ORIGINAL ARTICLE

Catheter use and infection reduction in plastic surgery

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ZJ Barnes, RC Mahabir. Catheter use and infection reduction in plastic surgery Can J Plast Surg 2013;21(2):79-82.

BACKGROUND: Catheter-associated urinary tract infections (CAUTI) are the most common hospital-associated infection and can result in increased health care costs, morbidity and even mortality. In 2009, The Scott & White Memorial Hospital/Texas A&M Health Science Center (Texas, USA) system's CAUTI rate placed it in the upper quartile (ie, highest rate) for the country, necessitating a system-wide change.

OBJECTIVE: To design and implement a guideline to reduce the incidence of CAUTI.

METHODS: A multidisciplinary team was formed and completed both a root cause analysis and a review of the available literature. Consolidating the best evidence, the team formulated a best practice guideline detailing the proper indications for insertion of, improper use of and techniques to minimize infection with catheters. Included as part of this protocol was nursing and patient education, changes in identifying patients with a catheter and automatic termination orders. Three-, six- and 12-month reviews identifying additional opportunities for improvement at the end of 2010 were completed.

RESULTS: In 2009, the hospital's CAUTI rate was 1.46 per 1000 catheter days. In 2011 – the first complete year of the finalized guideline – the hospital's CAUTI rate was 0.52 per 1000 catheter days, ranking the institution in the bottom quartile (ie, lowest rate) for the country. The surgery and plastic surgery subgroup analyses also demonstrated statistically significant reduction in both catheter use and CAUTI.

CONCLUSION: The incidence of CAUTI was successfully reduced at The Texas A&M Healthcare Center. The guideline, its development and how it applies to plastic surgery patients are discussed.

Key Words: *Catheter; Catheter-associated urinary tract infection CAUTI; Hospital-associated infection HAI; Infection; Infection reduction; Risk reduction*

L'utilisation d'une sonde et la réduction des infections en chirurgie plastique

HISTORIQUE : L'infection urinaire sur sonde (IUSS) est l'infection nosocomiale la plus fréquente. Elle peut accroître les coûts de santé, la morbidité et même la mortalité. En 2009, le taux d'IUSS du système de *The Scott & White Memorial Hospital* et du *Texas A&M Health Science Center* (Texas, États-Unis) la plaçait dans le quartile le plus élevé (c.-à-d. le taux le plus élevé) au pays, ce qui a exigé de modifier l'ensemble du système.

OBJECTIF : Concevoir et mettre en œuvre des lignes directrices pour réduire l'incidence d'IUSS.

MÉTHODOLOGIE : Une équipe multidisciplinaire a été créée et a effectué à la fois une analyse par arbre de défaillances et une analyse bibliographique. Après avoir regroupé les meilleures données probantes, l'équipe a formulé des directives sur les pratiques exemplaires, détaillant les bonnes indications sur l'insertion de la sonde, sa mauvaise utilisation et les techniques pour réduire au minimum les infections sur sonde. L'éducation des infirmières et des patients faisait partie du protocole, de même que les modifications pour déterminer les patients sur sonde et les arrêts automatiques. À la fin de 2010, les chercheurs ont effectué une analyse au bout de trois, six et 12 mois pour établir d'autres possibilités d'amélioration.

RÉSULTATS : En 2009, le taux d'IUSS de l'hôpital s'élevait à 1,46 cas sur 1 000 journées sur sonde. En 2011, la première année complète suivant les directives finales, ce taux avait fléchi à 0,52 cas sur 1 000 jours sur sonde, plaçant l'établissement dans le quartile inférieur (c'est-à-dire le taux le plus bas) au pays. Les analyses du sous-groupe de chirurgie et de chirurgie plastique ont également fait foi d'une réduction statistiquement significative de l'utilisation de la sonde et des IUSS.

CONCLUSION : L'incidence d'IUSS a diminué à *The Texas A&M Healthcare Center*. Les directives, leur préparation et leur mode d'application à la chirurgie plastique sont exposés.

Catheter-associated urinary tract infections (CAUTI) are the most common hospital-associated infection (HAI) in the United States (US), comprising 36% of all HAIs (1). Consequences of HAIs are overuse of antibiotics and the development of resistant organisms, increased hospital stays, increased morbidity and mortality, and increased costs. There are 13,000 deaths in the US annually attributed to CAUTI (2); the estimated cost to treat these infections is approximately $500 million per year. As of 2008, this is a nonreimbursable diagnosis by the Center for Medicare and Medicaid Services guidelines 2008 (1). CAUTI and its prevention is also part of the Surgical Care Improvement Project (SCIP, infection measure 9). Within these guidelines, urinary catheters must be removed by postoperative day 2 without a documented reason to continue catheterization to reduce the incidence of CAUTI in the perioperative setting.

