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## Major Article

## Effectiveness of a bundled approach to reduce urinary catheters and infection rates in trauma patients

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## Key Words:

Catheter-related infections  
urinary catheters  
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infection

**Background:** Catheter-associated urinary tract infections (CAUTIs) are common nosocomial infections. In 2015, the Centers for Medicare and Medicaid Services began imposing financial penalties for institutions where CAUTI rates are higher than predicted. However, the surveillance definition for CAUTI is not a clinical diagnosis and may represent asymptomatic bacteriuria. The objective of this study was to compare rates of urinary catheterization and CAUTI before and after the implementation of a bundled intervention.

**Methods:** This retrospective review evaluated trauma patients from January 2013-January 2015. The bundled intervention optimized the urinary catheterization process and culturing practices to reduce false positives. The CAUTI rate was defined as a positive surveillance CAUTI divided by total catheter days multiplied by 1,000 days.

**Results:** A total of 6,236 patients were included (pre: n = 5,003; post: n = 1,233). Fewer patients in the post bundle group received a urinary catheter (pre: 25% vs post: 16%;  $P < .001$ ). After bundle implementation, the CAUTI rate reduced over one third (pre: 4.07 vs post: 2.56; incidence rate ratio, 0.63; 95% confidence interval, 0.19-2.07).

**Conclusions:** Although the number of patients exposed to urinary catheters and catheter days was decreased, optimization of culturing practices was essential to prevent the CAUTI rate from increasing from a reduced denominator. Implementation of a CAUTI prevention bundle works synergistically to improve patient safety and hospital performance.

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## BACKGROUND

Urinary tract infections are the fourth most common health care-associated infection, most of which are secondary to indwelling urinary catheters.<sup>1</sup> It is estimated that 65%-70% of catheter-associated urinary tract infections (CAUTIs) may be prevented by

following evidence-based strategies.<sup>2</sup> This would reduce annual incidence in the United States by up to 387,000 cases, with an associated cost savings of >\$115 million per year.<sup>2</sup> Because of the high human and financial cost associated with CAUTIs, the Centers for Medicare and Medicaid Services have included CAUTI as a penalty in the value-based purchasing model, causing it to be a focus for improvement among acute care institutions in recent years.<sup>2-4</sup> However, in the context of CAUTI, it is proposed that introducing penalties may lead to unintended effects, such as the use of less sensitive tests, reduction in the frequency of diagnostic testing, and deflection of the uncompensated costs to non-Medicare payers.<sup>5-7</sup> Additionally, some studies have found no difference in CAUTI rates since the implementation of financial incentives in 2008.<sup>8,9</sup>

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<u>Urinary catheter process optimization</u>	<u>Standard process for obtaining a urine culture</u>
<ul style="list-style-type: none"> <li>• Caregiver engagement on appropriate patient selection</li> <li>• Optimization of insertion and maintenance technique</li> <li>• Prospective audits with evaluation for ongoing indication</li> <li>• Emphasis on early discontinuation</li> </ul>	<ul style="list-style-type: none"> <li>• Removing or placing a new catheter prior to urinalysis and culture for existing catheters greater than 72 hours</li> <li>• Defining a negative UA as white cells less than 10 WBC/HPF, where a culture is not indicated</li> <li>• Prospective urine culture surveillance and discontinuation of inappropriate cultures based on the UA definition</li> </ul>

**Fig 1.** Catheter-associated urinary tract infection prevention bundle. *HPF*, high power field; *UA*, urinalysis; *WBC*, white blood cells.

In spite of conflicting theories about reimbursement, decreasing CAUTI rates improves the quality of care and prevents patients from enduring potentially preventable complications. Preventing CAUTI begins with using catheters only for appropriate indications and using alternatives when possible. Once the decision has been made to use an indwelling catheter, appropriate insertion with sterile equipment and aseptic techniques should be used.<sup>10,11</sup> Similarly, proper maintenance and early discontinuation reduces exposure and CAUTI risk.<sup>12</sup>

Despite efforts to control CAUTIs, interventions aimed at appropriate patient selection and catheter utilization can have the unintended effect of actually increasing CAUTI rates, by reducing the total number of catheter days, or denominator, and selecting for a higher acuity population. Therefore, it is also crucial to standardize culturing practices given the high rates of asymptomatic bacteriuria (ASB) observed in catheterized patients, which can often meet the surveillance definition for CAUTI.<sup>13</sup> Inappropriate treatment of ASB has been associated with negative consequences, including acquisition of multidrug-resistant organisms and adverse drug events.<sup>14</sup>

