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Major Article

Gaps in infection prevention practices for catheter-associated urinary tract infections and central line-associated bloodstream infections as identified by the Targeted Assessment for Prevention Strategy

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A B S T R A C T

Background: Catheter-associated urinary tract infections (CAUTI) and central line-associated bloodstream infections (CLABSI) represent a substantial portion of health care-associated infections (HAIs) reported in the United States. The Targeted Assessment for Prevention Strategy is a quality improvement framework to reduce health care-associated infections. Data from the Targeted Assessment for Prevention Facility Assessments were used to determine common infection prevention gaps for CAUTI and CLABSI.

Methods: Data from 2,044 CAUTI and 1,680 CLABSI assessments were included in the analysis. Items were defined as potential gaps if ≥33% respondents answered Unknown, ≥33% No, or ≥50% No or Unknown or Never, Rarely, Sometimes, or Unknown to questions pertaining to those areas. Review of response frequencies and stratification by respondent role were performed to highlight opportunities for improvement.

Results: Across CAUTI and CLABSI assessments, lack of physician champions (<35% Yes) and nurse champions (<55% Yes), along with lack of awareness of competency assessments, audits, and feedback were reported. Lack of practices to facilitate timely removal of urinary catheters were identified for CAUTI and issues with select device insertion practices, such as maintaining aseptic technique, were perceived as areas for improvement for CLABSI.

Conclusions: These data suggest common gaps in critical components of infection prevention and control programs. The identification of these gaps has the potential to inform targeted CAUTI and CLABSI prevention efforts.

Device-associated infections, including catheter-associated urinary tract infections (CAUTI) and central line-associated bloodstream infections (CLABSI), are a leading cause of health care-associated infections (HAIs)[1] and are associated with increased morbidity, mortality, and health care costs.[2-4] Due to the seriousness of these infections, the US Department of Health and Human Services set a national goal of reducing infections among hospitalized patients by 25% for CAUTI and 50% for CLABSI from 2015 to 2020.[5] To facilitate reduction of HAIs through the use of data for action, the Centers for Disease Control and Prevention (CDC) created the Targeted Assessment for Prevention (TAP) Strategy as a quality improvement framework.

The TAP Strategy consists of TAP Reports, TAP Facility Assessments, and the use of TAP Implementation Guides.[6] TAP Reports are generated within the Patient Safety Component of the National Healthcare Safety Network, the largest HAI surveillance system in the United States with over 25,000 facilities reporting data.[7] The reports are designed to identify facilities and units with excess HAIs using the cumulative attributable difference (CAD) metric, which has been previously described in detail.[8] TAP Facility Assessments may then be used to identify perceived gaps in knowledge, awareness, and

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adherence to infection prevention practices by surveying staff across multiple roles within the facility or unit. Infection prevention improvements can then be made by accessing prevention resources within the CDC TAP Implementation Guides and implementing interventions to address identified gaps. A previous analysis of *Clostridioides difficile* infection rates in a system of 3 US hospitals before and after implementation of the TAP Facility Assessments showed a significant decrease in the system-wide *Clostridioides difficile* infection rate that was sustained postintervention.[9]

The goal of this evaluation was to describe reported gaps in infection prevention practices for CAUTI and CLABSI in acute care hospital settings, as identified by responses to the CAUTI and CLABSI TAP Facility Assessments.

METHODS

Data sources

TAP Facility Assessments are designed to be completed by hospital staff, including frontline personnel, mid-level management, as well as leadership and to capture their self-reported perceptions of infection prevention policies and practices at their facility. The CAUTI TAP Facility Assessments include 6 domains: general infrastructure (including training, competency assessments, audits, and feedback), appropriate indications for indwelling urinary catheter insertion, aseptic insertion of indwelling urinary catheters, proper indwelling urinary catheter maintenance, timely removal of indwelling urinary catheters, and appropriate urine culturing practices. For CLABSI, the TAP Facility Assessments include 5 domains: general infrastructure (including training, competency assessments, audits, and feedback), appropriate use of central lines, proper insertion of central lines, proper maintenance of central lines, and supplemental strategies. As the ability to identify infection prevention gaps increases with the number of assessments completed, multiple assessment modalities are available to facilitate collection, including paper assessments, fillable PDFs, and online through SurveyMonkey.

