ARUP LABORATORIES

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ARUP is a nonprofit enterprise of the University of Utah and its Department of Pathology.

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MAGNIFY

the art & science of diagnostic medicine

Leveraging Artificial Intelligence To Improve Clinical Diagnoses

Also in This Edition:
Better Cancer Screening Is Changing Lives

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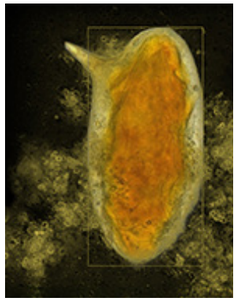
SUMMER 2025



About the
Cover

An iodine stained *Schistosoma mansoni* ova with a prominent lateral spine that is characteristic of this species.

This issue is dedicated to the memory of D'Arcy Monforte, a senior graphic designer at ARUP and a longtime Magnify contributor.

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Better Cancer Screening Is Changing Lives

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45 Is the New 50. She Was 29 Years Old When Colon Cancer Changed Her Life

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MAGNIFY

the art & science of diagnostic medicine

Contents

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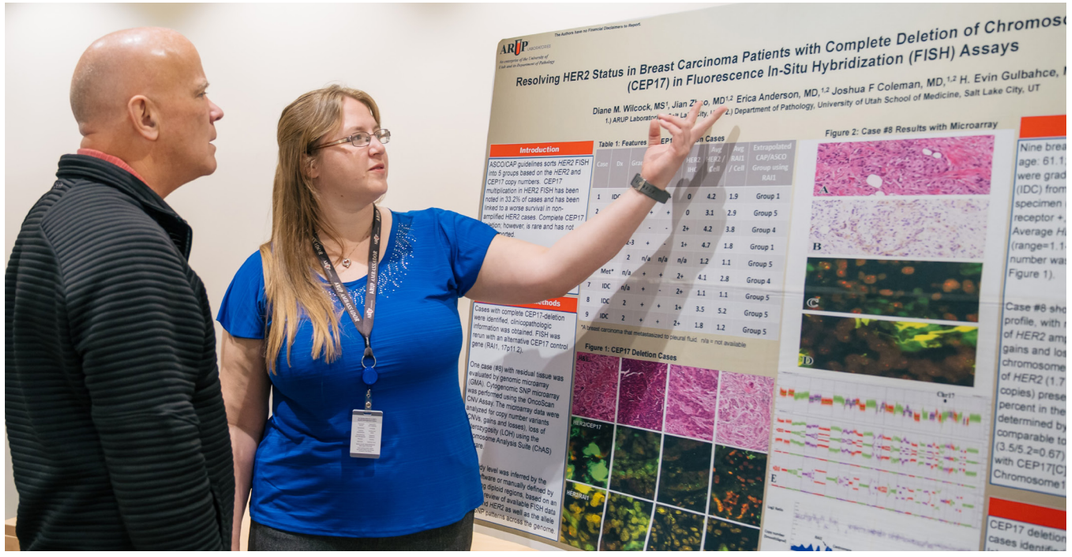

I had the opportunity during Medical Laboratory Professionals Week in April 2025 to learn from ARUP scientists who shared their advancements during our Research Expo. They included Diane Wilcock, MS, a scientist II in Research and Development, Histology, who is pictured here describing details of a breast cancer research project she participated in with ARUP medical directors. Their research is another example of ARUP's commitment to continually work to improve the diagnostic accuracy of our tests.

A Message From the CEO

At ARUP Laboratories, we continually evaluate new tools as we work to offer tests that help improve patient outcomes. We are committed to using new technology to enhance diagnostic accuracy while also streamlining workflows and reducing turnaround times.

I'm proud to share that, thanks to the expertise of our medical directors and the talented laboratory scientists with whom they work, ARUP this spring became the world's first clinical lab to apply artificial intelligence (AI) screening to the entire ova and parasite testing process, as just one example.

ARUP was first in 2019 to use an AI-augmented tool to review trichrome-stained slides to screen for gastrointestinal parasites. As of March of this year, we're also now using AI to examine wet-mount slides, making ARUP the world's first lab to use AI for both parts of the ova and parasite testing process.

You can read more about this advancement and why it revolutionizes testing for parasites in this edition of Magnify.

In these pages, you will also find spotlights on testing that provides early clues that may lead to cancer diagnoses. Gillian Jones poignantly demonstrates the value of one noninvasive screening test by sharing the story of her colorectal cancer diagnosis. Raising awareness about potentially lifesaving tests is a motivator behind each new edition of Magnify.

Enjoy these stories and others, and don't forget to subscribe to Magnify to make sure you're alerted when a new edition drops.

Andy Theurer, CEO

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Better Cancer Screening Is Changing Lives

"From germline genetic testing to determine cancer predisposition to less invasive screening methods for colon cancer, laboratory medicine drives the innovation that makes earlier detection possible."

Although cancer incidence in those older than 50 years has declined in recent years, a concerning upward trend has emerged as incidence in younger populations has increased.

But the news isn't all bad. Laboratory medicine has made great strides in screening methods that are more accessible and less invasive. Early screening and detection can dramatically alter the outcomes for patients diagnosed with cancer.

According to the American Cancer Society,[1] patients diagnosed with breast cancer while the cancer is still classified as local have a five-year survival rate of 99%, compared with only 32% when the cancer is classified as distant.

For colon cancer, the five-year survival rate in those with local disease is 91%, compared with just 13% in those with distant disease.

Gillian Jones discovered the importance of accessible screening when an early-onset cancer diagnosis shocked her and her family.

Screening and risk assessment are only effective if they are utilized. Julie Solimine, MGC, LCGC, a genetic counselor at ARUP Laboratories who has counseled patients with a family history of cancer on appropriate germline genetic testing, wishes providers and patients better understood their testing options.

From germline genetic testing to determine cancer predisposition to less invasive screening methods for colon cancer, laboratory medicine drives the innovation that makes earlier detection possible.

In this edition of Magnify: The Art and Science of Diagnostic Medicine, Jones and Solimine share how cancer screening has changed lives. Read their stories:

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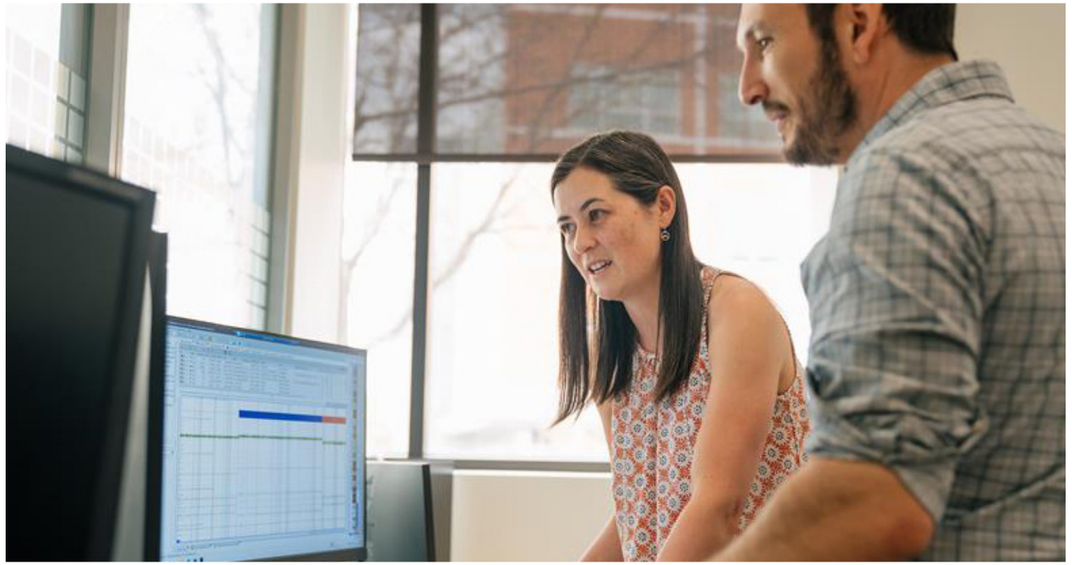

Kelsey Cone, PhD, a clinical variant scientist (CVS) and the supervisor of ARUP's Genomics Analysis team, reviews sequencing data with Daniel Reich, PhD, a CVS lead.

