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Concise Communication

Test stewardship, frequency and fidelity: Impact on reported hospital-onset *Clostridioides difficile*

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Abstract

We assessed the impact of an embedded electronic medical record decision-support matrix (Cerner software system) for the reduction of hospital-onset *Clostridioides difficile*. A critical review of 3,124 patients highlighted excessive testing frequency in an academic medical center and demonstrated the impact of decision support following a testing fidelity algorithm.

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Clostridioides difficile–positive test results are subject to mandatory reporting to the National Healthcare Safety Network (NHSN); specimens collected on or after day 4 of an inpatient stay are categorized as hospital-onset (HO) laboratory-identified (Lab ID) events.[1] This surveillance definition minimizes clinical evaluation resulting in overdiagnosis of *C. difficile* infections (CDI).[2] An estimated 4%–15% of hospitalized patients are colonized with *C. difficile*, which increases to ~50% for patients admitted from long-term care.[3] Overdiagnosis of CDI increases with more sensitive testing strategies, such as nucleic acid amplification testing (NAAT).[2]

Diagnostic test stewardship is defined as "coordinated systems or user-based interventions designed to promote evidence-based utilization of diagnostic tests, with the primary goals of improving value and care quality and safely reducing cost."[2] We assessed the impact of heightened *C. difficile* diagnostic test stewardship with a Cerner electronic medical record (EMR)–based decision support algorithm.

Methods

This retrospective study was conducted in an 865-bed academic medical center. EMR review for testing fidelity was conducted by the Hospital Infection Prevention Program by manually reviewing nursing and provider documentation in the Cerner software system (Cerner, Kansas City, MO). All stool specimens were laboratory tested utilizing NAAT. Testing fidelity was confirmed if tested patients had clinically significant diarrhea (watery diarrhea on days 1–3 or 3 or more loose stools within 24 hours on or after day 4), no laxative use within 24 hours, and confirmation of any additional symptoms or risk factors: a fever >38°C (100.4°F) and/or abdominal pain or tenderness within 48 hours, a white blood cell count >15,000/mm3 or <4,000/mm3 within 48 hours, antibiotic use or discharged from any healthcare facility within 30 days of testing. Otherwise, otherwise fidelity was denied. *Clostridioides difficile* polymerase chain reaction (PCR) tests completed between January and June of 2017 and 2018 were included in the study. To assist providers with appropriate ordering of *C. difficile* tests, a decision support matrix was embedded in the Cerner software on March 28, 2018. Beginning February 2018, service-line testing fidelity was reported monthly to hospital leadership for dissemination to providers. A z test was used to analyze test fidelity before and after the EMR-based intervention. Statistical analysis was completed using Epi-Tools (Sergeant, ESG, 2018. Ausvet Pty Ltd, http://epitools.ausvet.com.au).

Results

From January through June of 2017, a total of 1,797 tests were completed, and 247 of these were *C. difficile* PCR positive. Moreover, 150 positive patients did not meet testing criteria (61%); 123 of those patients were treated with CDI targeted antibiotics (82%). In January–June 2018, 1,327 tests were completed, and 224 of these were *C. difficile* PCR positive. In 2018, 79 positive patients (35%) did not meet testing criteria, and 72 (91%) of those patients were treated with CDI-targeted antibiotics.

In April–June 2017, 35% of the 874 tests performed met testing criteria. Comparatively, in April–June 2018, after EMR implementation, 51% of the 639 tests performed met testing criteria. Thus, there was a 27% reduction in total *C. difficile* testing and a statistically significant ($P < .0001$) improvement in test fidelity after the intervention (Table 1). A statistically significant reduction in the NSHN *C. difficile* HO event incidence rate was observed after the EMR intervention when comparing the 2017 and 2018 second quarters ($P < .0300$). With the decrease in HO event incidence, our standardized infection ratio (SIR) dropped below 1 for the first time since early 2014 (Table 1).

