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Fall 2024 Issue 3

Harnessing AI to Advance Public Health Laboratories

Inside:

ASSOCIATION OF PUBLIC HEALTH LABORATORIES

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LAB MATTERS FALL 2024 | CONTENTS

COLUMNS

INDUSTRY MATTERS

FROM THE BENCH

FEATURE

DIGITAL EXTRA

APHL PROGRAMS

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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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Taking (and Making) Opportunities

Like many of my colleagues, I kind of fell into public health. When I was in graduate school, I took some public health courses because I was always interested in public health. But I had created this job description in my head that was a mix of management, clinical laboratory diagnostics and community service. And I said, "What is this? I don't know, but this is what I want to do." I was fortunate enough to be connected to a senior laboratory leader at the Virginia state laboratory, and after sitting down with her for an hour, I walked out going, "This is exactly what I want to do. This is my job description that I didn't even know existed."

What I found in the public health laboratory world is an inspiring community. We are highly educated public servants who want to serve our communities and do fantastic quality work. We take whatever challenge is thrown at us, and we figure it out as we go, and we do not hesitate to share our knowledge across our community. In my career as a public health laboratory director, what surprised me is how much I really love policy and regulation. I always thought I was a bench scientist—after all, I'd worked in the laboratory since I was 19! But once I saw the impact that you can make by bringing people in and exposing them to what we do, I could not let any opportunity to shine a light on our work go to waste. As I got involved in committee work with APHL, starting with the Infectious Diseases committee, I also had the opportunity to take some more leadership roles in the state of California. The state has a public health laboratory-related organization and I found myself on different committees, being elected secretary-treasurer, then president. These other roles were a way for me to grow without leaving my laboratory, which was really rewarding.

One of my presidential priorities is retention of our public health laboratory workforce. We have done a really good job within APHL of bringing people into the field and exposing them to the rich and varied work of public health laboratories. I get more phone calls from students or others who are interested in working in public health laboratories than ever before! And now we have many levels to offer them with fellowships and internships. Many of them stay because of the great work that we do—they really love our community and love working for our laboratory. APHL also has great data on why people leave, as well as some suggestions and things that we can do to get them to stay. So, it's really going to be putting some of those ideas into action based on the data that APHL has gathered and encouraging my fellow directors and leaders in the field. It is up to all of us within the public health community to keep these people here. We have to really engage them and give them opportunities to grow. Fellows and interns are highly motivated—they want to work in public health and are excited to do so. And their excitement, as well as my fellow colleagues' across APHL, will be fueling my term as APHL president.

As many of you know, I am very much an extrovert, so I will be looking forward to collaborating with you all over the next year. As Scott stated at APHL 2024, we have over 5,300+ members engaged in the committees, subcommittees, workgroups and focus groups across the association. There are lots of opportunities for anyone looking for a bit more knowledge about and involvement in the public health community around them. Get involved—it will help your laboratory, and it will help you. It may seem overwhelming at first, or you may think you are not going to have enough time. But the knowledge and connections you will receive will pay dividends to both you and your laboratory in the future. ■

"There are lots of opportunities for anyone looking for a bit more knowledge about and involvement in the public health community around them. Get involved—it will help your laboratory, and it will help you."

Megan Crumpler, PhD
President, APHL

Finding the Path Forward Through Change and Ambiguity

"May you live in interesting times."
~Anonymous

As many do in the public health community, we do our work through many different circumstances. And as public health laboratorians, we are used to "doing more with less." But in the past several years, the "doing more with less" paradigm has pivoted to "doing more through change" or "doing more through ambiguity."

Due to more pressure from outside influences, our members find themselves confronted with new and different iterations of public health responses through new pathogen-specific events—like highly pathogenic avian influenza or mpox—that continue to stress public health response systems. While the clarion call for dedicated "warm base" funding has not gone away, each new event that affects APHL's membership gives us a little bit more experience and a little bit more information. So when we do need to surge and respond to an emergency, we have a greater degree of readiness than before. It may not seem like it when the response first starts (because of the initial "chaos" involved in standing up systems and getting to know all the partners involved), but in fact, we are more ready than we have ever been before.

But even as the world changes and evolves around us, the public health community is well-versed in adaptation—it is what we have done, it is what we always do. The recent US Food and Drug Administration ruling on laboratory-developed tests (LDTs), while not a shock, still felt unexpected. Our members have been using LDTs for decades to advance diagnostics within their own laboratory, with a goal to share their findings and discoveries with the greater public health community. Our adherence to rigorous quality control and regulations provides the optimum environment for innovations like LDTs. And while it is still early days of the ruling, APHL will be convening a task force to help our member laboratories work through some of the challenges that have been posed by this ruling. We also encourage members to share information and also ask questions by sending them to ldtquestions@aphl.org.

Another way we can continue to work on innovations is connecting with our public health partners around the globe. As the COVID-19 pandemic reinforced, disease and disasters know no borders. I had the opportunity to attend the Global Health Security Agenda Conference earlier this summer, and it was eye-opening; the importance of the role the US plays in health security cannot be understated. APHL has now established offices in 10 countries to support laboratory systems and are active participants in changing public health laboratory systems for the better. The association has also restarted its twinning initiative, pairing US public health laboratories with laboratories in Africa, Asia and Eastern Europe. It is a way to establish connections across different systems, as well as enable communications between like-minded scientists in other settings. We will be continuing the dialogue with our colleagues in the CDC Global Health Center, as well as our in-country partners in the many ministries of health to build that leadership infrastructure—through the Global Laboratory Leadership Programme.

Not long ago, I heard one of our newer members wishing to live in "precedented times," instead of "unprecedented times." While it is true that none of us has ever experienced anything quite like the times we are currently living in, I believe that the sentiment is not unique to one generation or another. Every day is different and every era will be different as well. What will continue to be as steady as ever, however, will be the passion and perseverance of our public health laboratory community. So I encourage you to reach out to each other, to connect and to support each other. APHL is here to help you make those connections, and, knowing that we have your back, hopefully that makes our changing times a bit less ambiguous. ■

"But even as the world changes and evolves around us, the public health community is well-versed in adaptation—it is what we have done, it is what we always do."

Scott Becker, MS
Chief Executive Officer, APHL

Milwaukee Becomes Test Site for Internship Program Participation at Annual Conference

By **Rudolph Nowak**, senior specialist, Marketing and Communications

Internship program participants Darrel Gibson, Allysea Smith, Gianna Serpe, Lucy Wellso, Tomi Ekibolaji and Delanie Prince pose in front of the Career Pathways' booth at APHL 2024 in Milwaukee. Photo: Michelle Foreman

During APHL 2024 in Milwaukee, many conference attendees did not realize they were taking part in a pilot program. Six college students participating in the Public Health Laboratory Internship Program: an APHL-CDC Initiative became test subjects in an experiment giving six interns the opportunity to become the first program attendees to an APHL Annual Conference and two participants the opportunity to present their project posters during the conference. Read more about the interns who presented posters on the APHL Blog.

I Spy With My Little Eye …

Internship participants Gianna Serpe, Delanie Prince and Allysea Smith from Michigan State University; Tomi Ekibolaji from Lamar University in Beaumont, Texas; Darrel Gibson from Florida International University; and Lucy Wellso from the University of Wisconsin were in attendance as the conference kicked off May 6.

The Internship Program began in March 2023 with no plans for the participation of interns during APHL's annual conference. That all changed when John Buchweitz, Nutrition & Toxicology Section chief at Michigan State University's Veterinary Diagnostic Laboratory, reached out to Mariane Wolfe, manager of APHL's Internship Program and asked, "Is this something that APHL would be willing to fund?" Since his interns would be submitting project posters, Buchweitz wanted to know if there was any financial support available for his students.

Wolfe said she would consult with the US Centers for Disease Control and Prevention (CDC) about supporting intern participation at the annual conference and get back with him.

"Sure enough, about a week later, she said 'yes, APHL would be willing to fund the trip,'" Buchweitz said.

In a short period of time, intern participation became a reality.

First Things First

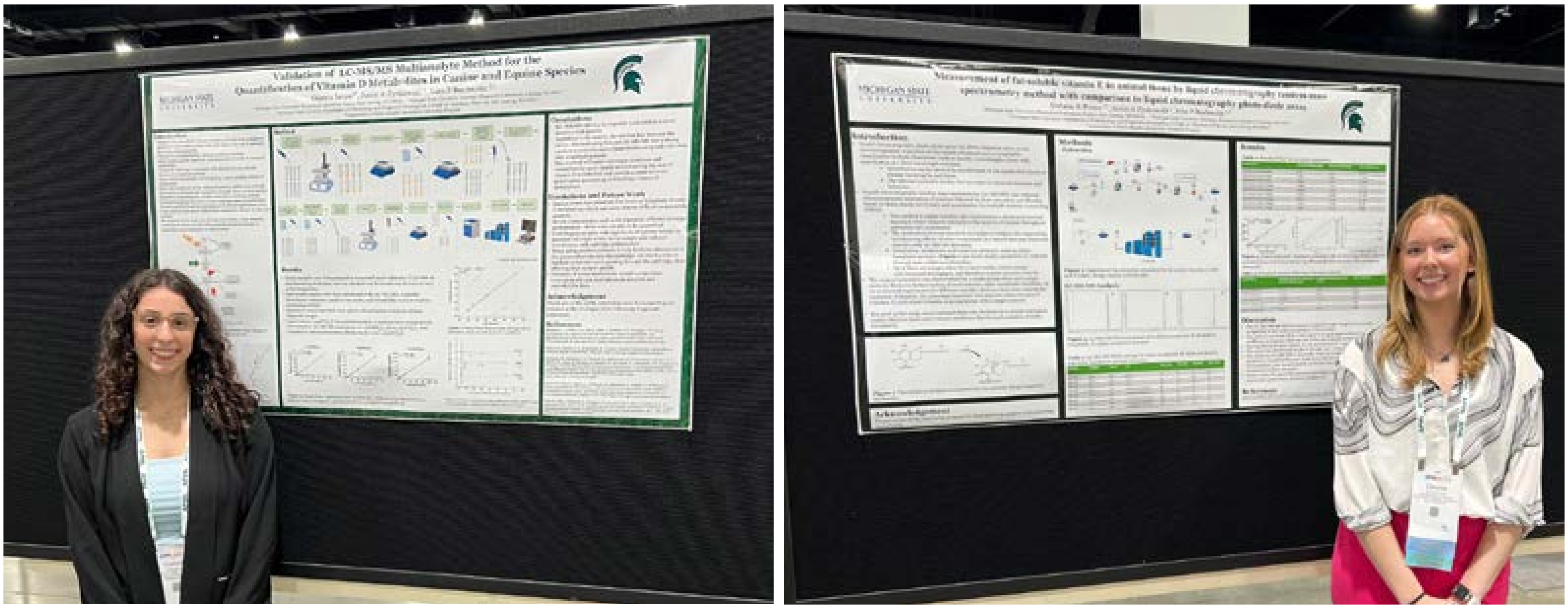
There are always going to be "firsts" in the laboratory science community. The Internship Team sent invitations for a pilot project to mentors who were asked to fill out a questionnaire. The internship team received 10 applicants and selected six to attend the conference.

APHL's internship team, Cherie Estrada, Chyna LaPorte and Janine Nowak, conducted orientation from booking their flights to crafting their elevator speech prior to their arrival at the annual conference.

Gibson, an intern at the Florida Department of Health in Tampa, FL experienced several firsts when he was selected for the trip.

"This was my first time flying and it was my first time being at a national conference. So, I was really excited," Gibson said. He was also able to learn about the other interns' jobs at their host laboratories.

"I was surprised about how many people didn't work in the laboratory, but still contributed to public health. I met people that were information technology and quality control. I didn't know that there



Michigan State University Veterinary Diagnostic Laboratory interns Gianna Serpe and Delanie Prince stand in front of the posters they presented during the APHL 2024 Annual Conference in Milwaukee. Photo by Rudolph Nowak

were other, major roles that still contribute to public health," Gibson said.

This was Serpe's and Prince's first conference as well.

"I thought it was a really great experience just to be in a professional setting, listening to the speakers, hearing their take on different subjects and learning new things. I had a good time." Serpe said.

Ekibolaji, an intern from the Houston Department of Health, was selected to attend the conference and hadn't been to a conference before. Ekibolaji's mentor, Kimmyata Smith, also attended.

"I talked to my fellow interns and heard about what they were doing in their laboratories that I did not know, or I was not familiar with. So, we were able to share experiences in the laboratory and connect with some of the fellows as well from the CDC" Ekibolaji said. She added that the interns talked about how long they have been in the laboratory, and future goals.

While some of the participating interns will return to school in the fall, there are a few exceptions. Three interns are looking to graduate to the Fellowship Program. Welso will be working at the Wisconsin laboratory as she prepares to become a fellow. Both Ekibolaji and Gibson have been accepted into the fellowship program.

The Experiment Proves Successful

Buchweitz sees the inclusion of interns as an opportunity to grow not just the program, but the public health laboratory profession.

"Being able to be in attendance at the conference, see the other posters, hear other speakers and actually interact with folks from other laboratories is an invaluable experience," Buchweitz said.

The APHL Internship team was also encouraged by this year's initial feedback.

"We hope that we can support interns again next year. We will share the report of the experience with our CDC partners and steering committee and we hope we can continue the program, or even expand it next year," Wolfe said.

