

# Key Definitions

In order to make sure that every member of the team is clear about the definitions that will be used, we have provided a list of key terms in the next few pages along with commonly used definitions for each term.

Additionally, we define both the process (also known “intermediate outcome”) measures as well as the clinically-relevant outcome measures we will be using to evaluate how our program is working.

These definitions were provided to us from the North Carolina Center for Hospital Quality and Patient Safety, Centers for Disease Control and Prevention (CDC), and from a toolkit used by the Michigan Health and Hospital Association written by Mohamad G. Fakhri, MD, MPH, Sanjay Saint, MD, MPH, Sarah Krein, RN, PhD., and Russ Olmsted, MPH, CIC. We have modified the definitions and the material as appropriate.

Finally, we also provide recent material and definitions used by the CDC’s National Healthcare Safety Network (NHSN) as a reference source.

**Key definitions (modified from the North Carolina Prevent Catheter-Associated Urinary Tract Infections Collaborative Tool Kit developed by the North Carolina Center for Hospital Quality and Patient Safety):**

1. Asymptomatic bacteriuria (a.k.a. ASB): the presence of bacteria in the urine, which is not causing symptoms of a UTI. 75% to 90% of patients with ASB do not develop a systemic inflammatory response or other clinical manifestations suggesting infection. Treatment of ASB has not been shown to be clinically beneficial in most patient populations and is associated with development of multi-drug resistant organisms. Of note, the National Healthcare Safety Network (NHSN) removed the ASB definition from its UTI definitions in 2009.
2. Biofilm: communities of different types of microorganisms that attach to environmental surfaces, such as medical devices. They enclose themselves in a protective matrix that is highly protective, and are typically far more resistant to antibiotics than free-floating organisms. They develop rapidly and may be found on any surface where moisture and nutrients are present.
3. Catheter-associated urinary tract infection (CAUTI): as defined by the NHSN, is divided into two classifications: symptomatic CAUTI and asymptomatic, bacteremic urinary tract infection (bloodstream infection secondary to a UTI). For details, see the NHSN definitions section at the end of this section. Of note, definitions of CAUTI vary between studies, making the appraisal of evidence very difficult. Unfortunately, investigators have used many different definitions for CAUTI, and have often not distinguished between symptomatic CAUTI and asymptomatic bacteriuria.
4. External catheter (a.k.a. condom catheter, Texas catheter.): a urine containment device that fits over the external genitalia and is attached to a urinary drainage bag. Used in men.
5. Indwelling urinary catheter: drainage tube that is inserted aseptically into the urinary bladder through the urethra, is left in place, and is connected to a closed collection system. (Frequently called a “Foley catheter.”)

6. Short-term catheterization: generally considered to be a period of less than 30 days of having an indwelling urinary catheter.
7. Straight catheterization (a.k.a. intermittent catheterization or in-and-out catheterization): brief insertion (and removal) of a catheter into the bladder via the urethra to drain urine at different time intervals.
8. Symptomatic UTI (SUTI): patients with a positive urine culture and experiencing, NHSN-defined UTI signs or symptoms with no other recognized cause of the symptoms.

### **Process measures:**

1. Utilization ratio = Number of patients with a urinary catheter on the unit / Total number of patients on the unit
2. Prevalence rate = (Number of patients with a urinary catheter on the unit / Total number of patients on the unit) x 100
3. Rate of unnecessary urinary catheter use = (Days of unnecessary urinary catheters / Total number of patient days) x 1000
4. Unnecessary urinary catheter % = (Days of unnecessary urinary catheters / Total number of days of urinary catheters used) x 100
5. Discontinuation rate of unnecessary urinary catheter % = (Number of unnecessary urinary catheters discontinued / All urinary catheters without valid indications) x 100

### **Outcome Measures**

1. Symptomatic CAUTI rate\* = (Number of symptomatic CAUTIs / number of urinary catheter days) x 1000
2. Symptomatic CAUTI rate (using patient days) = (Number of symptomatic CAUTIs / Number of patient days) x 10,000

3. Bloodstream infection related to CAUTI\* (NHSN rate) = (Number of bloodstream-related infections due to CAUTI/number of urinary catheter days ) x 1000

\* Established rates used by the CDC's National Healthcare Safety Network

The next several pages come from the CDC and provide additional definitions.



## Catheter-Associated Urinary Tract Infection (CAUTI) Event

**Introduction:** The urinary tract is the most common site of healthcare-associated infection, accounting for more than 30% of infections reported by acute care hospitals<sup>1</sup>. Virtually all healthcare-associated urinary tract infections (UTIs) are caused by instrumentation of the urinary tract.

CAUTI can lead to such complications as cystitis, pyelonephritis, gram-negative bacteremia, prostatitis, epididymitis, and orchitis in males and, less commonly, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in all patients. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality. Each year, more than 13,000 deaths are associated with UTIs.<sup>1</sup>

Prevention of CAUTIs is discussed in the CDC/HICPAC document, *Guideline for Prevention of Catheter-associated Urinary Tract Infections*<sup>2</sup>.

**Settings:** Surveillance will occur in any of three types of inpatient locations: (1) ICUs, (2) SCAs (includes hematology/oncology wards, bone marrow transplant units, solid organ transplant units, inpatient dialysis units, long term acute care areas), and (3) any other inpatient location in the institution where denominator data can be collected (e.g., surgical wards).

NOTE: It is not required to monitor for CAUTIs after the patient is discharged from the facility, however, if discovered, they should be reported to NHSN. No additional indwelling catheter days are reported.

**Requirements:** Surveillance for CAUTI is performed in at least one inpatient location in the healthcare institution for at least one calendar month as indicated in the *Patient Safety Monthly Reporting Plan* (CDC 57.106).

### Definitions:

Urinary tract infections (UTI) are defined using symptomatic urinary tract infection (SUTI) criteria or Asymptomatic Bacteremic UTI (ABUTI) criteria (Table 1 and Figure 1). Report UTIs that are catheter-associated (i.e. patient had an indwelling urinary catheter at the time of or within 48 hours before onset of the event). NOTE: There is no minimum period of time that the catheter must be in place in order for the UTI to be considered catheter-associated. NOTE: SUTI 1b and 2b and other UTI (OUTI) cannot be catheter-associated.

EXAMPLE: Patient has a Foley catheter in place on an inpatient unit. It is discontinued, and 4 days later patient meets the criteria for a UTI. This is not reported as a CAUTI because the time since Foley discontinuation exceeds 48 hours.



**Location of attribution:** The location where the patient was assigned on the date of the UTI event, which is further defined as the date when the first clinical evidence appeared or the date the specimen used to meet the criterion was collected, whichever came first.

**EXAMPLE:** Patient has a Foley catheter inserted in the Emergency Department and then is admitted to the MICU. Within 24 hours of admission to the MICU, patient meets criteria for UTI. This is reported to the NHSN as a CAUTI for the MICU, because the Emergency Department is not an inpatient location and no denominator data are collected there.

**EXAMPLE:** Patient on the urology ward of Hospital A had the Foley catheter removed and is discharged home a few hours later. The ICP from Hospital B calls the next day to report that this patient has been admitted to Hospital B with a UTI. This CAUTI should be reported to NHSN for Hospital A and attributed to the urology ward.

**EXCEPTION:** If a CAUTI develops within 48 hours of transfer from one inpatient location to another in the same facility, the infection is attributed to the transferring location. This is called the Transfer Rule and examples are shown below.

- Patient with a Foley catheter in place in the SICU is transferred to the surgical ward. Thirty six (36) hours later, the patient meets the criteria for UTI. This is reported to NHSN as a CAUTI for the SICU.
- Patient is transferred to the medical ward from the MSICU after having the Foley catheter removed. Within 24 hours, patient meets criteria for a UTI. This is reported to NHSN as a CAUTI for the MSICU.
- Patient with a Foley catheter in place is transferred from the medical ward to the coronary care ICU (CCU). After 4 days in the CCU, the patient meets the criteria for UTI. This is reported to NHSN as a CAUTI for the CCU.

**Indwelling catheter:** a drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a closed collection system; also called a Foley catheter; does not include straight in-and-out catheters.

**Numerator Data:** The *Urinary Tract Infection (UTI) Form* (CDC 57.114) is used to collect and report each CAUTI that is identified during the month selected for surveillance. The *Instructions for Completion of Urinary Tract Infection Form* (Tables of Instructions, Tables 5 and 2a) includes brief instructions for collection and entry of each data element on the form. The UTI form includes patient demographic information and information on whether or not an indwelling urinary catheter was present. Additional data include the specific criteria met for identifying the UTI, whether the patient developed a secondary bloodstream infection, whether the patient died, and the organisms isolated from cultures and their antimicrobial susceptibilities.

**Denominator data:** Device days and patient days are used for denominators (See Chapter 16 Key Terms). Indwelling urinary catheter days, which are the number of patients with an indwelling urinary catheter device, are collected daily, at the same time each day, according to the chosen location using the appropriate form (CDC 57.116,



57.117, and 57.118). These daily counts are summed and only the total for the month is entered into NHSN. Indwelling urinary catheter days and patient days are collected separately for each of the locations monitored.

**Data Analyses:** The CAUTI rate per 1000 urinary catheter days is calculated by dividing the number of CAUTIs by the number of catheter days and multiplying the result by 1000. The Urinary Catheter Utilization Ratio is calculated by dividing the number of urinary catheter days by the number of patient days. These calculations will be performed separately for the different types of ICUs, specialty care areas, and other locations in the institution, except for neonatal locations.

---

<sup>1</sup>Klebens RM, Edward JR, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. *Public Health Reports* 2007;122:160-166.

<sup>2</sup>Wong ES. Guideline for prevention of catheter-associated urinary tract infections. *Infect Control* 1981;2:126-30.

Table 1-Urinary Tract Infection Criteria

Criterion	<b>Symptomatic Urinary Tract Infection (SUTI)</b> Must meet at least 1 of the following criteria:
1a	<p>Patient had an indwelling urinary catheter in place at the time of specimen collection  <i>and</i>  at least 1 of the following signs or symptoms with no other recognized cause:  fever (<math>&gt;38^{\circ}\text{C}</math>), suprapubic tenderness, or costovertebral angle pain or tenderness  <i>and</i>  a positive urine culture of <math>\geq 10^5</math> colony-forming units (CFU)/ml with no more than 2 species of microorganisms.</p> <p>-----OR-----</p> <p>Patient had indwelling urinary catheter <u>removed within the 48 hours prior</u> to specimen collection  <i>and</i>  at least 1 of the following signs or symptoms with no other recognized cause:  fever (<math>&gt;38^{\circ}\text{C}</math>), urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness  <i>and</i>  a positive urine culture of <math>\geq 10^5</math> colony-forming units (CFU)/ml with no more than 2 species of microorganisms.</p>
1b	<p>Patient did <u>not</u> have an indwelling urinary catheter in place at the time of specimen collection nor within 48 hours prior to specimen collection  <i>and</i>  has at least 1 of the following signs or symptoms with no other recognized cause: fever (<math>&gt;38^{\circ}\text{C}</math>) in a patient that is <math>\leq 65</math> years of age, urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness  <i>and</i>  a positive urine culture of <math>\geq 10^5</math> CFU/ml with no more than 2 species of microorganisms.</p>
2a	<p>Patient had an indwelling urinary catheter in place at the time of specimen collection  <i>and</i>  at least 1 of the following signs or symptoms with no other recognized cause:  fever (<math>&gt;38^{\circ}\text{C}</math>), suprapubic tenderness, or costovertebral angle pain or tenderness  <i>and</i>  a positive urinalysis demonstrated by at least 1 of the following findings:</p> <ol style="list-style-type: none"> <li>positive dipstick for leukocyte esterase and/or nitrite</li> <li>pyuria (urine specimen with <math>\geq 10</math> white blood cells [WBC]/<math>\text{mm}^3</math> or <math>\geq 3</math> WBC/high power field of unspun urine)</li> <li>microorganisms seen on Gram stain of unspun urine</li> </ol> <p><i>and</i>  a positive urine culture of <math>\geq 10^3</math> and <math>&lt; 10^5</math> CFU/ml with no more than 2 species of microorganisms.</p> <p>-----OR-----</p> <p>Patient had indwelling urinary catheter <u>removed within the 48 hours prior</u> to specimen collection  <i>and</i>  at least 1 of the following signs or symptoms with no other recognized cause:  fever (<math>&gt;38^{\circ}\text{C}</math>), urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness  <i>and</i>  a positive urinalysis demonstrated by at least 1 of the following findings:</p> <ol style="list-style-type: none"> <li>positive dipstick for leukocyte esterase and/or nitrite</li> <li>pyuria (urine specimen with <math>\geq 10</math> white blood cells [WBC]/<math>\text{mm}^3</math> or <math>\geq 3</math> WBC/high power</li> </ol>



Table 1-Urinary Tract Infection Criteria

	<p>field of unspun urine)</p> <p>c. microorganisms seen on Gram stain of unspun urine</p> <p>and</p> <p>a positive urine culture of <math>\geq 10^3</math> and <math>&lt; 10^5</math> CFU/ml with no more than 2 species of microorganisms.</p>
2b	<p>Patient did <u>not</u> have an indwelling urinary catheter in place at the time of specimen collection nor within 48 hours prior to specimen collection</p> <p>and</p> <p>has at least 1 of the following signs or symptoms with no other recognized cause: fever (<math>&gt;38^\circ\text{C}</math>) in a patient that is <math>\leq 65</math> years of age, urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness</p> <p>and</p> <p>a positive urinalysis demonstrated by at least 1 of the following findings:</p> <ol style="list-style-type: none"> <li>positive dipstick for leukocyte esterase and/or nitrite</li> <li>pyuria (urine specimen with <math>\geq 10</math> WBC/mm<sup>3</sup> or <math>\geq 3</math> WBC/high power field of unspun urine)</li> <li>microorganisms seen on Gram stain of unspun urine</li> </ol> <p>and</p> <p>a positive urine culture of <math>\geq 10^3</math> and <math>&lt; 10^5</math> CFU/ml with no more than 2 species of microorganisms.</p>
3	<p>Patient <math>\leq 1</math> year of age with or without an indwelling urinary catheter has at least 1 of the following signs or symptoms with no other recognized cause: fever (<math>&gt;38^\circ\text{C}</math> core), hypothermia (<math>&lt;36^\circ\text{C}</math> core), apnea, bradycardia, dysuria, lethargy, or vomiting</p> <p>and</p> <p>a positive urine culture of <math>\geq 10^5</math> CFU/ml with no more than 2 species of microorganisms.</p>
4	<p>Patient <math>\leq 1</math> year of age with or without an indwelling urinary catheter has at least 1 of the following signs or symptoms with no other recognized cause: fever (<math>&gt;38^\circ\text{C}</math> core), hypothermia (<math>&lt;36^\circ\text{C}</math> core), apnea, bradycardia, dysuria, lethargy, or vomiting</p> <p>and</p> <p>a positive urinalysis demonstrated by at least one of the following findings:</p> <ol style="list-style-type: none"> <li>positive dipstick for leukocyte esterase and/or nitrite</li> <li>pyuria (urine specimen with <math>\geq 10</math> WBC/mm<sup>3</sup> or <math>\geq 3</math> WBC/high power field of unspun urine)</li> <li>microorganisms seen on Gram's stain of unspun urine</li> </ol> <p>and</p> <p>a positive urine culture of between <math>\geq 10^3</math> and <math>&lt; 10^5</math> CFU/ml with no more than two species of microorganisms.</p>
<b>Criterion</b>	<b>Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)</b>
	<p>Patient with or without an indwelling urinary catheter has <u>no</u> signs or symptoms (i.e., <u>no</u> fever (<math>&gt;38^\circ\text{C}</math>) for patients <math>\leq 65</math> years of age*; and for any age patient <u>no</u> urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness, <u>OR</u> for a patient <math>\leq 1</math> year of age, <u>no</u> fever (<math>&gt;38^\circ\text{C}</math> core), hypothermia (<math>&lt;36^\circ\text{C}</math> core), apnea, bradycardia, dysuria, lethargy, or vomiting)</p> <p>and</p> <p>a positive urine culture of <math>\geq 10^5</math> CFU/ml with no more than 2 species of uropathogen microorganisms**</p> <p>and</p> <p>a positive blood culture with at least 1 matching uropathogen microorganism to the urine culture.</p> <p>*Fever is not diagnostic for UTI in the elderly (<math>&gt;65</math> years of age) and therefore fever in this age group does not disqualify from meeting the criteria of an ABUTI.</p> <p>**Uropathogen microorganisms are: Gram-negative bacilli, <i>Staphylococcus</i> spp., yeasts, beta-hemolytic <i>Streptococcus</i> spp., <i>Enterococcus</i> spp., <i>G. vaginalis</i>, <i>Aerococcus urinae</i>, and <i>Corynebacterium</i> (urease positive).</p>
<b>Comments</b>	<ul style="list-style-type: none"> <li>Urinary catheter tips should not be cultured and are not acceptable for the diagnosis of a urinary tract infection.</li> <li>Urine cultures must be obtained using appropriate technique, such as clean catch collection or</li> </ul>

Table 1-Urinary Tract Infection Criteria

	<p>catheterization. Specimens from indwelling catheters should be aspirated through the disinfected sampling ports.</p> <ul style="list-style-type: none"> <li>• In infants, urine cultures should be obtained by bladder catheterization or suprapubic aspiration; positive urine cultures from bag specimens are unreliable and should be confirmed by specimens aseptically obtained by catheterization or suprapubic aspiration.</li> <li>• Urine specimens for culture should be processed as soon as possible, preferably within 1 to 2 hours. If urine specimens cannot be processed within 30 minutes of collection, they should be refrigerated, or inoculated into primary isolation medium before transport, or transported in an appropriate urine preservative. Refrigerated specimens should be cultured within 24 hours.</li> <li>• Urine specimen labels should indicate whether or not the patient is symptomatic.</li> <li>• Report secondary bloodstream infection = “Yes” for all cases of Asymptomatic Bacteremic Urinary Tract Infection (ABUTI).</li> <li>• Report <i>Corynebacterium</i> (urease positive) as either <i>Corynebacterium species unspecified</i> (COS) or, as <i>C. urealyticum</i> (CORUR) if so speciated.</li> </ul>
<b>Criterion</b>	<p><b>Other Urinary Tract Infection (OUTI) (kidney, ureter, bladder, urethra, or tissue surrounding the retroperineal or perinephric space)</b></p> <p>Other infections of the urinary tract must meet at least 1 of the following criteria:</p>
1	Patient has microorganisms isolated from culture of fluid (other than urine) or tissue from affected site.
2	Patient has an abscess or other evidence of infection seen on direct examination, during a surgical operation, or during a histopathologic examination.
3	<p>Patient has at least 2 of the following signs or symptoms with no other recognized cause: fever (&gt;38°C), localized pain, or localized tenderness at the involved site</p> <p>and</p> <p>at least 1 of the following:</p> <ol style="list-style-type: none"> <li>a. purulent drainage from affected site</li> <li>b. microorganisms cultured from blood that are compatible with suspected site of infection</li> <li>c. radiographic evidence of infection (e.g., abnormal ultrasound, CT scan, magnetic resonance imaging [MRI], or radiolabel scan [gallium, technetium]).</li> </ol>
4	<p>Patient ≤ 1 year of age has at least 1 of the following signs or symptoms with no other recognized cause: fever (&gt;38°C core), hypothermia (&lt;36°C core), apnea, bradycardia, lethargy, or vomiting</p> <p>and</p> <p>at least 1 of the following:</p> <ol style="list-style-type: none"> <li>a. purulent drainage from affected site</li> <li>b. microorganisms cultured from blood that are compatible with suspected site of infection</li> <li>c. radiographic evidence of infection, (e.g., abnormal ultrasound, CT scan, magnetic resonance imaging [MRI], or radiolabel scan [gallium, technetium]).</li> </ol>
<b>Comment</b>	<ul style="list-style-type: none"> <li>• Report infections following circumcision in newborns as SST-CIRC.</li> </ul>



