

# Fewer urine cultures — series of changes add up

## Amy Carpenter Aquino

November 2020—Five years after putting in place a urine reflex algorithm at Barnes-Jewish Hospital in St. Louis, and many tweaks later, Melanie Yarbrough, PhD, D(ABMM), D(ABCC), has tips to share on how to increase the odds for success in reducing the number of urine cultures. But even for Dr. Yarbrough and colleagues, use of the algorithm remains a work in progress.

“What we implemented five years ago is almost unrecognizable to what we have now because we’ve tweaked it as we’ve gone along,” says Dr. Yarbrough, assistant medical director of clinical microbiology and assistant professor, Department of Pathology and Immunology, Washington University School of Medicine.

The consolidated microbiology laboratory at Barnes-Jewish Hospital performs testing for five hospitals. “Even though we’ve taken on more and more microbiology work from these hospitals,” she says, “we’ve still seen a decrease in our urine culture rates steadily each year over the past five years as we’ve refined the algorithm.”



Dr. Yarbrough

Dr. Yarbrough and colleagues have also seen a concurrent increase in the lab’s urine culture positivity rate. “While this could be due to a number of factors, it’s a good sign that the reflex algorithm is contributing to this increased positivity rate by eliminating some of those unnecessary urine cultures that would have been negative,” she says.

The urine reflex algorithm works by reflexing to urine culture based on preset criteria for urinalysis results, and the criteria have changed over the years. “Our current reflex algorithm reflexes off of 10 white blood cells per high-power field,” she says. “Initially, we included other parameters such as blood, protein, leukocyte esterase, and nitrites. Subsequent studies have shown that 10 white blood cells per high-power field is a good predictor that is sensitive and yet specific enough to not miss too many positive urine cultures, so we tweaked our parameters to increase specificity and further improve our utilization.”

A retrospective study of the inpatient urine culture rates before and after changes were made to commonly used order sets in the computerized physician order entry system revealed a 45 percent reduction in the number of urine cultures performed. Dr. Yarbrough and her coauthors estimated laboratory cost savings of \$103,345 in inpatient urine culture testing during the post-intervention period of May 2016 to August 2017 (Munigala S, et al. *Infect Control Hosp Epidemiol.* 2019;40[3]:281-286).

The catheter-associated urinary tract infection rate remained unchanged after the intervention, says coauthor David Warren, MD, MPH, professor of medicine, Division of Infectious Diseases, Washington University School of Medicine. “There was no change, which suggested that we weren’t missing catheter-associated infections. That was a positive.”

“You can conversely look at it as some of those CAUTIs may meet the [National Health Care Safety Network] definition because of the way the definition is structured. If you have a fever due to any cause, you have a CAUTI with a positive urine culture and a catheter in place, so there is probably a lot of misclassification.” Theoretically, then, the CAUTI rate will decline, he says, because those patients are not being tested unnecessarily.

“Our first big lesson was to standardize specimen collection,” Dr. Yarbrough says. “We had good success when we

switched to a prepackaged urine collection kit.” It contained a collection cup and two vacutainer tubes: one tube for urinalysis and the other with boric acid preservative for culture.

“Having both of these tubes is a requirement for the reflex order because it allows us to extend the stability of the specimen for culture and permits add-on testing if a physician still wants the culture, even though it is first cancelled under the algorithm,” she explains.

The ability to add on a urine culture test for up to 48 hours alleviated a worry of the ordering physicians, Dr. Warren says, “that if they didn’t order the urine culture now, then the patient might receive antibiotics and that may somehow impact the results. So they tended to order urine cultures at the same time they were ordering urinalysis. This helped reassure them that that option was still available if they wanted it.”

Dr. Yarbrough advises laboratories that may move to adopt a urine reflex algorithm to consider workflow and storage requirements for maintaining extra urine specimens for up to 48 hours. “Having this collection kit will likely increase the number of tubes handled by the laboratory, so one thing the lab needs to do is to decide on an efficient workflow. Who is going to handle the tubes, and what part of the laboratory will ensure that reflex cultures get ordered and processed appropriately according to the urinalysis results?”

The core laboratory at Barnes-Jewish Hospital was designated to handle the lion’s share of the urine specimen management because the microbiology laboratory was not set up to receive so many additional urine specimens daily. However, the core laboratory was not accustomed to saving urine specimens for the 48 hours required for the urine reflex algorithm. “They were tossing them within 24 hours,” Dr. Yarbrough says.

The microbiology and core laboratories collaborated to design a urine specimen storage solution that would accommodate the extra tubes. “It needed to be streamlined and efficient so that it wasn’t a lot of extra work, yet organized in a way where the urine specimen could be quickly found if a urine culture needed to be added on,” Dr. Yarbrough says. The result was a rack system with tracking using a specimen management software, “so the urine specimen’s location was always known.”

Test names should be clear, she says, and they should not contain lab lingo that providers do not understand. “That was one of the things we tweaked almost as soon as we introduced the reflex order. We quickly realized that physicians didn’t understand what we were talking about because we had used some lab lingo in our test orderable names.”

Dr. Warren agrees: “Naming conventions matter. Before, we had what we called a ‘urine flex’ and ‘urine reflex,’ and to this day I can’t remember which one was which.”