Clinical Perspective: Better Adoption of Genetic Testing Would Mitigate Risk of Hereditary Cancer

Individuals who have inherited pathogenic gene variants may have an increased risk for developing a hereditary cancer syndrome. For these individuals, genetic testing can provide crucial information that would enable early intervention to mitigate their risk. Yet despite the clear benefits, genetic testing remains underutilized.

One barrier that prevents patients from receiving appropriate genetic counseling and testing is a general lack of awareness about which patients meet criteria for testing.

Julie Solimine, MGC, LCGC, a genetic counselor at ARUP, hopes to change that by increasing awareness of the genetic testing criteria. As a clinical genetic counselor in oncology, Solimine spent five years counseling patients about their risk for hereditary cancer while working at a hospital in Baltimore, Maryland.

Solimine said that while criteria vary based on cancer type, guidelines generally recommend inherited cancer testing for individuals who have early-onset cancer or a family history of three or more close relatives who have had the same type of cancer or potentially related cancers.

Identification of specific variants has the potential to improve clinical outcomes through intervention strategies. Patients whose genetics signal increased risk can begin screening early or opt for prophylactic surgery, such as mastectomy. For those with an existing cancer diagnosis, understanding the inherited aspect of their diagnosis can point to treatment approaches that target their specific cancer type.

For example, Solimine said that patients with gene variants that put them at risk for developing hereditary breast cancer might begin having mammograms at a younger age and alternate every six months with a breast magnetic resonance imaging (MRI) scan, which is not a routine form of screening.

Hereditary Cancer Testing

For every sample that's sequenced, ARUP's team of clinical variant scientists (CVSs) analyzes the data to interpret variants and determine whether any are pathogenic. A single sequencing run can produce almost a terabyte of data, so it's no small task.

"In my experience, the vast majority of patients I counseled did pursue testing, and most of them found it useful in surgical planning or identifying targeted chemotherapies," Solimine said.

In addition, Solimine often encounters cases in which providers order a single gene test when a larger panel may be more appropriate and provide more information that's relevant to preventive care.

"Historically, there was a lot of initial research on *BRCA1*, *BRCA2*, and Lynch syndrome. Many are familiar with those genes," Solimine said. "It's only been in the past 5 to 10 years that we've really started offering testing for all of these other variants associated with cancer syndromes."

Solimine has experienced cases in which ordering a panel rather than a less comprehensive test uncovered an incidental finding.

"These cases stick out in my mind, and I'm so glad I ordered a panel for this patient because otherwise they would never have known about their elevated risk or been able to take proactive measures to minimize risk," she said.

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Julie Solimine, MGC, LCGC, a genetic counselor at ARUP, has years of clinical experience counseling patients about hereditary cancer.

Solimine and other ARUP genetic counselors offer consultations on appropriate test ordering and results interpretation. They also often help providers interpret results in complex cases.

"Our genetic counselors provide a highly educated, white-glove service," said Steven Friedman, PhD, group manager of the Sequencing and Clinical Analytics Division. "They are a great resource for clients and clinicians."

According to the National Cancer Institute, inherited genetic alterations may cause up to 10% of all cancers.

"There's a misconception that inherited cancer syndromes are rare, when in the scheme of things, they are not," said Hunter Best, PhD, FACMG, ARUP medical director of Molecular Genetics and Genomics and operations platform director for next generation sequencing (NGS).

Variant Interpretation Driven by Real Intelligence

ARUP has been engaged in genetic testing for more than 25 years and has offered clinical NGS testing, also known as massively parallel sequencing, for more than 13 years.

"We were one of the first laboratories to implement clinical NGS testing," Best said. "You're not going to find more experience in variant interpretation than we have here at ARUP."

For every sample that's sequenced, ARUP's team of clinical variant scientists (CVSs) analyzes the data to interpret variants and determine whether any are pathogenic. A single sequencing run can produce almost a terabyte of data, so it's no small task.

"Any given patient will have several hundred variants, and we have to determine which variants are relevant enough to report," said Kelsey Cone, PhD, a CVS and the supervisor of ARUP's Genomics Analysis team, which includes CVSs and analysts. "Even though we may only report on a handful of those variants, we still have to go through each one."

The data analysis is facilitated by NGS.web, a software program that ARUP's Biocomputing team developed to the specifications of the medical directors and CVSs. NGS.web incorporates data analysis, data from genetics databases,

Hunter Best, PhD, FACMG, medical director of Molecular Genetics and Genomics and the operations platform director for next generation sequencing (NGS), has led the growth and development of NGS at ARUP.

Steven Friedman, PhD, group manager of the Sequencing and Clinical Analytics Division, in discussion with one of his team members.

and reporting tools, which makes it a one-stop shop for genetics case review. Since the first iteration of the program more than 10 years ago, the CVS team has been able to increase its caseload by three or four times, said Friedman.

Best and Friedman both emphasized the critical importance of having trained experts provide the final interpretation. As scientists with advanced degrees and extensive genetics training, ARUP's CVSs are leading experts in variant interpretation. In a field that changes rapidly, these scientists routinely review the literature and guidelines to stay up to date on the latest classifications. Additionally, ARUP medical directors, who are certified by the American Board of Medical Genetics and Genomics (ABMGG), review all reported variants and help tailor each patient report.

"We have highly trained scientists who are immersed in genetic variant interpretation all day, every day," Friedman said. "Every case is handled, one by one, by a PhD scientist with years of experience."

Not only do ARUP's team members provide interpretations for individual patient cases, but they also contribute to the genetics knowledge base. Several members of the team volunteer for ClinGen, a collaborative effort funded by the National Institutes of Health (NIH) to standardize variant classifications. ARUP also contributes to ClinVar, a public database of genetic variants and their clinical relevance. In 2024 alone, ARUP submitted more than 8,000 variants to the ClinVar database.

"We are always willing to talk to anyone who has a question or revisit a classification upon request," Cone said.

The Genomics Analysis team takes an additional step to ensure patients have all the clinically relevant information. When a variant is reclassified and clinically significant, the CVSs will go back to each patient with that variant and update their reports with the new information.

"I've never known ARUP to not do the right thing for the patient," Best said. "We are most focused on quality to make sure the patient receives a correct and accurate result."

Kellie Carrigan, kellie.carrigan@aruplab.com

45 Is the New 50. She Was 29 Years Old When Colon Cancer Changed Her Life

ARUP's Occult Blood, Fecal by Immunoassay Test: An Accurate, Inexpensive Screening Tool for Colorectal Cancer

Sydney, Jonathan, and Gillian Jones at their home in Utah.

