A qualitative, interprofessional analysis of barriers to and facilitators of implementation of the Department of Veterans Affairs’ *Clostridium difficile* prevention bundle using a human factors engineering approach

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**Key Words:** *Clostridium difficile* infection prevention, human factors engineering, focus groups, bundle

**Background:** *Clostridium difficile* infection (CDI) is increasingly prevalent, severe, and costly. Adherence to infection prevention practices remains suboptimal. More effective strategies to implement guidelines and evidence are needed.

**Methods:** Interprofessional focus groups consisting of physicians, resident physicians, nurses, and health technicians were conducted for a quality improvement project evaluating adherence to the Department of Veterans Affairs’ (VA) nationally mandated *C difficile* prevention bundle. Qualitative analysis with a visual matrix display identified barrier and facilitator themes guided by the Systems Engineering Initiative for Patient Safety model, a human factors engineering approach.

**Results:** Several themes, encompassing both barriers and facilitators to bundle adherence, emerged. Rapid turnaround time of *C difficile* polymerase chain reaction testing was a facilitator of timely diagnosis. Too few, poorly located, and cluttered sinks were barriers to appropriate hand hygiene. Patient care workload and the time-consuming process of contact isolation precautions were also barriers to adherence. Multiple work system components serve as barriers to and facilitators of adherence to the VA CDI prevention bundle among an interprofessional group of health care workers. Organizational factors appear to significantly influence bundle adherence.

**Conclusion:** Interprofessional perspectives are needed to identify barriers to and facilitators of bundle implementation, which is a necessary first step to address adherence to bundled infection prevention practices.

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*Clostridium difficile* infection (CDI) is an increasingly prevalent, severe, and costly health care–associated infection worldwide. Recent surveillance data indicate *C difficile* is responsible for nearly 500,000 infections and 29,000 deaths per year in the United States. The economic burden of CDI in the United States is significant and likely exceeds $3 billion per year. Although effective infection control practices are crucial for preventing *C difficile* transmission, health care worker (HCW) adherence remains suboptimal. Many health care institutions have created bundled infection control interventions to prevent CDI. However, these bundles can be difficult and complex to implement, even in the context of highly integrated health care systems. Lack of HCW adherence to infection prevention processes is a complex issue. Previous research using focus groups suggests clinical guideline ambiguity (ie, uncertainty or vagueness in guidelines that prevents a system from achieving its purpose) is a prominent
theme when attempting to implement evidence-based practices to reduce health care–associated infections. Given this gap between knowledge and implementation, effective strategies for translating evidence and guidelines into effective practice are needed.

The Systems Engineering Initiative for Patient Safety (SEIPS) model represents an innovative human factors engineering approach to patient safety. The SEIPS model has been applied extensively in the health care field, including in infection prevention. At the core of the SEIPS model is the work system that encompasses multiple interacting components: a person, tasks, tools and technologies, the physical environment, and organizational conditions (Fig 1). These 5 components are interrelated and influence care processes, such as implementation of a CDI bundle in health care settings. The Department of Veterans Affairs (VA) mandated implementation of a national CDI bundle at every VA hospital in early 2012, and implementation of such CDI bundles likely reduces CDI rates.

Guided by the SEIPS model, we conducted focus groups to perform a quality improvement, work system analysis of the VA’s nationally mandated CDI prevention bundle relevant to health care providers’ adherence to the CDI bundle (testing and diagnosis, hand hygiene, and contact isolation precautions [CIP]). Antimicrobial stewardship is addressed under a separate VA initiative and not a component of this bundle.

METHODS

Design

In this qualitative, descriptive project, 4 focus groups were convened over a 5-month period to identify work system barriers and facilitators to implementation of the VA CDI bundle. In contrast with individual interviews, focus groups promote conversations about a range of perceptions and experiences, and provide opportunities for group members to refine their comments based on feedback from others. In accordance with our institution’s institutional review board exemption policy and self-certification tool, this project did not constitute research as defined under 45 CFR 46.102(d).

Therefore, this quality improvement project was exempt from institutional review board review.

Setting and participants

The convenience sample consisted of attending hospitalist physicians, internal medicine resident physicians, and registered nurses (RNs) and health technicians (HTs) employed at our VA hospital, an 87-bed facility. Eligibility criteria included the following: regular contact with inpatients on the general medicine units and ability to understand English. E-mails were sent to all attending physicians, resident physicians, and RNs and HTs working on the general inpatient medical units to briefly introduce the project and invite participation.

Procedure

Four focus groups were conducted—1 with attending physicians, 1 with resident physicians, and 2 with RNs and HTs—between July and November 2013. The focus groups with attending physicians and resident physicians occurred during regular conference times. The RN and HT groups occurred outside their scheduled work hours; therefore, RNs and HTs received an hour of compensation time for their participation. No other compensation was provided, but light refreshments or lunch was provided. The attending physician group had 7 participants, the resident physician group had 8 participants, and the RN and HT groups had 7 participants total.

