



The Laboratory's Role in Improving *C. difficile* Rates

CLOSTRIDIODES DIFFICILE RATES PLUMMET AT ONE HEALTH SYSTEM WITH LABORATORY-DRIVEN REDESIGN

In the fight against *Clostridioides difficile* (*C. diff*; formerly known as *Clostridium difficile*), hospitals have become extra vigilant about rapidly diagnosing and treating infected patients, which can save lives as well as prevent the spread of the infection. Yet, as AMITA Health Saint Francis Hospital Evanston (Ill.) learned, this approach can backfire if laboratory testing is overly sensitive, leading to high numbers of false positives and unnecessary treatment of patients who might have *C. diff*-like symptoms (e.g., diarrhea, abdominal cramps) but don't have the infection. After the hospital redesigned laboratory testing for *C. diff*, cases declined by 54% and related costs decreased significantly.



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Mary Haak, R.N., director of quality and patient safety, AMITA Health Saint Francis Hospital Evanston

The leadership team at AMITA Health Saint Francis Hospital Evanston (Ill.) had gathered for a daily safety huddle when its hospital president, Kenneth Jones, raised a concern: “What is going on with *C. diff*?” he asked during the team’s review of hospital-acquired conditions and events.

“When we looked at our data, we saw that the number of positive *C. diff* cases was higher than the guidelines set by the CMS [Centers for Medicare & Medicaid Services],” said Mary Haak, R.N., director of quality and patient safety at the 250-bed community hospital.

Specifically, the hospital’s standardized infection ratio (SIR) for *C. diff* had risen steadily from 0.31% to 1.8% between October and December 2017. An SIR greater than 1% indicates that the actual number of infections is greater than the expected number.

“It really struck a nerve,” Haak said, during a March 2020 webinar sponsored by the American Hospital Association and the College of American Pathologists. “Our team immediately went into action and identified a number of suspected factors, primarily related to laboratory processes and tests.”

When the team reviewed cases of patients who had been diagnosed with *C. diff*, they found that many should never have been tested for the infection because they had not been properly screened based on an appropriate clinical assessment prior to testing. In addition, laboratory staff suspected that a large number of patients who had tested positive for *C. diff* — as many as 50% — did not actually have the infection. Like many hospitals around the country, Saint Francis had been using a highly sensitive laboratory test for *C. diff* that has been linked to many false-positive findings and the overdiagnosis of *C. diff* using a polymerase chain reaction (PCR) test.

Recognizing that the *C. diff* spike was tied to laboratory ordering and fulfillment, Saint Francis leaders launched a redesign initiative aimed at improving *C. diff* diagnostics.



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Janis Atkinson, M.D., FCAP, system vice president of medical affairs, Alverno Laboratories, AMITA Health, and medical laboratory director, Saint Francis

Getting *C. diff* Diagnosis Right

From a laboratory perspective, the diagnosis of *C. diff* infections requires two elements, according to Janis Atkinson, M.D., FCAP, system vice president of medical affairs, Alverno Laboratories for AMITA Health, and medical laboratory director at Saint Francis:

- Appropriate test ordering (i.e., ordering tests for the right patients) and
- A lab test or combination of tests that can diagnose *C. diff* infections accurately and rapidly with minimal risk of false-positive diagnoses.

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Redesigning Lab Ordering for Suspected *C. diff*

A multidisciplinary team was formed to determine how to redesign the lab test ordering process. In addition to Atkinson and Haak, the team included an infection prevention expert, the hospital’s administrative laboratory director, an internal medicine physician, and a nursing leader.

After interviewing front-line staff about current approaches for ordering *C. diff* labs, team members concluded that there was significant variation in procedures. To address this, the team developed a standardized process centered on evidence-based guidelines, which they called “*C. diff* ticket-to-lab.” Before ordering a *C. diff* lab test, Saint Francis physicians need to ensure that patients meet three criteria:

1. The patient has had three or more watery stools in the past 24 hours. The stool must be entirely liquid with no solid pieces, known as a Type 7 stool on the Bristol stool scale, a widely used diagnostic tool to classify samples of human feces.
2. The patient has not been given stool softeners, laxatives, or bowel preparation (i.e., cleansing prior to bowel surgery or colonoscopy) in the last 24 hours, which could cause *C. diff*-like diarrhea.
3. The patient has not had positive *C. diff* results in the past two weeks (i.e., not repeating tests to determine if the patient is cured since these tests have not been shown to be beneficial).

