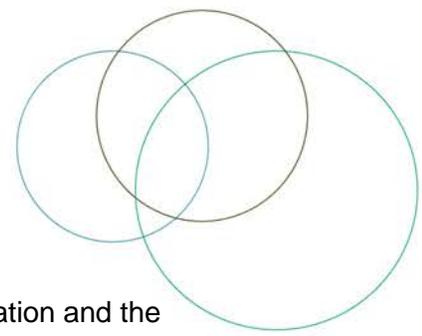


HOSPITAL HARM IMPROVEMENT RESOURCE

# Urinary Tract Infection



## ACKNOWLEDGEMENTS



The Canadian Institute for Health Information and the Canadian Patient Safety Institute have collaborated on a body of work to address gaps in measuring harm and to support patient safety improvement efforts in Canadian hospitals.

The Hospital Harm Improvement Resource was developed by the Canadian Patient Safety Institute to complement the Hospital Harm measure developed by the Canadian Institute for Health Information. It links measurement and improvement by providing evidence-informed resources that will support patient safety improvement efforts.

The Canadian Patient Safety Institute acknowledges and appreciates the key contributions of Dr. Jerome Leis, MD M.Sc. FRCPC and Dr. Shaun Morris, MD MPH FRCPC FAAP DTM&H for the review and approval of this Improvement Resource.



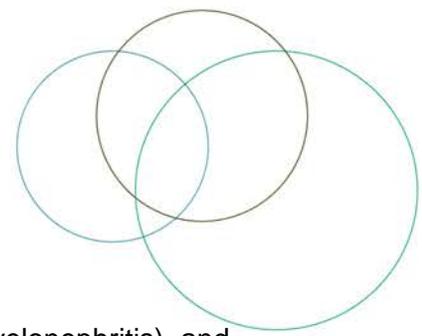


**DISCHARGE ABSTRACT DATABASE (DAD) CODES INCLUDED IN THIS CLINICAL CATEGORY:**

B12: Urinary Tract Infections					
<b>Concept</b>	Urinary tract infections identified during a hospital stay.				
<b>Notes</b>	<ol style="list-style-type: none"> <li>Urinary tract infections due to methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) or vancomycin-resistant enterococci (VRE) are also included in B18: Infections Due to <i>Clostridium difficile</i>, MRSA or VRE.</li> <li>In the neonatal age group, underestimation is probable, due to the exclusion of cases where identification of in-utero or birth process infections versus environment-acquired infections has been documented as a challenge.</li> </ol>				
<b>Selection criteria</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">N39.0</td> <td>Identified as diagnosis type (2) <b>OR</b> Identified as diagnosis type (3) AND T83.5 as diagnosis type (2) <b>AND Y60–Y84 in the same diagnosis cluster</b></td> </tr> <tr> <td>O86.202</td> <td>Identified as diagnosis type (M), (1), (2), (W), (X) or (Y)</td> </tr> </table>	N39.0	Identified as diagnosis type (2) <b>OR</b> Identified as diagnosis type (3) AND T83.5 as diagnosis type (2) <b>AND Y60–Y84 in the same diagnosis cluster</b>	O86.202	Identified as diagnosis type (M), (1), (2), (W), (X) or (Y)
N39.0	Identified as diagnosis type (2) <b>OR</b> Identified as diagnosis type (3) AND T83.5 as diagnosis type (2) <b>AND Y60–Y84 in the same diagnosis cluster</b>				
O86.202	Identified as diagnosis type (M), (1), (2), (W), (X) or (Y)				
<b>Exclusions</b>	Abstracts with a length of stay less than 2 days				
<b>Codes</b>	<b>Code descriptions</b>				
<b>N39.0</b>	Urinary tract infection, site not specified				
<b>O86.202</b>	Urinary tract infection following delivery; delivered with mention of postpartum complication				
<b>Additional codes</b>					
<b>Inclusions</b>					
<b>T83.5</b>	Infection and inflammatory reaction due to prosthetic device, implant and graft in urinary system				
<b>Y60-84</b>	Complications of medical and surgical care (refer to Appendix 6)				

For the descriptions of external cause codes of complications of medical or surgical care (Y60–Y84), please refer to the technical notes: [Hospital Harm Indicator: Appendices to Indicator Library](#).





## OVERVIEW AND IMPLICATIONS

### Urinary Tract Infection (UTI)

UTIs can be divided into upper tract infections, which involve the kidneys (pyelonephritis), and lower tract infections, which involve the bladder (cystitis), urethra (urethritis), and prostate (prostatitis). Infection may spread from one site to the other. Although urethritis and prostatitis are infections that involve the urinary tract, the term UTI usually refers to pyelonephritis and cystitis (Imam 2013).

Most cases of cystitis and pyelonephritis are caused by bacteria. The most common nonbacterial pathogens are fungi (usually candidal species), and, less commonly, mycobacteria, viruses, and parasites. Nonbacterial pathogens usually affect patients who are immunocompromised; have diabetes, urinary tract obstruction, or structural abnormalities; or have had recent urinary tract instrumentation. Urethritis is usually caused by sexually transmitted infections (STI). Prostatitis is usually caused by bacteria and sometimes STIs (Imam 2013).

