MLO-online.com

MEDICAL LABORATORY OBSERVER

MLO®

JUNE 2023 • Vol 55 • No 6

The Peer-Reviewed Management Source for Lab Professionals since 1969

CE:

# Carbapenem resistance in Pseudomonas aeruginosa

Page 6

## State of the Industry: Lab management best practices

Page 26

LAB INNOVATOR
Emily E. Volk, MD, FCAP
President of the
College of American Pathologists

PLUS

## Point-of-care ketone testing

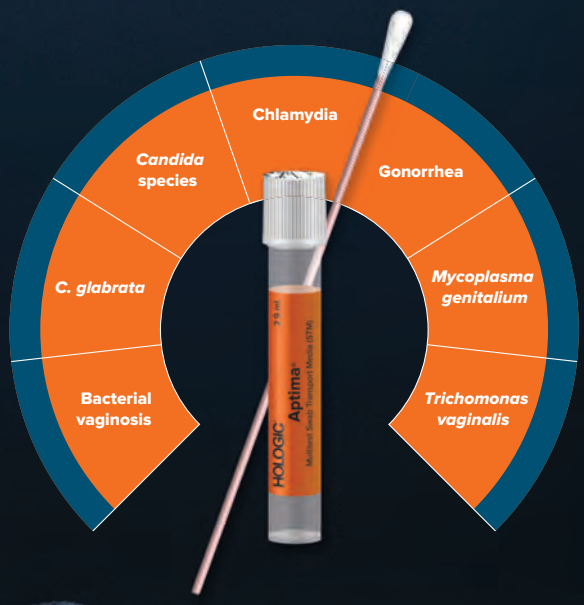
Page 12

## Diagnostic stewardship

Page 22

HOLOGIC®

# STI Testing Made Simple




With just one vaginal sample, the **Aptima® Multitest Swab** combined with our sexual and vaginal health assays can detect up to 7 infections and disease states on the Panther® system.

Scan to discover more

**Aptima®**

**References: 1.** Aptima Combo 2 Assay [package insert] AW-20535 (2021) San Diego, CA; Hologic, Inc., 2021. **2.** Aptima Mycoplasma genitalium assay [package insert] AW-17946, San Diego, CA; Hologic, Inc., 2019. **3.** Aptima CV/TV assay [package insert] AW-18812, San Diego, CA; Hologic, Inc., 2021. **4.** Aptima BV assay [package insert] AW-18811, San Diego, CA; Hologic, Inc., 2020. **5.** Aptima Trichomonas vaginalis Assay [package insert], 503684, San Diego, CA; Hologic, Inc., 2020

sysmex

"Sysmex makes my job as a lead easy to do."

**Suzette D., Lab Supervisor – 28 years experience**

**THE RELIABILITY OF YOUR HEMATOLOGY SOLUTION IS AS IMPORTANT AS THE RESULTS THEMSELVES**

Sysmex hematology analyzers are rated the highest in reliability, service and customer satisfaction* because we know the importance of what you do and why you do it. That's why clinical labs have chosen Sysmex as their reliable partner for over 50 years.

imv Part of Science and Medicine Group
HEMATOLOGY
ServiceTrak
2020 2021
2021 BEST SYSTEM PERFORMANCE WINNER:
Sysmex America, Inc.

**SYSMEX HAS RATED HIGHEST IN RELIABILITY BY SERVICETRAK™ FOR THE PAST 22 YEARS**

**www.sysmex.com/us**

MEDICAL LABORATORY OBSERVER
MLO
The Peer Reviewed Management Source for Lab Professionals since 1969


6


12


16


26


38

# Uncomplicate your PCR workflow with NeuMoDx™

Labs like yours are under pressure to do more with less. You need self-developed assays that are easy to use and efficient. What if you could transfer the power of your lab's assays into an easier workflow?

You could have time back. You would be in control of all parameters. All with the same security in your results. This is possible with NeuMoDx.

Discover how at **QIAGEN.com/self-developed-assays**



Ordering **www.qiagen.com/shop** | Technical Support **www.support.qiagen.com** | Website **www.qiagen.com**

Sample to Insight

# Best practices

By Christina Wichmann
Editor in Chief

In this issue of *Medical Laboratory Observer*, we are sharing the results of our State of the Industry survey on Lab Management Best Practices (page 26). It ended up being the biggest article in the issue. But as all of you know, probably better than me, laboratory best practices is a sizable topic. This issue also includes an article by Dr. Nicholas Moore on diagnostic stewardship (page 22), definitely a recognizable part of this sizable topic. And this month's Lab Innovator is Dr. Emily Volk, president of the College of American Pathologist's Board of Governors; an organization that has fostered laboratory excellence since its formation in 1946.

The healthcare industry is facing numerous challenges through changing payment models and a transition to value-based care, rising costs, an uncertain regulatory environment, and staffing shortages. Moreover, to thrive in this environment, healthcare organizations need to improve outcomes and reduce costs, i.e.,"do more with less."

Last year, *Forbes* published a helpful article on this unsympathetic catchphrase.[1] The author states,"Achieving ambitious goals while utilizing much fewer resources is an important task, but it must first be made clear that these goals are to be achieved as an organization and that these changes are not directed at individuals. Achieving more with less is not as simple as increasing output—it does not mean that you or your employees work more days, hours, weekends, or evenings." Instead, the author explains that doing more with less should be approached from the angles of prioritization and efficiency.

Every laboratory has a mission. Perhaps your laboratory's mission could be summarized as providing accurate, reliable, and timely patient test results. The author states that an organization's mission and its strategy are not interchangeable. Strategy is the plan put in place to accomplish your mission/purpose."This is where prioritization comes in. A leader must guide their team in a strategy that facilitates the company's long-term goals." Prioritize areas where you will have the biggest impact, so resources can be freed up and better utilized. All staff should be aware of what results the laboratory is prioritizing and when these results are expected to be achieved. In his article, Dr. Moore shares the strategies of his lab's diagnostic stewardship program to improve molecular testing for respiratory viral infections.

When the *Forbes* author moved into his current CEO position, he asked people,"What is a barrier to getting our work done?" He stated,"In some cases, people knew why we had to do it that way, but in many instances, when I asked, people just said, *Well, that's the way we have always done it.*" Many labs already know that improving communication is a key to improving efficiency (and achieving their goals). In this month's Lab Management Best Practices article, Susan Dawson shared that Quality Circle management is used to implement changes in her laboratory."When we have a goal to meet, we bring together the staff and engage them in figuring out how to meet our goals, change or adjust our process, and improve our work area. Everyone owns the project and works together. Sometimes it takes a couple of adjustments, and sometimes we get it right the first time."

I welcome your comments and questions – please send them to me at *cwichmann@mlo-online.com.*

## REFERENCES

1. Thiel C. Two approaches to doing more with less. *Forbes*. Published August 3, 2022. Accessed May 9, 2023. https://www.forbes.com/sites/forbesbusinesscouncil/2022/08/03/two-approaches-to-doing-more-with-less/?sh=1927bb545418.



MEDICAL LABORATORY OBSERVER Vol.55, No. 6



**Medical Laboratory Observer** USPS Permit 60930, ISSN 0580-7247 print, ISSN 2771-6759 online is published 12 times annually (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Sep CLR, Oct, Nov, Dec), with an additional issue in September, by Endeavor Business Media, LLC. 1233 Janesville Ave., Fort Atkinson, WI 53538. Periodical postage paid at Fort Atkinson, WI, and additional mailing offices. POSTMASTER: Send address changes to Medical Laboratory Observer, PO Box 3257, Northbrook, IL 60065-3257. SUBSCRIPTIONS: Publisher reserves the right to reject non-qualified subscriptions. Subscription prices: U.S. $160.00 per year; Canada/Mexico $193.75 per year; All other countries $276.25 per year. All subscriptions are payable in U.S. funds. Send subscription inquiries to Medical Laboratory Observer, PO Box 3257, Northbrook, IL 60065-3257. Customer service can be reached toll-free at 877-382-9187 or at MLO@omeda.com for magazine subscription assistance or questions.


# Reveal the Resistance

## Let HardyCHROM™ do the detective work

Antimicrobial resistance is among the top ten global health threats facing humanity, killing at least 1.27 million people worldwide. In the U.S., more than 3 million infections occur each year, resulting in 48,000 deaths. Antibiotic-resistant organisms, many of which are pan-resistant, are spreading rapidly. While progress is being made, development of new antibiotics is insufficient in addressing the spread of antibiotic-resistant organisms. Hardy Diagnostics is committed to making it easy for you to screen for these dangerous pathogens by developing novel chromogenic media for the detection of MSRA, ESBL, CRE and *Candida auris*. Vivid color change on a bright white agar background allows you to identify if one or more of these deadly pathogens is harming your patients.

**Hardy Diagnostics was the first company to introduce chromogenic media to the U.S.**

### HardyCHROM™ MRSA

For the detection of methicillin-resistant *Staphylococcus aureus* directly from anterior nares swabs. After 24 hours of incubation, MRSA produce pink to magenta colonies. Compatible with automated microbiology systems.
**Cat. no. G307**

### HardyCHROM™ ESBL

For the detection of Enterobacterales that are potentially non-susceptible to ceftazidime and cefpodoxime and ESBL-producing *E. coli*, *K. pneumoniae*, and *K. oxytoca* directly from stool specimens.
**Cat. no. G321**

### HardyCHROM™ CRE

For the detection of *E. coli* and KES (*K. aerogenes, K. oxytoca, K. pneumoniae, E. cloacae* complex, *S. marcescens*) that are not susceptible to carbapenems directly from stool specimens.
**Cat. no. G323**

### HardyCHROM™ Candida + auris

For the detection and differentiation of *C. auris, C. albicans, C. tropicalis, C. krusei*, and *C. glabrata**. All species develop a unique colony color and morphology, and *C. auris* fluoresces under UV light for rapid differentiation.
**Cat. no. G343**

**Easy-to-Read • Vivid Chromogenic Results • Detection at-a-Glance**

**Scan to learn more**

**Contact us for your FREE Sample**
**HardyDiagnostics.com/Hardy-CHROM**

*In conjunction with rapid trehalose fermentation broth or GlabrataQuick test.

HARDY DIAGNOSTICS
A Culture of Service™

12943472 © Monika Wisniewska | Dreamstime.com

# Carbapenem resistance in *Pseudomonas aeruginosa:* An ongoing challenge for clinical laboratories

By Shelley Campeau, PhD, D(ABMM)

In February 2023, both the Centers for Disease Control and Prevention (CDC) and the U.S. Food and Drug Administration (FDA) issued warnings to consumers and healthcare providers about infections due to an extensively drug-resistant *Pseudomonas aeruginosa* linked to the use of artificial tears.[1,2] Sixty-eight patients in 16 states have been identified, with various clinical presentations including keratitis, respiratory and urinary tract infections, and sepsis. Patient outcomes included permanent vision loss, hospitalization, and one death with a bloodstream infection.

## Earning CEUs

See test on page 10 or online at www.mlo-online.com under the CE Tests tab. Passing scores of 70 percent or higher are eligible for 1 contact hour of P.A.C.E. credit.

### LEARNING OBJECTIVES

Upon completion of this article, the reader will be able to:

1. Discuss the current outbreak of drug-resistant *Pseudomonas aeruginosa*.
2. Describe the background and epidemiology of carbapenem-resistant *P. aeruginosa* (CP-CRPA).
3. Differentiate between different testing methods for CP-CRPA.
4. List the entities and guidelines involved to combat future carbapenem-resistant *P. aeruginosa* (CP-CRPA) outbreaks.

The *P. aeruginosa* isolates were initially identified by clinical laboratories and submitted to local public health laboratories (PHLs) and/or the CDC for additional antimicrobial susceptibility testing (AST) by reference broth microdilution and molecular characterization. Isolates associated with the outbreak were resistant or showed intermediate susceptibility to nearly all agents routinely tested and used clinically for pseudomonal infections, including cefepime, ceftazidime, aztreonam, imipenem, meropenem, piperacillin-tazobactam, ceftazidime-avibactam, ceftolozane-tazobactam, ciprofloxacin, amikacin, gentamicin, and tobramycin. The only agents that showed any activity *in vitro* were cefiderocol and colistin.

Even more alarming, was the finding that outbreak isolates carried two transmissible genes for the carbapenemases, VIM and GES, a combination not previously identified in carbapenemase-producing carbapenem-resistant *P. aeruginosa* (CP-CRPA) in the United States. Therapeutically, carbapenem resistance in *P. aeruginosa* due to carbapenemases are challenging, as CP-CRPA are likely to exhibit resistance to other b-lactam agents and newer b-lactam–b-lactamase combination agents, including those designed to treat complicated pseudomonal infections, such as ceftolozane-tazobactam.[3,4] An example AST profile of one of the outbreak isolates is shown in **Table 1.**

This outbreak reaffirmed the importance of the clinical laboratory in the accurate detection of CRPA to help guide patient treatment, assist infection preventionists to help stop the local spread of CRPA, and support public health initiatives to combat antimicrobial resistance.


# Simplexa® Congenital CMV Direct Kit

## Direct detection of cytomegalovirus DNA in saliva swab and urine specimens

- **Broad coverage:**
  Validated for both saliva and confirmatory urine specimens from infants less than 21 days of age.
- **Sample-to-answer workflow with timely results:**
  CLIA moderate complexity providing results in about an hour - No DNA extraction required.
- **High performance:**
  Confirmatory urine testing (prospective and retrospective combined) 99.9% Negative Percent Agreement.

***Request more information:***
**https://bit.ly/cCMVRequest**

**molecular.diasorin.com/us/kit/simplexa-congenital-cmv-direct-kit/**

**+1 (562) 240-6500**


DiaSorin Molecular

The quality of treatment starts with diagnosis.

| Antimicrobial Agent | MIC (µg/mL) | Interpretation |
|---|---|---|
| Amikacin | >64 | R |
| Aztreonam | >64 | R |
| Cefepime | >32 | R |
| Cefiderocol | 1 | S |
| Ceftazidime | >32 | R |
| Ceftazidime-avibactam | >32/4 | R |
| Ceftolozane-tazobactam | >32/4 | R |
| Ciprofloxacin | >4 | R |
| Colistin | 1 | I |
| Gentamicin | >16 | R |
| Imipenem | 8 | R |
| Imipenem-relebactam | 8/4 | R |
| Meropenem | 8 | R |
| Piperacillin-tazobactam | 64/4 | I |
| Tobramycin | >16 | R |

Abbreviations: I: Intermediate; R: Resistant; S: Susceptible

**Table 1.** Example isolate AST profile.

## Background and epidemiology of CRPA

*P. aeruginosa* is commonly found in environmental sources, like soil and water. It is frequently associated with hospital-acquired infections and is especially problematic in immunocompromised individuals.[5] Antimicrobial resistance in *P. aeruginosa,* as with other gram-negative bacteria, continues to increase globally and has been elevated as an agent of Serious Threat by the CDC and a Critical Priority pathogen by the World Health Organization (WHO).[6,7] Of particular importance is carbapenem resistance, which can be due to the production of one or more carbapenemase enzymes (e.g., VIM, KPC, IMP, NDM). In contrast to carbapenemase production in Enterobacterales such as *Klebsiella pneumoniae* where KPC is the most prevalent carbapenemase in the United States, VIM is the most common carbapenemase in CP-CRPA.[8,9] Carbapenem resistance in *P. aeruginosa* can also be due to non-carbapenemase mechanisms such as changes in membrane permeability or activation of efflux pumps and/or increased cephalosporinase activity. Some CRPA may result from a combination of carbapenemase and non-carbapenemase resistance mechanisms. While containing the spread of all CRPA is important, the quick detection and control of CP-CRPA is paramount because genes coding for carbapenemases, which typically reside on plasmids with other antimicrobial resistance genes, are easily spread among bacteria in healthcare settings and other environments.[6]

## Laboratory identification of CRPA and CP-CRPA

Results from routine AST performed in the clinical laboratory are used to identify CRPA. As the name implies, CRPA are resistant to one or more carbapenems (doripenem, imipenem, and/or meropenem) when using current breakpoints as listed in Clinical and Laboratory Standards Institute (CLSI) M100 33rd Edition Standard (**Table 2**).[10]

Further characterization to determine if carbapenem resistance is due to carbapenemase production may be warranted for institutional infection control measures and/or epidemiological purposes. In some cases, clinicians may request the laboratory test for carbapenemase production in a CRPA isolate, as insight into the resistance mechanism may further guide patient management, although fewer than 5% of CRPA reported by the CDC have been shown to produce a carbapenemase.[11] However, a recent study

| Agent | Disk Diffusion (mm)[a] | | | MIC (µg/mL) | | |
|---|---|---|---|---|---|---|
| | S | I | R | S | I | R |
| Doripenem | ≥18 | 15-17 | ≤14 | ≤2 | 4 | ≥8 |
| Imipenem | ≥22 | 19-21 | ≤18 | ≤2 | 4 | ≥8 |
| Meropenem | ≥18 | 15-17 | ≤14 | ≤2 | 4 | ≥8 |

Abbreviations: I: Intermediate; R: Resistant; S: Susceptible

[a]Disk content for all carbapenems is 10 µg

**Table 2.** Carbapenem breakpoints.

showed that an intermediate or resistant result for cefepime, ceftazidime and/or ceftolozane-tazobactam can be used as a signal that a CRPA isolate may produce carbapenemase.[11] When testing 5,394 CRPA (resistant to imipenem or meropenem), only 177 (3%) were confirmed carbapenemase producers. Of the 903 isolates that were also intermediate or resistant to ceftolozane-tazobactam, 223 (25%) produced carbapenemase. Intermediate or resistant results for cefepime or ceftazidime can also be used to identify CRPA that are suspicious for carbapenemase production (sensitivity of 91%), but may be less useful given their much lower specificity for detecting CP-CRPA (50%) compared to ceftolozane-tazobactam (86%). One conclusion from these studies was that contemporary CRPA isolates in the United States that are susceptible to all three agents are unlikely to be carbapenemase producers. Some laboratories may use this criterion to determine which CRPA to further test for carbapenemase.