Supercharging the Workforce with Generative AI in Dallas County

By **Alexandra Portman**, LRN BT coordinator/microbiologist, Dallas County Health and Human Services Public Health Laboratory; **Kayle Cirrincione**, health and safety manager, Public Health Laboratory and alternate responsible official, Federal Select Agent Program, Dallas County Health and Human Services Public Health Laboratory; and **David Silva**, quality manager, Dallas County Health and Human Services Public Health Laboratory

When most people think of artificial intelligence (AI), images of science fiction pop culture references like *I, Robot* or *Battlestar Galactica* come to mind. While machine consciousness or intelligence known as super intelligence might be the stuff of curiosity or nightmares, generative AI is emerging as a powerful tool that can revolutionize the way work is done. Generative AI focuses on creating new content rather than understanding or learning autonomously from its environment. By entering well thought out commands or prompts into programs such as ChatGPT or Gemini, users can generate text, images and data that can be used in many different types of applications. This means that laboratories can write procedures that meet current regulations, develop effective training programs, and advance data analytics faster than ever before. The public health laboratory team at Dallas County Health and Human Services have learned to embrace this rapidly evolving technology while keeping in mind the limitations generative AI applications currently face.

Starting Simple with Automation

The hardest part of writing any document is figuring out where to start. Which is why one of the significant applications of generative AI at Dallas County is drafting the skeleton and bare bones of policies and procedures. You can achieve this in a couple of ways. First, you can prompt your chosen AI generator to create an initial draft based on a given topic or procedure, and then modify with further prompts to fit your requirements. Or alternatively, you can input an existing document and prompt the AI to review and compare. This ensures compliance with current regulations and standards while speeding up the creation of essential documents.

Generative AI also plays a crucial role in constructing comprehensive laboratory training programs that are based on Bloom's taxonomy and SMART learning objectives. From prompting for quiz questions that cover main points to identifying overarching themes in topics, this approach covers various cognitive levels from basic knowledge acquisition to complex analysis and creation tasks. By structuring training materials and documentation to address different learning needs, generative AI enhances the overall effectiveness of employee training initiatives, which ensure all staff members are well-prepared and knowledgeable.

Another critical application of generative AI is in supporting data analytics, particularly with Excel™ and coding commands. For instance, it can help write complex formulas or scripts that would typically require specialized knowledge, which allows our laboratory to conduct advanced data analysis without needing extensive programming expertise. It facilitates easier and more informed decision making, leading to improved planning for the future of our laboratory.

Still Needed: Human Oversight

While generative AI offers numerous benefits, it also comes with certain challenges that need to be carefully managed. One of the main advantages of generative AI is its efficiency. It can quickly automate routine tasks or develop new content, saving time for employees who need to process large volumes of information. However, generative AI should not be the primary source for critical work. The output can vary significantly based on the exact wording of the prompt, leading to potential inconsistencies or inaccuracies; it is important to be cautious of hallucinations and false information that AI systems may inadvertently generate. This variability necessitates human knowledge and oversight to ensure the quality and reliability of the content produced. Furthermore, there are significant privacy and security concerns, particularly around HIPAA compliance. Generative AI systems and their human operators must be carefully managed and monitored to prevent inadvertent disclosure of sensitive information.

Generative AI holds substantial promise for transforming organizational processes by enhancing efficiency and capability within our laboratory. Dallas County's use of generative AI in drafting policies, building training programs, and even assist in writing articles such as this one highlights its potential to revolutionize traditional workflows, while empowering the work of already exceptional and knowledgeable employees. However, to fully harness the benefits of this technology, it is crucial to balance its advantages with its limitations. This requires knowledgeable individuals who can effectively guide and utilize these programs; ensuring that generative AI serves as a tool to augment human efforts rather than replace them. By doing so, Dallas County can maintain the integrity and security of its operations while leveraging the power of generative AI to drive innovation and efficiency. ■

Piecing Together *Cyclospora*: A Puzzle for Public Health Labs

By **M Grzywinski**, Population Health Sciences Department, Virginia-Maryland College of Veterinary Medicine at Virginia Tech; **R Matheson**, Population Health Sciences Department, Virginia-Maryland College of Veterinary Medicine at Virginia Tech; **JC McEntire**, Food Safety Strategy; and **LK Strawn**, Food Science and Technology, Virginia Tech

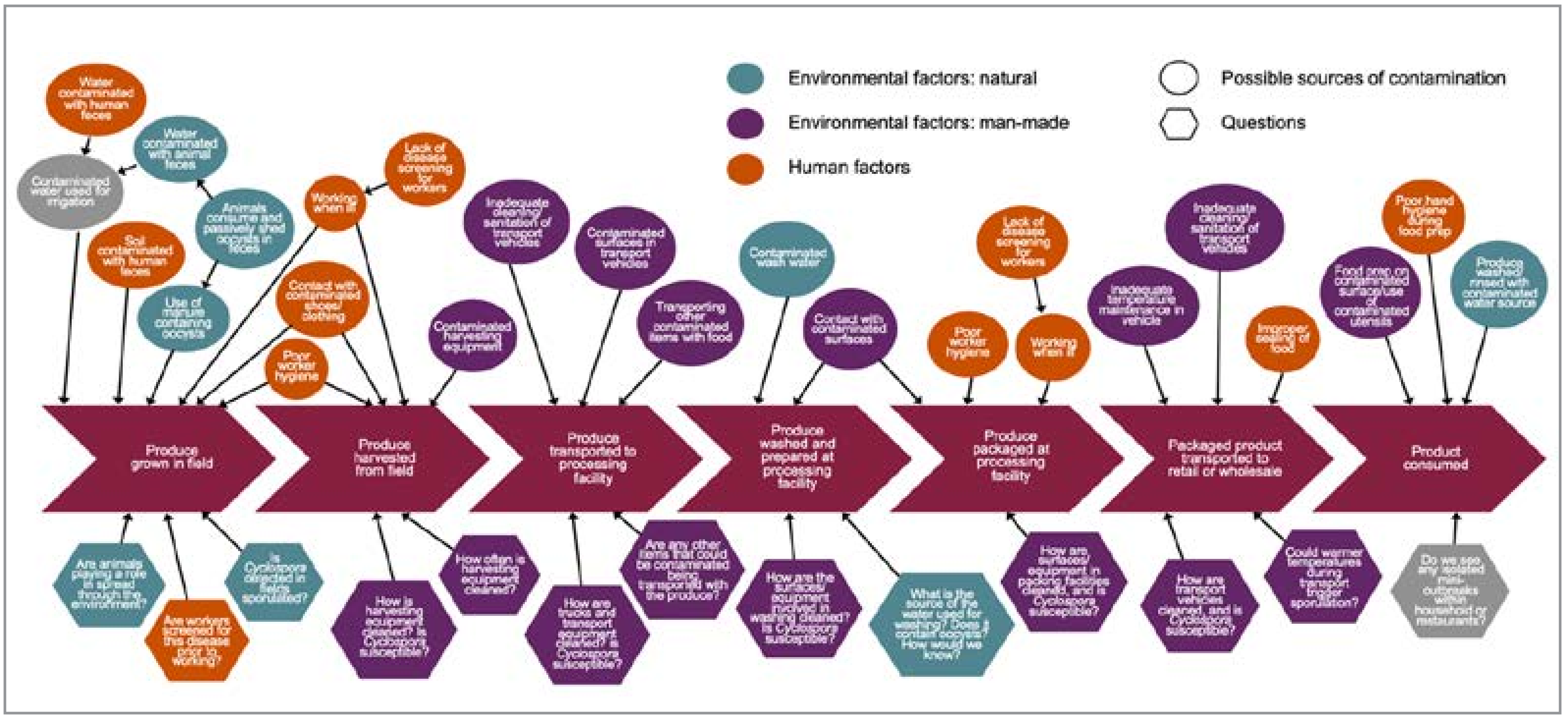


Figure 1. Mapping of the farm-to-fork supply chain with potential sources of contamination and key questions addressed.

Even the most well-versed professionals in infectious disease and food safety are puzzled by *Cyclospora cayetanensis*. *Cyclospora* is a human parasite that is presumed to be spread through fecal contamination, causing diarrheal disease of varying severity. Produce like raspberries, snow peas, lettuce, cilantro and basil have been involved in outbreaks of cyclosporiasis.[1] But beyond this, there is a surprising lack of concrete understanding about this sneaky pathogen, largely because research is limited due to a lack of oocysts. Public health labs have an opportunity to help solve the *Cyclospora* puzzle by collecting oocysts from cases and supporting academic and federal efforts to address this pathogen.

Cyclospora outbreaks tend to follow a seasonal cycle, occurring in the summer months worldwide.[1,2] Historically, outbreaks in the United States have been associated with international travel or imported foods. However, in recent years, there has been an apparent increase in domestically acquired cases, likely due to advances in clinical detection.[3] Despite knowing that cases will peak between May and August, public health professionals across the US are left relatively helpless when predicting and preventing illnesses. They rely solely on passive surveillance—reported cases from clinicians and public health laboratories—to understand disease patterns due to major gaps in knowledge surrounding the transmission, life cycle, genotyping and environmental detection of *Cyclospora*.

For example, in 2020, *Cyclospora* cases plagued the midwestern US in a multi-state outbreak. Cases were concentrated in Illinois and Iowa but spread as far as Massachusetts and Georgia. The outbreak was linked back to bagged salads. The US Centers for Disease Control and Prevention (CDC) and the US Food and Drug Administration (FDA) conducted thorough traceback investigations but were unable to definitively identify the specific salad component responsible for contamination.[4]

The inability to identify the specific cause of this outbreak, despite the extensive expertise and diligent efforts of epidemiologists, other public health professionals, and members of the food industry indicates how problematic this pathogen is. A host of factors could have contributed to this outbreak and there are several points along the farm-to-fork supply chain where contamination could have occurred, making it challenging to pinpoint the cause (**Figure 1**). There is also a lack of reliable environmental sampling and real-time genotyping methods for *Cyclospora*, limiting the genetic linkage of clinical specimens to a specific source.[5] Additionally, the sexual reproduction of the parasite allows for rapid genetic changes that make it difficult to trace. There is simply not enough information or reliable methods available to accurately and efficiently determine the source of *Cyclospora* outbreaks, hindering the possibility of employing targeted prevention measures. Therefore, *Cyclospora* continues to arise during the US summer months, affecting large numbers of individuals and the produce supply chain before disappearing without a trace.

So, what are some of the key concerns and knowledge gaps that must be addressed? First, good hygiene and sanitation practices among produce workers must be strictly enforced. Workers should avoid coming to work when ill, especially when experiencing gastrointestinal symptoms. Periodic screening of workers may be beneficial in detecting disease. Workers should also wash their hands frequently and thoroughly throughout the day. Equipment and surfaces that come into contact with produce should be cleaned regularly with appropriate types and concentrations of sanitizers to eliminate pathogens. However, the main challenge is that *Cyclospora* is resistant to many common sanitizers, thus adequate methods for killing oocysts must be researched.[2,6]

Cyclospora oocysts require a period of time in the environment to sporulate before becoming infective. However, the exact timing and specific triggers of sporulation are largely unknown. The details of *Cyclospora's* life cycle must also be investigated further. Solving the mystery of oocyst sporulation would reveal at what points in the farm-to-fork supply chain the parasite is infective and what factors trigger this sporulation (or shift to the infective state). Perhaps with this advancement of knowledge, methods to block sporulation could be developed and implemented as control measures at key points along the produce supply chain.

Several other essential questions persist with regard to transmission. Why are certain produce items commonly associated with outbreaks, and where does *Cyclospora* come from? Is this solely a foodborne pathogen, or is contaminated water playing a role in transmission? Is the organism endemic in the US? To predict and prevent the spread of this pathogen, we must know its source and what drives its movement throughout the environment. We hypothesize that *Cyclospora* could be found in various water sources, even treated ones, since its hardy structure allows it to resist many chemical treatments. It is possible that water could be one of the main facilitators of *Cyclospora* transmission.

Improvements in environmental sampling are needed to gather evidence to address these suspicions. Collection and analysis of environmental samples for *Cyclospora* are currently quite complicated for several reasons, including the relatively low concentrations of oocysts and the possible presence of other similar but distinct *Cyclospora* species—*C. ashfordi* and *C. henanensis*—as recently proposed by CDC scientists. New methods must be developed to ensure that *Cyclospora* is being detected even at low concentrations, with enough specificity to distinguish *C. cayetanensis* from other possible species, or closely related parasites. The development of swab sampling methods would also be highly beneficial, as they could be used to monitor contamination of equipment and surfaces. Lastly, the ability to genotype the collected environmental samples would enable public health professionals to connect clinical samples to environmental sources, which would be groundbreaking in improving the accuracy and efficiency of epidemiologic analyses during outbreaks.

While federal agencies in the US such as the CDC and FDA are working on initiatives such as improvement of genotyping and environmental detection methods, other aspects of this disease remain largely unknown and require further research to close gaps in knowledge. The increase in domestically acquired cases and consistent outbreak patterns in the US indicate that cyclosporiasis is a growing public health concern. An opportunity exists for public health laboratories to collaborate on research initiatives with both government and academic institutions.