### Healthcare-Associated UTI

Healthcare-associated UTI is the fourth leading cause of healthcare associated infections after pneumonia, surgical site infections and intra-abdominal infection (Magill et al, 2014).

Approximately 80 per cent of healthcare associated UTIs are attributable to indwelling urethral catheters (IHI 2012).

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

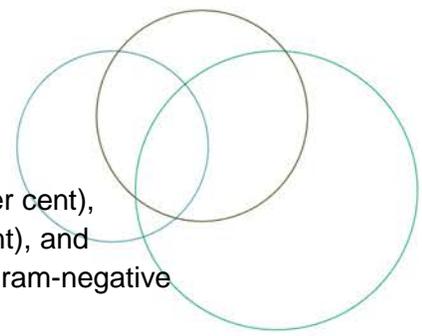
CAUTI is the presence of symptoms of infection along with a positive catheter or midstream urine specimen in a patient who was previously catheterized within 48 hours (Hooton et al, 2010).

A urinary catheter provides a portal of entry into the urinary tract. The source of bacteria causing CAUTI is usually endogenous—typically via meatal, rectal, or vaginal colonization—but rarely may be exogenous, from equipment or contaminated hands of healthcare personnel (APIC 2014).

The most important risk factor for development of CAUTI is the duration of catheterization. Daily risk of acquisition of bacteriuria with urinary catheters is around seven per cent and among those with catheter-associated bacteriuria, symptomatic CAUTI will develop in 24 per cent (95 per cent CI, 16-32 per cent) and bacteremia will develop in 3.6 per cent (95 per cent CI, 3.4-3.8 per cent) (Saint, 2000).

Other factors predispose CAUTI including patient-related factors such as diabetes, fecal incontinence, incomplete emptying of the bladder, dehydration etc.; care provider related factors such as poor hand hygiene practices, poor insertion technique, etc.; and hospital, equipment, and/or environmental systems (APIC 2014). The CDC reports that the most frequent pathogens associated with CAUTI in hospitals between 2006 and 2007 were *Escherichia coli* (21.4 per





cent) and *Candida* spp (21 per cent), followed by *Enterococcus* spp (14.9 per cent), *Pseudomonas aeruginosa* (10 per cent), *Klebsiella pneumoniae* (7.7 per cent), and *Enterobacter* spp (4.1 per cent). A smaller proportion was caused by other gram-negative bacteria and *Staphylococcus* spp (APIC, 2014).

CAUTIs account for the majority of healthcare-associated UTIs and have been associated with increased morbidity, mortality, hospital cost, and length of stay (APIC 2014). It is well established that the duration of catheterization is directly related to risk for developing a UTI. With a catheter in place, the daily risk of developing a UTI ranges from 3 to 7 per cent (IHI, 2012). During hospitalization, from 12 to 16 per cent of patients may receive short-term indwelling urinary catheters. The average rate of CAUTI is higher in ICU patients than in non-ICU patients (APIC 2014).

An estimated 17 to 69 per cent of CAUTIs may be preventable with implementation of evidence-based practices. Although there has been modest improvement in CAUTI rates, progress has been much slower than other device-associated infections (APIC 2014).

### **Post-partum UTI**

Post-partum UTI may begin as asymptomatic bacteriuria during pregnancy and is sometimes associated with bladder catheterization to relieve urinary distention during or after labor (Imam 2013). Physiological changes in the bladder occur during pregnancy and predispose women to develop post-partum urinary retention (PUR) during the first hours to days after birth which can lead to UTI (Leach 2011). PUR after vaginal birth is a relatively common event, with the reported incidence ranging from 1.7 to 17.9 per cent (Leach 2011). The risk is higher among instrument-assisted births and use of regional analgesia. Other common risk factors include primiparity, prolonged first and second stage perineal tearing and oxytocin use. Unrecognized PUR may lead to upper urinary tract damage and permanent voiding difficulties (Leach 2011).

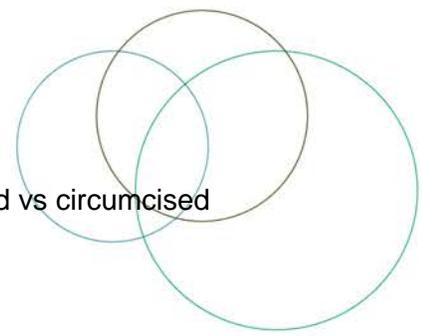
Pyelonephritis may occur postpartum if bacteria ascend from the bladder. The infection may begin as asymptomatic bacteriuria during pregnancy and is sometimes precipitated by peripartum urinary retention and/or bladder catheterization during or after labor (Imam 2013).

