Brief Report

On the hands of patients with *Clostridium difficile*: A study of spore prevalence and the effect of hand hygiene on *C difficile* removal

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Key Words:
*Clostridium difficile*  
Hand hygiene  
Infection prevention  
Health care–associated infection

The prevalence of *Clostridium difficile* spores was assessed in 48 observations of infected inpatients. Participants were randomized to hand hygiene with either alcohol-based handrub or soap and water. *C difficile* was recovered in 14.6% of pre-hand hygiene observations. It was still present on 5 of these 7 participants after hand hygiene (3/3 using alcohol-based handrub; 2/4 using soap and water).

Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc.

BACKGROUND

*Clostridium difficile* accounts for 12.1% of health care–associated infections, resulting in nearly 500,000 cases and 15,000 deaths in the United States each year.1–3 Patient hand hygiene is underused in infection control campaigns; however, patients themselves play a key role in the transmission of infection.4 Patients are less likely to perform proper hand hygiene in a hospital than at home because of limited mobility and the institution’s perceived cleanliness.4

Alcohol-based handrubs (ABHRs) are ineffective against *C difficile* spores, and soap and water is a key component of hand hygiene interventions during *C difficile* infection (CDI) outbreaks.5 However, there is little literature addressing hand contamination and the role of ABHR in the disinfection of the hands of CDI patients. We conducted a study to assess the baseline prevalence of *C difficile* on CDI patients’ hands and to compare the effectiveness of ABHR versus soap and water at eliminating *C difficile* when present.

MATERIALS AND METHODS

This study was conducted from October 2015-February 2016 at a 505-bed academic hospital where multiple CDI-targeted prevention efforts were in place. These included enhanced personal protective equipment, isolation for the duration of hospitalization, and institution-wide surveillance. The study was considered quality improvement and was exempt from institutional review board review.

Inpatient children and adults diagnosed with active CDI were recruited into the study by convenience sampling. CDI status was defined by a positive *C difficile* polymerase chain reaction test in patients with symptomatic diarrhea. Because patients started antibiotic treatment on CDI diagnosis and often enrolled several days after diagnosis, participants were not required to have active diarrhea at enrollment. Patients <8 years of age and those in the psychiatry unit were excluded. All participants provided consent before participating, with the exception of cognitively impaired patients, for whom verbal consent was provided by a family member.

All participants were randomized to ABHR or soap and water hand hygiene by an online randomization tool (Research Randomizer Version 4.0, https://www.randomizer.org/). Two rounds of microbial testing were conducted, with hand hygiene taking place between tests. In ABHR, a 62% ethanol rub was applied to participants’ hands for 30 seconds. For soap and water, mobile participants washed their hands up to the wrist in the sink for 30 seconds, using approximately 2 mL of chlorhexidine antimicrobial soap. Cognitively impaired and limited mobility participants were assisted by a researcher using a bedside basin and pitcher of water. All participants’
hands were dried with clean paper towels. A second microbial testing procedure was conducted immediately after the participant’s hands dried. To prevent cross-contamination and promote patient safety, the research assistant performed hand hygiene with ABHR and donned a gown and gloves before entering all participant rooms. The presence of *C. difficile* spores was measured using a modified version of the glove juice protocol. A total of 50 mL of sampling solution (1 × phosphate-buffered saline, 7 g/L lecithin, and 6 g/L sodium thiosulfate) was used. After sample collection, one aliquot of sampling solution was incorporated in *C. difficile* Brucella broth, and another was plated on *C. difficile* Brucella agar (CDBA). Both were incubated anaerobically for 48 hours at 35°C. Broth that turned from pink to yellow was streaked for isolation on a CDBA plate. Gram stain and catalase tests were run for subsequent isolates grown on CDBA, followed by standard polymerase chain reaction on all presumptively positive isolates for species confirmation.

**RESULTS**

Forty-four unique patients participated in the study for a total of 48 observations (Table 1). The 4 patients who participated twice were identified during separate hospital admissions. Pre-hand hygiene cultures recovered *C. difficile* in 7 observations (14.6%). Among these participants, *C. difficile* was subsequently recovered after hand hygiene on all 3 performing ABHR (100%) and 2 washing with soap and water (50%, *P* = .182). Although not statistically significant, the 5 participants on which *C. difficile* was recovered were more likely than those who cleared *C. difficile* to have limited mobility (80% vs 20%, respectively) and be treated with vancomycin (80% vs 0%, respectively). There was no notable difference between these groups regarding altered mental status.

