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Translating Health Care–Associated Urinary Tract Infection Prevention Research into Practice via the Bladder Bundle

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Article-at-a-Glance

Background: Catheter-associated urinary tract infection (CAUTI), a frequent health care–associated infection (HAI), is a costly and common condition resulting in patient discomfort, activity restriction, and hospital discharge delays. The Centers for Medicare & Medicaid Services (CMS) no longer reimburses hospitals for the extra cost of caring for patients who develop CAUTI. The Michigan Health and Hospital Association (MHA) Keystone Center for Patient Safety & Quality has initiated a statewide initiative, MHA Keystone HAI, to help ameliorate the burden of disease associated with indwelling catheterization. In addition, a long-term research project is being conducted to evaluate the current initiative and to identify practical strategies to ensure the effective use of proven infection prevention and patient safety practices.

Overview of the Bladder Bundle Initiative in Michigan: The bladder bundle as conceived by MHA Keystone HAI focuses on preventing CAUTI by optimizing the use of urinary catheters with a specific emphasis on continual assessment and catheter removal as soon as possible, especially for patients without a clear indication.

Collaboration Between Researchers and State wide Patient Safety Organizations: A synergistic collaboration between patient safety researchers and a statewide patient safety

organization is aimed at identifying effective strategies to move evidence from peer-reviewed literature to the bedside. Practical strategies that facilitate implementation of the bundle will be developed and tested using mixed quantitative and qualitative methods.

Discussion: Simply disseminating scientific evidence is often ineffective in changing clinical practice. Therefore, learning how to implement these findings is critically important to promoting high-quality care and a safe health care environment.

Health care–associated urinary tract infection (UTI) is an important cause of morbidity and excess health care costs in hospitals in the United States¹⁻⁶ and elsewhere. More than 100 million indwelling urinary catheters (commonly referred to as Foley catheters) are used annually in the world; more than a quarter of these are used in the United States.⁷ About 15% of patients admitted to acute care hospitals in the United States receive an indwelling urinary catheter at some point during their hospital stay.^{7,8} Most of these catheters are used for short-term catheterization (defined as 30 days or less). Given how commonly indwelling catheters are used, catheter-associated UTI (CAUTI) is, not surprisingly, the most common of all health care-associated infections (HAIs) and accounts for approximately 40% of all HAIs.^{8,9} About 80% of health care-associated UTIs are caused by a urinary catheter,⁵ with each episode of symptomatic CAUTI costing at least \$600.^{3,9,10} CAUTI is now even more costly for hospitals because the Centers for Medicare & Medicaid Services (CMS) no longer reimburses hospitals for the extra cost of caring for patients who develop CAUTI.¹¹⁻¹³

In addition to the health and financial burdens of CAUTI, there are additional patient safety concerns associated with urinary catheterization, such as patient discomfort, activity restriction, discharge delays, and the potential development of a reservoir of multidrug-resistant organisms that can be spread to other patients. In one study, 42% of catheterized patients reported that their indwelling catheter was uncomfortable, 48% complained that it was painful, and 61% noted that it restricted their activities of daily living.¹⁴ For some patients, urinary catheters act as a physical restraint, in essence binding them to the bed—we thus have referred to the urinary catheter as a “one-point restraint.”¹⁵ Restricted activity reduces patient autonomy and promotes other hospital-acquired complications such as pressure sores and venous thromboembolism. Indwelling catheter usage may also prolong the length of hospital stay if the patient is unable to void normally after the catheter is removed near the time of a planned discharge.

In this article we describe a statewide initiative that is already underway and an evolving collaboration between this statewide effort and researchers to better understand how to facilitate the use of key practices for preventing CAUTI across a diverse set of hospitals. First, we describe the Michigan Health and Hospital Association (MHA) Keystone Center for Patient Safety & Quality's new initiative to reduce HAIs in hospitals statewide, focusing specifically on the prevention of CAUTI. Then we describe a research project, which is designed in part to evaluate the current statewide initiative as well as to develop and test a more tailored approach to assist selected hospitals with implementing key practices to prevent CAUTI. The over-arching objective of this collaboration is to identify practical strategies to ensure the effective use of proven infection prevention and patient safety practices in real-world clinical settings.

CAUTI Preventive Practices

Given the clinical and economic consequences of CAUTI, updated consensus guidelines and a compendium of prevention strategies to prevent this common and costly hospital-acquired complication have been recently published.¹⁶⁻¹⁸ The Healthcare Infection Control Practices Advisory Committee (HICPAC) will also be releasing its final CAUTI guidelines soon. The key elements of the existing (and soon to be released) evidence-based practices to reduce

CAUTI can be summarized using the simple mnemonic “ABCDE” (Table 1, right), which emphasizes specific strategies to prevent CAUTI in an easy-to-remember way. Many of these elements are incorporated into the bladder bundle, as we now describe.