## Identification and Categorization of SUTI Indwelling Catheter Discontinued in Prior 48 Hours

Figure

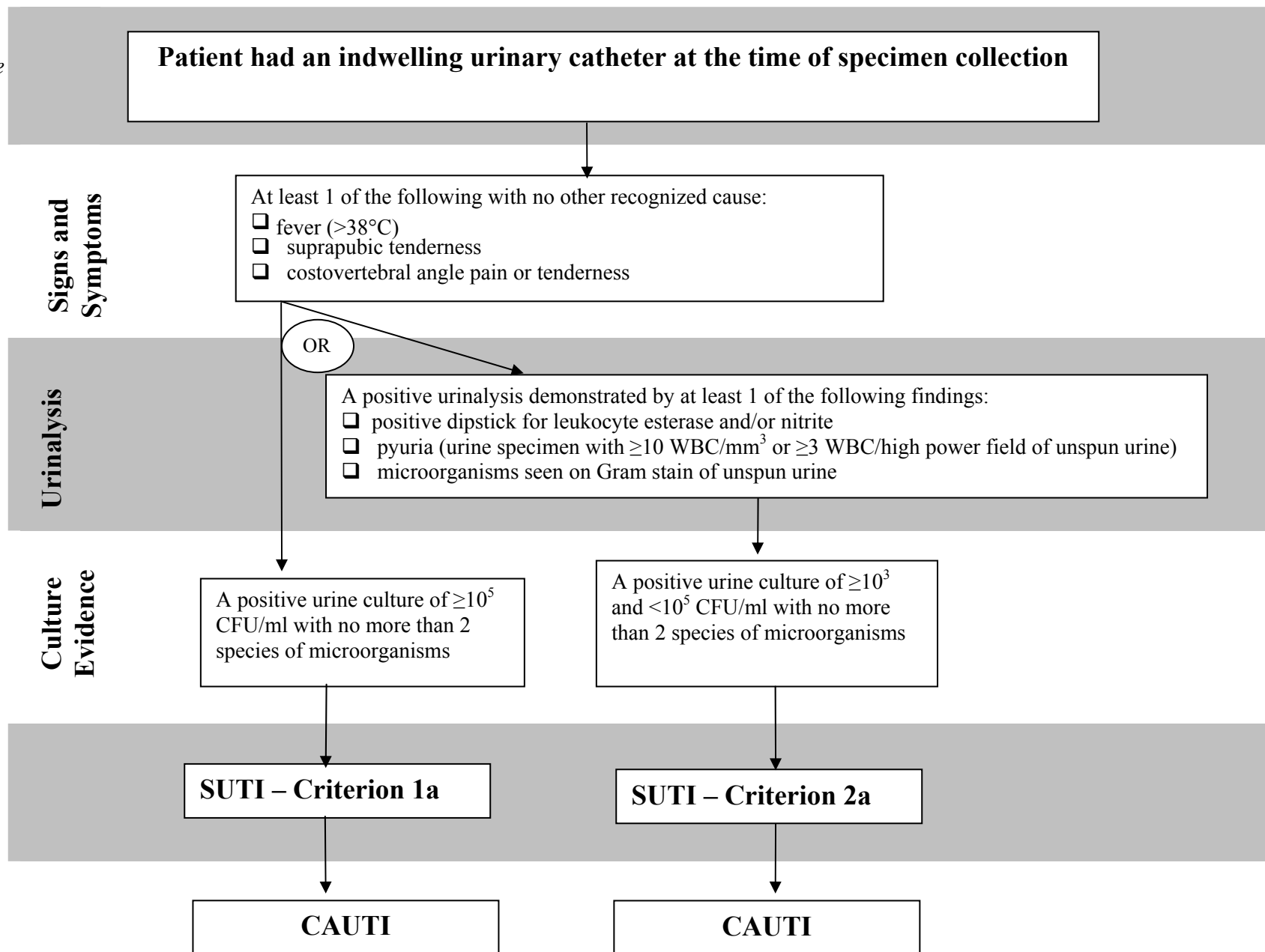
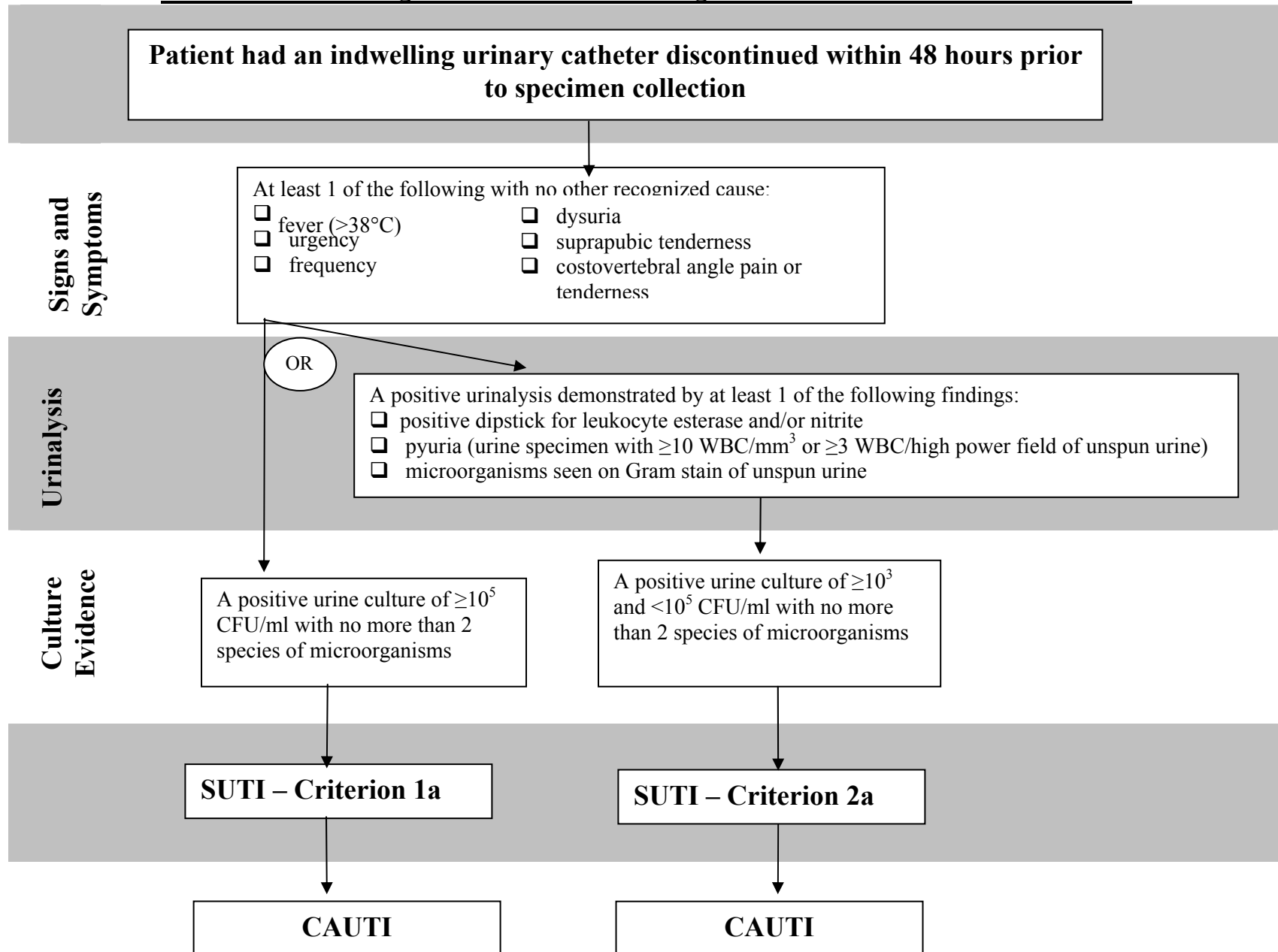


Figure 2.

March, 2009

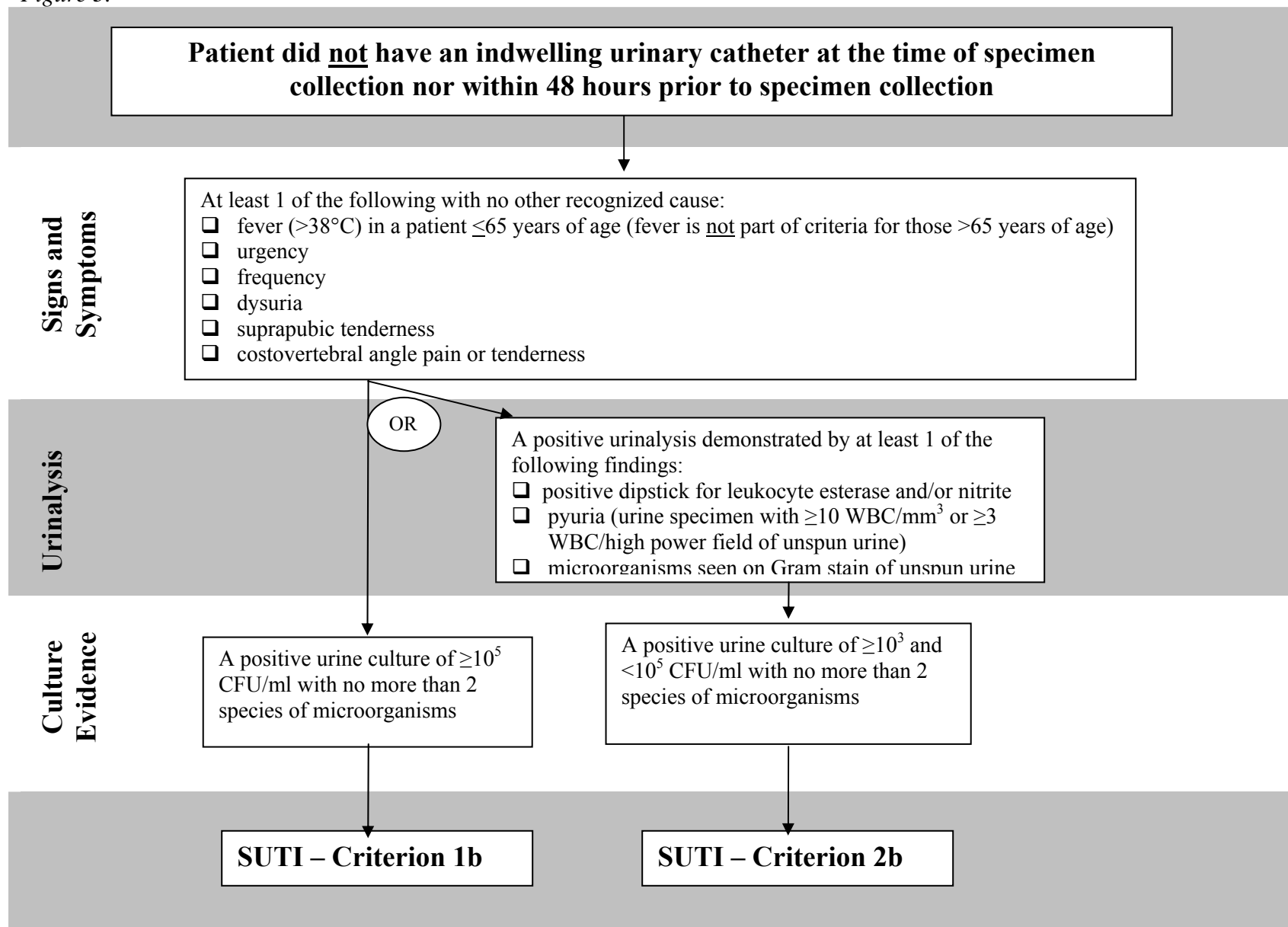
7-7

## Identification and Categorization of SUTI Indwelling Catheter Discontinued in Prior 48 Hours



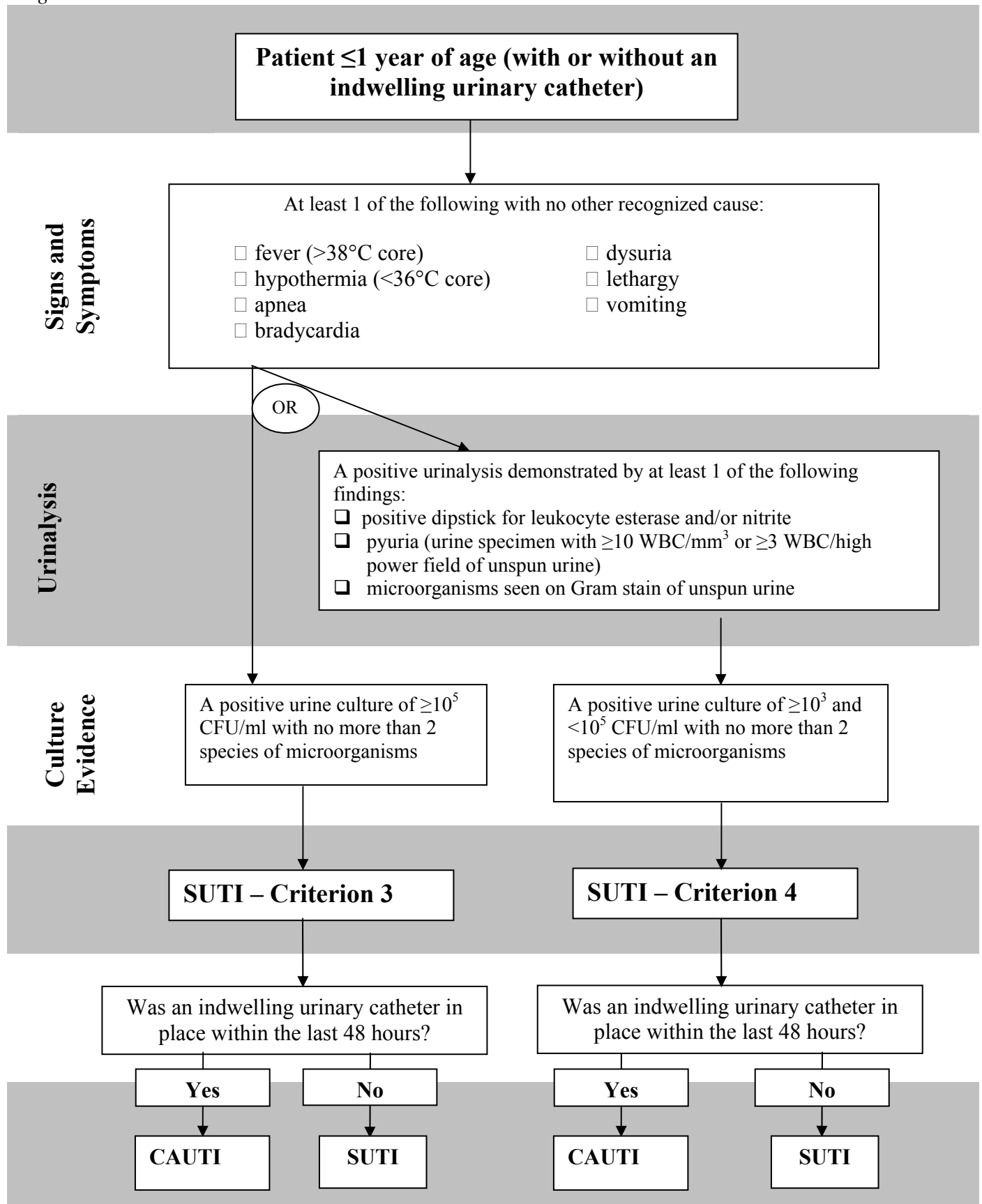
# Identification and Categorization of SUTI Without Indwelling Catheter at Time of or Within 48 Hours Prior to Specimen Collection

Figure 3.



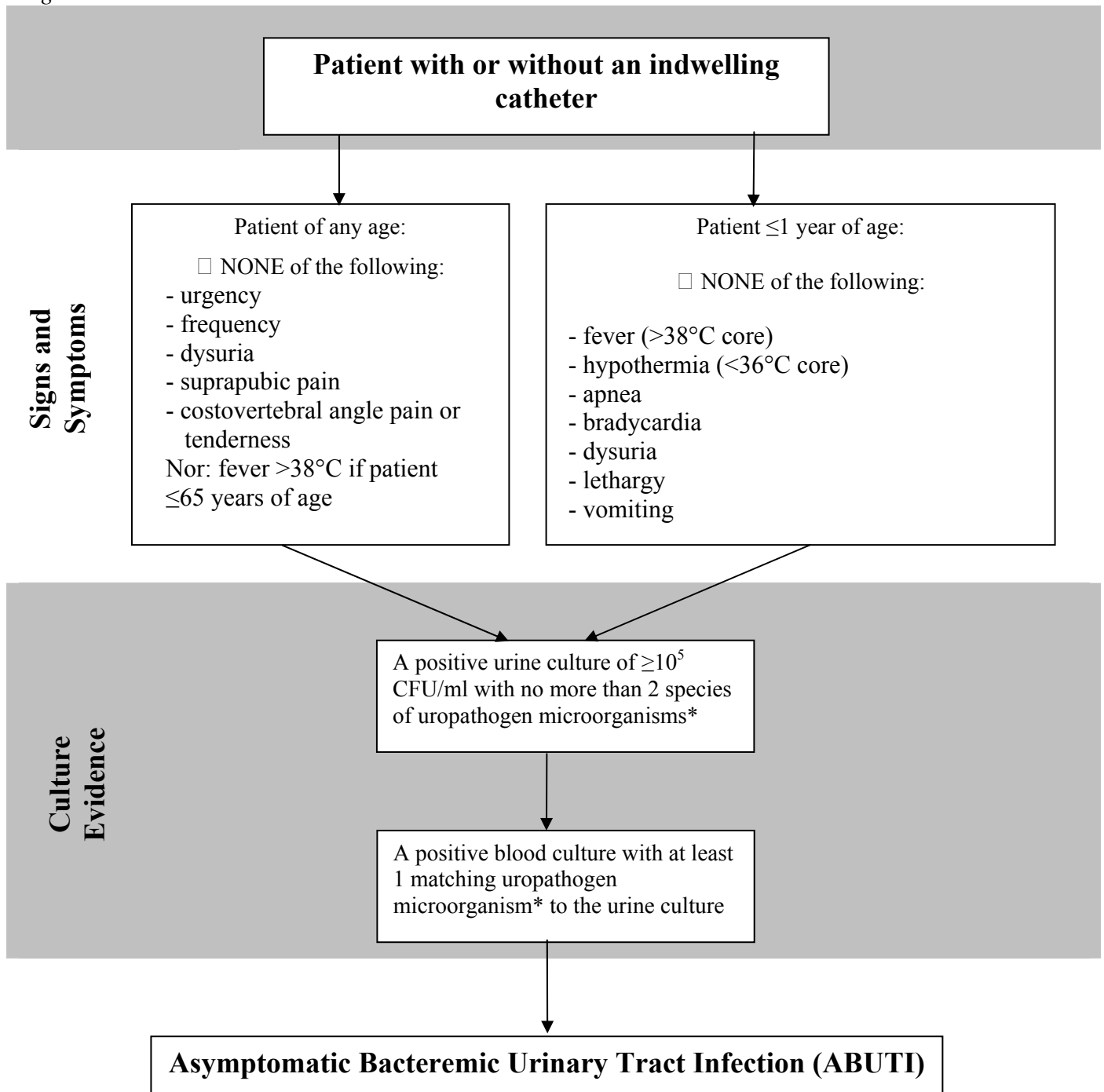
## Identification and Categorization of SUTI in Patient $\leq 1$ Year of Age

Figure 4.