Studies have shown that up to 25% of all hospitalized patients undergo urinary catheter insertion at some time during their admission (3) and this trend appears to be increasing (4). In 2000, a literature review (5) demonstrated that 26% of patients with indwelling catheters for between two and 10 days ultimately develop bacteriuria, of whom 24% will subsequently develop CAUTI. Three per cent of these patients will progress to develop bacteremia. Despite the strong link between catheterization and subsequent urinary tract infection (UTI), many hospitals have not widely implemented strategies to reduce hospital-acquired UTI (6).

In 2009, our hospital system's CAUTI rate placed it in the upper quartile (ie, highest rate) for the country, necessitating a system-wide change (Figure 1). The purpose of our study was to design and implement a guideline to reduce CAUTI. While the present article is not an exhaustive discussion of CAUTI, it does describe a process that may be used to address similar systems-based practice issues.

METHODS

Approval for the present study was obtained from the Scott & White Memorial Hospital/Texas A&M Institutional Review Boards (Texas, USA). The junior author (ZB) is a member of the hospital's CAUTI prevention team. Data were acquired continually and on an ongoing basis, and evaluated at monthly meetings by the team. Inclusion criteria were patients admitted to the hospital system who were subsequently catheterized, or patients who were catheterized at an outside institution and did not exhibit signs of an infection in the first 48 h after admission.

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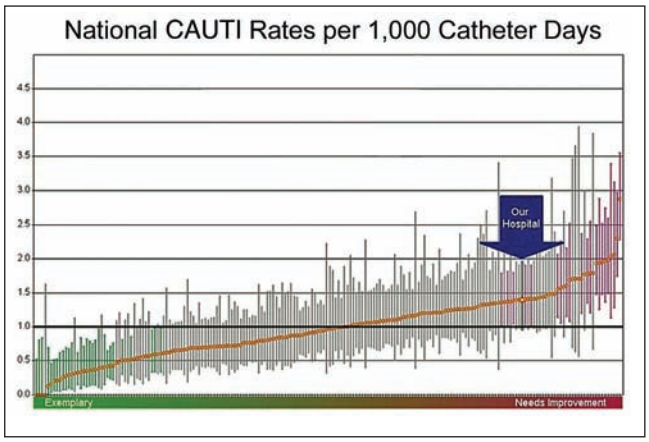

Figure 1) *National Surgical Quality Improvement Program (NSQIP) graph showing peer rank in 2009. Each bar represents one facility reporting catheter-associated urinary tract infection (CAUTI) rates to the NSQIP database. Yellow dots represent the facility average with the bars representing ±1 SD. 'Our Hospital' refers to the Scott & White Memorial Hospital (Texas, USA)*

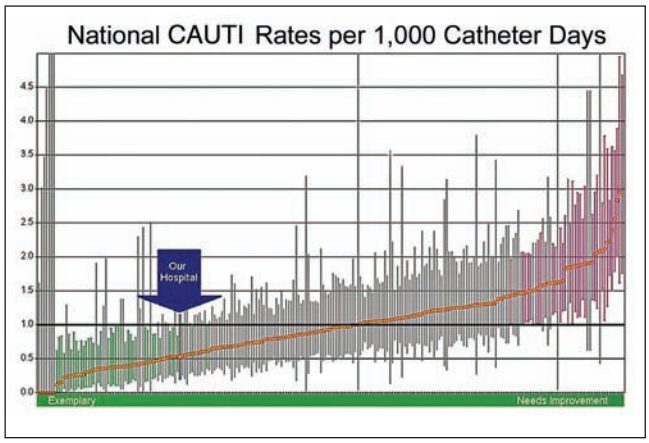

Figure 2) *National Surgical Quality Improvement Program (NSQIP) graph showing peer rank in 2011. Each bar represents one facility reporting catheter-associated urinary tract infection (CAUTI) rates to the NSQIP database. Yellow dots represent the facility average with the bars representing ±1 SD. 'Our Hospital' refers to the Scott & White Memorial Hospital (Texas, USA)*

The data were obtained through in-house collection following National Healthcare Safety Network guidelines, were anonymized and the comparison with peer hospitals was gathered using data from the National Surgical Quality Improvement Program (NSQIP). The NSQIP is a nationally validated, risk-adjusted, prospective, peer controlled database quantifying 30-day surgical outcomes with comparisons among similar hospitals.

