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Practice forum

Nurse-directed interventions to reduce catheter-associated urinary tract infections

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Foley catheter

Background: Catheter-associated urinary tract infections (CAUTIs) are common, morbid, and costly. Nearly 25% of hospitalized patients are catheterized yearly, and 10% develop urinary tract infections. Evidence-based guidelines exist for indwelling urinary catheter management but are not consistently followed.
Methods: A pre/post intervention design was used in this quality improvement project to test the impact of nurse-driven interventions based on current evidence to reduce CAUTIs in hospitalized patients on 2 medical/surgical units. Interventions consisted of hospital-wide strategies including policy and product improvements and unit-specific strategies that focused on a review of current evidence to guide practice.
Results: The number of catheter days decreased from 3.01 to 2.2 ($P = .018$) on the surgery unit and from 3.53 to 2.7 ($P = .076$) on the medical unit. CAUTI rates were too low to achieve significant reduction. Product cost savings were estimated at $52,000/year.
Conclusion: Guidelines derived from research and other sources of evidence can successfully improve patient outcomes. Nurse-driven interventions, combined with system-wide product changes, and patient and family involvement may be effective strategies that reduce CAUTI.

Hospital-acquired, catheter-associated urinary tract infections (CAUTIs) are a common and costly health care concern. In excess of 500,000 CAUTIs occur annually in the United States, accounting for more than 30% of health care-associated infections.[1] Although not as deadly as other health care-associated infections, CAUTI is the single largest source of bacteremia in hospitalized patients, commonly leading to unnecessary antimicrobial use, prolonged hospitalizations, and increased health care costs.[1,2] The indwelling urinary catheter (IUC) is associated with the majority of these infections.

Catheter-associated bacteriuria is the result of the widespread practice of urinary catheterization.[3] Despite this clear association, IUC use is ubiquitous. It is estimated that at least 25% of hospitalized patients have an IUC.[4] Nearly 50% of surgical patients remain catheterized beyond 48 hours postoperatively,[5] and, in the medical population, approximately 50% of patients do not have a clear indication for indwelling urinary catheters.[6] Catheters may be inappropriately retained for days because of convenience, misunderstanding of their necessity/appropriateness, or lack of clear orders for removal.[7] Therefore, efforts to reduce CAUTI prevalence must focus on evidence-based use of IUCs during insertion, maintenance, and removal.[3,8]

Fortunately, there is ample guidance regarding strategies to prevent CAUTI. In 2009, the Centers for Disease Control and Prevention updated their evidence-based guidelines for the diagnosis, prevention, and management of persons in hospitals and long-term care facilities with CAUTI. In addition, several professional societies have recently reviewed the evidence for CAUTI prevention.[2,3,8-10] These guidelines not only encompass diagnostic criteria but also delineate strategies to reduce CAUTI risk and review approaches that are not effective in reducing the incidence of urinary infections.[10,11]

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Based on a review of evidence, the University of Colorado Hospital's CAUTI Interdisciplinary Quality Intervention Team initiated a quality improvement project that provided a multifaceted nursing-driven approach to reduce CAUTIs. Our hospital was not using physician order entry; consequently, using electronic charting systems to provide question prompts or decision trees to validate the need for an indwelling bladder catheter as well as automatic stop orders were not available. The purpose of this quality improvement process study was to develop and implement evidence-based, multifaceted, nurse-driven interventions to improve urine elimination management in hospitalized patients and to measure the impact of these interventions on the duration of indwelling urinary catheterization (dwell time) and the CAUTI incidence among patients on the target inpatient units.