Currently, one of the major barriers in research is the limited ability to obtain oocysts, as they cannot be propagated in the laboratory. Purifying oocysts from human stool samples is laborious, but increased availability would allow for significant advancements in *Cyclospora* research. Federal institutions may not have resources to allocate towards purification for distribution to other researchers, but this is where public health and academic laboratories could put missing puzzle pieces into place. Both offer unique potential due to the constant need for student and fellowship projects and more readily available resources. Increasing the access to *Cyclospora* oocysts could allow for research into major knowledge gaps in the life cycle and transmission pathways. This, coupled with federal initiatives, could allow for a shift from passive to active surveillance and aid in prevention efforts to control *Cyclospora*. Only with effective teamwork and collaboration across disciplines will the momentum of this pathogen be halted. *Cyclospora* is more than a food safety concern, but a public health concern that needs to be addressed holistically. ■

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Tracking Severe Lead Poisoning from Imported Products in California

By **Linda Nguyen**, research scientist, California Department of Public Health; **Dinesh Adhikari**, research scientist, California Department of Public Health; **Ngoc Nguyen**, research scientist, California Department of Public Health; **Key-Young Choe**, research scientist, California Department of Public Health; **Josephine DeGuzman**, research scientist, California Department of Public Health Environmental Health Laboratory; and **Jianwen She**, section chief, Biochemistry, California Department of Public Health Environmental Health Laboratory

According to the World Health Organization (WHO), "there is no level of exposure to lead that is known to be without harmful effects." Even at low levels, lead exposure has been associated with decreased intelligence and behavioral issues in children. Lead poisoning is a serious health concern that can lead to severe outcomes such as brain and nervous system damage and sometimes death.

A 45-year-old mother from Sacramento County, California succumbed to severe lead poisoning after using an imported ointment for treating hemorrhoids. The woman purchased the ointment known as "Cao Bôi Trĩ Cây Thầu Dầu" through a Facebook group that does not ship to the United States. The product was then mailed to her through a relative from Vietnam.

Upon investigation of the fatality, initial hospital tests revealed alarmingly high levels of lead in the woman's blood, >200 µg/dL (CDC's blood lead reference value to identify children with levels that are higher than most children's level is 3.5 µg/dL) leading to the suspicions of the imported ointment she had been using. The California Department of Public Health (CDPH) Environmental Health Laboratory (EHL) was called in to solve the mystery. As part of EHL's emergency response capabilities the laboratory quickly mobilized to conduct a prompt, thorough analysis of the product.

Using advanced techniques of inductively coupled plasma mass spectrometry (ICP-MS) and multiple subsamples, EHL measured extremely high concentrations of lead in the ointment—nearly 4% lead. Rapid laboratory response was critical in identifying the source of the poisoning and a swift public health response followed. EHL's detailed analyses provided the evidence needed for CDPH to issue a statewide alert, warning the public about the dangers of the product.

This tragic event serves as an important reminder of the hidden dangers posed by unregulated imported products, and the essential role public health laboratories have in safeguarding communities from toxic exposures. EHL's involvement was pivotal in not only identifying the lethal contamination but also in preventing further tragedies. ■

APHL Newborn Screening Symposium 2024

October 20–24, 2024 • Omaha, NE

Join your colleagues in October for learning, networking, discussion and inspiration!

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Highlights

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Parent/Patient Panel
Hear compelling personal accounts of how newborn screening impacts the lives of families. Follow their journeys from screening and diagnosis to treatment and management.

APHL Newborn Screening Awards
Recognize your colleagues for their amazing accomplishments during the Newborn Screening Awards event.

Fun and Engaging Activities
Unwind with your newborn screening friends at events such as the welcome reception, Ignite session and the Revvity off-site social.

About the Symposium

The APHL Newborn Screening Symposium is an annual international gathering of more than 600 public health professionals that includes exhibits featuring the latest in laboratory technology and newborn screening systems practice.

The symposium addresses state, national and international newborn screening, genetic testing and policy issues important to public health newborn screening systems. Topics include molecular technologies, current and upcoming conditions, quality improvement, communicating with families and the public, and short- and long-term follow-up.

Participants enhance their knowledge of national and international newborn screening and genetics as related to emerging laboratory technologies, follow-up, candidate conditions, quality improvement and clinical outcomes.

How Investing in AI Helps the Public Health Mission

By **Alan Marcus**, chief growth officer, LabVantage Solutions

Public health effectiveness has been under the microscope since the COVID-19 pandemic, with underfunding emerging as a cause that needs correcting. And among the prescriptions, investment in data management and technology is paramount.

CDC's Data Modernization Initiative has received $1.1 billion in congressional funding since 2020, while it is estimated that another $7.84 billion is needed through 2028 to strengthen public health data collection and reporting at the state and local levels.

Public health laboratories—whether federal or state, tribal, local or territorial—find themselves exploring myriad options for investment, with laboratory information management systems (LIMS) among them. Described as "the backbone for laboratory data collection, analysis, management and sharing," LIMS and adjacent solutions for electronic lab reporting (ELR) and electronic test ordering and reporting (ETOR) require a $1.032 billion investment over the next five years.

Implementing a laboratory informatics platform, rather than standalone solutions, provides the breadth of data management and analysis required for today's and tomorrow's needs. This approach expands LIMS capabilities to include not only a laboratory execution system (LES), electronic laboratory notebook (ELN), and scientific data management system (SDMS), but also advanced analytics and semantic search functionality. With a secure portal that provides access to roles/responsibilities-controlled data, public health laboratories gain the necessary functionality for their workflows, while optimizing enterprise and cross-agency data flows for actionable insights that improve decision making in disease, disaster and bioterrorism surveillance and intervention.

With artificial intelligence/machine learning (AI/ML) and predictive and prescriptive analytic capabilities available as part of a public health laboratory informatics platform, a number of processes improve immediately:

- Disease surveillance and outbreak detection
- Resource optimization and allocation
- Data privacy
- Transparency

Advanced analytics leveraging semantic search tools seamlessly access public health data lakes and instantly analyze the volume, velocity and variety in a way no humans ever could, from social media to healthcare records to environmental factors. This helps public health laboratorians and other officials predict disease outbreaks in near-real time by rapidly identifying patterns and predicting the potential spread of infectious diseases before they become widespread. It also enables disease-progression tracking, allowing for quicker public health interventions.

AI can also be used to analyze multi-source public health data to identify high-risk populations, thus allowing public health officials to target resources and interventions more effectively. Advanced analytics in the laboratory can help allocate limited resources, like vaccines or medications, to areas with the greatest need to ensure healthcare equity.

A laboratory informatics platform also ensures data privacy and transparency through enforced SOPs of data collection and use. A well-designed solution builds data integrity into workflows, ensuring laboratorians are routinely prompted to gather, store and report data in a compliant manner. In addition, strong data governance practices can help mitigate any algorithmic bias in AI.

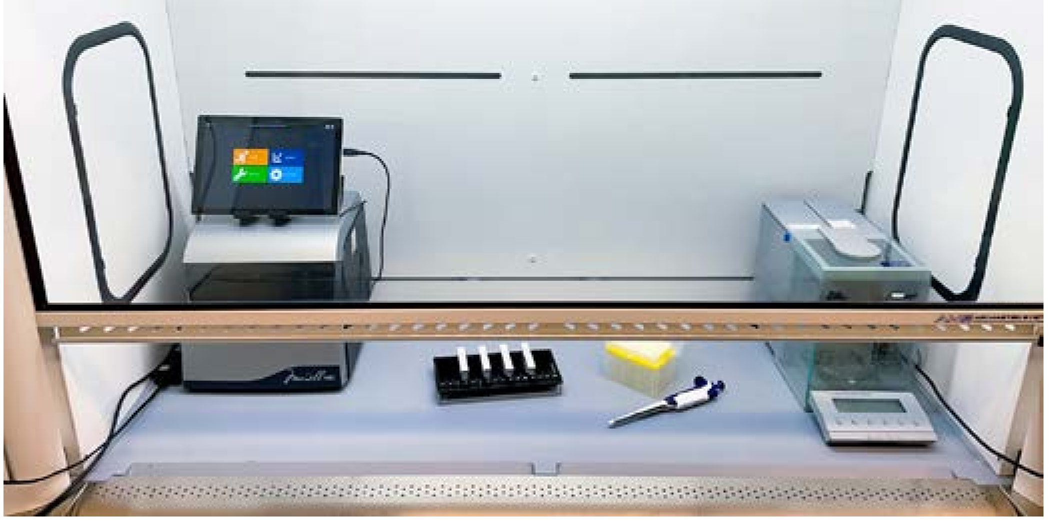
This comprehensive informatics approach can lead to other benefits, such as better public health education and mental health support through AI-generated chat bots and virtual assistants that provide 24/7/365 access to reliable health information or conduct virtual mental health screenings and direct users to appropriate resources.

The inclusion of AI/ML, predictive and prescriptive analytics, and semantic search in public health offers numerous benefits. LabVantage Solutions' advanced analytics LIMS platform offers more than 1,000 AI algorithms and 500 visualization options, while its semantic search solution (AILANI) enables users to integrate proprietary and public data to generate added value. A comprehensive pre-configured informatics platform for public health laboratories is a worthy investment to ensure the success of the public health mission. ■

LabVantage Solutions is an APHL Platinum Level Sustaining Member.

Enhancing Public Health Laboratory Operations: Standardized Technologies with Flexible Applications

By **Anna Bennett**, PhD, science writer, Promega



The Maxwell® RSC Instrument in a BSL-2 cabinet. Photo: Promega

The primary goal of public health laboratories is to detect and track emerging and reemerging diseases. Yet, beneath this surface challenge lies a secondary obstacle: laboratories are confronted with staffing shortages and budget constraints, limiting their ability to expand capacity and train researchers on new technologies. Furthermore, regulatory requirements and funding allocations differ from one jurisdiction to another, adding to unpredictability in resources and emphasizing the need for a cost-effective, standardized solution. The inherent pressure to deliver precise results under tight timelines exacerbates these challenges and amplifies the complexities of managing public health. The global diversity of pathogens—shaped by geographic, environmental and social factors—underscores the urgency for reliable and rapid testing methods. To effectively manage global diversity, public health laboratories rely on versatile, adaptable technologies to deliver accurate results.

Standardized Solutions with Flexibility

Recognizing variety in both pathogens and conditions under which public health laboratories operate, the paradigm is shifting towards a more agnostic approach to laboratory solutions. This approach enables the integration of various testing kits and technologies, thereby offering adaptability in a rapidly evolving field. To address the range of needs in a public health laboratory, Promega has developed automated and flexible solutions that support variety in sample type, volume and target. Our instruments support efficient extraction of both DNA and RNA from both viral and bacterial samples—including human and animal samples (e.g. whole blood, bone marrow and buccal swabs). Our instruments can also handle food, plants and environmental samples with diverse genetic profiles like soil, water and more.

To maximize scalability, our solutions permit precise extraction from sample volumes as small as 50 microliters to 1 milliliter, ensuring that even limited or precious samples yield reliable data. Because public health laboratories require adaptable workflows, our nucleic acid extraction and purification technologies are compatible in both manual and high-throughput settings.

To keep up with resource and time limitations, the technologies we offer are both scalable and efficient. Designed with simplicity and flexibility in mind, our automated extraction systems process from 1 to 48 samples in an easy, load-and-go workflow. We have developed all-in-one, ready-to-use reagents, minimizing contamination, maximizing consistency and efficiency. Finally, recognizing laboratory space constraints, our most compact instrument fits comfortably in a BSL-2 hood.

Our commitment to flexibility and standardization extends from instruments through to the supply chain. Our infrastructure is poised to offer flexible options while maintaining quality control standards. Over 85% of our products are manufactured in-house and over half of our external suppliers are located within 50 miles of our primary manufacturing facility. The benefits of product manufacturing taking place internally are twofold: 1) we can offer a high level of product customization to meet the ever-changing needs of public health laboratories; and 2) we can maintain quality control standards to ensure every product shipped is ready-to-use.

Public health laboratories require technologies that are built on standardized platforms and allow for flexibility in applications to meet new challenges. Our solutions—designed to be scalable and adaptable while meeting high-quality standards—ensure these crucial institutions can quickly and effectively respond to public health demands in a constantly changing healthcare landscape. ■

Promega is an APHL Platinum Level Sustaining Member.

Sustaining Member Spotlight: QIAGEN

QIAGEN booth at the 2024 APHL Annual Conference. Photo Credit: Bi Linton, QIAGEN

QIAGEN offers vital assistance to public health laboratories through cutting-edge diagnostic products and life science tools from sample prep, assay tech, automation, Digital PCR, NGS solutions, and data analysis. These technologies help promote early detection, precise diagnosis, and efficient treatment, underscoring our dedication to tackling worldwide health obstacles with our public health partners. Our continued collaboration with APHL elevates lab capabilities in the public health sector and empowers laboratories to enhance their testing and disease surveillance endeavors year-after-year.

Our Identity

QIA: Quality, Ingenuity, and Accessibility — We embody an unwavering commitment to excellence, fueled by our inventive spirit and dedication to transparency and authenticity. We are devoted to delivering top-tier solutions that push the boundaries of innovation and accessibility for all.

Our Vision

Making improvements in life possible — Our goal is to drive meaningful advancements in healthcare and beyond, transforming the world by enabling breakthroughs that improve the quality of life for individuals and communities globally.

Our Mission

Delivering Sample to Insight Solutions — Our mission is to empower our customers with innovative products and services that transform biological samples into valuable insights, enabling groundbreaking discoveries and advancements across various fields.

Enhancing Infectious Disease Surveillance

QIAGEN has significantly advanced infectious disease surveillance in public health with a combination of revolutionary technologies, automation, and comprehensive solutions. Our state-of-the-art sample preparation tools have been the gold standard for streamlining nucleic acid extraction and purification since 1984. Complementing these tools, our automated platforms, like the EZ2 and QIAcube Connect, enhance efficiency and accuracy by reducing manual handling and increasing throughput. As we continue to innovate, the QIAcuity Digital PCR system excels in precise pathogen quantification and has been instrumental in global wastewater monitoring, enabling early detection of pathogens such as COVID-19, Influenza A/B, and RSV. These efforts are further enhanced with our NGS solutions, including the QIAseq xHYB viral and bacterial panels, which provide detailed pathogen characterization using targeted sequencing panels. This integrated approach improves detection, monitoring, and response to infectious diseases, reinforcing public health surveillance efforts across various workflows.