Translating Evidence into Practice

Given the complexities inherent in translating evidence into practice, evidence-based practices are unfortunately not necessarily immediately applied in patient care settings. Studies suggest that certain infection prevention practices are not commonly used in some hospitals, even with evidence demonstrating that these practices substantially reduce infection risk,^{19,20} and practices to prevent CAUTI are no exception. In addition, we validated a long-standing paradox that despite the high frequency of UTI, it is often excluded from HAI surveillance and prevention activities, and therefore the use of practices to prevent UTI is not given as high a priority as those for preventing other infections, such as catheter-related bloodstream infections.²¹ Survey data collected from a national random sample of non-federal hospitals with an ICU and more than 50 hospital beds showed that approximately 30% do not have an established surveillance system for monitoring UTI rates, more than 50% do not have a system for monitoring which patients have urinary catheters, and more than 70% do not routinely monitor duration and discontinuation of urinary catheters.²² The use of specific practices to prevent UTI is also relatively low. For example, 9% of hospitals use a urinary catheter stop-order or reminder, 14% use condom catheters in appropriate men, and only about 30% use a portable bladder ultrasound scanner for determining postvoid residual.²²

Statewide Initiative to Prevent CAUTI

To reduce the clinical and economic burden of CAUTI, the State of Michigan developed a novel statewide initiative. The MHA's Keystone Center for Patient Safety & Quality, a division of the MHA Health Foundation, was established in 2003 to improve patient safety and health care quality statewide. Recently, the MHA Keystone Center for Patient Safety & Quality completed a successful statewide initiative that focused on enhancing the safety and quality of care for patients in ICUs (Keystone ICU).²³ This initiative, which included development of a patient safety collaborative and use of practice bundles, dramatically reduced the incidence of vascular catheter-related bloodstream infections in more than 100 ICUs.²³

Given the success of this initial collaborative effort, in 2007 the MHA Keystone Center launched an initiative to reduce HAIs in hospitals statewide (MHA Keystone HAI). Building on the achievements observed in the critical care setting, goals of MHA Keystone HAI include expanding of interventions to prevent device-associated HAIs, enhancing use of hand hygiene, and expanding a supportive culture of safety. However, extending findings from a closed system—such as an ICU—to other parts of the hospital—such as medical or surgical wards—may prove challenging because ICUs, in comparison with general hospital wards, usually have a smaller number of patients, higher nurse-to-patient ratios, and better-defined nurse and physician leadership roles. For example, when the procedures used for Keystone ICU for the insertion of central venous catheters were expanded to locations outside the ICU, modifications involving equipment, supplies, and interdisciplinary teamwork were required. Specifically, in some facilities, supplies (for example, central venous catheter insertion kit, proper attire) were packaged in portable kits and deployed strategically in medical-surgical inpatient units.

Overview of the Bladder Bundle Initiative in Michigan

Bladder Bundle

A “bundle” has been considered a set of evidence-based practices that are generally meant to be implemented together.²⁴ The bladder bundle as conceived by MHA Keystone HAI,

however, is a variant on this concept because it is both process-based and practice-based. In addition, not all elements need to be used in a given hospital. Specifically, the bladder bundle focuses primarily on preventing CAUTI by optimizing the use of urinary catheters with a specific emphasis on continual assessment and removal of the catheter as soon as possible, especially for those patients for whom there is no clear indication. The underlying rationale for this focus is that (1) most hospital-acquired UTIs are caused by an indwelling urinary catheter and (2) studies evaluating the indications for indwelling catheters have consistently found that only about half are appropriate. The bladder bundle is, thus, primarily focused on the “process” of reducing urinary catheter use. Practices included as part of the bladder bundle, along with measures tracked as part of MHA Keystone HAI, are summarized in Table 2 (above).

Importantly, nurses are expected to take a key role in implementing the bladder bundle, given that the insertion, care, and maintenance of the indwelling catheter falls most often on nursing personnel. Although physician collaboration is important to promote appropriate urinary catheter use, the recommended champion for the bundle is a nurse, especially one who has a leadership role on the patient care unit. This approach is based in part on an interventional study by Fakhri et al., in which unit-based personnel were engaged in optimizing appropriate use of urinary catheters.²⁵ The nurse champion oversees the project and works with members of the team (for example, infection preventionists, staff nurses) to actively evaluate the use of urinary catheters and provide real-time feedback to the patient's primary physician on whether the device is needed.