### **UTIs Among Neonates**

The characteristics of UTI in neonates differ from UTIs in infants and children. Its prevalence is much higher, male sex is affected predominantly non-*Escherichia coli* infections are more frequent, and there is a higher risk of urosepsis than in older age groups. UTI in neonates may be the first indicator of underlying abnormalities of kidneys and the urinary tract (Beetz 2012). Some 35 to 50 per cent of term and preterm neonates with UTI have abnormal urinary tract ultrasounds (Bonadio et al, 2014, Ismaili et al, 2011, Goldman et al, 2000, Sastre et al, 2007).

The prevalence of UTIs among full-term neonates has been reported to be up to 1.1 per cent, increasing up to seven per cent among those with fever. Evidence indicates that up to approximately 15 per cent of febrile neonates have positive urine culture (Bonadio et al, 2014, Ismaili et al, 2011) and most UTI in neonates is related to pyelonephritis as compared to cystitis





in older children. The presence of UTI is significantly higher in uncircumcised vs circumcised boys (Beetz 2012).

## **GOAL**

Prevention of urinary tract infection by implementing recommended components of care.

## **IMPORTANCE TO PATIENTS AND FAMILIES**

Catheters should be removed as soon as they are no longer clinically indicated. This often makes patients more comfortable, reduces their exposure to infections, and shortens their time in hospital (IHI, 2012).

## **Patient Story**

### **Don't get 'caught' in the CAUTI trap**

One nurse's story: My father died of a heart attack at age 39, and our mother raised my siblings and me. We were all close to mom; however, as the oldest she and I had a special bond. At age 46 she had undergone a mitral valve replacement and her aortic valve was replaced about nine years later. She had survived a cardiac arrest and pulmonary artery rupture. When she was hospitalized with dehydration and acute kidney injury, we believed she would spend some time in the hospital and be discharged. Her kidney function improved with fluids, and her output was carefully monitored with a urinary catheter. She had a history of atrial fibrillation and her rate control medications were held. One day, her temperature soared to 102.8 F and her heart rate increased to 130 beats per minute. She developed sepsis, which placed further stress on her pulmonary and cardiovascular system. In June 2001 my mother died from complications related to a catheter associated urinary tract infection. She was 61 years old; I still miss her (Townsend et al, 2013).

## **EVIDENCE-INFORMED PRACTICES**

### **Prevention of UTI (non-CAUTI)**

(Saskatchewan 2013)

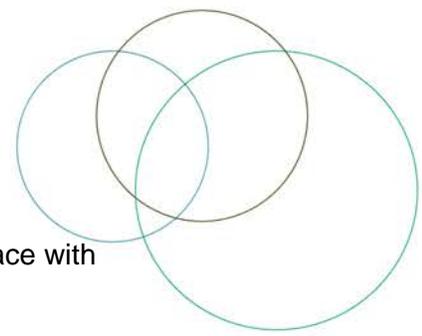
1. Ensure proper hydration and nutrition.
2. Provide good perineal hygiene.
3. Promote healthy voiding habits.

### **Prevention of CAUTIs**

(APIC 2014, Meddings et al, 2014, IHI 2011, Gould et al, 2010, Lo et al, 2014)

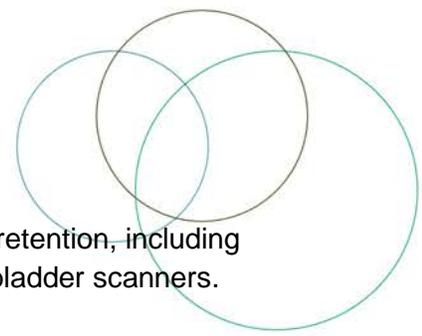
1. CAUTI Risk Assessment:
  - a. Assess whether an effective organizational program exists.
  - b. Assess population at risk.





- c. Assess baseline data.
2. Measurement/Surveillance: surveillance and reporting program in place with standardized definitions.
3. Insertion: Use appropriate technique for catheter insertion -
  - a. Only trained persons to insert and maintain catheter.
  - b. Insert urinary catheters only when necessary for patient care and leave in place only as long as indications remain.
  - c. Consider other methods for bladder management, such as intermittent catheterization, where appropriate.
  - d. Practice good hand hygiene and routine practices.
  - e. Use aseptic technique and sterile equipment for catheter insertion.
  - f. Use sterile gloves, drape, and sponges; a sterile or antiseptic solution for cleaning the urethral meatus; and a sterile single-use packet of lubricant jelly for insertion.
  - g. Use as small a catheter as possible consistent with proper drainage, to minimize urethral trauma.
4. Maintenance: Ensure appropriate maintenance of indwelling catheters -
  - a. Properly secure indwelling catheters after insertion to prevent movement and urethral traction.
  - b. Maintain a sterile, continuously closed drainage system.
  - c. Replace the catheter and the collecting system using aseptic technique when breaks in aseptic technique, disconnection, or leakage occur.
  - d. For examination of fresh urine, collect a small sample by aspirating urine from the needleless sampling port with a sterile syringe/cannula adaptor after cleansing the port with disinfectant. Obtain larger volumes of urine for special analyses aseptically from the drainage bag.
  - e. Maintain unobstructed urine flow:
    - i. Keep the collecting bag below the level of the bladder at all times; do not place the bag on the floor.
    - ii. Keep catheter and collecting tube free from kinking.
    - iii. Empty the collecting bag regularly using a separate collecting container for each patient. Avoid touching the draining spigot to the collecting container.
  - f. Employ routine hygiene; cleaning the meatal area with antiseptic solutions is unnecessary.
  - g. Do not change indwelling catheters or urinary drainage bags at arbitrarily fixed intervals.
5. Removal: Review urinary catheter necessity daily against pre-specified criteria.
  - a. Urinary catheter reminders.
  - b. Urinary catheter automatic stop orders.
  - c. Medical directives for nurse-guided urinary catheter removal.





