Reducing *Clostridioides difficile* Infections in a Medical Intensive Care Unit

A Multimodal Quality Improvement Initiative

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Background: Clostridioides difficile (C. diff) infection causes significant morbidity for hospitalized patients. A large medical intensive care unit had an increase in C. diff infection rates.

Objectives: The aim of this project was to reduce the C. diff polymerase chain reaction (PCR) test positivity rate and the rate of C. diff PCR tests ordered. Rates were compared between preintervention (July 2017 to December 2019) and postintervention (January 2021 to December 2022) timeframes.

Methods: Unit leadership led a robust quality improvement project, including use of quality improvement tools such as A3, Gemba walks, and plan-do-study-act cycles. Interventions were tailored to the barriers identified, including standardization of in-room supply carts; use of single-packaged oral care kits; new enteric precautions signage; education to staff, providers, and visitors; scripting for patients and visitors; and use of a C. diff testing algorithm. Statistical process control charts were used to assess for improvements.

Results: The average rate of C. diff PCR test positivity decreased from 34.9 PCR positive tests per 10 000 patient days to 12.3 in the postintervention period, a 66% reduction. The average rate of PCR tests ordered was 28 per 1000 patient days in the preintervention period; this decreased 44% to 15.7 in the postintervention period.

Discussion: We found clinically significant improvements in the rate of C. diff infection and PCR tests ordered as a result of implementing tailored interventions in a large medical intensive care unit. Other units should consider using robust quality improvement methods and tools to conduct similar initiatives to reduce patient harm and improve care and outcomes.

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Clostridioides difficile (*C. diff*) is a multidrug-resistant, spore-forming, toxin-producing bacteria that can cause serious, life-threatening antibiotic-associated colitis among hospitalized patients.[1] *C. diff* bacteria colonize the intestinal tract generally after the normal gut flora has been disrupted and are frequently associated with antibiotic therapy. Signs and symptoms of *C. diff* infection (CDI) can range from an asymptomatic carriage to fulminant colitis with toxic megacolon; clinical manifestations include diarrhea, abdominal pain and distension, fever, hypovolemia, and marked leukocytosis.[1] Risk factors for CDI include age greater than 65 years, recent antibiotic exposure, immunocompromised state, and prolonged hospitalization.[2] In 2017, there were approximately 223 900 cases of CDI in hospitalized patients.[2] *Clostridioides difficile* infection is one of the most common health care–associated infections and a significant cause of morbidity and mortality, especially among older adult hospitalized patients. As CDI increases patients' risk of mortality and is considered a preventable harm, health care–associated CDI is a serious safety event.[3] Additionally, CDI can increase length of stay and health care costs, and require patient isolation that can have an emotional and psychological impact to patients and their loved ones.[4]

Outside of antimicrobial stewardship efforts, the most effective way to prevent CDI is to interrupt transmission with horizontal prevention strategies such as hand hygiene, use of transmission-based precautions, and environmental cleaning.[5] *Clostridioides difficile* is a spore-forming bacteria that easily survives up to 5 months in the hospital environment.[6] Spores are shed by infected and asymptomatically colonized patients. Unlike other bacteria, *C. diff* spores are not killed by some commonly used disinfectants, and certain disinfectants (eg, bleach) must be used to inactivate spores. Additionally, alcohol-based hand rubs are not effective against spores, and hand hygiene with soap and water is required to mechanically remove spores from contaminated hands.[7]

In 2019, the medical intensive care unit (MICU) identified CDI as an area of opportunity for improvement due to an increase in the rate of *C. diff* positive tests. The purpose of this quality improvement (QI) project was to implement tailored interventions to improve patient care and outcomes. The specific aims were to reduce (1) the rate of *C. diff* polymerase chain reaction (PCR) positive tests and (2) the rate of *C. diff* PCR tests ordered by providers in a large MICU.

METHODS

This QI initiative was conducted in a large MICU in an academic health system in the southeastern United States. The unit cares for patients with a variety of conditions, such as acute respiratory failure, and other cardiac, renal, and neurological disorders, as well as infectious diseases such as COVID-19. The unit originally had 24 beds; this increased to 32 over the course of the project. The project was approved as an exempt QI initiative by the university's institutional review board.

Because of an increase in National Healthcare Safety Network hospital-onset CDI rates between July and December 2019 (46.9 CDI cases per 10 000 patient days), MICU leaders formed a multidisciplinary QI team including infection prevention specialists, environmental services, pharmacy, and the health system's quality management department. The team began by using A3 problem solving, a QI tool to help identify root causes and interventions.[8] The first step in using A3 problem solving is to identify the current condition and problem statement (eg, an increase in CDI cases). The team also conducted Gemba walks, a QI technique to observe and understand current conditions and practices.[9] The next step in the A3 is to analyze the process to help determine the root cause for the increase in CDI cases by using the "5 Whys" method.[10] The "5 Whys" includes having the multidisciplinary team ask "Why does this happen?" multiple times until the root cause is identified. For example, 1 identified barrier was that staff members do not consistently don and doff personal protective equipment when they enter and exit a room with a patient with CDI. Using the "5 Whys" method, the team identified a knowledge barrier and an opportunity for better signage outside the patient's room notifying staff of the patient being on enteric precautions isolation. The third step in the A3 process is to identify the target condition and determine solutions to prevent the root causes from reoccurring. Lastly, the team develops an action plan by determining next steps and the responsible person(s).