Using a Collaborative Model to Facilitate Implementation

To facilitate implementation of the bladder bundle, MHA Keystone HAI uses the Johns Hopkins University collaborative model for transformational change that was used for the Keystone ICU project and is based in part on the “four E's”: Engage, Educate, Execute, and Evaluate.^{26,27}

Engage and Educate—In the Engage and Educate steps in the bladder bundle initiative, hospitals choosing to participate receive information, including presentations, during content conference calls. In addition, during face-to-face workshops, each site receives a bundle toolkit with the description of the intervention steps, measures, and supporting references. The materials are also available on the MHA Keystone HAI Web site.

Execute—In the initial stage of the Execute step, the hospital is encouraged to identify and enlist at least one nurse champion (for example, a case manager, nurse coordinator, clinical nurse specialist) to lead the initiative and organize a bladder bundle team, usually also including a physician. Members of the bladder bundle team are invited to attend periodic face-to-face workshops as well as to participate in weekly team conference calls with other participating hospitals and MHA Keystone HAI staff. The conference calls include both content calls, with experts addressing a particular bundle topic, and coaching calls. These calls are recorded so participants who are not on the call can listen at any time to the discussion.

After the team has been formed and the target units identified, the team is asked to conduct a baseline assessment, which includes assessing the facility's catheter policy and procedures. The team also conducts a point-prevalence study of the appropriateness of urinary catheterization. During this local pre-intervention step, baseline data are collected, including tabulations of the indications for insertions and the total number of patients each day with an indwelling urinary catheter (Table 2). This information is then used to calculate an unnecessary catheterization rate. Findings from the baseline point-prevalence study can be reported to frontline personnel and used in training staff about appropriate indications for catheter

utilization. Some hospitals in MHA Keystone HAI that have completed the bladder bundle project are now conducting periodic point-prevalence surveys every quarter or six months to assess sustainability of process improvements. Other hospitals are just beginning the bundle project. Aggregate data are presented periodically at MHA Keystone HAI workshops.

As the intervention (or Execute) step continues, daily patient rounds (referred to as “catheter patrol”) are convened to assess patients for the presence of a catheter and, if present, to document in the chart the reason for insertion, along with the unit where the catheter was inserted. Hospitals are also encouraged to implement more active strategies for UTI prevention, such as the use of a nurse-based discontinuation protocol, some type of urinary catheter reminder or prompt, the use of alternatives to indwelling catheterization, and the use of portable bladder ultrasound monitoring. In addition, materials and the experiences of other hospitals that have implemented UTI prevention activities are shared. For example, one hospital in Michigan developed and tested an intervention in which a nurse trained in the indications for urinary catheter utilization participated in daily multidisciplinary rounds. If an appropriate indication for a urinary catheter was not found, then the patient's nurse was asked to contact the physician to request discontinuation. The intervention resulted in a significant reduction in the rate of urinary catheter use from the pre-intervention to the intervention steps.²⁵

Evaluate—Finally, during the postintervention (or Evaluate) step, catheter-use rates and unnecessary catheterization rates continue to be collected and shared with frontline staff, and the results are compared across the project steps. An important feature of the MHA Keystone HAI initiative is its Web-based data collection tool, which allows for data feedback and comparison across sites. Each site reports certain standardized data elements for monitoring specific processes and outcomes for urinary catheter prevalence (Table 2).

Although the ultimate goal is to decrease CAUTI rates, the initial focus is on process measures related to urinary catheter use because surveillance and reliable measurement of incidence by patient care units is labor intensive, requiring capture of CAUTI (numerator) and urinary catheter days (denominator) for the patient care unit(s). In addition, it may be difficult to demonstrate an impact of improved use of urinary catheters on CAUTI incidence unless a very large number of subjects are included.²⁸ Therefore, an intermediate outcome reflected by a crude uropathogen frequency analysis is optional for MHA Keystone HAI hospitals. The uropathogen frequency analysis involves creating a report from each participating unit that provides (1) all urine cultures that were positive, as defined in the surveillance definition 48 hours after the patient's date of admission, and (2) frequency, pathogen, and cumulative susceptibility profile for all of these positive cultures, sorted by unit if possible, comparing before versus after bundle implementation. Alternatively, traditional CAUTI rates for the targeted units can be used to examine the impact of the bundle if it is already in place, and some hospitals are using information technology to enhance efficiency of surveillance for CAUTI.²⁸⁻³⁰