METHODS

Quality improvement approach

Evidence-based practice guidelines derived from valid, current research and other evidence sources can successfully improve patient outcomes and quality care. However, simply disseminating scientific evidence is often ineffective in changing clinical practice. Learning how to implement findings is critically important to promoting high quality and safe care.[12] To facilitate effectively the translation of best evidence into practice, processes enhancing practice change must be embraced by the health care provider.[13] Understanding health care provider decisions, experiences, practice processes, and barriers are considered essential elements that must be explored to successfully implement practice change based on best evidence.[14]

This project used the following framework for implementation:

(1) Recruit a multidisciplinary team. The team included nurses (clinical, educators, and scientists), physicians (hospitalists, infectious disease), rehabilitation therapists and transport personnel, infection control preventionists, central supply, and clinical informatics representatives.
(2) Examine the evidence. An exhaustive literature review was performed, and highlights from the literature were summarized into an evidence table. Consensus guidelines and systematic reviews were used extensively to plan the intervention.
(3) Identify and understand product use, availability, and costs. Refine product use based on the best evidence and cost analysis. Examine the following:
    (a) IUC materials, sizes, kits, drainage bags;
    (b) catheter securement devices;
    (c) urinals and bedpan availability;
    (d) commodes (availability and size);
    (e) bladder scanners; and
    (f) alternatives (incontinence pads, condom catheters, and others).
(4) Measure outcomes. Work with infection control and clinical informatics staff to audit and measure outcomes Provide feedback to staff. Potential measurable outcomes include the following:
    (a) CAUTIs/1,000 catheter-days;
    (b) catheter-days/hospital-days; and
    (c) postoperative catheter-days/patient.

Ethical issues

This was a hospital quality improvement project exempt from institutional review board oversight. All patient data were kept confidential and stored in password protected electronic files; medical record number was the only identifier collected. This project was financially supported by a quality improvement small grant from the University of Colorado Hospital and the University of Colorado Denver School of Medicine.

Setting

The University of Colorado Hospital is a quaternary care, academic medical center located in Aurora, Colorado. The quality improvement project was conducted on 2 adjacent medical/surgical nursing units. Both units have 18 beds and an average daily census of 18 patients. There were approximately 150 patients/month with indwelling urinary catheters on the general surgery unit and 125 patients/month on the pulmonary unit. All patients, except those having urologic surgery, with indwelling urinary catheters were studied.

Intervention

Using a pre/post intervention design, this project evaluated the impact of a multifaceted, nurse-driven intervention incorporating evidence-based practice champions of change (nurses who met to review evidence sources), clinical nursing staff (registered nurses [RNs], and certified nursing assistants [CNAs]) and patients and families to reduce CAUTIs in hospitalized patients. The intervention occurred in 3 phases: phase 1, conducted from January to March 2009, was baseline data collection period on the intervention medical/surgical units; phase 2 included the house-wide intervention (February and March) and the second data collection period (April-June) to examine the impact of the initial intervention; and phase 3 consisted of a focused intervention on the study units (July), followed by the last data collection period (August-October).

Phase 1

Baseline data on IUC duration and CAUTI rates were obtained from the 2 medical/surgical inpatient units selected to measure changes in practice and infection rates.

Phase 2

The house-wide intervention included a revision of the hospital policy on insertion and care of an IUC based on the current best evidence and the 2008 Society for Healthcare Epidemiology of America, Inc/Infectious Disease Society of America practice recommendations,[15] competency-based catheter insertion training, and an evaluation of the hospital's IUC products. A factoid presentation of highlights of the policy changes was created as a mandatory educational tool via HealthStream (the hospital's learning management system) for all inpatient nurses and unlicensed assistive staff. Table 1 reviews the content presented in the hospital-wide, online factoid educational intervention.

Product evaluation was completed to evaluate the types and utilization patterns of urinary drainage systems and to standardize product use throughout the hospital. Product changes included (1) replacement of silver alloy-coated catheters with usual latex and nonlatex catheters, (2) standardization of catheter securement devices and stocking location, and (3) provision of metered drainage bags in the standard insertion kit in all patient care areas.

