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# Preventing catheter-associated urinary tract infection in the zero-tolerance era

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***Background:*** Catheter-associated urinary tract infection (CAUTI) is one of the most common health care–associated infections in the critical care setting.

***Methods:*** A quasi-experimental study involving multiple interventions to reduce the incidence of CAUTI was conducted in a medical-surgical intensive care unit (ICU) and in 2 step-down units (SDUs). Between June 2005 and December 2007 (phase 1), we implemented some Centers for Disease Control and Prevention–recommended evidence-based practices. Between January 2008 and July 2010 (phase 2), we intervened to improve compliance with these practices at the same time that performance monitoring was being done at the bedside, and we implemented the Institute for Healthcare Improvement's bladder bundle for all ICU and SDU patients requiring urinary catheters.

***Results:*** There was a statistically significant reduction in the rate of CAUTI in the ICU, from 7.6 per 1,000 catheter-days (95% confidence interval [CI], 6.6-8.6) before the intervention to 5.0 per 1,000 catheter-days (95% CI, 4.2-5.8; $P < .001$) after the intervention. There also was a statistically significant reduction in the rate of CAUTI in the SDUs, from 15.3 per 1,000 catheter-days (95% CI, 13.9-16.6) before the intervention to 12.9 per 1,000 catheter-days (95% CI, 11.6-14.2) after the intervention ($P = .014$).

***Conclusion:*** Our findings suggest that reducing CAUTI rates in the ICU setting is a complex process that involves multiple performance measures and interventions that can be applied to SDU settings as well.

***Key Words:*** Health care-associated infection prevention; urinary catheter; intensive care; step-down unit.



Urinary tract infections (UTIs) are commonly acquired in hospitals, with an estimated prevalence of 1%-10%, representing 30%-40% of all nosocomial infections.[1] The most important risk factor for the development of nosocomial UTIs, especially in the intensive care setting, is the presence of a urinary catheter (UC).[1,2]

Guidelines from the Centers for Disease Control (CDC) and the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America describe various interventions for preventing catheter-associated UTIs (CAUTIs) in intensive care units (ICUs).[3,4] Each of these recommendations is categorized on the basis of existing scientific evidence, theoretical rationale, applicability, and potential economic impact.

As part of the 5 Million Lives campaign endorsed by leading US agencies and professional societies, The Institute for Healthcare Improvement (http://www.ihi.org/ihi) recommends that all intensive care units (ICUs) implement a bladder bundle aimed at reducing the incidence of CAUTI to zero.[5] However, in ICUs, UCs might be needed for extended periods, and the duration of catheterization is the most important risk factor for the development of a CAUTI.[6] In addition, ICU patients may be colonized with hospital-acquired organisms, and sometimes a UC must be inserted in urgent situations when optimal attention to aseptic technique might not be feasible. Recent data suggest that non-ICU medical wards have considerably lower device utilization rates than medical ICUs.[7] Unfortunately, however, there are little data regarding the prevention of CAUTIs in step-down units (SDUs).[7] The types of organisms that most commonly cause hospital-acquired UTI change over time, but gram-negative organisms—principally enteric gram-negative bacilli—are responsible for the great majority of CAUTI cases.[6]

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The purpose of this prospective, quality improvement study was to examine the effect of a series of interventions implemented in an ICU and 2 SDUs to reduce the incidence of CAUTIs and to analyze the differences in CAUTI rates and causative microorganisms in the 2 study phases.

## METHODS

### Setting and study design

Thus quasi-experimental interrupted time series study was conducted in a 38-bed medical-surgical ICU and in two 20-bed SDUs with the same physical layout in a private tertiary care hospital in São Paulo, Brazil. The ICU has an open staffing model, and admits approximately 2,200 patients annually. All rooms in the ICU and the SDUs are single-bed rooms. The SDU patients are transferred from the medical-surgical ICU, from various wards, and from the Emergency Department. Because this study was considered a quality improvement project, it was not submitted to our Institutional Review Board.

The study was carried out in 2 phases. In phase 1 (June 2005 to December 2007), ICU nurses or and physicians (primarily urologists) inserted UCs using aseptic technique with a 2% chlorhexidine preparation for skin antisepsis. Catheter insertion and maintenance were in accordance with CDC guidelines.[3] UCs were not routinely replaced. The decision to remove a UC was made solely by the patient's physician, with catheters kept in place until it is no longer needed or until an adverse event necessitates its removal. Each year, in a convenience sample of patients, UC insertion was directly observed by assigned nurses, who provided feedback on compliance with appropriate practices to the ICU team via e-mail.

In phase 2 (January 2008 to July 2010), after the hospital's chief executive officer articulated a policy of zero tolerance for CAUTIs, we continued the processes begun in phase 1, but audited these process measures once monthly at random intervals in a small sample of patients undergoing UC insertion. In January 2008, we implemented the bladder bundle. The bundle components included the creation of a UC insertion cart; hand hygiene; chlorhexidine skin and meatal antisepsis; sterile field and sterile gloves; only one attempt at insertion allowed for each catheter (ie, a new catheter used for each attempt); adequate UC balloon inflation; and daily review of the need for a UC with prompt removal if no longer needed. The bundle was used for all ICU and SDU patients requiring a UC. Nurses intervened in this process at the same time that performance monitoring was occurring at the bedside if noncompliance with an element of the bundle (eg, hand hygiene was not performed) was detected during UC insertion.

Before the start of phase 2, we delivered a brief presentation to the ICU staff on CAUTI prevention, reviewed the study protocol, and encouraged participation in our ''UC Bundle—Getting to Zero'' program. During phase 2, each month we provided feedback on compliance with the bundle components via e-mail to the ICU and SDU teams (doctors and nurses). We also placed posters in the ICU and SDUs with bar graphs displaying compliance with process of care measures as well as the CAUTI rate, determined by surveillance conducted by the infection control and hospital epidemiology program. We created an ICU nurses' group to remove unnecessary UCs daily. Once a day, an ICU nurse (not on clinical duty) checked all of the ICU patients with UCs and asked the ICU doctor on duty if the UC was necessary. Placement of a UC was considered appropriate when the indication was for close monitoring of urine output in an incontinent patient or in a critically ill patient requiring intensive monitoring during vasopressor infusion.[8] The same strategy was followed in the SDUs, but with each bedside nurse questioning the SDU doctors on duty about the need for a UC in each patient. Unfortunately, these data are available for the SDUs only for May-July 2010.

We did not use impregnated UCs in the ICU and SDU patients. Compliance with all process measures during UC insertion was evaluated for all UCs placed in the ICU and SDUs. Bladder ultrasonography was used sporadically to aid the decision of whether or not to place a UC, and we plan to train all ICU doctors and nurses in the use of bladder ultrasonography to avoid indwelling catheterization. Since October 2009, all ICU and SDU patients with an indwelling device (eg, central venous catheter, UC) receive a daily chlorhexidine bath.

### Definitions

CAUTI surveillance was performed by trained infection control practitioners using the CDC's definition of laboratory-confirmed UTI for the 2 phases of the study.[9] A CAUTI was attributed to a specific unit if it was detected at least 48 hours after admission to or less than 48 hours after discharge from the unit.[3] The device utilization ratio was defined as the number of UC-days divided by the number of patient-days.

### Microbiological methods

All isolates were identified by manual or automated methods and confirmed using the Vitek 2 system (bioMerieux Vitek, Hazelwood, MO).

### Statistical analysis

A generalized linear model was used to model Poisson distribution count data using the number of