6. Post-catheter care:
  - a. Develop a protocol for management of postoperative urinary retention, including nurse-directed use of intermittent catheterization and use of bladder scanners.

### Special Considerations for Recurrent UTI in Pregnancy

(Epp et al, 2010)

1. Early detection, identification and management of UTI.
2. Prophylaxis for:
  - a. All women with a pre-pregnancy history of recurrent UTIs.
  - b. Persistent symptomatic or asymptomatic bacteriuria after two antibiotic treatments.
  - c. After only one UTI for a woman who has other conditions that potentially increase the risk of urinary complications during the episode of UTI (e.g., diabetes or sickle cell trait).

### Special Considerations for Prevention of Post-partum UTI

(Leach 2011)

1. Early detection, identification and management of urinary retention.
2. Steps to avoid and manage urinary retention:
  - a. Instruct women to void frequently with good amounts of urine.
  - b. Early ambulation following delivery.
  - c. Pain management.
  - d. Offer privacy when voiding.

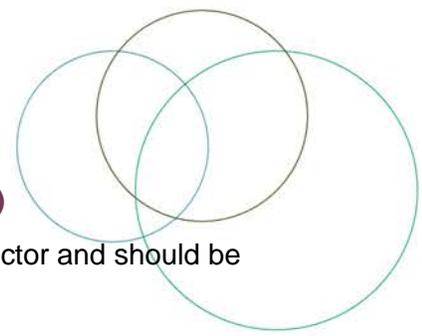
### Special Considerations for Prevention of CAUTI in Children

(APIC 2014)

The prevention of CAUTI in children, especially healthcare-associated infections (HAIs), is not procedurally different from the concerns confronted in serving adult patients. In pediatrics, the rationale for catheter insertion, catheter size, attention to aseptic technique on insertion, and the reliance on a “bundle” strategy for quality of care in managing the device are all necessary to prevent these infections. However, the additional concerns specifically inherent in the care of children include, but are not limited to:

1. The child’s age and the use of developmentally appropriate approaches to care.
2. Attention to family-centered care, cultural competency of the clinicians, and health literacy of the family.
3. Provision of emotional comfort (presence of parent, comforting objects, music, positive distraction).
4. Daily care and assessment for allergies, skin sensitivities, especially in the choice of cleansing agents and issues of catheter securement.





### Special considerations for prevention of CAUTI in neonates (0-28 days)

1. Similar to older children and adults, an indwelling catheter is a risk factor and should be minimized as much as possible.
2. Circumcision may be considered for uncircumcised male infants at higher risk for UTI including those with recurrent infections (Sorokan et al., 2015).
3. The strategies of antibacterial prophylaxis for the prevention of recurrent UTIs are changing as its benefits have not yet been proven by evident data (Beetz, 2012). It used to be that most infants with febrile UTI and any grade of reflux/hydronephrosis would be prophylaxed, there is a movement towards now prophylaxing only high grade reflux/significant hydronephrosis with recurrent febrile UTIs (Herz et al, 2014, Braga et al, 2015, Tullus, 2015).

## MEASURES

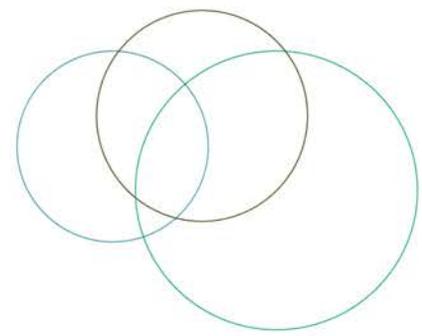
Vital to quality improvement is measurement, and this applies specifically to implementation of interventions. The chosen measures will help to determine whether an impact is being made (primary outcome), whether the intervention is actually being carried out (process measures), and whether any unintended consequences ensue (balancing measures).

Below are some recommended measures to use, as appropriate, to track your progress. In selecting your measures, consider the following:

- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the final results and the resources required to obtain them; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use different measures or modify the measures described below to make them more appropriate and/or useful to your particular setting. However, be aware that modifying measures may limit the comparability of your results to others'.
- Posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful and exciting (IHI, 2011).