Gillian Jones, at 40 years old, believes she likely would not be alive today and would not be the mother of a beautiful, lively 3-year-old named Sydney if she had not listened to herself. She was 29 years old when her husband, Jonathan, urged her to seek care for a severe sore throat. After Cynthia Lodding, MD, confirmed that she had strep, Lodding asked if there was anything else.

"I had some symptoms of dark stool for about two weeks, but I didn't think anything of it, figured it was something I ate. [But] I just had this nagging feeling, 'You need to say something,'" Jones recalled.

Lodding explained that dark stool could indicate the presence of blood, and she needed to have it checked. The doctor then ordered a test for occult (hidden) blood in stool, a laboratory test that can be used to look for possible signs of colorectal cancer (CRC). Jones remembered returning home with the at-home collection kit for the test—something her husband nervously joked about.

"He said, 'Well, they sure do strep tests a lot differently than I remember,' and then I had to fill him in about my symptoms," Jones said.

Jones' test came back positive. An urgent colonoscopy revealed a mass, which an initial biopsy showed was not cancerous. Within weeks, doctors surgically removed seven inches of Jones' colon, along with the ping-pong-ball-sized mass. As she was being discharged from the hospital, Jones learned that further testing had detected cancer in the mass and a few lymph nodes, and she would need chemotherapy.

"I was devastated. Being told, 'You have cancer,' your world stops spinning, your plans for the future are taken from you, and your mind goes straight to, 'I'm going to die,'" Jones said.

Jones is one of a growing number of younger people diagnosed with colon cancer. An American Cancer Society report[1] said CRC rates have declined since the mid-1980s in adults 50 years and older by about 1% a year due to screening. However, rates increased by 2.4% per year from 2012 to 2021 in people younger than 50 years. The U.S. Preventive Services Task Force (USPSTF)[2] now recommends people with average risk start getting screened for CRC at 45 years old, rather than 50.

"The gold standard is colonoscopy, but fecal immunochemical tests (FITs) are highly accurate and

Colon Cancer Screening

The kit for ARUP's FIT (Occult Blood, Fecal by Immunoassay) includes a urine and stool specimen collection pan, gloves, a collection tube with a mint green cap and tiny wand inside, a biohazard bag, and instructions.

Sydney Korzep, a technician in Infectious Disease Antigen Testing at ARUP, monitors specimens in a fully automated FIT analyzer named Diana, which cuts the foil on the samples, squeezes the tubes, and checks for optical density. Diana swooshes, whirs, and occasionally beeps while testing.

inexpensive, and specimens can be collected at home, without any patient prep," said Heather Nelson, PhD, DABCC, medical director of Clinical Chemistry and Mass Spectrometry at ARUP Laboratories. Nelson added that FITs, including the test that ARUP offers, Occult Blood, Fecal by Immunoassay, make it possible to screen more people, especially as guidelines change to encourage testing in younger patients.

"By using FIT first, we are prioritizing patients who need colonoscopies. Positive FIT results suggest there is a bleed in the lower intestinal tract, which could be caused by several different factors, including diverticulitis, polyps, precancerous lesions, or even colon cancer, and necessitate further testing, most often a colonoscopy," Nelson said.

Jones has had more colonoscopies than most people will ever have in their lifetime and says a FIT is easy in comparison.

"I'd rather do that any day. I just had to go to the bathroom. The kit came with some tweezers and gloves, and I just put the sample in a container and took it back," Jones said. She added that, for her, prepping for a colonoscopy often involves hours of vomiting in addition to the multiple bowel movements.

Nelson explained that the FIT kit includes a collection tube with a small, grooved wand in the cap. Patients collect a sample of their stool with the wand, put the wand back in the tube, which contains a stabilizer for hemoglobin, and return it to their doctor.

"[ARUP's] FIT assay is an FDA-approved test with some of the highest amounts of published data supporting its clinical performance. It's one of the best performers out there, and annual screening by a FIT is considered a first-tier test for colorectal cancer screening," Nelson said.

The USPSTF[2] recommends colonoscopies every 10 years for people with average risk factors, but that FIT be performed annually.

"Ten years is a long time, and something can develop. More frequent, less invasive screenings can help catch something as it starts," Nelson said.

Jones does not have a close family history of colon cancer. Her dark stool was the only clue something was wrong, and she is grateful that she spoke up and her doctor listened. She leaned on her support system, her family, her friends, and her faith, while enduring months of chemotherapy, and was inspired by someone who was also fighting colon cancer.

"I posted on Facebook and I just said, 'Hey, I'm going through this. Does anyone know anyone with colon cancer?' And a neighbor said, 'You've got to meet my buddy, Dov Siporin. He is a hoot. He loves to prank the nurses [and] just do all these funny things at chemo,'" Jones said. In one now infamous prank, Jones said Siporin had a friend dress up as the Grim Reaper, gave foam swords to patients receiving chemotherapy, surprised the staff, and captured the chaos on video, which is now on YouTube.

Siporin worked at ARUP for 16 years. He was diagnosed with CRC at 33 years old and lost his fight seven years later, in March 2015, but he left a legacy at Huntsman Cancer Institute, as indicated by a Facebook post[3] five years after

his death honoring him as “Chemo Cupid.” He had dressed up as Cupid with a crown of hearts, a bow and arrow, and candy hearts painted on his chest that said, “Terminally Yours,” and “Chemo 4 Life.” Comments included, “I’ll always be grateful for his humor,” and, “He taught me one of my most valuable lessons that happiness was a choice.”

Jones recalled some important advice he gave her during a chance meeting at Salt Lake City’s Comic Con, an annual pop culture expo. “I remember him saying, ‘If you get to the point that you just can’t take it anymore, and you need to fall down and scream and cry, it’s okay. Do it, but you need to get back up and keep going and fighting.’” Jones said she started doing funny things at chemotherapy to help others like Siporin had. She dressed up, put costumes on the infusion stand, and posted the photos on Facebook.

“Everyone would write happy … encouraging messages, and then on my bad days, when I just felt so sick and felt like giving up, I could go back to them,” Jones said.

The photos and messages she received are now in a special album, packed in a box for a move she and her family have made to a neighborhood with more children, where she hopes her daughter will make plenty of friends. Jones has been closely monitored with colonoscopies and has been cancer free for a decade, the same amount of time she says she struggled with infertility before her diagnosis.

“After chemo, we started looking into fertility treatments again … and we got our one little miracle. I thought for sure there was no way I’d be able to have children after chemo,” Jones said. Her husband added, “I just love her [Sydney]. She’s so curious and full of life and a joy to have around.”

Jonathan said it is uncomfortable to talk about poop, but his wife wouldn’t be here if she hadn’t.

“There’s some taboo about talking about stool and bowel movements. We don’t talk about having issues with our GI [gastrointestinal] tract, but we need to normalize it,” Nelson said.

Jones now encourages others to get checked. “Find out what cancers run in your family, see if you need screening earlier than recommended, and don’t ignore your symptoms,” she said.

Bonnie Stray, bonnie.stray@aruplab.com

Colorectal Cancer by the Numbers

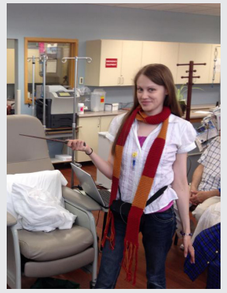
- **154,270 estimated new cases in 2025**[4]
- **2nd most common cause of cancer death**[4]
- **1 in 5 people age 45–49 years report being up to date on CRC screening**[4]
- **90% survival rate if detected early**[5]

Gillian’s Chemo Journal: “Colon Cancer Adventures”

First chemo session wasn’t bad at all. I was the youngest there by a lot.