Driving Public Health Forward: QIAGEN Responds to Emerging Threats

QIAGEN is currently at the forefront of combating Highly Pathogenic Avian Influenza (HPAI) by deploying our QIAamp and EZ1 extraction kits to public health organizations worldwide. Our expertise in early detection is bolstered by our extensive experience with previous global health crises. During the COVID-19 pandemic, we rapidly scaled up production and collaborated with global health organizations to enhance testing capabilities, making these processes faster, easier, and more efficient. These efforts extended to the Mpox outbreak, and we now apply this experience to support the detection and identification of HPAI in diverse samples. Our steadfast commitment to public health improves surveillance and ensures swift response efforts, preparing our nation to effectively tackle any emerging threat.

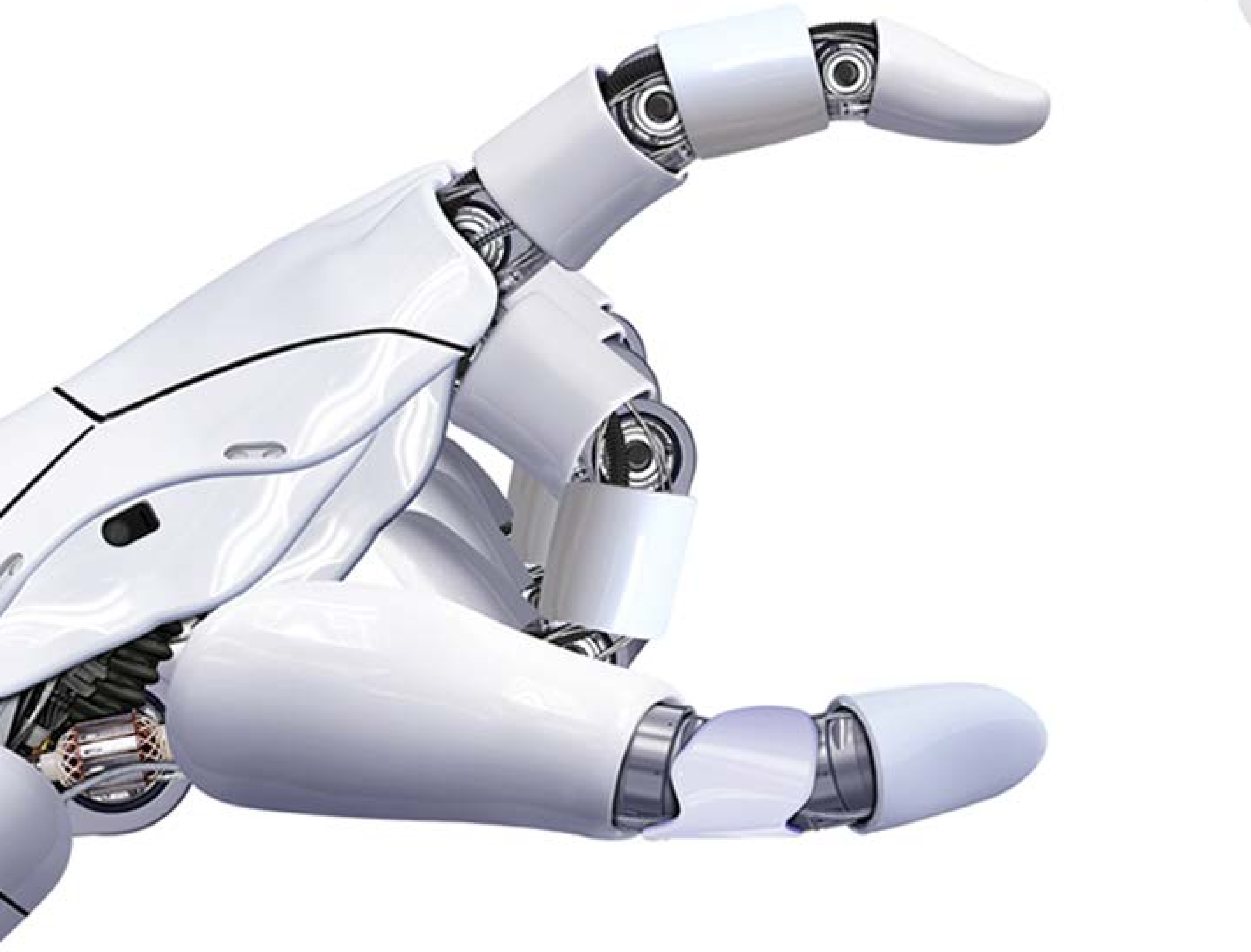
Pioneering Pathogen Detection: QIAcuity dPCR Innovations

QIAGEN is expanding our QIAcuity Digital PCR application list in public health labs, moving beyond wastewater surveillance to include areas like vector-borne disease testing, microbial source tracking, antimicrobial resistance (AMR) profiling, and precise pathogen quantification. Advancements in pathogen detection and quantification is particularly valuable for monitoring rising threats like *Legionella*, coliform bacteria, foodborne pathogens, vaccine-preventable diseases, HIV, and more. With the recent rise in Dengue cases, QIAcuity enhances mosquito pool surveillance by providing real-time monitoring of pathogen load in communities. With QIAcuity, public health laboratories can now proactively confront health threats, making it an essential component in the global effort to protect public health and ensure a safer future for all.

QIAGEN is an APHL Diamond Level Sustaining Member.

Harnessing AI to Advance Public Health Laboratories

By **Melanie Padgett Powers**, writer



In the near future, Kelsey Florek, PhD, MPH, a bioinformatician at the Wisconsin State Laboratory of Hygiene, imagines being able to "talk" to her data. Florek and other public health laboratory professionals could input their data securely into a software program that uses generative artificial intelligence (AI). They would open a chat box and ask their data questions.

Public health laboratorians could give their data queries or tasks such as: Is this COVID-19 variant more transmissible or evasive? Create a table that shows the location and potential relatedness of mpox cases over the past three months. Using the common characteristics of these cases, where were these individuals exposed to *Listeria*?

AI could also help solve puzzles, such as: Why does my bacteria look like this? Why did my sequencing not work? The computer would immediately provide answers, saving hours of analysis—but also provide important answers to questions experts might not be able to easily figure out alone.

"One of my biggest roles in the laboratory is acting as that interpreter between what the genomic data is showing us and how do we interpret it and make it actionable," Florek said. "I'm always looking for new ways to interrogate and make that data more useful. If generative AI is a potential avenue for us to use to make that data more accessible … those are areas we want to explore more of."

However, we're not quite there yet. AI needs to continue to advance, and there are plenty of concerns that must be worked out first—around accuracy, privacy, ethics, data protection and more.

The Potential of AI

AI and "machine learning" are often used interchangeably, but they are not synonymous. AI is actually an umbrella term with many different areas and types. However, most AI in society today is based on machine learning, which allows a computer to analyze data to do a task without being explicitly programmed, according to the Office of Public Health Data, Surveillance and Technology (OPHDST) at the US Centers for Disease Control and Prevention (CDC). Machine learning can find patterns in data and/or predict an output based on its training.

Tools such as ChatGPT are a specific type of AI called "generative AI" (GenAI), which uses a type of machine learning called a large language model (LLM). These LLMs can recognize and generate text, images, audio and video. LLMs are trained on large data sets. Right now, this means that ChatGPT and similar tools are not answering a question correctly as much as they are predicting what the response to a prompt (or question) should be. GenAI imitates human language, but its answers are not always accurate.

Today's GenAI has often been described as an intern who really wants to please you and give you answers—but their work products must be supervised and fact-checked.

"We're seeing a lot of the early adopters now use generative AI, but you have to realize it's not intelligence—we may call it artificial intelligence, but it's just math and code," said Jorge Calzada, MBA, head of machine learning and artificial intelligence and director of OPHDST's Platforms Division.

While Florek isn't in conversation with her data quite yet, her laboratory is using free open source machine learning models—often developed by academics—to help interpret data results. Florek works primarily in the infectious disease genomics arena. Her team has used machine learning in conjunction with their data analysis. "We're often using different models to help interpret and understand the genomic data to help explain or understand why we're seeing something—whether it's a new resistance mechanism or a new virus variant," she said.

Florek and her co-workers used machine learning during the COVID-19 pandemic to identify and classify emerging variants. "That was incredibly powerful and a really excellent use of how we can apply some of these machine learning models to help classify this evolution pattern as it's happening in real time," she said.

As the models become more sophisticated, Florek expects to move from using the software to support her analysis to being in conversation with the models, which would allow for more in-depth investigation and faster answers. Currently, working with large data sets can be difficult and require computer programming skills.

Kelly Oakeson, PhD, a bioinformatician at the Utah Public Health Laboratory, is excited about the prospect of using AI to determine things like how resistant an organism is to a specific antibiotic, which could lead to better and faster disease treatment. In that example, a laboratory would build up a training set of bacteria that are resistant to certain antibiotics. The team would conduct whole genome sequencing of those organisms to determine which genes are likely responsible for resistance to a specific antibiotic. Do that for 1,000 or so samples and you have a data set to use to train your internal machine learning algorithm, Oakeson explained.

Once you have the data set, "you could start predicting the level of what might be resistant to what antibiotic, just based on

"There's a real opportunity for public health in leveraging classical machine learning and generative AI. ... How can we lessen the burden on our data generators?"

Jorge Calzada, MBA, director, CDC OPHDST Platforms Division

their genetic signature," he said. "Without having to know anything about their physical attributes, you could predict these bacteria will all be resistant to this class of antibiotic because they've got this genetic background."

Managing and Improving Data

AI could also remove a tremendous burden that falls on public health laboratories: data management. Public health laboratory professionals are spending an inordinate amount of time managing data such as electronic reporting—taking time away from their area of expertise, said Michelle Meigs, MBA, APHL director of informatics.

"The maintenance right now to keep up, monitor and support all of those connections, to make sure the data are valid, and to make sure that it's done properly, is time-consuming," Meigs said.

Calzada calls it "data janitorial services," which includes cleaning data and transforming it from one format to another. "There's a real opportunity for public health in leveraging classical machine learning and generative AI. ... How can we lessen the burden on our data generators?"

Leveraging AI to take over those tasks would free up both employees and funds "and then that money could go back into other initiatives," Meigs said.

Of course it's not up to the public health laboratories by themselves—it takes funding, support and policy changes. The 2022 *Reimagining Public Health* survey by Ernst & Young questioned 301 public health officials. While 82% of senior leaders said they need to modernize their organization, only 39% of service delivery team members agreed. At the time, only 34% of respondents were pursuing major information technology upgrades, with only 10% integrating this activity with system-wide transformations.

This survey of 301 public health officials found that while slightly more than one in two (52%) are optimistic about what data can achieve for their communities, the rate of digital transformation remains uneven, and organizations face significant barriers to change.

Data modernization has been talked about and worked on for years in public health, but Calzada said he believes these recent and ongoing advancements in technology can help public health catch up to industry.

After the COVID-19 pandemic, CDC created three new offices, including the OPHDST which creates and manages tools to help the other divisions. Or, as Calzada explains, the Platforms Division is helping CDC become "AI ready."

The first step is to fix data quality. "We're starting to implement frameworks for how to measure that, doing that inside of a platform so it happens automatically and then sharing that information, so we can all have a common agreement on what the quality of our data is," Calzada said.

Organizations and laboratories can also assess the quality of their data. The Artificial Intelligence Maturity Model developed by MITRE is a free tool that provides a systematic framework that organizations follow as they manage, adopt, resource and implement AI. MITRE is a not-for-profit IT research and development company that works through public-private partnerships and federally funded research and development centers to solve challenges to the safety, stability and well-being of the US.

"The AI Maturity Model walks individuals and organizations through how to assess their state of readiness, where they can focus their resources, and how they can ...

assess where they are in this continuum of AI adoption," said epidemiologist E. Oscar Alleyne, DrPH, MPH, managing director of the Public Health Division at MITRE. The model also assists organizations in evaluating "how to build in maturity to more systemic, or perhaps more focused, areas of implementation," he said.

Another free tool from MITRE is ATT&CK, which is a cybersecurity tool that can develop threat models that data or organizations might be facing.

As Calzada sees it, the next step is to improve the data management lifecycle. A modern data platform should manage its data automatically, he said. That includes ingesting, storing, transforming, analyzing and sharing the data.

Calzada is a data scientist whose background is as a technology executive. After he joined the public health arena less than two years ago, he said he observed the numerous department and data siloes across public health. He believes "virtual knowledge graphs" could help public health data integration, management and access. Such graphs are more flexible and

AI is also excellent for modifying the tone of a message or altering the language for different audiences ... This could be helpful for technical documentation or reports from the public health laboratory that need to be translated into a brief summary—minus scientific jargon—to update executive leadership.

can adjust, link and find relationships among various data sets.

APHL has been partnering with CDC on a project called DETOR: The New Direction in Electronic Test Orders and Results. The project recognizes the problem of public health laboratories and health care organizations using incompatible data systems. This makes it hard to exchange critical test orders and results quickly, accurately and securely.