The group facilitator (E.Y.) reviewed ground rules for confidentiality of the discussion and again reviewed the group’s purpose—to identify barriers to and facilitators of use of the VA nationally mandated CDI prevention bundle. All groups were audio recorded with a digital recorder. The facilitator posed a series of open-ended questions (Appendices 1 and 2), guided by the SEIPS work system components and general literature on guideline implementation, and followed with probes to elicit elaboration. Another author (N.S.) recorded field notes during the groups to document nonverbal behaviors and track the flow of communication. Duration of the focus
groups averaged 45 minutes. Of note, the group facilitator (E.Y.) and other author (N.S.) did not have any direct, supervisory responsibilities for the participants, therefore avoiding any potential source of bias that could have influenced responses.

Qualitative analysis

Digital recordings of focus groups were transcribed verbatim by a professional transcription service, after any identifying information was removed. The first author listened to the audio recordings while reviewing the transcripts to confirm accuracy of transcription. Final transcript versions were uploaded to NVivo 8 (QSR International, Melbourne, Australia) to facilitate data organization.

A template organizing approach15 organized data in a priori categories corresponding to the interview questions derived from the 5 SEIPS work system components: person, organization, tools, tasks, and environment. Two investigators (E.Y. and H.M.) began open line-by-line coding of transcripts using in vivo terminology (actual words) to classify text units within each work system component, using a visual matrix display.16 This was followed by data reduction to group key text units into subthemes based on their similarity and fit with the 5 predetermined categories.17,18 Our coding process (Table 1) maximized the trustworthiness and efficiency of coding.

Trustworthiness and rigor

Criteria for rigor in qualitative research—credibility, dependability, and confirmability—were followed to insure trustworthiness of the data.19-23 Credibility (confidence in truth of the findings) was enhanced through the use of focus groups with different health professionals; multiple perspectives from these groups revealed a more complete picture of factors contributing to implementation of the CDI bundle. A member check also established credibility; the first author reviewed findings with 2 participants in each group, and all 8 persons confirmed that the preliminary findings and salient points accurately captured their ideas. Dependability of findings (consistency of findings) was enhanced through the use of 2 coders for analyses. One coder had minimal clinical expertise in infection control and no involvement with development of the interview tool or actual data collection; this added to dependability of data because it limited the potential for the coder's prior experience to influence the analysis. To support confirmability of the data, the 2 coders created an audit trail by recording theoretical and operational memos, thereby documenting the decisions they made throughout the analytic process.

Table 1

Protocol for coding

| 1. | Development of a matrix display for each of the 5 work system factors by group (attending physicians, resident physicians, and RNs and HTs). |
| 2. | Independent reading of each group transcript to achieve a deeper understanding of the whole gestalt. |
| 3. | Review and discussion of operational definitions and descriptions of the 5 work system factors in select articles by model developer and studies using the model. |
| 4. | Independent coding of 1 focus group, followed by comparison to evaluate consistency in coding text units under work system factors in the matrix. |
| 5. | Refinement of agreement around operational definitions for each work system factor to increase consistency in coding; addition of other interesting findings category to the matrix. |
| 6. | Independent coding of first focus group again by 2 coders with follow-up comparison to evaluate consistency. |
| 7. | After consistency in coding is achieved, independent coding of 3 other focus groups by 2 coders, who will memo and annotate liberally. |
| 8. | Follow-up comparisons to assess consistency between coders in coding text units in 3 other focus groups. |
| 9. | Review of matrix data display for all focus groups; text units under each work system factor will be condensed into distinct themes by each coder. |
| 10. | Discussion of themes under each work system factor to reach agreement between coders; agreed upon themes were then categorized as either barriers or facilitators to implementation of CDI bundle. |
| 11. | Examination of similarities and differences of themes within each group (attending physicians, resident physicians, and RNs and HTs) and among groups. |

NOTE: Through discussion among 3 research team members, we developed a protocol for coding the focus group transcripts that was followed by the 2 coders (2 coinvestigators).

CDI, Clostridium difficile infection; HT, health technician; RN, registered nurse.

FINDINGS

Attending physician findings

Testing and diagnosis

Attending physicians identified many organizational features that facilitate CDI testing and diagnosis: more frequent testing; empirical contact isolation precautions (CIP) when C difficile testing is ordered; and near universal testing of symptomatic, newly admitted patients (Table 2). One attending physician highlighted an institutional culture that assumes new diarrhea represents C difficile until proven otherwise: “Well, honestly, I think that at the moment they have diarrhea, they have C. diff.” In addition, attending physicians recognized and appreciated nurses’ role (person factor) in recognizing early C difficile symptoms, initiating early testing, and placing patients in CIP immediately when testing was ordered. Attending physicians also reported that laboratory policies of only testing stool once per week and rejecting stool if nonliquid (despite other clinical indicators) were organizational barriers. Another person barrier that attending physicians recognized was their own unawareness of many laboratory guidelines for C difficile testing, particularly guidelines related to possible, atypical presentations. Regarding the C difficile polymerase chain reaction (PCR) test itself as a tool, attending physicians reported many positive aspects of the current test: more expedient (faster), efficient (1 test instead of 3), and more available (performed on weekends). Attending physicians further described the C difficile PCR test as highly sensitive but also expressed concern about the cost and false positives that have occurred.