CDC provides technical assistance at the request of facilities, health departments, and other prevention partners to support quality improvement and infection prevention efforts. Upon request, CDC summarizes TAP Facility Assessments and provides feedback to partners. CAUTI and CLABSI TAP Facility Assessments collected by partners and sent to CDC from December 2014 to August 2019 were included in the analysis. During this time period, iterative tool development occurred, resulting in 2 versions of CAUTI assessments and 3 versions of CLABSI assessments. Where possible, similar questions across versions were combined, resulting in 64 unique assessment questions for CAUTI and 94 questions for CLABSI. When lack of consistency between question wording or response options occurred, the version with the highest number of responses was used for analysis.

Analysis

Self-reported respondent roles were categorized into nurses; medical providers (physicians, nurse practitioners, physician assistants); nurse assistants/technicians; leadership; infection prevention, quality, or education; administrative staff; and other staff. Questions were identified as potential gaps if 33% or more of respondents answered Unknown, 33% or more answered No, or if 50% or more of respondents answered No or Unknown or Never, Rarely, Sometimes, or Unknown.[6,9] Unknown responses were included in the identification of potential gaps as they may indicate opportunities for improved awareness of facility policies and practices. For those items that were not identified as potential gaps based on the categories above, review of response frequencies by clinical subject matter experts was also performed to highlight additional assessment questions where clinically relevant improvements may be needed, stratifying by respondent role as warranted. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC). This project was exempt from Institutional Review Board due to the quality improvement framework and use of aggregate assessment data voluntarily provided by the hospitals through technical assistance requests.

RESULTS

Respondent characteristics

CAUTI

Seventy-three facilities provided 2,044 CAUTI TAP Facility Assessments that were included in the analysis. Respondents comprised nurses (63.8%), medical providers (8.7%), leadership (11.9%), nurse assistants or technicians (7.1%), infection prevention, quality, or education personnel (4.7%), administrative staff (0.4%), and staff with other roles (3.5%; Table 1). Of the assessments collected, 97.4% were from acute care hospitals, 1.5% from long-term acute care hospitals, and 1.2% from critical access hospitals.

CLABSI

Thirty-eight facilities provided 1,680 CLABSI TAP Facility Assessments that were included in the analysis. Respondents comprised nurses (72.0%), medical providers (7.7%), leadership (9.2%), nurse assistants or technicians (3.5%), infection prevention, quality, or education personnel (2.7%), administrative staff (0.7%), and staff with other roles (4.2%; Table 1). Of the assessments collected, 92.7% were from acute care hospitals, 6.7% from long-term acute care hospitals, and less than 1% from critical access hospitals.

Reported gaps in infection prevention practices

CAUTI

Across CAUTI Facility Assessments, a lack of physician and nurse champions for CAUTI prevention activities were reported as gaps. In

Table 1
Respondent characteristics, Targeted Assessment for Prevention (TAP) Strategy catheter-associated urinary tract infections (CAUTI) and central line-associated bloodstream infections (CLABSI) Facility Assessments

Characteristic	CAUTI assessments N (%)	CLABSI assessments N (%)
Role		
Nurses	1,303 (63.8%)	1,209 (72.0%)
Medical providers*	178 (8.7%)	130 (7.7%)
Nurse assistants/technicians	145 (7.1%)	58 (3.5%)
Infection prevention staff†	96 (4.7%)	46 (2.7%)
Leadership	243 (11.9%)	155 (9.2%)
Administrative staff	8 (0.4%)	12 (0.7%)
Other staff	71 (3.5%)	70 (4.2%)
Facility type		
Acute care hospitals	1,990 (97.4%)	1,557 (92.7%)
Long-term acute care hospitals	30 (1.5%)	112 (6.7%)
Critical access hospitals	24 (1.2%)	11 (0.7%)
Facility region‡		
Northeast	1,002 (49.0%)	694 (41.3%)
Midwest	106 (5.2%)	80 (4.8%)
South	838 (41.0%)	699 (41.6%)
West	98 (4.8%)	207 (12.3%)
Survey modality		
Paper	371 (18.2%)	666 (39.6%)
PDF	241 (11.8%)	165 (9.8%)
SurveyMonkey	1,432 (70.1%)	849 (50.5%)

*Category includes physicians, nurse practitioners, and physician assistants.
†Category includes infection prevention staff, education staff, and quality improvement staff.
‡Defined as US Census Region.