When the new process first was rolled out, the ordering physician was required to complete and sign a paper form that included a checklist of the three criteria. The physician had to confirm that the patient met each criterion. The paper form was later converted to an electronic version in the EMR as part of the *C. diff* test.

Once the patient’s stool specimen was collected, a nurse ensured that the ticket-to-lab form accompanies the sample. The lab rejects all specimens that don’t arrive with a completed form, as well as specimens that are not Type 7 watery stools.

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Implementing a Two-Step Testing Algorithm

The second phase of the redesign involved investigating and implementing a more precise laboratory test procedure for diagnosing *C. diff*. Due to advances in laboratory sciences, a number of sophisticated pathology tests now are available to detect *C. diff*. “With so many tests and test combinations, selecting the best option is a challenge,” Atkinson said.

Hospital and health system laboratories typically use one or more of the following tests:

- Enzyme immunoassay (EIA) to detect *C. diff* toxins, the poisonous substances in the bacterium that cause diarrhea and other symptoms.
- EIA to detect glutamate dehydrogenase (GDH), a cell wall enzyme produced by the *C. diff* bacterium.
- Nucleic acid amplification test (NAAT), which detects genes that code for the toxins that cause *C. diff* infections.
 - Polymerase chain reaction (PCR) test, a type of NAAT assay that detects the toxin gene *tcdB*.

Until January 2019, Saint Francis had been using a single assay, the PCR test, which is highly sensitive for detecting patients who have the *C. diff* gene, but detection of the gene does not separate a patient with the disease colitis from a patient who is only a gene carrier. A *Journal of Clinical Microbiology* study found that PCR tests can inflate *C. diff* rates 2.5 to 3 times.

Reducing false-positive *C. diff* diagnoses is tricky because some patients may be carriers. Carriers are people who carry the gene(s) for *C. diff* may not be sick with *C. diff* (i.e., do not test positive for the toxin). Many carriers never develop the disease and do not benefit from treatment.

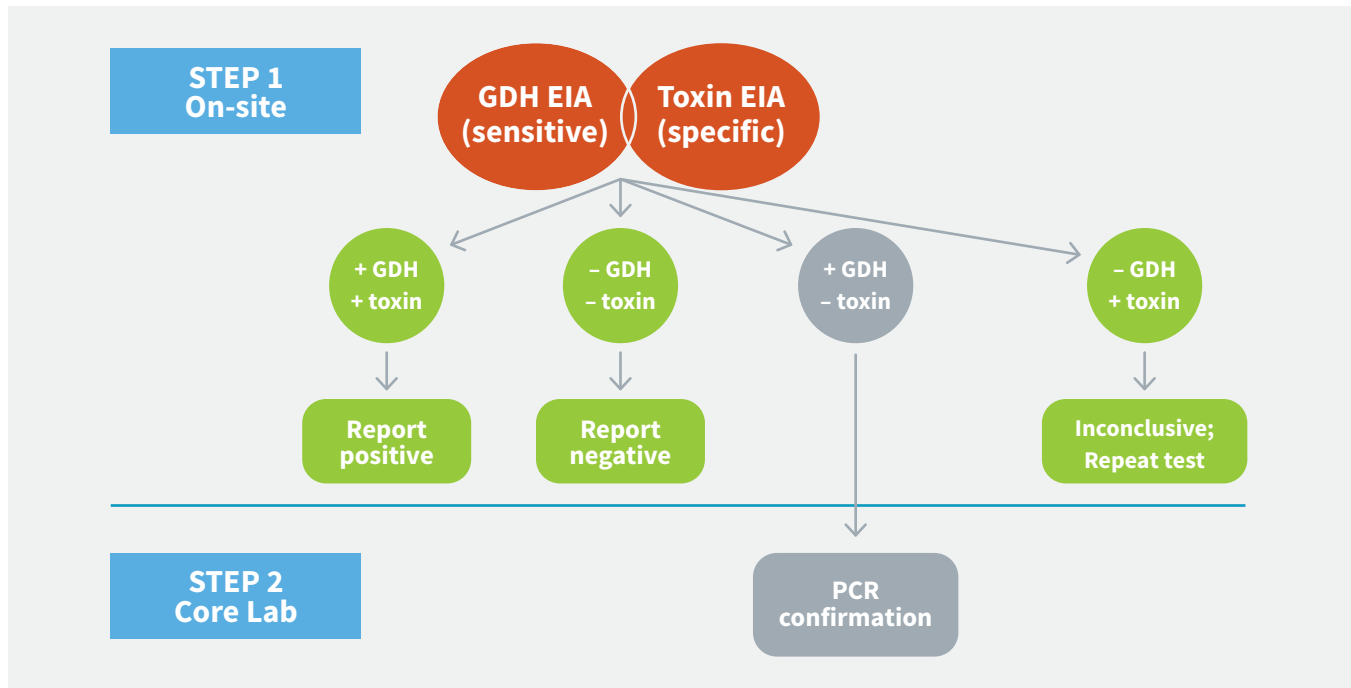
To determine how to improve *C. diff* testing, Saint Francis worked with its core lab, Alverno Laboratories. A committee at Alverno, consisting of infectious specialists, microbiologists, pathologists, and others, reviewed testing recommendations from various infectious disease specialty societies. This led to the adoption of an evidence-based approach to testing for *C. diff* (Figure 1):