Chemo round 2: Going Mortal Kombat style this time.

Chemo round 3: If I’m gonna be connected to this thing ... it better look good.

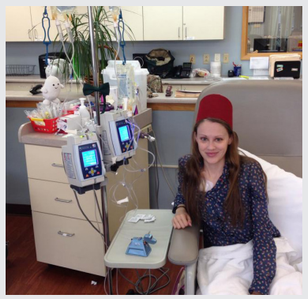


Chemo round four: Wizard’s Duel

Round 5: I took [Bolt’s] ... stuffed animal twin for comfort. ...

Chemo round six: Halfway mark

Chemo round seven



Chemo round 8: Doctor Who theme. Bow ties are cool! Fezzes are cool! Chemo sucks!

Gillian’s Chemo Journal: “Colon Cancer Adventures”

Round 9: Chemo countdown in months, weeks, and days. Getting so close!

Chemo round 10: It was my birthday, and I’ll wear a tiara and hand out cookies if I want to.

Round 11: Slay the Cancer!

Round 12: Last chemo!!!!!

Done with chemo. Get to ring that bell!!!

I owe my life to Dr. Lodding.

‘The Biggest Advancement in Parasite Screening Since the Microscope’: Leveraging Artificial Intelligence Improves Diagnosis

With the expansion in March 2025 of its artificial intelligence (AI) screening algorithm for the detection of human gastrointestinal parasites to include the wet-mount part of the testing method, ARUP became the first laboratory in the world to apply AI screening to the entire ova and parasite testing process.

“By using an AI-augmented screening approach, we have seen a significant increase in sensitivity and diagnostic yield,” said Marc Couturier, PhD. “The screening tool minimizes human error and detects ova and parasites that may otherwise be missed, which improves clinical diagnosis and ultimately treatment for patients who are affected.” Couturier, who formerly served as ARUP’s head of clinical operations for Clinical Microbiology and Immunology and as the medical director of Emerging Public Health Crises, Parasitology and Fecal Testing, and Infectious Disease Antigen Testing, led the development of AI-augmented parasitology screening at ARUP.

For decades, traditional microscopy has remained the standard method for detecting gastrointestinal parasites. The labor-intensive and time-consuming approach requires highly trained technologists to spend hours at a microscope manually examining slides.

In 2019, ARUP revitalized what had been a stagnant field by implementing the world’s first AI-augmented screening tool for the detection of gastrointestinal parasites. The tool initially included screening of trichrome-stained slides, one of two parts of the ova and parasite testing process. The second part involves examination of the wet-mount slides.

“This is the biggest advancement in parasite screening since the invention of the microscope,” said Ryan Jensen, M(ASCP)^{CM}, group manager of the Infectious Diseases Division.

ARUP developed the AI solution in partnership with Techcyte, a leader in the development of AI-powered solutions for anatomic and clinical pathology.

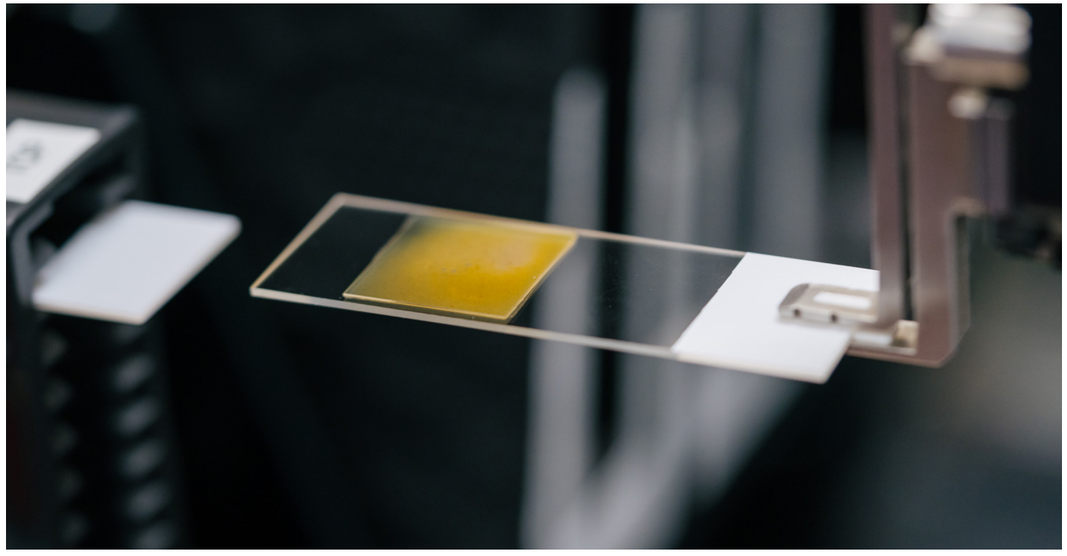
The addition of AI has allowed the parasitology staff to perform testing more efficiently. Prepared slides are scanned into a digital database and then initially screened by an AI algorithm for the presence of ova and parasites. Technologists then evaluate any specimens flagged by the algorithm as likely positive to identify and confirm the organism. Specimens identified as likely negative are also scrutinized by technologists and are not assessed by AI alone.

By leveraging the efficiency of AI, along with the experience of its highly trained parasitology staff, ARUP produces results with improved specificity and sensitivity. Since the initial launch of the tool in 2019, the positivity rate has steadily increased.

“In fact, the positivity rate has almost doubled at this point,” said Couturier. “We’ve seen so many instances in which we are finding more parasites than we were before.”

The AI-enhanced process enables a level of precision that is not easily achieved by humans. The scanner can perfectly scan the entire slide each time, which is an unreasonable expectation for even the most experienced technologist. However, missing even a tiny section of the slide can prevent diagnosis.

Ova and Parasite Testing



A robotic arm removes slides from the stack and then inserts them into the scanner to be scanned. Once they are scanned, the AI algorithm screens digital images generated from each slide for the presence of ova and parasites.

“Eggs of worms are notoriously difficult because they are excreted in very low prevalence. If that one egg happens to be in the sliver that was missed, we don’t see it,” Couturier said. “Parasitology is a very difficult discipline. No matter how good your staff is, and ARUP has some of the best, there are inherent limitations.”

AI has also made it possible to detect parasites with unconventional methods.

Cyclospora, a protozoan parasite that causes seasonal illness in the United States and can cause severe diarrhea, was not detectable by standard trichrome staining because the dyes were unable to penetrate the oocyst wall. Instead, *Cyclospora* required a separate stain, known as a modified acid-fast stain, for detection.

However, the AI-augmented method is sensitive enough to detect *Cyclospora* from the trichrome stain and wet mount, and that initial detection can then be confirmed with fluorescent microscopy. Since the addition of *Cyclospora* to the AI model, ARUP has been able to report *Cyclospora* results from the trichrome stain rather than requiring a separate test.

