INTERNATIONAL SOCIETY FOR INFECTIOUS DISEASES

# GUIDE TO INFECTION CONTROL IN THE HEALTHCARE SETTING

# Hospital-Acquired Urinary Tract Infection


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## Topic Outline

References

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## KEY ISSUES

- “The decision to use the urinary catheter should be made with the knowledge that it involves the risk of producing a serious disease.” Even though Paul Beeson made this statement about fifty years ago, it is still relevant for both patients and healthcare workers. Urinary catheters represent the major risk factor related to the acquisition of hospital-acquired urinary tract infections (HUTIs).
- The frequency of HUTIs among hospital-acquired infections is 12.9%, 19.6%, and 24% in the United States, Europe, and developing countries, respectively. HUTI prevalence in countries ranges between 1.4% and 3.3%.
- Catheter-associated urinary tract infection (CA-UTI) is defined as a UTI where an indwelling urinary catheter was in place for more than 2 calendar days on the date of event, with day of device placement being day 1, and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for more than 2 calendar days and then removed, the date of event for the UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated.
- Each year approximately 96 million urethral catheters are sold worldwide, nearly a quarter of which are sold in the United States. Approximately 30% of initial urinary catheterizations are unjustified, and one-third to one-half of days of continued catheterization are also unjustified. Many of these catheters are inserted in the emergency room without a documented order, and providers are not aware that the catheter is in place in 21-28% of cases. The reduction of inappropriate use of indwelling urinary catheter, the use of closed drainage systems, and the early removal “as soon as possible” of the catheter already in place, are the main tools to reduce HUTIs.

## KNOWN FACTS

- In the United States, between 15% and 25% of hospitalized patients have an indwelling urinary catheter (IUC) in place. The daily rate of acquiring bacteriuria among hospitalized patients with urinary catheters is approximately 3 to 10%, and between 10 to 25% of patients with bacteriuria will develop symptoms of UTI. Of patients with a symptomatic CA-UTI, about 5% of patients with CA-UTI develop a bacteremia. Mortality associated with bacteremia secondary to nosocomial UTI is approximately 30%. The costs of CA-UTI are modest compared with other device-associated infections but the large number of patients with indwelling urinary catheters results in a substantial burden. Each CA-UTI adds approximately USD 675 to the costs of hospitalization and when bacteraemia develops, this additional cost increases to at least USD 2800. In total, CA-UTIs result in an estimated USD 131 million annual excess medical costs.
- The first step in CA-UTI pathogenesis is the development of biofilms on the surfaces of catheters. Microorganisms causing endemic HUTIs derive from the patient's own flora or from the hands of HCWs during catheter insertion or manipulation of the collection system. Bacteria can enter the urinary tract in catheterized patients in three ways:
    - introduction of organisms into the bladder at the time of catheter insertion;
    - periurethal route; or
    - intraluminal route.
- The most frequent pathogens associated with CA-UTI in hospitals reporting to National Healthcare Safety Network (NHSN) between 2009-2010 were *Escherichia coli* (26.8%) and *Pseudomonas aeruginosa* (11.3%), followed by *Klebsiella* spp. (11.2%), *Candida albicans* (8.9%), *Enterococcus faecalis* (7.2%%), *Proteus* spp. (4.8%), other *Enterococcus* spp. (4.8%), *Enterobacter* spp. (4.2%), other *Candida* spp.

(3.8%) and *Enterococcus faecium* (3.1%). A smaller proportion was caused by *Staphylococcus aureus* (2.1%), coagulase-negative staphylococci (2.2%), *Serratia* spp. (1.0%), *Acinetobacter baumannii* (0.9%), and other pathogens (7.7%). Urinary tract pathogens such as *Serratia marcescens* and *Pseudomonas cepacia* have special epidemiological significance. Since these microorganisms do not commonly reside in the gastrointestinal tract, their isolation from catheterized patients suggests acquisition from an exogenous source, likely through the hands of personnel. HUTIs comprise perhaps the largest institutional reservoir of nosocomial antibiotic-resistant pathogens, the most important of which are vancomycin-resistant enterococci, extended-spectrum β-lactamase (ESβL)-producing Enterobacteriaceae, and carbapenem-resistant Enterobacteriaceae.

