Clostridium difficile colitis: A retrospective study of incidence and severity before and after institution of an alcohol-based hand rub policy

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Background: *Clostridium difficile*-associated diarrhea is a leading cause of hospital-acquired diarrhea. We sought to determine whether the institution of a hospital-wide alcohol-based hand rub (ABHR) policy was associated with an increase in the incidence and/or severity of health care facility-onset, health care facility-associated *C difficile* diarrhea (CDAD).
Methods: We used a retrospective chart review analysis to compare incidence rates of CDAD before and after implementation of the ABHR policy. We also compared rates of sepsis, colectomy, and death in patients with CDAD before and after implementation of the ABHR policy.
Results: The incidence rate of CDAD was 3.98 per 10,000 patient-days after implementation of the ABHR policy, compared with 4.96 per 10,000 patient-days before implementation ($P = .0036$). The crude mortality rate in patients diagnosed with CDAD was 10.7% after implementation, compared with 13.3% before implementation ($P = .275$). The rate of sepsis in patients diagnosed with CDAD was 19.6% after implementation, compared with 5.2% before implementation ($P < .0001$).
Conclusion: Our data provide no evidence of an increased CDAD rate after implementation of an ABHR policy at our institution. The rate of sepsis in patients diagnosed with CDAD did rise, indicating increased severity of illness in patients with *C difficile* infection.
Key Words: *Clostridium difficile*; alcohol-based hand hygiene; *Clostridium difficile*-associated diarrhea.

Clostridium difficile-associated diarrhea (CDAD) is the most common cause of hospital-acquired diarrhea.[1] Patients who develop *C difficile* infection have 50% higher total hospital costs compared with those who do not.[2] During the last decade, there has been a recognized increase in *C difficile* infection rate and severity, along with a decreased response to standard therapy.[3] This trend underscores the importance of further research into the proper prevention and treatment of this disease.

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Conflicts of interest: None to report.

0196-6553/$36.00

doi:10.1016/j.ajic.2009.12.008

The increasing severity of CDAD is likely due to a new hypervirulent strain of *C difficile*. To investigate epidemics in Quebec and several US sites, associated strains of *C difficile* were analyzed and compared with historic isolates obtained before 2001. The majority of these outbreaks are associated with the BI/NAP1 strain, which produces more toxin and is resistant in vitro to fluoroquinolones.[4,5] In addition to a new strain of *C difficile*, prevailing practices of antimicrobial agent use also may play a role in the increased rate and/or severity of infection. Whereas clindamycin exposure is a well-established risk factor for *C difficile* infection, other antibiotics have been shown to impact infection rates as well. For example, third-generation cephalosporins and, more recently, fluoroquinolones have been associated with higher rates of *C difficile* infection.[6,7]

Markers of increasing severity of *C difficile* infection include increases in the rates of treatment failure, morbidity, and mortality. Metronidazole and vancomycin are the main treatment options for CDAD. A review of treatment strategies from 1980 to 2005 found failure rates of 13% for metronidazole and 4% for vancomycin.[8] Excess mortality associated with *C difficile* infection has been documented in 3 large-scale studies performed in 2003 and 2004. A study conducted in

Quebec measured mortality attributable to *C difficile* infection.[3] At 30 days after diagnosis, 23% of the patients with *C difficile* infection had died; at 12 months after diagnosis, 37.3% had died. The cumulative attributable mortality in that study was 16.7%.[3] Surveillance data from 12 hospitals in Canada showed a 30-day attributable mortality rate of 6.9%.[9] Analysis of patients at a Missouri hospital demonstrated an attributable mortality of 5.7% at 180 days.[10]

Given the increasing rate of treatment failure, effective prevention is imperative. Alcohol-based hand rub (ABHR) policies have been widely adopted by health care facilities to improve hand hygiene compliance. However, ABHRs do not effectively eradicate spores of *C difficile*, and it has been suggested that this type of policy actually may increase the incidence of *C difficile* infection.[11,12] Few studies to date have compared the incidence of *C difficile* infection after implementation of an ABHR policy. One study demonstrated a decrease in infection rate after implementation, whereas a second study showed an increase in infection rate after implementation.[12,13] In neither study was the result statistically significant, however. A third study found no correlation between ABHRs and infection.[14] The literature provides no conclusive evidence to guide the use of ABHR policies with regard to *C difficile* infection.

In January 2003, an ABHR policy was approved by our institution's Infection Control Committee in an effort to improve hand hygiene compliance. Education regarding the policy and installation of the ABHR dispensers on all nursing units was completed by the end of April 2003. The goal of the present study was to evaluate the incidence rates of CDAD along with markers of severity before and after institution of this policy. Given the possibility of a confounding effect of changing patterns of antibiotic usage, we also examined the total doses of common antibiotics administered over the majority of this time period.

METHODS

This study was a retrospective chart review analysis conducted at a 795-bed community teaching hospital. Adult (age ≥18 years) patients with in-patient status at our institution between January 1, 2001, and June 30, 2008, were included. In our study, CDAD was defined as health care facility-onset, health care facility-associated diarrhea with a positive assay for *C difficile* toxin A, toxin B, or both. Throughout the study period, *C difficile* assays were performed using an enzyme immunoassay (Wampole, TechLab, Blacksburg, VA) for the detection of toxins A and B. All in-patients with a diagnosis of CDAD were identified by ICD-9 code from our medical records database or by positive *C difficile* toxin assay from our microbiology laboratory database. We verified that each in-patient from the medical records database list had a positive stool assay in the microbiology laboratory database; otherwise, the patient was excluded from the study. In-patients identified in the microbiology laboratory database who met the CDAD definition and who were not identified in the medical records database were added to the master list. In accordance with the definition of health care facility-onset, health care facility-associated infection, we verified that the first positive toxin assay was obtained on or after the third day after hospital admission.[15] If a positive assay was detected within 3 days of admission, then we investigated whether the patient had been admitted to our hospital within the last 2 months. A patient with a previous admission within that time frame was included in the study; otherwise, he or she was excluded.

After obtaining a master list of all in-patients diagnosed with CDAD, we determined whether each patient also carried a diagnosis of sepsis (by International Classification of Diseases, 9th revision [ICD-9] code), had undergone colectomy (by Current Procedure Terminology [CPT] code), or had a discharge status code indicating death. These codes were used as surrogate markers for severity of disease. Five ICD-9 codes for systemic inflammatory response syndrome were added in 2003. All other ICD-9 codes, CPT codes, and discharge status codes remained unchanged during the study period, as did practices for assigning these codes by our Medical Records Department. No physician education program was in place to guide the documentation of these diagnoses. Only the occurrence of sepsis, colectomy, or death in patients diagnosed with CDAD infection was recorded; whether any of these was directly attributable to the CDAD infection was not investigated further.

Full implementation of the ABHR policy at our institution was completed by May 1, 2003. For our study period, the total number of patients diagnosed with CDAD was determined before and after this date. The total number of colectomy and sepsis diagnoses, as well as the total number of deaths, were calculated for these patients.

A list of total admissions, discharges, and patient-days during the study period was obtained from our billing records database. This information was used to calculate total patient-days.

Hand hygiene, including appropriate use of ABHR and soap and water, was monitored after ABHR implementation. Before implementation, only a 2% chlorhexidine-based soap product was available in the hospital. At the time of implementation, all existing antimicrobial products were removed and replaced with the alcohol-based hand foam. The only soap product available was a lotion soap with no antimicrobial activity. Education regarding the new program instructed