Education of other providers of care included rehabilitation therapists (physical and occupational therapists), radiology staff (computerized tomography/magnetic resonance imaging), and transport staff. Key areas of education encompassed routine and frequent emptying and placement of urinary catheter bag below the bladder prior to therapy, radiologic examination, and transport. After the house-wide intervention, IUC duration rates and CAUTI

Table 1
Factoid educational presentation

Preventing catheter-associated urinary tract infections: The facts
1. Cleanse the patient's genitalia area with an aseptic cleanser prior to catheter insertion[3,9]; daily cleansing and PRN (eg, after a bowel movement) using the hospital-approved bathing products.[9]
2. Nonsterile gloves should be used for precleaning genital area, and sterile gloves should be used for the IUC insertion.[9]
3. Once the IUC is placed, it should be secured to the patient's thigh with a securement device to prevent irritation, inflammation, and infection.[17,18]
4. Keep the IUC drainage bag below the level of the bladder at all times; this will prevent backflow and guard against infections.[2,3,8,17]
5. Empty the drainage bag every 8 hours and when the bag is two-thirds full or prior to all patient transfers.[10]
6. If the IUC has been in place for more than 2 days, provide a daily reminder to the health care provider to evaluate continued need for the device.[7,16]
7. Know the clinical indication for IUC for your patient. Did you know an IUC is not indicated for patients with limited mobility, uncontrolled pain, nurse or patient convenience, or the prevention of skin breakdown?[2,3,8]
8. Once an IUC is removed, if the patient does not void within 4-6 hours, use a bedside bladder scanner to determine urine volume. In and out catheterize the patient if the volume is greater than 500 mL; avoid replacing an IUC.[19,21,22]
9. Once an IUC is removed, offer the patient a bedside commode if they cannot ambulate safely to the bathroom.

IUC, indwelling urinary catheter; *PRN*, as needed.

rates were measured on the medical/surgical units to gauge the effect of the intervention on practice.

Phase 3

Phase 3 interventions targeted the 2 medical/surgical inpatient nursing units and included the following:

(1) Sixty-minute education sessions, held multiple times to facilitate attendance, were provided by the research nurse scientists and unit nurse educator to address the following topics:
   (a) A focused journal club session reviewing an article that highlighted risk factors associated with indwelling catheters and recommended prevention interventions[10];
   (b) discussion of the scope of the problem and dissemination of the nursing and patient-centered interventions; and
   (c) competency-based training on the use of bladder scanners for postresidual volumes for high-risk and older adult patients and proper urinalysis/culture collection procedure.
(2) Increased availability of bedside commodes (in multiple sizes) to promote patient adherence to postcatheter voiding safely.
(3) Purchase of a bladder scanner to accurately assess postvoid residuals.
(4) Four translating research into practice (TRIP) fliers covering catheter care, the change in IUC products, use of bladder scanners, and early removal (Fig 1). The TRIP fliers were posted on various sites on the nursing units.
(5) Charge nurse catheter care rounds incorporated into daily rounds where reminders for early catheter removal were made.
(6) Partnered with patients and families to promote involvement in their care. This intervention consisted of the development of educational (English and Spanish) materials describing catheter care guidelines that could be given to patients and families encouraging communication with nursing staff to question whether continued use of the catheter was necessary.

All nursing staff (RNs and CNAs) on the intervention units were encouraged to participate in the educational sessions. The Quality Intervention Team had no supervisory relationship with the nursing staff on the study units. Recruitment of RNs and CNAs was facilitated by the nurse managers and educators. Nursing staff were incentivized to attend by offering continuing education credit for the educational sessions and by providing refreshments. Attendance records were kept for all educational sessions, competency training sessions, and journal clubs.

Data collection and measurement

Demographic patient data, CAUTI rates, and IUC duration were collected at baseline (phase 1) and after the 2 intervention phases (phase 2 was house-wide education and product changes; phase 3 was focused intervention on the study units). Appropriate use of the bladder scanner was an additional measure of intervention uptake. A bladder scanner log was completed for a 60-day period after the phase 2 intervention.