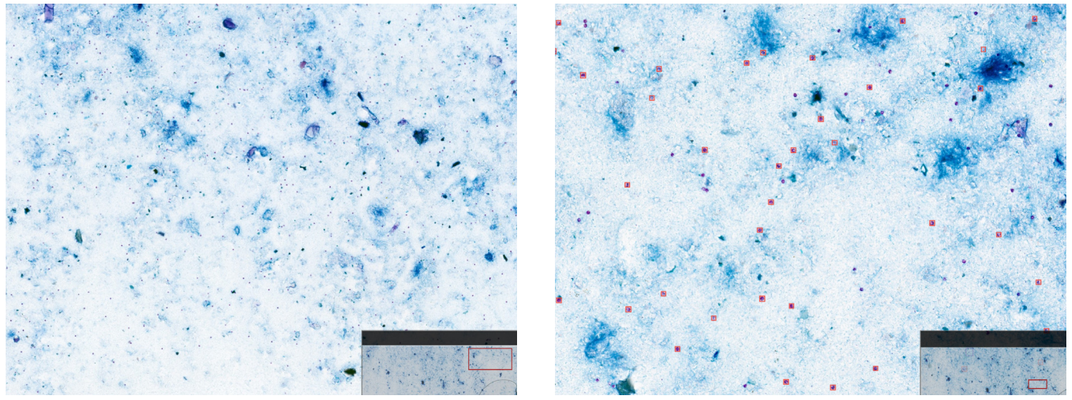
“We have good sensitivity already, but we know this is going to augment that sensitivity even further,” said Cole Neider, BS, I(ASCP), lab supervisor of the Parasitology and Fecal Testing Laboratory. “Even in samples that were originally reported as negative, the software has found organisms. The AI algorithm is about three to four times more sensitive than a human.”

In addition, the increase in efficiency has allowed the lab to institute a double read-back policy that further ensures a high level of accuracy. In accordance with this policy, the findings of the first technologist are confirmed by a second technologist, and any discrepancies are escalated to a senior technologist or medical director.

“A mechanical process driven by a computer algorithm is better in some respects,” Couturier said. “But what the software can’t do is be infallible on the identification. … Our staff members, especially with the verification process, are nearly infallible.”

Blaine Mathison, BS, M(ASCP), technical director of Parasitology at ARUP, reviews digital images of wet-mount slides. Mathison played a significant role in the validation of the AI-screening tool for the detection of gastrointestinal parasites.

By leveraging the efficiency of AI, along with the experience of its highly trained parasitology staff, ARUP produces results with improved specificity and sensitivity. Since the initial launch of the tool in 2019, the positivity rate has steadily increased.



A prepared modified acid-fast stain with a fecal specimen that contains *Cryptosporidium*. The image on the left depicts a standard whole slide, which a technologist would evaluate manually with conventional testing. The image on the right demonstrates the assistance AI provides by detecting the presence of parasites, as indicated by the small red boxes.

Every Parasite That Can Be Detected in Stool

The ARUP team completed a comprehensive and thorough validation of the AI screening tool. They accounted for an extensive number of organisms, including organisms that are rarely seen in the U.S.

"We have to account for everything, because you never know what a patient might have encountered," said Blaine Mathison, BS, M(ASCP), technical director of Parasitology at ARUP, who played a key role in the validation process. "There are 26 organisms on the wet-mount model compared with around eight targets for the trichrome."

Mathison and his colleagues worked with international collaborators to acquire specimens of these rare and exotic parasites to use in training the AI recognition software.

"We have some rare organisms in this model that I guarantee most lab staff have never seen," Mathison said. "In my 25 years of experience, I've only seen some of these once or twice."

These rare organisms include *Schistosoma japonicum* and *Paracapillaria philippinensis* from the Philippines and *Schistosoma mansoni* from Africa.

"Our validation was so thorough, we validated all parasites likely to be detected in stool," Jensen said.

Working with a liquid specimen presented another series of challenges.

Unlike trichrome stains, wet-mount slides quickly dry out, and the quality of the specimens deteriorates. This creates a limited window in which slides can be scanned from the time they are prepared. To solve this challenge, the ARUP team developed a new mounting media to extend the longevity of prepared slides.

In liquid specimens, objects can settle at different depths. While worm eggs can be 150 µm in size, protozoa tend to be only 5 µm. The difference in size means that the scanner needs to scan at different depths to capture both eggs and protozoa. The software then stitches together the scans to create a single image.

Mathison spent a significant amount of time performing discrepancy analysis to confirm the AI was recognizing organisms accurately. In some cases, the AI tool detected more organisms than originally found in the specimens. Mathison reanalyzed the specimens to confirm the AI tool's findings.

"Our limit of detection studies consistently showed the scanner and software were more sensitive than technologists," Mathison said.

Once validation was completed and the AI algorithm had been sufficiently trained to recognize the organisms, the team locked down the model so that it "does not adapt or deviate from the expected performance," Mathison said.

Efficiency Gains Increase Job Satisfaction

The advancement in AI also benefits staff working in the laboratory. Spending a significant amount of time at the microscope is tiring for staff.

"Time at the microscope can be draining and cause problems such as repetitive stress injuries and eye strain," Jensen said. "We have already seen our time at the microscope reduced in half, and the addition of the wet-mount part will reduce that time even more."

Jensen and Nieder expect the increased automation to also improve job satisfaction among laboratory staff. While the addition of AI will improve efficiency and increase capacity, it doesn't negate the need for competent parasitologists.

"As a screening tool, the AI filters out negative specimens. It doesn't diminish the need for competent staff who can identify parasites," Mathison said.

In addition, parasite detection has also placed an increasing strain on clinical labs. The requirement for extensive training and the manual labor involved makes maintaining this testing challenging.

"There is less and less expertise in the field, and there are fewer opportunities to gain the necessary expertise," Jensen said. "The more you are exposed to organisms, the faster you become proficient."

A typical clinical lab may see only two to three samples in a day, but as an academic reference laboratory, ARUP processes hundreds of samples every day. The sheer volume of testing and the variety of organisms that pass through ARUP's laboratory have helped to establish a highly competent parasitology staff.

"I'd put our parasitology lab against any other parasitology lab in the country," Jensen said.

Kellie Carrigan, kellie.carrigan@aruplab.com

ARUP Healthcare Advisory Services Helps Growing Health Systems Integrate and Optimize Laboratory Services

Expanding a health system is often a complex and messy process. A growing system may build new hospitals and acquire others, all while renovating older facilities and shifting departments around to keep pace with evolving needs. For laboratories, the result can be a hodgepodge of test menus, interfaces, workflows, and supply chains that are patched together well enough to work, but not to work well.

System laboratory alignment efforts integrate laboratory services across the entire health system to improve efficiency, save money, and better support patient care.

"The idea behind most mergers or acquisitions is that the whole will be greater than the sum of its parts. You're not achieving that if you don't integrate operations. You're just acquiring pieces that don't work together any better than they did before you brought them on."

David Shiembob, MBA, C(ASCP)CM, Manager, ARUP Healthcare Advisory Services

In the postpandemic landscape, health systems are pursuing growth more aggressively, which has led to an upswing in requests for ARUP Healthcare Advisory Services to partner in system laboratory alignment projects. In 2024, the volume of mergers and acquisitions (M&A) activity was 70% higher than the pre-COVID-19 trendline, according to PwC, a global accounting and professional services firm.

"The idea behind most mergers or acquisitions is that the whole will be greater than the sum of its parts. You're not achieving that if you don't integrate operations. You're just acquiring pieces that don't work together any better than they did before you brought them on," said David Shiembob, MBA, C(ASCP)CM, manager, ARUP Healthcare Advisory Services.

