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Brief Report

Optimizing testing for *Clostridium difficile* infection: A quality improvement project

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Overtesting for *Clostridium difficile* may result in increased health care facility–onset *C difficile* infection LabID events. Our quality improvement project optimized testing through standardization of laboratory processes, electronic health record clinical decision support, and real-time monitoring. Our intervention resulted in a 59% reduction in health care facility–onset *C difficile* infection LabID events.

The diagnosis of *Clostridium difficile* infection (CDI) is established on the basis of clinical symptoms and laboratory results. The highly sensitive nucleic acid amplification tests used in many US hospitals to detect *C difficile* may yield false-positive results in patients without clinical symptoms.[1] Appropriate testing plays a key role in identifying true cases of CDI and supports antimicrobial stewardship through avoidance of unnecessary treatment.[2,3]

Preintervention, a nurse-driven *C difficile* testing protocol, had been in place since 2009. In 2014 (also preintervention), an electronic health record (EHR) alert was added to the testing protocol that prompted nurses to consider testing based on the criteria of ≥3 documented stools in a 24-hour period. In early 2016, we noted an increase in health care facility–onset (HO) CDI LabID events as defined by the National Healthcare Safety Network.[4] Our retrospective EHR review of HO CDI LabID events showed that *C difficile* testing was performed when there were alternative explanations for diarrhea, such as laxative use, and when specimens did not meet laboratory submission requirements. The purpose of this quality improvement (QI) project was to decrease HO CDI LabID events by optimizing the clinically indicated testing for *C difficile*. The Institute for Healthcare Improvement's Model for Improvement served as the project's framework.[5]

METHODS

The project setting was a 424-bed community hospital that had been using a *C difficile* nucleic acid amplification test (GeneXpert; Cepheid, Sunnyvale, CA) since 2009. The project team was led by an infection preventionist (IP) and included laboratory, information technology, and quality improvement professionals and an infectious disease physician. The intervention period began in May 2016 and consisted of 3 interventions based on findings from our EHR review: (1) standardization of laboratory processes, (2) EHR clinical decision support, and (3) real-time monitoring by the laboratory and IP to ensure that ordering and specimen criteria were met. Intervention education was delivered to nurses and clinicians (physicians, physician assistants, and nurse practitioners) in e-mails and face-to-face presentations and framed in the context of diagnostic stewardship.[1]

Standardized laboratory processes

The written procedure for stool specimen assessment and rejection criteria was revised to align with hospital policy and testing best practices.[6] Laboratorians were trained on the procedure before the intervention and received periodic updates via newsletters, one-on-one coaching, and staff huddles.

EHR clinical decision support

The nurse-driven *C difficile* testing protocol with EHR alert based on stool frequency was replaced with a clinician-initiated EHR order with clinical decision support. The new order promoted comprehensive

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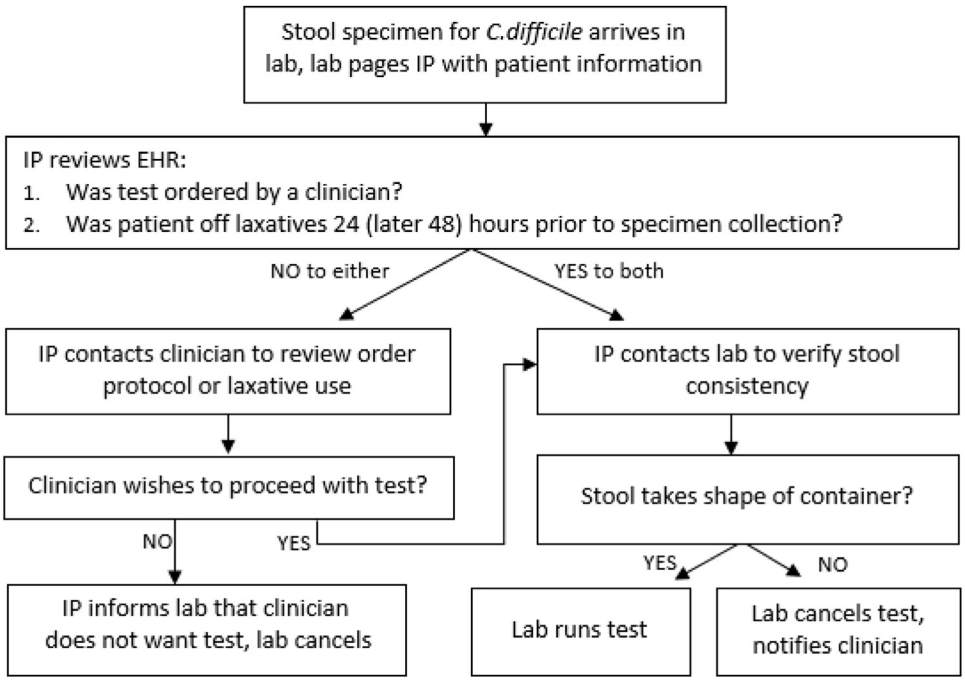

