Evidence-Based Prevent Catheter-Associated Urinary Tract Infections Guidelines and Burn-Injured Patients: A Pilot Study

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The objective of this pilot study was to describe effectiveness of an evidence-based guideline designed to prevent catheter-associated urinary tract infection (CA-UTI) in reducing CA-UTI in the burn-injured patient population. The study used a pre- and post-bundle implementation comparison design. Inclusion criteria included burn-injured patients of all ages with an indwelling urinary catheter. Patient demographic data were collected by medical record review when informed of a CA-UTI. The Rosswurm–Larrabee Model six-step process model guided implementation of practice change. The sample included eight burn-injured patients (7–88 years). Catheter day range was 1 to 27 days. Each patient had a clear indication for an indwelling urinary catheter; the need for accurate urinary output measurement in a critically injured patient. Four patients had a catheter placed twice during the stay. Nurses reported using a bladder scanner to assess bladder volume for post-operative patients with urinary retention avoiding use of an indwelling urinary catheter in some cases. Integration of evidence-based guidelines in practice resulted in a reduced CA-UTI rate, reduced catheter days, increased days between CA-UTI, and outperformance of the national benchmark statistic. In 2013, the burn unit reduced catheter days by about 75% and reduced infection incidence by >90% in three quarters after implementation of the practice changes. The unit was able to sustain a CA-UTI rate of zero for 248 days. (J Burn Care Res 2015;36:e1–e6)

More than 25% of patients with an indwelling urinary catheter for >2 days develop bacteriuria and a quarter of these patients develop a catheter-associated urinary tract infection (CA-UTI) representing 80% of healthcare-associated infection.[1] A strong, direct correlation exists between CA-UTI and catheter dwell time >6 days.[2] Evidence-based guidelines exist to prevent CA-UTI, making it a preventable healthcare-associated infection.[1,3–10] Hospitals report an estimated 450,000 events/year as compared to Centers for Disease Control and Prevention (CDC). National Healthcare Safety Network (NHSN) reported CA-UTI pooled mean rates that range from 1.2 infections per 1,000 catheter-days in pediatric hematology or oncology critical care units to 7.4 in burn and neurology critical care units.[3–7] The Centers for Medicare & Medicaid Services (CMS) estimates the annual treatment cost of CA-UTI, using the consumer pricing index for inpatient hospital services, to be between $424 and $451 million annually.[8] A CA-UTI episode prolongs a hospital stay an estimated 0.5 to 1 day. Individual hospitals report CA-UTI associated costs of between $500 and $700 per case. If the patient develops a secondary blood stream infection, the estimated cost per case increases to between $2,500 and $3,000.

The Joint Commission National Patient Safety Goal June 7, 2001 on CA-UTI allows for each organization to decide based on its risk assessment whether CA-UTI is a priority warranting surveillance.[7] As a result, CA-UTI rate may be underreported with less than 50% of hospitals conducting CA-UTI surveillance.[9] Clinicians may perceive CA-UTI as a benign or acceptable side effect of care despite the risk secondary blood stream infection and acute pyelonephritis.[10]

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Risk factors include catheterization method, catheter dwell time, quality of catheter care, and host susceptibility.[11–13] Reviews and meta-analyses of silver-coated and antibacterial urinary catheters consistently conclude that evidence does not support a recommendation for the uniform use of such devices.[14–17] The literature identifies four key drivers for CA-UTI prevention. The first key driver is a clear indication for insertion and the second is prompt removal to reduce unnecessary catheter days. National guidelines report up to nine indications for an indwelling urinary catheter with wide variance in adoption.[1,10,18–20] The third key driver, proper insertion, and fourth key driver, maintenance technique, both prevent introduction of non-intestinal or environmental microbes into the bladder.[2,10,19,20] Nursing care quality directly impacts CA-UTI since nurses have primary responsibility for catheter insertion and maintenance care.[21] Bundles include a small, straightforward set of evidence-based practices that, when performed collectively and reliably, improve patient outcomes.[22] The CDC urinary catheter insertion and maintenance bundles provide standard practices for improving the care processes and outcomes for patients with an indwelling urinary catheter.[1]

U.S. hospitals are experiencing unacceptable CA-UTI incidence despite established evidence-based guidelines and external forces calling for improved outcomes (CMS, The Joint Commission, American College of Surgeons National Surgical Quality Improvement Program, ANCC Magnet Recognition Program, National Solutions for Patient Safety Children's Hospitals Collaborative).[1,9] The National and State Healthcare-Associated Infections Progress Report (2014) describes a 3% national increase in CA-UTI rates from 2009 to 2012. Fifteen states performed better and 16 worse than the standardized infection ratio. The frequency of CA-UTI creates a patient safety and quality concern.