- Step 1: EIA tests are performed to detect both *C. diff* toxins and GDH. If both tests are positive, then the patient is diagnosed as having *C. diff* infection. If both tests are negative, then the result is reported as negative.
- Step 2, as needed: If the specimen tests negative for *C. diff* toxin but positive for GDH, then a PCR test is conducted to detect the *C. diff* gene. If the PCR test is positive, then the result is reported as positive for *C. diff*.

This two-step testing approach is supported by the 2019 guidelines from the American Society of Microbiology.

Figure 1

Two-step algorithm *C. difficile*: Laboratory improvement based on best-practice guidelines



References: Infectious Disease Society of America; Society of Healthcare Epidemiology of America; Journal of Clinical Microbiology, June 2010, pp. 2082-2086

C. diff Lab Tests: Sensitivity versus Specificity

The best lab test is one that is highly sensitive and highly specific:

Sensitivity: Is the proportion of patients *with* the disease who test **positive**.

- **EXAMPLE:** A test with an 85% sensitivity rate will positively identify 85% of patients who truly have a *C. diff* infection, while giving false-negative results to 15% of patients who actually have the disease. False negatives may lead to infected patients not receiving needed treatment and not being isolated to prevent the spread of the infection.

Specificity: Is the proportion of patients *without* the disease who test negative.

- **EXAMPLE:** A test with an 85% specificity rate will correctly identify 85% of patients who do not have a *C. diff* infection, but will issue false positives for 15% of this uninfected group. False positives may lead to uninfected patients being put in isolation and getting unnecessary antibiotic treatment.

Currently, there is no single lab test for *C. diff* that has both high sensitivity and high specificity. That is why Saint Francis decided to adopt a two-step testing approach.

Reducing *C. diff* False Positives

After implementing the new lab ordering and testing procedures, Saint Francis saw its *C. diff* rate decrease dramatically, with the SIR rate declining to 0.48 from 1.80 (Figure 2). This represents a 54% decline in patient cases between fall 2017 and summer 2019.

The incremental cost of caring for a patient with hospital-acquired *C. diff* is approximately \$17,260 per case, according to the Agency for Healthcare Research and Quality. In 2019, Saint Francis had 15 fewer *C. diff* cases than in 2018, which translates to \$258,900 in cost savings.