CAUTI data

Daily electronic medical record reports were used to identify patients with an IUC and to determine duration of catheterization. CAUTIs rates were calculated and tracked by the hospital's infection preventionist nurses. CAUTI rates for both focused intervention units for the baseline and postintervention periods were tracked quarterly. CAUTIs were reported as an absolute number and a number of infections per 1,000 catheter-days for eligible patients.

Demographic data

Patient age, gender, surgical procedure, and hospital length of stay (LOS) were collected by medical record abstraction.

Evaluation

All variables were summarized using descriptive statistics appropriate for the level of measurement. Statistical analyses were conducted to compare the differences between the baseline and the 2 postintervention catheter-days using Student *t* test. Alpha was set at .05. CAUTI rates were not compared because of the low numbers of incidences and rates.

RESULTS

Patient demographics remained similar among the 3 data collection periods. Table 2 summarizes the patient characteristics.

Intervention uptake

Healthstream module compliance

The IUC policy changes were highlighted in a factoid Healthstream (hospital learning management system) module and assigned to all RNs, CNAs, and emergency medical technicians (N = 947). Ninety-six percent of the assigned staff completed the module.

Competency-based IUC insertion training

One hundred percent of the operating room nurses successfully completed the competency training. Competency training was suggested to the emergency department nursing staff, however, it was never accomplished.

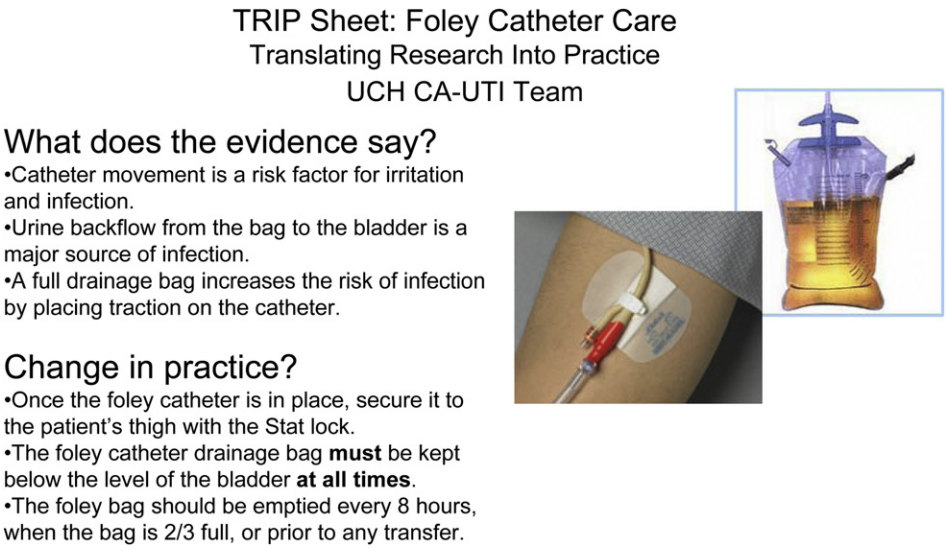

Fig 1. TRIP sheet.

Table 2
Characteristics of study subjects

Pulmonary unit	Phase 1, 12/ 2008-2/2009	Phase 2, 4/ 2009-6/2009	Phase 3, 8/ 2009-10/2009
Age, yr, mean (SD)	58.2 (14.0)	58.1 (14.6)	57.2 (14.9)
Sex, n (%)			
Female	45 (56.3)	57 (58.8)	56 (58.3)
Male	35 (43.8)	40 (41.2)	40 (41.7)
Length of stay, days, mean (SD)	7.4 (9.0)	7.2 (7.4)	6.7 (6.5)
Surgery unit			
Age, yr, mean (SD)	52.6 (15.2)	55.3 (14.4)	52.3 (14.8)
Sex, n (%)			
Female	86 (61.9)	76 (50.8)	93 (65.5)
Male	53 (38.1)	65 (49.2)	49 (34.5)
Length of stay, days, mean (SD)	6.9 (7.1)	8.0 (9.0)	6.6 (7.1)

SD, standard deviation.