In October 2009, the CAUTI prevention team was formed at Scott & White Memorial Hospital in light of data that were obtained through NSQIP, showing that within the institution's peer group (academic institutions with >500 beds), it had a higher than acceptable CAUTI rate (upper quartile). A multidisciplinary team was formed to evaluate and implement measures to decrease the CAUTI rate at the Scott & White Memorial Hospital. The team was designed to be inclusive and had members from administration, nursing, infection control and biostatistics, as well as senior staff physician and residents. The mission statement of the team was to reduce CAUTI by 50% within one year. A best practice guideline was created from a literature review. System-wide education was undertaken and new order sets were created for catheter insertion (that included indications for insertion), use (reasons for continued use) and discontinuation (to meet SCIP requirements unless there was documentation of a reason for continued usage). The team met monthly through 2010 to evaluate the data acquired, assess new products and strategies, and form new interventions to decrease the institution's overall incidence of CAUTI. During 2010, new interventions, order sets, technologies and products underwent trials on a limited basis in different units within the facility. At the start of 2011, the staff had completed the education modules, the order sets were active and the guideline had been in practice for >6 months (learning curve). Data included in the present study are from January 2009 through December 2011.

RESULTS

In 2009, the hospital CAUTI rate was 1.46 per 1000 catheter days. This rate placed the facility in the top quartile (ie, highest rate) for the country among comparable institutions. In 2011, the first complete year of the finalized guideline and, after a six-month learning curve, the hospital rate was 0.52 per 1000 catheter days, ranking it in the bottom quartile (ie, lowest rate) for the country (Figure 2). The surgery and plastic surgery subgroup analyses also demonstrated statistically significant reductions in both catheter use and CAUTI, with the plastic surgery service experiencing zero CAUTI within the study period.

DISCUSSION

Catheters are a medical device with inherent risks and benefits. As such, we need to ask ourselves, as in everything else we do: Why am I doing this, what are the indications? What benefits do I assume from this, for the patient and surgeon? What risks am I accepting and placing on the patient? Are there alternative methods to achieve a similar goal? Is the risk worth the benefit?

There is a clear causal relationship between catheters and UTIs. With the overwhelming exposure rate, it is understandable that CAUTI comprise the largest portion of HAIs. The system costs associated with these infections are no longer reimbursed by the Center for Medicare and Medicaid Services, which has produced heavy pressure on hospitals to decrease the incidence of CAUTI. In the recent past, a catheter was a ubiquitous part of the admission/surgical process. It was regarded as an innocuous intervention comparable with intravenous catheters. Current indiscriminate and unnecessary catheter use also contributes to making it one of the most preventable device-related infections. Studies have shown that the rate of inappropriately inserted catheters ranges from 21% to 54% of those inserted (7) and, in one study, 33% of catheters were inserted without an order in the chart (8). An estimated 16% to 79% of CAUTI may be preventable (9), which represents up to 380,000 infections and 9000 deaths per year.

How does this relate to plastic surgery? Getting involved with quality assurance initiatives, such as this, is an excellent opportunity for the plastic surgeon to show their value within their hospital/university, as explained by Rohrich (10). This not only increases the profile of your division/department while enhancing its image as a 'good citizen' within your system, but is also a vital part of being a good steward of the patient within a system-based practice.

Following a thorough literature review (11), our indications for catheter insertion in plastic surgery were the following:

- aggressive treatment with either fluids or diuretics;
- urinary retention or obstruction relief;
- urinary retention: in terminally ill or pressure ulcer >stage 2;
- prolonged (>3 h to 4 h) or epidural anesthesia; and
- other surgery-specific indications that must be indicated on insertion order

If placed, catheters should be removed at the conclusion of the case or in the postanesthesia recovery unit. If catheters are left in after that point, their necessity should be addressed each day and be removed as promptly as possible (12). The risk of developing CAUTI is 21% more

likely following two days of urinary catheter placement. Developing a CAUTI is associated with extended time to discharge home and increased 30-day mortality (13). When considering these facts, urinary catheters should be removed at the earliest possible time to reduce the incidence of CAUTI. Within the guidelines, urinary catheters must be removed by postoperative day 1 unless a documented reason to continue catheterization exists. The recommendations do not address avoiding catheterization altogether. No literature was identified specific to plastic surgery regarding removal.

Exclusion was permitted for patients <18 years of age or with hospital length of stay >120 days; when preoperative infection is documented; if enrolled in a clinical trial; when urological, gynecological or perineal procedures were performed; if cardiac or other procedures were performed under general or spinal anesthesia within four days or three days, respectively; if perioperative mortality occurred; length of hospital stay <2 days; or suprapubic catheter or intermittent catheterization existed preoperatively.