Phenotypic methods and genotypic methods can be used for detecting carbapenemases in CRPA. Phenotypic methods, such as the Modified Carbapenem Inactivation Method (mCIM), will tell whether or not a carbapenemase is being produced but cannot identify the specific carbapenemase or carbapenemase gene(s).[12] Genotypic tests, on the other hand, mostly involve polymerase chain reaction (PCR) methods that target specific carbapenemase gene(s), and it should be assumed that an isolate that harbors a carbapenemase gene produces or is capable of producing the respective carbapenemase enzyme. The commercial genotypic methods used most commonly in clinical laboratories target the main carbapenemase genes reported to date in the United States, sometimes referred to as the "big 5": KPC, NDM, VIM, IMP, and OXA-48.[13] Consequently, the GES carbapenemase concomitantly present with VIM in the CP-CRPA responsible for the outbreak described above would not have been detected with most commercial molecular kits. In addition to PCR methods, at least one commercial lateral flow immunoassay detects the five most common carbapenemases and is gaining wide use in clinical laboratories.[14] In contrast to genotypic methods, phenotypic methods may identify novel carbapenemases that are not targeted in genotypic assays. When a phenotypic test is positive but a genotypic test for the "big 5" is negative, methods such as whole genome sequencing may be used to further characterize the carbapenemase.

As some genotypic tests for carbapenemases can be performed directly from a clinical specimen (e.g., rectal swab or positive blood culture), the results that a carbapenemase gene is present may be available before carbapenem resistance is detected by a standard AST method. In such cases, it should be presumed that a positive result by a molecular method infers carbapenem resistance. CLSI M100 provides guidance for testing and reporting results in laboratories that use molecular methods, with or without a phenotypic test, for detecting carbapenem resistance. Specifically, Appendix H - Using Molecular Assays for Resistance Detection, contains this information, including how to handle discrepancies between phenotypic and genotypic results.[10]

## Surveillance for CRPA and the Antibiotic Resistance Laboratory Network

In 2016, the CDC established the Antibiotic Resistance Laboratory Network (AR Lab Network) to better understand the scope of antimicrobial resistance in the United States.[8] The network consists of PHLs in all 50 states, several large cities, and Puerto Rico, and includes seven regional laboratories. The goal of the AR Lab Network is to support laboratory testing to detect and contain antimicrobial resistance in health care, the community, and the environment.

A major focus of the AR Lab Network has been carbapenem-resistant organisms including CRPA. PHLs have developed various mechanisms for interacting with their local clinical laboratories to obtain data and/or isolates. In some states with low prevalence of carbapenem resistant organisms (CRO), clinical laboratories may be required to submit all CRO to their public health laboratory. In others, where the burden of CRO is high, clinical laboratories may be required to report all CRO and submit only select species of CP-CRO, such as CP-CRPA or CP-CRO that produce less common carbapenemases. The AR Lab Network and local/state PHLs can assist clinical laboratories with identification and characterization of CRPA and/or CP-CRPA as well as other CROs because they often have additional testing capabilities beyond what is available in routine clinical laboratories, such as ability to strain type and perform whole genome sequencing. At the time of this writing, CDC's AR Lab Network dashboard reports that during 2018–2021, there were 56,016 CRPA isolates tested, and 2.11% (N=1,181) had at least one targeted carbapenemase gene detected. The most common carbapenemase detected was VIM, found in 57.8% of CP-CRPA.[11] This data was corroborated in a recent global, observational study of CRPA, which demonstrated differences in both prevalence and diversity of carbapenemases across various geographical regions. In the United States, only 2% (N=10) of CRPA isolates harbored a carbapenemase. Additionally, there was an increase in mortality in patients with CP-CRPA infections compared to those with non-CP-CRPA. This study highlighted the impact these pathogens have on clinical outcomes and importance of continued surveillance to monitor global patterns of carbapenemases and regional shifts in carbapenemase emergence.[3]

Laboratories should refer to local or state PHL guidelines for reporting of suspected or confirmed CRPA and potential isolate submission requirements. This is of particular importance when there is a suspected outbreak being investigated, as was the case with the VIM-GES-CRPA cases.

## What is next for CRPA?

The continuing evolution of carbapenem resistance in *P. aeruginosa* worldwide highlights the ongoing need for various strategies and diligent efforts to combat CRPA. Clinical laboratories should evaluate their internal processes to ensure they are able to accurately detect and subsequently report CRPA. Some recommendations for consideration are provided in **Table 3.** It is important to remember that continuous communication and collaboration between clinical laboratories, their facilities' infection prevention partners, their local or state PHLs, and the CDC helps strengthen efforts for combatting antimicrobial resistance.

| Measures to Consider: |
|---|
| Ensure AST method applies current CLSI breakpoints and can reliably detect carbapenem resistance in *P. aeruginosa*. |
| Include protocols to confirm AST results on P. aeruginosa resistant to most commonly used agents to avoid reporting false resistance due to technical errors such as contamination.[a] |
| Identify a mechanism for carbapenemase testing on select CRPA, as needed.[b] |
| Identify a mechanism for testing any additional antimicrobial agents that might be useful for CRPA isolates R to all drugs on your routine panel, as needed.[b] |
| Include protocols for rapid notification of CRPA to infection preventionists and public health authorities, as appropriate. |
| Ensure all staff involved with reporting AST results on patient isolates are informed of the clinical and public health significance of CRPA. |

Abbreviation: R: Resistant
[a]Refer to CLSI M100 Appendix A for guidance.
[b]Perform testing in house or send out to a reference laboratory.

**Table 3.** Recommendations to clinical laboratories for addressing CRPA.

### REFERENCES


1. Centers for Disease Control. Outbreak of Extensively Drug-resistant *Pseudomonas aeruginosa* Associated with Artificial Tears. https://emergency.cdc.gov/han/2023/han00485.asp. Published February 1, 2023. Accessed April 27, 2023.

2. US Food and Drug Administration. FDA warns consumers not to purchase or use EzriCare Artificial Tears due to potential contamination. https://www.fda.gov/drugs/drug-safety-and-availability/fda-warns-consumers-not-purchase-or-use-ezricare-artificial-tears-due-potential-contamination. Published February 2, 2023. Accessed April 27, 2023.

3. Reyes J, Komarow L, Chen L, et al. Antibacterial Resistance Leadership Group and Multi-Drug Resistant Organism Network Investigators. Global epidemiology and clinical outcomes of carbapenem-resistant Pseudomonas aeruginosa and associated carbapenemases (POP): a prospective cohort study. *Lancet Microbe*. 2023 Mar;4(3):e159-e170.

4. Giani T, Arena F, Pollini S, et al. Pseudomonas aeruginosa Working Group. Italian nationwide survey on Pseudomonas aeruginosa from invasive infections: activity of ceftolozane/tazobactam and comparators, and molecular epidemiology of carbapenemase producers. *J Antimicrob Chemother*. 2018 Mar 1;73(3):664-671.

5. Centers for Disease Control. *Pseudomonas aeruginosa* in Healthcare Settings. https://www.cdc.gov/hai/organisms/pseudomonas.html. Published November 13, 2019. Accessed April 27, 2023.

6. Centers for Disease Control Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/drugresistance/biggest-threats.html. Accessed April 27, 2023.

7. World Health Organization Media Center. WHO publishes list of bacteria for which new antibiotics are urgently needed. https://www.who.int/news/item/27-02-2017-who-publishes-list-of-bacteria-for-which-new-antibiotics-are-urgently-needed Published February 27, 2019. Accessed April 20, 2023.

8. CDC Antimicrobial Resistance Laboratory Network. https://arpsp.cdc.gov/profile/arln/crpa. Accessed April 18, 2023.

9. Wang M, Earley M, Chen L, et al. Multi-Drug Resistant Organism Network Investigators. Clinical outcomes and bacterial characteristics of carbapenem-resistant Klebsiella pneumoniae complex among patients from different global regions (CRACKLE-2): a prospective, multicentre, cohort study. *Lancet Infect Dis*. 2022 Mar;22(3):401-412.

10. CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 33rd ed. CLSI supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute; 2023.

11. Vallabhaneni S, Huang JY, Grass JE, et al. Antimicrobial Susceptibility Profiles to Predict the Presence of Carbapenemase Genes among Carbapenem-Resistant Pseudomonas aeruginosa Isolates. *J Clin Microbiol*. 2021 May 19;59(6):e02874-20.

12. Tamma PD, Simner PJ. Phenotypic Detection of Carbapenemase-Producing Organisms from Clinical Isolates. *J Clin Microbiol*. 2018 Oct 25;56(11):e01140-18.

13. Tenover FC. Using Molecular Diagnostics to Develop Therapeutic Strategies for Carbapenem-Resistant Gram-Negative Infections. *Front Cell Infect Microbiol*. 2021 Sep 28;11:715821.

14. Jenkins S, Ledeboer NA, Westblade LF, et al. Evaluation of NG-Test Carba 5 for Rapid Phenotypic Detection and Differentiation of Five Common Carbapenemase Families: Results of a Multicenter Clinical Evaluation. *J Clin Microbiol*. 2020 Jun 24;58(7):e00344-20.


**Shelley Campeau, PhD, D(ABMM)** is a Diplomate of the American Board of Medical Microbiology and currently a Senior Consultant with **Scientific and Medical Affairs Consulting, LLC**. Prior to consulting, she worked in both clinical and public health microbiology for over 10 years, and then in industry at an in vitro diagnostics company for 4 years. She has been a volunteer with CLSI for almost 10 years, helping to bring updated breakpoints and new test methods to clinical laboratories for improved patient care.

## Carbapenem resistance in *Pseudomonas aeruginosa*: An ongoing challenge for clinical laboratories

**JUNE 2023** *[This form may be photocopied. It is no longer valid for CEUs after DECEMBER 31, 2024.]*

**Passing scores of 70 percent or higher are eligible for 1 contact hour of P.A.C.E. credit.**

## TEST QUESTIONS

Circles must be filled in, or test will not be graded. Shade circles like this: ● Not like this: ○ X

1. **The FDA and CDC have issued warnings about drug-resistant *Pseudomonas aeruginosa* linked to the use of**
   - A. Refresh tears
   - B. Systane
   - C. Theratears
   - D. Artificial tears
2. **_____ patients in _____ states have been identified with drug-resistant *Pseudomonas aeruginosa*.**
   - A. Eight-six; 16
   - B. Sixty-eight; 16
   - C. Sixteen; 86
   - D. Sixteen; 68
3. **Clinical signs and presentation of drug-resistant *Pseudomonas aeruginosa* include**
   - A. Keratitis and sepsis
   - B. UTI and sepsis
   - C. Respiratory tract infections
   - D. All of the above
4. **In the outbreak, the only antimicrobial agents that have shown any activity *in-vitro* were**
   - A. Amikacin and Cefepime
   - B. Colistin and Gentamicin
   - C. Cefiderocol and Colistin
   - D. Imipenem and Cefiderocol
5. **There were two transmissible carbapenemase genes that were found in the outbreak isolate that haven't previously been identified in carbapenem-resistant *P. aeruginosa* (CP-CRPA).**
   - A. True
   - B. False
6. ***P. aeruginosa* is commonly found in**
   - A. Soil and water
   - B. Water and air
   - C. Soil and air
   - D. Animals and water
7. **_____ is the most common carbapenemase in CP-CRPA.**
   - A. KPC
   - B. NDM
   - C. VIM
   - D. IMP
8. **Carbapenem resistance in *P. aeruginosa* is only due to carbapenemase resistance.**
   - A. True
   - B. False
9. **CRPA are resistant to**
   - A. One carbapenem
   - B. One or more carbapenems
   - C. All carbapenems
   - D. None of the above
10. **The _____ method of testing will tell whether or not a carbapenemase is being produced, but cannot identify which one.**
    - A. PCR
    - B. OXA-48
    - C. mCIM
    - D. Culture
11. **The most genotypic test to detect a specific carbepenemase gene is**
    - A. PCR
    - B. Immunoassay
    - C. Culture
    - D. mCIM
12. **Commercial methods used most in U.S. labs will detect**
    - A. KPC and NDM
    - B. VIM and IMP
    - C. OXA-48
    - D. All of the above
13. **The carbapenemas gene present in CP-CRPA that was responsible in the outbreak would not have been detected with most commercial kits.**
    - A. True
    - B. False
14. **_____ may identify novel carbapenemases that are not targeted by _____.**
    - A. Immunoassay; culture
    - B. Genotypic methods; phenotypic methods
    - C. Phenotypic methods; genotypic methods
    - D. None of the above
15. **_____ provides guidance for testing and reporting results that show a discrepancy between genotypic and phenotypic methods.**
    - A. CDC
    - B. WHO
    - C. CLSI M 100
    - D. FDA
16. **Public health laboratories have developed various mechanisms for interacting with their local laboratories to detect and contain antimicrobial resistance in the community using the**
    - A. CLSI M 100
    - B. AR Lab Network
    - C. WHO Lab Network
    - D. FDA Network
17. **Between 2018–2021 there were 56,016 CP-CRPA isolates tested and _____% had at least _____ targeted -carbapenemase gene(2) detected.**
    - A. 1.11; three
    - B. 5.11; one
    - C. 2.11; one
    - D. 2.11; three
18. **To strengthen the efforts of combatting antimicrobial resistance, there must be collaboration between**
    - A. Clinical laboratories
    - B. Local and state public health laboratories
    - C. CDC
    - D. All of the above

**Tests can be taken online or by mail. Easy registration and payment options are available through NIU by following the links found at www.mlo-online.com/ce. The certificate is automatically awarded with a passing online test score.**

**PLEASE PRINT CLEARLY**

NAME _____ MAILING ADDRESS _____ ☐ HOME ☐ WORK

CITY _____ STATE _____ ZIP _____ INSTITUTION/FACILITY _____

PHONE _____ E-MAIL ADDRESS _____

**Send your $20 check payable to Northern Illinois University with this form to:** University Outreach Services, Northern Illinois University, DeKalb, IL 60115-2860
email: outreach_helpdesk@niu.edu. FEE NOT REFUNDABLE OR TRANSFERABLE

**P = Poor; E = Excellent**

1. **To what extent did the article focus on or clarify the objectives?** P ① ② ③ ④ ⑤ E
2. **To what extent was the article well-organized and readable?** P ① ② ③ ④ ⑤ E
3. **How will you use the CE units?** ☐ state license ☐ employment ☐ recertification ☐ other

**CE Licensure Information for FL and CA:**

**FL: Your FL license number:** _____ *(required for CE credit)*

**CA: Accrediting Agency: 0001** *(for use in submitting your CE credits to CA)*

*MLO* and Northern Illinois University (NIU), DeKalb, IL, are co-sponsors in offering continuing education units (CEUs) for this issue's CE article. CEUs or contact hours are granted by the College of Health and Human Sciences at Northern Illinois University, which has been approved as a provider of continuing education programs in the clinical laboratory sciences by the ASCLS P.A.C.E.® program. Approval as a provider of continuing education programs has been granted by the state of Florida (Provider No. JP0000496). Continuing education credits awarded for successful completion of this test are acceptable for the ASCP Board of Registry Continuing Competence Recognition Program. Readers who pass the test successfully (scoring 70% or higher) will receive a certificate for 1 contact hour of P.A.C.E.® credit. Participants should allow three to five weeks for receipt of certificate. The fee for this continuing education test is $20. **This test was prepared by Amanda Voelker, MPH, MT(ASCP), MLS, Clinical Education Coordinator, School of Health Studies, Northern Illinois University, DeKalb, IL**

# We are here

In the positive outcomes that care brings to life, we are here. With information and insight that empower clinicians to make the right decision at the right time, we are here. And in settings across the continuum of care where innovation and inspiration can be the difference, we are here. QuidelOrtho. Wherever you are, we are here.

