practice and retain the knowledge and skills they had learned during the phases. These challenges caused the program to run for a much longer period and necessitated the need to repeat multiple course concepts to ensure continuity and retention for the trainees. ■

Sharing Is Caring: Informatics Experts ColLABorate on LIMS

By **Sam Abrams**, senior specialist, Informatics and **Rachel Shepherd**, specialist, Informatics

A laboratory information management system (LIMS) is the beating heart of a laboratory. It is integral to how a laboratory communicates and receives information, connects its various instruments, manages accessioning and workflows, and, in some cases, inventory and billing. With the unprecedented volume of data that came along with the COVID-19 pandemic, the need for LIMS enhancements and changes in capabilities soon followed. Long delayed upgrades were suddenly urgent, and, with a surge in funding, many laboratories sought to change systems altogether.

For months, APHL fielded calls from members asking to be connected to any laboratory using System X, Y, or Z and hoped that fellow informaticians would be willing to provide guidance and illuminate pros and cons. It soon became clear that people needed a place to connect with other laboratories using the same systems in order to address common challenges and work towards system-specific solutions. To meet this need, APHL launched a handful of system-specific user-group spaces on ColLABorate to help laboratorians identify and address cross-cutting concerns among their peers.

APHL currently hosts ColLABorate spaces for public health laboratory informatics specialists to discuss issues impacting their LIMS and other data systems. One is dedicated to STARLIMS users, the most widely used LIMS among state public health laboratories, tackling issues such as implementing upgrades to specific tests and their potential impact on reporting. In addition to ad hoc needs addressed in ColLABorate, the group meets monthly to discuss a range of topics such as the impact of electronic test order and results (ETOR) on their informatics workflows. The group also engages with industry peers on emerging issues and opportunities, having recently hosted the US Food and Drug Administration to present on the National Food Safety Data Exchange Services Platform and engaging member



In addition to the LIMS user group spaces, APHL has also launched a public health laboratory informatics community space for members to engage in discussions, pose questions, seek and provide guidance, explore resources and keep abreast of other engagement opportunities such as the Interoperability Forum, informatics related events and other ongoing initiatives. E-mail Rachel Shepherd to join the group (rachel.shepherd@aphl.org)

laboratories on how their participation can help grow the platform.

Recently, a new space launched to support members who use Horizon LIMS in their laboratory. Similar to the STARLIMS group, this space allows members to connect on strategies with utilizing Horizon and to address upcoming testing needs that may need to be integrated into the platform. It also serves as a repository for resources such as guidance documents and other support.

The ColLABorate spaces are open to all public health personnel currently using

or considering adopting one of these platforms in their laboratory. They are a convenient area to quickly connect with peers and to stay up to date on industry changes. For more information on any of these spaces, or to request a new ColLABorate space to support your laboratory's LIMS, please contact Sam Abrams (samuel.abrams@aphl.org) or Rachel Shepherd (rachel.shepherd@aphl.org). ■

CALL FOR ARTICLES:

From The Bench

a regular feature of *Lab Matters*



Lab Matters, APHL's flagship publication, is seeking submissions from laboratorians at all levels of practice for "From the Bench," a member-driven section of its quarterly magazine.

We welcome both technical and non-technical articles covering topics across public health laboratory science, administration, careers and management. Articles may be 500-1200 words in length.

We're looking for a few key components in "From the Bench" articles –

- 1. A compelling story.** Tell us about an initiative that streamlined an administrative process or fostered relationships with external communities. Describe how your lab has worked with other public health partners to stop an outbreak or respond to an environmental health threat. Or tell us how you dealt with an initiative that failed.
- 2. A complete story.** Give us an article with a beginning, middle and end. The end should provide some resolution of the narrative. You don't need to have fully implemented the new algorithm, analyzed all the research data or completed the electronic laboratory reporting system discussed in your article.
- 3. An insider's view.** We want articles told from the unique perspective of a laboratory scientist that will be interesting and informative for APHL members and partners.

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New Analysis Services for Public Health in Next Generation Sequencing

By **Brian Garrett**, product manager, Datapult; **Millie Malai**, technical product manager, Datapult; and **Patina Zarcone**, director, Datapult

Next generation sequencing (NGS) is heralded as the frontier in public health surveillance. Today, new technologies capable of analyzing pathogen genomes are unlocking positive outcomes for public health. In 2020, the **US Centers for Disease Control and Prevention (CDC)** launched its **Data Modernization Initiative (DMI)** positing five priorities; among them is “accelerating data into action.” Hundreds of millions of dollars have been allocated to support public health, data modernization and surveillance efforts. Meanwhile, NGS data analytics programs have been generally out of reach for public health, with software and pipeline support focusing on more lucrative markets.