# Identification of Asymptomatic Bacteremic Urinary Tract Infection (ABUTI)

Figure 5.



\*Uropathogen microorganisms are: Gram-negative bacilli, *Staphylococcus* spp., yeasts, beta-hemolytic *Streptococcus* spp., *Enterococcus* spp., *G. vaginalis*, *Aerococcus urinae*, *Corynebacterium* (urease positive)<sup>†</sup>.

<sup>†</sup>Report *Corynebacterium* (urease positive) as either *Corynebacterium species unspecified* (COS) or, as *C. urealyticum* (CORUR) if so speciated..

# Catheter Maintenance

The risk of infection increases by 5% for each day that a catheter remains in place, and the length of time that a catheter remains in place is the most important risk factor for the development of catheter-associated urinary tract infection. Up to half of patients with an indwelling catheter for 5 days or longer will have bacteria or fungus in their urine.

Therefore, once an indwelling urinary catheter is inserted, ongoing vigilance is needed to reduce the risks of both infectious and non-infectious complications. Many times physicians are not aware that patients' urinary catheters are still in place, so we begin this section with assessment strategies to maintain awareness of catheter presence and determine the ongoing need for an indwelling catheter.

In this section we also provide guidance for catheter care and securement, drainage, transportation with a catheter, and talking points for patients and families related to indwelling urinary catheters. While it is better for the patient not to have an indwelling urinary catheter at all, when catheters *are* necessary our recommendations in this section will help minimize risks associated with catheter use.



## **Shift Assessment**

- Once a shift, document ongoing need for catheter, based on criteria for catheterization.
- At shift change, include discussion of catheter necessity with oncoming nurse.
- Include discussion of catheter with physicians as part of “daily goals” checklist or patient care rounds.
- Document ongoing necessity of catheter on transfer checklist.
- Do not change catheter unnecessarily or as part of routine practice.

## **Dependent Drainage/Drainage Bag Placement**



- Drainage bag should never be lifted above the level of the bladder.
  - For transport, first drain whatever urine is in the tube into the drainage bag.
  - Prior to transporting patient, empty the drainage bag and tubing to avoid urine reflux.
- 
- If dependent drainage cannot be maintained, clamp the urinary drainage bag tube and remove the clamp as soon as dependent drainage can be resumed.
  - Drainage bag should never come into contact with the floor.

## Securement



- Catheter should be secured in a comfortable position for the patient.

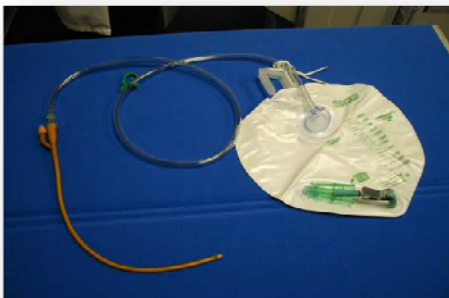
## Daily Cleaning

- Routine personal hygiene only (i.e., wash urinary meatus with soap and water only).
- More frequent cleaning is indicated if the patient has diarrhea.

## Single Patient Collection Devices

- Use a separate and clean container for each patient.
- Avoid contact between the urinary drainage spigot and container.
- Empty the urinary drainage bag frequently enough to maintain urine flow and prevent reflux.

## Closed Systems



- Ensure that the connection between the catheter and the urinary drainage system is not broken.
- If breaks in aseptic technique, disconnection, or leakage occur, replace the catheter and collecting system using aseptic technique and sterile equipment.

- Obtain any urine samples from a sampling port using an aseptic technique.
- Wash hands and wear a new pair of clean non-sterile gloves before manipulating a patient's catheter and wash hands again after removing gloves.

### **Engagement of Patients/Families**

- Involve patients/families in decision-making regarding catheterization; educate patients/families about need for catheter, based on indication.
- Teach patients/families to query physician every day about ongoing need for catheter.
- Educate patients/families to not empty drainage bag themselves or to remove the securement device.
- Instruct patients/families/significant others to keep drainage bag and tubing below the level of the bladder at all times.

# Early Removal of Unnecessary Urinary Catheters

Urinary catheters are often placed unnecessarily, remain in place without physician awareness, and are not removed promptly when no longer needed. Prolonged catheterization is the strongest risk factor for catheter-associated urinary tract infection (CAUTI). Promptly removing unnecessary catheters is an important step in reducing a patient's risk of CAUTI.

In most hospitals, 4 steps are required before a urinary catheter is removed:

1. Physician recognizes that a urinary catheter is *present*,
2. Physician recognizes that the urinary catheter is *unnecessary*,
3. Physician *writes the order* for urinary catheter removal,
4. Nurse *removes the catheter* in response to the physician's order.

Thus, many hours and days can pass before a urinary catheter that is no longer necessary is recognized and removed; by default, urinary catheters usually remain in place until these steps occur. In contrast, using strategies to remind and prompt removal of unnecessary urinary catheters has the potential to bypass several of these steps, and reduce the occurrence of hospital-acquired catheter-associated urinary tract infections.

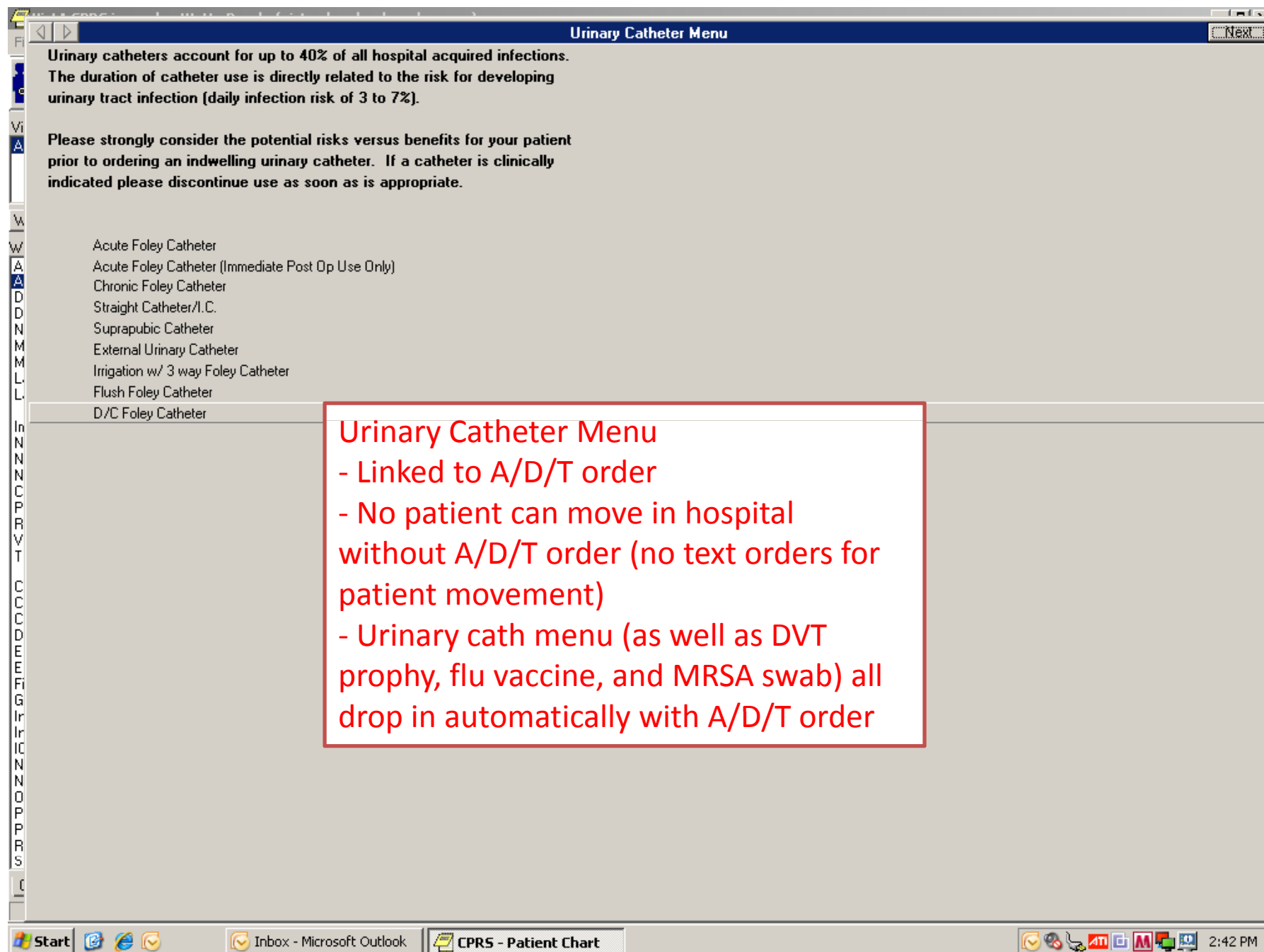
Two types of reminder systems have been studied:

1. "Reminders" function simply to remind the clinicians (physician and/or nurse) that a urinary catheter is still being used, and may provide an educational list of reasons to continue or discontinue the urinary catheter. "Reminders" help bypass steps 1-2.
2. "Stop orders" prompt the clinician to remove the catheter *by default* after a certain time period or a set of clinical conditions has occurred (such as 24 or 48 hours post-operative) unless the catheter remains clinically appropriate. Stop orders "expire" in the same fashion as restraint or antibiotic orders, unless action is taken by physicians.
  - Stop orders directed at physicians require an order to renew or discontinue on the basis of review at specific time intervals (bypassing steps 1-3).
  - Stop orders directed at nurses will empower nurses to remove the catheter on the basis of a list of indications, without requiring the nurse to obtain a physician-signed order before removing the catheter (bypassing steps 1-4).

# Challenges and pearls to keep in mind when implementing catheter removal strategies:

- Capitalize on “nurse-to-nurse” communication at times of care transition (between shift and between units) as opportunities to reassess catheter need. Having a nurse champion on every shift may facilitate reassessment, especially if shift schedules make it difficult to share information.
- Reminder system chosen should be tailored to the care setting (stickers, electronic, etc). Both low-tech and high-tech strategies have been effective.
- Simple reminders are often ignored. It is challenging to sustain the impact of reminders.
- If using electronic reminders/stop orders, make sure the reminder/stop order is directed at the primary team and not the consultants.
- Using electronic catheter orders can increase catheter use inadvertently by making indwelling catheters easier to order than alternatives.
- Physicians and/or nurses should document the rationale for leaving the catheter in if appropriate indications are not met. Documentation makes the rationale explicit and communicates it to the rest of the health care team.
- Nurses may not be comfortable initially with the responsibility of removing urinary catheters without a physician order. Supportive nursing and physician leadership can help overcome nurses’ reluctance to act using nurse-empowered orders.
- Incontinence is a very tempting reason for placing a urinary catheter. Encourage bedside staff to avoid placing catheters for incontinence by providing other readily available strategies to manage incontinent patients, including bedside commodes, incontinence garments, condom catheters for male patients, and “people power” to provide prompted toileting and bed linen changes.

- Posting weekly or monthly catheter prevalence on the unit and in a physician venue can maintain engagement by providing feedback on progress and sending the message that early removal is important.
- Consider instituting a protocol in which the appropriate use of urinary catheters is assessed prior to transferring patients from one unit to another.



## Urinary Catheter Menu

Urinary catheters account for up to 40% of all hospital acquired infections.  
The duration of catheter use is directly related to the risk for developing urinary tract infection (daily infection risk of 3 to 7%).

Please strongly consider the potential risks versus benefits for your patient prior to ordering an indwelling catheter. If the catheter is no longer indicated please discontinue.

### [Acute Foley Catheter](#)

Acute Foley Catheter (Indwelling)  
Chronic Foley Catheter  
Straight Catheter/I.C.  
Suprapubic Catheter  
External Urinary Catheter  
Irrigation w/ 3 way Foley  
Flush Foley Catheter  
D/C Foley Catheter

### Acute Foley Catheter

Start: NOW ...

Catheter Status: ACUTE

Instructions:

Indication:

If other:

Stop: t+5d ...

Comments:

FOLEY CATHETER

Accept Order

Quit

Sample Acute Catheter standard order screen



## Urinary Catheter Menu

Urinary catheters account for up to 40% of all hospital acquired infections. The duration of catheter use is directly related to the risk for developing urinary tract infection (daily infection risk of 3 to 7%).

Please strongly consider the potential risks versus benefits for your patient prior to ordering an indwelling urinary catheter. If a catheter is clinically indicated please discontinue use as soon as is appropriate.

### [Acute Foley Catheter](#)

Acute Foley Catheter (Immediate Post Op Use Only)

Chronic Foley Catheter

Straight Catheter/I.C.

Suprapubic Catheter

External Urinary Catheter

Irrigation w/ 3 way Foley Catheter

Flush Foley Catheter

D/C Foley Catheter

### Acute Foley Catheter

Start: NOW ...

Catheter Status: ACUTE

Instructions: [dropdown]

Indication: INSERT  
MAINTAIN  
APPLY

If other: [text area]

Stop: t+5d ...

FOLEY CATHETER

Accept Order

Quit

Instructions Menu

### Wade Park Admission

- ☒ Admit to Wade Park
- ☒ NARES PCR SCREEN
- ☒ DVT Prophylaxis Menu (Inc
- ☐ Urinary Catheter Menu
- ☐ Strict I&O

Stop Order Set

## Urinary Catheter Menu

Urinary catheters account for up to 40% of all hospital acquired infections. The duration of catheter use is directly related to the risk for developing urinary tract infection (daily infection risk of 3 to 7%).

Please strongly consider the potential risks versus benefits for your patient prior to ordering an indwelling urinary catheter. If a catheter is clinically indicated please discontinue use as soon as is appropriate.

### [Acute Foley Catheter](#)

Acute Foley Catheter (Immediate Post Op Use Only)  
Chronic Foley Catheter  
Straight Catheter/I.C.  
Suprapubic Catheter  
External Urinary Catheter  
Irrigation w/ 3 way Foley Catheter  
Flush Foley Catheter  
D/C Foley Catheter

### Acute Foley Catheter

Start: NOW

Catheter Status: ACUTE

Instructions:

Indication:

If other:

Stop:

FOLEY CATHETE

BPH  
COMFORT CARE/TERMINALLY IL  
EPIDURAL  
ICU/SICU DIURESIS  
ICU/SICU VENTILATED  
NEUROGENIC BLADDER  
OBSTRUCTION/RETENTION  
OPEN WOUND

Accept Order

Quit

Indications Menu Slide #1

## Urinary Catheter Menu

Urinary catheters account for up to 40% of all hospital acquired infections. The duration of catheter use is directly related to the risk for developing urinary tract infection (daily infection risk of 3 to 7%).

Please strongly consider the potential risks versus benefits for your patient prior to ordering an indwelling urinary catheter. If a catheter is clinically indicated please discontinue use as soon as is appropriate.

### [Acute Foley Catheter](#)

Acute Foley Catheter (Immediate Post Op Use Only)

Chronic Foley Catheter

Straight Catheter/I.C.

Suprapubic Catheter

External Urinary Catheter

Irrigation w/ 3 way Foley Catheter

Flush Foley Catheter

D/C Foley Catheter

### Acute Foley Catheter

Start: NOW

Catheter Status: ACUTE

Instructions:

Indication:

If other:

Stop:

FOLEY CATHETE

NEUROGENIC BLADDER  
OBSTRUCTION/RETENTION  
OPEN WOUND  
OTHER (Specify Below)  
PERIOPERATIVE  
STRICT I&O  
UNABLE TO USE OTHER METHO  
UNRESPONSIVE/SEDATED

Accept Order

Quit

Indications Menu Slide #2

Vista CPRS in use by: Watts,Brook (vista.cleveland.med.va.gov)

File Edit View Action Options Tools Help

**ZZ BEAUTY,SLEEPING** YLU Apr 23,10 13:00 Primary Care Team Unassigned **Flag** VistaWeb  
 000-00-0001 Dec 10,1953 (56) Provider: WATTS,BROOK CV DEC 31,2010 Remote Data

View Orders Active Orders (includes Pending & Recent Activity) - ALL SERVICES

Service	Order	Start / Stop	Provider	Nurse	Clerk	Chart	Status
A/D/T	>> Admit to... B24ADOM ALCOHOL TREATMENT Attending: A,MCCARTHY JOSEPH Primary: A,MCCARTHY JOSEPH *UNSIGNED*		Watts,B				unreleas
Lab	MRSA SURVL NARES DNA NASAL SWAB/NARES WC ONCE *UNSIGNED*	Start: T	Watts,B				unreleas
A/D/T	>> Admit to... B24ADOM ACUTE PSYCHIATRY (<45 DAYS) Attending: A,MCCARTHY JOSEPH Primary: A,MCCARTHY JOSEPH *UNSIGNED*		Watts,B				unreleas
Lab	MRSA SURVL NARES DNA NASAL SWAB/NARES WC ONCE *UNSIGNED*	Start: T					
Nursing	>> MAINTAIN FOLEY CATHETER *UNSIGNED*	Start: NOW Stop: t+5d	Watts,B				unreleas
	>> Potable Chest X-ray Q am x 7 if tubated. If not intubated, portable Chest x-ray stat on admission.						
Non-VA M	Non-VA IRON POLYSACCHARIDE COMPLEX CAP,ORAL 150MG TAKE 1 CAPSULE BY MOUTH						
	Non-VA VITAMIN E CAP,ORAL 400UNT TAKE 1 CAPSULE BY MOUTH Feb 10, 2010						
	Non-VA GINSENG CAP/TAB ONE CAP/TAB MOUTH TWICE A DAY Non-VA medication						

Write Delayed Orders

Write Orders

- Add New Orders ...
- Admission/Discharge/Trans
- DNR Order
- Dietetics Orders...
- Non VA Medications
- Medications (Outpatient)
- Medications (Inpatient)
- Lab Orders...
- Lab Tests
- Lab Add On Test(s)
- Imaging...
- Non VA Imaging Request
- Non VA Procedures/Service
- Nuclear Medicine ...
- Consults...
- Procedures
- Restraints
- Vitals
- Text Orders...