For more information on measuring for improvement contact the Canadian Patient Safety Institute Central Measurement Team at [measurement@cpsi-icsp.ca](mailto:measurement@cpsi-icsp.ca)





## Outcome Measures

1. Rate of UTI.
  - a. Rate of non-CAUTI (CDC 2016).
  - b. Rate of CAUTI (CDC 2016, Gould et al, 2010, APIC 2014).
    - i. CAUTI per 1000 patient days.
    - ii. CAUTI per 1000 catheter days.
2. Rate of Bloodstream Infections (BSI) Secondary to CAUTI (Gould et al, 2010).
  - i. BSI per 1000 patient days.
  - ii. BSI per 1000 catheter days.

## Process Improvement Measures

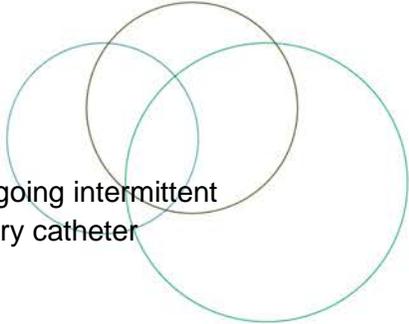
### CAUTI

1. Overall Catheter Days per Patient Days.
2. Unnecessary Urinary Catheters or Unnecessary Catheter Days.
3. Average Duration of Urinary Catheterization.
4. Compliance with Educational Program (Gould et al, 2010).
5. Compliance with Documentation of Catheter Insertion and removal Dates (Gould et al, 2010).
6. Compliance with Documentation of Indication for Catheter Placement (Gould et al, 2010).
7. Per cent of Unnecessary Insertion of Urinary Catheters (IHI 2011).
  - a. Inappropriate use:
    - i. Management of incontinence.
    - ii. Obtaining urine sample when patient able to void.
    - iii. Prolonged postoperative duration without appropriate indication (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anaesthesia, etc.).
8. Urinary Catheter Insertion Bundle Compliance (IHI 2011, APIC, 2014).
  - a. Hand hygiene.
  - b. Trained persons.
  - c. Aseptic technique and sterile equipment (acute setting).
  - d. Clean (i.e., non-sterile) technique for intermittent catheterization for patients requiring chronic intermittent catheterization (non-acute care setting).
  - e. Properly secure indwelling catheters after insertion to prevent movement and urethral traction.
  - f. Use the smallest bore catheter possible, consistent with good drainage..
  - g. Perform intermittent catheterization at regular intervals to prevent bladder over distension.



## HOSPITAL HARM IMPROVEMENT RESOURCE

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- h. Consider using a portable ultrasound device in patients undergoing intermittent catheterization to assess urine volume and reduce unnecessary catheter insertions.
  9. Urinary Catheter Maintenance Bundle Compliance (IHI 2011).
    - a. Urinary catheters maintained according to recommended guidelines (Sterile, continuously closed drainage system, Catheter properly secured, Collection bag below the level of the bladder, Unobstructed urine flow, Regular emptying of collection bag).
  10. Daily Review of Urinary Catheter Necessity (IHI 2011).
  11. Unnecessary Urinary Catheter Days (IHI 2011).

## STANDARDS AND REQUIRED ORGANIZATIONAL PRACTICES

### Accreditation Canada Standards

Accreditation Canada Standards include several requirements with regards to infection prevention and control including: providing information to clients about how to protect themselves from infections; conducting risk assessments; using procedure-specific care maps or guidelines; following routine practices; administering prophylactic antibiotics; using airborne, droplet and contact precautions; reprocessing; etc.

### Accreditation Canada Required Organizational Practice

Hand-Hygiene Compliance: Requires the evaluation of compliance with accepted hand-hygiene practices.

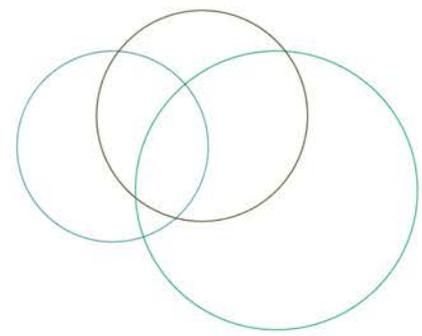
## GLOBAL PATIENT SAFETY ALERTS

[Global Patient Safety Alerts](#) provides access and the opportunity to learn from other organizations about specific patient safety incidents including alerts, advisories, recommendations and solutions for improving care and preventing incidents. Learning from the experience of other organizations can accelerate improvement.

### Recommended search terms:

- Urinary tract infection
- Catheter-associated urinary tract infection
- CAUTI



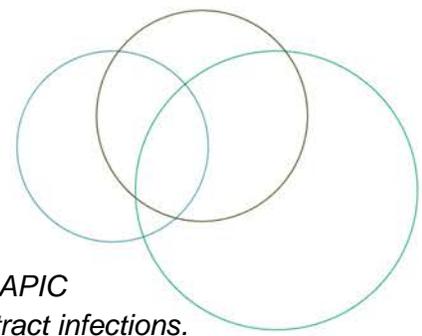


## SUCCESS STORIES

### The National Surgical Quality Program in BC

Ten hospitals are engaged in a UTI improvement project as part of the National Quality Surgical Quality Program in BC, each with site-specific areas of focus, resources and action teams. An overall improvement trend is noted starting to emerge in the non-risk adjusted UTI rates for the 10 sites from August 2011 to April 2013. While the data is still preliminary, there is a notable trend of a reduction in UTI in the last five months (December 2012 to April 2013).