The goal of system laboratory alignment efforts is to integrate laboratory services across the entire health system to improve efficiency, save money, and support patient care. "Essentially, we're looking to optimize the delivery of lab services across the enterprise," said Sandy Richman, MBA, C(ASCP), vice president, ARUP Healthcare Advisory Services.

Health Systems Are Under Pressure

M&A activity is just one reason health systems are seeking stronger laboratory alignment. Another is the tremendous pressure they are under to reduce costs. Shiembob described four factors that are contributing to increased laboratory expenses: inflation in labor and supply costs, the aggressive growth plans of systems that are attempting to get back on track after the COVID-19 pandemic, the escalating expense of new specialty testing, and the continued incorporation of physician groups into health systems, which increases demand for system laboratory services.

In the face of that financial pressure, system laboratory alignment can help achieve cost savings by pinpointing areas for consolidation, eliminating redundancies, and optimizing resources such as laboratory space, equipment, and staffing.

"A unique approach Healthcare Advisory Services takes is not just focusing on saving the most money but on delivering the best patient care, as well," Richman said. "Centralizing some tests would reduce the lab budget, for example, but if key treatment decisions are being made based on those test results, you could save a little money in the lab but lose more money in delayed diagnoses and treatments or worse patient outcomes."

The Problems of Misalignment

Poor system laboratory alignment can cause a host of operational challenges for an organization. "As health systems get larger, they're not always doing things in the most efficient way. Different hospitals may have separate reference laboratories. They may have duplicate testing that doesn't need to be done at multiple sites. They're on different lab information and electronic medical records systems," Richman said.

Additionally, the system may have incompatible or redundant laboratory equipment, and sites may be relying on different vendors. Due to poor interfacing between laboratories, the

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Sandy Richman, MBA, C(ASCP), Vice President, ARUP Healthcare Advisory Services

system may be losing revenue to test leakage—outsourcing tests to reference or boutique labs when those tests could be performed internally instead.

All these inefficiencies are costly for the health system, but they also affect clinicians and their patients. For example, physicians practicing at multiple facilities may encounter entirely different test ordering and resulting processes at each location. Patients who travel between different system facilities are similarly affected. "They could have their records in different systems; they could have different testing performed depending on where they go—different manufacturers, different reference ranges—so it can be difficult for a physician to see all the testing that's been done on the patient and compare those results," Shiembob said.

Patients may have very different experiences based on which system facility they visit. Billing processes may differ from one location to another, and test results might be delivered through varying platforms or formats. "That's a dissatisfier," Shiembob said.

Benefits of Alignment

A well-aligned system is fine-tuned to operate efficiently. Each lab has a distinct role in the system, with thoughtfully curated test menus. "You're making holistic decisions about which testing should be performed at each lab so you can benefit from economies of scale while also providing rapid results to enable clinical decision-making," Shiembob said. Additionally, workflows and communications are streamlined between labs and with clinicians.

These efficiencies can translate into significant cost savings for the system. When labs are well aligned, each lab makes the most of its space, staffing, and instrumentation, which reduces redundancy and eliminates waste. Standardizing technology across all labs streamlines vendor management, enables bulk purchasing, and supports consistent reporting and test reference ranges.

Alignment also creates the opportunity to establish centers of excellence that specialize in complex or rare types of testing. "A benefit of building up those centers of excellence is that they will attract talent to your organization—experts in the field," Richman said.

Most importantly, alignment can help improve patient outcomes. "If you have well-integrated system laboratories, patient results are consistent and transparent, providers have easy access to those results, and your turnaround times for routine testing should be top-notch," Shiembob said. "You're prioritizing getting those test results fast, even if it means a little higher cost per test."

Making an Impact

"System lab alignment projects allow us to make a bigger impact with our clients," Shiembob said. "When we're talking about new lab construction and laboratory operations across many different hospitals, that is a scale of impact that is very large."

ARUP consultants are ideally suited for system laboratory alignment projects, Richman said. "We're proud of the fact that our team has a diverse healthcare background. We all recognize how important the laboratory is to patient care and to the health system overall. Each team member brings a unique and valuable perspective to these projects," he said.

In this issue of Magnify, we profile two Healthcare Advisory Services consultants who draw upon their extensive experience in clinical laboratory management and operations to help clients overcome challenges and strategize for future success.

A Blueprint for Alignment

Because every health system is unique, ARUP Healthcare Advisory Services takes an adaptable, agile approach to system laboratory alignment. In general, the consultations the team offers focus on the following categories:

Governance

Many health systems lack the laboratory governance that equips the leadership to make decisions for the entire organization. Instead, lab leaders "often focus on the needs of their individual hospital rather than approaching the laboratory as a system-level service line," said Chris Rabideau, MBA, MSL(ASCP)^{CM}, senior healthcare consultant with ARUP Healthcare Advisory Services.

In the case of one recent client, "Each facility functioned independently of the others, not only in how the laboratory was managed, but also in the selection of instruments and whether those purchases were made at the system level or by the facility itself," explained Ladonna Bradley, MT(ASCP), senior healthcare consultant.

Healthcare Advisory Services consultants can help health systems establish a robust governance structure to oversee lab services and support efficient decision-making.

Testing Data

ARUP consultants take a deep dive into testing data to assess which tests are performed at each facility, the instruments in use, testing volumes, and whether the testing is for inpatients, outpatients, or outreach programs. Using these data, the team provides recommendations in the following areas:

Consolidation. Consolidating certain high-volume testing to a single laboratory can reduce redundant instrumentation and enable labs to specialize.

Leakage. Facilities may be outsourcing tests that could be performed within the system to external referral laboratories.

Insourcing. By analyzing system instrumentation and sendout volumes, the team can identify tests that could be brought in-house with an FDA-approved, commercially available kit or methodology.

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Each of these categories presents cost-saving opportunities. In one recent engagement, ARUP advisors identified nearly $2.5 million in test leakage, along with $1.1 million in potential insourcing opportunities, based on the client's existing instrumentation.

Integration Opportunities

Integrating equipment and other technologies systemwide can enhance efficiency. ARUP consultants often recommend aligning vendor platforms across the system, which allows for fewer vendor contracts and better economies of scale for purchasing while also supporting improved continuity of care.

Relying on multiple laboratory information systems (LISs) can hinder efforts to consolidate and streamline testing. In one case, consultants discovered that a single facility accounted for 75% of a system's testing leakage. That facility's lab operated on a separate LIS, which made it difficult to order tests from other system laboratories.

"Having orders and results flow seamlessly between facilities is critical," Rabideau said.

Laboratory Space

Testing consolidation and lab specialization often impact space utilization across system facilities. Some labs may need to squeeze in more equipment, whereas others may need underutilized equipment removed. As testing volumes shift, demand may increase for storage and workspace to support added capacity.

Sometimes, systems may need to construct new facilities to accommodate growth. "As demand on a hospital laboratory grows, they don't have the luxury of expanding their lab, so they start growing outside of the laboratory. They end up fragmented in different rooms, different parts of the hospital, different parts of the campus, and that fragmentation can lead to issues," Richman said.

This was the case for a growing system with 12 laboratory facilities. ARUP consultants partnered with the organization to develop a long-term strategy for aggressive consolidation that included the creation of a new central laboratory. As a transitional step, the plan established specialty hubs within the system to help alleviate pressure on the overburdened hospital labs.

Staffing

Healthcare Advisory Services consultants help health systems plan for current- and future-state staffing needs based on the recommendations provided. "We utilize established industry benchmarks to assess productivity across all locations and measure the impact of our recommendations," Rabideau explained.