Hand hygiene

From a person perspective, attending physicians reported uncertainty whether they should wash their hands inside or outside a patient’s room (task interacting with physical environment). They also expressed concern for how patients might react to the location and number of staff performing hand hygiene: “I wonder what the patient would think if a full team of five people all go in and out of his or her bathroom and wash their hands there.” Regarding tools for handwashing, attending physicians noted that sink water was often too hot; however, they described soap supplies as usually adequate. Environment barriers included clutter around patient sinks and the need to touch room curtains after washing hands in the room, possibly causing recontamination.

CIP

Person factors that were barriers or facilitators to CIP were most commonly cited. Attending physicians reported a lack of clarity around many aspects of CIP: gown reuse, the level of patient contact requiring gowns, gown and gloving donning and doffing sequence, and when to discontinue CIP. They observed noncompliance of family members and food service workers with gowns. Attending physicians also reported that HCWs engaged in brief tasks in patients’ room would not don gowns. However, they acknowledged the proactive nursing practice of placing patients in CIP when testing is...
ordered and reported that environmental services appears particularly effective and organized as it relates to CIP. Attending physicians also identified several organizational barriers: the emergency department (ED) and outpatient clinics do not routinely follow CIP, the hospital does not share compliance data with staff, and the policy and enforcement of family compliance with CIP are unclear; however, some attending physicians felt it was nursing’s responsibility to enforce CIP with families. Attending physicians specifically articulated their desire for data on the impact of the VA C difficile bundle to increase staff motivation for compliance. Organizational facilitators included consistent use of CIP when C difficile testing is ordered and the impression that environmental services is effective despite attending physicians’ lack of awareness of their actual processes for C difficile room cleaning: “I don’t think I have a clue what they do. The room gets empty, someone comes, they clean it...”

Environment factors observed by attending physicians included barriers both inside and outside patient rooms. Gown and glove dispensers were in different locations (ie, gown dispenser outside patient rooms, glove dispenser inside patient rooms). Isolation stethoscopes were often missing inside patient rooms, and signs outside patient rooms were confusing and easy to miss: “I’ll be honest, if I'm entering and the patient is in precautions, I wear the gown. But have I entered without wearing a gown when I was supposed to? Yes, because I didn’t see the sign. I just totally missed the sign.” However, attending physicians acknowledged that the gown dispensers present outside all patient rooms were visible and accessible. Regarding the tools component, attending physicians described the supply of clean gowns as usually adequate; however, gown dispensers were sometimes empty. They expressed concern that bags of gowns in the intensive care units were not clearly labelled if clean or dirty. Further, attending physicians described the overall task of CIP compliance as time-consuming and expressed concern that they spend less time talking to and examining patients under CIP.

**Table 2**
Classification of themes identified in focus group for attending physicians (n = 7)

<table>
<thead>
<tr>
<th>SEIPS component</th>
<th>Testing and diagnosis</th>
<th>Hand hygiene</th>
<th>CIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>• Unaware of laboratory guidelines for stool and atypical presentations</td>
<td>• Lack of clarity around where handwashing should occur</td>
<td>• Lack of clarity around many aspects of CIP</td>
</tr>
<tr>
<td></td>
<td>• Identify and appreciate nurses’ role in testing</td>
<td>• Concern about patients’ reactions to staff handwashing location (eg, patient bathroom)</td>
<td>• Observation of lack of gowning by family, food service, and also by HCWs during brief patient contacts</td>
</tr>
<tr>
<td>Task</td>
<td>• Many positive aspects of newer PCR test (expedient, efficient, available, and highly sensitive)</td>
<td>• Sinks (water too hot)</td>
<td>• ER and outpatient clinics do not institute CIP</td>
</tr>
<tr>
<td>Tools</td>
<td>• Barriers to testing related to laboratory policy</td>
<td>• Soap supplies adequate</td>
<td>• Hospital does not share bundle compliance data</td>
</tr>
<tr>
<td>Organization</td>
<td>• Facilitators to testing (increased frequency, almost universal testing of new admissions, assumption of CD with diarrhea until testing proves otherwise)</td>
<td>• ICU gown bags without clear labels as to dirty or clean status</td>
<td>• Desire data on impact of bundle to increase motivation for bundle adherence</td>
</tr>
<tr>
<td>Environment</td>
<td>• Patient placed in CIP once CD test ordered</td>
<td>• Problems with location of equipment (gowns and gloves) and containers</td>
<td>• Family compliance and enforcement responsibilities not clear</td>
</tr>
<tr>
<td></td>
<td>• Barriers to testing related to laboratory policy</td>
<td>• Problems with signs</td>
<td>• Nursing with responsibility to enforce with families</td>
</tr>
<tr>
<td></td>
<td>• Observation of lack of gowning by family, food service, and also by HCWs during brief patient contacts</td>
<td>• Stethoscopes missing in CIP rooms</td>
<td>• CIP begin when testing ordered to reduce transmission</td>
</tr>
<tr>
<td></td>
<td>• Observation of lack of gowning by family, food service, and also by HCWs during brief patient contacts</td>
<td>• Visible and accessible wall gown dispensers</td>
<td>• Physicians see ES as effective, but lack knowledge of processes for cleaning room</td>
</tr>
</tbody>
</table>