No studies reporting the degree to which burn centers can prevent CA-UTI were located. The pilot study goal was to describe the effectiveness of an evidence-based guideline designed to prevent CA-UTI in reducing CA-UTI in the pediatric and adult burn-injured patient population in children's hospital acute care setting. The study was approved by the hospital institutional review board.

METHODS

A pre- and post-bundle implementation comparison design was used for study of the impact of implementation of best practices to prevent CA-UTI in adult and pediatric burn-injured patients admitted to the study site burn unit located in a children's hospital. Inclusion criteria were burn-injured patients of all ages with an indwelling urinary catheter.

Providers used consistent antibiotic prescribing practices during the study period (pre- and post-implementation of the bundles). Surgeons prescribed prophylactic antimicrobial therapy only for coverage of the immediate perioperative period surrounding excision or grafting of the burn wound if used to cover the documented increase in risk of transient bacteremia. Surgeons started treatment immediately before the procedure and generally discontinued within 24 hours. The surgeons prescribed systemic antimicrobials to treat documented infections such as pneumonia, bacteremia, wound infection, and urinary tract infection (UTI). Empiric antimicrobial therapy to treat fever is not standard practice at the study site as burn patients often have fever secondary to the systemic inflammatory response to burn injury.

The process to investigate possibility of UTI and CA-UTI remained the same throughout the study period (pre- and post-bundle implementation). Providers (physician, nurse practitioner, physician assistant) followed the CDC NHSN definitions for investigating possibility of a symptomatic UTI (UTI associated, asymptomatic (UTI catheter associated, or UTI after catheter removal).[23] The hospital infection control nurse determined presence of CA-UTI using the CDC definition of development of a laboratory confirmed presence of a UTI (≥50,000 colonies per milliliter of a single uropathogenic organism in an appropriately collected specimen of urine) in a patient who had an indwelling urethral urinary catheter in place within the 48-hour period before the onset of the UTI (the "accepted standard" for infection prevention and control); a standard procedure at the study site.[24] An indwelling catheter is a drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a closed collection system.[24] The burn unit used Foley® catheters (C.R. Bard, Covington, GA).

Patient demographic data were collected by medical record review when informed of a CA-UTI. The Rosswurm–Larrabee Model guided implementation of practice change with a six-step organizational and usage plan.[25] In the first step, the study team selected the burn unit as a pilot site after review of 2011 to 2012 unit-level CA-UTI outcome data and NHSN pooled mean benchmark statistic preimplementation of the bundles at a unit-level research committee meeting. Providing CA-UTI rate data to clinicians helps reduce infection rates.[26] In the second step,

the interventions and outcomes were linked by introducing NHSN standard language for CA-UTI, describing proposed measures to prevent CA-UTI, and identifying process measures (adherence to bundle components) and outcome indicators (number of events, rate, catheter days, and days between CA-UTI events). In the third step, the literature review and synthesis of evidence was completed. The CDC guidelines provide a detailed description of the insertion and maintenance bundles used.[1] The research committee engaged in a discussion of the feasibility, benefits, and risks of implementing or not implementing the proposed practice changes. Involving clinicians provided the opportunity for an understanding of rationale for the proposed practice changes for more successful adoption. In the fourth step, the team designed the practice change by defining proposed practice changes, identifying needed resources, and planning the implementation process (staff education, establishing process reliability, process for clarification as needed, and a process for outcome reporting). Engaging clinicians in design of the implementation was a critical component that identified facilitators and barriers to implementation of best practices. For example, nursing staff reorganized supplies to assure catheter securement devices were stored near the urinary catheters and catheter kits and requested bundle checklists for placement in patient rooms as reminders of the bundle elements. If questions arose, the nursing staff contacted the unit nurse educator and/or the researcher who followed up with an SBAR (Situation, Background, Assessment, Recommendation) communication with answers to all burn unit staff. Process measures and outcome data were discussed monthly at interdisciplinary burn unit research committee meetings. During the bundle effectiveness evaluation phase, the surgical team initiated a significant practice change by recommending that nursing staff provide wound care for patients with an indwelling urinary catheter over the hydrotherapy tub instead of by immersion in the hydrotherapy tub; not a standard bundle component. The surgical team and nursing staff provided feedback on algorithms for catheter insertion, catheter maintenance, and contributed to refinement of a nurse-directed catheter removal algorithm. The use of insertion and maintenance bundle checklists and removal algorithms are effective strategies to monitor indication for an indwelling urinary catheter and bundle components.[27] Licensed nurses and unlicensed assistive personnel assigned to or temporarily assigned to work in the burn unit who have responsibility for insertion and maintenance of indwelling urinary catheters, handling the urinary drainage system, and/or assisting with patient hygiene completed a pretest, education module, and posttest on the prevention guidelines. After the posttest, two registered nurses observed 25% of the burn unit staff (a representation of all unit staff) for reliability of use of the bundles in practice with staff coaching on best practices as needed. Interrater reliability of staff use of the bundles was established at 100%. In the fifth step, the team implemented the practice change and evaluated process reliability measures and outcome indicators. The unit education coordinator and investigator provided bedside coaching in best practices to sustain high reliability with best practices. Staff also completed daily self-report forms indicating barriers and facilitators for use of the bundles. Based on outcomes, it was recommended that the unit adopt, adapt, or reject the change in practice. If the practice change was not effective in improving quality of care by reducing CA-UTI, the process would have ended. Since the unit adopted and/or adapted the practice changes, the process moved to the sixth and final step of integrating and maintaining the practice change. The bundles were integrated into hospital policy and guidelines, an organization-wide staff education plan, and patient or family education materials. In the sustain phase, quality improvement methodology was continued for ongoing tracking, trending, and analysis of process measures and outcome indicators. This data are tracked internally and benchmarked with the National Database of Nursing Quality Indicators and the national Children's Hospitals' Solutions for Patient Safety network.[28,29] During the bundle implementation phase, all CA-UTI events were evaluated with the clinical team using a CA-UTI-specific apparent cause analysis process. CA-UTI rate, national benchmark statistic, catheter days, and days between CA-UTI were communicated with the unit every month. Monitoring and reporting of intervention outcomes on a consistent basis and considering implementation of additional improvements facilitates sustained success.[10]