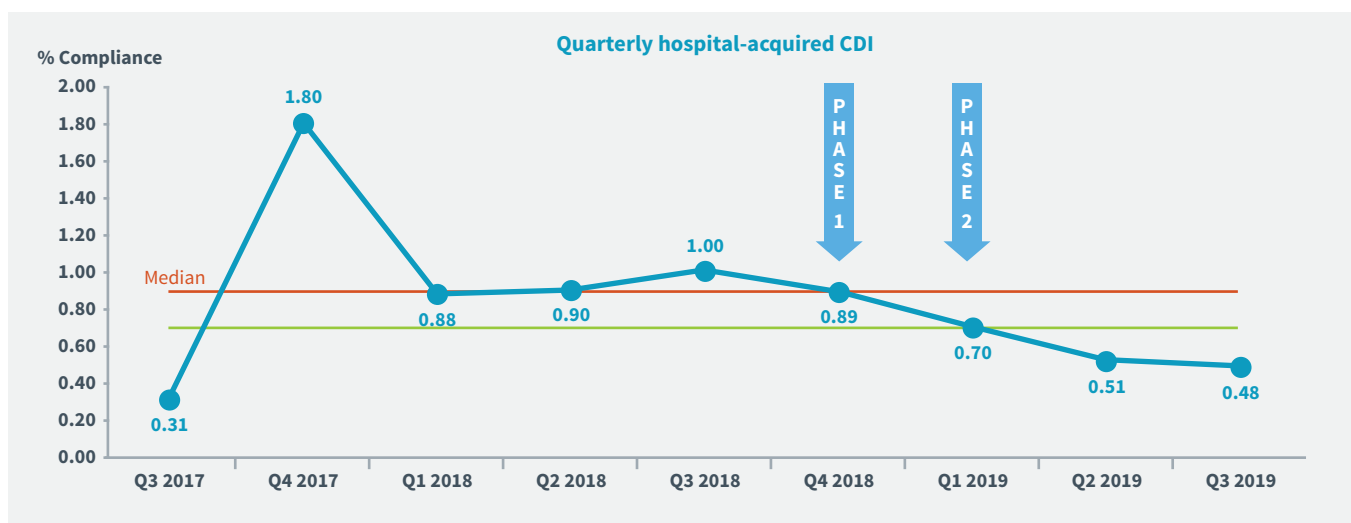
The new laboratory procedures and the decline in *C. diff* cases led to other positive results:

- A decrease in the use of the antibiotic vancomycin, which can cause serious side effects, and a related decrease in drug costs of approximately \$16,500 per quarter.
- A decline in *C. diff* labs ordered, representing a 33% reduction in associated lab costs.

Test-turnaround time also improved. The EIA tests used to detect *C. diff* can be done in the Saint Francis hospital laboratory with an average turnaround time of 2 hours. The PCR testing is performed at the health care system's core laboratory, resulting in an average turnaround time of 16 hours. Now that most patients can be diagnosed with EIA tests, the average turnaround has decreased by 87%.

Figure 2

Results: Third quarter, 2019



Keys to Success

Janis Atkinson, M.D., system vice president of medical affairs, Alverno Laboratories for AMITA Health, and medical laboratory director, and Mary Haak, R.N., director of quality and patient safety, both at AMITA Health Saint Francis Hospital Evanston (Ill.), cite the active support of senior leaders, including the president, chief medical officer, and chief nursing officer as key to the success of the laboratory redesign. Other success factors include:

- **Visual cues.** “Our ticket-to-lab process was designed to include visual cues, which had a significant impact on our compliance,” Haak said. For instance, the ticket-to-lab form included an illustration of the Bristol stool scale so clinicians could quickly discern a Type 7 watery stool from other types of stools.
- **Hard-wiring ordering process.** Eventually, information technology staff at Saint Francis hard-wired the new *Clostridioides difficile* lab criteria into the electronic health record (EHR).

When a physician electronically orders a *C. diff* lab test, the EHR prompts the physician to confirm that the patient meets all three criteria. If the patient does not, the physician will not be able to complete the order electronically, but can contact the laboratory director with questions.

- **Wide-scale communication.** The laboratory teams spent considerable time educating clinicians and others on the new guidelines and processes. “We educated whenever and wherever we could,” Haak said. “This included our daily leadership safety huddle, our unit safety huddle, our resident meetings, our medical executive committee, our medical staff department meetings, and our town halls. I can’t stress the importance of communication.”

“Providing education [to clinicians] at the time of order is more effective than memos, lectures, and other passive forms of communication that are often learned and forgotten,” Atkinson said.

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