CD, Clostridium difficile; CIP, contact isolation precautions; ER, emergency room; ES, environmental services; HCW, health care worker; ICU, intensive care unit; PCR, polymerase chain reaction; SEIPS, Systems Engineering Initiative for Patient Safety.

**Resident physician findings**

**Testing and diagnosis**

Resident physicians identified a preponderance of person factors related to testing and diagnosis, particularly the variable testing thresholds among attending physicians and nurses (Table 3). This resulted in “task ambiguity” regarding when exactly to order C difficile testing who makes the final decision to order testing as exemplified by one resident physician’s comments: “[Resident physicians] get asked [by nurses], ‘Do you want to run a C. diff?’” and [resident physicians] say, ‘Um, maybe?’ I don’t know. Some attendings go one way, and some attendings say ‘Do not run a C. diff.’” Regarding the tool component, resident physicians felt C difficile PCR test was being performed more often, but this was unlikely to cause significant harm. Relevant to the task component, resident physicians reported occasional difficulty in actually obtaining a stool sample (eg, stool flushed in toilet, patient unable to produce stool) after ordering testing.

**Hand hygiene**

Resident physicians reported lacking education (person component) on the details of effective handwashing (eg, where to wash hands, handwashing technique). They also described the task of handwashing as time-consuming and the tools available for handwashing as inadequate (eg, too few sinks, sink water too hot), as reflected in one resident physician’s comment: I think it’s an access and time thing too. If you’ve got two residents and then two medical students and an attending and all of you go in there and you’ve got 12 patients to round on post-call. Half your team is wandering down the hall continuing rounds, and half are still washing their hands. I don’t know if people are doing a good job then, either, or if it’s like slap some soap on, throw your hands under the water, and run.
Table 3
Classification of themes identified in focus group for resident physicians (n = 8)

<table>
<thead>
<tr>
<th>SEIPS component</th>
<th>Testing and diagnosis</th>
<th>Hand hygiene</th>
<th>CIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>Threshold for testing varies</td>
<td>Lack education regarding how and where</td>
<td>Residents aware of individual bundle components, but not bundle as a whole</td>
</tr>
<tr>
<td>Task</td>
<td>Challenges in obtaining specimen for testing</td>
<td>Time-consuming</td>
<td>Resident lack of knowledge and education</td>
</tr>
<tr>
<td>Tools</td>
<td>Risk-benefit ratio for CD testing</td>
<td>Sinks (number, characteristics, and water too hot)</td>
<td>Staff with inconsistent adherence to CIP</td>
</tr>
<tr>
<td>Organization</td>
<td></td>
<td></td>
<td>Concern about CD transmission with lack of family member adherence to CIP</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
<td>Unclear who is educating and enforcing CIP with families</td>
</tr>
</tbody>
</table>

CD, Clostridium difficile; CIP, contact isolation precautions; EMR, Electronic medical record; ES, environmental services; SEIPS, Systems Engineering Initiative for Patient Safety.

CIP

Many person factors were identified as barriers to CIP. Resident physicians were unaware of the VA C difficile bundle despite being very familiar with the individual bundle components (eg, gowns, gloving, hand hygiene). Resident physicians reported they lacked education regarding CIP details (eg, how to remove gowns, how long to keep patients in CIP). In addition, they voiced concern about the adherence of other HCWs but also acknowledged they do not consistently adhere to CIP themselves. Resident physicians were particularly concerned about family members’ lack of CIP adherence and resulting risk of CDI spread, and they reported it was unclear who should be educating and enforcing CIP with families. Tool factors were also commonly reported. Inappropriate personal stethoscope use, low-quality isolation stethoscopes, and lack of Electronic medical record functionality were described as significant barriers to resident physician adherence to CIP, whereas consistently stocked gowns and consistent use of CIP for any possible enteric infection (eg, viral gastroenteritis) were facilitators. Resident physicians noted that the environment outside the patients’ rooms did not effectively and consistently alert providers to patients under CIPs (eg, signs were not highly visible), and there was a lack of adequate equipment (eg, gown hampers, isolation stethoscopes) in the environment inside the room. From an organization standpoint, resident physicians described a culture of equality and teamwork that facilitates effective CIP use: “I feel like people take it pretty seriously. I appreciate that if they notice someone is leaving and only uses hand sanitizer, I think anybody is comfortable pointing it out, regardless of what your role is on the health care team. So, I think that is a positive as an institution.”