Cardiology Order Menu

**Urinary Catheter**

Urinary catheters account for up to 40% of all hospital acquired infections. The duration of catheter use is directly related to the risk for developing urinary tract infection (daily infection risk of 3 to 7%).

Please strongly consider the potential risks versus benefits for your patient prior to ordering an indwelling urinary catheter. If a catheter is clinically indicated please discontinue use as soon as is appropriate.

[Acute Foley Catheter](#)

Acute Foley Catheter (Immediate Post Op Use Only)

Chronic Foley Catheter

Straight Catheter/I.C.

**Order Details - 51550550;1**

>> MAINTAIN FOLEY CATHETER \*UNSIGNED\*

Activity:  
 05/12/2010 14:41 New Order entered by WATTS,BROOK (INTERNIST)  
 Order Text: MAINTAIN FOLEY CATHETER  
 Nature of Order: ELECTRONICALLY ENTERED  
 Ordered by: WATTS,BROOK (INTERNIST)  
 Signature: NOT SIGNED

Current Data:  
 Treating Specialty:  
 Ordering Location: YOU PCM/LU  
 Start Date/Time:  
 Stop Date/Time:  
 Current Status: UNRELEASED  
 Orders that have not been released to the service for action.  
 Order #51550550

Order:  
 \ FOLEY CATHETER  
 Start: NOW  
 Catheter Status: ACUTE  
 Instructions: MAINTAIN  
 Indication: BPH  
 If other:  
 Stop: 5 DAYS FROM TODAY  
 Comments:

Resulting Order as appears in CPRS

\*\*\*\*\* URINARY CATHETER REMINDER \*\*\*\*\*

Date: \_\_\_\_\_

This patient has had an indwelling urethral catheter since \_\_\_\_\_.

Please indicate below either your 1) approval to remove the catheter **OR** 2) state the reason for continued indwelling urethral catheterization.

- ☐ Please discontinue indwelling urethral catheter; **OR**
- ☐ Please continue indwelling urethral catheter because patient requires indwelling catheterization for the following reasons (please check **all** that apply):
- ☐ Urinary retention
  - ☐ Very close monitoring of urine output and patient unable to use urinal or bedpan
  - ☐ Open wound in sacral or perineal area and patient has urinary incontinence
  - ☐ Patient too ill or fatigued to use any other type of urinary collection strategy
  - ☐ Patient had recent surgery or radiation to the pelvic area
  - ☐ Management of urinary incontinence on patient's request (documented in chart)
  - ☐ Other - please specify: \_\_\_\_\_

\_\_\_\_\_  
Physician's Signature

\_\_\_\_\_  
Doctor Number

# Antimicrobial Catheters

Given the important clinical and economic consequences of catheter-associated urinary tract infection (CAUTI), researchers have tried novel approaches to prevent this common patient safety problem. While [the primary preventive focus](#) – as described under “[General catheter-associated urinary tract infection \(CAUTI\) prevention practices](#)” – has been on avoiding the indwelling catheter, using alternatives to the indwelling catheter, and removing the indwelling catheter as soon as possible, investigators have also assessed whether antimicrobial catheters can prevent CAUTI.

Several clinical and economic studies have evaluated antimicrobial urinary catheters, including [individual trials](#), [systematic reviews](#) and [meta-analyses](#). [Economic evaluations](#) are important to consider given the additional cost of antimicrobial catheter trays (approximatley \$5).

Different antimicrobial urinary catheters have been evaluated in patients over the past few decades, including silver (either alloy or oxide) and [nitrofurazone-releasing](#) catheters. While there have been numerous studies comparing either silver alloy or nitrofurazone-releasing catheters to non-coated catheters, we are unaware of any clinical trial that has directly compared silver alloy to nitrofurazone-releasing catheters.

[A Cochrane Review of antimicrobial catheters](#) conducted in 2008 included 23 trials involving 5236 hospitalized adults in 22 parallel group trials. Schumm and Lam wrote summarized their findings as follows: “...Silver alloy (antiseptic) coated or nitrofurazone-impregnated (antibiotic) urinary catheters might reduce infections in hospitalized adults ... but the evidence was weak.”...Larger, more scientifically rigorous, trials are needed on whether catheters impregnated with antibiotics or antiseptics reduce infection.”

While the studies to date appear to indicate that antimicrobial catheters reduce (or delay) bacteriuria, it remains unclear if these

novel catheters will reduce clinically more important endpoints, such as symptomatic infection or urinary tract-related bacteremia. However, in patients at high-risk of CAUTI (e.g., neutropenic and severely immune-compromised patients) or of developing a complication after bacteriuria occurs, or in those hospitals that have unacceptably high CAUTI rates despite adherence to other preventive strategies, antimicrobial catheters may play an adjunctive role in preventing CAUTI.

# Data Collection and Evaluation

Collecting data is critically important for understanding whether or not your facility has an unacceptably high number of patients with indwelling urinary catheters without an appropriate indication. Collecting and comparing data both before and after an intervention will provide a relatively objective way to evaluate if your interventions are successful in reducing unnecessary catheter-days and subsequent catheter-associated urinary tract infection (CAUTI). Occasional assessments, done after the initial intervention and compared to historical trends from the same unit, will allow you to assess if the intervention has been sustained.

In this section, we provide several examples of the many data collection tools you can use. These examples are taken from multiple sites, including some that have been initially developed and implemented at St. John Hospital and Medical Center in Detroit, Michigan. You may decide to modify these tools or use a different option altogether. Whichever tools you decide to use, it is important to apply a consistent approach to data collection at all stages of your prevention program, so that you can compare across time periods and units.



## Examples of Data Collection and Evaluation

We have created examples of tools you can use to enter the data you collect during all the phases of the program: at baseline, during implementation, immediately after implementation, and several weeks after implementation. Documentation includes the presence or absence of urinary catheters, reasons for utilization, and whether the urinary catheter is indicated. Indications are based on the 2009 Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines published by the Centers for Diseases Control and Prevention (CDC).

Before implementing the CAUTI initiative in your hospital, you may want to identify units with high and unnecessary urinary catheter utilization rates. At baseline and during the early implementation phase of your CAUTI initiative, you may want to look at both overall urinary catheter utilization and the unnecessary use of urinary catheters. After your program is implemented, you may choose to obtain data on urinary catheter utilization alone as a marker of both the proportion of patients with urinary catheters and the proportion of patients with unnecessary catheters.

The following data collection process was used at St. John Hospital, Detroit and Michigan Health and Hospital Association:

Data are collected in four phases:



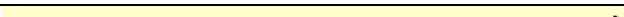

- 1) Baseline: Data collected 5 consecutive workdays for two weeks (10 days total). Record both urinary catheter prevalence and evaluation for indications.
- 2) During implementation: Data collected 5 consecutive workdays for two weeks (10 days total). Record both urinary catheter prevalence and evaluation for indications.
- 3) After implementation: 1 day a week for 8 weeks. Record urinary catheter prevalence only.
- 4) Sustainability: 5 consecutive days every quarter. Record urinary catheter prevalence only.

A sample of the data collection sheet is shown below. Use a new collection sheet for every day of data reporting. Fill in the date and phase as shown, in the upper left-hand corner of each sheet. For phases 1 and 2, fill in, for each patient, whether a catheter is present, if the catheter is indicated, and the indication or non-indication for each catheter; for phases 3 and 4, fill in, for each patient, only whether a catheter is present (see example below).

## Data Collection Sheet:

[illegible]

## Example of a program timeline\*

PROGRAM TIMELINE: Removing Unnecessary Urinary Catheters					
Date	Week 0	Weeks 1 & 2	Weeks 3 & 4	Weeks 5-10	Quarterly
Baseline		Collect urinary catheter prevalence, including indications, on a unit for 5 consecutive days each week			
Implementation			Collect urinary Catheter prevalence, including indications, on a unit for 5 consecutive days each week		
After Implementation				Collect urinary catheter prevalence, on a unit 1 day each week	
Sustainability					Collect urinary catheter prevalence, on a unit for 5 consecutive days each quarter

\*This is an example of a program timeline that was developed at St. John Hospital and Medical Center in Detroit, Michigan. This can be modified based on your hospital or unit needs.

## Examples of Calculations Made From the Data to Evaluate Your Program:

### Process measure:

#### 1. Catheter Utilization Rate (All Phases):

$$\text{Total \# catheter-days} / \text{Total \# patient-days} \times 100$$

Calculate the total catheter-days (the number of days all urinary catheters were used) and patient-days (the number of days patients were on the unit involved). Dividing the total catheter-days (numerator) by total patient-days (denominator) multiplied by 100 will provide us with baseline catheter utilization rate. You will track this rate across all phases. A trend that shows a reduction in utilization may reflect a successful program.

### Outcome measures:

#### 2. NHSN measure:

# of symptomatic CAUTI / 1,000 urinary catheter days as measured in NHSN.

<http://www.cdc.gov/nhsn/library.html>

Calculate the number of patients with symptomatic CAUTIs (using the NHSN definition of symptomatic CAUTI) and catheter-days (the number of days all urinary catheters were used) over a period of time. The number of symptomatic

CAUTIs is divided by the number of catheter-days and multiplied by a 1000 to obtain the rate.

### 3. Population-based measure:

Total # of symptomatic CAUTIs / 10,000 patient days

Calculate the number of patients with symptomatic CAUTIs (using the NHSN definition of symptomatic CAUTI) and patient-days (the number of days patients were on the unit involved) over a period of time. The number of symptomatic CAUTIs is divided by the number of patient-days and multiplied by a 10,000 to obtain the rate.

### Additional measures to consider:

#### 1. Unnecessary Urinary Catheter % (Phases 1 and 2):

$\# \text{ of unnecessary catheter-days} / \text{Total \# catheter-days} \times 100$

Calculate unnecessary catheter-days (the number of days all urinary catheters were used unnecessarily) and total catheter-days (the number of days all urinary catheters were used).

Dividing the unnecessary catheter-days (numerator) by total catheter-days (denominator) multiplied by 100 will provide us with unnecessary catheter utilization rate. You will track this rate across phases 1 and 2. The goal is to have a drop in the unnecessary catheter % rate.

#### 2. # of bloodstream infections secondary to the urinary tract / 1000 catheter days.

Calculate the number of episodes of bloodstream infections attributed to CAUTIs and the number of catheter-days (the number of days all urinary catheters were used) over a period of time. The number of bloodstream infection episodes (attributed to CAUTI) is divided by the number of catheter-days and multiplied by a 1000 to obtain the rate.

The following pages are additional sample data collection tools, which you may choose to use. These are only examples, and in some cases the indications are different. However, that is often the case because local customs may dictate some variation in the determination of appropriate indications. Ideally, however, we would still recommend that you use the HICPAC December 2009 guidelines as your reference for appropriate indications.<sup>1</sup>

1. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infect Control Hosp Epidemiol*;31:319-26.



Unit		Urinary Catheter Data Collection Sheet				
Date						
<b>Phase</b>						
Room/bed	Patient #	Urinary Catheter present	Indicated?	Indication		
Baseline Implementation After Implementation Sustainability		No = 0 Yes = 1	Non-Indicated = 0 Indicated = 1 Evaluated only for the baseline and implementation phases	<b>Indications:</b> Acute urinary retention or obstruction = 1 Perioperative use in selected surgeries = 2 Perineal and sacral wounds in incontinent patients = 3 Hospice/comfort/ palliative care = 4 Required immobilization for trauma or surgery = 5 Chronic indwelling urinary catheter on admission = 6 <b>Not Indicated Urinary Catheters Reasons:</b> Urine output monitoring OUTSIDE intensive care = 7 Incontinence without a sacral or perineal pressure sore = 8 Prolonged postoperative use = 9 Others = 10 (include those transferred from intensive care, morbid obesity, immobility, confusion or dementia, and patient request) Evaluated only for the baseline and implementation phases		

# Preventive Practices

Given the important clinical and economic consequences of catheter-associated urinary tract infection (CAUTI), researchers across the world have attempted various methods to prevent this common, costly, and morbid patient safety problem. In this section, we include several of the guidelines, some of which are very recent, that summarize the evidence supporting the use of several practices to prevent CAUTI.

Between October 2008 and July 2010, at least 4 guidelines have been published from various organizations such as the Society for Healthcare Epidemiology of America (SHEA), the Centers for Disease Control and Prevention (CDC), the Association for Professionals in Infection Control (APIC), and the Infectious Diseases Society of America (IDSA). Fortunately, members of our Ann Arbor VA Medical Center/University of Michigan Patient Safety Research group have been involved in the development of most of these guidelines.

While there are, of course, some differences between the different guidelines, there are several key areas of overlap. We provide below a concise summary of the recommended practices used to prevent CAUTI using the memory aide: “**ABCDE**”

- **A**dherence to general infection control principles (e.g., hand hygiene, surveillance and feedback, aseptic insertion, proper maintenance, education) is important
- **B**ladder ultrasound may avoid indwelling catheterization
- **C**ondom catheters or other alternatives to an indwelling catheter such as intermittent catheterization should be considered in appropriate patients
- **D**o not use the indwelling catheter unless you must!
- **E**arly removal of the catheter using a reminder, stop-order, or nurse-initiated removal protocol is warranted

Of the above, **A**, **D**, and **E** are the most important.

# Physician Engagement

Indwelling urinary catheters lead to both infectious and non-infectious complications. Despite these potential harms, studies have found that initial catheterization was inappropriate 21% to 50% of the time, and that continued catheter use was inappropriate almost half of the days that patients are catheterized.

A common reason for inappropriate continued catheter use is that physicians forget, or are never aware of, the presence of the catheter. In one multi-center evaluation, inpatient physicians at 4 hospitals were asked whether or not each patient on their service had a urinary catheter in place. Incorrect negative responses were recorded for over one-third of attending physicians and more than a quarter of resident physicians. For inappropriately catheterized patients, the proportion of physicians unaware of the presence of a catheter was even higher (over 50% for attending physicians and over 40% of senior residents). These “forgotten” catheters often remain in the patient until either a catheter-related complication occurs or the patient’s discharge is imminent.

Physicians should assess daily whether or not their catheterized patient still requires the catheter. While nursing involvement in catheter insertion, care, and removal is paramount, physicians also play an important role in prevention efforts. The physician champion – often an infectious diseases specialist, hospital epidemiologist, urologist, or hospitalist – can inform physicians about the planned prevention program, encourage support for the program, be available to answer questions, and help educate other physicians about the appropriate indications for catheter use.

# Strategies for Physician Engagement

- Involve physicians as much as possible in planning, education, and implementation; include physicians (e.g., hospitalists, urologists, hospital epidemiologists, and infectious disease physicians) on your team.
- Garner support of medical leadership, e.g., chief of staff, chief medical officer.
- Have the physician champion meet with physicians to get them on board.
- Conduct education on, for example, CMS rule changes, proper indications, evidence supporting reducing catheter use, evidence that physicians are often not aware that a patient has a catheter.
  - Education can be conducted through, for example, presentation in staff meetings by the physician champion and nurse managers, CME's, one-on-one, and through printed and electronic materials such as pocket cards, flyers, or a newsletter. See section "[Fliers and pocket cards](http://catheterout.org/?q=fliers-and-pocket-cards)" at <http://catheterout.org/?q=fliers-and-pocket-cards>.
- Periodically post catheter prevalence and CAUTI rates in a physician venue.
- If you are part of a large health care system, influence and leverage system policies on physician practices.
- Physicians-in-training, physician assistants, and nurse practitioners may also play a key role in catheter-associated urinary tract infection-related activities, depending on the hospital and the unit; thus the above strategies may also apply to these inpatient care providers.

# Nurse Engagement



What do we mean by nurse engagement? Nurse engagement refers to a persistent, positive state of fulfillment experienced by nurses at work. When nurses are engaged they feel energetic and dedicated to their work. They become immersed in work activities. Engagement has also often been described as the opposite of burnout. However nurse engagement is defined, it refers to buy-in, and in our case buy-in by nurses for the catheter-associated urinary tract infection (CAUTI) prevention program.

Getting nurses to buy-in to *any* new initiative can be challenging, but especially an initiative aimed at changing nursing practice. The question answered in this section is: how can nurses break their bond with the catheter?

In this section we offer numerous strategies for bolstering nursing engagement. Many of the strategies are practical and easy to implement right away. Other strategies are best implemented on specific nursing units, since local customs and traditions may help shape the CAUTI prevention program on a particular unit. A final group of strategies may take longer to get under way, but we offer them as well, so that your organization has the full range of strategies needed to get nurses excited about saying: “Let’s get that catheter out!”

## ACTIVITIES FOR NURSING ENGAGEMENT

### A. Activities that Can be Used Throughout the Hospital

- Encourage nurses to be creative, developing visual cues to stimulate interest and keep the catheter-associated urinary tract infection (CAUTI) initiative a top priority.
  - Post flyers/banners on the unit, such as “This is a catheter out zone.” 
  - Make/distribute buttons for nursing staff to wear: “Catheter Out!” or “We  the CAUTI Prevention Program.”
  - Welcome other ideas too. If an idea comes from the nurses and is used, the nurses will be more likely to want to keep it up.
- Provide feedback on progress
  - Initially, feedback on “baby steps” and small changes may be best.
  - Regular feedback, as often as on a weekly basis is crucial to maintaining engagement.
  - Feedback can take the form of:
    - recognition
    - praise for a job well done overall
    - praise for progress on specific aspects of the CAUTI prevention program.
  - Include feedback on prevention program adherence as part of staff annual evaluations.