DETOR enables real-time electronic test orders and results to be shared between public health laboratories and providers. It is built on the AIMS Platform and transmits and translates data between disparate systems. The platform was created by APHL and fully funded by CDC. It's available free to public health laboratories and their partners through APHL.

After data quality and management improves, Calzada said the next step is to focus on machine learning operations. He said CDC has been successful at creating sophisticated computer models, but the agency needs to get better at deploying and operationalizing these models across public health.

"Can you build a factory floor that lets you produce machine learning at scale and in a reliable way, or are you going to leave it as an artisanal craft where, if you want to run a model, you call the person who built it to do it," he said. "I think we can have much more impact on public health with a factory floor approach."

Calzada encourages public health laboratories and individuals to reach out to him to discuss high-value models that CDC could build to address current public health challenges.

Generative AI has the power right now to improve efficiencies in the workplace, including in public health laboratories, said Jade Wang, a senior bioinformatics scientist at the New York City Public Health Laboratory. GenAI tools include ChatGPT, Google Gemini (now built into the Google search engine) and Microsoft CoPilot (an add-on to Microsoft 365, formerly Microsoft Office).

Wang's laboratory has not used GenAI, but she has personally used it for brainstorming and other tasks that don't use data, don't need to be fact-checked and don't involve any privacy concerns. For example, she might have trouble thinking of a certain phrase or word. Instead of turning to a dictionary or thesaurus, she uses GenAI, asking something like, "I'm looking for the word that means XYZ."

Wang outlined other use cases that could speed up and streamline tasks: You might prompt or instruct a GenAI tool to draft an email you've had difficulty writing, though you will want to edit it. Or you may need to write a new standard operating procedure (SOP). You could input the template and the SOP's basic steps and then GenAI would turn that into complete sentences and finish writing the SOP.

"That would save so much time. You wouldn't have to sit there and manually describe every single step of what you're trying to do," Wang said.

Challenges and Concerns

Current public GenAI tools do not follow data privacy or patient privacy guidelines. The models also store and learn from the text you type in, whether it is patient identification details, confidential documents, or drafts of reports that haven't been fact-checked or published yet.

Other concerns include inaccuracies and bias. GenAI is pulling information from the data sets it has been given. That data might include inaccuracies, biases, racist and bigoted language, and outdated guidelines or materials. These biases and falsehoods can be perpetuated as the tool continues to use them. In addition, marginalized voices and outlier cases will be included less frequently in the LLMs.

Back to that "intern" who wants to please you: the GenAI tool may not have an exact answer to your prompt in its data set, but it will still respond to you. These are called "hallucinations"—plausible answers that are made up. There have been instances of GenAI creating fake journal citations and nonexistent court cases.

CDC's Office of the Chief Information Officer built an internal instance using the Azure OpenAI Service, which allowed for the creation of a chatbot at CDC. Staff can use the tool to test out use cases in a safe and secure environment and increase their familiarity with AI. They can ask questions or inputs that will not be shared outside CDC and will not be used to train other versions of ChatGPT.

"That was really about protecting employees from inadvertently disseminating information that they shouldn't to the public," Calzada said. "The approach that we took was 'let's be cautious, but let's not stifle innovation'."

AI conversations often include another worry: job loss. Workers fear computers pushing them out of their roles. But that's something that public health laboratory professionals don't have to anguish over, Florek said. In fact, the expectation is that AI will help with or take over low-level tasks, like data entry and data management, freeing up laboratory staff to work on more complex tasks and projects.

Florek envisions transitioning people from data entry roles to validation roles—ensuring the quality of the data coming out of the AI models—or data interpretation or process management roles. "It's less about replacing people, and it's more about shifting responsibilities," she said.

Calzada has seen this happen in other industries as technology improves. "Machines don't replace humans. Humans who use AI are the ones that end up replacing people who don't," he said. "We see it time and time again. It's experts that embrace AI tools and make themselves far more productive than either one alone who are the ones that are the real winners."

Alleyne has seen how public health, especially public health laboratories, have often been excluded from technological advancements. But he sees an opportunity now for public health laboratories to begin exploring machine learning models, brainstorming best use cases and educating themselves about the potential of AI.

"AI has lots of great potential, but it's not something that I think you'll see being utilized tomorrow," Oakeson said. "There are still a lot of questions about its security, safety, privacy and ethics that have to be addressed and answered before it really makes its way into the government level, public health, the state level. But I think once it does, it's going to be a big boon for public health laboratories." ■

NWSS Centers of Excellence Live Up to Their Name

By **Erin Morin**, MHS, specialist, Environmental Health

In 2021, to support nationwide wastewater surveillance capability and capacity, the US Centers for Disease Control and Prevention's (CDC's) National Wastewater Surveillance System (NWSS) established Wastewater Surveillance Centers of Excellence (CoE) at the California Department of Public Health, Colorado Department of Public Health and the Environment, Houston Health Department and Wisconsin State Laboratory of Hygiene.

The four CoEs share common goals including introducing additional targets, improving laboratory processes, enhancing genomic sequencing and collaborating with public health partners for network optimization. Each CoE brings their unique perspective to address these challenges in a way that will best meet their program and NWSS region needs.

Looking Beyond SARS-CoV-2

All four CoEs are working to include additional targets beyond SARS-CoV-2 to expand the current range and utility of wastewater surveillance. Targets range from respiratory diseases such as influenzas A (including H5N1) and B, RSV and Enterovirus Disease 68 (EV-D68), to other vaccine-preventable diseases, fungal and enteric pathogens, multi-drug-, antimicrobial- and carbapenem-resistant genes, and vector-borne diseases (**Table 1**).

Improving Laboratory Processes

Wisconsin is leading an all-CoE collaborative effort to develop a best practice guide for additional target validation. Colorado is working to increase protocol efficiency by determining which pathogens can be multiplexed and which are best tested seasonally versus year-round. Houston is developing new multiplexed assays (e.g., COVID-19, influenza and RSV) to continue increasing testing coverage and efficiency. They are also comparing detection levels and consistency between facility-level and wastewater treatment plant sampling sites to better understand wastewater surveillance data across different testing scales. California continues to develop assays and work with disease programs and subject matter experts to pilot new pathogen targets. Wisconsin is developing a laboratory performance assessment program that will help ensure analytical consistency across all NWSS jurisdictions.

Enhancing Genomic Sequencing

All four CoEs plan to provide sequencing guidance due to considerable differences in clinical and wastewater sample type and preparation. California is developing a sequencing center to scale up testing, while Colorado continues to be a resource for laboratories navigating wastewater sequencing. Houston is working on laboratory sequencing validation, has developed a computational pipeline to improve and automate tiled amplicon primer design to increase target specificity, and has multiplexed sequencing of several pathogens. Wisconsin is optimizing concentration and extraction methods to achieve the highest quality and concentration of a sample's genetic material. This will enable successful sequencing of

Additional CoE Wastewater Surveillance Targets	
Target	**CoE**
Respiratory (R) and/or Vaccine-preventable (VP) Diseases	
Enterovirus Disease 68 (EV-D68) (R, VP)	California, Colorado, Wisconsin
Hepatitis A (VP)	All
Influenza A (including H5N1) (R, VP)	Colorado, Houston, Wisconsin
Influenza B (R, VP)	Colorado, Houston, Wisconsin
Measles-Mumps-Rubella (MMR) (R, VP)	All
Mpox (VP)	All
Respiratory Syncytial Virus (RSV) (R, VP)	Colorado, Houston, Wisconsin
Fungal Pathogen	
Candida auris	All
Enteric Pathogens	
Norovirus	All
Rotavirus	All
Salmonella	All
Shiga Toxin-Producing *E. Coli* (STEC)	All
Vector-borne Diseases	
Dengue	California, Colorado, Houston
West Nile Virus	California, Colorado, Houston
Zika Virus	California, Colorado, Houston
Multi-drug-, Antimicrobial- and Carbapenem-resistant Genes	Houston, Wisconsin

Table 1.

pathogens with low innate concentration in wastewater, such as influenza.

Network Optimization through Collaboration

The CoEs are working with their utility, health department, academic and other partners to determine how wastewater surveillance can be used in a multitude of approaches and scales. California is building capacity at the local health department level to expand a statewide municipal network and is developing a response plan for H5N1 surveillance, intended to be adaptable to similar future outbreak scenarios. Colorado and Houston have developed plans for scaling testing up or down based on routine sentinel site detection levels as well as strategic testing at long-term care facilities and schools. Wisconsin is evaluating surveillance approaches at the building level and at large-scale, time-limited events.

Mentoring Opportunities

All four CoEs are available to mentor other jurisdictions, both in person and remotely. Visits can focus on specific aspects of or the full workflow. Reach out to NWSS@cdc.gov to be connected with your jurisdiction's CoE.

APHL Training Opportunity

APHL is excited to announce the development of our wastewater surveillance peer-to-peer training program. Starting soon, APHL will sponsor laboratories to visit not only CoEs but also other peers to learn more about their wastewater surveillance workflow. If you are interested in hosting a peer laboratory or attending a site visit, please email eh@aphl.org.

Audience at the California Water Environment Federation Workshop on June 5 that focused on utility support and public health communication. Photo credit: Jenny Sabater/WEF

Public Health Laboratories: Preventing Lead Poisoning Then and Now

By **Paul Allwood**, PhD, MPH, Lead Poisoning Prevention and Surveillance Branch, US Centers for Disease Control and Prevention; **Jennifer Liebreich**, MPH, manager, Environmental Health; and **Perri Zeitz Ruckart**, DrPH, MPH, Lead Poisoning Prevention and Surveillance Branch, US Centers for Disease Control and Prevention

There are no safe blood lead levels (BLL) in children. Even low levels of lead in blood can cause developmental delays and behavioral issues. Since 1991, the US Centers for Disease Control and Prevention's (CDC's) Childhood Lead Poisoning Prevention Program (CLPPP) has supported state and local health departments to protect children from lead exposure and its harmful effects. Doctors' offices often test children's blood for lead using point-of-care devices, such as LeadCare. Public health laboratories use instrument platforms such as inductively coupled plasma/mass spectrometry (ICP-MS) and graphite furnace atomic absorption spectroscopy (GFAAS) to provide more accurate (e.g., lower detection and reporting limits) and confirmatory testing.

Complexities of Lead Testing

Currently, lead testing capabilities include point-of-care or definitive laboratory tests. Point-of-care tests may offer immediate results during a patient's visit but are approved for use on capillary specimens only. Laboratory tests using either GFAAS or ICP-MS provide the most sensitive and accurate tests results. At lower detection limits, steps must be taken to minimize contamination during specimen collection and analysis.

Role of Laboratories in Lead Poisoning Prevention

CLPPP and state and local public health laboratories have played a major role in blood lead testing. Building upon the work of multiple long-standing state programs, state public health laboratories are able to leverage lead testing capacity and capabilities through the Laboratory Response Network for Chemical Threats (LRN-C), a national network of CDC and local and state public health laboratories prepared to respond to chemical terrorism and other public health emergencies. Some LRN-C laboratories are qualified to perform the LRN-C blood metals panel, which includes lead.

In 2023, APHL's Pediatric Lead Testing Capability and Capacity Survey assessed the current extent of public health laboratory involvement in lead testing and desire to develop or expand childhood lead testing programs if funds were available. Of the 70 (63% response rate) public health laboratories responding to the survey:

- 36% conduct routine analyses of pediatric lead testing
- 7% perform such analyses only in emergency situations
- One laboratory provides a reference laboratory service

Public health laboratories currently capable of blood lead testing indicated that their laboratories have the capacity to provide additional analyses for their pediatric lead testing program if more resources were made available.

Since CDC lowered the blood lead reference value (BLRV) from 5.0 to 3.5 micrograms per deciliter (µg/dL) in 2021, the survey included a question about resultant changes to analytical practices. The survey examined the average detection and reporting limits for a variety of testing platforms and how the reported limits compare to the BLRV. In response to the updated BLRV:

- 26% of respondent state laboratories made changes to their contamination control practices
- 53% enhanced communication with collaborators like public health partners and clinicians

Collaboration Is Key to Success

Recent events highlight the importance of environmental health system collaboration to prevent lead exposure. In fall 2023, a nationwide lead contamination investigation began when the North Carolina Department of Health and Human Services (NCDHHS) CLPPP identified four children with high blood lead levels due to contaminated applesauce pouches. The investigation included collaboration with the local health departments, NC State Laboratory of Public Health, and the North Carolina Department of Agriculture & Consumer Services to determine the route of exposure.

NCDHHS identified apple puree pouches as a potential source of exposure and reported that to the US Food and Drug Administration (FDA). FDA's Laboratory Flexible Funding Model (LFFM) laboratories—who support an integrated food safety system by testing human and animal food and are also APHL members—swiftly collected samples and conducted testing across the country. Lead chromate found in the cinnamon of these products was identified as the source of contamination. The collaborative investigation by CDC, FDA, and state and local government agencies resulted in a national recall, demonstrating the impact of laboratory and public health partnerships.

Looking Toward the Future

The BLRV has declined as BLLs in American children decreased. If the BLRV is lowered further, quality laboratory practices, contamination controls, and highly accurate testing methods and instrumentation are expected to rise in importance for achieving accurate test results. The existing relationships between public health laboratories and environmental health system partners provide an inimitable web of preparedness to potentially expand pediatric lead testing efforts and prevent lead poisoning. ■

Disclaimer: The content and conclusions in these presentations are those of the authors and presenters and do not necessarily represent the views of, nor should any endorsements be inferred by, the US Centers for Disease Control and Prevention.