RN and HT findings

Testing and diagnosis

RNs and HTs recognized multiple person factors as facilitators of C difficile testing and diagnosis (Table 4). They reported strong knowledge of C difficile risk factors, symptoms, and possible mimickers and good RN and HT collaboration, which allowed initiation of earlier testing. RNs reported ordering C difficile testing despite external resistance (from providers and other facilities) but also described difficulty in obtaining a stool sample from a patient, which could delay diagnosis (related to task and organization components). Overall, RNs believed the risk-benefit ratio favored more frequent C difficile testing: “I’ve given a call and said, ‘Hey, this is what’s going on. Do you mind if we do a C diff?’ I’ve never had anyone say no because I think they trust our judgment at the bedside and know what we are seeing or if there was a big change.”

Organization themes were next most common factors identified by RNs and HTs. RNs felt they usually had institutional support for ordering testing independently. However, they also described variable RN-provider communication when actually ordering C difficile testing. Other organizational barriers they recognized were laboratory guidelines that only allow testing of liquid stool and problems with the ED (pressure from the ED to admit patients, missed CDI diagnoses in the ED). Regarding the C difficile PCR test, a tool, RNs noted that rapid test results facilitate CDI diagnosis and reduce unnecessary room changes, and RN concern for C difficile transmission motivates their initiation of early C difficile PCR testing.

Hand hygiene

Tools were most commonly identified as barriers to effective hand hygiene: problems with soap dispensers (empty or malfunctioning), problems with sinks (water too hot or not automatic), and clutter on patient sinks. Signs on hand sanitizers directing staff to wash hands and the recent addition of an extra sink in the hallway were viewed as facilitators of hand hygiene. Environment barriers were also cited: inadequate number of sinks and poor placement of sinks. Broken soap dispensers were described as being fixed quickly from an organization standpoint. However, the task of handwashing itself was reported as time-consuming, and RNs and HTs expressed desire for a faster method of hand hygiene, as reflected in one comment: “It would be great to have a different product. Of course, everyone wants a product that’s easy, that’s quick, you know, that would do the same job as hand washing. That’s hard.”

CIP

RN and HTs described a culture of institutional support for CIP compliance and support for independent RN C difficile testing and decision-making. For example, RNs would independently start CIP when C difficile testing was ordered. RNs and HTs felt most staff were compliant with CIP, and they usually felt comfortable pointing out lapses in compliance: however, this was harder with physician noncompliance. They also reported appreciation for environmental services’ work in preventing C difficile transmission. However, unclear policies surrounding universal gown use in rooms and disposal of C difficile patient feces were depicted as organization barriers. Also related to organization culture, RNs expressed their perception of nursing staff being primarily responsible for preventing C difficile transmission: “If there were a transmission, I guarantee most of
us would feel like it’s our fault.” RNs and HTs described several person facilitators of CIP: (1) RNs independently review patients’ history and symptoms and order CIP if indicated; (2) the infection control nurse is a significant resource who facilitates timely CIP initiation and discontinuation; (3) environmental services are knowledgeable and willing to educate other HCWs on CIP room cleaning; and (4) food service and visitors are increasingly compliant with CIP. RNs and HTs were largely unaware of the VA C difficile bundle but felt the VA has been doing a good job of reducing CDI transmission. However, RNs and HTs also observed variable family member compliance with CIP despite RN education: “We will explain to the family members why they should be wearing a gown. A lot of times, they won’t. They say, ‘I have been around him for the last month, if I am going to have it, I have it.’ And then we just make sure we push hand washing, going in, going out. We can’t force them to wear a gown.”

Multiple tool factors were viewed as barriers: (1) isolation gowns fell off easily; (2) personal provider stethoscopes were used inappropriately in CIP rooms; (3) isolation stethoscopes were occasionally inappropriately removed from CIP rooms; (4) lack of bleach wipes, (5) overloaded and poorly maintained soiled linen bags, (6) lack of pens in CIP rooms, and (7) lack of EMR functionality (linking C difficile testing to CIP ordering). RNs and HTs identified task barriers of CIPs, in particular their increased workload when caring for multiple CIP patients, leading to their inadvertent noncompliance with CIP when nurses were very busy: “[You] spend half your day gowning up.”