Dr. Warren

Making the urine test names more self-explanatory was one of the most significant changes made to the CPOE system, he says. “We changed them to ‘urinalysis with reflex to microscopy’ or ‘urinalysis with reflex to microscopy and culture.’ It was much more straightforward naming, and that is very important for physicians on the floor because they may not think of these tests in the same way as the laboratory would.”

In another refinement, the team worked with Epic to add an entry requirement for the urine specimen source. “Specimen type matters for urine culture because often hospitals have different thresholds for a positive urine culture depending on the specimen type,” Dr. Yarbrough says. To help with its interpretation of urine culture results, the laboratory created a prepopulated list of specimen types—in-and-out catheter, indwelling catheter,

suprapubic aspirate, suprapubic catheter, and clean-catch specimen.

As for where urine tests appear in the CPOE system, Dr. Warren says, “Subtle changes can have pretty big effects.”

An interdisciplinary team looked specifically at order sets for the emergency department. “We moved ‘urine culture’ off of their frequently ordered tests” in the ED electronic order set, “and we kept ‘urinalysis with reflex to microscopy,’” he says. “They could still order a reflex urine culture or a urine culture by itself, but they were two to three clicks away in the computer.”

This intervention in 2015 reduced the daily culture rate per 1,000 ED visits by 46.6 percent, but urinalysis, microscopy, and catheterized urine culture rates were unchanged (Munigala S, et al. *BMJ Qual Saf.* 2018;27[8]:587–592).

“One of the concerns was, were we inappropriately missing people who should have gotten a urine culture?” Dr. Warren says. “So one of the things we looked at was, with people who had gotten admitted to the hospital, what proportion of those patients had a urine culture within 24 hours of admission, suggesting that the primary team felt that the urine culture was missed. And we saw no increase in that percent of patients over time.”

A standalone urine culture must remain orderable for those who need it, Dr. Yarbrough says, such as pregnant women and perhaps urology patients, “but you need to make it harder to find for places like the emergency department.”

Another lesson learned: “If you’re a hospital that has immunosuppressed patients, be sure that the reflex algorithms for this patient population, such as transplant or oncology patients, are not restricted to a urine reflex algorithm that relies on pyuria or white blood cells as its main criteria,” Dr. Yarbrough says. “These patients are often neutropenic, so having white blood cells as a reflex parameter is not useful for that patient population.”

To address this, a second reflex algorithm was created called the UA reflex algorithm for neutropenic patients. Says Dr. Warren: “We allowed—if they had a positive blood, protein, leukocyte esterase, nitrite—if any of those were present, then it would potentially reflex to microscopy and urine culture. The concern with those patients was that because they’re neutropenic, they may not be able to mount a leukocyte response, and so the leukocyte esterase may be negative. So we wanted to increase the sensitivity in that patient population because we felt they were more at risk, and we realized we may have to trade off the specificity.”

Even today the laboratory is still working to refine its clinical decision support, with the aim of optimizing how urine culture results are displayed in the EMR.

“Although the algorithm is working to help optimize utilization of our urine cultures, many patients in our hospital do continue to have inappropriate repeat urine cultures ordered,” Dr. Yarbrough says. “This often occurs after collection of the initial sample in the emergency department. Then the patient gets admitted, and a repeat urine culture is ordered on the floor.”

Dr. Warren and colleagues conducted a retrospective study of adult inpatients who had one or more urine cultures performed during their hospitalization between January 2015 and February 2018 and found that 7.3 percent of urine cultures were repeated within 48 hours of the index urine culture. Of those, 54.4 percent were found to be inappropriate, defined as a culture performed after a negative index culture or a repeat urine culture on a specimen obtained from the same urinary catheter (Foong KS, et al. *J Clin Microbiol.* 2019;57[10]:e00910–e00919).

“Among inpatients with a negative index urine culture,” the authors of the study wrote, “the diagnostic gain of an inappropriate urine culture repeated within 48 hours for detecting bacteriuria was only 4.7 percent.”

A more than fivefold increased risk for having inappropriate inpatient repeat cultures performed within 48 hours after the index culture was found when the initial culture was performed with a sample obtained in the ED.

Says Dr. Warren, “We noticed there was a large proportion of hospitalized patients with a urine culture ordered,

about 20 percent, that had duplicate urine cultures ordered, especially in the emergency department to inpatient transition.”

The study’s findings led to an alert added in recent months for duplicate urine culture testing, one they had planned to add at the start of this year but were unable to do so because of the pandemic.

The estimated laboratory charges for inappropriate repeat urine cultures were \$16,800 over the study period, according to the authors.

New emerging technologies may hold promise for improved UTI diagnosis, but Dr. Yarbrough says more published studies are needed. So far, “not many of them are consistently reliable.”

“The real limitation is that current technologies, such as flow cytometry, for the detection of bacteria in urine do not provide all the necessary information,” she says. “For example, contaminated urine cultures may flag positive under the flow cytometry method. Also, you don’t get the identification of the organism or antimicrobial susceptibility information that would help you treat.”

What is needed are technologies that have a shorter assay time compared with culture, she says, ones “that are adaptable to point of care but that also discriminate uropathogens from contaminating organisms, or that are capable of measuring biomarkers of the host immune response to help determine the clinical relevance of bacteria in the urine.”□

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