



Contents lists available at ScienceDirect

# American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

## Brief Report

# Braden score may be associated with time to onset of catheter-associated urinary tract infection in high-risk patients: Lessons learned from a root cause analysis tool

Beverly Sturgill RN, MSN, CIC<sup>a</sup>, Harsh Patolia BS<sup>b</sup>, Alexis Gushiken MD<sup>a,b</sup>,  
Mariana Gomez dela Espriella MD<sup>a,b</sup>, Anthony W. Baffoe-Bonnie MD<sup>a,b,\*</sup>

<sup>a</sup> Carilion Roanoke Memorial Hospital, Roanoke, VA

<sup>b</sup> Virginia Tech Carilion School of Medicine, Roanoke, VA



### Key Words:

Healthcare-acquired infection  
Nurse driven catheter removal protocol

Timely removal of the urinary catheter is an important strategy for decreasing catheter-associated urinary tract infections (CAUTIs). Data were aggregated from an electronic root cause analysis tool, which is used to collect and guide discussions on patient factors following a CAUTI event at our facility. This identified the Braden Scale score as a possible important predictor of early-onset CAUTI in high-risk patients and could potentially be leveraged for early action in urinary catheter removal.

© 2018 Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.

## BRADEN SCALE SCORE

### Health care–acquired infection

Timely removal of the urinary catheter (UC) is an important strategy for decreasing catheter-associated urinary tract infections (CAUTIs), which remain a significant public health, economic, and patient safety burden.<sup>1–3</sup> The Braden Scale is a widely employed and well-validated tool among nursing staff in assessing the risk for pressure ulcers in the inpatient setting<sup>4,5</sup> (Table 1).

Cohen et al<sup>6</sup> have demonstrated the Braden Scale score as an independent predictor of adverse outcomes in geriatric surgical patients. No literature exists on how this commonly used and readily available scale impacts the time to development of health care–acquired infections such as CAUTIs. The objective of our study was to determine if early CAUTI occurrence in high-risk patients could be related to their Braden Scale scores on admission. Such information would augment the nurse-driven protocol for catheter removal by focusing staff on the high-risk patient who is likely to develop an early CAUTI.

## METHODS

This was a retrospective cohort analysis based on aggregated patient data abstracted from an electronic root cause analysis (RCA) tool for CAUTI cases. All hospitalized patients ( $\geq 18$  years old) with CAUTIs, as defined by using the Centers for Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) criteria from January 2015 to December 2015, were included.<sup>7</sup>

A CAUTI event is “called” by the hospital infection preventionist using the CDC/NHSN criteria. This triggers an electronic questionnaire on patient and care-related factors preceding the event (age, sex, days between insertion of Foley catheter and CAUTI event, body mass index, Braden score at admission, reason for UC insertion and maintenance, presence of diabetes, organism type, etc), which is answered by the infection preventionist, the patient’s nurse, and nurse manager for the unit in which the CAUTI occurred. A debriefing of the individual CAUTI case is then undertaken and guided by the questionnaire responses and held among stakeholder nurses, patient safety advocates, and the infection preventionist at weekly quality rounds. We aggregated this prospectively collected data for all CAUTI cases in the calendar year 2015 with the intention of probing the patient and care-related factors for association with early development of CAUTI.

Our outcome measure was time (days) to development of a CAUTI. Cases were stratified into early-onset CAUTI, defined as the occurrence of an event within 7 days of UC placement, and late-onset CAUTI, defined as the occurrence of an event after 7 days of UC placement. Categorical and continuous variables were assessed using the

\* Address correspondence to Anthony W. Baffoe-Bonnie, MD, 213 McClanahan Dr, Roanoke, VA 24014.

E-mail address: [abaffoe6@vt.edu](mailto:abaffoe6@vt.edu) (A.W. Baffoe-Bonnie).

Conflicts of interest: None to report.

**Table 1**  
The Braden Scale

Sensory perception	1. Completely limited	2. Very limited	3. Slightly limited	4. No impairment
Moisture	Constantly moist	Very moist	Occasionally moist	Rarely moist
Activity	Bedfast	Chairfast	Walks occasionally	Walks frequently
Mobility	Completely immobile	Very limited	Slightly limited	No limitation
Nutrition	Very poor	Probably inadequate	Adequate	Excellent
Friction and shear	Problem	Potential problem	No apparent problem	

NOTE. Score is the sum of the highest individual scores across the 6 listed categories and is used to assess pressure ulcer risk.

**Table 2**  
Patient and care-related characteristics at time of admission of the full cohort, early-CAUTI, and late-CAUTI populations

Variables	Full cohort (n = 114)	Early CAUTI (n = 63)	Late CAUTI (n = 51)	P value
Mean age, y	61.6	61.6	61.5	.963
Female sex	62 (54.4%)	39 (61.9%)	23 (45.1%)	.073
Mean body mass index	29.6	29.7	29.3	.773
Diabetes or hyperglycemia (glucose > 200 mg/dL) (n = 112)	56 (50%)	30 (49.2%)	26 (51%)	.851
Median Braden score at admission (IQR)	15 (12–20)	17 (13–20)	14 (12–18)	.048

CAUTI, catheter-associated urinary tract infection; IQR, interquartile range.