Intervention unit in-services and bladder scanner training

Journal club discussions and bladder scanner training were offered multiple times and days during July 2009. Ninety-five percent of the nurses and assistive staff on the intervention units attended these sessions.

Primary patient outcomes

Catheter duration

At baseline, the mean catheter-days were 3.53 and 3.01 on the pulmonary and surgical units, respectively. The catheter-days increased slightly between phase 1 and phase 2 data periods on the surgical unit but decreased in all phases on the pulmonary unit (Table 3). The surgical unit demonstrated a significant decrease ($P = .018$) between phase 1 and 3 data periods. In total, catheter-days decreased from 400 days in phase 1 to 305 days in phase 3.

Incidence of CAUTI

CAUTI rates were calculated for each unit using the following formula: number of urinary tract infections/number of catheter-days $\times$ 1,000. At baseline, the CAUTI rates were 0.0 and 1.9 on the pulmonary and surgical units, respectively. The pulmonary unit continued to have 0.0 incidence of CAUTI in the postintervention data collection periods. The surgical unit rate increased in the second data collection period (3.4) and decreased (2.2) in the third period.

Table 3
Per-patient catheter duration in days

Unit	Data collection time			*P* value (Student *t* test)
	Phase 1	Phase 2	Phase 3	(Phase 1 to 3 comparison)
Pulmonary, mean (SD)	3.53 (3.4)	2.81 (2.7)	2.7 (2.7)	.076
General surgery, mean (SD)	3.01 (3.3)	3.3 (3.7)	2.2 (2)	.018

SD, standard deviation.

LOS

The mean LOS on the surgical unit was 6.91, 8.03, and 6.55 days for the 3 data collection phases, respectively. On the pulmonary unit, there was a progressive decrease in LOS from 7.39, 7.21, and 6.72 days, respectively.

Bladder scanner usage

There were 50 recorded uses on the bladder scanner log for a 2-month period after the unit-specific intervention. Post-IUC inability to void and post-void residual measurement were the most common uses for the scanner, and only 2 IUCs needed to be reinserted.

Product streamlining

The removal of silver alloy indwelling catheters as the primary device throughout the hospital did not negatively impact overall CAUTI rates and resulted in an annual cost savings of $52,000. Streamlining IUC insertion kits to be standardized with a metered drainage bag was cost neutral. No changes were made in the IUC securement device; it was relocated in the unit product rooms to be closer to other IUC materials to assist with product availability and use.

DISCUSSION

The goal of this quality improvement project was to decrease CAUTI rates through implementation of hospital-wide nursing interventions that emphasized education for inpatient nurses and

specific unit-based nursing practice actions on a pulmonary medical and a general surgical inpatient unit. Management and ongoing care of an IUC is within the purview of nursing practice. Re-education of nurses regarding placement, management, and early removal of IUCs as well as focused, unit-specific interventions were found to decrease catheter-days and had a less consistent effect on CAUTI rates. Improved care processes and patient outcomes were achieved by examining best evidence to guide practice and developing system supports that provided education and improved product accessibility to achieve optimal care. Whereas electronic media for education of health care providers can be challenging,[20] creating an online educational program for RNs and CNAs as well as updating hospital policy offered consistent, succinct, and factual content providing an effective medium to improve practice. Re-education about a common nursing intervention (catheter insertion) to ensure that best practice occurred elevated this perceived "simple" skill to a higher level of importance. Expanding the education to ancillary services (eg, rehabilitation professionals and transport staff) helped raise collective awareness of drainage bag location to reduce reflux and CAUTI risks. Product changes that streamlined IUC devices, collection bags, and catheter type (eg, removal of silver alloy catheters) provided an important opportunity for practice improvement and cost savings.