### B. Activities that Can be Tailored to Specific Nursing Units

- Culture change activities—getting nurses excited about the CAUTI prevention program

- Get a volunteer from the staff to be a change champion for each shift. This person need not be the most senior staff member, but someone who other staff respect and who is committed to the process (examples include a front line nurse or a nurse educator). You can have more than one champion if that works best in your unit.
  - Remember to recognize the change champion with a small token of appreciation and also at annual evaluation time!
- Give nursing staff authority to make changes to the CAUTI prevention program, based on evidence they collect.
- Involve all nursing staff in the development of unit-specific CAUTI prevention programs. Make it a team effort.
  - Provide space and time for nurses to develop the program.
  - Set aside staff meeting time to report on progress of the program
  - Have discussion on the successes and challenges of the CAUTI prevention program be a standing meeting agenda item.
- Encourage more experienced staff to mentor new staff in maintaining the CAUTI prevention program
  - Use the buddy system
  - Reward mentors
  - Acknowledge new staff if/when they come up with an idea that moves the CAUTI prevention program even further along.

- Provide ice cream socials or other such events when predetermined goals are met.
  - Have staff be involved in the setting of predetermined goals
- Promote empowerment:
  - Routinely provide nursing staff with **information** about CAUTI rates, catheter use rates, infection rates, and other relevant updates as they become available.
  - Involve nursing staff in deciding on the **resources** they believe they need to implement the CAUTI prevention program, and then do your best to provide those resources. For example, more bedside commodes and/or bedpans may be needed to accommodate frequent toileting needs of patients who are no longer catheterized. More fracture pans, standard sized bedpans, and/or measurement “hats” (toilet inserts that measure urine output) may be needed, depending on the unit and patient population. Linen cart PAR levels may need to be increased; skin protectants may need to become part of the standard cart supply.
  - Provide leadership/administrative **support** to nursing staff as they work to implement the CAUTI prevention program. For example, unit-level nurse managers can demonstrate support by being visible on the unit, and rounding regularly (e.g., weekly) with staff to discover successes and challenges of the program. Arrange a time for staff to meet with senior administrators to report on successes and challenges of the initiative.



- Provide **opportunities** to nursing staff to become involved in data collection and analysis efforts related to the CAUTI prevention program.
- Consider changes to workload as a result of implementing a CAUTI prevention program
  - Consider qualitative as well as quantitative elements of workload. Qualitative workload is workload you can't put a number on, and comes from:
    - lack of skill necessary to complete tasks,
    - aspects of the program that may not be easy to quantify but still take up time, for example more frequent linen changes, hunting for missing supplies.
  - Consider adding CAUTI prevention program information to annual competency evaluations, and to orientation programs. This helps assure that nursing staff have the skill set to perform tasks properly.
  - Ask nurses about elements of the CAUTI prevention program that they don't think are included in workload, but should be.
  - Then add those elements into workload consideration.
    - For example, using portable bladder scanners may take away the need for catheterization. If bladder scanners are not readily available or in proper working order, however, the hunt for a scanner and troubleshooting to get it working will increase workload.

### C. Comprehensive Longer-Term Activities

- Integrate an evidence-based, professional nursing practice model into the workplace
  - Include a nursing philosophy that incorporates evidence-based practice into the mission, vision, values of the organization and relevant inpatient units.
  - Organize a committee of staff nurses from several areas (areas that have the highest catheter use rates) to help draft an evidence-based nursing philosophy and disseminate it to their peers.
  - Transition to an evidence-based practice approach for patient care delivery.  
Several evidence-based practice models are available to choose from; they all provide guidelines for enlisting nurse support and buy-in.
  - Base nursing documentation on a nursing framework that includes evidence-based practice.
  - Enable collaborative and decentralized decision-making. Allow nurses to make decisions that affect their practice.

# Fliers and Pocket Cards

Fliers and pocket cards can be useful tools to frequently remind care givers about appropriate indications and early removal of indwelling urinary catheters. This tab contains several examples of fliers that can be posted on your local bulletin boards, adapted for use as computer screensavers, or utilized as pocket cards that staff can carry with them anywhere. Any of the materials in this tab can be used exactly as they appear or could be adapted for your local institution. These tools can be used to publicize and disseminate your local indwelling urinary catheter removal message to physicians, nurses, aides and other staff involved in the insertion and care of indwelling urinary catheters!



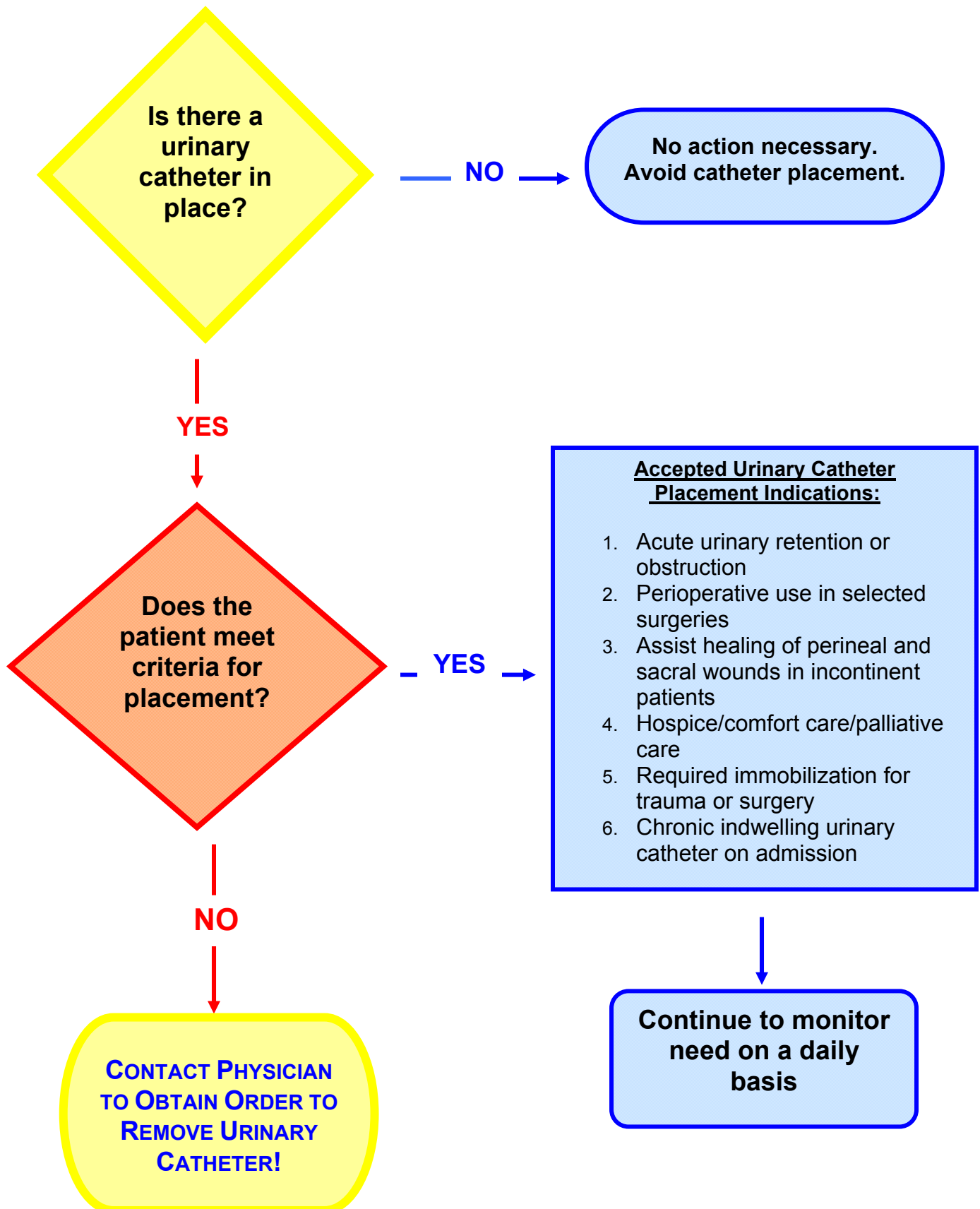
# **DOES YOUR PATIENT *REALLY* NEED A URINARY CATHETER?**

## **INDICATIONS FOR URINARY CATHETER USE INCLUDE:**

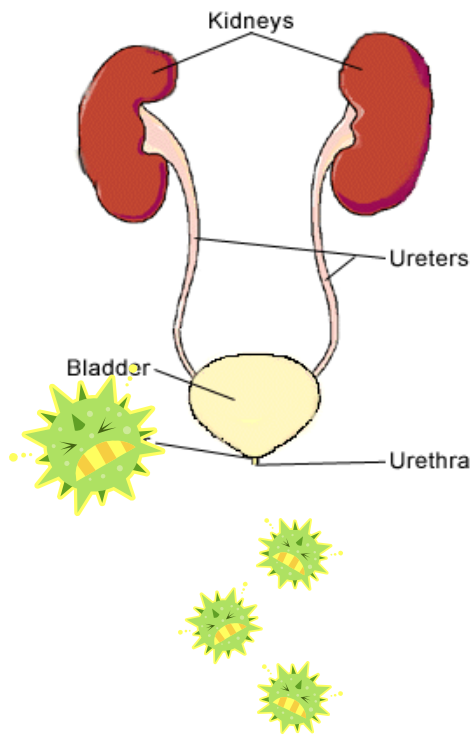
- Acute urinary retention or obstruction
- Perioperative use in selected surgeries
- Assist healing of perineal and sacral wounds in incontinent patients
- Hospice/ comfort care/ palliative care
- Required immobilization for trauma or surgery
- Chronic indwelling urinary catheter on admission

ANY QUESTIONS, PLEASE CALL [INSERT CONTACT INFO]

## GUIDELINES FOR URINARY CATHETER NEED IN NON-INTENSIVE CARE UNITS



# REMOVE THAT URINARY CATHETER!



## **Questions?**

Contact [Insert info]

### Urinary Catheters Increase:

- Likelihood of Infection
- Patient Discomfort
- Antibiotic Use
- Length of Stay
- Cost

*\* Patients with urinary catheters tend to stay in bed, making them more immobile, and increasing their risk of skin breakdown*



### Urinary Catheters ARE Indicated for:

- ☑ Acute urinary retention or obstruction
- ☑ Perioperative use in selected surgeries
- ☑ Assist healing of perineal and sacral wounds in incontinent patients
- ☑ Hospice /comfort care/ palliative care
- ☑ Required immobilization for trauma or surgery
- ☑ Chronic indwelling urinary catheter on admission



### Foley Catheters are **NOT** indicated for:

- ☑ Urine output monitoring OUTSIDE intensive care
- ☑ Incontinence (place on toileting routine, change frequently)
- ☑ Prolonged postoperative use
- ☑ Patients transferred from intensive care to general units
- ☑ Morbid obesity
- ☑ Immobility (turn patient q 2 hours, up in chair)
- ☑ Confusion or dementia

# REMOVE UNNECESSARY URINARY CATHETERS!

Hospital Logo  
Placed Here

## URINARY CATHETER PROJECT

### Goals:

- To decrease catheter-associated urinary tract infections (CAUTI)
- To improve patient safety
- To teach nurses the indications for urinary catheter use
- To reduce the unnecessary use of urinary catheters in the inpatient setting

### Background:

- 600,000 patients develop hospital-acquired UTIs per year.
- 80% of these are urinary catheter-associated.
- Approximately half of the patients with a urinary catheter do not have a valid indication for placement.
- Each day the urinary catheter remains, the risk of the CAUTI increases 5%.

### Prevention of CAUTI:

Follow criteria indicated for a urinary catheter:

1. Acute urinary retention or obstruction
2. Perioperative use in selected surgeries
3. Assist healing of perineal and sacral wounds in incontinent patients
4. Hospice /comfort care/ palliative care
5. Required immobilization for trauma or surgery
6. Chronic indwelling urinary catheter on admission

**Promptly Remove Unnecessary Urinary Catheters!**

**Questions? Call [Contact Info]**

## Sample Pocket Cards for Physicians and Nurses

### **REMOVE THAT URINARY CATHETER!**

Foley catheters can cause:

- ↑ Infections
- ↑ Length of Stay
- ↑ Cost
- ↑ Patient Discomfort
- ↑ Antibiotic Use

Urinary Catheters confine patients to bed, making them more immobile and thus increasing their risk for skin breakdown.

*PREVENTION IS KEY.*

**OBTAIN ORDERS TO  
DISCONTINUE UNNECESSARY  
URINARY CATHETER!**

**Front**

### **REMOVE THAT URINARY CATHETER!**

Foley Catheters **are** indicated for:

- Acute urinary retention or obstruction
- Perioperative use in selected surgeries
- Assist healing of perineal and sacral wounds in incontinent patients
- Hospice/comfort/ palliative care
- Required immobilization for trauma or surgery
- Chronic indwelling urinary catheter on admission

Foley Catheters are **not** indicated for:

- Urine output monitoring OUTSIDE intensive care
- Incontinence (place on toileting routine, change frequently)
- Prolonged postoperative use
- Patients transferred from intensive care to general units
- Morbid obesity
- Immobility (turn patient q 2 hours, up in chair)
- Confusion or dementia
- Patient request

**Back**



# Infectious Complications of Indwelling Urinary Catheters

Urinary tract infection represents almost 40% of all healthcare-associated infections, with the vast majority due to the indwelling urinary catheter. Over 900,000 patients develop a catheter-associated urinary tract infection (CAUTI) in a U.S. hospital each year. Urinary catheter-related infection leads to substantial morbidity. The incidence of bacteriuria in catheterized patients is about 5% per day. Among patients with bacteriuria, 10 to 20% will develop symptoms of local infection, while 1 to 4% will develop bloodstream infection. The urinary tract is implicated as the source in 11 to 40% of hospital-acquired bacteremic episodes.

The presentation of catheter-associated infection varies from asymptomatic bacteriuria to overwhelming sepsis and even death. Clinical manifestations of CAUTI may include such local symptoms as lower abdominal discomfort or flank pain, or systemic symptoms such as nausea, vomiting, and fever. Patients with bloodstream infection may present with fever, confusion, and hypotension.

A key first step leading to CAUTI is the colonization of the catheter with organisms. Indeed, urinary catheters readily develop biofilm – a collection of microbial organisms on a surface that is surrounded by an extracellular matrix – on their inner and outer surfaces once they are inserted. Such biofilm provides a protective environment for microorganisms.

Many of the infectious complications of the urinary catheter could be prevented by using the catheter only when necessary and promptly removing it when no longer needed.

# **Patient and Family Education Materials**

The brochure entitled, “What Patients and Family Members Need to Know About the Risks Associated with Urinary Catheters” can be very helpful in situations where there are frequent patient or family requests for a urinary catheter without an appropriate indication. Educating patients and their family members about the importance of urinary catheter risks can be an important way to reduce the unnecessary use of urinary catheters. The brochure was authored by: Christine Kowalski, MPH, Mohamad Fakih, MD, MPH, Sarah Krein, PhD, RN, Russ Olmsted, MPH, CIC, and Sanjay Saint, MD, MPH.

The one page sheet entitled, “FAQs about Catheter-Associated Urinary Tract Infections,” provides patients with a good overview of urinary catheters as well as catheter-associated urinary tract infections and how patients can safely care for their urinary catheter. This sheet is distributed by SHEA, et. al. and is also available online.

# FAQs

(frequently asked questions)

## about “Catheter-Associated Urinary Tract Infection”

### *What is “catheter-associated urinary tract infection”?*

A urinary tract infection (also called “UTI”) is an infection in the urinary system, which includes the bladder (which stores the urine) and the kidneys (which filter the blood to make urine). Germs (for example, bacteria or yeasts) do not normally live in these areas; but if germs are introduced, an infection can occur.

If you have a urinary catheter, germs can travel along the catheter and cause an infection in your bladder or your kidney; in that case it is called a catheter-associated urinary tract infection (or “CA-UTI”).

### *What is a urinary catheter?*

A urinary catheter is a thin tube placed in the bladder to drain urine. Urine drains through the tube into a bag that collects the urine. A urinary catheter may be used:

- If you are not able to urinate on your own
- To measure the amount of urine that you make, for example, during intensive care
- During and after some types of surgery
- During some tests of the kidneys and bladder

People with urinary catheters have a much higher chance of getting a urinary tract infection than people who don’t have a catheter.

### *How do I get a catheter-associated urinary tract infection (CA-UTI)?*

If germs enter the urinary tract, they may cause an infection. Many of the germs that cause a catheter-associated urinary tract infection are common germs found in your intestines that do not usually cause an infection there. Germs can enter the urinary tract when the catheter is being put in or while the catheter remains in the bladder.

### *What are the symptoms of a urinary tract infection?*

Some of the common symptoms of a urinary tract infection are:

- Burning or pain in the lower abdomen (that is, below the stomach)
- Fever
- Bloody urine may be a sign of infection, but is also caused by other problems
- Burning during urination or an increase in the frequency of urination after the catheter is removed.

Sometimes people with catheter-associated urinary tract infections do not have these symptoms of infection.

### *Can catheter-associated urinary tract infections be treated?*

Yes, most catheter-associated urinary tract infections can be treated with antibiotics and removal or change of the catheter. Your doctor will determine which antibiotic is best for you.

### *What are some of the things that hospitals are doing to prevent catheter-associated urinary tract infections?*

To prevent urinary tract infections, doctors and nurses take the following actions.

### **Catheter insertion**

- o Catheters are put in only when necessary and they are removed as soon as possible.
- o Only properly trained persons insert catheters using sterile (“clean”) technique.
- o The skin in the area where the catheter will be inserted is cleaned before inserting the catheter.
- o Other methods to drain the urine are sometimes used, such as
- External catheters in men (these look like condoms and are placed over the penis rather than into the penis)
- Putting a temporary catheter in to drain the urine and removing it right away. This is called intermittent urethral catheterization.

### **Catheter care**

- o Healthcare providers clean their hands by washing them with soap and water or using an alcohol-based hand rub before and after touching your catheter.

If you do not see your providers clean their hands, please ask them to do so.

- o Avoid disconnecting the catheter and drain tube. This helps to prevent germs from getting into the catheter tube.
- o The catheter is secured to the leg to prevent pulling on the catheter.
- o Avoid twisting or kinking the catheter.
- o Keep the bag lower than the bladder to prevent urine from backflowing to the bladder.
- o Empty the bag regularly. The drainage spout should not touch anything while emptying the bag.

### *What can I do to help prevent catheter-associated urinary tract infections if I have a catheter?*

- Always clean your hands before and after doing catheter care.
- Always keep your urine bag below the level of your bladder.
- Do not tug or pull on the tubing.
- Do not twist or kink the catheter tubing.
- Ask your healthcare provider each day if you still need the catheter.

### *What do I need to do when I go home from the hospital?*

- If you will be going home with a catheter, your doctor or nurse should explain everything you need to know about taking care of the catheter. Make sure you understand how to care for it before you leave the hospital.
- If you develop any of the symptoms of a urinary tract infection, such as burning or pain in the lower abdomen, fever, or an increase in the frequency of urination, contact your doctor or nurse immediately.
- Before you go home, make sure you know who to contact if you have questions or problems after you get home.

If you have questions, please ask your doctor or nurse.