**QuidelOrtho.com**

QuidelOrtho™

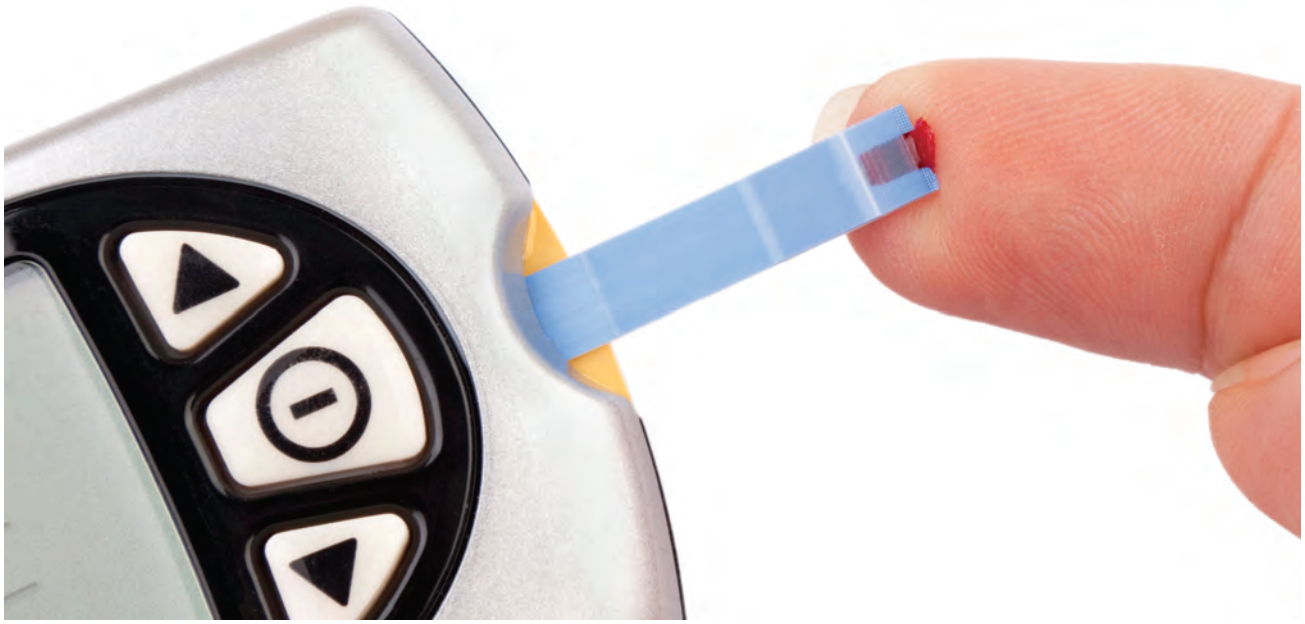


Photo 12130442 © Vicente Barcelo Varona | Dreamstime.com

# The role of point-of-care ketone testing in the hospital

By Dennis Begos, MD, FACS

Blood glucose testing in hospitals using point-of-care testing (POCT) devices has been a mainstay of glycemic control for decades, and the benefits of this are well documented and recognized by patients, providers, and laboratory professionals. POCT measurement of ketones is a more recent development and is the next logical step in managing patients with diabetes in the hospital. Measuring ketones goes hand in hand with hyperglycemia, and POCT ketone testing confers the same advantages as it does for glucose: rapid, accurate results with the ability to make treatment decisions in real time.

## Ketone physiology and diabetic ketoacidosis

Ketone metabolism and physiology is quite complex, but at its simplest level, ketones are produced when the body utilizes fat for energy production. The most serious and common example of this is diabetic ketoacidosis (DKA), where there is insufficient insulin to allow for proper glucose entry into cells. DKA is more common in type-1 diabetics but occurs in type-2 diabetics as well. It can be the presenting sign of new onset diabetes but can also develop from poor compliance with an insulin regimen, or from a coexisting illness such as infection, trauma, coronary syndrome, or surgery. Less common causes of ketosis or ketoacidosis may include a low-carbohydrate ("keto") diet, excessive alcohol use, and starvation. DKA is far more likely to be seen in hospitals than any of the other conditions and while mortality from DKA is decreasing, the incidence is increasing.[1,2]

When there is insufficient insulin or inadequate glucose (at the cellular level these are indistinguishable), the body "thinks" it is being starved, and a series of metabolic processes swing into action to allow for alternate energy production. These include increased glucagon production, which stimulates glucose production from glycogen in the liver and peripheral breakdown of triglycerides, increased lipase production to break down fat, and an increase in stress hormones such as cortisol and catecholamines. This starts a cascade of lipolysis where triglycerides are broken down into free fatty acids, glycerol, acetyl CoA, and ketones, which consist of beta-hydroxybutyrate (BHB), acetoacetate (AA), and acetone.[3,4] BHB accounts for roughly 80% of ketones in humans, and its production is useful because it is one of the few substances, other than glucose, which can be used by the brain as a fuel source. Acetone is excreted in the lungs and gives the breath a characteristic fruity odor. If this process goes unchecked, severe acidosis ensues, and is a potentially life-threatening condition that needs immediate treatment and close monitoring.

## Diagnosing DKA

As its name implies, diagnosing DKA was traditionally based on an elevated blood glucose (> 250 mg/dL) ("diabetic"), positive ketones in either the blood or urine ("keto"), and acidosis either based on measuring pH or serum bicarbonate("acidosis"). Recently, however, there has been a rise in so-called "euglycemic" DKA, where the blood glucose is normal, which is commonly seen in patients taking a class of medications known as SGLT2 inhibitors. A recent consensus statement from leading diabetic management groups in the United States has defined DKA as *any* elevation of serum or urine ketones above the upper limit of normal, and either a pH < 7.3 or serum bicarbonate < 15 mmol/L.[5] Other guidelines still require an elevated glucose and require a BHB level of > 3 mmol/L,6 in addition to acidosis.

Regardless of the fine points of diagnosis, measuring ketones is key to identifying and treating DKA. Ketones can be measured in the blood or urine. Urine ketones are measured qualitatively using the nitroprusside method with a dipstick. This may be adequate for screening a patient with suspected DKA but has several limitations: the nitroprusside method only measures AA and acetone and not BHB; AA levels may actually remain elevated for up to 48 hours after BHB levels decline, giving a false sense of persistent DKA; measuring ketones in the urine

# Dropper® A1c

## Diabetes Control


## The ideal 3rd party QC solution for multiple platforms.

- 3 years frozen shelf-life*
- 6 months refrigerated**
- 21 days at room temperature**

Dropper A1c has incredible shelf-life, reduces waste, and eliminates storage issues. It features three years frozen shelf-life, six months of refrigerated open vial stability, AND **twenty-one days** of open vial room temperature stability.

* from date of manufacture
** closed and opened bottles

Connect with us & learn more @

**quantimetrix.com**

can reflect a state of ketosis from several hours prior, as urine can dwell in the bladder for long periods of time in DKA due to dehydration; and the measure is qualitative and subjective, based on a color change in the strip. Thus, it is recommended that urine ketone testing only be used for screening purposes and any positive should be verified in blood. Urine ketone testing is not acceptable for monitoring DKA treatment.[6,7] Some laboratories still use the nitroprusside test for ketones in the blood—a College of American Pathologists survey in 2020 found that roughly one-third of laboratories were using this method (840/2625 labs).[7] This testing, for the reasons noted above, is less ideal than direct testing for BHB, which is done by POC meters, and by most labs. Early diagnosis of DKA is now feasible using POC technology, and this can be used in the prehospital or emergency department setting to initiate treatment, rather than waiting for central laboratory testing.[8,9] The ability to rapidly diagnose ketosis and DKA in an unwell diabetic patient allows for prompt initiation of therapy, and this is best done using POCT. Having the ability to measure glucose and ketones with a single meter allows for instantaneous reflex testing for ketones in anyone with an elevated blood sugar.

## Treating and monitoring DKA

The mainstays of DKA treatment are insulin and fluid administration and monitoring laboratory values, especially glucose and ketone levels, as well as pH and electrolytes.[6,10] Although it does not appear that absolute levels of BHB correlate with the severity of DKA, most guidelines recommend that BHB levels be monitored to assess the success of treatment. The American Diabetic Association recommends monitoring until the ketonemia is controlled but doesn't specify a frequency.[11] More recent guidelines from the Joint British Diabetes Societies recommend use of POCT for BHB measurement, and to aim for a reduction in BHB concentration of 0.5 mmol/L/hr.10 Likewise, the International Society for Pediatric and Adolescent Diabetes also recommends POCT be used for BHB measurement when available, and that the BHB level should be checked every 2 hours until the level is less than 1 mmol/L.[12] This group also recommends a target reduction of 0.5 mmol/L/hr.

Since glucose measurement is also done frequently in DKA (typically every 1–2 hours), and done using POCT, it makes logical and practical sense to have a combined device for testing both ketones and glucose, and such devices exist.[13] This makes assessing the effectiveness of treatment fast and allows immediate adjustment of treatment regimens, rather than waiting for a central laboratory result. Almost all POC ketone meters measure BHB directly, so that results are quantitative, and some of these devices have been shown to have good analytical performance compared with central laboratory.[14]

Although handheld meters to measure ketones are available for self-testing, it is important to learn the lessons from self-testing glucose meters. It has long been known that hospitalized patients are a more complex and heterogeneous group than those at home, with potential for interference of accurate measurement from endogenous sources (e.g., hematocrit, pH) and exogenous sources (medications such as acetaminophen and vitamin C) with glucose meters. These same interferences can, and do, affect some POCT ketone devices.[13] In fact, there is only one glucose meter cleared by the U.S. Food and Drug Administration (FDA) for use in all hospitalized, mainly due to a lack of demonstrated interferences.[15] The technology used in this device is also available for ketone measurement in a combined meter, although its FDA ketone clearance status is pending as of the date this article was written. Since not all POC meters are created equally, it is imperative to choose a POC device wisely, and with knowledge of potential risks for errors.[3,13,14]

### REFERENCES


1. Benoit SR, Zhang Y, Geiss LS, Gregg EW, Albright A. Trends in Diabetic Ketoacidosis Hospitalizations and In-Hospital Mortality - United States, 2000-2014. *MMWR Morb Mortal Wkly Rep.* 2018;30;67(12):362-365. doi:10.15585/mmwr.mm6712a3.

2. Desai D, Mehta D, Mathias P, Menon G, Schubart UK. Health Care Utilization and Burden of Diabetic Ketoacidosis in the U.S. Over the Past Decade: A Nationwide Analysis. *Diabetes Care.* 2018;41(8):1631-1638. doi:10.2337/dc17-1379.

3. Dhatariya K. Blood Ketones: Measurement, Interpretation, Limitations, and Utility in the Management of Diabetic Ketoacidosis. *Rev Diabet Stud.* 2016;13(4):217-225. doi:10.1900/RDS.2016.13.217.

4. Gosmanov AR, Gosmanova EO, Kitabchi AE, et al. *Hyperglycemic Crises: Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State, in Endotext [Internet],* A.B. Feingold KR, Blackman MR, et al., Editor. 2021, MDText.com, Inc. p. 1-30.

5. Agiostratidou G, Anhalt H, Ball D, Blonde L, et al. Standardizing Clinically Meaningful Outcome Measures Beyond HbA1c for Type 1 Diabetes: A Consensus Report of the American Association of Clinical Endocrinologists, the American Association of Diabetes Educators, the American Diabetes Association, the Endocrine Society, JDRF International, The Leona M. and Harry B. Helmsley Charitable Trust, the Pediatric Endocrine Society, and the T1D Exchange. *Diabetes Care.* 2017;40(12):1622-1630. doi:10.2337/dc17-1624.

6. Dhatariya KK, Glaser NS, Codner E, Umpierrez GE. Diabetic ketoacidosis. *Nat Rev Dis Primers.* 2020;14;6(1):40. doi:10.1038/s41572-020-0165-1.

7. Kilpatrick ES, Butler AE, Ostlundh L, Atkin SL, Sacks DB. Controversies Around the Measurement of Blood Ketones to Diagnose and Manage Diabetic Ketoacidosis. *Diabetes Care.* 2022;1;45(2):267-272. doi:10.2337/dc21-2279.

8. Prothero L, Foster T, Dhatariya K, et al. PP37 Use of capillary blood ketone meters to improve ambulance service care of hyperglycaemic patients: protocol for a stepped-wedge, controlled feasibility study (KARMA2). *Emerg Med J.* 2021;38(9):A15.3-A16. doi:10.1136/emermed-2021-999.37.

9. Bektas F, Eray O, Sari R, Akbas H. Point of care blood ketone testing of diabetic patients in the emergency department. *Endocr Res.* 2004;30(3):395-402. doi:10.1081/erc-200035231.

10. Dhatariya KK, Joint British Diabetes Societies for Inpatient Care. The management of diabetic ketoacidosis in adults-An updated guideline from the Joint British Diabetes Society for Inpatient Care. *Diabet Med.* 2022;39(6):e14788. doi:10.1111/dme.14788.

11. Kitabchi AE, Umpierrez GE, Miles JM, Fisher JN. Hyperglycemic crises in adult patients with diabetes. *Diabetes Care.* 2009;32(7):1335-43. doi:10.2337/dc09-9032.

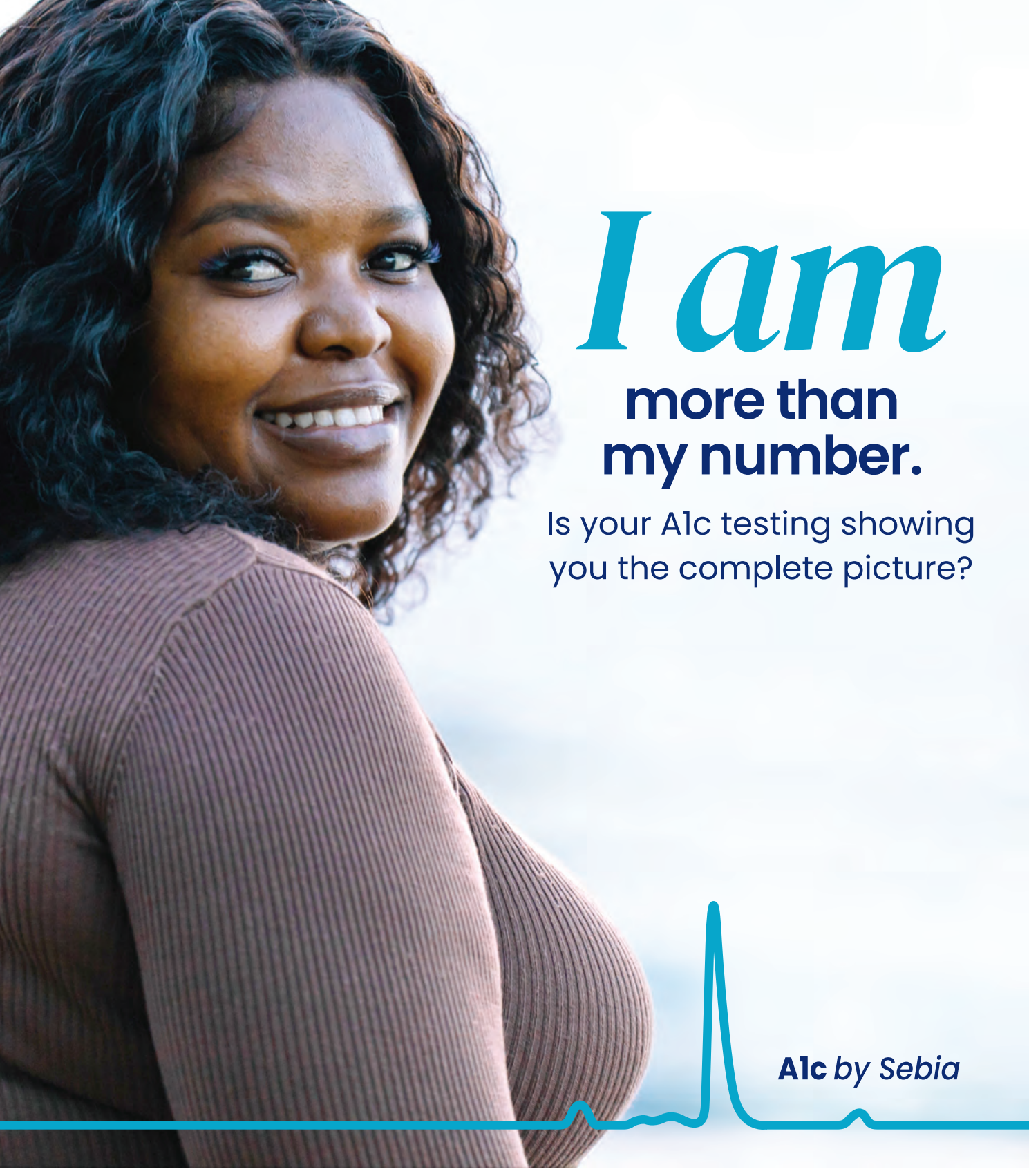
12. Wolfsdorf JI, Glaser N, Agus M, Fritsch M, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Diabetic ketoacidosis and the hyperglycemic hyperosmolar state. *Pediatr Diabetes.* 2018;19 Suppl 27:155-177. doi:10.1111/pedi.12701.

13. Ceriotti F, Kaczmarek E, Guerra E, Mastrantonio F, Lucarelli F, Valgimigli F, Mosca A. Comparative performance assessment of point-of-care testing devices for measuring glucose and ketones at the patient bedside. *J Diabetes Sci Technol.* 2015;9(2):268-77. doi:10.1177/1932296814563351.

14. Vandamme S, Van Mechelen K, Cluckers H, Van Hoof V. Validation of the Nova point-of-care testing StatStrip β-ketone test in a laboratory and clinical setting. *Point Care.* 2018;17(1):13-14. doi:10.1097/poc.0000000000000155.

15. StatStrip and StatStrip Xpress®2 Glucose Meters-Only glucose meters accurate enough to be FDA cleared for use with ALL patients, including critically ill. Novabiomedical.com. Accessed April 14, 2023. https://www.novabiomedical.com/statstrip-glu/.


**Dennis Begos, MD, FACS** is Senior Medical Director at **Nova Biomedical**. He is a board-certified physician and surgeon with over 20 years' experience in clinical medicine, medical education, and administration.




sebia

The new language of life

1705 Corporate Dr # 400 | Norcross, GA 30093 | 1.800.835.6497
info@sebia-usa.com | www.sebia-usa.com

Sebia USA SebiaUS

Scan for more information

Photo 37130206 © Tyler Olson | Dreamstime.com

# No quick fix: A sustainable solution to lab personnel shortages

## Professional certification can help with staffing

By Kathy Cilia MLS(AMT), CAE

After years of discussion around the shortage of qualified clinical laboratory testing personnel, the combined causes are well documented such as changing demographics, fewer school programs, the pandemic, and lack of recognition of the profession. Meanwhile, solutions have emerged, and the American Medical Technologists (AMT) association is working on the front lines to resolve the problem. The crux of the issue is maintaining laboratory quality and producing reliable testing results while finding new ways to staff the laboratory.