They also acknowledged their awareness of the increased workload for environmental services in cleaning a CIP room, which typically requires an hour. Environment factors noted included overall good accessibility of CIP supplies (e.g., gowns, gloves, stethoscopes) and clear CIP signs outside of patient rooms.

### DISCUSSION

To our knowledge, this is the first qualitative, interprofessional analysis of the VA nationally mandated C difficile prevention bundle using the SEIPS model. Our analysis suggests all components of the SEIPS work system function as both facilitators of and barriers to compliance with the VA C difficile prevention bundle. Several common themes, encompassing both barriers and facilitators, emerged among interprofessional groups related to CDI testing and diagnosis. Both RNs and HTs and attending physicians described the rapid turnaround time of the C difficile PCR test (tool) as a facilitator of timely diagnosis. Highlighting the value of multiple perspectives with interprofessional focus groups, RN and HTs specifically noted the benefit of rapid test results in avoiding unnecessary room changes (e.g., in the setting of double patient rooms), a theme absent in resident or attending physician groups. This is consistent with previous, multidisciplinary focus groups analyses that have documented differences in perception of value of patient safety practices between nurses and physicians.24

### Table 4

<table>
<thead>
<tr>
<th>SEIPS component</th>
<th>Testing and diagnosis</th>
<th>Hand hygiene</th>
<th>CIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>RNs identify CDI risk factors, symptoms, and mimics, which allow them to initiate earlier testing</td>
<td>• Handwashing time-consuming</td>
<td>• RNs review patient history and symptoms and order CIP independently</td>
</tr>
<tr>
<td></td>
<td>HTs collaborate with RNs for identification of CDI</td>
<td>• Desire for faster methods</td>
<td>• Resource of infection control nurse facilitates initiating and discontinuing CIP</td>
</tr>
<tr>
<td></td>
<td>RNs order CD testing despite external resistance</td>
<td>• Soap dispenser problems (empty or broken)</td>
<td>• Variable family adherence to CIP despite RN education</td>
</tr>
<tr>
<td></td>
<td>Delay in obtaining stool sample delays diagnosis</td>
<td>• Sink problems (hot water, manual faucets, or clutter on sink)</td>
<td>• ES is knowledgeable and willing to educate others on CIP room cleaning</td>
</tr>
<tr>
<td></td>
<td>RNs believe that risk-benefit ratio supports more frequent testing</td>
<td>• Signs on hand sanitizers direct staff to wash hands</td>
<td>• Adherence to CIP by food service and visitors has improved</td>
</tr>
<tr>
<td></td>
<td>Many RNs unaware of bundle</td>
<td>• Addition of sink in hallway</td>
<td>• Increased RN and HT time and workload</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Broken soap dispensers fixed quickly</td>
<td>• RNs aware CIP room cleaning is time-consuming (approximately 1 h)</td>
</tr>
<tr>
<td>Task</td>
<td>Concern for CDI transmission drives initiation of early testing</td>
<td>• Necropsy problems (hot water, manual faucets, or clutter on sink)</td>
<td>• Inadvertent noncompliance with CIP when nurses very busy</td>
</tr>
<tr>
<td></td>
<td>Rapid PCR testing facilitates CDI diagnosis and reduces unnecessary room changes</td>
<td>• Signs on hand sanitizers direct staff to wash hands</td>
<td>• Adequate gown supplies</td>
</tr>
<tr>
<td>Tools</td>
<td></td>
<td>• Personal stethoscopes are inappropriately used by providers</td>
<td>• Gowns fall off easily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Isolation stethoscopes are inappropriately used by providers</td>
<td>• Equipment and supply problems</td>
</tr>
<tr>
<td>Organization</td>
<td>RNs usually have organizational support for independently ordering test</td>
<td>• Breakpoint stethoscopes usually meant for patient rooms</td>
<td>• Isolation stethoscopes mean for patient rooms are taken outside</td>
</tr>
<tr>
<td></td>
<td>Variable RN-provider communication when ordering CDI testing</td>
<td>• Variable family adherence to CIP despite RN education</td>
<td>• No automatic EMR ordering of CIP when ordering CDI testing</td>
</tr>
<tr>
<td></td>
<td>Laboratory guidelines only allow for testing loose stools</td>
<td>• Culture of institutional support for CIP</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
</tr>
<tr>
<td></td>
<td>Problems with ED (pressure and missed diagnosis)</td>
<td>• RNs have organizational support for independent testing and decision-making</td>
<td>• RNs have organizational support for independent testing and decision-making</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td>• Unclear policies on always wearing gowns in CIP rooms and disposal of CIP patient feces</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
</tr>
<tr>
<td></td>
<td>Problems with sinks (too few or poor location)</td>
<td>• Most staff adherent to CIP; RNs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
<td>• RNs have organizational support for independent testing and decision-making</td>
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<td></td>
<td></td>
<td>• Resource of infection control nurse facilitates initiating and discontinuing CIP</td>
<td>• RNs appreciate role and workload of ES in preventing CDI transmission</td>
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<td></td>
<td></td>
<td>• Variable adherence to CIP despite RN education</td>
<td>• RNs think an EMR prompt screening for CDI symptoms would expedite early testing</td>
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<td></td>
<td></td>
<td>• Resource of infection control nurse facilitates initiating and discontinuing CIP</td>
<td>• Ordering CD testing prompts nurses to start IP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increased RN and HT time and workload</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
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<td></td>
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<td>• CIP signs are clear</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
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<td>• Accessibility of CIP supplies (e.g., gowns, gloves, stethoscopes)</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
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<td>• CIP signs are clear</td>
<td>• RNs and HTs usually comfortable pointing out lapses in CIP, although harder to do with MDs</td>
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</table>