Interventions

Through the A3 and Gemba walks, the team identified several interventions. Plan-do-study-act cycles were conducted between January and March 2020. First, the team identified that the in-room supply carts were not stocked with the essential supplies needed, requiring staff to exit and reenter patient rooms multiple times to obtain supplies; this practice could contribute to inappropriate and unnecessary donning/doffing practices and increase the risk of spread and contamination of *C. diff* spores from staff's hands throughout the unit. Additionally, it was observed that staff were not always accessing the in-room supply carts with clean hands. To mitigate these risks, the team completed an organizational 5S process (sort, set in order, shine, standardize, sustain) to standardize the minimal amount of items necessary for in-room supply carts to help reduce potential contamination of supplies between patients. Labels were added to each supply cart drawer and section with what item(s) should be stored there. Each

supply cart was restocked according to the labels and piloted in 5 MICU patient rooms. Feedback was sought from nurses, and the drawers were updated as needed (eg, moving items that were frequently used to the top/front of the cart, adding or removing items in the cart). Observation audits were completed to ensure staff were using the supply carts appropriately and only accessing them with clean hands. The team implemented a process for regular cleaning of the supply carts to be done at least monthly.

Clostridioides difficile infection can be caused by ingestion of *C. diff* spores. One way hospitalized patients may inadvertently ingest *C. diff* spores is through spores landing on toothbrushes or oral swabs that are left open in the patient's room and then used for subsequent oral care. This potential risk was identified during the leadership Gemba walks. To prevent potential ingestion of *C. diff* spores, the MICU team began using single-packaged oral care kits rather than reusing oral care products that were placed near the patients' sink.

During the Gemba walks, leaders also noted that staff were not appropriately donning and doffing personal protective equipment required for patients with CDI (enteric precautions including gown and gloves) and/or were not washing their hands with soap and water (a requirement for patients on enteric precautions to mechanically remove spores from the hands). Additionally, some staff and visitors were unaware that a patient was on enteric precautions due to the location of the sign on the patient's door. As such, education and signage were developed to educate staff on the importance of and appropriate way to don personal protective equipment and complete hand hygiene with soap and water, including a QR code with further information. In addition to the enteric precautions isolation sign posted on the patient's door, an additional, smaller enteric precautions sign was placed over the hand sanitizers located outside of the room. This smaller sign served as a reminder to staff to perform hand hygiene with soap and water upon exiting the room. Also, as the sign was placed over the hand sanitizers just outside of the patient's room, it was a more visible reminder of the patient being on enteric precautions isolation.

Developing education and scripting for patient visitors was identified as another opportunity based on observations of variable visitor adherence to protocols. An escalation pathway was developed to leverage the entire care team when reinforcing the need for enteric precautions. Medical intensive care unit nursing staff developed a *C. diff* bulletin board to share learnings from the QI initiative. The multidisciplinary team also developed a shared equipment cleaning guide that specified the responsible person(s) to clean shared equipment, such as ergonomic equipment.

Lastly, education was given to the MICU physicians and advanced practice providers on appropriate *C. diff* testing stewardship through the use of an algorithm developed by the infection prevention team and informed by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Clinical Practice Guidelines.[11] Per the algorithm, providers were guided to only send *C. diff* PCR tests if the patient had a new episode of clinically significant diarrhea (3 unformed bowel movements or more than 600 mL of stool within the last 24 hours, or a new requirement for a rectal tube) that was not due to laxative use. The *C. diff* testing algorithm was given to providers and also available in the electronic health record within the *C. diff* PCR test order panel for easy accessibility.[12] Exceptions to using the algorithm could be made based on the provider's judgment and the patient's clinical symptoms.

Outcomes Analysis

To evaluate improvements from the QI initiative, the team measured *C. diff* PCR positive cases per 10 000 patient days. The number of *C. diff* tests ordered was used to measure provider ordering practices; this was measured as a rate per 1000 patient days to standardize the data, as the MICU increased their number of beds from 24 to 32 over several months in 2020 to 2021. Rates were compared between preintervention (July 2017 to December 2019) and postintervention (January 2021 to December 2022) timeframes.