The Final Assessment

Solutions are never one-size-fits-all. That's why Healthcare Advisory Services offers clients a range of tailored options to achieve system laboratory alignment.

"One of our key deliverables is a current-state assessment, which provides a detailed analysis of existing workflows, staffing, and service operations to identify strengths, challenges, and opportunities for improvement. Then we present future-state options—models designed to optimize their services—which clients can adapt and scale to meet their systemwide goals," Bradley said. "Every recommendation provides a clear, actionable road map to guide next steps."

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ARUP Healthcare Advisory Services

Laboratories are often hidden gems within an organization, and their inherent value is easily overlooked. ARUP Healthcare Advisory Services can help laboratories quantify their value in terms of revenue potential and impact on patient care. ARUP consultants can also help highlight the hidden costs of outsourcing and work with labs to improve operational efficiencies. Healthcare Advisory Services is a full-service clinical laboratory consulting group that provides tailored solutions that equip labs with the necessary tools and strategies to deliver value-based care and achieve long-term revenue goals for their health systems.

Book a consultation with our advisors to see how we can help demonstrate the value of your laboratory or meet other operational goals.

Watch the companion video for this issue of Magnify at: **aruplab.com/magnify-spring25**

Bradley relies on her 25-year career in the clinical laboratory to help clients overcome challenges and strategize for future success.

Ladonna Bradley Provides ARUP Healthcare Advisory Services Clients With a Wider View of Their Operations

Ladonna Bradley, MT(ASCP), a senior healthcare consultant with ARUP Healthcare Advisory Services, was drawn to the medical technology and laboratory science fields by her passion for math and science, as well as by a health scare in her teenage years.

"I experienced a significant health event that led to my hospitalization. Throughout that time, I underwent multiple tests, and I found myself curious about what was being ordered and what the results would mean for my diagnosis and treatment. And that curiosity really stayed with me, sparking my desire to learn more about the laboratory itself," she said.

Her curiosity led Bradley to earn her bachelor's degree in medical technology from East Tennessee State University. "Medical technology not only satisfied my love for science, but it also gave me the opportunity to play a crucial role in healthcare by providing accurate and essential diagnostic information to clinicians and their patients," she said.

Bradley began her career as a laboratory generalist at Holston Valley Hospital, which allowed her to develop a broad foundation of experience in laboratory testing and operations. Then she became supervisor of the urinalysis and body fluid department. Shortly after Bradley stepped into that role, Holston Valley merged with other hospitals to form Wellmont Health System, which opened up an opportunity for her to become chemistry supervisor at Bristol Regional Medical Center, one of the system's other hospitals.

"In that role, my career quickly accelerated, and I soon moved into the position of laboratory manager. Within a year I was promoted to administrative laboratory director, and I worked in that capacity for 14 years," Bradley said.

Toward the end of that time, the laboratory was acquired by a large, commercial lab. "That transition brought a host of challenges, including administrative hurdles, staffing challenges, a reduced on-site test menu, and turnaround time issues, just to name a few," she said. "After navigating that for a few years, I decided to pursue a leadership opportunity in a neighboring health system that still owned and operated its laboratories."

Bradley has always taken quality and compliance very seriously. "It's a reflection on the laboratory and the work that we do," she explained. As a laboratory director, she worked to ensure her laboratory performed well on College of American Pathologists (CAP) inspections. "The last inspection that I had as a laboratory director, we had zero deficiencies. We went above and beyond to make sure we had everything in order—and it really paid off. It was something that, as a team, we could be very proud of."

Bradley served with Mountain States Health Alliance for three years and then decided to make the jump to ARUP Healthcare Advisory Services. As a senior healthcare consultant, Bradley leverages the skills and experiences she gained from a 25-year laboratory career to help clients contend with their many challenges.

"Having been in their position, I understand the issues they face," she said. "That brings a level of credibility to the role. I have been in their shoes, and I have experienced some of the things they're going through, whether it's a buyout by a commercial lab or the day-to-day challenges of staffing and accreditation and making the most of limited resources."

With her extensive background as a laboratory director, Bradley brings unique expertise in quality management systems and regulatory and compliance issues. She can also help clients take a close look at their technical operations to make them more efficient and effective.

Laboratory directors are often so enmeshed in the daily details of running a laboratory that they don't have the space to step back and take a wider view of the operations or assess what might need to change. "What can I do differently? Do I need to focus more on stewardship? Do I need to look at expanding outreach—and how would I do that? My role as a consultant is to be that extra set of eyes and ears in the operation so I can give them recommendations for improvement," Bradley said.

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> *"The last inspection that I had as a laboratory director, we had zero deficiencies. We went above and beyond to make sure we had everything in order—and it really paid off. It was something that, as a team, we could be very proud of."*
>
> Ladonna Bradley, MT(ASCP)
> Senior Healthcare Consultant

Rabideau was the business operations manager for Northern Light Laboratory before joining ARUP as a senior healthcare consultant.

Chris Rabideau Brings a Passion for Laboratory Operations to ARUP Healthcare Advisory Services

Early in his career, Chris Rabideau, MBA, MLS(ASCP)CM, senior healthcare consultant for ARUP Healthcare Advisory Services, hit a pivot point that drew him to laboratory operations and management. After graduating with a medical laboratory science (MLS) degree from the University of Maine, he worked as a medical laboratory scientist in the hematology, chemistry, and microbiology departments of Affiliated Laboratory Inc., an independent regional reference laboratory, until he was promoted to evening shift technical supervisor at 24 years old.

"At 10:00 at night, our unpacking bench would be mounded with a pile of specimens. As a supervisor, I wanted to understand the peaks and valleys of our testing. Why is 10:00 at night our largest influx of volume? That started my interest in how the lab operates as a business," he recalled. "Seeing that many specimens led me to investigate where all the testing was coming from, and then I realized we were doing work for clients over three hours north and six hours south. How did all of this connect and come together? How did it impact workflow and staffing levels?"

At that time, Affiliated Laboratory had robust outreach operations and served as the sole reference lab for Northern Light Eastern Maine Medical Center. This breadth of work gave the laboratorians wide experience with different patient populations and clinical specialties.

"I was really interested in the independent nature of our laboratory—how we operated as a business and how we made money. So I went to our COO at the time and asked her, 'If I wanted to run a lab like this, what would you recommend?'" As a result of this conversation, he decided to return to school and attain his MBA with a focus in healthcare administration from Husson University.

In 2015, Rabideau became Affiliated Laboratory's business operations manager. Additionally, he was given responsibility for the lab's outreach operations, which spanned the entire state of Maine and part of Vermont and encompassed hundreds of physician's offices, alternative care clinics, and hospitals.

"I loved the autonomy of our laboratory. When I first started, it was my intent always to run that business. However, the company took some twists and turns along the way," he said. One twist was the laboratory's evolving integration into Northern Light Health, a 10-hospital system in Maine. As business operations manager for the newly rebranded Northern Light Laboratory, Rabideau helped grow the lab's outreach business and served in additional roles as the laboratory's safety officer, preanalytics manager, and education manager.

The second twist in Rabideau's career came when Northern Light Laboratory was sold to a large, commercial laboratory in the wake of the financial turmoil resulting from the COVID-19 pandemic. The laboratory was no longer the scrappy, independent enterprise that Rabideau had devoted his career to, and he made the decision to join ARUP Healthcare Advisory Services as a healthcare consultant in 2022.