Reference: CLSI. Measurement Procedures for the Determination of Lead in Whole Blood. 3rd ed. CLSI guideline C40. Clinical and Laboratory Standards Institute; 2024.

Timeline of Key Laboratory Developments in the United States

1971: Lead-based Paint (LBP) Poisoning Prevention Act of 1971; 40 μg/dL=undue absorption of lead; BLLs of 80 μg/dL=lead poisoning; CDC initiates lead poisoning prevention grant program for cities.

1972: EPA initiates health-based regulation to remove lead from gasoline.

1974: Safe Drinking Water Act authorizes EPA to set limits of lead in drinking water.

1978: 1971 LBP ban in federal residences becomes effective. CDC defines elevated blood lead level as 30 μg/dL.

1988: The Lead Contamination Control Act of 1988 authorizes CDC to support local and state agencies to develop comprehensive childhood lead poisoning prevention programs (CLPPPs).

1990: Clean Air Act bans leaded gasoline.

1991: CDC lowers blood lead level of concern to 10 μg/dL. CDC CLPPP receives funding to support a comprehensive program that recommended universal screening and provides guidance on case management (1991-1997).

1993: Centers for Medicare and Medicaid Services (CMS) adopts CDC's universal screening requirements for children receiving Medicaid benefits.

1995: CDC and the Council of State and Territorial Epidemiologists (CSTE) develop national surveillance system for monitoring BLLs. BLLs become the first national notifiable noninfectious condition. CDC CLPPP begins collecting pediatric BLL surveillance data from state health departments.

1996: Leaded gasoline ban becomes effective.

1998: CDC recommends targeted screening and focuses on improving surveillance.

2012: CDC replaces "level of concern" with BLRV to identify children with BLLs that are much higher that most US children. BLRV was set at 5μg /dL, based on the 97.5 percentile of the estimated blood lead distribution in children 1-5 years old using data from the National Health and Nutrition Examination Survey (NHANES).

2012–2013: Congress reduces CDC CLPPP appropriations to $2 million, resulted in the loss of extramural funding of state and local CLPPPs (previously $36 million).

2014: Congress restores CDC CLPPP funding to $13 million after Flint, MI water contamination. Funding is used for surveillance and community-based strategies and partnerships to focus on children who are at high risk.

2016: Water Infrastructure Improvements for the Nation (WIIN) Act allocates $35 million to CDC to enhance childhood lead poisoning prevention activities; to establish a voluntary Flint, MI lead exposure registry; and to establish the Lead Exposure and Prevention Advisory Committee (LEPAC).

2017: FDA issues a safety recall to discontinue using Magellan Diagnostics' Lead-Care Testing Systems for analyzing venous blood samples. To promote accurate measurements of BLLs, CDC sponsors a voluntary external quality assurance program for laboratories.

2021: CDC updates its BLRV from 5 μg/dL to 3.5 μg/dL, based on NHANES data.

Source: https://www.cdc.gov/lead-prevention/php/about-clppp/timeline.html

Building a Blueprint for Excellence in Food Safety

By **Robyn Randolph**, manager, Integrated Food Safety Systems

In June 2024, APHL completed the development of the National Curriculum Standard (NCS) Laboratory Curriculum Framework (LCF). This national effort aims to standardize training and competency in human and animal food testing laboratories, increasing confidence in and use of state laboratory data. The framework spans four professional levels (entry, mid, expert, director) and depicts the content areas in which laboratory professionals must possess competencies (i.e., knowledge, skills, abilities, behaviors and attributes) to successfully perform their job functions. These competencies are categorized into core content areas for all laboratory professionals, and program-specific content areas for specialists in chemistry, microbiology or other focused programs. Although the LCF was designed with regulatory human and animal food testing in mind, many content areas, such as laboratory ethics and basic laboratory math, are broadly applicable across various types of laboratory testing.

Supporting a New Training System

In April 2024, the US Food and Drug Administration (FDA) announced the design of the Regulatory and Laboratory Training System (RLTS) to establish a standardized training protocol for all regulatory and laboratory professionals involved in an Integrated Food Safety System. The RLTS focuses on delivering consistent, high-quality training to create a highly competent, integrated workforce. It utilizes the competencies outlined in the LCF and the NCS Food Protection Professionals Framework as guides for developing training opportunities. Through the RLTS, various partners—including state and federal agencies, associations, academia and industry—can design and deliver competency-based training to regulatory and laboratory professionals. The RLTS will also define learning paths for these professionals, detailing the necessary competencies and associated training for their current positions and career advancement.

Competency Blueprints

Each content area in the LCF is supported by a blueprint document that lists the competencies and behavioral anchors required for those testing human and/or animal food. A competency statement represents the target benchmark against which an individual is assessed. A behavioral anchor provides observable evidence that a person possesses a specific competency. The LCF competencies describe an ideal analyst's knowledge, skills or abilities. These competencies can be acquired through appropriate classroom or on-the-job training. These competencies were validated by members of the governmental human and animal food testing laboratory community, ensuring consensus on important concepts and competencies beyond the NCS LCF development group.

Course Development

APHL is developing training opportunities to accompany the LCF. To date, APHL has completed 14 online courses aligned with entry level core topics, with eight more in development. These online, asynchronous learning modules are available on the APHL Learning Center and can be found by searching "LCF." Additionally, APHL is working with FDA's Office of Training, Education and Development (OTED) and Office of Regulatory Science (ORS) to create two instructor-led trainings on various methodologies, which will be available to FDA and state participants in 2025.

Significance for Public Health Laboratories

The NCS LCF promotes consistent, high-quality work among laboratorians nationwide. Laboratory supervisors can use the competency blueprints to assess staff proficiency in various content areas and identify individual training needs. These courses can supplement in-house training, offering additional resources for new-hire orientation and continuing education. Additionally, the LCF provides a structured approach for documenting staff competency and completed training, helping laboratories meet ISO/IEC 17025 and other accreditation standards. The framework also aids in retaining and transferring knowledge by cataloging essential competencies for laboratorians. With many states facing workforce shortages due to impending retirements of senior-level staff, the LCF helps preserve institutional knowledge by outlining key competencies that should be passed on to future laboratorians.

To learn more about the LCF and how to use the LCF competency blueprints in your laboratory, please contact Robyn Randolph, manager, Integrated Food Safety Systems, at robyn.randolph@aphl.org.

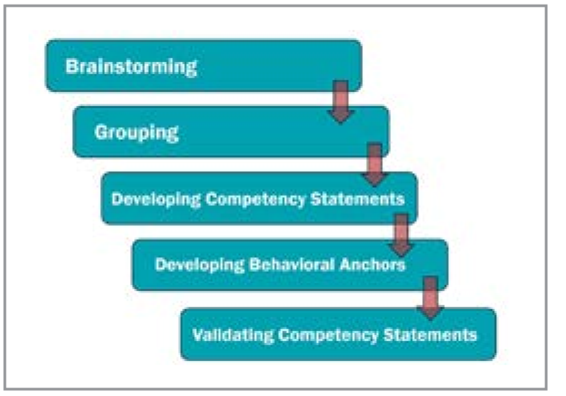


Figure 1. FDA OTED Competency Development Process

APHL collaborated with a number of partners on this project, including:

- US Food and Drug Administration (FDA)
- Association of Food and Drug Officials (AFDO)
- Association of American Feed Control Officials (AAFCO)
- International Food Protection Training Institute (IFPTI)
- Canadian Food Inspection Agency (CFIA)
- US Department of Defense (DOD)
- State laboratory partners
- Independent consultants

A Strong Sustaining Member Relationship Drives Success in Resolving Testing Issues

By **Rhodel Bradshaw**, senior specialist, Food Safety

In 2022, APHL brought together leaders from bioMérieux, member laboratories and federal partners to address an issue with the *Cryptosporidium* spp. target on the BioFire® FilmArray® Gastrointestinal (GI) Diagnostic Panel. The BioFire GI Panel screens for up to 22 gastrointestinal pathogens using stool specimens from patients and is a US Food and Drug Administration (FDA)-cleared tool for clinical and public health laboratories to diagnose enteric illness and investigate foodborne disease outbreaks.

CryptoNet National Surveillance Program

The US Centers for Disease Control and Prevention (CDC) established CryptoNet in 2015 to increase national reporting of cryptosporidiosis and better understand outbreaks and the transmission of *Cryptosporidium* spp. The CryptoNet network utilizes molecular subtyping to detect clusters of illness, help identify a source for those clusters and facilitate real-time sharing of *Cryptosporidium* case data in the United States. Many public health and clinical laboratories conduct testing for *Cryptosporidium* using multiplex nucleic acid amplification tests (NAATs) such as the BioFire FilmArray GI Panel. Positive *Cryptosporidium* specimens via NAATs, direct florescent antibody (DFA), or enzyme immunoassay are forwarded to CryptoNet-certified public health laboratories that partner with CDC to conduct additional molecular subtyping and whole-genome sequencing (WGS) on those specimens.

CryptoNet uses the Sanger sequencing protocol and WGS. Sanger utilizes primers for amplification of two gene targets and is performed on all specimens. CryptoNet laboratories then utilize bioinformatics to perform quality control checks to ensure sequencing data aligns with original NAAT results. The Minnesota, Wisconsin and Nebraska public health laboratories are in the process of validating *Cryptosporidium* WGS protocols, which will eventually be rolled out to all CryptoNet sites. WGS is performed on two species, *C. parvum* and *C. hominis*, but CryptoNet's overall goals include expansion to all 50 *Cryptosporidium* species and other potential undiscovered subspecies. WGS will provide higher resolution including Actin, heat shock protein hsp70, 18srRNA and GP60 genes.

CryptoNet Detects an Issue

In April 2022, four CryptoNet sites—Wisconsin, Minnesota, New York and Georgia—noticed inconsistencies between original submitter results and in-house testing. When looking at the method used, the majority of inconsistent results were from the BioFire platform. In Wisconsin's case, the negative specimens forwarded to CDC had originally tested positive for *Cryptosporidium* on the BioFire platform at the clinical laboratories. Concerns were raised as to why public health testing was not matching the initial results being observed and reported by clinical laboratories. After performing quality checks and investigating potential causes, Wisconsin notified CDC of a suspected false positive issue with the *Cryptosporidium* target on the BioFire. Wisconsin also observed that there was a shift in the median and mean age of all cases that were negative via 18srRNA and GP60 gene analysis.

Shortly following Wisconsin's report, Minnesota contacted CDC with similar discrepancies between the confirmation rate from the original submitter tests and their in-house PCR test results. Minnesota noted that BioFire specimen confirmation rates went from 90% to 20% between October 2021 and April 2022. In their initial investigation, 31 out of 74 BioFire confirmed specimens were negative. After reanalyzing the data later in the year, all 2022 specimens that tested positive via BioFire came back negative. Like Wisconsin, Minnesota noted an increase in age distribution and immunocompromised cases. New York and Georgia observed similar trends. New York saw a three-fold increase in submission numbers and a considerable number of negatives that had previously tested positive using the BioFire platform (38%). Georgia had 32 of 53 BioFire-positive specimens (60%) that tested negative. The age demographic of reported cases increased by 8.3 years from 2019–2022.

Leveraging APHL Connections and Partnerships

APHL previously collaborated with sustaining member bioMérieux on a separate initiative, and had existing connections to BioFire staff, which proved to be crucial in the investigation. APHL facilitated and ensured timely communication between bioMèrieux, member laboratories and federal partners by setting up calls with affected states, distributing the bioMérieux Client Letter, posting in ColLABorate communities, sending emails and arranging an All-Laboratory Director presentation in January 2023. Additionally, APHL developed multiple resources to assist members, including a FAQ document drafted in consultation with key members and cleared by CDC, and a tracking sheet intended to capture epidemiologic and demographic data on suspected false positive specimens.

CDC sent 68 suspected false positive specimens and an additional five positive specimens to bioMérieux for BioFire scientists to evaluate onsite. Through their investigative research, bioMérieux scientists determined that the BioFire software was misreading products of the non-specific *Cryptosporidium* target within the *crypt2* assay. As indicated by BioFire scientists, the non-specific product has a melting temperature that lands in a temperature range that the software used for background signal normalization and therefore expects to be "negative." When this product is present and generates a melt signature in this temperature range, it creates an artifact or distortion of the signal in the expected temperature range for a positive *Cryptosporidium* result. This distortion (an inappropriate signal subtraction) is sometimes interpreted as "positive." Once the issue was clear, bioMérieux was able to develop an

continued on page 28

Using Machine Learning to Evaluate Text Responses from a Laboratory Data Repository

By **Fredrick Mwasekaga**, informatics specialist, Tanzania; and **Reshma Kakkar**, informatics manager, Global Health

Machine learning (ML), a subset of artificial intelligence (AI), involves training algorithms to recognize patterns and make decisions based on data. Supervised and unsupervised learning are types of ML.

APHL has helped several countries set up a central laboratory data repository that captures all data produced by laboratory systems and/or modules. A ML model is a program or algorithm that can be fine-tuned by performing a supervised training to extract the type of data required to do the analysis. For example, people's names may not be captured in the central laboratory data repository, therefore there is no need to train the algorithm on that process.

The majority of the supervised training will involve:

1. **Text Classification:** Categorizing data into predefined categories, such as whether a laboratory result is normal or abnormal.
2. **Sentiment Analysis:** Analyzing data to determine the sentiment expressed, such as "an organism found" versus "an organism not found."
3. **Named Entity Recognition (NER):** Identify and classify entities like chemical compounds, gene names or disease conditions within text data. International terminology standards are a great source for NER.