Collaboration Between Researchers and Statewide Patient Safety Organizations

Developing Process Knowledge for Implementation

To implement evidence-based practices effectively across a diverse group of hospitals and hospital settings requires not only knowledge about best practices—in this case, the bladder bundle—but developing *process knowledge* that can be used to adapt them to the particular settings.^{31,32} Yet, how best to develop and sustain this process knowledge remains an underdeveloped and not well understood component of many evidence-based quality improvement efforts. Although the MHA Keystone HAI initiative provides many tools, as just

described, to support implementation of the bladder bundle, we expect that some hospitals will need more explicit guidance and strategies. Therefore, we will be working in collaboration with the MHA Keystone Center to develop and evaluate strategies to enhance and promote the bladder bundle's effective use.

The Three-Phase Research Design

This approximately three-and-a-half-year project, which has been approved by the University of Michigan Institutional Review Board, uses a sequential mixed-methods approach, with each of the three phases building on work conducted in the previous phase (Table 3, above). Phase 1 consists of a survey of hospital infection preventionists to examine the diffusion, adoption, and implementation of UTI prevention practices and selected patient outcomes. Phase 2 involves in-depth semistructured telephone and on-site interviews with both clinical and administrative staff at select medical centers. The interview data will allow us to examine the implementation process as experienced by different types of hospitals (for example, small, rural critical access hospital versus large, tertiary, academically affiliated hospital). Our goal for the site visits is not only to more fully understand the processes involved in implementing the bladder bundle but, more important, to describe and explain variation in implementation among the hospitals.

Phase 3 entails the development and evaluation of explicit implementation strategies in collaboration with three hospitals that are just beginning to implement the bladder bundle. These hospitals will be chosen on the basis of factors such as size, geographic location, and facility type. (At this time, 122 of the approximately 140 general medical/surgical hospitals in Michigan are participating in MHA Keystone HAI).

We will collect qualitative data before, during, and after the implementation of the intervention to conduct a formative evaluation—an evaluation with the intent of improving programs in which strategies are assessed and then adjusted during the course of the assessment (before their completion). This process will include an evaluation of the implementation process, attainment, and sustainability.³³ Data collected during the implementation process will be used to assess practice “fidelity” (that is, the extent to which the practice, which broadly defined could be a new technology or organizational process, is being used as intended to produce the expected outcomes). Moreover, data collected during implementation will help identify unanticipated issues that may arise and lead to refinement or adaptations to the practice or implementation strategy to promote optimal outcomes. Finally, data collected after implementation will be used to assess the implementation process and attainment and the potential sustainability of the practices after active efforts are completed or to identify additional steps that may be required to promote sustainability. In Phase 3, we will also collect quantitative data on several patient-specific outcomes such as catheter use, discontinuation, and infection rates.

Of note, the approach we propose to use in Phase 3 draws heavily on the concept of facilitation, as described in the PARIHS framework for research utilization in practice settings.³⁴ Our goal is to facilitate the implementation of the bladder bundle by helping to make change easier or increase the desire for change.^{33,34} Although a local opinion leader could play a role as a facilitator in promoting a change in clinical practice, in some circumstances the process of facilitation may require a broader set of resources and skills that can span various professional and organizational boundaries.³³ As such, certain members of the research team, in collaboration with key medical center personnel, will serve as external facilitators in the implementation of the bladder bundle. Moreover, as part of the implementation process we will also focus explicitly on assessing and understanding the organizational context.³⁵ This information will then be used to tailor the types of prevention practices and the implementation process to the local setting to promote effective and sustained practice use.

Discussion

Our proposed intervention approach shares many of the same features as the two major models of quality improvement across multiple sites that have been described extensively in the literature, the Institute for Healthcare Improvement (IHI)'s Breakthrough Collaborative approach, and the Integrated Model for Translating Evidence into Practice developed by the Quality and Safety Research Group at Johns Hopkins University School of Medicine.^{27,36-42} Notably, all three approaches emphasize implementing a set of best practices identified through careful review of the literature, as well as practices shared across sites—both research- and experientially based practices. They also all emphasize practical, behavioral approaches to implementing these practices. Our approach, however, includes a more explicit use of facilitation and local tailoring (development of strategies to suit the characteristics of the local setting) and an increased focus on identifying and evaluating process knowledge. Thus, the strategies used will to some extent be hospital specific and could even vary among different units within a hospital, depending on the context. Moreover, rather than necessarily promoting the practices included in the bladder bundle as an “all or nothing” proposition,⁴³ we believe that it may not be possible or necessary to implement all components. For example, if a hospital is already using a nurse-initiated Foley removal protocol, then most likely it would not need to implement a computerized reminder. Also, if a site is unable to implement a nurse-initiated Foley removal protocol we would help it look to other options. Finally, our measurement and evaluation approach also includes enhanced focus on process measurement and process evaluation in an attempt to gain new insights into which elements of quality improvement collaboratives and practice bundles are most useful in obtaining desired patient outcomes.