Datapult, an APHL Company, recognized public health’s dire need for technological modernization upon its creation in 2020. Utilizing APHL proficiency, and a group of public health bioinformaticians, Datapult got to work on its NGS suite of services.

A New Way Forward...

While evaluating existing solutions, it was discovered that no single, off-the-shelf solution would meet public health’s requirements. What is needed is a secure, trusted, cloud-based NGS data pipeline management system that could allow organizational hierarchy as well as interorganizational collaboration; a sandbox environment for innovation and a simple launchpad for daily analytics. The catch? To operate within the functions of public health and utilize existing analytics programs, an individual requires an exceedingly rare combination of bioinformatics expertise and serious programming chops.

The solution is complex in its simplicity—break up the minimum requirements. For Datapult, that meant splitting the “work” and leaning on the expertise of

NGS InSight’s value is the ability to efficiently analyze pathogen genomes, enabling laboratories to recognize differences in a pathogen’s genotypes.

three parties. Datapult’s NGS InSight is the result of a collaboration with Seqera and Two Bulls, leveraging three expertly developed elements.

Seqera’s Nextflow Core and Tower addresses pipeline management and organizational needs by simplifying the writing and deployment of compute and data-intensive pipelines, is scalable and agnostic. State bioinformaticians can easily create, share and manage reliable and reproducible scientific workflows.

Easy Genomics, implemented by Two Bulls, is a graphic user interface that plugs into Tower and removes much of the technical complexity for easy system administration and automation. It further automates Tower, making a great NGS analysis tool even easier to utilize in daily capacities and amplifies InSight’s capabilities. Lastly, Datapult’s utilization of the APHL Informatics Messaging Services (AIMS) platform provides a cloud platform for housing a public health centric NGS analysis solution.

AIMS is a cloud platform strictly maintained to the security protocols governed by the National Institute of Standards and Technology (NIST); earning it FISMA Moderate compliance and inherited FedRAMP controls. Rigorous HIPAA compliance for other services on AIMS means that NGS InSight benefits from the scrutiny and protections necessary for guaranteeing the privacy of private health information.

...With Multiple Uses

As an extension of InSight, NGS TB Pipeline permits access to the *Mycobacterium tuberculosis* analysis pipeline created by the **New York State Department of Health Wadsworth Center**. This pathogen genome analysis pipeline predicts drug resistance for *M. tuberculosis* isolates for clinical reporting. The pipeline was originally deployed on APHL’s AIMS Platform in a proof-of-concept pilot project managed by the APHL Infectious Diseases Program.

NGS TB Pipeline has incorporated lessons learned from the pilot’s proof-of-concept to enhance its new configuration and onboarding process. The white-glove onboarding process ensures that there is the right technical support from kickoff to go-live. Access to this *M. tuberculosis* pipeline is available exclusively through Datapult.

Datapult’s NGS InSight & NGS TB Pipeline are easy, secure ways to access pre-packaged pipelines and workspaces tailored to public health sequencing needs. NGS InSight’s value is the ability to efficiently analyze pathogen genomes, enabling laboratories to recognize differences in a pathogen’s genotypes. That information is actionable in protecting public health. Datapult’s vision for the future of NGS InSight includes adding functionality for sharing data across states or with other partners. ■



Public Health deserves a trusted, secure, easy-to-use solution for analyzing pathogen genomic sequence data.

Introducing NGS InSight™

Your easy, secure way to access prepackaged pipelines and workspaces tailored to public health sequencing needs.

AIMS Platform

Safe, secure, trusted cloud platform. Built for public health, by public health.

NGS Analysis powered by NextFlow Tower

Utilize open-source, public health curated pipelines for the analysis of pathogen genomic sequences in a collaborative community.

Easy Genomics User Interface

Harnessing the power of Nextflow Tower in easy to organize and deploy workflows.

Complex problems, Collaborative Solutions

The issues for Public Health with NGS are complex.

NGS InSight™ is a collaborative approach to addressing your barriers and needs in the process of obtaining the critical information to identify, determine susceptibility and surveil infectious disease threats.

NGS InSight

Realize the value and the ability of efficiently analyzing pathogen genomes, enabling laboratories to recognize differences in public health threats. NGS InSight creates information that is actionable in protecting public health.

Realize the value and ability to efficiently analyze NGS data.

- dynamic workflows
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- and much more

Additional NGS Services from Datapult

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- **NGS TB Pipeline** grants access to, and utilization of, a WGS pipeline for *M. tuberculosis* developed by and for public health.

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