RESULTS

The sample included eight burn-injured patients ranging in age from 7 to 88 years (mean = 45, SD = 25) with one patient under age 18 years. Six participants were male patients (75%). All participants, legal guardian and/or legal authorized representative spoke and understood English as their primary language. The TBSA ranged from 5 to 35% (Table 1). The hospital laboratory reported 24 urine cultures/245 catheter days pre-bundle implementation, 17 urine cultures/120 catheter days during

Subject	%TBSA	Burn Location
6	0-4%	Genitalia, R Thigh, L Thigh
1	5-10%	Anterior Trunk, R Upper Arm
8	5-10%	R Buttock, L Buttock, L Thigh, R Thigh, Anterior Trunk
5	11-15%	Neck, L Lower Arm, Genitalia, Posterior Trunk, Anterior Trunk
3	16-20%	R Hand
4	16-20%	L Upper Arm, Anterior Trunk, Posterior Trunk, Head
2	26-30%	L Upper Arm, Posterior Trunk, Anterior Trunk, R Hand, R Upper Arm
7	31-35%	Anterior Trunk, Left Upper Arm, Neck, R Hand

Table 1. Percent TBSA and location by subject.

education on the bundles, and 7 urine cultures/83 catheter days after bundle implementation. Catheter days ranged between 1 to 27 days (mean 12 days, median 13 days). Each patient had a clear indication for an indwelling urinary catheter; the need for accurate urinary output measurement in a critically injured patient. In 2013, the burn unit reduced catheter days by about 75% and reduced CA-UTI incidence by >90% in the first three quarters after implementation of the bundles (practice changes; Figures 1–3). The urinary catheter usage ratio dropped from 0.24 in 2011 and 0.23 in 2012 to 0.10 in 2013.

DISCUSSION

Implementation of easily replicable evidence-based bundles using a process model appears to have been effective at reducing the CA-UTI rate, catheter days, and days between CA-UTI in the study site compared to standard practice. Small sample size during the bundle implementation phase of the study prevented additional statistical analysis to establish statistical significance. The burn unit was able to sustain a CA-UTI rate of zero for 248 days—a major milestone. Four patients had a catheter placed twice during the stay increasing risk of CA-UTI. Nurses reported using a bladder scanner to assess bladder volume for post-operative patients with urinary retention avoiding use of an indwelling urinary catheter in some cases, reducing risk of CA-UTI. The CA-UTI rate expressed as events per 1000 device days serves as the traditional metric as reported in the literature. However, as catheter days decrease and infection events, the CA-UTI rate does not adequately measure quality improvement efforts to decrease catheter usage. Consistent with the literature, UTI occurred principally in patients with indwelling urinary catheters. Compounded by a 75% decrease in catheter days post-bundle implementation, there were fewer expected CA-UTI. If replicating this study, the literature recommends selecting multiple appropriate measures of success in addition to the CA-UTI rate.[30]