> ***"I love ARUP's mission to keep testing close to the patient. We don't compete with our clients. We want our clients to grow and thrive locally within their systems. And I wholeheartedly advocate for that."***
>
> Chris Rabideau, MBA, MLS(ASCP)CM
> Senior Healthcare Consultant

Rabideau's many years of experience at an independent regional reference laboratory and later at a statewide health system have been invaluable in his consulting work. "Connecting with outreach clients, being part of service-line decisions, equipment-level decisions—I understand what those decisions can mean for the bottom line," he said.

As a consultant, Rabideau brings unique expertise in outreach, business, and technical operations.

"I enjoy the opportunity to see other labs and how they operate. A vast majority of these laboratories are dealing with similar challenges. Oftentimes, I've encountered these issues already," Rabideau said. "Lab operations is what I lived and breathed for so many years, and I value being able to help a client, and I believe they value our team coming in and providing support to them."

Rabideau had become familiar with ARUP while working at Affiliated Laboratory, which had been a longtime ARUP client, and he values ARUP's approach to supporting its clients.

"I love ARUP's mission to keep testing close to the patient. We don't compete with our clients. We want our clients to grow and thrive locally within their systems. And I wholeheartedly advocate for that," he said. "Helping our clients keep their labs healthy, keep their testing local, support their staffing at a local level—that's what drives me."

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Beyond the Lab: How Central Exception Handling Supports Laboratory Operations

Diagnostic testing is sometimes thought of as a puzzle to be solved. Each piece must fall into place throughout the testing process for patients to receive their results. To begin with, the specimen must be collected properly, transported appropriately, and stored under the right conditions. An order must be placed with the intended test clearly indicated and with relevant patient information included.

So what happens when a piece of the puzzle is missing? ARUP's Exception Handling (EH) Department steps in to investigate any missteps, promptly solve the problem, and enable the performing laboratory to proceed with testing. One of the first stages of EH's investigation process is to "put a test on Except," which indicates the specimen or order has an issue that must be resolved.

Multiple EH teams exist at ARUP, including specialized teams for Infectious Disease, Genetics and Oncology, and Referral Testing. Issues involving specimens not intended for one of these specialized areas are handled by Central EH (CEH).

"We're essentially the problem-solving department for the company," said Cidney Collett, laboratory client support specialist (LCSS) trainer. "Any issue that is identified by the performing laboratories or by Specimen Processing is sent to Exception Handling to be resolved."

The Except process is critical to laboratory operations and enables ARUP to test specimens that can't be tested following standard processes. For example, red blood cells in a specimen might have broken down during transport, or the volume of a specimen may be insufficient for the requested testing. A test order could have been entered incorrectly. Paperwork could be missing or provide unclear information.

"We're opening up possibilities to be able to test specimens that otherwise couldn't be tested," said Ally Ledesma, a supervisor in CEH. "This is especially helpful in situations with complicated test orders for a patient."

Ledesma reported that approximately 15,000 Excepts are processed each month in CEH. Without CEH's involvement, these specimens would not be tested. ARUP tests approximately 2.1 million specimens per month, which means that roughly 0.7% of specimens are put on Except by CEH. Although Excepts are rare, CEH's handling of Excepts ensures that more testing can be performed.

The process that CEH follows to investigate and resolve an Except is complicated and varies from case to case. The first step is always to see if the issue can be resolved internally, without contacting the client.

"Trying to find internal resolutions is our priority," Collett said. "This could involve substituting one sample with another sample from the same patient or contacting the lab to see if they can reroute samples."

If there is no internal solution, the laboratory client support technician (LCST) must contact the client for resolution through ARUP Connect™, a secure online platform that helps clients manage the testing they send to ARUP, or by phone.

One of the most complicated scenarios that CEH handles are "four-by-fours." In these situations, it is unclear which client sent the sample to ARUP, and while working to resolve the issue, CEH uses a miscellaneous client ID, 4444, in its case documentation. Four-by-fours occur when clients have not included the submitting facility's information in packing lists, labels, or test orders.

A laboratory client support technician (LCST) scans a specimen's label during the "Except" process—the process of investigating and resolving issues with specimens so that testing can proceed.

Anna Blaes, a laboratory client support technician (LCST), recently graduated from her training in Central Exception Handling (CEH).

Anna Blaes, an LCST, said, "The process involves sorting through paperwork, checking bag images, and looking at orders under the same patient if you have patient information. Hopefully something on the label or paperwork can give me a good indication of who it might have come from."

Blaes added, "If the specimen doesn't have a label, that's also a problem. We don't know what it is or when it was drawn. We don't know when it goes out of stability, or what test the client wants. It's a huge mystery."

Of the 15,000 Excepts CEH handles per month, approximately 210 are four-by-fours, Ledesma said.

To ensure that LCSTs are well prepared to tackle challenges like these, all newly hired LCSTs go through 10 weeks of training before working independently.

Collett said that CEH's training program is intensive and personalized. Each trainer is dedicated to one trainee throughout the training process and works alongside that trainee one on one.

"Ten weeks is necessary because we see so many different cases in Exception Handling," said Collett. "It gives trainees time to exercise problem-solving and get comfortable making judgment calls. It's like a muscle that needs to be exercised to be a comfortable and strong technician when they hit the floor."

Collett said that during their training, LCSTs learn and practice three main types of tasks: triaging, client communication, and labeling. Triaging is the problem-solving part of the job and requires LCSTs to handle samples in the laboratory, document any issues, and search for internal solutions. If no internal solution is found, then the client needs to be contacted. Labeling takes place after the issue has been resolved and the sample needs to be routed for further testing or for storage.

Blaes recently graduated from the CEH training program and now handles Excepts independently. She was surprised by how many complex cases she saw during training.

"There were some things that even the trainers had never seen," Blaes said. "We'd pull up an issue and they'd say, 'I've been here for 16 years, and I've never seen that.' Then, we'd methodically break down the process of problem-solving and come to a solution."

Specimens placed "on Except" are stored in Central Exception Handling (CEH) while laboratory client support technicians (LCSTs) investigate the case.

CEH's trainers aim to create a supportive, collaborative environment and encourage trainees to ask questions and develop their problem-solving skills. "In training, we create structure, but at the same time, it's a bit relaxed," Collett said. "We try to foster a very comfortable atmosphere to encourage people to ask questions."

Blaes said that she enjoyed her training program and the people she works with. "The type of work we do lends itself to creative thinkers and people who are very detail oriented. Everyone here is also very friendly. In our downtime we have great conversations, and it's easy to make fast friends."

Collett's role on the training team is unique, as she is the only floor trainer. She oversees employees who have graduated from training and answers questions about complicated cases, offers retraining, and observes trends on the floor.

"It's really a never-ending process," Collett said. "We care about constant improvement and continued education throughout an LCST's time in Exception Handling."

This commitment to continuous improvement and education is not only evident in the training process, but also in CEH's quality assurance procedures. Tracy Dinsdale, an LCSS is also CEH's dedicated quality assurance specialist. An LCSS usually helps LCSTs with more complicated cases that need extensive investigation, but Dinsdale's role is focused primarily on quality assurance.

"One of the Five Pillars of ARUP Culture is continuous improvement," Dinsdale said. "We identify issues and resolve them so they don't happen again." Dinsdale also pointed out that the quality process is a necessary component of ARUP's many quality accreditations, including the ISO 15189 certification.

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