- Among *E. coli* isolates reported to the NHSN from CA-UTIs in ICU and non-ICU settings, 29.1% and 33.5%, respectively, were resistant to fluoroquinolones. Many Enterobacteriaceae produced ESβLs; 26.9% of *Klebsiella* spp. and 12.3% of *E. coli* isolates were resistant to extended-spectrum cephalosporins. Furthermore, 12.5% of *Klebsiella* spp. from patients with CA-UTIs were resistant to carbapenems.
- A continuously closed urinary drainage system is pivotal to the prevention of CA-UTI. For short-term catheterization, this measure alone can reduce the rate of infection from an inevitable 100% when open drainage is employed to less than 25%. Breaches in the closed system, such as unnecessary emptying of the urinary drainage bag or taking a urine sample, will increase the risk of catheter-related infection and should be avoided. Before manipulating the closed system, hands must be washed with an antiseptic agent and gloves worn.
- Non-infectious complications secondary to indwelling urinary catheters are common, and in case of long-term catheterization are 4 times higher than CA-UTI. Although the most frequent complications are minor (for example, leakage around the catheter), serious complications, such as urethral strictures and gross hematuria, occur in a substantial proportion

of patients. Moreover, long-term catheterization and catheter use in patients with spinal cord injury result in even greater illness, with more than 30% of patients having several complications.

- Studies comparing meatal cleansing with a variety of antiseptic/antimicrobial agents or soap and water demonstrated no reduction in bacteriuria when using any of these preparations for meatal care compared with routine bathing or showering. Meatal cleansing is not necessary and may increase the risk of infection. Daily routine bathing or showering is all that is needed to maintain meatal hygiene.
- Antibiotic prophylaxis should not be administered to patients for catheter-placement or catheter-removal or replacement in order to prevent CA-UTI. Overall, potential disadvantages of antibiotic prophylaxis are an increased risk of development of antimicrobial resistance, an increase in costs, and potential side effects. A 2013 meta-analysis by Marschall et al. found that antibiotic prophylaxis was associated with an absolute reduction in risk of CA-UTI of 5.8% (RR 0.45, 95% CI 0.28 to 0.72). Another 2013 meta-analysis by Lusardi et al. revealed that there is limited evidence that antibiotic prophylaxis reduces the rate of bacteriuria and other signs of infection, such as pyuria, febrile morbidity, and Gram-negative isolates, in surgical patients who undergo bladder drainage for at least 24 hours postoperatively, and there is also limited evidence that prophylactic antibiotics reduce bacteriuria in non-surgical patients.
- Another proposed approach to prevent CA-UTI is to coat catheters with antibacterial materials. Antimicrobial catheters are typically coated with nitrofurazone, minocycline, or rifampin. In patients with short-term indwelling urethral catheterization, antimicrobial (antibiotic or silver alloy)-coated urinary catheters may reduce or delay the onset of catheter-associated bacteriuria, but do not decrease the frequency of CA-UTI. Therefore, their routine use is not recommended.
- An alternative option to the use of antibiotic impregnated catheters, coating the catheter surface with an antiseptic, such as a silver

compound, could reduce the presence of the biofilm on the surface of the catheter. Early studies with a silver-oxide coated catheter reported no benefit for preventing bacteriuria, but silver alloy catheters were subsequently reported to decrease acquisition of bacteriuria, although symptomatic infection was not adequately evaluated. In a multicentre randomized controlled trial, Pickard et al. observed that silver alloy-coated catheters were not effective for reduction of incidence of symptomatic CA-UTI. In conclusion, current evidence does not support a clinical benefit for use of silver alloy-coated indwelling catheters, and routine use of these catheters is not recommended. More recently, a 2014 meta-analysis by Lam et al. found no significant difference in symptomatic CA-UTI incidence (RR 0.99, 95% CI 0.85 to 1.16) between silver alloy-coated catheters and standard catheters. Silver alloy catheters achieved a slight but statistically significant reduction in bacteriuria (RR 0.82, 95% CI 0.73 to 0.92).

- The most important, potentially modifiable risk factor, identified in every study, is prolonged catheterization beyond 6 days; by the 30th day of catheterization, infection is near universal. Thus, every operative strategy should aim to reduce to a minimum the duration of urinary catheterization. Nurse or computer-generated reminders or automatic stop orders are important tools for early removal of urinary catheters. In a 2010 meta-analysis, Meddings et al. observed that the rate of CA-UTI was reduced by 52% (RR 0.48; 95% CI 0.28 to 0.68) with use of a reminder or stop order. The mean duration of catheterization decreased by 37%, resulting in 2.61 fewer days of catheterization per patient in the intervention versus control groups. The pooled standardized mean difference (SMD) in the duration of catheterization was -1.11 overall (95% CI, -2.32 to +0.09; P = 0.070), including a statistically significant decrease in studies that used a stop order (SMD -0.30, 95% CI -0.48 to -0.12; P <0.001) but not in those that used a reminder (SMD -1.54, 95% CI -3.20 to +0.13, P = 0.071). More recently, Felix et al. compared the effectiveness of physician-initiated daily verbal reminders to primary