Focused unit interventions, specifically providing detailed education on postoperative retention, use of a bladder scanner to evaluate urinary retention and intermittent catheterization, and encouraging early removal of the IUC resulted in reduced indwelling catheter-days.

A dedicated bladder scanner provided an objective means for the nurse to evaluate the patient's urinary retention and guide interventions. Use of the bladder scanner averted reinsertion of an IUC after initial removal. The nurses perceived the bladder scanner to be an important aspect of the intervention and the Quality Intervention Team believed it was used appropriately to prevent IUC reinsertion.

It was beyond the scope of this quality improvement project to determine which of the individual components of this comprehensive intervention were the most effective in changing practice. However, our results suggest an important impact of the house-wide (phase 2) intervention on catheter duration apart from that of the focused unit intervention (phase 3). In particular, the pulmonary unit appeared to see improvements in performance following phase 2 with little additional room for improvement in phase 3, whereas the surgery unit appeared to realize its improvements only after phase 3. We cannot conclusively say that phase 2 or 3 was superior as a quality intervention strategy; however, this difference in response raises the possibility that there were unit-specific differences in implementation and/or response to the different intervention phases. This heterogeneity in response is probably not unusual. Earlier work has demonstrated that nurses identify a wide variety of barriers to evidence-based use of urinary catheters and that the identified barriers are markedly different on nursing units with different patient populations and/or range of conditions cared for.[23] This project suggests that a focused unit intervention may be indicated when there is inadequate response to hospital-wide strategies. However, additional implementation research may be needed to determine what strategies are amenable to specific settings of care.

Outcomes from the surgical unit demonstrated fluctuating CAUTI rates during the project. Given the low rate of CAUTIs at our institution, we were not able to demonstrate reductions in CAUTI rates during this quality improvement project. In addition, the small fluctuations we observed in CAUTI rates may be artifact—because reductions in catheter-days were achieved.

Implications for practice

Focusing on nursing-driven interventions to improve the nursing care of IUCs was found to positively impact CAUTI rates. Re-educating on the importance of a perceived "basic" skill and infusing best evidence into current practice were important to raise awareness of simple interventions that positively impacted patient outcomes.

Limitations

There were several limitations in this quality improvement project. First, because this was an uncontrolled pre/post intervention study, we cannot exclude the possibility that factors other than our intervention were responsible for the changes in catheter duration and CAUTI rates observed. Conversely, our assessment of the focused interventions within 2 units may have provided only a snapshot of the overall effectiveness of the education, policy, and product changes implemented in this study as a more comprehensive assessment of the impact of the intervention were not undertaken. In addition, the number of CAUTIS on the intervention units during the study period was low, and the confidence intervals around the CAUTI rates were relatively large, making it difficult to assess the impact of the intervention on the outcome of interest. Abstracting data and providing feedback in a timely manner of the IUC utilization were a challenge and might limit the dissemination of this data collection strategy to other settings without the use of an electronic means of tracking patient-level catheter duration. This project focused on nursing management of IUC to reduce CAUTIs; engaging physician and other health care providers who direct insertion and removal of bladder catheters was not addressed in this study. Additionally, while patient and family information flyers were developed, the impact of the educational flyer was not measured.

To effectively change practice, multifaceted efforts are necessary to reduce CAUTI in hospitalized patients. IUCs are often indicated in the management of patients in acute care hospital facilities, and efforts that re-examine practice and strategies for care management based on best evidence are needed and must be continuously revisited. The findings of this project support the effectiveness of implementation of a CAUTI program that encompasses nursing education, competency training, products, and surveillance to positively impact patient outcomes. Re-examining a common nursing procedure resulted in improved practice with IUC care and improved patient outcomes.

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