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Table 1. Demonstration of Test Reduction, Improved Testing Fidelity, Improved NHSN Rate and Improved NHSN SIR After Implementation of EMR-Based Decision Support in a Facility Utilizing PCR *C. difficile* Testing

Comparison Before and After Intervention April–June 2017–2018						
	Testing		Testing Fidelity		Rate per 10,000 Patient Days	SIR
Periodf	Total *C. difficile* Tests Completed, No.	*C. difficile* Tests/ Patient Days	Results Meeting Test Criteria, No.	% Compliant	Hopital Onset *C. difficile* NHSN Rate	Hospital Onset *C. difficile* NHSN SIR
Preintervention, April–June 2017	874	0.016	310	35	11.446	1.424
Postintervention, April–June 2018	639	0.012	324	51	7.209	0.952
Significance	27% reduction	25% reduction	*P* value <.0001		*P* value <.03	

Note. NHSN, National Healthcare Safety Network; SIR, standardized infection ratio; EMR, electronic medical record; PCR, polymerase chain reaction.

Discussion

We investigated the impact of increased diagnostic test stewardship on *C. difficile* testing at a university hospital. From 2014, numerous interventions aimed at enhanced infection prevention were implemented and monitored until performance at high fidelity was achieved. Nevertheless, *C. difficile* rates remained high; providers ordered an average of 300 tests per month, with many patients lacking signs or symptoms to indicate testing. Introducing a new *C. difficile* testing algorithm, a Cerner-based decision support system using interactive dialogue boxes, resulted in a significant reduction in test frequency, and statistically significant improvement in test fidelity. This intervention also impacted the incidence of reportable *C. difficile* events. Teaching hospitals may be at particular risk of overtesting and overdiagnosing *C. difficile* due to the wide adoption of NAAT testing and potentially excessive ordering practices of trainees. Other institutions have targeted this group in particular for education and incentives for testing stewardship, with promising outcomes.[4]

Our experience highlights the impact of testing volume as a driver of *C. difficile* rate. Test stewardship is distinct from "gaming" efforts because only tests that do not meet criteria are discouraged. Overdiagnosis of CDI has adverse effects on patient care similar to any false-positive result. Positive results require contact isolation and private room assignment, and employees are required to wear proper protective equipment. Retrospective chart review demonstrated that 195 *C. difficile*–positive patients who were treated with *C. difficile*–targeting antibiotics did not meeting testing criteria. Antibiotic therapy is not recommended for those colonized with *C. difficile*, and given the disruption of gut flora caused by therapy, it may predispose colonized patients to future CDI.[3,5] Providers must understand that patients with positive PCR results may not need treatment if they do not meet clinical criteria for infection. As a result, increased clinical understanding and test guidance is necessary to decrease unnecessary testing and treatment. Audit of service-line adherence to test fidelity and feedback to hospital leadership for dissemination to providers supports the goal of test stewardship and quality patient care in tandem with provider education.

The strengths of this study are the inclusion of negative and positive PCR results in the chart review and the granularity of data collected by manual chart review by the infection prevention team. A significant limitation of this study is that the results are confined to a single academic medical center over a short evaluation period. Although the improvement in test fidelity and decrease in testing volume seemingly decreased NHSN reported rates, such results must be interpreted with caution given short time of follow-up to date and concurrent infection prevention initiatives. Nevertheless, ongoing infection prevention efforts targeting *C. difficile* pre-date the EMR-based decision support and were maintained at high fidelity throughout the EMR implementation.

As more healthcare centers embrace test stewardship, there are concerns about missed or late diagnoses of *C. difficile*. No provider was denied the ability to perform a *C. difficile* test. We acknowledge that there may be circumstances that necessitate a *C. difficile* test despite lack of documented criteria. We further acknowledge that with an emphasis on thoughtful testing, it is possible that patients with true CDI were missed. Potentially, these cases may be diagnosed later with more severe disease. However, a review of all colon surgeries yielded zero colectomies for CDI during the study period. The potential benefits of *C. difficile* test stewardship must be assessed against the potential harms of under-diagnosis. More studies are needed to define optimal diagnostic strategies for *C. difficile*.

Test stewardship driven by EMR-based decision support decreased the frequency of *C. difficile* testing, improved test fidelity, and decreased the number of patients potentially overtreated with antibiotics for *C. difficile* colonization. Additional studies are needed to optimize *C. difficile* testing strategies and to minimize the potential harms of *C. difficile* underdiagnosis.

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