$\chi^2$  test, the Student t test, or the Mann-Whitney U test when appropriate, and regression models were used to identify independent risk factors. Statistical analyses were performed by using Stata (version 14.2; Stat Corp LLC, College Station, TX). The study was deemed as quality improvement by our institutional review board.

## RESULTS

A total of 114 patients were identified as having a CAUTI based on the CDC/NHSN criteria (Table 2). The mean age was 62 years, and most patients (54%) were female. Fifty-six (50%) patients with available data were either diagnosed as diabetic or had a blood sugar level > 200 mg/dL prior to the CAUTI event. Seventy-three (68%) patients with a reported body mass index were in the overweight ( $\geq 25$  kg/m<sup>2</sup>) or higher category. The average duration of catheter placement prior to the CAUTI in this population was 7 days. Sixty-three patients developed early-onset CAUTI, whereas 51 patients had late-onset CAUTI. The most common reason stated for UC insertion was for use in the critically ill patient requiring accurate input and output measurements in 94 (82.5%) patients and was used similarly across the groups. Of the 13 patients with a UC placed to assist healing of a sacral decubitus wound, 12 were in the late-CAUTI group. Gram-negative rods accounted for 78% of the infections, with *Escherichia coli* accounting for 30% of all infections. When sex was included in the multivariate model, a higher Braden score was not found to be a predictor of early-onset CAUTI (odds ratio, 0.91; 95% confidence interval, 0.82–1.00;  $P = .051$ ).

## DISCUSSION

The cohort of 114 patients with CAUTIs was predominantly female and elderly, with 50% having diabetes, all important factors for developing a CAUTI. In this high-risk cohort, our univariate analysis suggested a possible relationship between higher Braden scores at admission and early-onset CAUTI. This counterintuitive finding was not confirmed with our multivariate model but merits further probing given the widespread use of Braden scores by nurses.

Patients with high Braden scores at admission tend to have better mobility and are less likely to develop pressure ulcers. Although this may be protective with regard to developing pressure ulcers, we hypothesize that such patients are also more likely to be more active while they have a urethral catheter in situ, leading to local trauma

and introduction of bacteria in the urethra. There is also an increased chance that the urine bag may be repositioned above the bladder or kinking of the catheter drain may occur with independent patient movement. As such, although prompt catheter removal is encouraged for all patients, the nurse who identifies a high Braden score at admission in a patient with a UC should reassess the continued need for the UC and advocate for noninvasive alternatives, including the condom catheter in males or the female external catheter when feasible.

Our study utilized aggregated data from an electronic CAUTI RCA questionnaire to determine if certain patient or patient-care factors were associated with early-onset CAUTI in a manner that individual RCAs would not have identified. Trends generated from this global analysis of our data can be used to inform local quality improvement initiatives such as targeted provider and unit-based education on UC alternatives.

This retrospective study was conducted in a single center and with a small sample size. The inherent limitations of the study design and sample size currently limit its generalized application. Another limitation of this study is the absence of data on UC insertion technique and hand hygiene, which are known risk factors for early-onset CAUTI.<sup>8</sup> We propose a larger multisite prospective study with a priori defined data points to overcome these limitations. We believe that replication of our study is feasible at multiple centers considering that the Braden score is widely used and its implication for CAUTI would readily be applicable at the bedside.

## CONCLUSIONS

We view our study finding of high Braden scores possibly being associated with early-onset CAUTI as information that the bedside nurse in our institution may leverage for early nurse-driven catheter removal but recognize that it merits further probing. Furthermore, the role of the Braden score in the development of CAUTI should also be examined.

## References

1. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control* 2000;28:68–75.
2. Klevens RM, Edwards JR, Richards CL, Horan TC, Gaynes RP, Pollock DA, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. *Public Health Rep* 2007;122:160–6.

3. Leuck AM, Wright D, Ellingson L, Kraemer L, Kuskowski MA, Johnson JR. Complications of Foley catheters—is infection the greatest risk? *J Urol* 2012;187:1662-6.
4. Bergstrom N, Demuth PJ, Braden BJ. A clinical trial of the Braden Scale for predicting pressure sore risk. *Nurs Clin North Am* 1987;22:417-28.
5. Park S-H, Choi Y-K, Kang C-B. Predictive validity of the Braden Scale for pressure ulcer risk in hospitalized patients. *J Tissue Viability* 2015;24:102-13.
6. Cohen R-R, Lagoo-Deenadayalan SA, Heflin MT, Sloane R, Eisen I, Thacker JM, et al. Exploring predictors of complication in older surgical patients: a deficit accumulation index and the Braden Scale. *J Am Geriatr Soc* 2012;60:1609-15.
7. Centers for Disease Control and Prevention. Urinary tract infection (catheter-associated urinary tract infection [CAUTI] and non-catheter-associated urinary tract infection [UTI]) and other urinary system infection [USI] events. Available from: <https://www.cdc.gov/nhsn/PDFs/pscManual/7pscCAUTIcurrent.pdf>. Accessed June 7, 2018.
8. Lo E, Nicolle L, Coffin S, Gould C, Maragakis L, Meddings J, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol* 2014;35:464-79.