CD, Clostridium difficile; CDI, Clostridium difficile infection; CIP, contact isolation precautions; EMR, Electronic medical record; ES, environmental services; HT, health technician; IP, infection prevention; MD, medical doctor; PCR, polymerase chain reaction; RN, registered nurse; SEIPS, Systems Engineering Initiative for Patient Safety.
Attending physicians were generally appreciative of RNs' proactive role in ordering and sending CDI testing. However, resident physicians described ambiguity regarding who enters the order for testing and who ultimately decides whether the test should be run, an example of responsibility ambiguity related to guideline adherence. The issue of RN- versus physician-initiated *Clostridium difficile* testing is also particularly relevant in light of recent evidence suggesting discordance between physician and RN perception of CDI risk factors. Identification of barriers to hand hygiene was remarkably consistent across all professional groups. Members from all groups described sink-related (tool) barriers: too few sinks and water that was too hot. Closely related were the environmental barriers of poor sink location and cluttered sinks and the time-consuming task of handwashing (as opposed to alcohol-based hand sanitizer). Resident physicians and attending physicians both reported a lack of knowledge (person) regarding the exact technique and location for handwashing (eg, inside patient's room vs outside patient's room). The prominence of these physical, tangible themes, particularly related to sink use, is consistent with previous qualitative analysis of HCWs' perception of barriers to prevention of methicillin-resistant *Staphylococcus aureus* transmission. However, studies of increasing the number of available sinks have been underwhelming regarding improved handwashing compliance. This further underscores the need for evaluation of multiple work system factors (beyond the environment) when pursuing health care system design and argues in favor of an interdisciplinary design process involving both architectural and clinical staff.

CIP themes were more diverse and wide-ranging. However, the barrier of workload and time (task) was prominent and consistent among most groups, which has been previously well described in the infection prevention literature. Several RNs reported inadvertent noncompliance with CIP in the setting of a heavy workload with multiple patients under CIP. Attending physicians similarly admitted they probably spend less time with CIP patients because of time constraints. The phenomenon of health care providers spending less time with patients in CIP has been objectively documented previously and is considered one of several significant adverse consequences of CIP. Given the prominence of workload and time barriers associated with providing health care to CIP patients in our project and others, the data as a whole suggest consideration of modifying health care providers' workload and number of patients assigned related to infection prevention needs (ie, limiting the number of patients in CIP, assigning fewer total patients). An additional RN and HT identified barrier was the challenge of obtaining, appropriately cleaning, and disposing of common supplies or tools needed in patient rooms (eg, pens, whiteboard markers, stethoscopes). The lack of clear policy on this issue was also raised, reflecting the organization component of this barrier as well. Concerns regarding how to implement the CIP bundle in multiple contextualized patient situations (eg, how to correctly use a pen with CIP) suggest that simulation may be a useful technique to prepare clinicians for safely making difficult decisions in complex patient care environments. In light of recent evidence suggesting HCW gown and glove adherence is generally poor, simulation may become crucial to ensure infection prevention practice adherence in high-stakes circumstances, particularly given the recent emergence of the Ebola virus.

RN and HTs reported overall good staff adherence to CIP and also described a culture of institutional support for CIP, both facilitators of CIP adherence within the organization. RNs further stated they were generally comfortable pointing out lapses in CIP but were less comfortable pointing out lapses to physicians. Reluctance of nursing staff to remind physicians of infection prevention practices lapses has been described in the literature, but overall has received little attention. Previous studies also suggest veteran patients are similarly reluctant to identify lapses in hand hygiene of VA physicians. Our findings indicate that further research on the dynamics and perceived hierarchy among nurses, physicians, and patients could offer insight into potential improvement in communication processes contributing to HCW compliance with infection prevention practices.

All professional groups reported poor visitor (usually family member) adherence to CIP as a significant barrier. Both physician groups reported observing visitors not following CIP and expressing uncertainty regarding who is responsible for visitors' education and CIP enforcement. RNs reported taking responsibility for visitor CIP education, but they described frequent visitor CIP nonadherence despite providing education. A recent literature review found visitor adherence to isolation precautions (including hand hygiene and CIP) to be variable but generally poor. To date, no study has specifically evaluated visitor adherence to CIP in patients with CDI. Recent survey data also suggest that CIP education is not consistently provided to visitors, in either written or in-person formats. Our findings reinforce the need for further research on the role of hospital visitors in infection prevention and the need to identify better methods to proactively engage patients and visitors in infection prevention practices.