Table 2
Catheter-associated urinary tract infections (CAUTI) Targeted Assessment for Prevention (TAP) Strategy Facility Assessment, response frequencies for identified gaps*, all respondents

Domain	Question	Yes		No		Unknown	
General infrastructure	Does your facility have a nurse champion for CAUTI prevention activities? (N = 2,024)	1,069 (52.8%)		260 (12.8%)		695 (34.3%)	
	Does your facility have a physician champion for CAUTI prevention activities? (N = 2,020)	619 (30.6%)		329 (16.3%)		1,072 (53.1%)	
	Does your facility conduct competency assessments of all health care personnel on use of bladder scanners (for all personnel who use them)?						
	B. At least annually? (N = 1,975)	829 (42.0%)		583 (29.5%)		563 (28.5%)	
		Always	Often	Sometimes	Rarely	Never	Unknown
Appropriate indications for indwelling urinary catheter insertion	In the Emergency Department, is an order provided prior to insertion of an indwelling urinary catheter? (N = 1,727)	387 (22.4%)	168 (9.7%)	157 (9.1%)	97 (5.6%)	16 (0.9%)	902 (52.2%)
	Do Emergency Department providers order indwelling urinary catheters for appropriate indications? (N = 1,731)	245 (14.2%)	207 (12.0%)	216 (12.5%)	135 (7.8%)	40 (2.3%)	888 (51.3%)
	Do Emergency Department providers document an indication when ordering indwelling urinary catheters? (N = 1,729)	262 (15.2%)	273 (15.8%)	232 (13.4%)	81 (4.7%)	17 (1.0%)	864 (50.0%)
Aseptic indwelling urinary catheter insertion	Does your facility require at least 2 personnel to be present for indwelling urinary catheter insertions (N = 1,878)	536 (28.5%)	177 (9.4%)	167 (8.9%)	186 (9.9%)	425 (22.6%)	387 (20.6%)
Proper indwelling urinary catheter maintenance	In the Emergency Department, are preconnected, sealed urinary drainage systems with urine meters used in critically ill patients to avoid breaking the system once transferred to the intensive care unit? (N = 1,854)	520 (28.0%)	199 (10.7%)	82 (4.4%)	28 (1.5%)	26 (1.4%)	999 (53.9%)
Timely removal of indwelling urinary catheters	Are indwelling urinary catheters removed in the postanesthesia care unit (PACU) if there is no indication for continued use after surgery? (N = 1,806)	413 (22.9%)	291 (16.1%)	225 (12.5%)	98 (5.4%)	32 (1.8%)	747 (41.4%)
	If applicable, do physicians respond to alerts or reminders by removing unnecessary urinary catheters? (N=1,465)	307 (21.0%)	286 (19.5%)	186 (12.7%)	60 (4.1%)	52 (3.5%)	574 (39.2%)

*Gaps defined as ≥33% Unknown, ≥33% No, or ≥50% Negative responses (Unknown + No, Unknown + Never + Rarely + Sometimes).

addition, gaps in practices that were meant to facilitate the timely removal of urinary catheters were also found, including suboptimal use of stop orders or alerts for removing unnecessary urinary catheters (Table 2). Other practices defined as gaps included not having 2 personnel present for urinary catheter insertion and lack of Emergency Department documentation of catheter insertion orders and catheter indications.