Identify the problem

As stated earlier, NSQIP data showed that our institution's CAUTI rate was approximately in the upper 25% of cohort institutions, which falls into the 'needs improvement' end of the scale. The matter of CAUTI is multifactorial: catheters are overused; placed when not indicated; left in place for too long; many systems have no monitoring or prevention plan in place; and our cultural acceptance of a catheter as a normal part of the admission or surgical process.

Form a team

A multidisciplinary team was constructed consisting of a senior staff physician as the leader, with resident physicians, nurses, infection control staff, statistical personnel and administrative members. The team was initially tasked to reduce the hospital's rate of CAUTI by 50%. Having a defined mission statement helped clarify the goal and acted as a measure by which to gauge progress.

The team leader was a staff physician who oversaw meetings, monitored the project's progress and acted as the mediator of the group. Nurses from representative sections of the hospital were chosen as champions and tasked with implementation and record keeping of various interventions, in addition to presenting formulated plans to the appropriate personnel and departments. Resident physicians were involved with policy development, education, revising current protocols and orders, and their implementation. As in most institutions, residents and nurses were considered the first line of defense.

Infection control and data staff members organized monthly and longitudinal reports that showed how the hospital, individual units and services were performing. They helped identify progress and areas that required attention. Administrative members of the team presented formulated plans to management and appropriate departments, which resulted in the timely approval of new protocols, order sets and educational programs.

Establish and implement an action plan

A review of the current literature with an emphasis on national guidelines and governmental policy, such as the Centers for Disease Control and Prevention (Georgia, USA), National Healthcare Safety Network and SCIP, was used as a starting point. The NSQIP website (14) has resources for its member participants that allow them to communicate with one another and share ideas, data and even form larger multi-institutional groups.

Education was a cornerstone of the process. This had to start from the ground up, with orientation for support staff, nurses, residents and physicians. It was also important to educate existing staff to help them recognize the catheter as a device that needs to be administered judiciously, monitored continually for its necessity and discontinued promptly. Roles were defined and assigned not only to team members but also to individuals throughout the hospital in important areas such as the emergency room, operating room, recovery unit (postanesthesia care unit), intensive care unit, day surgery and individual floors (Figure 3).

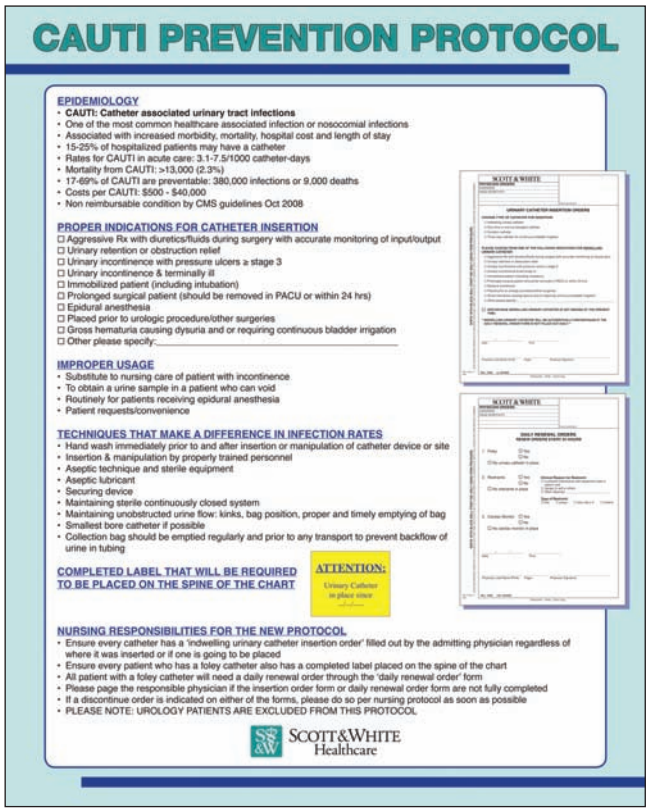

Figure 3) *Catheter-associated urinary tract infection (CAUTI) prevention poster. Included were epidemiology, indications, improper usage, techniques that make a difference, labelling instructions, nursing responsibilities, and sample insertion and daily renewal order sets*

Collect and review data

Data were continually collected, and team members discussed what was and was not working. Reasons were identified and changes were made to improve that process. It was important to attempt to identify where or why the failure occurred in a seemingly well-planned intervention. Root cause analysis demonstrated failures in education of staff, systems-based practices that had to be changed, impractical strategies and downstream-unintended consequences. Identification and abandonment of nonworking strategies and implementing alternatives was key to this process.