Co-sponsored by:



## BROCHURE WRITTEN BY:

### ADD LOCAL STAFF NAMES ALSO

Christine Kowalski, MPH  
VA Ann Arbor Healthcare System

Mohamad Fakih, MD, MPH  
St. John Providence Health System

Sarah Krein, PhD, RN  
VA Ann Arbor Healthcare System  
The University of Michigan

Russ Olmsted, MPH, CIC  
St. Joseph Mercy Hospital

Sanjay Saint, MD, MPH  
VA Ann Arbor Healthcare System  
The University of Michigan



**VA Ann Arbor Healthcare System  
HSR&D (152)  
P.O. Box 130170  
Ann Arbor, MI 48113-0170**

<http://www.va.gov/annarbor-hsrd/>  
<http://www.med.umich.edu/psep>



## What Patients and Family Members Need to Know About the Risks Associated with Urinary Catheters

WHAT IS A URINARY CATHETER?

Urinary catheters are used when a person cannot empty his or her bladder either because something is blocking the urine flow or the bladder does not feel the need to empty. Urinary catheters may also be used during and shortly after some types of surgeries.



## WHEN SHOULD YOU NOT RECEIVE A URINARY CATHETER?

Urinary catheters should not be placed just because you cannot get out of bed or because you leak urine (meaning you are “incontinent” of urine). There are other more safe measures that can be used instead.

## WHAT ARE THE RISKS OF A URINARY CATHETER?

Urinary catheters can be harmful. They can hurt the bladder and cause you to feel pain below your belly button. Also, urinary catheters cause urinary infections which could spread to your blood and lead to a longer stay in the hospital.

How do you get an infection from your urinary catheter? Bacteria can travel along the catheter to your bladder or kidneys.

Urinary catheters can tend to limit your movement in bed and in your room. Limited activity will make you weak. Also, urinary catheters can be uncomfortable.

## WHAT ARE SOME ALTERNATIVES TO A FOLEY CATHETER?

A temporary catheter can be put in your bladder and then removed within minutes. Alternatively, men can use an external catheter (also known as a “condom-style” catheter) that is placed over the penis rather than in it.

## I JUST HAD SURGERY OR I DO NOT FEEL LIKE I CAN GET OUT OF BED. SHOULD I REQUEST A URINARY CATHETER?



If your doctor believes it is important for you to have a urinary catheter he or she will tell you. One of the best ways to recover after surgery or while you are staying in the hospital is to get up and move as soon as your doctor says that it is fine to do so. Research shows that sometimes urinary catheters can interfere with your movement.

So, unless your doctor tells you the urinary catheter is necessary, it would be best for you not to have one.

## IF YOU ALREADY HAVE A URINARY CATHETER WHAT CAN YOU DO?

Ask your doctor or your nurse every day if your urinary catheter is still necessary. The sooner it is removed, the lower your risk of infection and the sooner you can increase your mobility.

Make certain you know how to care for your urinary catheter and keep it clean. If you do not know how to do this, please ask your nurse or doctor today. Wash where the catheter enters your body every day with soap and water.

Clean your hands with soap and water or alcohol-based hand rub before and after touching your urinary catheter.

The urine drainage bag from your urinary catheter should stay lower than your bladder (your bladder is just below your belly button) at all times to prevent the urine from flowing back up into your bladder. This helps to prevent infection. If you notice that your drainage bag is too high, please tell your nurse.

You have a role in preventing infection!

# Barriers and Potential Solutions

Implementing a change in a clinical practice or process often requires overcoming certain barriers or challenges. This section describes several common barriers encountered by other hospitals when instituting changes related to the insertion and care of indwelling urinary catheters as well as the strategies they used to overcome those barriers. While the situation may not be exactly the same at your hospital, both the barriers described and the suggestions provided may be helpful in identifying potential solutions when challenges arise or for anticipating issues that may need to be addressed.

BARRIERS	POSSIBLE SOLUTIONS
<b>ENGAGEMENT</b>	
<p><b>Some nurses may not be on board</b> with indwelling urinary catheter removal [See section on Nurse Engagement: <a href="http://catheterout.org/?q=nurse-engagement">http://catheterout.org/?q=nurse-engagement</a>]</p>	<ul style="list-style-type: none"> <li>• Get buy in before implementation. For example, ask, “who do we have to convince on this floor?” Have that person help to develop the plan or participate in the education for that unit.</li> <li>• Listen to nurses’ concerns and address them to nurses’ satisfaction.</li> </ul>
<p><b>Lack of or problems with nurse champions</b> [See section on Nurse Engagement: <a href="http://catheterout.org/?q=nurse-engagement">http://catheterout.org/?q=nurse-engagement</a>]</p> <ul style="list-style-type: none"> <li>• Nurse managers tell your team that they are “too busy” to implement the new practice.</li> <li>• Individuals identified as champions do not go out on the unit and do not have direct contact with inpatients.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the types of champions that work in your organization. Not a one-size-fits-all strategy. For example: <ul style="list-style-type: none"> <li>○ Use nurse educators as champions.</li> <li>○ Have more than one nurse champion, e.g., co-champions, all nurse managers and educators.</li> <li>○ An LPN can be the champion if s/he is someone who others on the unit respect and go to for advice.</li> </ul> </li> <li>• Recognize nurse champions via such mechanisms as certificates of recognition, annual evaluation appraisals, newsletters, notifying CNO.</li> </ul>
<p><b>Lack of physician buy-in to new practice or physician’s are resistant to change in general</b> [See section on Physician Engagement: <a href="http://catheterout.org/?q=physician-engagement%20">http://catheterout.org/?q=physician-engagement%20</a>]</p> <ul style="list-style-type: none"> <li>• Do not see indwelling urinary catheters as a risk.</li> <li>• “Way down on their priority list.”</li> <li>• Can’t get physicians to buy in to the new practice bundle because they do not want “to make waves”.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide data about urinary catheter use, feedback to physicians about monthly indwelling urinary catheter prevalence &amp; CAUTI rates.</li> <li>• Provide one-on-one education (evidence-based and patient safety oriented).</li> <li>• Engage medical leadership support, e.g., chief of staff.</li> <li>• Involve physicians as much as possible in planning, education, and implementation; include physicians on your team.</li> <li>• Identify a physician champion who will: <ul style="list-style-type: none"> <li>○ Meet with other physicians to get them on board.</li> <li>○ Back up nurses when there’s a disagreement.</li> <li>○ Conduct CME. Present evidence, e.g., highlight how often physicians have a patient with a indwelling urinary catheter and forget.</li> </ul> </li> </ul>
<p><b>Lack of physician champion</b></p>	<ul style="list-style-type: none"> <li>• In some institutions, physicians may tend to go along with nurse recommendations so they rely heavily on nurse champions. The new practice could be seen as a “nursing initiative.”</li> <li>• Also see Lack of physician buy-in above.</li> </ul>
<p><b>Leadership does not see CAUTI as a priority</b> [See section on Leadership &amp; Policy Implications:</p>	<ul style="list-style-type: none"> <li>• Prepare and present a business case to help convince leadership the time and cost factors for implementing the new practice would be worth it. Present a good business case.</li> </ul>

## Barriers and Possible Solutions

BARRIERS	POSSIBLE SOLUTIONS
<a href="http://catheterout.org/?q=leadership-and-policy">http://catheterout.org/?q=leadership-and-policy</a>	<ul style="list-style-type: none"> <li>Remind leadership about CMS non-payment rule.</li> <li>Be sure leadership gets monthly CAUTI/catheter use data.</li> </ul>
<b>Large size hospital makes unit-to-unit roll-out difficult</b>	<ul style="list-style-type: none"> <li>Create unit-based teams with stakeholders from different units/depts.</li> </ul>
<b>General guidance</b>	<ul style="list-style-type: none"> <li>Get people on the team who feel CAUTI is worth working on.</li> <li>Highlight staff who have adopted the new practice.</li> <li>Know the system and how to get practice changes through relevant committees.</li> </ul>
<b>EDUCATION</b>	
<p><b>Gaps in knowledge of infectious and non-infectious consequences of CAUTI for patients</b> [See Sections on Infectious Complications: <a href="http://catheterout.org/?q=infectious-complications-general-background">http://catheterout.org/?q=infectious-complications-general-background</a>, and Noninfectious Complications: <a href="http://catheterout.org/?q=Non-infectious-complications-general-background%20">http://catheterout.org/?q=Non-infectious-complications-general-background%20</a>]</p> <ul style="list-style-type: none"> <li>UTI not seen to be as serious as other infections</li> <li>Belief that since the patient is going to be on bed rest the catheter is indicated.</li> <li>Not thinking about an indwelling urinary catheter as an invasive device or as a less risky device compared to other devices, such as central venous catheters.</li> </ul>	<ul style="list-style-type: none"> <li>Content <ul style="list-style-type: none"> <li>See Education Materials tab in toolkit (<i>hyperlink</i>) <ul style="list-style-type: none"> <li>Distribute Signs and pocket guides with insertion/DC criteria</li> </ul> </li> <li>See Tab C – Preventive Practices (<i>hyperlink</i>)</li> <li>Share safety and quality literature</li> </ul> </li> <li>Options on how educate staff <ul style="list-style-type: none"> <li>Create tailored educational materials. Different materials for IPs, nurses, physicians, clinical leadership, and perhaps for each unit, depending on what motivates staff in that unit (e.g., decrease length of stay, ambulate patient, decrease UTI risk).</li> <li>Nurses: <ul style="list-style-type: none"> <li>Education mandated by nurses' direct supervisor.</li> <li>Educate on the floor, in grand rounds, other venues.</li> </ul> </li> <li>If it's difficult to educate all staff, as in a large hospital, create computerized education modules.</li> </ul> </li> </ul>
<b>Not knowing what to do to prevent CAUTI</b>	<p>HICPAC guidelines. [See Section on General Prevention Practices: <a href="http://catheterout.org/?q=general-prevention-practices">http://catheterout.org/?q=general-prevention-practices</a>, and HICPAC guidelines: <a href="http://www.cdc.gov/hicpac/cauti/001_cauti.html">http://www.cdc.gov/hicpac/cauti/001_cauti.html</a>]</p>
<p><b>Nurses schedules are inflexible, so difficult to do education</b></p> <ul style="list-style-type: none"> <li>Overtime not allowed.</li> <li>No "dedicated" time away from patient care.</li> </ul>	<ul style="list-style-type: none"> <li>Rather than having the nurses attend education sessions, bring the education to the bedside. E.g., doing competencies on the unit; talking with nurses one-to-one during the point prevalence assessments.</li> <li>Incorporate education on CAUTI into annual competency testing (e.g., at</li> </ul>



BARRIERS	POSSIBLE SOLUTIONS
	the same time that CPR is renewed).
<b>EXECUTE: ELIMINATE UNNECESSARY USE OF INDWELLING URINARY CATHETERS</b>	
<b>Non-indicated indwelling urinary catheters inserted in the ED</b> <ul style="list-style-type: none"> <li>Indwelling urinary catheter is inserted with no order written. When patient gets to the floor, nurses and physicians don't know the indwelling urinary catheter is there.</li> <li>ED nurses think they are doing the floor nurses a favor by inserting the indwelling urinary catheter and assume that the patient might need it.</li> <li>ED nurses using catheter for specimen collection and then leaving it in place.</li> <li>Alternative practices (e.g., closed straight catheter system) eliminated due to cost.</li> </ul>	<ul style="list-style-type: none"> <li>Involve ED medical and nursing directors as champions or supporters of practice change.</li> <li>Work with ED to put a process in place that assures that an order was written and appropriate indications for use are followed.</li> <li>Education about indications for insertion for the ED nurses and physicians. <i>[See section on Indications for indwelling urinary catheter use: <a href="http://catheterout.org/?q=Indications-for-indwelling-urinary-catheter-use">http://catheterout.org/?q=Indications-for-indwelling-urinary-catheter-use</a>]</i></li> <li>Re-implement alternative practice (e.g., closed straight catheter system). <i>[See section on Avoiding the Indwelling Urinary Catheter: <a href="http://catheterout.org/?q=avoiding-the-indwelling-urinary-catheter">http://catheterout.org/?q=avoiding-the-indwelling-urinary-catheter</a>]</i></li> </ul>
<b>No catheter policy in place</b>	<ul style="list-style-type: none"> <li>Develop a policy on catheter insertion indications</li> </ul>
<b>Patient request</b> <i>[See section on Patient &amp; Family Education Materials: <a href="http://catheterout.org/?q=patient-family-ed">http://catheterout.org/?q=patient-family-ed</a>]</i> Clinicians give in to patient or family requests for indwelling urinary catheter, or believe that the patient wants the catheter in.	<ul style="list-style-type: none"> <li>Discuss risks of indwelling urinary catheters with patients and families. <i>[See section on Patient &amp; Family Education Materials: <a href="http://catheterout.org/?q=patient-family-ed">http://catheterout.org/?q=patient-family-ed</a>]</i></li> <li>Review documentation of the rationale for placement if indications are not met and reinforce use of appropriate indications.</li> </ul>
<b>Lack of physician buy-in once the new practice is initiated.</b> See Lack of Physician Buy-in, above	
<b>EXECUTE: ENSURE PROPER INSERTION TECHNIQUE</b>	
<b>Non-Aseptic Insertion Technique</b> <i>[See section on Aseptic Insertion: <a href="http://catheterout.org/?q=aseptic-insertion">http://catheterout.org/?q=aseptic-insertion</a>]</i> <ul style="list-style-type: none"> <li>By nurses, aides, nursing care assistants.</li> </ul>	<ul style="list-style-type: none"> <li>Develop competencies for those who insert catheters.</li> <li>Restrict catheter insertion practice to RNs.</li> <li>Develop a policy on catheter insertion techniques if none is in place.</li> </ul>
<b>EXECUTE: TIMELY DISCONTINUATION OF INDWELLING URINARY CATHETERS</b> <i>[See section on Early Removal of Unnecessary Indwelling Urinary Catheters: <a href="http://catheterout.org/?q=early-removal">http://catheterout.org/?q=early-removal</a>]</i>	
<b>Nursing workload</b> <ul style="list-style-type: none"> <li>Nurses are concerned that they will have to spend more time cleaning up patients if the indwelling urinary</li> </ul>	<ul style="list-style-type: none"> <li>Monitor <ul style="list-style-type: none"> <li>Catheter patrol: daytime charge nurses monitor which patients have indwelling urinary catheters, assisting with toileting, and assess</li> </ul> </li> </ul>

# Barriers and Possible Solutions

BARRIERS	POSSIBLE SOLUTIONS
<p>catheter is removed.</p> <ul style="list-style-type: none"> <li>• General feeling of being overworked ("just trying to get through my shift").</li> <li>• What you might see: <ul style="list-style-type: none"> <li>○ Nurses tell the physician or other nurses, "I do not want this catheter out" or that the physician doesn't want the catheter out (e.g., 'the physician needs I's and O's').</li> <li>○ Especially problematic on weekends—no one is monitoring catheter removal.</li> </ul> </li> </ul>	<p>indications. If not indicated, talk with bedside nurse or ask physicians to DC. [See section on Data Collection &amp; Evaluation: <a href="http://catheterout.org/?q=data-collection">http://catheterout.org/?q=data-collection</a>]</p> <ul style="list-style-type: none"> <li>○ Daily assessment tool: bedside nurse assesses indications for continued use and if not indicated, nurses discuss removal with physician.</li> <li>• Feedback: <ul style="list-style-type: none"> <li>○ Data board in nurse units w/ monthly indwelling urinary catheter prevalence and CAUTI rates.</li> </ul> </li> <li>• Education Workload reduction Nurse aides delegated to prioritize toileting activities over other activities (e.g. stocking supplies or cleaning equipment).</li> </ul>
<p><b>Shift schedules hamper communication among nurses</b> 3 day, 12 hour shifts and block schedules can make it difficult to share information across shifts and departments.</p>	<ul style="list-style-type: none"> <li>• Identify a nurse champion on each shift.</li> </ul>
<p><b>No catheter policy on discontinuation in place</b></p>	<ul style="list-style-type: none"> <li>• Develop a policy on discontinuation.</li> </ul>
<p><b>Patient or family request</b> [See section on Patient &amp; Family Education Materials: <a href="http://catheterout.org/?q=patient-family-ed">http://catheterout.org/?q=patient-family-ed</a>]</p> <ul style="list-style-type: none"> <li>• Nurses and/or physicians believe their patients want the catheter in. Some patients do (e.g., because they are incontinent or don't want to get out of bed), and will convince their nurses and physicians to keep it in even if it's not indicated.</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss risks of indwelling urinary catheters with patients and families [See section on Patient &amp; Family Education Materials: <a href="http://catheterout.org/?q=patient-family-ed">http://catheterout.org/?q=patient-family-ed</a>]</li> <li>• Review documentation of the rationale for use and reinforce use of appropriate indications.</li> </ul>
<p><b>Patient Safety: Balancing risk of falls.</b></p> <ul style="list-style-type: none"> <li>• A fall is a "never event"</li> </ul>	<ul style="list-style-type: none"> <li>• Institute fall prevention strategies, for example: <ul style="list-style-type: none"> <li>○ Instruct the patient to request assistance.</li> <li>○ Provide patient with non-skid footwear.</li> <li>○ Ensure that path to restroom is free of obstacles.</li> <li>○ Evaluate chair and bed height.</li> <li>○ Ensure that assistive devices (if being used) are within patient reach</li> <li>○ Engage patient and family in efforts to provide assistance as needed.</li> <li>○ Other strategies as determined by nursing care plan and institutional policy.</li> </ul> </li> </ul>

Barriers and Possible Solutions

BARRIERS	POSSIBLE SOLUTIONS
	<ul style="list-style-type: none"> <li>• Incorporate urinary management (e.g., planned toileting) as part of broader fall prevention program.</li> </ul>
<p><b>Nurses are not confident speaking with physicians about removal.</b></p>	<ul style="list-style-type: none"> <li>• Find a physician champion to support nurse requests for removal. <i>[See section on Physician Engagement: <a href="http://catheterout.org/?q=physician-engagement%20">http://catheterout.org/?q=physician-engagement%20</a>]</i></li> <li>• Nurse manager prompts nurses to speak with physicians.</li> <li>• Education on communication.</li> </ul>
<p><b>Physician resistance to nurses discontinuing indwelling urinary catheters using an automatic stop order</b></p>	<ul style="list-style-type: none"> <li>• Nurses prompt physicians for DC order as an initial strategy to build rapport. <i>[See section on Nurse-Initiated Removal: <a href="http://catheterout.org/?q=nurse-initiated-removal">http://catheterout.org/?q=nurse-initiated-removal</a>]</i></li> <li>• Identify a physician champion who can act as an advocate.</li> </ul>
<p><b>Lack of physician Buy-in</b> <i>[See section on Physician Engagement: <a href="http://catheterout.org/?q=physician-engagement%20">http://catheterout.org/?q=physician-engagement%20</a>]</i> See Lack of MD Buy-in, above</p>	
<p><b>Resistance to Early indwelling urinary catheter Removal -- Surgeons and Urologists</b></p>	<ul style="list-style-type: none"> <li>• Physician champion presents at med staff meeting about indwelling urinary catheter indications and non-indications. <i>[See section on Indications for Indwelling Urinary Catheter Use: <a href="http://catheterout.org/?q=Indications-for-indwelling-urinary-catheter-use">http://catheterout.org/?q=Indications-for-indwelling-urinary-catheter-use</a> and Strategies for Physician Engagement: <a href="http://catheterout.org/drupal/Bladder%20Bundle/sites/webservices.itcs.u-mich.edu.drupal.Bladder%20Bundle/files/Section%20M%20Strategies%20for%20Physician%20Engagement_1.pdf">http://catheterout.org/drupal/Bladder%20Bundle/sites/webservices.itcs.u-mich.edu.drupal.Bladder%20Bundle/files/Section%20M%20Strategies%20for%20Physician%20Engagement_1.pdf</a>]</i></li> <li>• Work with the physician assistants to DC indwelling urinary catheters on day 2 after surgery.</li> <li>• Participate in SCIP initiative.</li> <li>• Engage a surgeon and/or urologist as a physician champion and work with them to establish conditions under which the catheter can be retained.</li> </ul> <p>Also see Lack of Physician Buy-in, above</p>
<p><b>Indwelling urinary catheters left in as when patient is transferred within the hospital</b> (e.g., catheter placed in surgery, patient goes up to ICU, then to floor]</p>	<ul style="list-style-type: none"> <li>• Establish process to ensure that all lines and devices are reviewed and removed (if appropriate) prior to transfer.</li> <li>• Consider changes to transfer forms to include information about catheter presence, date of insertion, indication.</li> </ul>

# Leadership Engagement & Policy Considerations

Increasingly, healthcare leaders are focusing their attention on preventing healthcare-associated infection. Indeed, recent empiric work demonstrates that certain characteristics of leaders (the term “leader” was applied broadly) were used by those perceived as being effective in implementing evidence-based infection prevention recommendations. Specifically, successful leaders tended to insist on a culture of clinical excellence which they instill through effective communication, thinking strategically while acting locally, inspiring staff, and taking a solutions-oriented approach to overcoming barriers. Importantly, some of the most important leaders in infection prevention activities are not senior executives. Examples abound of infection prevention personnel – hospital epidemiologists and infection preventionists – who play crucial leadership roles in their hospital’s patient safety activities.