Fig 1. Process flow for laboratory and infection preventionist (IP) assessment of specimens submitted for *Clostridium difficile* testing. *EHR*, electronic health record.

clinical evaluation by prompting clinicians to complete the following yes/no questions:

- Has the patient had ≥3 loose/diarrheal stools in the past 24 hours?
- Has the patient received any laxatives in the past 24 hours?
- If on tube feedings, does the patient have abdominal pain, fever ≥38 °C, or elevated serum white blood cell count?

Clinicians could proceed with the EHR order regardless of question responses.

Laboratory and IP real-time monitoring

IPs and laboratorians partnered to ensure that all inpatient specimens submitted for *C difficile* testing met the following criteria: (1) the test was ordered by a clinician, (2) the patient was not receiving laxatives before testing, and (3) the stool specimen was unformed (Fig 1). IPs documented criteria assessments on a spreadsheet. A weekly data summary was shared with hospital senior leadership and used to identify process improvements and ensure intervention fidelity. Initially, this process was in place 7 days a week, from 8 AM to 10 PM, and applied to specimens collected on or after the day of inpatient admission. The intervention was progressively modified based on ongoing evaluation of results. Clinical decision support was enhanced by auto-populating the EHR *C difficile* order with the most recent white blood cell count and laxative administration (Fig 2).

Patients with HO CDI were monitored until discharge for adverse events, including delayed diagnosis, surgery, and death. Outcomes were evaluated using a 1-group time series design and analyzed using descriptive statistics and comparison to the Centers for

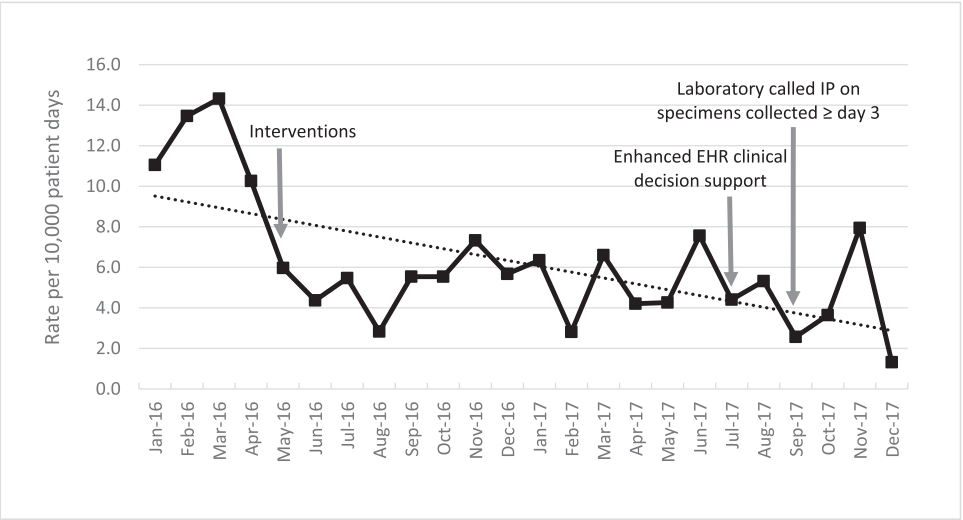

Fig. 2. Health care facility–onset *Clostridium difficile* infection LabID incidence. *EHR*, electronic health record; *IP*, infection preventionist.