Data were analyzed using standard QI methodologies with statistical process control charts.[13] The mean, upper control limits, and lower control limits were calculated for the preintervention data; these data lines were frozen and extended through the postintervention timeframe to identify special cause variation. The following rules were used to interpret statistical process control charts for special cause variation: (1) a single point outside the lower control limits, (2) a shift of 8 or more points in a row below the mean, or (3) a trend of 6 or more consecutive decreasing points. The occurrence of any one of the rules indicated special cause variation (eg, improvement).[13]

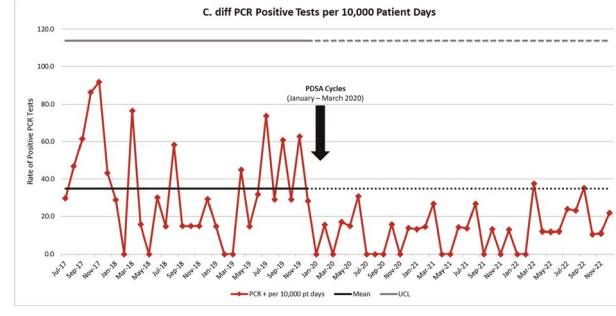

Figure 1. *C. diff* PCR positive tests per 10 000 patient days. Abbreviations: *C. diff*, *Clostridioides difficile*; PCR, polymerase chain reaction; PDSA, plan-do-study-act; UCL, upper control limits.

RESULTS

Preintervention, the average rate of *C. diff* positivity was 34.9 PCR positive tests per 10 000 patient days; this decreased 66% to an average of 12.3 in the postintervention period. Special cause variation was noted in the statistical process control chart, with 34 data points falling below the frozen mean in the postintervention period, known as a shift (Figure 1).

Preintervention, the average rate of PCR tests ordered by providers was 28 per 1000 patient days; this decreased 44% to 15.7 PCR tests ordered per 1000 patient days in the postintervention period. Special cause variation was noted, with 36 data points falling below the frozen mean in the postintervention period (shift). Additionally, 2 points were outside of the frozen and extended lower control limits (April 2020 and May 2021) (Figure 2).

DISCUSSION

We found clinically significant reductions in the rate of CDI cases and PCR tests ordered. These findings are comparable to others who also found a reduction in CDI cases when using QI methodologies and strategies.[14,15] Similar to our findings, Sperling and colleagues[16] found a reduction in the rate of *C. diff* tests ordered after implementing diagnostic stewardship interventions to optimize testing for CDI. Appropriate testing plays an important role in identifying true CDI cases and further supports antimicrobial stewardship efforts. Additionally, appropriate testing can reduce overall health care costs and the potential for unnecessary antibiotic usage.[17]

Using robust QI methods and tools that help identify interventions tailored to the local context can result in significant improvements in patient care. Indeed, Reynolds and Granger[18] noted that tailoring strategies to the local context and identified barriers can improve implementation of interventions. This project is unique in that, with strong leadership support, these seemingly simple interventions have led to sustained improvements in CDI and the quality of patient care. Future QI projects may work to quantify other impacts of CDI reduction, particularly the implications of reduced utilization of transmission-based precautions. Potential outcomes could include the number of disposable isolation gowns used, cost savings of saved supplies and workflow efficiency, and impact on care delivery and patient well-being.

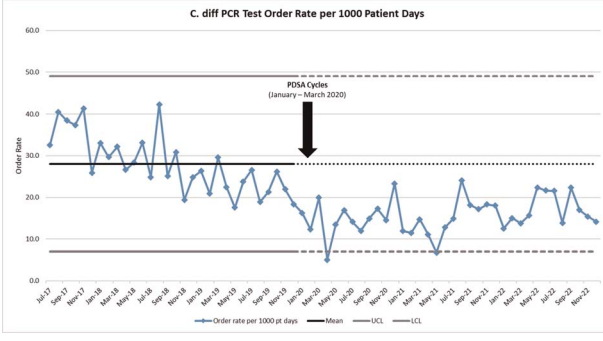

Figure 2. Rate of *C. diff* PCR tests ordered per 1000 patient days. Abbreviations: *C. diff*, *Clostridioides difficile*; LCL, lower control limits; PCR, polymerase chain reaction; PDSA, plan-do-study-act; UCL, upper control limits.

Limitations

This QI project has several limitations. First, it was conducted in only the MICU at 1 health system, which limits generalizability. We were aware of the changes made during the plan-do-study-act cycles; however, other interventions may have contributed to the decrease in CDI. Indeed, the MICU admitted the most COVID-19–positive patients after March 2020; as such, an increase in environmental cleaning due to the pandemic may have also contributed to the reduction in CDI.

CONCLUSIONS

This QI project found clinically significant reductions in the rate of *C. diff* test positivity and testing. Using robust QI methods and tools, such as the A3 process, Gemba walks, and plan-do-study-act cycles, with multimodal strategies tailored to the needs of a specific unit, can effectively and efficiently help reduce harm to patients.

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