A prominent global theme among all professional groups was a lack of knowledge of the VA CDI bundle as a whole while demonstrating knowledge of many, but not all, individual elements of the CDI bundle. Most participants were aware of the role of hand hygiene and CIP, but knowledge of timely testing and diagnosis as a bundle element was low. This finding has implications for the success of the CDI bundle overall: effective bundles are composed of multiple elements, all of which are necessary, sufficient, and must be consistently and uniformly executed. Lack of knowledge of the complete bundle jeopardizes its effective execution by HCWs.

Our project had several strengths. The qualitative, interprofessional nature of our project guided by a human factors and systems engineering model provided detailed insight into the current state of the VA nationally mandated CDI bundle. Consistent with previous infection prevention focus group research, our experience supports the utility and value of focus groups in illuminating work system factors from multiple perspectives in a safe and candid manner. These multiple HCW perspectives are essential to identify barriers to bundle implementation and adherence, which often differed significantly among HCW groups. Identification of facilitators is equally important for development of protocols and interprofessional initiatives to modify work system factors with the ultimate goal of improving bundle implementation, adherence, and effectiveness.

Our project also had limitations. Addition of laboratory personnel would have further strengthened our interprofessional approach, particularly given the frequency with which laboratory policy and procedure was referenced during focus group interviews. Similarly, focus groups with family members, hospital visitors, and patients would provide an even broader perspective. We also did not include direct, visual observations of HCWs using CIP as part of this project; however, we have reported such findings previously. Our focus groups were somewhat smaller than typically found in social science research, but such smaller groups are often ideal for addressing sensitive issues (eg, bundle adherence) in health research. This descriptive project was a necessary first step to better understand work system factors related to bundle implementation. Future research should include larger samples from multiple VA and non-VA sites to support generalizability of findings to other samples and settings.

All groups recognized the role of environmental services in reducing CDI transmission, and we conducted environmental services focus group interviews because of the importance of their role. These findings will be reported in a future article.
In conclusion, multiple work system components serve as barriers to and facilitators of adherence to the VA nationally mandated CDI prevention bundle among an interprofessional group of HCWs. Rapid C difficile test results were a common facilitator of timely CDI diagnosis, whereas the increased time required for handwashing and CIP were prominent barriers among all groups. Organizational and environmental factors influencing bundle adherence identified in this project also point to important directions for systems and environmental redesign. Taken as a whole, our findings underscore the need for interprofessional perspectives and collaboration to identify barriers to and facilitators of adherence to infection prevention practices.

References

12. U.S. Department of Veterans Affairs. Implementation of guideline for prevention of clostridium difficile infection (CDI). In: Veterans Health Administration (VHA) acute-care facilities (VAQ # 71201267); Washington (DC): Department of Veterans Affairs; 2012.
APPENDIX 2.

Interview guide for 2 focus groups with RNs and HTs

**Person**

What do you know about the VA national *C difficile* bundle (environmental management, hand hygiene, contact precautions, and cultural transformation)?

How well do the current *C difficile* policies reduce transmission of *C difficile* at the VA, that is, do you think the bundle is effective?

**Organization**

How well does the Madison VA make reducing the transmission of *C difficile* an organizational priority?

How well do all members of the patient care team (medical doctors, RNs, certified nursing assistants, patient transport, food service, and environmental services) appropriately share and take responsibility for reducing *C difficile* transmission?

How important do you think environmental services and room cleaning is to reducing the transmission of *C difficile*?

**Tools**

What are barriers to testing and diagnosing patients with *C difficile* diarrhea in the hospital?

How often do you suggest *C difficile* testing to a physician (resident or staff medical doctor)? How well is this suggestion received?

What will make you more likely to suggest *C difficile* testing to the primary team (eg, stool features, patient features)?

**Tasks**

What are barriers to placing patients in isolation precautions for *C difficile* diarrhea in the hospital?

What are barriers to using contact isolation precautions for patients with *C difficile* diarrhea in the hospital?

How comfortable do you feel pointing out when other members of the patient care team do not adhere to *C difficile* precautions (eg, handwashing, gowning, gloving)?

**Environment**

What are barriers to performing appropriate hand hygiene after caring for patients with *C difficile* diarrhea in the hospital?

How long do you typical see patients kept in *C difficile* precautions? Do medical doctors ever discontinue isolation precautions on a patient with *C difficile*? Do you ever ask medical doctors to discontinue *C difficile* precautions?

How could the layout of the rooms be changed to make contact isolation precautions easier to use?