Conclusion

The MHA's Keystone Center for Patient Safety & Quality has initiated an ambitious patient safety project to help ameliorate the burden of disease associated with indwelling catheterization. Simply disseminating scientific evidence, however, is often ineffective in changing clinical practice. Therefore, learning how to implement these findings effectively in practice is critically important to promote high-quality care and a safe health care environment. Determining the best methods for ensuring the effective use of proven practices in real-world clinical settings can be challenging, and implementation strategies must be tailored accordingly. Unfortunately, little is known about the sustained use of prevention bundles or what is needed to ensure that infection rates remain low, especially as organizational resources and attention shift to other issues. Consequently, we expect that our study of hospitals' experiences in implementing the bladder bundle can subsequently be used to develop more effective strategies for implementing a range of important patient safety practices across a variety of settings.

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Table 1**Prevention of Catheter-Associated Urinary Tract Infection: Concise Summary of Guideline Recommendations (“ABCDE”)**

Adherence to general infection control principles (e.g., hand hygiene, surveillance and feedback, aseptic insertion, proper maintenance, education) is important.

Bladder ultrasound may avoid indwelling catheterization.

Condom catheters or other alternatives to an indwelling catheter such as intermittent catheterization should be considered in appropriate patients.

Do not use the indwelling catheter unless you must!

Early removal of the catheter using a reminder or nurse-initiated removal protocol appears warranted.

Table 2**Keystone Bladder Bundle Practices and Measures****Key Practices**

1. Nurse-initiated urinary catheter discontinuation protocol
2. Urinary catheter reminders and removal prompts
3. Alternatives to indwelling urinary catheterization
4. Portable bladder ultrasound monitoring
5. Insertion care and maintenance

Measures (All Pre- and Postintervention)

1. Prevalence rate of urinary catheter utilization (number of urinary catheter days/total number of patient-days during a period of time)
2. Indication for each insertion
3. Prevalence rate of unnecessary urinary catheter utilization (number of unnecessary urinary catheter days/total number of patient-days during a period of time)
4. Rate of discontinuation of unnecessary urinary catheters (number of unnecessary catheters discontinued/number of urinary catheters evaluated for which no indication was found)

Table 3

Overview of Research Design *

Phase 1	Quantitative Phase Quantitative Measures	Phase 2	Qualitative Phase Qualitative Measures	Phase 3	Both Quantitative and Qualitative Phase and Quantitative Measures
<ul style="list-style-type: none"> Develop survey. Administer survey to key infection control and nursing personnel at all Michigan hospitals and a random sample of U.S. hospitals. Analyze survey data. 	<ul style="list-style-type: none"> Infection prevention practice use Urinary tract infection rates Hospital characteristics Infection control program characteristics Environmental context 	<ul style="list-style-type: none"> Select cases for qualitative study based on participation in MHA Keystone HAI, the use of key bladder bundle practices, and maximum variation in other relevant variables. Conduct phone interviews to collect qualitative data from 7 hospitals that have implemented the MHA Keystone HAI bladder bundle and 3 that are planning to implement it. Conduct site visits at 3 hospitals that participated in the phone interviews. Analyze qualitative data using thematic techniques looking within and across cases and begin to develop implementation strategies. 	<ul style="list-style-type: none"> Understand the steps being taken in preparation for implementation. Ascertain barriers to and facilitators of implementing the bladder bundle across a diverse group of hospitals. Understand the processes involved in implementing the bladder bundle. Describe and explain variation in the implementation of the different practices in the bladder bundle among hospitals that have adopted those practices. 	<ul style="list-style-type: none"> Develop and evaluate implementation strategies in collaboration with 3 hospitals that are participating in MHA Keystone HAI and planning to implement the bladder bundle (formative evaluation). Understand the hospital culture and resources as well as current practices/problems to determine what type of implementation strategies might be most suitable given the context. Practice fidelity. 	<ul style="list-style-type: none"> Catheterization rates, catheter discontinuation and re-insertion rates, and catheter-associated urinary tract infection rates Organizational readiness Understand the hospital culture and resources as well as current practices/problems to determine what type of implementation strategies might be most suitable given the context. Practice fidelity.

* MHA, Michigan Hospital Association; HAI, health care-associated infection.