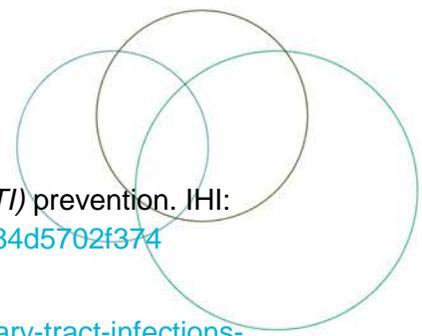
## REFERENCES

- Association for Professionals in Infection Control and Epidemiology (APIC). *APIC Implementation Guide: Guide to preventing catheter-associated urinary tract infections*. Washington DC: API; 2014. [http://apic.org/Resource/\\_EliminationGuideForm/0ff6ae59-0a3a-4640-97b5-eee38b8bed5b/File/CAUTI\\_06.pdf](http://apic.org/Resource/_EliminationGuideForm/0ff6ae59-0a3a-4640-97b5-eee38b8bed5b/File/CAUTI_06.pdf)
- Beetz R. Evaluation and management of urinary tract infections in the neonate. *Curr Opin Pediatr*. 2012; 24 (2): 205-11. doi: 10.1097/MOP.0b013e32834f0423.
- Bonadio W, Maida G. Urinary tract infection in outpatient febrile infants younger than 30 days of age: a 10-year evaluation. *Pediatr Infect Dis J*. 2014; 33 (4): 342–344. doi: 10.1097/INF.0000000000000110.
- Braga LH, Farrokhyar F, D'Cruz J, Pemberton J, Lorenzo AJ. Risk factors for febrile urinary tract infection in children with prenatal hydronephrosis: A prospective study. *J Urol*. 2015; 193 (5 Suppl): 1766–1771. doi: 10.1016/j.juro.2014.10.091.
- Centers for Disease Control and Prevention (CDC). *Urinary tract infection (catheter-associated urinary tract infection [CAUTI] and non-catheter-associated urinary tract infection [UTI]) and other urinary system infection [USI] events*. CDC; 2016. <http://www.cdc.gov/nhsn/pdfs/pscmanual/7pscCAUTICurrent.pdf>
- Epp A, LaRoche A. SOGC Clinical Practice Guideline: Recurrent urinary tract infection. *J Obstet Gynaecol Can*. 2010; 32 (11): 1082–1090. <http://sogc.org/guidelines/recurrent-urinary-tract-infection/>
- Goldman M, Lahat E, Strauss S, et al. Imaging after urinary tract infection in male neonates. *Pediatrics*. 2000;105 (6): 1232–1235.
- Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA, Healthcare Infection Control Practices Advisory Committee (HICPAC). *Guideline for prevention of catheter-associated urinary tract infections 2009*. Centers for Disease Control and Prevention (CDC); 2010. <http://www.cdc.gov/hicpac/pdf/cauti/cautiguide2009final.pdf>
- Herz D, Merguerian P, McQuiston L. Continuous antibiotic prophylaxis reduces the risk of febrile UTI in children with asymptomatic antenatal hydronephrosis with either ureteral dilation, high-grade vesicoureteral reflux, or ureterovesical junction obstruction. *J Pediatr Urol*. 2014; 10 (4): 650–654.
- 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*. 2010; 50 (5): 625-663. <http://cid.oxfordjournals.org/content/50/5/625.long>
- Institute for Healthcare Improvement (IHI). *How-to Guide: Prevent catheter-associated urinary tract infections*. Cambridge, MA: IHI; 2011. <http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventCatheterAssociatedUrinaryTractInfection.aspx>