Review of response frequencies also highlighted that only 56.1% of respondents reported annual competency assessments on aseptic technique for urinary catheter insertion and only 58.8% reported annual competency assessments on proper urinary catheter maintenance procedures. In addition, only 69.9% reported that their facilities routinely audited adherence of health care personnel to aseptic technique for urinary catheter insertion. Inconsistencies in whether ordering providers documented an indication for indwelling urinary catheters were also reported (36.7% Always, 25.6% Often, 20.9% Sometimes, 6.9% Rarely, 1.9% Never, 7.9% Unknown). In addition, the percent of respondents who reported that their facilities "Always" used alerts, reminders, or stop orders for indwelling urinary catheter removal was also low (42.2% Always, 14.6% Often, 8.4% Sometimes, 3.9% Rarely, 8.2% Never, 22.7% Unknown).

When stratifying by respondent role, 35.3% of medical providers reported that they did not know if feedback was routinely given to staff on CAUTI rates or standardized infection ratios, and 48.5% did not know if feedback was given on indwelling urinary catheter device utilization ratios (DURs). Additionally, 25.5% of medical providers reported they did not know if their facility identified patients who had indwelling urinary catheters in place (eg, flagged in electronic medical records or daily unit lists). For both nurses and medical providers, a high percentage of respondents did not know if nurses responded to alerts or reminders for urinary catheter removal by removing unnecessary catheters or calling the physician (nurses, 17.7% Unknown; medical providers, 25.2% Unknown) or if physicians were supportive of nurses using nurse-directed removal protocols if they were in place (nurses, 20.4% Unknown; medical providers, 22.2% Unknown). A large percentage of medical providers also did not know if nurses were comfortable using these protocols (36.8% Unknown).

CLABSI

Across CLABSI assessments, a lack of physician champions for CLABSI prevention activities was reported as a gap, along with inconsistencies in whether training was provided and competency assessments were conducted on proper insertion of central lines upon hire, annually, and with the introduction of new equipment or protocols (Table 3). A lack of feedback to staff on central line DURs was also reported, in addition to inconsistencies in whether central lines were replaced within 48 hours when adherence to aseptic technique could not be ensured, and the use of chlorhexidine-impregnated dressings for short-term nontunneled central lines in adults.

Review of response frequencies also highlighted that only 54.5% of respondents reported that their facility had a nurse champion for CLABSI prevention activities, only 73.8% reported that aseptic technique was "Always" maintained during central line insertions and only 75.4% reported that clean skin was "Always" prepared as recommended before central line insertions with >0.5% chlorhexidine with alcohol. Additionally, there was inconsistent knowledge of whether health care providers used maximal sterile barrier precautions when performing central line insertions. The percentages of staff who reported that personnel "Always" used these precautions was only 73.0% for caps, 81.0% for masks, 79.4% for sterile gowns, 84.5% for sterile gloves, and 75.2% for sterile full body drapes.

Stratification by respondent role identified that among nurses, only 81.1% reported that central venous catheters were "Always" accessed with only sterile devices, 68.8% reported that dressings were "Always" immediately replaced when wet, soiled, or dislodged, and only 70.0% reported that dressings for short-term, nontunneled central lines were changed within recommended time frames. For medical providers, 36.4% reported they did not know if auditing of daily documentation regarding the need for central venous catheters occurred. Only 61.6% of medical providers and 62.0% of nurses

Table 3
Central line-associated bloodstream infections (CLABSI) Targeted Assessment for Prevention (TAP) Strategy Facility Assessment, response frequencies for identified gaps*, all respondents

Domain	Question	Yes	No	Unknown
General infrastructure	Does your facility have a physician champion for CLABSI prevention activities? (N = 1,657)	568 (34.3%)	237 (14.3%)	852 (51.4%)
	Does your facility provide training to all health care personnel on proper insertion of central lines for all health care personnel with this responsibility?			
	A. Upon hire/during orientation? (N = 1,319)	705 (53.4%)	146 (11.1%)	468 (35.5%)
	B. At least annually? (N = 1,312)	563 (42.9%)	189 (14.4%)	560 (42.7%)
	C. When new equipment or protocols are introduced? (N = 1,312)	731 (55.7%)	123 (9.4%)	458 (34.9%)
	Does your facility conduct competency assessments of all health care personnel on proper insertion of central lines for all health care personnel with this responsibility?			
	A. Upon hire/during orientation? (N = 1,275)	579 (45.4%)	120 (9.4%)	576 (45.2%)
	B. At least annually? (N = 1,270)	486 (38.3%)	164 (12.9%)	620 (48.8%)
	C. When new equipment or protocols are introduced? (N = 1,270)	568 (44.7%)	120 (9.4%)	582 (45.8%)
	Does your facility routinely provide feedback to health care personnel on central line device utilization ratios (DUR)? (N = 1,613)	881 (54.6%)	167 (10.4%)	565 (35.0%)

