worn. Moreover, during work rounds, the cuffs of physician's long-sleeved white coats frequently contacted patients or environmental surfaces.

Our study has some limitations. We studied the transmission of a DNA marker rather than a pathogen. However, in simulated examinations, dissemination of the DNA marker was analogous to dissemination of the live virus bacteriophage MS2 and nontoxigenic *C. difficile* spores.[4] We did not assess whether wearing uniforms with short sleeves reduces the risk for the transfer of pathogens in clinical settings. Thus, additional studies are needed in healthcare facilities.

In summary, our results provide support for the recommendation that healthcare personnel should wear short-sleeved uniforms to reduce the risk for pathogen transmission.[1–3] There is a need to test other approaches to reduce the potential for transfer from the cuffs of long-sleeved coats. For example, some studies suggest that antimicrobial-impregnated clothing might reduce microbial contamination of uniforms.[10] Simple approaches such as rolling up the sleeves of white coats when examining patients might also be effective.

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A Successful Strategy to Decrease Hospital-Onset *Clostridium difficile*

Cambridge Health Alliance adopted polymerase chain reaction testing (PCR; Cepheid, Sunnyvale CA) for *Clostridium difficile* (CD) in 2011. Like many facilities, we realized an increase in our CD rate soon thereafter. This increase occurred despite excellent hand hygiene, private room with contact precautions, daily bleach disinfection of high-touch surfaces, ultraviolet disinfection after terminal clean, and an antimicrobial stewardship program.

In 2013, the National Healthcare Safety Network (NHSN) implemented surveillance for CD based on a positive laboratory test (Lab ID),[1] a proxy measure for infection. Providers had been educated that a clinical diagnosis of CD should be based on symptoms and that indiscriminate use of PCR for diarrhea from any cause could inflate our rate because PCR cannot differentiate colonization from infection. Providers were encouraged to only test patients with clinically significant diarrhea (>2 episodes in 24 hours).

In 2015, related to an incentive program, our organization sought to drive our CD standardized infection ratio (SIR) to <1.

METHODS

A multidisciplinary team implemented a performance improvement project. To optimally identify patients with

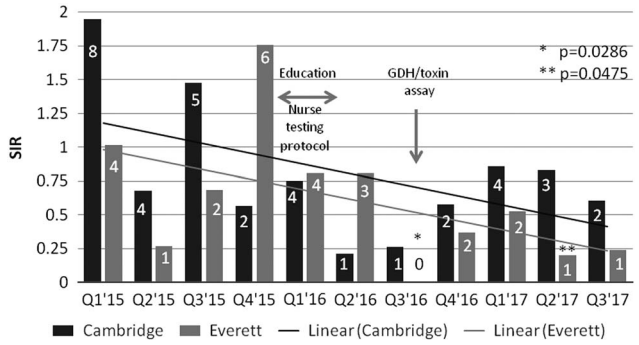

FIGURE 1. Quarterly standardized infection ratio (SIR) for *Clostridium difficile* at Cambridge and Everett Hospitals before and after the implementation of the nurse testing protocol with polymerase chain reaction (PCR) testing during hospital days 1–3 and a combined glutamate dehydrogenase and toxin assay after hospital day 3. The number of hospital-onset cases is depicted in the bar graph.

community-onset (CO) CD (positive Lab ID on hospital day [HD] 1–3), an automated nurse testing protocol (NTP) was implemented in Epic healthcare software (Verona, WI), triggered by documentation of diarrhea in the flowsheet during HD 1–3, to facilitate prompt stool collection, initiation of contact precautions, and PCR testing. The NTP was approved by the Medical Executive Committee on January 12, 2016, and was fully implemented at 2 community teaching hospitals by mid-February. Nurse and provider education emphasized that patients with a positive PCR test may not require therapy because PCR detects whether the organism possesses the gene for toxin production but not whether toxin is present. If there was recent antibiotic exposure or previous infection, combined with fever, severe diarrhea, and/or leukocytosis, treatment was advised. If the clinical picture was not severe, review for another reversible cause of diarrhea (eg, medication, diet, laxatives, etc) was encouraged with continued observation. A combined glutamate dehydrogenase (GDH) antigen and toxins A and B assay (Alere, Waltham, MA) was implemented on July 27, 2016, for testing patients after HD 3 because this test is more specific for disease; indeterminate results reflexed to PCR by lab protocol. Our lab limited testing to stool taking the shape of the container and to no more than 1 test per patient weekly.

RESULTS

In the first quarter of implementation, both hospitals observed fewer hospital-onset (HO) CD cases than expected (risk stratified by bed size, hospital affiliation, number of CO-CD cases, and lab test used).[2] The improvement has been sustained and enhanced by subsequently adopting the GDH/toxin assay for HO-CD (Figure 1). In 2016, the SIR was <1 at both hospitals and at Cambridge, the SIR of 0.46 was statistically significant ($P = .01$). Considering the overall burden of CD, our organization demonstrated that the overwhelming majority of cases fulfilled the CO-CD surveillance definition (see Supplementary Materials).

DISCUSSION

A delay in CD testing will inflate the SIR.[3] Establishing whether a patient has clinically significant diarrhea inherently delays testing. If documentation or communication regarding episodes of diarrhea or the consistency of stool is less than optimal, an order and specimen collection will be delayed. Others have noted a tendency for providers to not consider CD and thereby fail to order the test.[4] Staff are often unaware of reporting requirements, pay-for-performance incentives, and nuances of surveillance definitions. For example, patients admitted at 11:59 PM (HD 1) must have stool collected before 11:59 PM on HD 3, which requires that an order and specimen be collected within a 48-hour window for a positive test to fulfill the CO-CD definition. Less reliance on "clinically significant" diarrhea, as demonstrated in England,[4] and prompt collection of the first diarrheal specimen by empowering the bedside nurse to order and collect the stool at the time of initial documentation in Epic were instrumental to our success. After HD 3, orders for CD were no longer processed by the NTP. Providers were required to enter the order, which defaulted to the GDH/toxin assay. This test was adopted based on performance characteristics: 99.4% specificity and a predictive negative value of 98.1% compared to tissue culture assay.[5] Because CD colonization increases with the duration of hospitalization,[6] it is advantageous to use a specific test for diagnosis, treatment, and reporting purposes. Although some patients meeting the CO-CD definition may not have had CD infection, CD colonization increases the risk for subsequent disease.[7] This information is useful to the clinician because it could impact subsequent therapy, and it is beneficial to the organization because these patients will not be eligible to meet the HO-CD definition, thereby decreasing a hospital's vulnerability to a proxy measure for disease. As more pay-for-performance metrics are introduced for CD, adopting this strategy may be beneficial to other organizations. Additionally, improved detection of CO-CD will increase the predicted number of HO cases in the current risk-adjustment model.[2]

The limitations of our findings include a quasi-experimental design and implementation at a single organization, although 2 hospitals participated and benefited. We were able to demonstrate a further decline in HO-CD at Everett after adopting the GDH/toxin assay, perhaps related to a higher proportion of patients from skilled-nursing facilities who may have a higher prevalence of CD colonization.[4] The combined strategy of testing earlier and smarter has merit. Our project also demonstrates that empowering nurses can be instrumental in reducing HO-CD.

SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2017.289

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