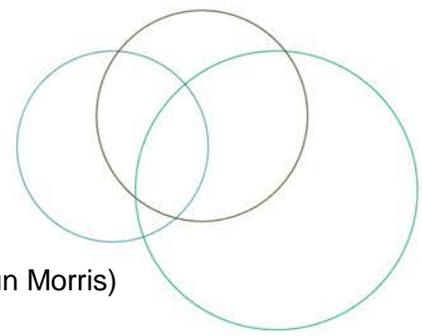
## HOSPITAL HARM IMPROVEMENT RESOURCE

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- IHI. *IHI Improvement Map: Catheter-associated urinary tract infection (CAUTI) prevention*. IHI: 2012. <http://app.ihl.org/imap/tool/#Process=2e1ead62-c0c8-41f2-96f6-884d5702f374>
- Imam TH. Introduction to urinary tract infections. Merck Manual; 2013. <http://www.merckmanuals.com/professional/genitourinary-disorders/urinary-tract-infections-uti/introduction-to-urinary-tract-infections>
- Ismaili K, Lolin K, Damry N, Alexander M, Lepage P, Hall M. Febrile urinary tract infections in 0- to 3-month-old infants: a prospective follow-up study. *J Pediatr*. 2011; 158 (1): 91–94. doi: 10.1016/j.jpeds.2010.06.053.
- Leach S. 'Have you had a wee yet?' Postpartum urinary retention. *Pract Midwife*. 2011; 14 (1): 23-25.
- Lo E, Nicolle LE, Coffin SE, et al. Strategies to prevent catheter-associated urinary tract infections in acute care Hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2014; 35 (5): 464-479. doi: 10.1086/675718.
- Magill SS, Edwards JR, Bamberg W, et al. Multistate point-prevalence survey of health care-associated infections. *N Engl J Med*. 2014; 370 (13): 1198-1208. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4648343/>
- \*Meddings J, Rogers MA, Krein SL, Fakhri MG, Olmsted RN, Saint S. Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: an integrative review. *BMJ Qual Saf*. 2014; 23 (4): 277-289. doi: 10.1136/bmjqs-2012-001774. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3960353/>
- Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control*. 2000; 28 (1): 68-75.
- Saskatchewan Infection Prevention and Control Program. *Guidelines for the prevention and treatment of urinary tract infections (UTIs) in continuing care settings*. Government of Saskatchewan Ministry of Health; 2013.
- Sastre JB, Aparicio AR, Cotallo GD, Colomer BF, Hernández MC, Grupo de Hospitales Castrillo. Urinary tract infection in the newborn: clinical and radio imaging studies. *Pediatr Nephrol*. 2007; 22 (10):1735–1741.
- Sorokan ST, Finlay JC, Jefferies AL, Canadian Paediatric Society, Fetus and Newborn Committee, Infectious Diseases and Immunization Committee. Position Statement: Newborn male circumcision. *Paediatr Child Health* 2015;20(6):311-15. <http://www.cps.ca/documents/position/circumcision>
- Townsend T, Anderson P, Meeker L. Don't get 'caught' in the CAUTI trap. *Am Nurse Today*. 2013; 8 (12): 6. <http://www.americannursetoday.com/dont-get-caught-in-the-cauti-trap/>
- Tullus K. Vesicoureteric reflux in children. *Lancet*. 2015; 385 (9965): 371–379. doi: 10.1016/S0140-6736(14)60383-4.





## UTI RESOURCES AND HELPFUL WEBSITES

\*(Key Resources recommended by Dr. Jerome Leis, \*\*recommend Dr. Shaun Morris)

### Professional Associations and Helpful Websites

- Centers for Disease Control and Prevention: [http://www.cdc.gov/HAI/ca\\_uti/uti.html](http://www.cdc.gov/HAI/ca_uti/uti.html)
- Association for Professional in Infection Control and Epidemiology  
<http://apic.org/Resources/Topic-specific-infection-prevention/Catheter-associated-urinary-tract-infection>
- Institute for Healthcare Improvement  
<http://www.ihl.org/Topics/CAUTI/Pages/default.aspx>

### UTI Clinical Practice Guidelines

Andreessen L, Wilde MH, Herendeen P. Preventing catheter-associated urinary tract infections in acute care: the bundle approach. *J Nurs Care Qual.* 2012; 27 (3): 209-217. doi: 10.1097/NCQ.0b013e318248b0b1.

Association for Professionals in Infection Control and Epidemiology (APIC). *APIC Implementation Guide: Guide to preventing catheter-associated urinary tract infections.* Washing DC: API; 2014. [http://apic.org/Resource\\_/EliminationGuideForm/0ff6ae59-0a3a-4640-97b5-eee38b8bed5b/File/CAUTI\\_06.pdf](http://apic.org/Resource_/EliminationGuideForm/0ff6ae59-0a3a-4640-97b5-eee38b8bed5b/File/CAUTI_06.pdf)

Centers for Disease Control and Prevention (CDC). *Urinary tract infection (catheter-associated urinary tract infection [CAUTI] and non-catheter-associated urinary tract infection [UTI]) and other urinary system infection [USI] events.* CDC; 2016.  
<http://www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf>

Clarke K, Tong D, Pan Y, et al. Reduction in catheter-associated urinary tract infections by bundling interventions. *Int J Qual Health Care.* 2013; 25 (1): 43-49.  
<http://intqhc.oxfordjournals.org/content/25/1/43>

Conway LJ, Larson EL. Guidelines to prevent catheter-associated urinary tract infection: 1980 to 2010. *Heart Lung.* 2012; 41 (3): 271-283. doi: 10.1016/j.hrtlng.2011.08.001.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3362394/>

\*Epp A, LaRoche A. SOGC Clinical Practice Guideline: Recurrent urinary tract infection. *J Obstet Gynaecol Can.* 2010; 32 (11): 1082–1090. <http://sogc.org/guidelines/recurrent-urinary-tract-infection/>

Flodgren G, Conterno LO, Mayhew A, Omar O, Pereira CR, Shepperd S. Interventions to improve professional adherence to guidelines for prevention of device-related infections. *Cochrane Database Syst Rev.* 2013; 3: CD006559. doi: 10.1002/14651858.CD006559.pub2.