Challenges

While the advantages are compelling, there are several challenges to keep in mind when using machine learning for text evaluation:

1. **Data Quality:** The effectiveness of ML models depends heavily on the quality of the data used for training. Inconsistent, incomplete or biased data can lead to inaccurate results; these are called hallucinations. Using natural language processing (NLP), which is another component of AI, data can be extracted from free-written text results, especially ones with misspelled words (i.e., Malaria vs Mariah).
2. **Model Training:** Smaller ML models can process data faster but are not as accurate. ML models have to address issues like data privacy, consent (i.e., licenses), and potential biases in the algorithms.
3. **Interpretability:** Understanding how complex ML models arrive at a specific decision is crucial for trust and transparency (i.e., how a NER is classified as a person rather than an organism).
4. **Computing Power:** To be able to process large models, hardware utilized for processing must be able to load them (i.e., lots of random access memory (RAM) on the memory stick and graphical processing unit (GPU).

Future Prospects

APHL is working on incorporating these ML models with the next version of the laboratory data repository tool to enhance the analysis and automating process. ■

Sustaining Member Relationship

continued from page 27

updated version of the GI panel software. The software update changes the way that the background subtraction is done for the *crypt2* assay so that the non-specific melt product is no longer able to influence the background subtraction.

FDA rapidly cleared the software update, and bioMérieux followed up with Field Corrective Action (FCA) 5747 on April 25, 2023, deploying the software to BioFire FilmArray Torch Systems and BioFire FilmArray 2.0 system users. Within the technical note distributed by bioMérieux, customers were able to find instructions on installation procedures and technical support. Subsequently, CryptoNet and member sites were able to observe and confirm the update was an appropriate solution to the issue. As of June 2023, with the updated software in place, state laboratories were seeing concordance rates of 98% when re-testing samples received from clinical laboratories.

Conclusion

Enhanced collaboration between CDC, APHL, public health laboratories and sustaining members facilitates streamlined data and information sharing, and enables a rapid, coordinated response to public health challenges. By fostering open dialogue and cooperation, public health partners can address emerging issues more efficiently, adapt to technological changes, and improve patient care outcomes. As culture-independent diagnostic tests continue to evolve, maintaining strong inter-agency and cross-sector communication will be essential for maximizing its potential benefits and navigating future challenges in disease diagnostics and surveillance.

For more information on this success or other CryptoNet related projects, please contact Rhodel Bradshaw, senior specialist, Food Safety at rhodel.bradshaw@aphl.org. ■

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Building Arbovirus Testing Capability in Puerto Rico

By **Ismael Rodríguez Rodríguez**, laboratory operations manager, Puerto Rico Public Health Laboratory and **Anne M. Gaynor**, PhD, deputy director, Infectious Diseases

From right to left: Julio Valentín Román, Ismael Rodríguez, Ricardo Mendoza Cabassa, Ramon Flores Ramos and Denisse Padilla Medina. Photo: PR PHL

In Puerto Rico, the word "dengue" is not exotic or unknown—it is an endemic virus that causes large outbreaks in cycles approximately every three to seven years. Since the most recent large outbreak occurred in 2012–2013, a large outbreak was overdue for the island. In March 2024, the Puerto Rico Department of Health (PRDH) declared a public health emergency and, in June 2024, the US Centers for Disease Control and Prevention (CDC) released a Health Alert Network (HAN) Advisory warning of increased risk of dengue virus (DENV) infections in the United States because of increased global incidence, record-breaking numbers of cases in the Americas and the increasing number of cases in Puerto Rico.

Public health surveillance of arboviruses—DENV in particular—is a critical and ongoing public health activity within the PRDH. Weather events such as el Niño and increased hurricane activity can heavily influence vector-borne diseases such as dengue, making arboviral surveillance critical prior to and immediately following an event. With ongoing concern for increasing hurricane activity and the known impacts from Hurricane Maria, the PRDH has been reviewing its existing systems and is working to enhance arbovirus-specific diagnostic testing capacity. Historically, arboviral testing was performed by the Biological and Chemical Emergencies Laboratory (BCEL), which focuses on testing for emergency response and preparedness for PRDH. To create more efficiency in the system, PRDH leadership was interested in transitioning testing from BCEL to the Infectious Diseases section of the public health laboratory, which handles more routine surveillance and testing. In 2023, APHL was able to add support to this effort through a number of activities.

When APHL started supporting the work, efforts were already underway at the public health laboratory with some minor renovations to the molecular laboratory, including relocation of some office spaces, installation of benchtops and new air conditioning units as well as procurement of necessary equipment. The public health laboratory, with the support of CDC's Division of Vector-Borne Diseases, Dengue Branch (based in San Juan, PR and funding through the Epidemiology and Laboratory Capacity Program (ELC), had also begun purchasing equipment, identifying staffing needs to create and hire new positions, working through testing algorithms and establishing ordering and reporting mechanisms. In December 2023, APHL staff and consultants were able to perform a site visit to meet laboratory staff, PRDH staff and partners, and tour the facility along with completing a survey tool for arbovirus disease testing. APHL also hosted a one-day meeting with all relevant partners to discuss in detail testing algorithms, test ordering and results and think through processes and systems. The meeting helped to identify positive progress toward the transition as well as identify some gaps where additional technical and financial support might be helpful.

By early spring the public health laboratory was validating equipment and staff were gaining familiarity with the methods through trainings with CDC and BCEL. Updating the laboratory

continued on page 36

AI, Automation and Public Health Laboratories

By **Rebecca Abelman**, senior specialist, AMR Informatics

The use of automation and artificial intelligence (AI) is growing in clinical laboratories, and new instruments and solutions are debuted regularly. These innovations aim to decrease bench time, increase test sensitivity/specificity, and decrease turnaround time for results. These new technologies will shape the future of public health laboratories and data.

"Artificial intelligence" is a broad term used to describe computer systems or algorithms used to imitate human intelligence. There are various types of AI and various ways it can be applied, but the most relevant to healthcare is machine learning. While traditional programing requires a human programmer inputting predefined patterns into an algorithm to create rules for analyzing data, machine learning instead uses a computer model to develop an algorithm that creates the analysis rules. Traditional programming can create an algorithm that is defined and customizable by the programmer, but machine learning algorithms can be created for large input variables and complex data that exceed the limits of human capacity. This ability to handle larger, multiplex data sets allows for instrumentation that perform tasks typically performed by humans and can even out-perform them in some cases.

Automation is already implemented across a variety of laboratory technologies and it is a vital part of modernization of laboratories around the world. Laboratory automation is the utilization of technologies that can be controlled with minimal scientist interaction. Most automated instruments in laboratories today are classified as partial automation, as they automate one process in a testing workflow. This includes all-in-one PCR instruments and culture systems. However, full workflow automation instrumentations are entering the market, and these instruments provide beginning-to-end automation of entire assays. Some even include sample processing so laboratorians can load samples directly into the instrument. These workflow automation instruments increase walkaway time for scientists, decrease error and turnaround time, and facilitate interoperability between different laboratory technologies and systems.

A Place in the Public Health Laboratory

Practical applications of AI and automation are already out in the field. Digital microscopy image analysis programs for hematology and microbiology can review thousands of images using AI and learn to alert laboratorians of abnormal/significant view fields or pathological conditions present in a sample. This AI type is found in the Beckman Coulter Scopio™ System, which uses an AI-based application to view peripheral blood smears and claims to reduce turnaround times by 60 percent. The BD Kiestra™ is an example of both AI and automation used to create a collection of workflow automation instruments for microbiological culture. The Kiestra™ system uses incubators attached to a series of cameras to create digital images of culture plates, and some models include culture plate tracks to deliver plates from the specimen processing units to incubators to connected workbenches. Screening culture plates like Methicillin-resistant *Staphylococcus aureus* (MRSA) and Urine plates can be read by AI applications trained to interpret negative or positive cultures by colony morphology.

The impact of AI and automation on public health is still being explored, and many of these innovations could have a major impact in the field of public health. The high data and variable capacity of AI analysis could be used by epidemiologists, research scientists and public health laboratories for improved data analysis. Increased automation could decrease the burden on public health laboratorians by decreasing bench time. These technologies could also create new data elements that need to be added to databases—a process that takes extensive time and resources. The scope and scale of these improvements are dependent on how accessible these technologies are and whether they produce quality data and test results. Even if these tools are implemented, the current lack of standards and quality assurance resources needs to be addressed before these solutions can be utilized in public health laboratories. Preparation for the current and eventual application of more AI and automation in public health is crucial for supporting the future of public health laboratories, scientists and data. ■

Enhancing Laboratory Safety, Preparedness and Response through In-person Workshops

By **Jill Sutton Hanratty**, specialist, Emergency Preparedness and Response; and **Stormy Chester**, specialist, Biosafety and Biosecurity

APHL Technical Biosafety Workshop attendees displayed their creativity with Play-Doh art.

As laboratory science, practice and policy continue to evolve, public health laboratories depend on a capable workforce to have the management skills, technical knowledge and leadership experience needed to effectively manage laboratory operations and embrace innovations. Workforce development for public health laboratory scientists is a continuous cycle to maintain competency and strengthen skills. Across the United States, many laboratories are seeing significant staff turnover, with such attrition resulting in a loss of institutional knowledge and leadership needed in the disciplines of laboratory preparedness and response.

In early 2024, via funding from the US Centers for Disease Control and Prevention (CDC), Center for Laboratory Systems and Response (CLSR), Division of Laboratory Systems (DLS), APHL convened four in-person workshops to facilitate professional development, enhance technical knowledge and provide leadership training to laboratory preparedness coordinators and biological safety professionals working in state, local, territorial and US-affiliated Pacific Island (USAPI) public health laboratories.

Enhancing Technical Skills of Biosafety Professionals

APHL convened three regional biosafety technical workshops in Tampa, FL, Pearl City, HI, and Richmond, CA, reaching 77 attendees from 24 states and seven USAPIs. These workshops targeted biosafety officers (BSOs) in state, local and USAPI public health laboratories and provided training on biosafety fundamentals such as risk assessment, risk mitigation, competencies, quality and outreach. During each workshop, APHL used an affinity exercise to provide a forum for attendees to share their priority needs and challenges in laboratory safety. APHL also tasked the attendees with identifying possible solutions they can then incorporate at their own institutions. Upon the conclusion of the three biosafety technical workshops, APHL observed common challenges:

1. **Inconsistent Biosafety Buy-in:** Securing commitment on biosafety enhancements from both bench-level staff and leadership can be challenging, especially when implementing additional biosafety protocols within facilities.
2. **Implementing Risk Assessments:** Participants noted they are confident performing risk assessments with the training and resources they received; however, they struggle with the implementation process of risk assessments within their facilities.
3. **Varying Biosafety Practices:** Participants noted that biosafety practices varied across laboratories and as such, it is difficult to utilize information from other laboratories when they follow different practices for the same procedures.
4. **Lack of Training:** Participants noted a lack of accessible and affordable in-person and virtual training and insufficient knowledge of how to conduct effective training within their facilities. Participants expressed a desire to improve their ability to deliver biosafety training to others in their facilities.

In collaboration with its Biosafety and Biosecurity Committee, APHL will

continued on page 32

APHL would like to thank the laboratory directors and staff for assisting APHL with hosting the four preparedness workshops: **Andrew Cannons**, PhD, laboratory director, Bureau of Public Health Laboratories-Tampa; **Edward Desmond**, PhD, D(ABMM), state laboratories administrator, Hawai‘i State Department of Health; **Anthony Tran**, DrPH, MPH, D(ABMM), director, California Department of Public Health; and **Emily Travanty**, PhD, Laboratory Director, Colorado State Public Health Laboratory.

From left to right: Chris Mangal, Andrew Cannons (FL-Tampa), Tricia Blevins (CDC), Remedios Gose (HI), JohnAric Peterson (WA), Jill Sutton Hanratty, Ruby Rong Ni (OK), Irma Cornejo (CA-Solano County), John (Brad) Bowzard (CDC), Andrea Morris (IA), Pandora Ray (APHL Consultant), Kelsey Wieland (IA), Breahna Giles (MN), Lisa Smith (AK), Robert Tran (CA-Los Angeles), Kate Fitzpatrick (AZ), Stephanie Barahona, Peter Kyriacopoulos, Kim Christensen (UT), LeAnn Covington (LA), Tyler Wolford, Kayla Morgan (MO), Leanne Nicholls (SD), Caroline West (WA), Benjamin Ayers (NE) , Alexandra Portman (TX-Dallas), Kimberly Newman (MT), Ricardo Quijano (TX-Houston), Amanda Cosser, Ashley Luntsford (CO). Not Pictured: Emily Travanty (CO) and Peter Davis (CO)

continued from page 31

identify strategies to support biosafety professionals with addressing the challenges mentioned above.

Strengthening Preparedness and Response Skills of Laboratorians

APHL facilitated the first Emergency Preparedness and Response (EPR) Leadership Workshop in Denver, CO, convening laboratory professionals working in state, local and territorial public health laboratories located west of the Mississippi River as well as subject matter experts (SMEs) from APHL member laboratories and partners to serve as instructors. Twenty participants—including laboratory directors, biothreat preparedness coordinators, chemical threat preparedness coordinators and biosafety officers—engaged in interactive, skill-building sessions over two days, focusing on:

- Leadership
- Public health incident management
- Coordination with emergency preparedness and response networks and key partners
- Public policy and its implications on laboratory operations
- Communications and strategies for effective communication
- Developing and implementing effective training programs
- Approaches to implementing continuous quality improvements.