care providers with nurse-initiated daily verbal reminders in decreasing the duration of inappropriate indwelling urinary catheter use in hospitalized patients and found that catheter use duration was significantly decreased in the physician-initiated intervention group compared with the nurse-initiated intervention group (P = 0.03). Finally, in a retrospective cohort study, Baillie et al. evaluated the effectiveness of a computerized clinical decision support intervention aimed at reducing the duration of urinary tract catheterizations. The study showed a decrease in the use of urinary catheter (from 0.22 to 0.19, P <0.001) and of CA-UTI (from 0.84 to 0.51 CA-UTI/1000 patient-days, P<0.001).

- Finally, in an academic medical intensive care unit in USA, a successful strategy to decrease indwelling catheter utilization rates included a multidisciplinary approach with stepwise interventions strategies and CA-UTI bundles. A significant decrease in the catheterization utilization ratio and CA-UTI rates was reported, whereas incontinence associated dermatitis (IAD) identified as a potential complication of not using an IUC after the initiation of the project has been minimized by a multidisciplinary strategy, including nursing staff, nutritionists, and wound care specialists, creating a durable cultural change among the staff involved.

# SUGGESTED PRACTICE

## Information

Provide patients with information about the need, insertion, maintenance, and removal of their catheter.

## Education

- Educate HCWs about:
  1. Appropriate indications for indwelling urinary catheters in:
     - patients with anatomic or physiologic outlet obstruction;
     - patients undergoing surgical repair of the genitourinary tract;
     - critically ill patients who need to measure the daily urinary output;
  2. Alternative strategies for the management of urinary incontinence (e.g. condom or intermittent catheters).
  3. Infectious complications and adverse events associated with urinary catheterization.
  4. Optimum selection of the smallest gauge catheter for free urinary outflow.
  5. Correct techniques for catheter insertion and care.
  6. Adopting and maintaining the sterile continuously closed system of urinary drainage.
  7. Avoiding catheter irrigation unless needed to prevent or relieve obstruction.
  8. Maintaining unobstructed urine flow.
  9. Minimizing the duration of the urinary catheter.

## Care and Maintenance

- Maintain adequate urine flow at all times. Ideally, sufficient fluid to maintain urine output of greater than 100 ml/h should be given if it is not contraindicated by the patient's clinical condition.
- Gravity drainage should be maintained.
- Do not change catheters unnecessarily or as part of routine practice.
- Consider the use of catheters with anti-infective surface at least for those patients at high risk of serious complications of catheter-associated bacteriuria.

## Stop order

Consider automatic “stop orders” for indwelling urinary catheters; these orders should require that the catheter either be removed or reordered after a specified period of catheterization.

## Quality Control, Surveillance and Documentation

- Use quality-control patient audits to design programs to decrease inappropriate use of indwelling urinary catheters.
- Develop and implement a periodic surveillance system of HUTI.
- Document all procedures involving the catheter or drainage system in the patient’s records.

# SUGGESTED PRACTICE IN UNDER-RESOURCED SETTINGS

There are no specific guidelines for the management and prevention of CA-UTI in developing or under developed countries. The cornerstones of CA-UTI prevention are:

- HCW education.
- Use of aseptic technique during insertion of the catheter.
- Use of continuously closed urinary drainage systems.
- Early removal of indwelling catheters.
- Consider alternatives to indwelling catheterization.
- Consider automatic “stop orders” for indwelling urinary catheters.

# SUMMARY

The development of a nursing, physician, and laboratory team to review and revise protocols and procedures for better catheter management can promote the proper indications for urinary catheter placement and management. A continuously closed system of urinary drainage is the cornerstone of infection control and clear criteria for the removal of urinary catheters without a physician's order are part of bundled strategies for the reduction of CA-UTI. Novel urinary catheters impregnated with antibiotic drugs or coated with anti-infective material exhibit antimicrobial activity that reduces the risk of HUTI for short-term catheterizations; however, their routine use is not recommended. In the future, a major biotechnology effort to reduce the prevalence rate of HUTIs and indeed of all hospital-related nosocomial infections is likely to be represented by vaccines against important multidrug-resistant microorganisms, such as enteric Gram-negative bacilli.

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