AMT has a history of adapting with changes in the industry. AMT was started in 1939 by a group of working med techs who wanted to offer an additional quality program in the burgeoning field of clinical laboratory technology. Since then, the AMT mission has not changed but expanded to include certifications for more medical laboratory roles and other allied health professions. To ensure quality throughout the lab, AMT offers a set of certification exams that assess competency at every level from specimen collection and processing to molecular diagnostics (see **Figure 1**). AMT is accredited by the National Commission for Certifying Agencies (NCCA) of the Institute for Credentialing Excellence (ICE). According to James Fidler, PhD, director of testing and competency assurance for AMT, "The third-party recognition of a credential by NCAA is an important way of affixing an imprimatur, or 'stamp of approval,' attesting that the many elements comprising a certification program adhere to generally accepted industry standards. In addition, many states which have laws regulating the practice of particular occupations recognize AMT certification for licensure purposes, which is yet another reflection of the quality of a certification and its examinations."

While staying true to its roots of maintaining quality in the lab as the goal, over time, AMT has adapted its eligibility criteria for certifications—and the exams themselves—to reflect the demands of the current industry. Years ago, laboratory personnel


WSLH Proficiency Testing
WISCONSIN STATE LABORATORY OF HYGIENE
UNIVERSITY OF WISCONSIN–MADISON

Reliable, affordable, and easy-to-use proficiency testing with rapid access to results

**wslhpt.org**

did not need an undergraduate degree to qualify for any credential from any agency. But practices evolve, and now a higher level of education is required for medical laboratory scientists. Still, several basic certifications for lab personnel are accessible with lower levels of thorough training to build competency.

## Sustainable versus non-sustainable solutions

Just as there is not a single cause for the shortage of qualified testing personnel, there will not be a single solution. Some answers to the shortfall may be more effective than others. For example, some AMT members are filling contract roles in the clinical lab and traveling to locations around the United States for lucrative pay and the opportunity to live in different parts of the country. But when they leave a full-time position, there is a new problem for the employer who lost them. Competing for talent through pay and perks may solve the problem in the near term, but it may not for the long term. Laboratories and systems are going to have to invest in longer-term solutions to acquire, develop, and retain talent.

Investing in staff can pay off and we are seeing that with the rise of employer-based training or apprenticeships. Borrowing from successful practices in other labor markets, many systems around the country are creating their own programs to hire, train, and get credentials for their employees so they have sufficient and properly trained staff to process the heavy workload of their labs.

There are bespoke solutions emerging in different pockets from rural hospitals to major systems. The solutions range from establishing registered apprenticeships through the US Department of Labor in order to obtain funding and create a stream of new employees, or simply hiring talent and training them systematically. AMT collaborates directly with employers in any of these scenarios from the outset to follow-through. When employers are initially planning for work-based training, AMT expertise can help them define the competencies necessary to fill a job role. The employer hires and trains the laboratorians. Then AMT helps at the end of the training process by assessing the trained individuals via a rigorous credentialing exam, which gains them a professional certification proving competency to fill an entry-level job.

For example, to fill a phlebotomist role, an employer can hire a dependable individual and give them hands-on training and enroll them in qualifying online courses to meet the required number of hours for phlebotomy certification. The right combination of didactic learning and verified experience makes those employees eligible to sit for the AMT certification exam. At the end, the individual has a job and a certification, and the lab has a reliable employee. You can work directly with AMT to make sure your training program is going to be sufficient to give individuals the best chance to succeed in obtaining a valuable credential.

If you need specimen processors, you can do as some hospitals have and train existing staff who are working in non-technical roles but want to improve themselves. To qualify as a Certified Medical Laboratory Assistant CMLA (AMT), they need to complete a course of study with 200 clock hours of didactic instruction and 120 hours of approved lab experience. Once they pass the test, they become members of the AMT professional association, which helps them maintain their professionalism and their skills.

We have seen a number of career-technical education startup programs around the country that certify students to work as lab assistants right out of high school. This can be the first rung of a career ladder that advances to medical laboratory technician (MLT) with an associate degree and medical laboratory scientist (MLS) or a molecular credential with a four-year degree.

Another AMT option can more quickly fill MLS roles. There is an untapped resource in science majors with degrees in biology or chemistry who would like to work in the lab but are considered unqualified. Labs can readily help them get qualified to work in the medical laboratory with a Medical Laboratory Scientist MLS (AMT) credential through our alternate route to

**Eligibility for AMT Laboratory Certifications**

Applicants must meet one of the routes listed below to be eligible to take the AMT exams. Routes listed are in summary format; please see detailed requirements and automated eligibility assistance at www. americanmedtech.org.

**Medical laboratory scientist MLS(AMT)**

- Bachelor's degree in MT (or other major with a heavy emphasis in scientific coursework + 1 year clinical lab experience)
- Bachelor's degree and 50-week US military program or accredited MLT program + 1 year clinical lab experience

**Medical laboratory technician MLT(AMT)**

- Associate degree in MLT (or other major + 6 months clinical lab experience)
- Complete 50-week US military lab training program

**Registered phlebotomy technician RPT(AMT)**

- Complete a phlebotomy technician program (120 didactic hours)
- 1040 hours of relevant work experience
- 50 successful venipunctures/10 capillaries (for all routes)

**Molecular diagnostics technologist MDT(AMT)**

- MT certification, BS degree + 6 months molecular science experience
- Bachelor's degree + diagnostic molecular science program completion
- Bachelor's degree + one-year molecular science experience
- Graduate degree in related science field + six months molecular science experience

**Certified medical laboratory assistant CMLA(AMT)**

- Complete a relevant course of study (200 didactic hours) + 120 hours lab experience
- 1040 hours of relevant work experience

**Certified laboratory consultant CLC(AMT)**

- A portfolio-based certification not requiring an exam

**Figure 1**. See laboratory profession profiles with typical duties and current salaries AMT Laboratory Certification: The Right Choice for You, American Medical Technologists (americanmedtech.org).

certification. Labs have told us this is a well-kept secret, though that is certainly not our intention! Through the AMT alternative route, an individual with a qualifying science degree can take supplementary laboratory science courses, rotate through departments in the clinical lab, and become eligible to sit for the AMT Medical Laboratory Scientist certification in a year. It is a great way to attract and retain talent.

## Developing and keeping current staff

High turnover consistently is cited as a significant expense for healthcare providers. To maintain those long-term employees, managers may consider offering further certification that develops talents and keeps employees on a career path. Molecular Diagnostics Technologist is a certification that appeals to working lab professionals and to those in the IVD industry.

Offering employees career progression opportunities can be a way to develop the skills and responsibility levels for your current staff or to attract new ones. Some AMT members stack credentials progressively by starting a career as a phlebotomist, progressing to MLT, and culminating through education as an MLS. There are a variety of routes one can take to become certified in the laboratory, and we have seen employers take advantage of these. While non-traditional solutions are not easy, they are successful. You'd be amazed how quickly some AMT partners are getting their programs up and running and building a pipeline to fill critical roles.

## Certification proves skills to work at top of practice

Laboratory managers are well aware that a warm body is not enough to fill a job gap. Proven competency in a defined skill set is a necessity, which is the purpose of a certification. When managers know exactly what to expect of an individual with a certification, that certified person can be expected to work at the top of their credential in order to free up the time of more highly credentialed staff. We have seen laboratories utilize more Certified Medical Laboratory Assistants (CMLA) to help with work previously completed by an MLT. And an MLT may conduct tasks once the province of an MLS. A thorough, free resource of expected competencies by job role can be found at americanmedtech.org in the exam content outline for each lab certification role.

## A brighter future through innovation

There is not going to be a quick fix to the shortage of qualified laboratory testing personnel. Many contributing factors are beyond the control of the laboratory. But innovation is a hallmark of laboratory work, and I am confident that laboratory leaders who are open to new ways of staffing will find the next generation to carry on their laboratories' critical work and contributions to care.

**Kathy Cilia** is executive director of **American Medical Technologists** (AMT), the credentialing agency and professional organization for more than 85,000 actively certified allied health professionals.

Photo 2333510 © Sebastian Czapnik | Dreamstime.com

# Automation: Continued innovation and evolution in clinical laboratories

By Ann Ludwig, MT(ASCP)

Clinical laboratory automation can improve the quality, efficiency, safety, and cost-effectiveness of laboratory operations and continues to evolve and expand into areas such as specimen handling, accessioning, testing, and inspection readiness. Innovation and evolution must focus on patient results as well as front-to-back sample handling with a robust informatics presence. Laboratories can benefit from the standardization that adding automated processes delivers. From automating rerun and reflex testing to smear production and digital image output, laboratories can do more with less, and consistently, across a health system. Automation applies across the spectrum of laboratories from lower volume, rural laboratories to the highest-volume reference laboratories. More and more scalable options are available in today's market that will provide a seamless approach such as pairing an integrated digital imaging analyzer in the core lab with a benchtop digital imaging analyzer in the satellite lab via the lab's internal network to ensure consistent and timely result interpretation and pathology consults across the health network.

Manufacturers must keep a pulse on laboratories and laboratorians to understand current needs as well as what labs of the future might look like. Labor shortages continue to plague clinical laboratories. While at the same time, testing is absolutely critical to patient care in diagnosing disease, monitoring patient care, and determining overall wellness. New tests are developed all the time; yet the number of people available to run the tests is in rapid decline. Due to a lack of high school and college student awareness and interest in clinical lab science programs and a decrease in the number of programs available, the challenge may only worsen.

Each manufacturer should shoulder some responsibility to contribute to the foundation of what it is to be a medical laboratory scientist. Interfacing with laboratorians is an integral part of the business. By continually seeking the voice of the customer information, invaluable feedback will guide the way through current, on-market product enhancements, improvements to the product development process, and understanding where needs are greatest in the laboratory. Building a two-way communication channel is imperative to ensure that laboratorians can submit

feedback and that the manufacturer proactively seeks input. This builds trusting relationships and partnerships across the industry.

With the ever-present labor shortage, it is imperative that we look for ways to provide automation from pre-analytical to post-analytical touchpoints and ultimately sample storage — it is beyond generating best-in-class patient results, it must be a best-in-class solution. Offering complementary products to enhance sample management can alleviate many labor shortage pain points. Adding a de-capper to your automated urinalysis solution can eliminate a manual step in the process. Similarly, adding erythrocyte sedimentation rate and A1c testing to your automated hematology solution can minimize the number of touchpoints of every lavender top tube in the laboratory. Adding tube sorting and archiving functionality can provide even further relief. And there are scalable solutions available to meet the needs of any sized laboratory. Adding an automated hematology quality control (QC) and maintenance module paired with a QC management software package such as Sysmex America's BeyondCareSM Quality Monitor (BCQM) will take the guesswork out of QC management by automatically performing QC and the start-up and shutdown of a system based on customized settings specifically to meet each lab's needs. Take it a step further and connect through total lab automation (TLA) and the laboratory will realize the relief that front-to-back automation can bring.

And it is not just about the large-volume facilities in urban areas. The smallest rural facilities are also feeling the labor shortage pain and are in the greatest need to automate their processes. It is critical that manufacturers continue to work together on behalf of the laboratory's needs to ensure a seamless total laboratory automation experience. This alleviates a great deal of stress and pressure on the staff, freeing them up to perform critical functions in the laboratory when there simply just are not enough people. Scalable solutions are available that will provide relief to all labs. Quality control management software with on-demand, peer-comparison reports and the ability to perform daily calibration verification ensures inspection readiness at all times. Using dedicated software programs can also provide troubleshooting measures for the operator to take the guesswork out and drive consistency across all users and across all laboratories in a health system. And no matter the size of the lab or the volume of samples run, adding automation via hardware and software eases much of the heavy lifting.

The ability to provide state-of-the-art laboratory equipment with the capability to perform functions from pre- to post-analytics with innovative informatics and automated quality control management and daily automated calibration verification will ensure the best-in-class patient care but may also aid in recruiting best-in-class staff. Let the feedback loop guide development from one generation of products to the next to ensure we garner interest in the field and grow the next generation of laboratorians.

**Ann Ludwig, MT (ASCP)** is Assistant Director, Automation Solutions Marketing at **Sysmex America, Inc**. Ann is responsible for reference lab strategy and total laboratory automation for optimizing the efficiency, operations, and financial performance of clinical laboratories. With 25 years of clinical marketing and product management experience and lab experience, Ann has successfully launched new and innovative products to the market including Sysmex's 5th generation slidemaker stainer, the SP-50, and first-of its-kind automated urinalysis platform, the UN-Series, across North America. Ann holds a Bachelor of Science in microbiology from the University of Kansas and a bachelor of science in Medical Technology from the University of Kansas School of Medicine – Allied Health.

Photo 117377978 © Sergey Klopotov | Dreamstime.com

# Diagnostic stewardship: An opportunity to shine in and outside of the clinical laboratory

By Nicholas M. Moore, PhD, D(ABMM), MLS(ASCP)cm

Laboratory testing has greatly evolved since its early beginnings in the late 19th century. Education in laboratory medicine for medical trainees has not kept pace with advances in technology, however, leading to uncertainty among physicians on test selection and result interpretation. Laboratory medicine training is not required in the majority of U.S. medical schools, and of those that do, the median time allocated is 12.5 hours.[1] Improper test selection and errors in result interpretation are a significant cause of diagnostic errors affecting millions of patients annually.

## Diagnostic errors in medicine

One publication suggests that medical errors are the third leading cause of death in the United States but are not listed on death certificates.[2] Diagnostic errors are one of four types of errors described in the Institute of Medicine (IOM) report, "To Err is Human: Building a Safer Health System."[3] Some diagnostic errors may result in direct harm while others may lead to delays in establishing a diagnosis. Inappropriate utilization of diagnostic tests, including over- and under-utilization, can contribute to diagnostic errors. In 2015, The IOM published their report, "Improving Diagnosis in Health Care."[4] Designed as a follow up to the 2000 report, this publication highlighted that little had been done to move the needle in terms of diagnostic error detection. This report emphasized the importance of diagnostic error, that diagnostic error had received little attention, and that there was a paucity of good data. Additionally, this report emphasized that making a diagnosis of a disease or condition is a collaborative effort, requiring both intra- and interprofessional teamwork. This report explicitly stated the important role of pathologists, radiologists, and other healthcare personnel who may be forgotten about in the big picture, including medical laboratory scientists.

Data published by the Centers for Disease Control and Prevention reports that an estimated 14 billion laboratory tests are ordered annually in the United States each year by physicians.[5] Samples are collected from patients and tested in the more than 260,000 CLIA-certified laboratories that report patient results back to the ordering physician. Given the large volume of tests ordered, undoubtedly there are opportunities for a test to be incorrectly ordered or the results to be interpreted incorrectly. A 2014 survey of 1,768 physicians trained in general internal medicine and family medicine reported uncertainty in test selection and uncertainty in result interpretation 15% and 8% of the time, respectively, in patient diagnostic encounters.[6] These self-reports are likely severely underestimated, especially given the significant growth of advanced molecular assays, including next generation

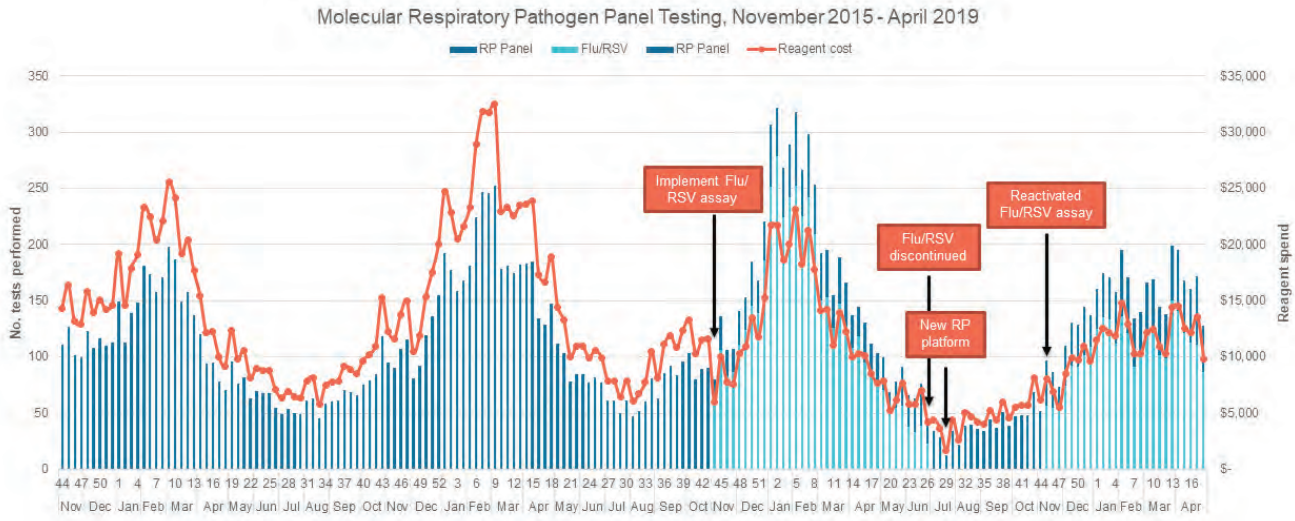



**Figure 1**. Molecular respiratory pathogen testing trends over four influenza seasons (2015-2019).

sequencing and the use of metagenomics. A frequently described challenge regarding the use of advanced molecular diagnostics such as metagenomics from experts lies in the interpretation of the data generated.[7]

In fact, a 2021 multicenter study led by Daniel Morgan, MD, evaluated clinicians' abilities in several scenarios to determine the probability of a variety of disease states before and after laboratory testing.[8] Startlingly, they found that clinicians overestimated the probability of disease between 2 to 10 times both before and after testing, and that all clinicians, regardless of training, tended to overestimate disease likelihood. Findings such as these highlight the need for and the importance of diagnostic stewardship approaches in the clinical laboratory.