Continued analysis and interventions

This process was iterative and detailed data regarding the effectiveness of both single interventions and the program as a whole were collected. New ideas, techniques, technology or products were given test runs on smaller scales such as single wards. Team meetings were consistent to maintain good data and focus on the goal. This was an excellent opportunity to perform cost-based analyses of current contracts and products, and was broken down according to hospital location to maximize appropriate resource use.

The best way to minimize the rate of CAUTI is simply to reduce the use of catheterization by limiting its use to patients who have clear indications for placement and discontinuation as soon as it is no longer necessary (15). Our goal with the present article was to show that preventing CAUTI, as well other similar quality issues, such as deep vein thrombosis, wound infections and blood stream infections, was not only possible but also achievable through systematic implementation of a best practice team. Paramount to the success of any program that is evidenced based is the ability to abandon strategies that do not work and to develop and implement alternatives.

A thorough discussion of the implementation of practice guidelines is beyond the scope of the present article, but is widely available in the literature, particularly the health services literature such as *Medical Care* or *Health Affairs*. A recent *Journal of the American Medical Association* article (16) is a good example. Our goal was to report on our experience at decreasing a common infection.

CONCLUSION

We successfully designed and implemented a guideline that reduced the incidence of catheter-associated UTIs at our institution.

DISCLOSURE: Zach J Barnes has no commercial associations or financial conflicts of interest to declare. Raman C Mahabir has no commercial associations or financial conflicts of interest to declare.

REFERENCES

1. Guide to the elimination of catheter-associated urinary tract infections (CAUTIs): Developing and applying facility-based prevention interventions in acute and long-term care settings. Greene L, Marx J, Oriola S. Association for Professionals in Infection Control and Epidemiology (APIC), 2008.
2. Bradley SM, Harleman D, Klee A et al. Preventing Cather-Associated Urinary Tract Infections (CAUTI). <www.qipa.org/getfile/c831c1b9-d1b6-476f-a6a2-3ec09aa1183c/CAUTI_BPIP-(1).aspx?chset=c219ee29-5483-4dac-bb39-b162c40d8c9f> (Accessed April 15, 2013).
3. Haley RW, Hooton TM, Culver DH, et al. Nosocomial infections in U.S. hospitals, 1975-1976: Estimated frequency by selected characteristics of patients. Am J Med 1981;70:947-59.
4. Warren JW. Catheter-associated urinary tract infections. Infect Dis Clin North Am 1997;11:609-22.
5. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. Am J Infect Control 2000;28:68-75.
6. Saint S, Kowalski CP, Kaufman SR, et al. Preventing hospital-acquired urinary tract infection in the United States: A national study. Clin Infect Dis 2008;46:243-50.
7. Hazelett SE, Tsai M, Gareri M, Allen K. The association between indwelling urinary catheter use in the elderly and urinary tract infection in acute care. BMC Geriatr 2006;6:15.
8. Gokula RR, Hickne JA, Smith MA. Inappropriate use of urinary catheters in elderly patients at a Midwestern community teaching hospital. AJIC 2004;32:196-9.
9. Umscheid C, Mitchell M, Agarwal R, Williams K, Brennan P. Mortality from reasonably-preventable hospital acquired infections. Included in written testimony by the Society of Healthcare Epidemiology of America for the Committee on Oversight and Government Reform hearing on Healthcare-Associated Infections: A Preventable Epidemic, chaired by Henry A. Waxman, April 16, 2008, Washington, DC. In: Guideline for Prevention of Catheter-Associated Urinary Tract Infections 2009. Atlanta: Centers for Disease Control and Prevention, US Department of Health and Human Services, 2009.
10. Rohrich, RJ. Mandating departments of plastic surgery: The future of plastic surgery is now. Plast Reconstr Surg 2008;121:1499-502.
11. Guideline for Prevention of Catheter-associated Urinary Tract Infections. <www.cdc.gov/hicpac/pdf/CAUTI/CAUTIguideline2009final.pdf> (Accessed February 25, 2013).
12. Wald H, Epstein A, Kramer A. Extended use of indwelling urinary catheters in postoperative hip fracture patients. Med Care 2005;43:1009-17.
13. Coakley BA, Sussman ES, Wolfson TS, et al. Postoperative antibiotics correlate with worse outcomes after appendectomy for non-perforated appendicitis. J Am Coll Surg 2011;213:778-83.
14. American College of Surgeons National Surgical Quality Improvement Program <http://site.acsnsqip.org/.NSQIP> (Accessed February 25, 2013).
15. Hooton TM, Bradley SF, Cardenas DD, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis 2010;50:625-63.
16. Kuehn BM. Hospitals slash central line infections with program that empowers nurses. JAMA 2012;308:1617-8.