One important way to engage healthcare leaders – especially those in senior positions – in the topic of healthcare-associated infection prevention is through familiarity with the policy changes recently initiated by the Center for Medicare and Medicaid Services (CMS) that affect hospital reimbursement if adverse events occur during hospitalization. In brief, since October 2008, hospitals are no longer eligible for additional payment from CMS to treat several common and/or high morbidity hospital-acquired complications, such as catheter-associated urinary tract infections and pressure ulcers. This same policy has also facilitated and encouraged public reporting of hospital-acquired condition events – another topic of high interest to healthcare leaders. Therefore, this single policy regarding non-payment of hospital-acquired conditions may engage the interest of healthcare leaders along the lines of financial implications, patient safety, and public reporting.

# Non-Infectious Complications of Indwelling Urinary Catheters

Over five decades ago, the late Dr. Paul Beeson persuasively argued against the routine use of indwelling urinary catheters in hospitalized patients. His advice remains relevant today. While these devices provide important benefits in some patients, they are also the primary risk factor for catheter-associated urinary tract infection (CAUTI). Indwelling urinary catheters, however, also lead to significant non-infectious complications. Perhaps most importantly, they have the practical effect of restricting patients in what some consider a “one-point” restraint, raising serious safety and ethical concerns analogous to those noted a few decades ago with “four-point” (or limb) restraints.

Urinary catheters cause patient discomfort. In one prospective study, for example, 42% of catheterized patients report the indwelling catheter was uncomfortable, 48% complained that it was painful, and 61% noted that it restricted their activities of daily living.

Thus, for some patients urinary catheters operate as a physical restraint, tantamount to binding them to the bed, substantially and unnecessarily limiting their ability to function freely and with dignity. Restricted activity not only reduces patient autonomy, it also promotes other patient safety problems, such as venous thromboembolism, deconditioning, and pressure ulcers.

In short, there are compelling reasons to limit indwelling urinary catheterization because of both non-infectious and infectious complications.

# Indications for Indwelling Urinary Catheter Insertion

## 1. Before placing an indwelling catheter, please consider if these alternatives would be more appropriate:

- *Beside commode, urinal, or continence garments:* to manage incontinence.
- *Bladder scanner:* to assess and confirm urinary retention, prior to placing catheter to release urine.
- *Straight catheter:* for one-time, intermittent, or chronic voiding needs.
- *External “condom” catheter:* appropriate for cooperative men without urinary retention or obstruction.

## 2. Before placing an indwelling catheter, does the patient have one of the following appropriate indications for placing indwelling urinary catheters?

- *Acute urinary retention:* e.g., due to medication (anesthesia, opioids, paralytics), or nerve injury
- *Acute bladder outlet obstruction:* e.g., due to severe prostate enlargement, blood clots, or urethral compression
- Need for *accurate measurements of urinary output in the critically ill*
- To assist in healing of *open sacral or perineal wounds in incontinent patients*
- *To improve comfort for end of life*, if needed
- *Patient requires strict prolonged immobilization* (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fracture)
- Selected peri-operative needs:
  - Urologic surgery or other surgery on contiguous (adjacent) structures of the genitourinary tract
  - Anticipated prolonged duration of surgery (Note: catheters placed for this reason should be removed in PACU)
  - Large volume infusions or diuretics anticipated during surgery
  - Need for intraoperative monitoring of urinary output

## **Avoiding the Indwelling Urinary Catheter**

Alternatives to an indwelling urinary catheter should be considered based on a patient's individual care needs. Why? In general, alternative devices and procedures provide a much lower risk of infectious complications, such as urinary tract infection. Additionally, these alternative methods can reduce or eliminate the non-infectious complications – such as discomfort and immobility – that are associated with indwelling urethral (also called “Foley”) catheters.

The most common alternatives to the indwelling catheter are:

- External catheter for men (also called a “condom catheter,” which is a urine containment device fitted over the genitalia and is attached to a urinary drainage bag);
- Intermittent (“in-and-out” or “straight”) catheterization;
- Programmed toileting (behavioral therapy); and
- Suprapubic catheter (surgically inserted into the bladder through an incision above the pubis).

The following pages provide further information on these alternatives.

We discuss below the most common alternatives to the indwelling urinary catheter:

- External catheters for men (condom catheters),
- Intermittent (“in-and-out” or “straight”) catheterization,
- Programmed toileting, and
- Suprapubic catheterization.

External catheters for male patients are underused. A national survey of hospitals found that external catheters were almost always or always used in only 14% of hospitals, however, there was a statistically higher use in VA hospitals.<sup>1</sup> This low level of use persists despite evidence that condom catheters lower the risk of infectious and other complications of urinary catheterization and are more acceptable to patients.<sup>2</sup> When using condom catheters, it is important to choose an appropriate size to improve fit and adherence despite patients’ movement.

### **Condom catheter**

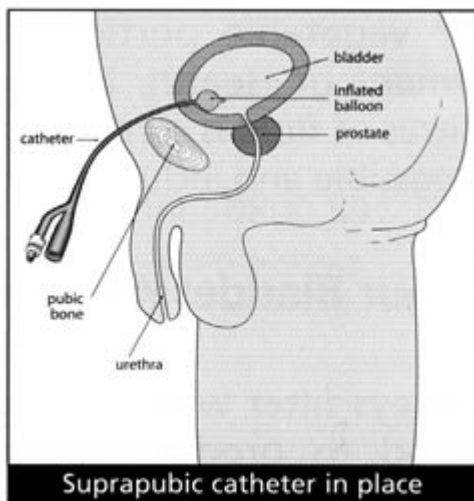


Intermittent catheterization, often used in patients with neurogenic bladder or spinal cord injury, lessens the risk of urinary tract infection. Intermittent catheterization is preferable to indwelling urethral or suprapubic catheters in patients with bladder emptying dysfunction. When the patient returns to the community, intermittent catheterization enhances patient privacy and dignity, and facilitates return to activities of daily living.<sup>3</sup> It is important to perform intermittent catheterization at regular intervals to avoid over-distending the bladder. Among hospitalized patients, intermittent



catheterization is often used in combination with a portable bladder ultrasound. Portable bladder ultrasound is a non-invasive portable tool for diagnosing and managing urinary outflow dysfunction. For example, portable bladder ultrasound could be used to detect that a patient has insufficient quantities of urine to justify catheterization.

Toileting programs typically consist of a patient-specific assessment of incontinence followed by a program of prompted voiding, habit retraining, and/or timed voiding as part of an individualized care plan. Evidence from one investigation demonstrates toileting programs can significantly lessen risk of falls, skin breakdown – and, if patient lifting technology is available, back injuries experienced by personnel during patient assists.<sup>4,5</sup> Emphasis on self-voiding also results in less post void residual compared to use of indwelling urinary catheters.<sup>5</sup>



Suprapubic catheter [Image from the Duke of Cornwall Spinal Treatment Center, accessed December 27, 2010 from <http://www.spinalinjurycentre.org.uk/information/029.asp?UType=1&CType=1>]

Suprapubic catheterization is an alternative to the Foley catheter. It can be used for both short- and long-term catheterization. However, in general, intermittent urethral catheterization is preferable to suprapubic catheterization. Insertion of the suprapubic catheter should be performed by a health professional with training and expertise in this procedure. Guidelines on insertion and care of this device have been published.<sup>6</sup>

---

1. 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.
  2. Saint S, Kaufman SR, Rogers MA, Baker PD, Ossenkop K, Lipsky BA. Condom versus indwelling urinary catheters: a randomized trial. *J Am Geriatr Soc*. 2006;54:1055-61.
  3. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infect Control Hosp Epidemiol*;31:319-26.
  4. Morgan C, Endozoa N, Paradiso C, McNamara M, McGuire M. Enhanced toileting program decreases incontinence in long term care. *Jt Comm J Qual Patient Saf* 2008;34:206-8.
  5. Fink HA, Taylor BC, Tacklind JW, Rutks IR, Wilt TJ. Treatment interventions in nursing home residents with urinary incontinence: a systematic review of randomized trials. *Mayo Clin Proc* 2008;83:1332-43.
  6. Harrison SC, Lawrence WT, Morley R, Pearce I, Taylor J. British Association of Urological Surgeons' suprapubic catheter practice guidelines. *BJU Int* 2010; Nov 4. doi: 10.1111/j.1464-410X.2010.09762.x. [Epub ahead of print]
-

# Aseptic Insertion

Aseptic technique is strongly recommended during the insertion of indwelling urinary catheters, based on biologic principles, the pathogenesis of catheter-associated urinary tract infection (CAUTI), and the growing prevalence of multidrug-resistant organisms.

A recent analysis of patient safety practices by the Agency for Healthcare Research and Quality emphasized the important role of nurses in preventing CAUTI, the most common healthcare-associated infection. While physicians and medical students occasionally insert indwelling urinary catheters, nurses are generally responsible for the insertion and maintenance of urinary catheters; unlicensed personnel may also insert indwelling catheters under the direction of registered nurses. As part of their nursing education, student nurses are taught catheter insertion practices through simulation and clinical experiences. Once out of school, nurses refine their catheter insertion practices in the practice setting, where they tend to develop practice skills similar to those of other nurses with whom they work.

Anecdotal evidence – coupled with preliminary observations done by the University of Michigan CAUTI research group – reveal that proper aseptic technique is not reliably used when indwelling urinary catheters are inserted.

In this section we provide several resources related to aseptic insertion for anyone inserting an indwelling urinary catheter: nurses, physicians, medical students and unlicensed healthcare personnel. Some resources are in the form of written documents, while others are web-based.

**A. Decision to Insert a Urinary Catheter:****1. Before placing an indwelling catheter, please consider if these alternatives would be more appropriate:**

- *Bladder scanner*: to assess and confirm urinary retention, prior to placing catheter to release urine
- *Straight catheter*: for one-time, intermittent, or chronic voiding needs
- *External "condom" catheter*: appropriate for cooperative men without urinary retention or obstruction

**2. Does the patient have one of the following appropriate indications for placing indwelling urinary catheters?**

- Acute urinary retention: e.g., due to medication (anesthesia, opioids, paralytics), or nerve injury
- Acute bladder outlet obstruction: e.g., due to severe prostate enlargement, blood clots, or urethral compression.
- Need for accurate measurements of urinary output in critically ill patients
- To assist in healing of open sacral or perineal wounds in incontinent patients
- To improve comfort for *end of life*, if needed
- Patient requires strict prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fractures)
- Selected peri-operative needs (see back of page)

*If Yes* -> Proceed to Insertion Checklist

*If No* -> Confirm with ordering physician why catheter is necessary, and list: \_\_\_\_\_

**B. Insertion Checklist:****C. Maintenance Checklist:**

1. Assess Daily: Does patient meet criteria to remove the catheter?

**D. Criteria to Remove Urinary Catheter:**

- Reason for catheter placement has resolved.
- *Before replacing indwelling urinary catheter*: consider bladder scanner to confirm urinary retention, and consider using alternatives to non-indwelling catheters (such as intermittent straight catheterization).  
**? insert bladder scanner protocol?**

**Other indications for peri-operative use of urinary catheters:**

- Urologic surgery or other surgery on contiguous (adjacent) structures of the genitourinary tract
- Anticipated prolonged duration of surgery (Note: catheters placed for this reason should be removed in PACU).
- Anticipated to have large volume infusions or diuretics during surgery
- Need for intraoperative monitoring of urinary output.

*Note: there are plenty of other surgery-specific criteria that have been employed by in studies (but are not included in the HICPAC, SHEA or ISDA guidelines).*

*Others ideas to consider: that will be part of the appropriateness inclusion panel*

- *24 hour urine collection for diagnostic purposes in patient whose urine output cannot be managed with other urine collection strategies (such as bedside urinal/pan, intermittent straight catheter).*
- *Instead of Open sacral wound.....specify stage-specific (Faikih: stage 3 or 4).....some studies specify stage 2 or greater.*

Please use the correct **INSERTION TECHNIQUE CHECKLIST** and check “yes” or “no” or “NA” in each box:

Procedural Steps	Yes	No	NA
Place patient in supine position			
Inspect the sterile catheterization kit and remove it from its outer packaging			
Open the inner paper wrapping to form a sterile field			
Form sterile field on bedside table or other flat surface but not patient bed			
With washed hands carefully retrieve the absorbent pad from the top of the kit			
Place absorbent pad beneath patient’s buttocks, with plastic side down			
Don sterile gloves			
Cover patient’s abdomen and superior pubic region with fenestrated drape			
Organize contents of the tray on the sterile field			
Pour antiseptic solution over the preparation swabs in the tray compartment			
Squeeze some sterile catheter lubricant onto the tray to lubricate the catheter tip			
* Test balloon prior to insertion			
Using gloved non-dominant hand, identify the urethra by spreading labia majora & minora			
Use the thumb and index finger to spread the inner labia with gentle traction and pulling upward towards patient’s head			
Non-dominant hand is not removed from this position			
Use an expanding circular motion to clean the opening with remaining swabs			
Lubricate distal end of the catheter with the sterile jelly			
Holding the catheter in the dominant hand, gently introduce the catheter tip into meatus			
Slowly advance catheter through the urethra into the bladder			
If catheter is accidentally contaminated, it is discarded, and a new sterile catheter is obtained			
* If catheter is accidentally inserted into the vagina, it is left in place until a new sterile catheter is obtained and inserted correctly			
Once urine is observed in tubing, the catheter is advanced another 3 – 5 cm.			
Balloon is inflated with entire contents of 10cc. syringe of sterile water only after urine is observed in tubing			
With balloon completely inflated, pull gently on catheter			
Secure catheter to medial thigh			
Place drainage bag below level of bladder			
* Health care provider never turns his/her back on the sterile field			

## INSERTION TECHNIQUE CHECKLIST for Male Patients

Procedural Steps for Male Patients	Yes	No	NA
Place patient in supine position			
Fully retract foreskin on uncircumcised male patient			
Inject 10 – 15 ml. of viscous lidocaine into urethral meatus with needle-less syringe			
Pinch tip of penis for several minutes to retain lidocaine in urethra			
Inspect the sterile catheterization kit and remove it from its outer packaging			
Open the inner paper wrapping to form a sterile field			
Form sterile field on bedside table or other flat surface but not patient bed			
Don sterile gloves			
Organize contents of the tray on the sterile field			
Pour antiseptic solution over the preparation swabs in the tray compartment			
Squeeze some sterile catheter lubricant onto the tray before insertion into the urethra			
* Test balloon prior to insertion			
Drape pubic region and proximal thighs			
Grasp penile shaft using non-dominant hand, holding penis taut and perpendicular to the plane of patient's body			
Cleanse the glans penis in a circular motion, using cotton balls soaked in antiseptic			
Lubricate the tip of the catheter with sterile jelly or viscous lidocaine before inserting it			
If a coudé catheter is used, point the tip of the catheter upward, in the 12 o'clock position			
Slowly advance catheter through the urethra into the bladder			
If substantial resistance is met, do not forcefully advance catheter			
The catheter is advanced to the level of the balloon inflation port			
Balloon is inflated only after urine is observed in tubing. If no urine is observed, flush the catheter with saline. Free return of saline and/or urine signifies that catheter is in place.			
Balloon is inflated with entire contents of 10cc. syringe of sterile water			
With balloon completely inflated, pull gently on catheter			
Foreskin is reduced to its anatomical position in uncircumcised males			
Secure catheter to medial thigh			
Place drainage bag below level of bladder			

Procedural Steps	
Determine if indwelling catheter insertion is appropriate <input type="checkbox"/> yes <input type="checkbox"/> no	
Supply preparation - Gather supplies – use as small a size of catheter as possible Inspect the sterile catheterization kit and remove it from its outer packaging Open the inner paper wrapping to form a sterile field Form sterile field on bedside table or other flat surface but not patient bed	
Patient preparation - Explain procedure Place patient in supine position	
Provider preparation - Wash hands Don sterile gloves Organize contents of tray on sterile field Pour antiseptic solution over preparation swabs in tray compartment Squeeze some sterile catheter lubricant onto tray to lubricate catheter tip Test balloon prior to insertion Lubricate distal end of catheter with sterile jelly Use sterile drapes as desired	
Catheter Insertion – male <ul style="list-style-type: none"> <li>- Fully retract foreskin on uncircumcised male patient</li> <li>- Inject 10 – 15 ml. of viscous lidocaine into urethral meatus with needle-less syringe</li> <li>- Grasp penile shaft using non-dominant hand, holding penis taut and perpendicular to the plane of patient's body</li> <li>- Cleanse the glans penis in a circular motion, using cotton balls soaked in antiseptic</li> <li>- Slowly advance catheter through the urethra into the bladder</li> <li>- If substantial resistance is met, do not forcefully advance catheter</li> <li>- The catheter is advanced to the level of the balloon inflation port</li> <li>- Foreskin is reduced to its anatomical position in uncircumcised males</li> </ul>	Catheter insertion - female <ul style="list-style-type: none"> <li>- Using gloved non-dominant hand, identify the urethra by spreading labia majora &amp; minora</li> <li>- Use prepared swabs to clean</li> <li>- Holding the catheter in the dominant hand, gently introduce the catheter tip into meatus</li> <li>- Slowly advance catheter through the urethra into the bladder</li> <li>- If catheter is accidentally contaminated, it is discarded, and a new sterile catheter is obtained</li> <li>- If catheter is accidentally inserted into the vagina, leave in place until a new sterile catheter is obtained and inserted correctly</li> <li>- Once urine is observed in tubing, the catheter is advanced another 3 – 5 cm.</li> </ul>
Catheter insertion, common steps- <ul style="list-style-type: none"> <li>- Balloon is inflated with entire contents of 10cc. syringe of sterile water only after urine is observed in tubing With balloon completely inflated, pull gently on catheter</li> <li>- Secure catheter to medial thigh</li> <li>- Place drainage bag below level of bladder</li> </ul>	



#### Indwelling trans-urethral catheter insertion:

- Perform hand hygiene immediately before and after insertion
- Use sterile gloves, drapes, sponges, and appropriate antiseptic or sterile solution for periurethral cleaning, and a single-use packet of lubricant jelly for insertion

#### Indwelling trans-urethral catheter management:

- Nursing staff to discontinue the indwelling catheter when primary indications for insertion are resolved
- If breaks in aseptic technique, disconnection, or leakage occur, replace the catheter and collecting system using aseptic technique and sterile equipment.
- Maintain unobstructed urine flow
- Keep the collecting bag below the level of the bladder at all times
- Do not rest the bag on the floor
- Properly secure indwelling catheters after insertion to prevent movement or urethral traction
- Routine hygiene with soap and water is appropriate
- Do not flush indwelling catheters unless physician ordered
- Obtain urine samples aseptically.
  - If a small volume of fresh urine is needed for examination, aspirate the urine from the needleless sampling port with a sterile syringe/cannula adapter after cleaning the port with a disinfectant.
  - Obtain large volumes of urine for special analyses aseptically from the drainage bag.