## What is diagnostic stewardship?

Diagnostic stewardship is a term used to refer to initiatives and activities that encompass the entire testing process from pre-analytic to post-analytic phases. It should include input from multiple stakeholders, including experts in pathology and laboratory medicine sub-specialties, who, ideally, lead these efforts. As defined by the World Health Organization, the goal of diagnostic stewardship is to "promote appropriate, timely diagnostic testing, including specimen collection, and pathogen identification and accurate, timely reporting of results to guide patient treatment."[9] In other words, diagnostic stewardship is about using the right test, with the right patient, at the right time. Balancing each of these considerations can be challenging in clinical microbiology, especially given that a large volume of the testing is still culture-based, and final reports will not be available for several days to weeks after the specimen is received in the laboratory.

## Use of diagnostic stewardship to improve molecular testing for respiratory viral infections

Like many clinical microbiology laboratories, we moved viral respiratory testing from antigen or large batch runs to syndromic rapid molecular assays with a shortened turnaround time (TAT) in 2014 before the start of the 2014–2015 influenza season. Clinicians were exceedingly happy with the rapid TAT and the breadth of targets included (>20 viral and 3 atypical bacterial pathogens) on the panel. This assay was swapped out for our old one, and there was no education regarding its use to ordering clinicians. Needless to say, use of the test skyrocketed, and after two respiratory seasons we had already spent more than $2 million on test reagents alone.

In May 2017, Palmetto GBA, a Medicare A/B contractor, issued a draft local coverage determination regarding reimbursement for multiplex respiratory panels. The initial draft proposed a non-coverage policy for these assays arguing that they were not medically necessary tests.[10] Around the same time, our emergency medicine faculty were seeking a molecular answer for influenza and RSV diagnosis with a more rapid turnaround time in order to maximize patient throughput in our emergency department during the next respiratory season.

The amount of money spent on reagents thus far, the possibility of lack of reimbursement in the future for use of a large molecular assay, and a request for a more rapid test from our largest utilizer of the assay, were signals that a change needed to be made. All of this led us to implement a rapid molecular assay for influenza and RSV. This assay would be the workhorse for the majority of testing, including all testing in our emergency department with results available within 30 minutes from assay start on the analyzer. Testing would be seasonally discontinued when prevalence fell below recommended thresholds for testing. In collaboration with our infectious disease and information services colleagues, we also developed new electronic order sets in our electronic medical record system and developed patient criteria for broad respiratory pathogen panel testing at the start of the 2017–2018 influenza season (**Figure 1**).

The criteria for an expanded respiratory pathogens panel included: 1) Patients with influenza-like illness who were admitted to an inpatient unit, 2) patients who have a medical condition that puts them at higher risk of severe infection (solid organ or bone marrow transplant, AIDS, ongoing receipt of cancer chemotherapy and/or other immunosuppressive medication), and 3) patients who had already received testing for influenza and RSV that was negative. Notably, for adult patients, all three criterion had to be met before expanded respiratory viral testing would be performed. This was guided by the fact that only one-third of all viral respiratory panels in the two previous influenza seasons had been positive for any viral pathogen. Eight percent had been positive for influenza, and four percent for RSV. The remaining positives were for other respiratory pathogens for which directed therapy is not available.

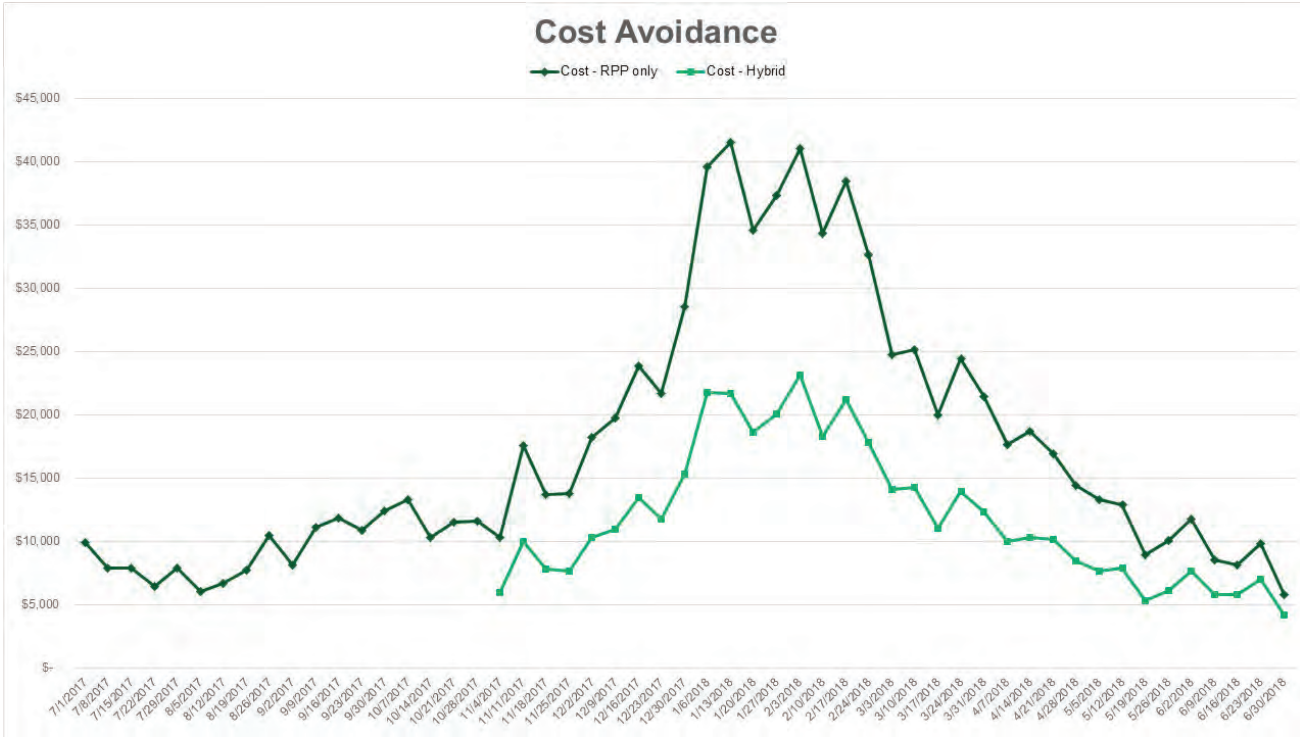



**Figure 2**. Cost avoidance for molecular reagents by implementing a hybrid test model (light green line, actual costs) versus testing with the expanded respiratory pathogen panel (dark green line) alone during the first year of implementation.

We determined that at our institution, the cost of diagnosing a patient with a viral respiratory illness that was not influenza to be nearly 18 times the cost of diagnosing an episode of bacteremia. At the end of the first year of the diagnostic stewardship program, we calculated the cost avoidance using the implementation of this hybrid approach to testing. We identified that our laboratory saved $321,740 in reagent costs for respiratory virus testing by shifting most of the testing away from our broad respiratory panel (**Figure 2**). Additional cost savings were also realized in July of 2018 when we adopted a new platform for our expanded respiratory pathogens panel testing.

Much of the work on this highlighted examples focused on optimizing test utilization of molecular panels. Specifically, we were focused on using the right test, balancing test volume and cost, testing the right patient, and focusing on appropriate use criteria and test indications at the right time to ensure that a result would be available in time to reasonably impact patient care. Unfortunately, many of the improvements made and attributed to diagnostic stewardship to improve our viral respiratory testing were hindered as a result of the COVID-19 pandemic.

In an ever-evolving healthcare landscape, clinical laboratories need to remain flexible to meet the needs of their patients and the clinicians they serve, all the while being fiscally responsible due to changes related to laboratory regulations and reimbursement. Ensuring that clinical laboratories are thinking about ways to partner with clinical colleagues to develop and implement diagnostic stewardship practices can be used to improve patient care and reduce diagnostic errors.

## REFERENCES

1. Smith BR, Kamoun M, Hickner J. Laboratory Medicine Education at U.S. Medical Schools: A 2014 Status Report. *Acad Med.* 2016;91(1):107-12. doi:10.1097/ACM.0000000000000817.

2. Makary MA, Daniel M. Medical error-the third leading cause of death in the US. *BMJ.* 2016;3;353:i2139. doi:10.1136/bmj.i2139.

3. *To Err Is Human: Building a Safer Health System.* National Academies Press; 2000.

4. Ball JR, Miller BT, Balogh EP, eds. Committee on Diagnostic Error in Health Care, Board on Health Care Services, Institute of Medicine. *Improving Diagnosis in Health Care.* National Academies Press; 2015.

5. Strengthening clinical laboratories. Cdc.gov. Published November 15, 2018. Accessed April 25, 2023. https://www.cdc.gov/csels/dls/strengthening-clinical-labs.html.

6. Hickner J, Thompson PJ, Wilkinson T, Epner P, et al. Primary care physicians' challenges in ordering clinical laboratory tests and interpreting results. *J Am Board Fam Med.* 2014;27(2):268-74. doi:10.3122/jabfm.2014.02.130104.

7. Johansen Taber KA, Dickinson BD, Wilson M. The promise and challenges of next-generation genome sequencing for clinical care. *JAMA Intern Med.* 2014;1;174(2):275-80. doi:10.1001/jamainternmed.2013.12048.

8. Morgan DJ, Pineles L, Owczarzak J, Magder L, et al. Accuracy of Practitioner Estimates of Probability of Diagnosis Before and After Testing. *JAMA Intern Med.* 2021;1;181(6):747-755. doi:10.1001/jamainternmed.2021.0269.

9. Diagnostic stewardship. Who.int. Accessed April 25, 2023. https://apps.who.int/iris/bitstream/handle/10665/251553/WHO-DGO-AMR-2016.3-eng.pdf.

10. Palmetto GBA. MolDX: Multiplex Nucleic Acid Amplified Tests for Respiratory Viral Panels (DL37258). Accessed April 23, 2023. https://www.aphl.org/Materials/Multiplex_Nucleic_Acid_Tests_for_Resp_Viral_Panels_(DL37258)_Palmetto.pdf.

**Nicholas M. Moore, PhD, D(ABMM), MLS(ASCP)**[cm] is the Associate Director of Clinical Microbiology and Associate Professor, **Rush University Medical Center, Chicago, Illinois**. His research interests are focused on antimicrobial resistance in Gram-negative bacilli and the use of advanced molecular diagnostics to inform infection control decision-making related to nosocomial outbreaks.

# WHICH WOULD YOU CHOOSE FOR YOUR LABORATORY SUBCULTURE PROCEDURE?

**Safety SubCulture Unit 2**
needleless subculture procedures

**Other subculture devices**
exposed needle subculture procedures

**Safety SubCulture Unit 2** enables a safe and needleless subculture procedure of positive blood culture bottles to slides and media plates.

**Other subculture devices** transfer samples with **exposed needles.** Protect your staff with a safety oriented subculture solution.

**Request your samples today at itlbiomedical.com/scu2.**

The CDC estimates ~ 385,000 healthcare workers[1] sustain sharps injuries each year, resulting in an increased risk for bloodbourne virus transmission and increased costs to personnel and healthcare systems.

1.888.411.2851 sales@itlbiomedical.com **itlbiomedical.com**



[1]https://www.cdc.gov/sharpssafety/index.html

ITL BioMedical


# State of the Industry: Lab Management Best Practices

By Kara Nadeau

Despite continued struggles with staffing shortages and supply chain issues, clinical laboratory professionals are pushing ahead with greater standardization of processes and procedures, and overcoming obstacles to system interoperability and automation, according to the results of the 2023 Medical Laboratory Observer (MLO) State of the Industry (SOI) survey on Lab Management Best Practices.

Kathy Nucifora, MPH, MLS(ASCP)

We gathered responses from 255 clinical laboratory professionals with 63% of respondents in director, manager, administrator, or supervisor positions, and most employed by hospitals (66%).

The survey results provide insights into best practices around controlling costs, optimizing contracts, capturing reimbursements, managing supplies, implementing technology solutions, navigating staffing shortages, and improving the quality and efficiency of testing.

Alongside the quantitative data, the article presents write-in comments from lab professionals who took part in the survey, along with commentary from COLA Chief Operating Officer Kathy Nucifora, MPH, MLS (ASCP), and clinical lab service and solutions providers.

## REVVING UP REIMBURSEMENTS

Payments for lab services from the Centers for Medicare & Medicaid Services and other payers have been cut in recent years as labs face the challenge of increased supply and labor costs.[1]

When asked what steps they had taken to ensure reimbursements cover their costs, over half of survey respondents said they had created standard lab processes and staff education materials (53%) or standardized instrumentation workflows and checklists (52%).

Next highest on the list was incorporation of IT solutions to reduce human error (40%), followed closely by the adoption of analyzers that provide walkaway testing to reduce staffing and FTE hours (39%), and adoption of processes to review savings opportunities, such as evaluating analyzers, on a regular schedule (38%).

Nearly one-quarter of lab professionals surveyed said they have incorporated IT solutions to help keep current with regulations (24%), followed by those who had implemented ongoing waste and efficiency studies to find potential savings in overhead (19%), or implemented ongoing efforts to reduce coding frustrations and modifications (18%).

For those respondents who said their labs cannot track whether reimbursement covers their costs, the top challenges holding them back were not having the software to automate tracking/analysis of costs (35%), followed closely by lack of interoperability between laboratory information system (LIS) and revenue cycle management software (34%), and not enough staff time (32%). Much lower on the list was not enough barcoded testing supplies (7%) and point-of-care testing (POCT) products (6%).

# THINK BEYOND CONNECTIVITY

Expand your orbit with ELLKAY

LK Orbit

**One platform and one partner**
to expand your possibilities

ELLKAY's end-to-end, cloud-based connectivity platform eliminates provider workflow challenges and maximizes reimbursements. The LKOrbit Platform is robust and scalable to meet the unique needs for any type or size of laboratory, radiology center, and more.

LK Orbit

- OPTIMIZED CONNECTIVITY & OUTREACH
- END-TO-END ORDERING & RESULTING
- AUTOMATED CODE MAPPING
- CLEAN, COMPLETE ORDERS DATA


ELLKAY

**Expand your orbit and power your growth with ELLKAY!**

www.ELLKAY.com | TeamELLKAY@ELLKAY.com | 201-791-0606

# The value of cost accounting

According to Diana Richard, Sr. Director, Pathology and Strategic Development at XiFin, the practice of cost accounting — the procedure for recording and reporting measurements of the cost of performing services that allows laboratories to measure profitability by test type — is one of the most effective ways to manage and track lab costs against reimbursement.

"The practice of implementing cost accounting is neither simple nor straightforward," explained Richard. "Labs need a consultant experienced in this area to perform at least the initial assessment, though there will be gray areas the laboratory will still need to work through based on a multitude of factors that drive cost (place of service, patient type, etc.). That said, defining a material range-of-cost will provide labs with the foundation needed to support critical business decisions. From there, the labs can decide if reimbursement exceeds cost by test, by payor, and provider (particularly if client billing applies). Understanding the margins by test/payor/provider facilitates sales and growth initiatives, such as defining viable markets, investments into new or expanded testing, efficiencies in the lab workflow, and sunsetting unprofitable testing.

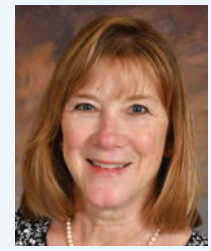

Diana Richard

"Further, understanding the cost of testing can play a substantive role in your negotiations with payors," she continued. "Payors often blanket regions with reimbursement cuts, in some cases as low as 40–60% of Medicare. When a laboratory, or a consortium of laboratories, leverages cost data to facilitate discussions on viability of these substantive cuts, it can help drive a more thoughtful discussion of 'need' versus 'want.'"

"Finally, data must be used and updated often," Richard added. "Having a reporting tool that can measure cost against reimbursement in real time is invaluable for daily, weekly, and monthly financial assessments. Leveraging a robust financial platform, particularly one from an RCM provider that can maintain those data elements as part of its organic reporting strategy, enables automated generation of trending and other analyses, which streamlines ongoing evaluation."

# Automation and collaboration support improvements

"We have had automation and middleware with auto validation since 2002, and it has evolved over time," said Susan E. Dawson, MBA, MT(ASCP), Laboratory Administrative and Operations Director, Swedish Hospital, Part of NorthShore – Edward-Elmhurst Health. "Today utilizing our Atellica Data Manager middleware (ADM) we 'do less and accomplish more' by using the capabilities of auto validation in conjunction with the ability to separate outpatient results by specimen priority levels and location to help us meet the needs of our patients."


Susan E. Dawson, MBA, MT(ASCP)

"The counters on the software, with criteria determined by the techs, bring the tech directly to a specifically defined patient population," Dawson continued. "The stat specimens from the emergency department are separated from inpatient stats, which are separated from routine blood work. Counters are set up for chemistry and hematology. Hematology specimens only needing a manual differential are separated from specimen results needing a review of the entire CBC. By separating the different populations and priorities, we are able to efficiently address results that don't pass auto validation and require a technologist to review."