Complex interplay between these various components necessitates a multifaceted approach to effectively reduce the incidence of CAUTIs. Many institutions have successfully reduced CAUTIs by use of a bundled approach.<sup>15-17</sup> Appropriate indications, technique, and duration are the backbone to reducing patient exposure to indwelling urinary catheters and subsequently CAUTIs. Common methods used as part of a bundled approach include training sessions, virtual distribution of guidelines, reminders in patient records, memory tools, pocket cards, and provider feedback.<sup>15-19</sup> Although most institutions take an interdisciplinary approach, many nurse-driven interventions, such as checklists, direct observation of urinary catheter placement, and utilization of the CAUTI prevention tool published by the American Nurses Association, have proven to be successful as well.<sup>20-23</sup>

The purpose of this study was to evaluate the effect of a CAUTI prevention bundle on the utilization of urinary catheters and CAUTI rates in trauma patients. The prevention bundle focused on optimizing technical aspects of urinary catheterization, including appropriate indications, insertion and maintenance techniques, and timely discontinuation, while concurrently standardizing urine culturing practices (Fig 1). Both interventions were thought to work synergistically; a focus on only technical aspects of urinary catheterization may increase the CAUTI rate with reduced catheter days, whereas a focus on culturing practices misses potential opportunities to improve patient care. Although the intervention was applied hospital-wide, trauma patients were selected specifically for this study given it is a predominant service line, it frequently uses urinary catheters, and its availability of patient characteristics in the Trauma Quality Improvement Program registry. It was hypothesized that the bundled intervention would have a positive impact and reduce both urinary catheter utilization and CAUTI rates.

## METHODS

This retrospective cohort study evaluated all adult trauma patients admitted to an urban, level I trauma center from January 2013-January 2015. Approval of the study design and a waiver for consent was granted from the Seton Family Healthcare Institutional Review Board prior to the collection of patient data in accordance with ethical standards. Data were collected from January 2013-January 2015 to compare groups before and after a CAUTI prevention bundled intervention that was implemented on August 1, 2014. Patients were classified as receiving postintervention care if they were admitted after the implementation date. Trauma patients between 18 and 89 years of age with complete medical records were included. Neutropenic patients were excluded because of the potential inability to mount an appropriate immune response and present with an elevated white blood cell (WBC) count on urinalysis.

The trauma database registry and electronic medical records were used to obtain data for each group, including demographics, vitals, Abbreviated Injury Scale score, Injury Severity Score, catheter days, length of stay, and days of mechanical ventilation. The infection prevention department identified CAUTIs based on the Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN) criteria during that period. During the 2013-2015 period, the Centers for Disease Control and Prevention's NHSN required 3 elements to define CAUTI: presence or recent use (within 1 day) of indwelling urinary catheter of >2 days, 1 sign (ie, fever [ $>38^{\circ}\text{C}$ ]) or 1 symptom without another recognized cause, and a positive urine culture ( $\geq 10^5$  colony forming units [cfu]/mL).<sup>24</sup> Symptoms included urgency, frequency, dysuria, suprapubic tenderness, costovertebral angle pain, or tenderness. If a urinalysis showed leukocyte esterase or nitrite,  $\geq 10$  WBCs/mm<sup>5</sup> cfu/mL, or microorganisms seen on unspun urine gram stain, then the cfu threshold on the urine culture was lowered to a range of  $\geq 10^3$ - $10^5$  cfu/mL.

Before the bundle implementation, fever and altered mental status commonly triggered pan culturing, including a urine sample. During a root cause analysis, it was recognized that approximately half of the recent CAUTI cases likely represented ASB given the lack of pyuria (defined as  $>10$  WBCs per high power field [HPF]) on urinalysis. Subsequently, a bundled approach was developed by a multidisciplinary team of physicians, nurses, and pharmacists to target many of the factors that contribute to CAUTI (Fig 1). To reinforce appropriate indications for use, proper maintenance techniques, and early discontinuation of urinary catheters, nurse-led rounds were conducted 4 times per week for 3 months in the intensive care unit (ICU). During these rounds, each patient with a catheter was assessed for appropriateness and potential for removal. Additionally, a diagnosis algorithm was created to provide broad education and supplement bedside rounds. This algorithm helped to solidify these practices as standards of care. Prior to urinalysis and culture, catheter removal and re-placement was recommended if the existing catheter was in place for more than 72 hours based on

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