The workshop allowed participants to gain a broader skill set and network with laboratorians from neighboring jurisdictions. APHL is planning the second EPR Leadership Workshop for public health laboratories east of the Mississippi River and is using feedback gathered from the first workshop to make improvements as well as provide more training opportunities and resources to all its members.

In collaboration with its Public Health Preparedness and Response Committee and other partners, APHL will continue to develop and deliver quality training courses to laboratory professionals. These in-person workshops, supported by CDC, provide vital opportunities to deliver much needed in-person training to strengthen technical, management and leadership skills of the public health laboratory workforce. ■

Emergency Preparedness and Response Leadership Workshop attendees complete Play-Doh creations.

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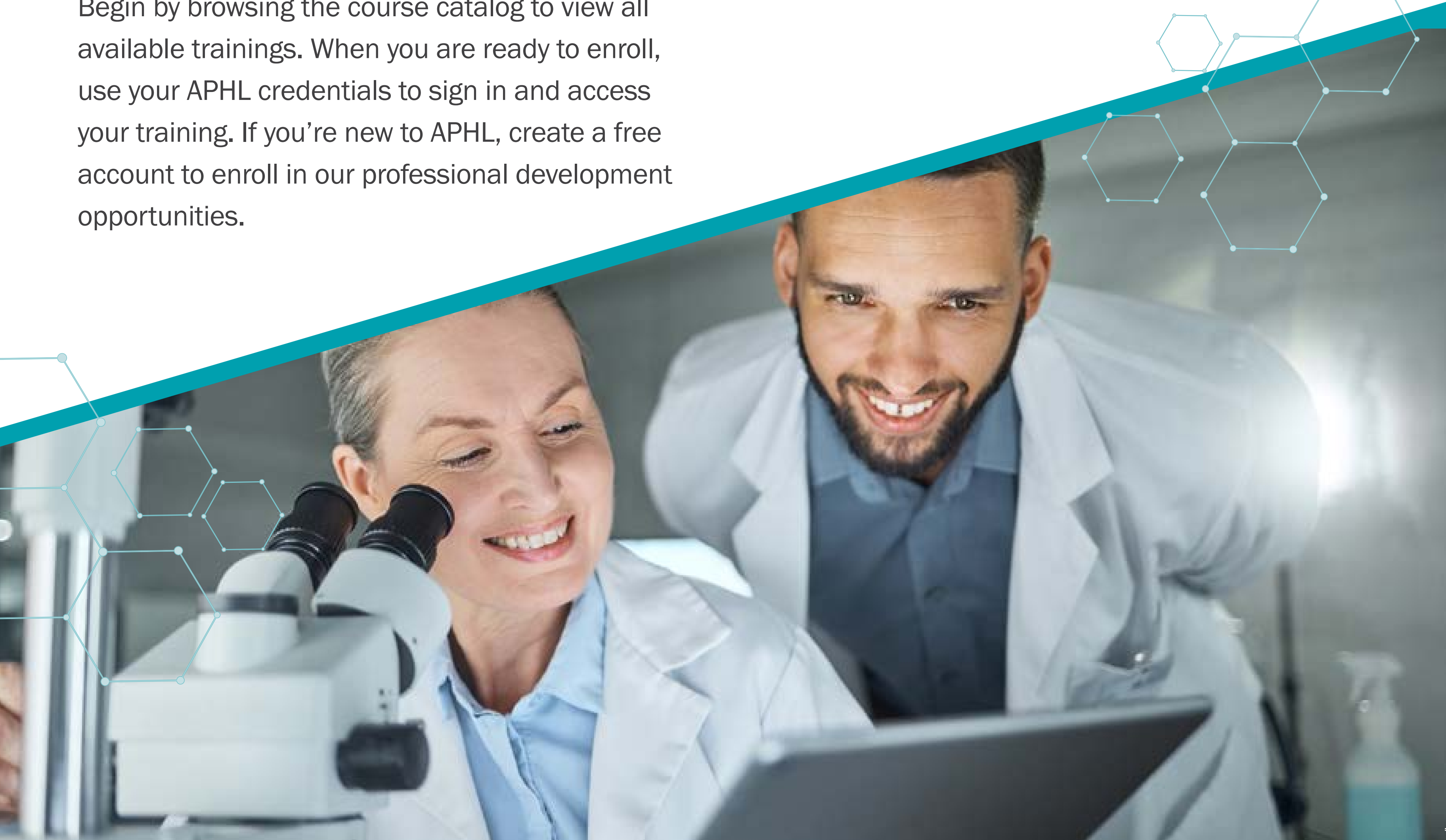

Celebrating 25 Years of the Laboratory Response Network

By **Chris N. Mangal**, MPH, director, Public Health Preparedness and Response; and **Rana Rahmat**, MPH, specialist, Laboratory Response Network

In 1999, the US Centers for Disease Control and Prevention (CDC), in partnership with APHL and the Federal Bureau of Investigation (FBI) launched the Laboratory Response Network (LRN) to strengthen the nation's ability to rapidly detect biological and chemical threats. Over the past 25 years, the network has prepared for and responded to numerous threats that can cause serious illness or death, and they have been involved in several high-profile public health emergencies including Anthrax, Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), Ebola, Zika and Mpox as well as supported responses for pandemic influenza. Presently, the network has two components: Biological Threats Preparedness (LRN-B) and Chemical Threats Preparedness (LRN-C). CDC and its partners recognize the need to expand the network to address radiological threats.

LRN-B

In 1999, the LRN-B began with only 17 laboratories and has since expanded to approximately 120 member facilities that include domestic and international laboratories, and sentinel clinical laboratories, which form the foundation of the system. The LRN-B is diverse and encompasses public health, military, veterinary, environmental and food laboratories providing reference testing for a wide array of sample types including environmental samples and clinical specimens.

The LRN-B's role in ongoing responses underscores its crucial importance in enhancing the nation's ability to detect and respond to public health threats promptly.

History of the LRN-B

1999 LRN established in 17 laboratories

2001 **Anthrax attacks:** LRN activates for first major response

2002 **SARS:** CDC develops and deploys new test to LRN-B member laboratories

2004 **RNC and DNC:** LRN-B experts deploy for rapid response

2009 **Anthrax in New Hampshire:** quick diagnosis for prevention of additional cases

2012 **MERS:** CDC develops and deploys new test to LRN-B member laboratories

2014 **Ebola:** CDC develops and deploys new tests to LRN-B member laboratories

2016 **Zika:** CDC develops and deploys new test to LRN-B member laboratories
2020–2024 LRN laboratories utilize their assets to respond to COVID-19

2022–2024 **Mpox:** LRN laboratories utilize CDC FDA 510 (k) Non-Variola Orthopox test to detect first and subsequent cases of Mpox in the US

2024 Over 120 LRN-B member laboratories maintain preparedness to respond to biological and other emerging threats

LRN-C

The LRN-C began with only five laboratories and has since expanded to 54 member facilities located in the US including one US territory. During large-scale national events, LRN-C member laboratories assist CDC in testing samples for chemical exposures and serve as front-line conduits for communication among CDC and local health officials, hospitals and poison control centers.

Forty-four LRN-C laboratories can identify exposures to toxic chemical agents such as cyanide, nerve agents and toxic metal, and 10 LRN-C laboratories have high-threat testing capabilities for mustard agents, nerve agents and toxic industrial chemical exposures. Within a 24-hour period, 8,500 clinical samples can be processed, tested and reported to CDC. The LRN-C utilizes a surge capacity model:

- Level 1 laboratories have the highest level capability and provide 24/7 assistance to CDC by testing samples in the event of a large-scale chemical emergency. These laboratories must maintain adequate staffing and equipment to support high volume testing with quick turnaround times. CDC also requires these laboratories maintain testing capabilities for exposures to high-threat chemical agents. In addition, Level 1 laboratories maintain all Level 2 testing capabilities.
- Level 2 laboratories maintain testing capabilities for exposures to chemical terrorism agents such as cyanide, toxic metals and toxic industrial chemicals.
- Level 3 laboratories provide local support with sample logistics as well as training and outreach with local hospitals. All LRN-C laboratories maintain Level 3 capabilities.

The LRN is an excellent model of an interconnected yet distributed system that has proven its value by detecting several threats. However, perhaps the most successful aspect of this network is its role in strengthening the US public health laboratory system.

- Strengthens existing public health and defense laboratory systems—public health laboratories use CDC-provided funds to

continued on page 36

Public Health Laboratory Ambassadors Program: A Year in Review

By **Amra Handzic**, MBA, specialist, Academic Partnerships; **Hailey Reiss**, specialist, Academic Partnerships; and **Ladan Ghedi**, MA, specialist, Academic Partnerships

Carin Huset (left) and Marla DeVault (right) from the Minnesota Public Health Laboratory attended the University of Minnesota career fair with Ladan Ghedi in September 2023

In September 2023, APHL hosted a webinar for public health laboratory professionals to introduce them to the Public Health Laboratory Ambassadors program, an initiative launched by Cohort 16 of the Emerging Leader Program (ELP). Designed to develop the public health laboratory workforce, our ambassadors promote public health laboratory careers to students, fostering the next generation of leaders. Webinar participants learned about the program's objectives, practical strategies for promoting public health laboratory science careers, and the steps to becoming an ambassador. The webinar had 121 registrations and 68 attendees.

There are currently 79 members in the program, mainly consisting of laboratory personnel. Ambassadors have participated in 21 reported events and counting, promoting careers in public health laboratory science to students at in-person and virtual outreach events at Washburn University, University of Wisconsin Stevens Point, Centralia College, Hamline University and other institutions.

Experiences From the Year

In the past year, Public Health Laboratory Ambassadors have engaged with students and community members through career fairs, classroom presentations and more. Leslie Wolf, laboratory technical director of the Louisville Metro Health Department Laboratory, feels that outreach is key to encouraging students to consider career paths in public health laboratory science.

"I have participated in a healthcare career fair at a local high school. I have also participated in a Health Occupations Student Association (HOSA) event in which cohorts of attendees were able to 'walk through' an outbreak investigation, and one of the stops was the 'laboratory'," said Wolf. "Both events indicated that students are interested in health, but are not familiar with public health options, so raising awareness at the high school level was a success for me."

Paige Drury, safety & security officer at the Kansas Health and Environmental Laboratories, became an ambassador to participate in as many opportunities as possible.

"I'm currently trying to expand our outreach to other universities in the state to provide information to students about career opportunities in public health, and the seemingly endless opportunities within," she said. "Being involved in the Public Health Laboratory Ambassadors program is a great way to remind yourself of what you love about public health and share that joy with others."

Heather Seymour, outreach analyst at the Michigan Bureau of Laboratories, has engaged in multiple events since becoming an ambassador, including a classroom presentation and an elementary school activity night.

"As a member of the Public Health Laboratory Ambassadors program, it's been rewarding to provide education and mentorship in a field many are unaware of," said Seymour. "I like to believe that my knowledge and enthusiasm provide a spark of encouragement to explore more about public health and the work we do at the laboratory."

Become an Ambassador

Current and former public health laboratory employees can join by completing an interest form. The quick guide has answers to the most common questions about the program. For further inquiries about the Public Health Laboratory Ambassador program, please contact the APHL Academic Partnerships program at academic.partnerships@aphl.org. ■

Arbovirus Testing

continued from page 29

information management system (LIMS) was underway along with building out the BioPortal, the custom-made electronic test orders and results (ETOR) portal created by PRDH during COVID-19, to improve data entry and streamline reporting. With no shortage of activities for the laboratory scientists leading this transition extra pressure was added as cases of dengue virus started to rise at the start of the year, well before the "typical" season of June-December.

Meanwhile the leadership of PRDH was busy updating their arbovirus response plan and wanted to ensure that all relevant agencies were aware of the current dengue situation and the mechanisms for response within and across their sectors. APHL, in coordination with PRDH and CDC, facilitated a tabletop exercise in mid-April that included over 100 attendees representing the federal and territorial epidemiology and public health laboratories, vector control, healthcare systems and hospitals, communications, leadership from municipalities and other territorial departments including Education, Agriculture, Housing and Tourism. The meeting allowed all partners to identify triggers for surge and surge capacity and areas requiring additional attention during a response setting them up for a successful response.

As the public health laboratory completes the final touches of validating their testing, informing their submitters and working out any final challenges in their test orders and results process, they will become a critical aspect of the overall PRDH arbovirus response plan—not only for this year but for years to come. ■

Laboratory Response Network

continued from page 34

ensure they have safe and secure facilities, procure instrumentation and associated maintenance agreements; military laboratories use the DoD resources to support their LRN activities .

- Invests in public health workforce – federal funds support personnel at the state, territorial and local levels.
- Provides training to ensure a highly skilled workforce.
- Provides technical assistance such as troubleshooting scientific assays and equipment.
- Provides standardized protocols and tests.
- Uses advanced technologies, which continue to evolve.
- Provides standardized data messaging with laboratory results that contribute to sound public health decisions.
- Uses a specific system for communications and provides help desk support to member laboratories.
- Utilizes a secure website to house materials, which can be accessed by member laboratories.
- Invests in continuous quality improvements such as conducting multi-center evaluations of assays, issuing challenge panels, seeking feedback on operations from laboratories, providing scientific and policy guidance to laboratories, and collecting and sharing model practices.
- Promotes partnerships by convening member laboratories via routine conference calls, technical and national meetings; and by engaging with subject matter experts across the federal agencies to ensure scientific integrity.

To learn more about the LRN, visit: Laboratory Response Network (aphl.org). ■

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