"Quality Circle management has been used to implement changes in our laboratory over the years," said Dawson. "When we have a goal to meet, we bring together the staff and engage them in figuring out how to meet our goals, change or adjust our process, and improve our work area. Everyone owns the project and works together. Sometimes it takes a couple of adjustments, and sometimes we get it right the first time."

## CONTROLLING CONTRACTS AND COSTS

Looking at steps to improve inventory control and consumable supply costs, top on the list was the evaluation of inventory levels for basic supplies, such as assays and controls/reagents, with nearly three-quarters of respondents having taken this step (74%). Second highest on the list was the development of supply utilization tracking and record keeping (40%).

Only 20% of those surveyed indicated they had worked with other members of the organization, such as the chief medical officer (CMO) and physicians, to standardize test ordering throughout the organization, which was down from 36% in 2022. The same percentage of respondents (20%) said they had developed an ongoing review comparing supply reports to the number of invoiced tests, which was up from 15% last year.

A greater percentage of respondents in 2023 had secured access to electronic inventory tracking from the supply chain/materials management department (from 13% in 2022 to 18% in 2023) or implemented lease agreements that do not include volume commitments (from 10% in 2022 to 18% in 2023). Fewer respondents selected vendor-managed ordering as a step to improve inventory control and consumable supply costs (from 19% in 2022 to 15% in 2023).

Among the write-in comments for this question, one lab professional said they had assigned specific technicians to departments to "keep up with expirations dates and usage." Another wrote they had employed their own supply technician. A third said they had utilized test volume tracking on instruments to allow "just in time" loading of required supplies to reduce waste and get the most use out of reagents.

With regards to best practices for streamlining the contracting process, 65% of individuals surveyed said they worked with supply chain management on supplies that are on group purchasing organization (GPO) contracts that offer additional savings, and nearly half (48%) had developed good relationships with supplier support personnel to secure access to training and product optimization suggestions. Next on the list of best practices was ongoing reviews of reference lab costs and contracts (40%), followed by signing longer contracts (20%).

## ADDRESSING STAFFING SHORTAGES

According to the U.S. Bureau of Labor Statistics, about 25,600 openings for clinical laboratory technologists and technicians are projected each year, on average, through 2031, with many of those openings

# Tools and processes for quality and efficiency improvements

Hunter Bowen, Senior Marketing Manager, Workflow & Informatics Technologies Solutions, Beckman Coulter Diagnostics, defines quality as "accuracy, repeatability and timeliness of reported test results." He said, "improving quality means striving to reduce variability and drive process consistency beyond meeting regulations and independent standards, as errors and process variation can be introduced at any point in a sample's journey."


Hunter Bowen

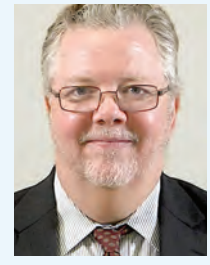
Bowen offered the following considerations for how to improve laboratory quality and efficiency with tools and processes:

- Teams should be empowered to document, communicate, and address errors before samples arrive in the laboratory. This can include issues such as improper labeling and container types that risk erroneous results. While automation systems and middleware can identify these errors, improving quality requires addressing these upstream problems to prevent recurrence.
- Automation systems and software tools like middleware are capable of intelligently managing workflows when conducting testing at scale by automatically delivering samples at the right place at the right time to reduce overall process variation while also helping teams conduct and document manual activities such as calibrations and quality control testing.
- Automation can also reduce process variation after sample analysis when processing add-on tests or re-runs. Automated add-on processes managed by automation systems and reflex rules will not only reduce the time staff will spend looking for samples, but automation can also integrate analyzer information such as QC status, available reagent inventory, and instrument status when routing samples to analyzers.

"Common automation, instrumentation and software in a laboratory network can amplify the benefits of standard laboratory practices and processes and improve quality," Bowen added. "While the use of automation and software tools can improve laboratory quality, one of the foundational elements of any process improvement activity when holistically looking at the laboratory is strong communications between teams, shifts and departments to continuously identify and address areas for improvement and amplify the use of tools."

# QC with a focus on patients and test naming

John Yundt-Pacheco, Sr. Principal Scientist, Bio-Rad Laboratories, offered his advice on improving lab test quality and efficiency through patient-centered quality control (QC) and the U.S. Centers for Disease Control and Prevention (CDC) TRUU lab initiative.


John Yundt-Pacheco

"Labs have traditionally established QC targets with an instrument-focused strategy, which is fine when there is a single instrument for a type of test. But when multiple identical instruments run the same tests, that approach can lead to QC management issues and discordant results between instruments. In a patient-focused QC strategy, a single set of QC targets are established where, for a given worst case failure, the risk of patient harm is minimized to an acceptable level."

"Testing efficacy can be improved through a better test-naming strategy," Yundt-Pacheco added. "Physicians are often confused about which test to order, as many test names are chosen without consideration of the clinician user. A 2014 study uncovered that physicians were uncertain 15% of the time as to which test to order.[2] In another study, the wrong vitamin D test was ordered over 30% of the time due to confusion over the name.[3] These common mistakes led to the CDC-funded TRUU Lab initiative, which will recommend new naming conventions for lab tests. Labs can follow their work while at the same time engage with clinicians to clear up some of the most confusing names in their systems."

"expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire."[4]

MLO asked survey respondents if they had implemented measures to retain and recruit staff. More than half (53%) said they had offered financial incentives (sign-on bonuses, merit allowances, retention bonuses), and 50% had provided continuing education.

Shift changes to offer employee scheduling flexibility (12-hour shifts, weekends, etc.) was another popular choice (40%), along with establishing partnerships with local colleges and tech schools to offer internships (38%), and daily huddles with peer recognition (38%).

Slightly fewer respondents this year compared with last year indicated they had established clinical ladders (30% in 2023 down from 33% in 2022), while more had established succession-planning processes by offering additional responsibilities to top performers and measuring results (29% in 2023 up from 22% in 2022).

A slightly higher percentage of respondents said their labs offered perks (free parking, on-site gym, on-site day care, reimbursed public transportation costs) compared with last year (21% in 2023 up from 17% in 2022).

## TACKLING SUPPLY CHAIN ISSUES

With supply chain issues continuing to impact all of healthcare, including the lab environment, survey respondents were asked if they had implemented any measures to address them. More than half (58%) had implemented standing orders (instead of just in time) for crucial supplies. The second ranking action was to utilize multiple testing platforms (44%), and the third was working with state public health officials to gain access to needed testing supplies (31%).

Fewer respondents noted they had turned to laboratory-developed tests (14%) or switched to reusable types of personal protective equipment, such as moving from disposable to reusable lab coats, (14%), with one lab professional writing in the comment, "Reusable lab coats are probably not the safest option. Quality is of concern."

Write-in comments on efforts to address supply chain issues included moving to just-in-case, from just-in-time inventory management practices, diversifying supplier base, working closely with supply-chain ordering staff to find new supply sources, sourcing supplies in bulk on the federal level, and increasing PAR level for certain critical supplies.

## INVESTING IN TECHNOLOGY

The majority of respondents (70%) said they prioritized technology needed to improve quality/reduce costs in their capital budgets. More than half (52%) said they prioritized technology needed to cover staff shortages with automated equipment. A high percentage also said technology needed to remain competitive (42%)

## A multipronged approach to the staffing crisis

Kathy Nucifora, MPH, MLS(ASCP), Chief Operating Officer, COLA, cited flexible schedules and career ladders as ways to address retention by offering staff a way to "enjoy work-life balance while aspiring to future advancement in your laboratory." She also suggested labs take part in mentorship programs with local schools and consider on-the-job training for laboratory assistants and phlebotomists who have the potential and interest in pursuing careers as a Medical Laboratory Science (MLS) or Medical Laboratory Technician (MLT).

"The laboratory community recognizes that the workforce shortage has been brewing for many years and has now become a critical concern," said Nucifora. "The public health emergency had something to do with the escalation, but the shortage has multiple origins, and the solution must include several initiatives, with engagement and collaboration among the entire community."

According to Nucifora the good news is that many industry organizations are now coming together to identify and plan impactful solutions to the shortage. For example, in 2022, the American Society for Clinical Pathology (ASCP) published a comprehensive review of the staffing problem and recommendations for addressing the shortage, "The Clinical Laboratory Workforce: Understanding the Challenges to Meeting Current and Future Needs Blueprint for Action."[5]

"It is a must-read for all stakeholders and can serve as a springboard for the community to get involved," said Nucifora. "This document can be found online at ASCP Blueprint for Action and is replete with recommendations including improving visibility of medical laboratory careers, working with schools to improve recruitment, focusing on retention and promoting diversity, to name a few. ASCP has initiated the Medical and Public Health Laboratory Workforce Coalition, which has begun focusing on visibility and is a great example of how various organizations can work together for a common cause."

Nucifora said this momentum had continued with the establishment of the Workforce Action Alliance (WAA) in 2022, of which COLA is a member. She noted how the WAA will be launching initiatives aimed at addressing the shortage throughout the coming year, with plans and results documented and shared online at Workforce Action Alliance - COLA.

"While these group efforts are taking off, there are still many things laboratory managers and leaders can do on a local level," said Nucifora. "If you are not already, consider becoming a clinical training site for area MLS or MLT programs. Programs often struggle to find enough sites for clinical training. Yes, training takes up valuable time, but the payoff is potentially huge, as you will have the opportunity to evaluate future employees to fill the needs in your laboratory."

## Tips for lab technology implementation

When considering the implementation of new diagnostic instrumentation or laboratory automation, Gino Gonnelli, Senior Global Product Manager, Bio-Rad Laboratories, said it can be crucially important to do some pre-work to set your laboratory up for success.


Gino Gonnelli

"Consider conducting a workflow analysis," Gonnelli commented. "This can give you a clear and statistically relevant snapshot of your laboratory performance, highlighting where your current lab setup is succeeding and where there may be opportunities for improvement. A workflow analysis can provide the objective evidence needed to convince key stakeholders to invest in new automation for your laboratory. Taking the time to capture a 'current state' scenario also provides the opportunity to repeat the workflow analysis post automation implementation and demonstrate to other stakeholders the clear wins in efficiency, productivity, and investment value."

"When moving forward with changes, consider the role that your existing personnel will play post-implementation," Gonnelli added. "The goal of any new laboratory automation or software is freeing up personnel's expertise for other high-value tasks. By having a future-state game plan in mind, while clearly communicating your post-automation vision, you can transform resistant personnel into champions of change."

and technology needed to cover broken equipment (38%) were current priorities in terms of budget.

When asked for best practices implemented for adopting new tools for laboratory automation, topping the list was analyzing workflow processes for proper space planning (55%), followed closely by involving the IT department early in the process (51%), and ensuring system integration for seamless process and data flows (48%). Less than one-quarter of respondents (23%) indicated they had designated a project manager to coordinate short- and long-term planning and implementation with the vendor.

The write-in comments provided insight into what is holding some labs back from automation, including lack of IT support and lab size, with a professional from a small lab writing in how "automation would be cost and time prohibitive."

High up on the list of best practices for training staff on new software were the creation of a train-the-trainer model (57%) and standard workflows for all lab employees (56%). Vendor-hosted in-house training was another popular choice with 37% of respondents selecting it.

There was a jump in the number of respondents who had sent a lab team member to LIS training to develop an in-house expert compared with last year (31% in 2023 up from 14% in 2022). Another 20% of those surveyed had established mandatory training for new lab employees that is led by the IT department and 15% developed lunch-and-learn training sessions.

## THE FUTURE OF LAB MANAGEMENT

Looking to the future of the medical laboratories, Kathy Nucifora, MPH, MLS(ASCP), Chief Operating Officer, COLA, encourages lab professionals to get involved in the movement to harness laboratory data to improve population health, positively affect patient outcomes, and control the cost of care. She stated:

"Laboratories, as 'first responders,' have the potential to play a crucial role on clinical teams to identify high-risk patients early, to work with pharmacists and providers on antibiotic stewardship and become a key catalyst as our healthcare system seeks to move to value-based care. Laboratory testing makes up only a small fraction (3–4%) of healthcare costs yet has a profound impact on patients and has the potential to also significantly improve the health of populations and reduce costs."

"Young people want to make a difference; they want meaningful work," she added. "And while those of us who have spent our careers in laboratory science understand the importance and value of our work, we have not always done a stellar job of promoting our profession or getting involved in clinical teams to provide leadership and data that can improve outcomes and control costs. To find out more about how laboratories can join this movement, I urge you to check out the Clinical Lab 2.0 initiative and read about the fantastic work started by the Project Santa Fe Foundation. What an exciting time to be or become a laboratory professional!"

### REFERENCES


1. Reimbursement & coverage. American Clinical Laboratory Association. Published September 1, 2020. Accessed May 2, 2023. https://www.acla.com/reimbursement-coverage/.

2. Hickner J, Thompson PJ, Wilkinson T, et al. Primary care physicians' challenges in ordering clinical laboratory tests and interpreting results. *J Am Board Fam Med*. 2014;27(2):268-274. doi:10.3122/jabfm.2014.02.13010.

3. Unnecessary and unintended 1,25 dihydroxyvitamin D order patterns: A metaphor for life. AACC. Accessed May 2, 2023. https://www.aacc.org/cln/articles/2015/january/patient-safety.

4. Clinical laboratory technologists and technicians, U.S. Bureau of Labor Statistics. Accessed May 2, 2023. https://www.bls.gov/ooh/healthcare/clinical-laboratory-technologists-and-technicians.htm#tab-6.

5. The clinical laboratory workforce: Understanding the challenges to meeting current and future needs blueprint for action, April 2021. Accessed May 2, 2023. https://familymedicine.uw.edu/chws/wp-content/uploads/sites/5/2021/05/Siemens_Clinical-Laboratory-Workforce_Report_042721.pdf.


**Kara Nadeau** has 20+ years of experience as a healthcare/medical/technology writer, having served medical device and pharmaceutical manufacturers, healthcare facilities, software and service providers, non-profit organizations and industry associations.

Photo 89801171 © Rawpixelimages | Dreamstime.com

# Molecular diagnostics of women's health issues

By Rajasri Chandra, MS, MBA

Women face diverse and unique health concerns that can affect their overall health and wellness. Additionally, women are more prone to certain infectious, autoimmune, and mental health diseases than men. For example, genital herpes from herpes simplex virus 2 (HSV2) is nearly twice as common among women than in men; women account for more cases of chlamydia, lupus, and scleroderma compared to men;[1] and community studies show that women have about two to three times higher risk of developing post-traumatic stress disorder (PTSD) in their lifetime compared to men.[2]There are also diseases that affect only women such as cervical cancer, breast cancer, ovarian cancer, and Rett syndrome.[3] For some diseases, women face complications or more dire consequences than seen in men infected with the same causative agent. For example, women with HIV are at a higher risk of severe cases of gynecological problems, such as chlamydia or bacterial vaginosis, than are noninfected women.

Women also risk passing some diseases, such as HIV, to children during pregnancy or breastfeeding.[1] Women can also run the risk of passing group B streptococcus (GBS) to newborns. One in four pregnant women are believed to be carrying GBS in the intestine and genital tract without any symptoms. However, when they are passed on to the newborn, the bacteria may cause bloodstream infections or serious diseases like meningitis in the newborn within the first three months of life. 4%–6% of babies who develop GBS disease die.[4]

> With the emergence of new high-complexity tests and integration of new technologies, clinical laboratories have introduced molecular diagnostics in various fields such as infectious diseases, genetics, pharmacogenomics, and oncology.

## Importance of molecular diagnostics in women's health

A molecular diagnostic technique was first used in 1976 to make a prenatal diagnosis of α-thalassemia.[5]

Since then, molecular diagnostics have undergone a period of rapid development and growth. With the emergence of new high-complexity tests and integration of new technologies, clini-

| Infection/ causative agent | Possible disease manifestations | Curable/ chronic | Notifiable | Commercial molecular test | Screening recommendation |
|---|---|---|---|---|---|
| Chlamydia trachomatis[9] | • Asymptomatic[9]<br>• Pelvic inflammatory disease (PID)[9]<br>• Ectopic pregnancy[9]<br>• Infertility[9] | Curable[9] | Notifiable[9] | NAAT, SDA available[9] | Annual screening recommended for all sexually active women aged <25 years and for older women at increased risk for infection.[9] |
| Neisseria gonorrhea[10] | • Asymptomatic[9]<br>• Pelvic inflammatory disease (PID)[9]<br>• Ectopic pregnancy[9]<br>• Infertility[9] | Curable[10] | Notifiable[10] | NAAT, SDA available[10] | Annual screening recommended for all sexually active women aged <25 years and for older women at increased risk for infection. |
| Trichomonas vaginalis[11] | • 70%–85% either have minimal or no genital symptoms[11]<br>• Greater likelihood of preterm birth[11]<br>• Premature rupture of membranes, and infants who are small for gestational age[11]<br>• Increased risk for cervical cancer [11]<br>• Increased risk of HIV infection[11]<br>• Increased risk for PID for HIV positive patients[11] | Curable[11] | Not notifiable[11] | NAAT, SDA available[11] | Annual screening might be considered for persons receiving care in high-prevalence settings (e.g., STD clinics and correctional facilities) and for asymptomatic women at high risk for infection.[11] |
| Genital herpes/herpes simplex virus 1 (HSV-1) & herpes simplex virus 2 (HSV-2)[12] | • Mostly asymptomatic[12]<br>• Lesions typically appear as one or more vesicles, or small blisters, on or around the genitals, rectum, or mouth.[12] | Lifelong, chronic[12] | Not notifiable[12] | NAAT, SDA available[12] | None |
| Syphilis/ Treponema pallidum[13] | Can manifest in various stages and show varied manifestations.[13]<br>• Primary syphilis: a single painless ulcer or chancre at the site of infection, or multiple, atypical, or painful lesions<br>• Secondary syphilis: skin rash, mucocutaneous lesions, and lymphadenopathy<br>• Tertiary syphilis: cardiac involvement, gummatous lesions, tabes dorsalis, and general paresis | Lifelong, chronic[13] | Notifiable[13] | There is no commercially available NAAT test for T. pallidum; however, certain laboratories have developed and validated PCR tests for detecting T. pallidum DNA.[13] | All women should be screened serologically for syphilis at the first prenatal care visit.[13] |
| Human immunodeficiency virus (HIV)[14] | HIV may cause some health problems that are unique to women, such as:<br>• Gynecological health issues<br>• Increased risk of cervical cancer<br>• Increased risk of heart disease<br>• HIV medicine side effects and drug interactions<br>• Aging-related issues | Lifelong, chronic[14] | Notifiable[14] | NAAT available from various manufacturers for detection and viral load monitoring.[14] | CDC recommends that everyone between the ages of 13 and 64 get tested for HIV at least once as part of routine health care and annual screening for those with high risk.[14] |

**Table 1**. Molecular testing for sexually transmitted infections.

cal laboratories have introduced molecular diagnostics in various fields such as infectious diseases, genetics, pharmacogenomics, and oncology.