*C. difficile* was also recovered after hand hygiene on the hands of 3 participants previously negative for *C. difficile* hand flora at baseline (2/21 using ABHR [9.5%] and 1/20 using soap and water [5.0%]; *P* = .587) (Fig 1). One of the 3 participants had limited mobility, 1 had both limited mobility and altered mental status, and 1 had neither.

All 4 participants providing 2 observations were randomized once to ABHR and once to soap and water (8 observations total). In 7 of these observations, participants were negative for *C. difficile* spores pre- and post-hand hygiene. In the eighth, the participant was positive for *C. difficile* both before and after cleaning with soap and water.

**DISCUSSION**

In our study of 48 CDI observations, 14.6% had *C. difficile* spores on the hand prior to hand hygiene. This result is half the prevalence reported in a prior study assessing hand hygiene effectiveness in *C. difficile* patients. This previous study found that 32.1% of CDI patients and 37.5% of asymptomatic carriers had *C. difficile* on the hand at baseline. Possible reasons for these disparate results include variation in the degree and severity of CDI. Time on effective CDI treatment and type of treatment may also impact shedding of CDI. Future studies are necessary to evaluate the reasons for variation in recovery of CDI from the hands of CDI patients.

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All observations (N = 48)</th>
<th>ABHR (n = 24)</th>
<th>Soap and water (n = 24)</th>
<th><em>P</em> value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, female</td>
<td>16 (33.3)</td>
<td>7 (29.2)</td>
<td>9 (37.5)</td>
<td>.76</td>
</tr>
<tr>
<td>Mean age, y (IQR)</td>
<td>56.7 (49.5-68.0)</td>
<td>58.4 (53.5-68.3)</td>
<td>54.9 (48.0-66.5)</td>
<td>.45</td>
</tr>
<tr>
<td>Mean BMI (IQR)</td>
<td>26.9 (21.1-29.6)</td>
<td>26.4 (20.3-28.5)</td>
<td>27.4 (22.6-34.0)</td>
<td>.69</td>
</tr>
<tr>
<td>Altered mental status*</td>
<td>17 (36.2)</td>
<td>10 (41.7)</td>
<td>7 (30.4)</td>
<td>.62</td>
</tr>
<tr>
<td>Limited mobility*</td>
<td>25 (53.2)</td>
<td>15 (62.5)</td>
<td>10 (43.5)</td>
<td>.31</td>
</tr>
<tr>
<td>Primary <em>Clostridium difficile</em> antibiotic treatment at time of enrollment</td>
<td></td>
<td></td>
<td></td>
<td>.69</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>39 (84.8)</td>
<td>21 (87.5)</td>
<td>18 (81.8)</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>7 (15.2)</td>
<td>3 (12.5)</td>
<td>4 (18.1)</td>
<td></td>
</tr>
<tr>
<td>Mean time between laboratory confirmed <em>C. difficile</em> infection and study enrollment, d (IQR)</td>
<td>5.5 (2.0-7.0)</td>
<td>6.1 (2.0-7.5)</td>
<td>4.8 (2.0-7.0)</td>
<td>.41</td>
</tr>
</tbody>
</table>

NOTE. Data are number of observations (%), unless otherwise indicated. Four participants were tested on 2 distinct admissions, totaling 8 observations.

ABHR, alcohol-based handrub; BMI, body mass index; IQR, interquartile range.

*Ascertained from patient chart review.

Fig 1. *Clostridium difficile* growth based on the hand hygiene method. Four participants were tested on 2 distinct admissions, totaling 8 observations. HH, hand hygiene.
Given the unanticipated low rate of *C difficile* recovery at baseline, our assessment of the comparative efficacy of soap and water and ABHR is limited by the small sample size. Subjects’ typical hand hygiene, even with soap and water, did not always remove *C difficile*. With numerous known impediments to proper patient handwashing in the hospital setting, including invasive medical devices, immobility, and limited access to sinks, portable hand hygiene products that are effective against spore-forming organisms such as *C difficile* are urgently needed.

**CONCLUSIONS**

This study highlights the need for future work to rigorously assess effective hand hygiene methods for *C difficile*.

**References**