		Always	Often	Sometimes	Rarely	Never	Unknown
Proper insertion practices for central venous catheters	Are central lines replaced within 48 h when adherence to aseptic technique cannot be ensured (ie, catheters inserted emergently)? (N = 1,567)	548 (35.0%)	214 (13.7%)	101 (6.4%)	42 (2.7%)	19 (1.2%)	643 (41.0%)
	Are chlorhexidine-impregnated dressings used for short-term, nontunneled central lines in patients ≥18 years of age? (N = 1,092)	619 (56.7%)	60 (5.5%)	12 (1.1%)	5 (0.5%)	20 (1.8%)	376 (34.4%)
Proper maintenance practices for central venous catheters	Is tubing used to administer propofol infusions replaced every 6-12 h, when the vial is changed, according to manufacturer's recommendations? (N = 1,505)	721 (47.9%)	112 (7.4%)	20 (1.3%)	1 (0.1%)	6 (0.4%)	645 (42.9%)

*Gaps defined as ≥33% Unknown, ≥33% No, or ≥50% Negative responses (Unknown + No, Unknown + Never + Rarely + Sometimes).

reported that audits on proper central line insertion practices took place in their facilities.

DISCUSSION

Across both CAUTI and CLABSI TAP Facility Assessments, lack of physician and nurse prevention champions and inconsistency in awareness of competency assessments, audits, and feedback were reported. For CAUTI, additional deficiencies were reported in timely removal practices for urinary catheters, while for CLABSI, respondents perceived issues with select device insertion practices, such as maintaining aseptic technique, skin preparation, and utilizing maximal sterile barrier precautions.

For both CAUTI and CLABSI, only around half of respondents reported that nurse champions were present at their facilities and only around 30% of respondents reported that physician champions were present. This perceived lack of champions signals that champions may not exist or may not be facilitating prevention efforts effectively enough for staff to be aware of their presence. This may hinder the success of infection prevention efforts and was similarly identified by state level personnel as a perceived barrier to the implementation of a national collaborative for *C. difficile* infection prevention in hospitals.[10] CAUTI and CLABSI champions are important to help shape change by overcoming implementation barriers, developing organizational support for initiatives, and facilitating use of resources.[11] When implementing behavioral changes, more than one champion may be needed. Furthermore, the presence of active champions may be a signal of healthy working relationships and could be a structure or process indicator when evaluating process improvement programs.[12]

For both CAUTI and CLABSI, responses for several assessment items related to whether competency assessments were conducted highlighted possible areas for improvement. For CAUTI, responses indicated that competency assessments may not have been conducted at least annually on aseptic technique for urinary catheter insertion and urinary catheter maintenance procedures. For CLABSI, failure to conduct competency assessments on proper insertion of central lines was perceived. This highlights a potential opportunity for improvement in device-associated care, as conducting competency assessments has been shown to improve adherence to preferred practices.[13] Another possible explanation for this gap is staff comprehension of the term competency assessments and varied interpretation among groups on what this term meant. In TAP Facility Assessments, competency assessment is defined as a process of ensuring that health care personnel demonstrate the minimum knowledge and skills needed to safely perform a task according to facility standards and policies.[6] Educating staff on why competency assessments are being performed may improve understanding of the importance of competency assessments in preventing HAIs.