Molecular diagnostics techniques including nucleic acid amplification tests (NAAT) using polymerase chain reaction (PCR), real-time PCR, or strand displacement amplification (SDA) have high sensitivity and specificity with rapid turnaround time compared to many nonmolecular techniques. Thus, they are more often preferred over cell culture, fluorescent antigen-antibody detection, and immunoassays — especially for diagnosing bacterial or viral infections.

High-throughput methods, such as next-generation sequencing (NGS) or genome-wide association studies, provide invaluable insights into the mechanisms of disease, and genomic biomarkers allow physicians to not only assess disease predisposition but also to design and implement accurate diagnostic methods and to individualize therapeutic treatment modalities.[6]

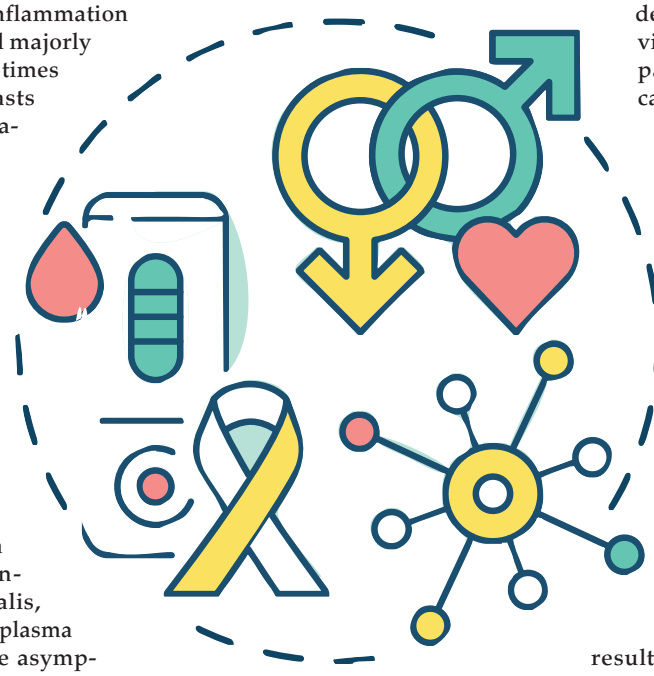
## Using NAAT to diagnose infections and disease

**Sexually transmitted infections:** Young women's bodies are biologically more prone to sexually transmitted diseases (STDs).[7] The common sexually transmitted infections are caused by chlamydia, gonorrhea, trichomonas,[8] genital herpes, human papillomavirus (HPV), syphilis, and HIV.[7] Chlamydia trachomatis, Neisseria gonorrhea, and Trichomonas vaginalis cause substantial health losses among women in the United States.[8] Chlamydia and gonorrhea cause the two most frequently reported bacterial infectious diseases in the United States, and prevalence is highest among persons aged ≤24 years. **Table 1** provides details on the various sexually transmitted infections.

**Vaginosis/vaginitis:** This is the most common cause of vaginal infections and discharge among women ages 15–44. It has been associated with preterm birth and contracting sexually transmitted infections, such as HIV and pelvic inflammatory disease. It can be caused due to infections from bacteria (bacterial vaginosis), yeasts (vaginal candidiasis /vulvovaginal candidiasis), protozoan parasite, Trichomonas vaginalis (Trichomoniasis), or non-infectious vaginitis (atrophic vaginitis) caused by allergic reactions from vaginal sprays, douches, or spermicidal products.[15]

Bacterial vaginosis (BV) is caused due to reduction in lactobacilli and increase in diverse anaerobic and facultative bacteria in the vaginal microbiome.[16] Candida vaginitis (CV) or

vulvovaginitis that leads to inflammation of vulva and vagina is caused majorly due to Candida albicans or at times due to non-C, albicans yeasts such as C. glabrata, C tropicalis, C parapsilosis, C krusei, C. dubliniensis. There are a few commercially available molecular tests that detect bacterial vaginitis and candida vaginitis simultaneously. Several clinical laboratories have also developed validated molecular tests to detect some of the bacteria and Candida species.[17]



ID 205728605 © Nesterenkoruslan | Dreamstime.com

**Cervicitis:** It is an infection of the cervix and can be caused due to Chlamydia trachomatis, Neisseria gonorrhea, Trichomonas vaginalis, herpes simplex virus, or Mycoplasma genitalium. Cervicitis can be asymptomatic or show symptoms such as purulent discharge, pelvic pain, bleeding between periods or after sexual intercourse or urinary problems.[18, 19] Commercial molecular tests (NAAT) are available to detect the organisms that can cause cervicitis.

**Group B streptococcus (GBS):** About 1 in 4 pregnant women carries GBS bacteria in their body. As GBS can cause serious infections if passed to the newborns, pregnant women need to get tested for GBS bacteria when they are 36 through 37 weeks pregnant.[20] Commercial molecular tests are available for GBS.

**Cervical cancer:** Cervical cancer (CC) is a group of invasive epithelial neoplasms of the cervix, which have metastatic potential. 70% of CC are squamous cell carcinoma and 25% adenocarcinoma, with the remainder rare tumors, such as small cell carcinoma.[21] 99% of CC cases are caused due to persistent infection with high-risk human papilloma virus (HR-HPV).21 There are as many as 15 HR-HPV genotypes (16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68, 73, and 82), and globally, HPV 16 is the most frequent oncogenic type. HPV types 16 and 18 have been found to cause 75% of cervical cancer cases.[22,23] Approximately 7000 patients die from it yearly. That said, not every patient with HPV precancerous lesions will progress to CC.[22]

A patient with HR-HPV infection goes through various stages over the years to develop CC. Early screening, ongoing surveillance, and accurate diagnosis are crucial for the elimination of CC.[24] Screening refers to testing for disease among individuals who are asymptomatic, have not been tested previously, or have normal prior results, and the strategies can be primary HPV screening, co-testing with HPV testing and cervical cytology, or cervical cytology alone.[24]

Surveillance is the interval testing among individuals who had a prior abnormal result, with or without treatment. The 2019 American Society for Colposcopy and Cervical Pathology (ASCCP) Risk-Based Management Consensus Guidelines describe clinical actions that providers can use when managing patients with abnormal cervical cancer screening test results.[25]

Several commercially available molecular tests are available that detect HR-HPV and genotype HPV 16 and 18 that can be used for screening and surveillance for CC. Diagnosis of cervical cancer involves colposcopy and biopsy.[24]

## Using Sequencing/ NGS technique or genome-wide studies

**Breast cancer:** Molecular testing for genetic and genomic variation has become an integral part of breast cancer management.[26] About 3% of breast cancers (about 7,500 women per year) result from inherited mutations in the BRCA1 and BRCA2 genes.[27] Per the Consensus Guideline on Genetic Testing for Hereditary Breast Cancer put forth in 2019 by the American Society of Breast Surgeons, genetic testing should be made available to all patients with a personal history of breast cancer. The genetic testing should include BRCA1/ BRCA2 and PALB2 and other genes as appropriate for the clinical scenario and family history.[28] With the advancements in next-generation sequencing technology, it is possible to test a panel of other genes; however, their clinical significance are not yet certain and no actionable recommendation are available.[28]

> Detection and treatment of women's health issues received a big boost with the developments in molecular diagnostics.

**Ovarian cancer:** It is estimated that up to 25% of ovarian cancers are hereditary.[29] Mutations in BRCA1 or BRCA2 genes account for most hereditary ovarian cancers and 10% – 15% of all ovarian cancer diagnoses. Researchers are continuing to investigate genetic mutations, both inherited and acquired, that may increase the risk of cancer. Studies are emerging that link ovarian cancer with mutations in other genes involved in DNA repair, including RAD51C, RAD51D, BRIP1, PALB2 (which stands for partner and localizer of BRCA2), STK11, ATM.[29]

**Rett Syndrome:** Rett syndrome (RTT) is an early-onset neurodevelopmental disorder that almost exclusively affects girls and is totally disabling. Three genes have been identified that cause RTT: MECP2, CDKL5, and FOXG1.[30] Next generation sequencing (NGS) has promoted genetic diagnoses because of the quickness and affordability of the method.

## Conclusion

Detection and treatment of women's health issues received a big boost with the developments in molecular diagnostics. These molecular diagnostic tests give laboratory professionals and healthcare providers the power to assess a wide range of women's health conditions. Continued research in the field of genomics and proteomics and emergence of newer technologies will lead to further improvement in screening, surveillance, and diagnosis of women's health-related diseases.

**REFERENCES**

1. Women's health. Nih.gov. Accessed April 19, 2023. https://www.niaid.nih.gov/research/womens-health.

2. Kimerling R, Weitlauf JC, Iverson KM, Karpenko JA, Jain S. Gender issues in PTSD. In: Friedman MJ, Keane TM, Resick PA, eds. *Handbook of PTSD: Science and Practice*. Guilford Press; 2013.

3. National Center for Biotechnology Information (US). *Female-Specific Diseases*. National Center for Biotechnology Information; 1998.

4. Fast facts. Cdc.gov. Published October 18, 2022. Accessed April 19, 2023. https://www.cdc.gov/groupbstrep/about/fast-facts.html.

5. Molecular diagnostics in the medical laboratory in real time. Asm.org. Published July 7, 2021. Accessed April 19, 2023. https://asm.org/Articles/2021/July/Molecular-Diagnostics-in-the-Medical-Laboratory-in.

6. Patrinos GP, Ansorge WJ, Danielson PB. Preface, Third Edition. In: *Molecular Diagnostics*. Elsevier; 2017:xvii-xviii.

7. Adolescents and STDs. Cdc.gov. Published June 30, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/life-stages-populations/stdfact-teens.htm.

8. Li Y, You S, Lee K, Yaesoubi R, et al. The Estimated Lifetime Quality-Adjusted Life-Years Lost Due to Chlamydia, Gonorrhea, and Trichomoniasis in the United States in 2018. *J Infect Dis*. 2023;18;227(8):1007-1018. doi:10.1093/infdis/jiad047.

9. Chlamydial infections. Cdc.gov. Published August 15, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/treatment-guidelines/chlamydia.htm.

10. Gonococcal infections among adolescents and adults. Cdc.gov. Published December 5, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/treatment-guidelines/gonorrhea-adults.htm.

11. Trichomoniasis. Cdc.gov. Published September 21, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/treatment-guidelines/trichomoniasis.htm.

12. Detailed STD facts - genital Herpes. Cdc.gov. Published June 28, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/herpes/stdfact-herpes-detailed.htm.

13. Syphilis. Cdc.gov. Published April 14, 2023. Accessed April 19, 2023. https://www.cdc.gov/std/treatment-guidelines/syphilis.htm.

14. How does HIV impact women's health? Hiv.gov. Accessed April 19, 2023. https://www.hiv.gov/hiv-basics/staying-in-hiv-care/other-related-health-issues/womens-health-issues/.

15. Vaginitis. Hopkinsmedicine.org. Accessed April 19, 2023. https://www.hopkinsmedicine.org/health/conditions-and-diseases/vaginitis.

16. Coleman JS, Gaydos CA. Molecular Diagnosis of Bacterial Vaginosis: an Update. *J Clin Microbiol*. 2018;27;56(9):e00342-18. doi:10.1128/JCM.00342-18.

17. Lillis RA, Parker RL, Ackerman R, et al. Clinical evaluation of a new molecular test for the detection of organisms causing vaginitis and vaginosis. *J Clin Microbiol*. 2023;61(3). doi:10.1128/jcm.01748-22.

18. Urethritis and cervicitis - STI Treatment Guidelines. Cdc.gov. Published September 21, 2022. Accessed April 19, 2023. https://www.cdc.gov/std/treatment-guidelines/urethritis-and-cervicitis.htm.

19. Cervicitis. Hopkinsmedicine.org. Published November 19, 2019. Accessed April 19, 2023. https://www.hopkinsmedicine.org/health/conditions-and-diseases/cervicitis.

20. Diagnosis, treatment, and complications. Cdc.gov. Published October 18, 2022. Accessed April 19, 2023. https://www.cdc.gov/groupbstrep/about/diagnosis.html.

21. Kurman RJ. International agency for research on cancer, world health organization. WHO classification of tumours of female reproductive organs. In: *International Agency for Research on Cancer*. 2014.

22. Amin FAS, Un Naher Z, Ali PSS. Molecular markers predicting the progression and prognosis of human papillomavirus-induced cervical lesions to cervical cancer. *J Cancer Res Clin Oncol*. 2023 Mar 31. doi:10.1007/s00432-023-04710-5.

23. Williams J, Kostiuk M, Biron VL. Molecular Detection Methods in HPV-Related Cancers. *Front Oncol*. 2022;27;12:864820. doi:10.3389/fonc.2022.864820.

24. Zhu Y, Feldman S, Leung SOA, Creer MH, et al. AACC Guidance Document on Cervical Cancer Detection: Screening, Surveillance, and Diagnosis. *J Appl Lab Med*. 2023;6;8(2):382-406. doi:10.1093/jalm/jfac142.

25. Egemen D, Cheung LC, Chen X, Demarco M, et al. Risk Estimates Supporting the 2019 ASCCP Risk-Based Management Consensus Guidelines. *J Low Genit Tract Dis*. 2020;24(2):132-143. doi:10.1097/LGT.0000000000000529.

26. Litton JK, Burstein HJ, Turner NC. Molecular testing in breast cancer. *Am Soc Clin Oncol* Educ Book. 2019;39(39):e1-e7. doi:10.1200/EDBK_237715.

27. The BRCA1 and BRCA2 genes. Cdc.gov. Published March 31, 2020. Accessed April 19, 2023. https://www.cdc.gov/genomics/disease/breast_ovarian_cancer/genes_hboc.htm.

28. Manahan ER, Kuerer HM, Sebastian M, Hughes KS, et al. Consensus Guidelines on Genetic` Testing for Hereditary Breast Cancer from the American Society of Breast Surgeons. *Ann Surg Oncol*. 2019;26(10):3025-3031. doi:10.1245/s10434-019-07549-8.

29. Genetic mutations in ovarian cancer. OCRA. Accessed April 19, 2023. https://ocrahope.org/get-the-facts/genetic-testing/.

30. Vidal S, Brandi N, Pacheco P, et al. The utility of Next Generation Sequencing for molecular diagnostics in Rett syndrome. *Sci Rep*. 2017;7(1):12288. doi:10.1038/s41598-017-11.


**Rajasri Chandra, MS, MBA** is a global marketing leader with expertise in managing upstream, downstream, strategic, tactical, traditional, and digital marketing in biotech, in vitro diagnostics, life sciences, and pharmaceutical industries. Raj is an orchestrator of go-to-market strategies driving complete product life cycle from ideation to commercialization.

## We have you covered

The dIFine 30 System is a powerful partnership which pairs the ZEUS dIFine digital immunofluorescence system with the new ZEUS SP30 slide processor! The SP30 is our easy-to-use and efficient walk-away benchtop instrument for IFA slide processing, designed to improve laboratory workflow and ensure high quality results… including cover slipping!

**Zeus Scientific**

## Point-of-care instrument to test for fentanyl

The CLC Fentanyl Urine Detection Kit is a fluorescence immunoassay intended for the qualitative detection of fentanyl in human urine at a cutoff concentration of 1.0 ng/mL. The assay is intended for use with CLC immunofluorescence analyzer RYAN. The test provides a preliminary test result.

**Carolina Liquid Chemistries**


## Detect the "Big 5" in 15 minutes

NG-Test CARBA 5 is a rapid, multiplex, phenotypic test capable of detecting KPC, OXA-48-like, VIM, IMP and NDM carbapenemases produced by Enterobacterales and Pseudomonas aeruginosa. CARBA 5 is a lateral flow assay that detects the gene expression, which is crucial to aiding therapeutic decisions. Results in 15 minutes.

**Hardy Diagnostics**

## New series of fume hoods

The NEW "SL" high-performance laboratory fume hoods are constructed of chemical resistant, flame retardant, lightweight composite resin. This non-metallic fume hood has an interior fume chamber that is molded one piece seamless with all corners coved and a slotted VaraFlow baffle system for airflow uniformity.