Difficulty in determining whether a CA-UTI is hospital acquired when the patient is admitted with a catheter in place or when the patient may have had asymptomatic UTI before catheter placement was a study limitation. Quality of nursing care impacts reimbursement since CA-UTI is one of the hospital acquired condition "never events" that CMS will not reimburse for care. When CMS released their plan to eliminate payment for CA-UTI, screening patients before catheter insertion to detect UTI was a hot

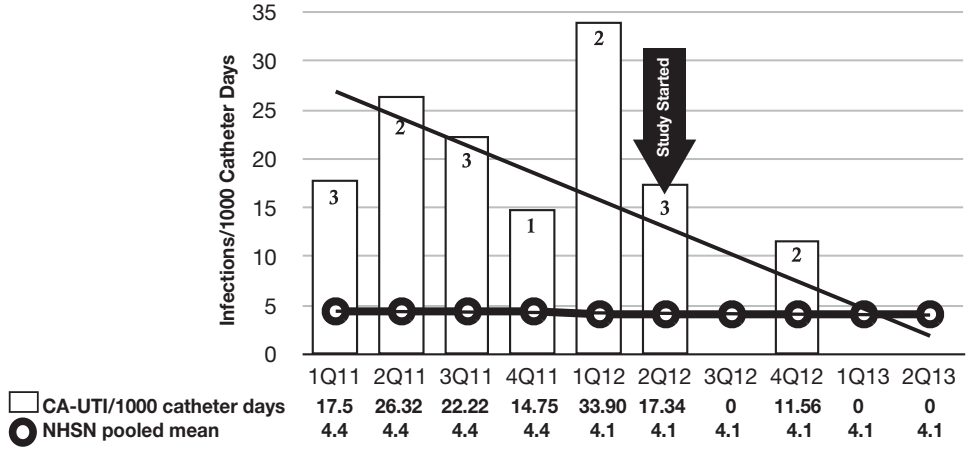

Figure 1. CA-UTI Rate Pre- and Post-Bundle Implementation.

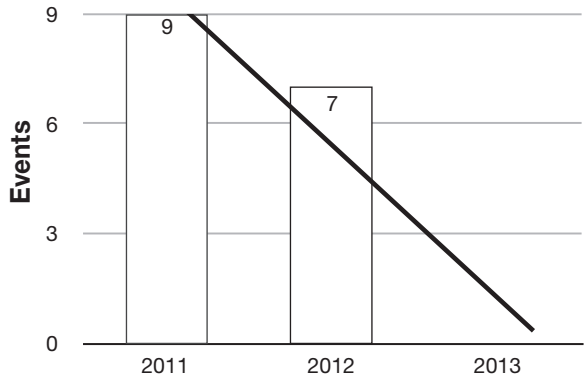

Figure 2. CA-UTI Events Pre- and Post-Bundle.

topic in the literature. Experts recommend against routine screening for baseline UTI, except in high-risk populations (eg, pregnant women).[31]

Benefits to the study site included reduced CA-UTI rate, reduced catheter days, reduced days between CA-UTI, and outperformance of the national benchmark statistic as a measure of quality of care. The improvements optimized opportunity for CMS inpatient prospective payment. Mentoring on planned changes in practice based on evidence using a process model is an effective strategy to increase quality of nursing care.

This pilot study examined the feasibility of an approach intended for a larger scale study with an opportunity to achieve a sample size calculated using statistical power analysis. The pilot served as an initial step in exploring the effectiveness application of an evidence-based practice model for integration of evidence-based insertion and maintenance bundles to reduce CA-UTI into practice and determined the feasibility of recruitment of burn-injured patients in a burn unit that is part of a regional burn center. Pilot results informed about modifications needed in the design of a larger hypothesis testing study—possibly multi-site. There is a need for additional study of factors preventing elimination of CA-UTI in burn injured patients.

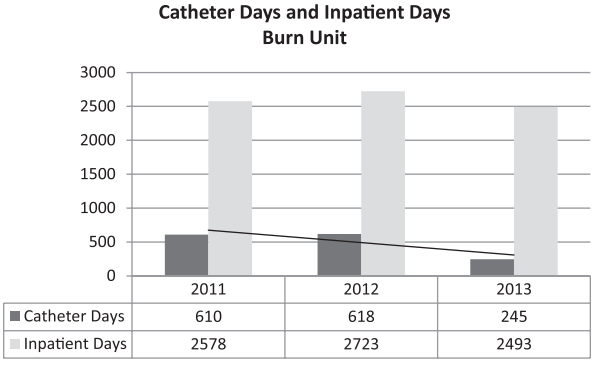

Figure 3. Indwelling urinary catheter days compared to inpatient days pre- and post-bundle implementation.

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