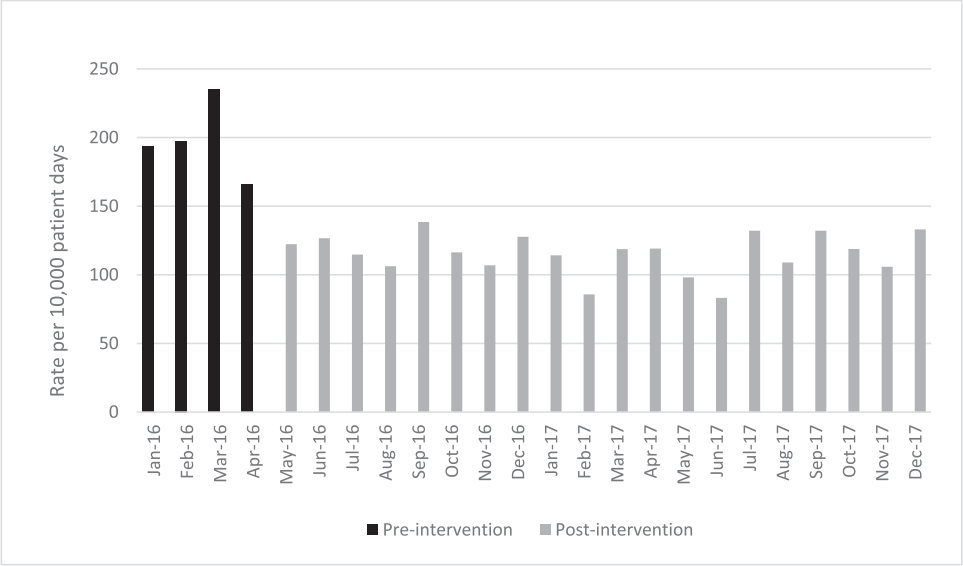

Fig. 3. Rate of *Clostridium difficile* testing per 10,000 patient-days preintervention and postintervention.

Medicare and Medicaid Services 2017 value-based purchasing threshold standardized infection ratio. This QI project did not require approval by the hospital institutional review board.

RESULTS

The baseline *C difficile* testing rate was reduced by 42%, from 198 tests per 10,000 patient-days preintervention to 115 tests per 10,000 patient-days postintervention (Fig 3). The average number of *C difficile* tests cancelled also decreased from 8.9 in May through December 2016 to 3.8 in 2017. HO CDI LabID event rates decreased by 59%, from 12.3 cases per 10,000 patient-days preintervention to 5.0 cases per 10,000 patient-days postintervention (Fig 2). The HO CDI LabID standardized infection ratio in 2016 was 1.017 and decreased to 0.699 below the Centers for Medicare and Medicaid Services threshold. Days of oral vancomycin therapy in hospitalized patients decreased by 27%, from 7.3 per 1,000 patient-days preintervention to 5.3 per 1,000 patient-days postintervention. No adverse events were noted during the intervention period.

DISCUSSION

Similar to Rock et al,[7] we identified inappropriate *C difficile* testing as a factor that contributed to increased HO CDI LabID events preintervention. In this QI project, we implemented 3 interventions to optimize testing for *C difficile* that align with the emerging concept of diagnostic stewardship and support antimicrobial stewardship.[1] During the intervention period, we observed decreased *C difficile* testing and decreased HO CDI LabID events, with no adverse patient impacts. Yen et al[8] similarly reported decreased CDI with the implementation of diagnostic stewardship interventions. We also observed decreased use of oral vancomycin, commonly used for CDI treatment, suggesting that optimizing testing also has a role in supporting antimicrobial stewardship.

This study has several limitations. Administrative support and interprofessional partnerships were crucial to the success of this project. Generalizability to a setting without these cultural elements would be limited. Other CDI prevention efforts, including an antimicrobial stewardship program and enhanced environmental disinfection, were under way at our facility and may have impacted HO CDI LabID event reduction. This project is ongoing, and because it is resource intensive for IPs, the long-term sustainability of real-time monitoring is a concern.

CONCLUSIONS

This QI project contributes to the growing body of evidence describing the importance of testing for *C difficile* when clinically indicated and strategies to optimize testing. Testing patients for *C difficile* when alternative explanations for diarrhea are present can yield false-positive results and lead to unnecessary antibiotic treatment, which potentially is harmful. In addition, because HO CDI LabID events are pay-for-performance indicators defined only by the hospital day of a positive test, false-positive results can carry financial consequences for hospitals. As the availability of highly sensitive testing technologies grows, clinicians, laboratorians, and IPs must collaboratively question the best way to test.

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