**HEMCO**

## High blood volume capillary sampling

Unistik Touch Blade Device is a contact activated safety lancet designed to provide a high volume of capillary blood for testing. Unistik Touch Blade Device is simple to use and permanently retracts after activation and features individually marked lot numbers for complete traceability.

**Owen Mumford**

## Multi-level clinical reference materials

VERICHEM's triglyceride reference materials comprise a definitive set of reference products containing levels of the analyte ranging from 10 mg/dL to 1,250 mg/dL, which are established by gravimetric weight of glycerol expressed as triolein. The liquid stable format is free of glycols, surfactants, azides and other interfering substances.

**VERICHEM Laboratories**


## Leakproof urine cups

Graduated wide-mouth urine cups feature two-click lids. First click closes the cup. Second click ensures 95kPa compliance and maximum leak-resistance. Ribs on the lid and cup make opening and closing easier when wearing examination gloves. Tamper-tab ensures the integrity of the sterile interior. Available options: 90mL (108190) and 120mL (108191).

**Marketlab**

## Automated price transparency and prior auths

seeQer is a secure, online platform that automates benefits eligibility, price transparency, and PAs in real-time. It helps labs project revenues earlier, identifies patient payment responsibility, and breaks it down between patient and payor. seeQer flags when PAs are needed and is consistently updated, removing administrative burden from labs.

**Careviso**

## Premium quality microscopes

iScope series microscopes provide comfort and convenience for microscopists. Available in various configurations, the iScope series is suitable for high schools, universities, and life and biomedical sciences. Packed with features including quintuple objective turret design, diascopic intensity adjustable 3W NeoLED illumination, Abbe NA 1.25 condenser for brightfield, and cable storage management system.

**Globe Scientific**


## New syndromic test for joint infections

The BIOFIRE Joint Infection (JI) Panel is a syndromic infectious disease test available for testing patients with suspected joint infections. The panel tests for a comprehensive grouping of 39 targets including bacteria, yeast, and select antimicrobial resistance genes commonly associated with joint infections.

**BioMerieux**

## Empowering congenital CMV diagnosis

Simplexa Congenital CMV Direct is a FDA cleared real-time PCR assay enabling the in vitro qualitative detection of cytomegalovirus (CMV) from both saliva and urine from infants. Utilized on the LIAISON MDX instrument, the assay combines workflow simplicity and clinical sensitivity critical for aiding in the diagnosis of congenital CMV infection.

**DiaSorin**

## Cardiac advance

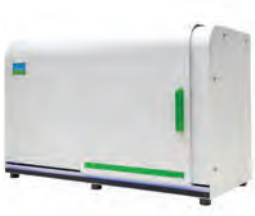
Designed to monitor precision-of-instrument testing for cardiac events, Cardiac Advance is a next generation control optimized with Troponin I and T targets near the limit of instrument detection adhering to the latest guidelines. It is consolidated with ten of the most tested cardiac analytes including Troponin, CK-MB, BNP/ProBNP, and Myoglobin.

**Bio-Rad**

## Seriously simple strep testing


Solana, a simplified molecular testing platform, is making molecular diagnostics faster and easier by combing QuidelOrtho's proprietary helicase-dependent amplification (HDA) with fluorescence detection. The Solana Strep Complete Assay allows for rapid, accurate detection of Group A and pyogenic Group C/G Strep without the need for culture confirmation.

**Quidel**



## Next-generation sequencing library prep system

The benchtop design and automation capabilities of the research-use-only BioQule Next-Generation Sequencing (NGS) System enable high quality NGS libraries for labs of all sizes. The system is featured with built-in quantification of the libraries it creates, up to 8-sample-throughput preparation, and easy-to-use operation.

**Revvity**

# Leader of the CAP Board of Governors

By Christina Wichmann


Image courtesy of Dr. Emily E. Volk

**Dr. Emily E. Volk**, president of the **College of American Pathologists** since September 2021, has been active on the CAP Board of Governors since 2013 and in the CAP at large for two decades. She has led numerous CAP committees and councils, including the Council on Government and Professional Affairs, and the Ad Hoc Committee for the Pathologists Quality Registry. Additionally, Dr. Volk served on the PathPAC Board of Directors, and the CAP's House of Delegates representing both Michigan and Texas.

She is on faculty at the University of Louisville School of Medicine and serves as the University of Louisville Health System vice president of pathology and clinical laboratories. She recently completed a two-year role as the chief medical officer at Baptist Health Floyd. Prior to moving to the Louisville metropolitan area, Dr. Volk worked as the senior vice president of clinical services and faculty pathologist at University Health System in San Antonio, Texas.

Dr. Volk received her undergraduate degree and medical degree from the University of Missouri in Kansas City and her MBA from the University of Massachusetts in Amherst. She completed an anatomic and clinical pathology residency from the Cleveland Clinic Foundation and a cytopathology fellowship from the William Beaumont Hospital in Royal Oak, Michigan.

**MLO's 2023 Lab of the Year winner, the Department of Pathology and Laboratory Medicine at Avera McKennon Hospital and University Health Center, was the first laboratory to achieve the CAP's ISO 15189 certification. What type of support does the CAP provide to labs interested in pursuing this certification?**

True, in 2009, Avera was the first hospital laboratory in the nation and world to achieve this accreditation, through the College of American Pathologists. This is a voluntary accreditation based on the International Organization for Standardization, hence the ISO reference. It is achieved through a highly disciplined approach to implementing and sustaining change. The CAP 15189 program offers laboratories a quality partnership, unequalled knowledge, and support. There are dedicated assessors to your hospital all through the accreditation cycle who specialize in ISO 15189. That partnership drives results by continuing to identify opportunities for improvement. There's cost savings, because of better defined processes, fewer errors, and isn't that what we are all striving for? Turnaround times are reduced, and greater efficiency increases opportunities to expand testing capacity or expand your test menu. Bottom line: it's all about protecting patients' health and operating at the top of your game.

It really is a marvelous achievement for a laboratory to have both CAP and ISO accreditation. The ISO accreditation really focuses on consistency and process, where the CAP's standard accreditation is driven by our checklists and the CLIA requirements and other requirements our Accreditation and Scientific Committees believe will enhance patient care. Having a laboratory maintaining both ISO and CAP accreditation is truly a next-level laboratory. I congratulate MLO for making an excellent choice!

**What role do you think laboratory medicine can play in reducing health care disparities?**

The clinical laboratory is truly at the foundation of all things affecting patients, without accurate, reliable laboratory data and patient diagnoses, everything else falls apart. Because the clinical laboratory is at the foundation, it provides us an opportunity to constantly explore for implicit bias. One of the key things the CAP has identified over the last few years, and really embraced and promoted, is changing the antiquated and non-scientific adjustment for the estimated glomerular filtration rate for patients who are identified as Black or African-American. We now understand the race-based adjustment that used to be commonplace for the eGFR calculation was not scientific. It got in the way of early identification of end stage renal disease and possibly transplant opportunities for patients in the Black community. Adopting the non-raced based eGFR calculation methodology is imperative to improving patient health and health care disparities. I am thrilled that many of our more than eight-thousand CAP-accredited laboratories were quick to comply with this change, with many more following suit.

Other opportunities to identify health care disparities include the reference ranges for the transgender community. Estrogen taken over an extended period will impact physiology in such a way that we may need to consider how to take that into account as far as normal ranges are concerned.

Just like every other specialty in medicine access to health care is an issue. This may be either in urban areas where there are health care deserts, or it may be in rural areas where there isn't an acute care hospital for hundreds of miles. Just like patients will have trouble finding primary care physicians, they will also have trouble finding pathologists and appropriate clinical laboratory support and diagnostic services. One of the things the CAP is looking at is trying to bridge this gap and how digital pathology can be leveraged to reach smaller hospitals in rural areas where a pathologist may be working alone or only be able to visit a day or two a week. Using digital pathology, a solo pathologist can have ready access to other pathologists with whom they can consult, allowing that pathologist and that patient to benefit from those intellectual and academic resources of having a larger group practice.

**Coming out of the pandemic, what current challenges from members of the CAP and its accredited laboratories are you hearing about?**

During the height of the pandemic, we definitely saw a need for more public health resources. As we are coming out of COVID, we are all certainly wondering when the next pandemic will hit. Has

COLA™

Training and Development

LABORATORY ENRICHMENT FORUM

*Medical Laboratory Science: The Hidden Gem of Healthcare*

MAY 7-9, 2024

Emerald Coast, Florida

Destin-Fort Walton Beach Convention Center

## *25% OFF**

## *Register before July 4, 2023*

Past attendees have benefited from the following

- **Learning from Subject Matter Experts, including CMS and CDC**
- **Earning required CEUs and CMEs**
- **Networking with industry thought leaders**

**Discount valid for general registration and laboratory director track only*

cola.org/Forum2024

there been enough investment into those public health resources to shore up where we saw weak points in the last couple of years? Are the weaknesses in the supply chain we all experienced at different points of time during the last three year been shored up? Have public laboratories been more generously staffed?

We also realized how critical medical technologists, clinical laboratory scientists, and pathologists are to the very foundations of health care. Again, without testing, you don't know what you're treating. During the pandemic we were all reminded of how important testing was and how precious the human resources around clinical laboratory testing is. Coming out of this pandemic, I am even more concerned about building a solid pipeline for future pathologists and clinical laboratory scientists and enthusiastic about any efforts to let bright young STEM students know that following these pathways will be very fruitful.

## Where do you think laboratory medicine should be headed in the future?

Like so many industries, pathology is going to have a future that will in some way shape or form include augmented intelligence tools. We are going to have to figure out how to work in consort with these tools. Occasionally, I have heard concerns that AI might replace diagnosticians like radiologists and pathologists. I frankly see that as very unlikely. I see AI as a tool that will augment our ability to make diagnoses, efficiently, accurately, and reliably. When IHC came out in the late 1980's and then really blossomed in the 90s, there were some in the laboratory community that thought this would replace pathologists because you could just stain the slide and determine if something was benign or malignant, you didn't need morphology anymore, you didn't need the routine histology, you could just rely on this brown stain to tell you all you needed to know about a tumor. Of course, pathologists practicing today know that certainly is not how that turned out. In fact, you must have the same amount of sensitivity to morphology, that is basic H&E histology, to use IHC tools accurately. The same thing is going to be the case for applying AI tools — it will be another layer, another depth of knowledge and understanding that we can provide. It's not suddenly going to make things simple. I think our expertise will be in even greater demand.

## What have you most enjoyed in your leadership role at the CAP?

There have been so many positive things about my experience leading the CAP. First, it has been a wonderful opportunity to get to know more of the members. We have such a terrific and involved membership base. Getting to know pathologists in all diverse kinds of practices or work situations from various parts of not only the country, but the entire world, has been remarkable. I will tell you working with the CAP staff has also been extremely rewarding. We have a staff of more than six hundred incredibly talented and dedicated people who support the members every day and who are making my job as president much easier.

Another thing I found really rewarding, is the number of physicians from all diverse backgrounds sharing with me that by having a mid-career woman as president of the College, it opened their eyes to what they might be able to do and achieve. It seems to have inspired at least some people to pursue stretch goals that they might not have otherwise pursued. They can begin to see themselves in leadership roles they might not have otherwise considered because they haven't seen anybody who looked like them or who didn't represent a traditional leadership profile.

I do hope the pathologist community will continue to embrace the CAP as their professional home. All throughout my career, the CAP has been there to support me. Not only in making accurate and reliable surgical and cytopathology diagnoses, but also providing me with the support and knowledge that I needed to be an effective medical director of laboratory. The CAP has also been there as a professional family for me and a place where I can go and share challenges, get great feedback, wonderful comradery, and a sense of community.

All this by far, has made it more fun and rewarding to do this work.

## INDEX OF ADVERTISERS

COLLEGE of AMERICAN PATHOLOGISTS

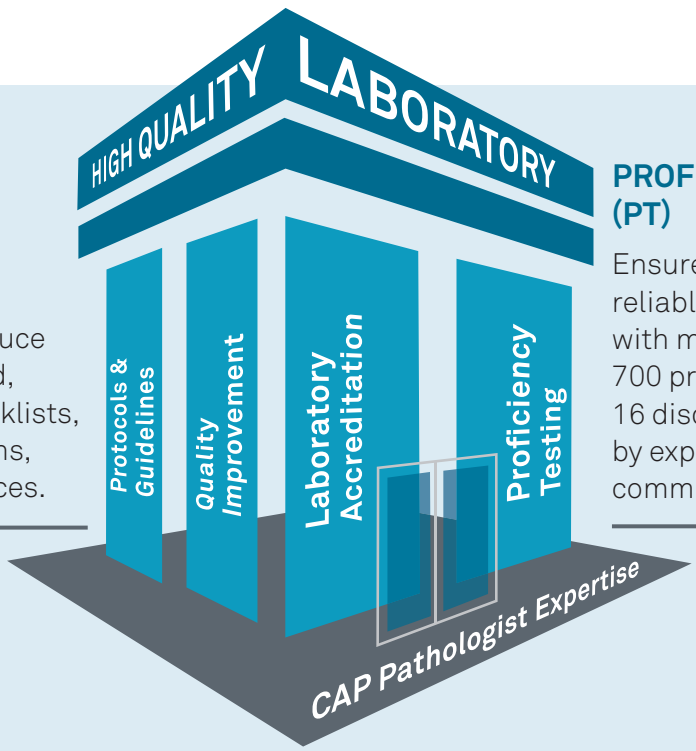
Laboratory Quality Solutions

# Laboratory Quality Solutions to **Ensure Quality Patient Care**

Built on a foundation of pathologist expertise, the College of American Pathologists (CAP) partners with laboratories worldwide to elevate the quality of laboratory medicine with best-in-class solutions designed to drive operational excellence, achieve diagnostic confidence, and ensure the best patient care.

## LABORATORY ACCREDITATION PROGRAM

Improve quality and reduce risk through customized, discipline-specific checklists, collegial peer inspections, and educational resources.




## PROFICIENCY TESTING (PT)

Ensure accurate and reliable testing results with more than 700 programs across 16 disciplines developed by expert scientific committees.

## PROTOCOLS AND GUIDELINES

Improve cancer reporting and clinical decision making, providing more effective testing with consistent, high-quality results, and expert interpretations.

## QUALITY IMPROVEMENT

Improve processes and strengthen staff expertise while reducing risk and improving patient outcomes.

**Learn more about how the CAP can help you achieve your laboratory quality goals.**



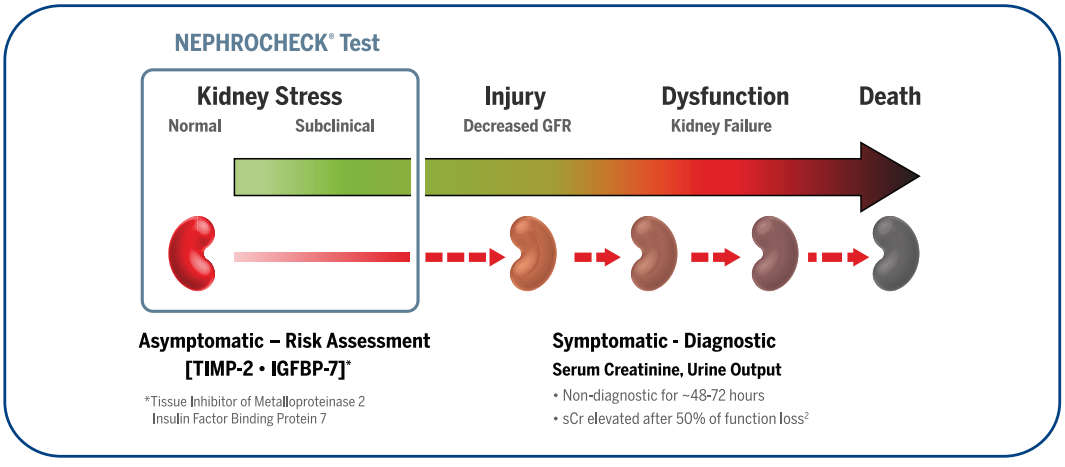
cap.org

BIOMÉRIEUX

# Know Earlier. Intervene Sooner. Avoid Acute Kidney Injury (AKI).

The **NEPHROCHECK® Test [TIMP-2 • IGFBP-7]** adds confidence to the clinician's judgement:

- The only FDA-cleared test to aid in the risk assessment of AKI[1]
- Fast and simple 20-minute urine test
- Specific to AKI, accurately distinguishing between AKI and no AKI (P=0.0001)[1]




## Identify kidney stress before damage occurs.

- The NEPHROCHECK Test is designed to help clinicians identify patients at risk of developing moderate to severe AKI within 12 hours of assessment
- Biomarkers are produced during kidney stress before significant damage occurs, spreading the alarm to nearby cells via TIMP-2 and IGFBP-7 [1,3]

**INTENDED USE:** The NEPHROCHECK Test System is intended to be used in conjunction with clinical evaluation in patients who currently have or have had within the past 24 hours acute cardiovascular and/or respiratory compromise and are ICU patients as an aid in the risk assessment for moderate or severe AKI within 12 hours of patient assessment. The NEPHROCHECK Test System is intended to be used in patients 21 years of age or older.


1. NEPHROCHECK Test Package Insert.
2. Mårtensson J. Brit J Anaesth. 2012;109(6):843-850
3. Kashani K. Crit Care. 2013;17:R25.


**NEPHROCHECK®**
[TIMP-2 • IGFBP-7]



PIONEERING DIAGNOSTICS