Additionally, fewer respondents reported that competency assessments occurred at least annually compared to upon hire/during orientation or when new equipment or protocols were introduced, suggesting that annual competency assessments were less common in facilities. This also aligned with responses regarding annual training on the insertion of central lines found in CLABSI assessments. This may be due to the limited number of health care personnel completing the assessments who are actually responsible for inserting central lines. However, frontline personnel should be aware of the importance of these procedures and competency on understanding of the insertion procedure should be assessed in an ongoing manner to ensure that frontline personnel are able to monitor the sterility of the procedure and address lapses if they occur.[14]

Lack of feedback about prevention practices was also commonly highlighted across both Assessments. A low percentage of medical providers reported that feedback was provided on CAUTI rates or standardized infection ratios and indwelling urinary catheter DURs, and a low percentage of overall respondents reported that feedback

was given on central line DURs for CLABSI, highlighting that feedback may not have been provided to staff or was not provided in an effective manner. These practices may indicate a key area for improvement, as providing feedback to providers has been cited as an important aspect of using data for action in the prevention of infections.[15] Ensuring that personnel that insert or maintain central lines or urinary catheters receive feedback about adherence to CAUTI and CLABSI bundle elements, and investigating causes of nonadherence, may assist in the implementation of needed behavioral change. Feedback may be most effective when it is provided by a trusted source, is multimodal (ie, talk and text), when it provides relevant comparisons, and when it is related to a goal.[16]

Specific to CAUTI assessments, inconsistencies in several practices to facilitate the timely removal of urinary catheters were reported. These included whether facilities used alerts, reminders, or stop orders for indwelling urinary catheter removal, and whether physicians and nurses responded to alerts or reminders by removing urinary catheters. The perceived deficiencies in these practices across assessments highlight a possible area for improvement, as they have been cited by CDC as effective strategies to reduce the risk of CAUTI.[17] Inconsistencies in whether nurse-directed removal protocols were utilized in facilities, including whether nurses were comfortable using these protocols and whether physicians were supportive of nurses using these protocols, were also reported and indicate an opportunity for improvement. As described by Parry et al, implementation of nurse-directed removal protocols may facilitate the timely removal of urinary catheters, thus minimizing the infection risk and improving infection prevention practices.[18]

In CLABSI assessments, several practices related to the insertion of central lines were highlighted as possible areas for improvement in infection prevention. In addition to reported gaps in whether training and competency assessments on proper insertion were conducted, a suboptimal number of respondents reported that aseptic technique was “Always” maintained during insertions and that skin was cleaned with 0.5% chlorhexidine with alcohol before insertions. These practices, along with the reported inconsistencies in whether maximal sterile barrier precautions were used during insertions highlight that several practices which are essential to infection prevention during the insertion of central lines may not be consistently performed and/or may not be consistently understood and recognized by all staff. This is particularly important given that insertion practices rolled into bundles have consistently been shown to decrease CLABSI rates.[19-22] However, adherence to all bundle components may be essential, as a nationwide study of critical care units with central line insertion bundles found that only 38% of facilities with bundles monitored adherence and among these facilities, decreases in infections occurred only among those with ≥95% bundle adherence.[21]

This evaluation had several limitations. It was conducted as part of technical assistance and therefore reflects a convenience sample of facilities with varying characteristics that were not controlled for in the analysis. Hence, the data presented are not nationally representative. The information on infection prevention procedures and policies collected in assessments were self-reported by respondents and only represented respondent perceptions. Varying operationalization and understanding of terms between facilities and roles may also have impacted the responses to some assessment questions. This may have led to higher numbers of unknown responses and resulted in misidentification of some gaps. However, it is important to note that unknown responses may provide an opportunity for improvement through additional inquiries or analyses at an individual facility level. Based on interpretation at the facility level, unknown responses may indicate either a lack of awareness or adherence to an existing policy, or an absence of the policy itself. To best inform infection prevention efforts, all potential gaps should require further investigation and evaluation in order to direct prevention activities to areas of greatest need.

CONCLUSIONS

Overall, these data point to a need for champion and leadership involvement, conduct of audits and provision of feedback, as well as provider training and competency, in device-related HAI prevention practices. These remain basic and critical components of any infection prevention and control program. Understanding gaps in infection prevention and control is essential for implementing targeted and efficient improvement efforts. Facilities should work to mitigate gaps identified in these areas for successful CAUTI and CLABSI prevention efforts.

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