## References:

1. Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton TM. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. *Clin Infect Dis* 2005;40:643-54.
2. Phipps S, Lim YN, McClinton S, Barry C, Rane A, N'Dow J. Short term urinary catheter policies following urogenital surgery in adults. *Cochrane Database Syst Rev* 2006;CD004374.
3. Lo E, Nicolle L, Classen D, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals. *Infect Control Hosp Epidemiol* 2008;29 Suppl 1:S41-50.
4. Guide to the Elimination of Catheter-Associated Urinary Tract Infections (CAUTIs): An APIC Guide. 2008. (Accessed September 9, 2010, at [http://www.apic.org/Content/NavigationMenu/PracticeGuidance/APICEliminationGuides/CAUTI\\_Guide\\_0609.pdf](http://www.apic.org/Content/NavigationMenu/PracticeGuidance/APICEliminationGuides/CAUTI_Guide_0609.pdf).)
5. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infect Control Hosp Epidemiol*;31:319-26.
6. 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*;50:625-63.
7. 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.
8. Platt R, Polk BF, Murdock B, Rosner B. Mortality associated with nosocomial urinary-tract infection. *N Engl J Med* 1982;307:637-42.
9. Platt R, Polk BF, Murdock B, Rosner B. Reduction of mortality associated with nosocomial urinary tract infection. *Lancet* 1983;1:893-7.
10. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control* 2000;28:68-75.
11. Beeson PB. The case against the catheter. *Am J Med* 1958;1-3.
12. Trautner BW, Darouiche RO. Catheter-associated infections: pathogenesis affects prevention. *Arch Intern Med* 2004;164:842-50.
13. Maki DG, Tambyah PA. Engineering out the risk for infection with urinary catheters. *Emerging Infectious Diseases* 2001;7:342-7.
14. Saint S, Chenoweth CE. Biofilms and catheter-associated urinary tract infections. *Infectious Disease Clinics of North America* 2003;17:411-32.
15. Saint S, Lipsky BA. Preventing catheter-related bacteriuria: Can we? Should we? How? *Arch Intern Med* 1999;159:800-8.
16. Cope M, Cevallos ME, Cadle RM, Darouiche RO, Musher DM, Trautner BW. Inappropriate treatment of catheter-associated asymptomatic bacteriuria in a tertiary care hospital. *Clin Infect Dis* 2009;48:1182-8.
17. Tambyah PA, Knasinski V, Maki DG. The direct costs of nosocomial catheter-associated urinary tract infection in the era of managed care. *Infection Control & Hospital Epidemiology* 2002;23:27-31.
18. Wald HL, Ma A, Bratzler DW, Kramer AM. Indwelling urinary catheter use in the postoperative period: analysis of the national surgical infection prevention project data. *Arch Surg* 2008;143:551-7.
19. Wald HL, Epstein AM, Radcliff TA, Kramer AM. Extended use of urinary catheters in older surgical patients: a patient safety problem? *Infect Control Hosp Epidemiol* 2008;29:116-24.
20. Saint S, Lipsky BA, Goold SD. Indwelling urinary catheters: A one-point restraint? *Annals of Internal Medicine* 2002;137:125-7.
21. The prevention and management of urinary tract infections among people with spinal cord injuries. National Institute on Disability and Rehabilitation Research consensus statement. January 27-29, 1992. *SCI Nurs* 1993;10:49-61.
22. Bladder management for adults with spinal cord injury: a clinical practice guideline for health-care providers. *J Spinal Cord Med* 2006;29:527-73.
23. Jain P, Parada JP, David A, Smith LG. Overuse of the indwelling urinary tract catheter in hospitalized medical patients. *Arch Intern Med* 1995;155:1425-9.
24. Gokula RM, Smith MA, Hickner J. Emergency room staff education and use of a urinary catheter indication sheet improves appropriate use of foley catheters. *Am J Infect Control* 2007;35:589-93.
25. Fakih MG, Pena ME, Shemes S, et al. Effect of establishing guidelines on appropriate urinary catheter placement. *Acad Emerg Med*;17:337-40.
26. Chen YT, Lin MH, Lai HY, Hwang SJ, Chen LK. Potentially inappropriate urinary catheter indwelling among long-term care facilities residents. *J Eval Clin Pract* 2009;15:592-4.
27. Fink HA, Taylor BC, Tacklind JW, Rutks IR, Wilt TJ. Treatment interventions in nursing home residents with urinary incontinence: a systematic review of randomized trials. *Mayo Clin Proc* 2008;83:1332-43.
28. Saint S, Kaufman SR, Rogers MA, Baker PD, Ossenkop K, Lipsky BA. Condom versus indwelling urinary catheters: a randomized trial. *J Am Geriatr Soc* 2006;54:1055-61.

29. Saint S, Lipsky BA, Baker PD, McDonald LL, Ossenkop K. Urinary catheters: What type do men and their nurses prefer? *J Am Geriatr Soc* 1999;47:1453-7.
30. Ouslander JG, Greengold B, Chen S. External catheter use and urinary tract infections among incontinent male nursing home patients. *J Am Geriatr Soc* 1987;35:1063-70.
31. Ouslander JG, Greengold B, Chen S. Complications of chronic indwelling urinary catheters among male nursing home patients: a prospective study. *J Urol* 1987;138:1191-5.
32. Niel-Weise BS, van den Broek PJ. Urinary catheter policies for short-term bladder drainage in adults. *Cochrane Database of Systematic Reviews* 2005:CD004203.
33. Kuhn W, Rist M, Zaech GA. Intermittent urethral self-catheterisation: long term results (bacteriological evolution, continence, acceptance, complications). *Paraplegia* 1991;29:222-32.
34. Lapides J, Diokno AC, Silber SJ, Lowe BS. Clean, intermittent self-catheterization in the treatment of urinary tract disease. *J Urol* 1972;107:458-61.
35. Lapides J, Diokno AC, Lowe BS, Kalish MD. Followup on unsterile intermittent self-catheterization. *J Urol* 1974;111:184-7.
36. Sparks A, Boyer D, Gambrel A, et al. The clinical benefits of the bladder scanner: a research synthesis. *Journal of Nursing Care Quality* 2004;19:188-92.
37. Moore DA, Edwards K. Using a portable bladder scan to reduce the incidence of nosocomial urinary tract infections. *MEDSURG Nursing* 1997;6:39-43.
38. Stevens E. Bladder ultrasound: avoiding unnecessary catheterizations. *MEDSURG Nursing* 2005;14:249-53.
39. Ostaszkievicz J, Johnston L, Roe B. Timed voiding for the management of urinary incontinence in adults. *Cochrane Database Syst Rev* 2004:CD002802.
40. Jirovec MM, Templin T. Predicting success using individualized scheduled toileting for memory-impaired elders at home. *Res Nurs Health* 2001;24:1-8.
41. Morgan C, Endozoa N, Paradiso C, McNamara M, McGuire M. Enhanced toileting program decreases incontinence in long term care. *Jt Comm J Qual Patient Saf* 2008;34:206-8.
42. Ortega R, Ng L, Sekhar P, Song M. Videos in clinical medicine. Female urethral catheterization. *N Engl J Med* 2008;358:e15.
43. Thomsen TW, Setnik GS. Videos in clinical medicine. Male urethral catheterization. *N Engl J Med* 2006;354:e22.
44. Harris TA. Changing practice to reduce the use of urinary catheters. *Nursing*;40:18-20.
45. Newman DK. The indwelling urinary catheter: principles for best practice. *J Wound Ostomy Continence Nurs* 2007;34:655-61; quiz 62-3.
46. Management of short term indwelling urethral catheters to prevent urinary tract infections. 2000. (Accessed September 30, 2010, at [http://www.joannabriggs.edu.au/pdf/BPISEng\\_4\\_1.pdf](http://www.joannabriggs.edu.au/pdf/BPISEng_4_1.pdf).)
47. Darouiche RO, Goetz L, Kaldis T, Cerra-Stewart C, AlSharif A, Priebe M. Impact of StatLock securing device on symptomatic catheter-related urinary tract infection: a prospective, randomized, multicenter clinical trial. *Am J Infect Control* 2006;34:555-60.
48. Gray ML. Securing the indwelling catheter. *Am J Nurs* 2008;108:44-50; quiz
49. Burke JP, Garibaldi RA, Britt MR, Jacobson JA, Conti M, Alling DW. Prevention of catheter-associated urinary tract infections. Efficacy of daily meatal care regimens. *Am J Med* 1981;70:655-8.
50. Burke JP, Jacobson JA, Garibaldi RA, Conti MT, Alling DW. Evaluation of daily meatal care with poly-antibiotic ointment in prevention of urinary catheter-associated bacteriuria. *J Urol* 1983;129:331-4.
51. Kunin CM, McCormack RC. Prevention of catheter-induced urinary-tract infections by sterile closed drainage. *N Engl J Med* 1966;274:1155-61.
52. Meddings J, Rogers MA, Macy M, Saint S. Systematic review and meta-analysis: reminder systems to reduce catheter-associated urinary tract infections and urinary catheter use in hospitalized patients. *Clin Infect Dis* 2010;51:550-60.
53. Gokula RR, Hickner JA, Smith MA. Inappropriate use of urinary catheters in elderly patients at a midwestern community teaching hospital. *Am J Infect Control* 2004;32:196-9.
54. Zaouter C, Kaneva P, Carli F. Less urinary tract infection by earlier removal of bladder catheter in surgical patients receiving thoracic epidural analgesia. *Reg Anesth Pain Med* 2009;34:542-8.
55. Apisarnthanarak A, Thongphubeth K, Sirinvaravong S, et al. Effectiveness of multifaceted hospitalwide quality improvement programs featuring an intervention to remove unnecessary urinary catheters at a tertiary care center in Thailand. *Infect Control Hosp Epidemiol* 2007;28:791-8.
56. Crouzet J, Bertrand X, Venier AG, Badoz M, Husson C, Talon D. Control of the duration of urinary catheterization: impact on catheter-associated urinary tract infection. *J Hosp Infect* 2007;67:253-7.
57. Dumigan DG, Kohan CA, Reed CR, Jekel JF, Fikrig MK. Utilizing national nosocomial infection surveillance system data to improve urinary tract infection rates in three intensive-care units. *Clin Perform Qual Health Care* 1998;6:172-8.
58. Jain M, Miller L, Belt D, King D, Berwick DM. Decline in ICU adverse events, nosocomial infections and cost through a quality improvement initiative focusing on teamwork and culture change. *Qual Saf Health Care* 2006;15:235-9.

59. Murphy D, Francis K, Litzenberger M, Lucente K. Reducing urinary tract infection: a nurse-initiated program. *Pa Nurse* 2007;62:20.
60. Reilly L, Sullivan P, Ninni S, Fochesto D, Williams K, Fetherman B. Reducing foley catheter device days in an intensive care unit: using the evidence to change practice. *AACN Advanced Critical Care* 2006;17:272-83.
61. Stephan F, Sax H, Wachsmuth M, Hoffmeyer P, Clergue F, Pittet D. Reduction of urinary tract infection and antibiotic use after surgery: a controlled, prospective, before-after intervention study. *Clin Infect Dis* 2006;42:1544-51.
62. Topal J, Conklin S, Camp K, Morris V, Balcezak T, Herbert P. Prevention of nosocomial catheter-associated urinary tract infections through computerized feedback to physicians and a nurse-directed protocol. *Am J Med Qual* 2005;20:121-6.
63. Weitzel T. To cath or not to cath? *Nursing* 2008;38:20-1.
64. Huang WC, Wann SR, Lin SL, et al. Catheter-associated urinary tract infections in intensive care units can be reduced by prompting physicians to remove unnecessary catheters. *Infection Control & Hospital Epidemiology* 2004;25:974-8.
65. Saint S, Wiese J, Amory JK, et al. Are physicians aware of which of their patients have indwelling urinary catheters? *Am J Med* 2000;109:476-80.
66. Saint S, Kaufman SR, Thompson M, Rogers MA, Chenoweth CE. A reminder reduces urinary catheterization in hospitalized patients. *Joint Commission Journal on Quality & Patient Safety* 2005;31:455-62.
67. Fakih MG, Dueweke C, Meisner S, et al. Effect of nurse-led multidisciplinary rounds on reducing the unnecessary use of urinary catheterization in hospitalized patients. *Infect Control Hosp Epidemiol* 2008;29:815-9.
68. Cornia PB, Amory JK, Fraser S, Saint S, Lipsky BA. Computer-based order entry decreases duration of indwelling urinary catheterization in hospitalized patients. *American Journal of Medicine* 2003;114:404-7.
69. Loeb M, Hunt D, O'Halloran K, Carusone SC, Dafoe N, Walter SD. Stop orders to reduce inappropriate urinary catheterization in hospitalized patients: a randomized controlled trial. *J Gen Intern Med* 2008;23:816-20.
70. Karchmer TB, Giannetta ET, Muto CA, Strain BA, Farr BM. A randomized crossover study of silver-coated urinary catheters in hospitalized patients. *Archives of Internal Medicine* 2000;160:3294-8.
71. Stensballe J, Tvede M, Looms D, et al. Infection risk with nitrofurazone-impregnated urinary catheters in trauma patients: a randomized trial. *Ann Intern Med* 2007;147:285-93.
72. Saint S, Veenstra DL, Sullivan SD, Chenoweth C, Fendrick AM. The potential clinical and economic benefits of silver alloy urinary catheters in preventing urinary tract infection. *Arch Intern Med* 2000;160:2670-5.
73. Johnson JR, Kuskowski MA, Wilt TJ. Systematic review: antimicrobial urinary catheters to prevent catheter-associated urinary tract infection in hospitalized patients. *Ann Intern Med* 2006;144:116-26.
74. Schumm K, Lam TB. Types of urethral catheters for management of short-term voiding problems in hospitalised adults. *Cochrane Database Syst Rev* 2008;CD004013.
75. Saint S, Olmsted RN, Fakih MG, et al. Translating health care-associated urinary tract infection prevention research into practice via the bladder bundle. *Jt Comm J Qual Patient Saf* 2009;35:449-55.
76. Patrizzi K, Fasnacht A, Manno M. A collaborative, nurse-driven initiative to reduce hospital-acquired urinary tract infections. *J Emerg Nurs* 2009;35:536-9.
77. Saint S, Kowalski CP, Banaszak-Holl J, Forman J, Damschroder L, Krein SL. How active resisters and organizational constipators affect health care-acquired infection prevention efforts. *Jt Comm J Qual Patient Saf* 2009;35:239-46.
78. Saint S, Kowalski CP, Forman J, et al. A multicenter qualitative study on preventing hospital-acquired urinary tract infection in US hospitals. *Infect Control Hosp Epidemiol* 2008;29:333-41.
79. Saint S, Meddings JA, Calfee DP, Kowalski CP, Krein SL. Catheter-associated urinary tract infection and the Medicare rules changes. *Ann Intern Med* 2009;150:877-85.
80. Zhan C, Elixhauser A, Richards CL, Jr., et al. Identification of hospital-acquired catheter-associated urinary tract infections from Medicare claims: sensitivity and positive predictive value. *Med Care* 2009;47:364-9.
81. Meddings J, Saint S, McMahon LF, Jr. Hospital-acquired catheter-associated urinary tract infection: documentation and coding issues may reduce financial impact of Medicare's new payment policy. *Infect Control Hosp Epidemiol* 2010;31:627-33.
82. Saint S, Kowalski CP, Banaszak-Holl J, Forman J, Damschroder L, Krein SL. The importance of leadership in preventing healthcare-associated infection: results of a multisite qualitative study. *Infect Control Hosp Epidemiol* 2010;31:901-7.
83. Kotter J. Leading change: why transformation efforts fail. *Harv Bus Rev* 1995:59-67.
84. Wald HL, Kramer AM. Nonpayment for harms resulting from medical care: catheter-associated urinary tract infections. *JAMA* 2007;298:2782-4.
85. Pronovost PJ, Goeschel CA, Wachter RM. The wisdom and justice of not paying for "preventable complications". *JAMA* 2008;299:2197-9.
86. Straube B, Blum JD. The policy on paying for treating hospital-acquired conditions: CMS officials respond. *Health Aff (Millwood)* 2009;28:1494-7.
87. McNair PD, Luft HS, Bindman AB. Medicare's policy not to pay for treating hospital-acquired conditions: the impact. *Health Aff (Millwood)* 2009;28:1485-93.