## HOSPITAL HARM IMPROVEMENT RESOURCE

### Urinary Tract Infection

Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA, Healthcare Infection Control Practices Advisory Committee (HICPAC). *Guideline for prevention of catheter-associated urinary tract infections 2009*. Centers for Disease Control and Prevention (CDC); 2010. <http://www.cdc.gov/hicpac/pdf/cauti/cautiguide2009final.pdf>

Hill TC, Baverstock R, Carlson KV, et al. Best practices for the treatment and prevention of urinary tract infection in the spinal cord injured population: The Alberta context. *Can Urol Assoc.J.* 2013; 7 (3-4): 122-130. doi: 10.5489/cuaj.337. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3650772/>

\*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.* 2010; 50 (5): 625-663. <http://cid.oxfordjournals.org/content/50/5/625.long>

Institute for Healthcare Improvement (IHI). *How-to Guide: Prevent catheter-associated urinary tract infections*. Cambridge, MA: IHI; 2011. <http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventCatheterAssociatedUrinaryTractInfection.aspx>

The Joint Commission. Surgical Care Improvement Project (SCIP). SCIP-Inf-9: Urinary catheter removed on postoperative day 1 (POD 1) or postoperative day 2 (POD 2) with day or surgery being day zero. *Specifications manual for national hospital inpatient quality measures*. Joint Commission; 2013. <http://www.hospitalsafetyscore.org/media/file/SCIPINF9.pdf>

Saskatchewan Infection Prevention and Control Program. *Guidelines for the prevention and treatment of urinary tract infections (UTIs) in continuing care settings*. Government of Saskatchewan Ministry of Health; 2013.

Toward Optimized Practice (TOP). *Diagnosis and management of urinary tract infection in long term care facilities: Clinical practice guideline*. Edmonton, AB: TOP; 2015. [http://www.topalbertadoctors.org/cpgs/?sid=15&cpg\\_cats=66](http://www.topalbertadoctors.org/cpgs/?sid=15&cpg_cats=66)

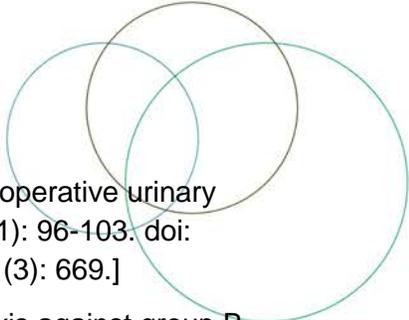
### Additional Resources for Prevention of UTI

Barnoiu OS, Sequeira-Garcia Del Moral J, Sanchez-Martinez N, Diaz-Molina P, Flores-Sirvent L, Baena-Gonzalez V. American cranberry (proanthocyanidin 120mg): Its value for the prevention of urinary tracts infections after ureteral catheter placement. *Actas Urol Esp.* 2015; 39 (2): 112-117. doi: 10.1016/j.acuro.2014.07.003.

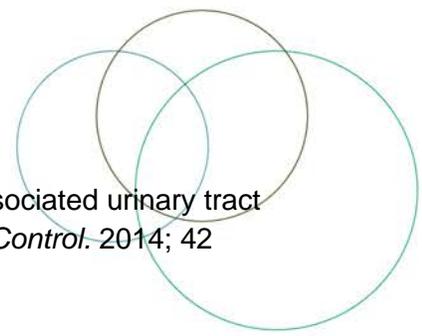
Chenoweth CE, Gould CV, Saint S. Diagnosis, management, and prevention of catheter-associated urinary tract infections. *Infect Dis Clin North Am.* 2014; 28 (1): 105-119. doi: 10.1016/j.idc.2013.09.002.

Chenoweth CE, Saint S. Urinary tract infections. *Infect Dis Clin North Am.* 2011; 25 (1): 103-115. doi: 10.1016/j.idc.2010.11.005.



- 
- Dieter AA, Amundsen CL, Edenfield AL, et al. Oral antibiotics to prevent postoperative urinary tract infection: a randomized controlled trial. *Obstet Gynecol.* 2014; 123 (1): 96-103. doi: 10.1097/AOG.000000000000024. [Erratum, *Obstet Gynecol.* 2014; 123 (3): 669.]
- Dumas AM, Girard R, Ayzac L, et al. Effect of intrapartum antibiotic prophylaxis against group B streptococcal infection on comparisons of rates of endometritis and urinary tract infection in multicenter surveillance. *Infect Control Hosp Epidemiol.* 2008; 29 (4): 327-332. doi: 10.1086/529210.
- Evron S, Dimitrochenko V, Khazin V, et al. The effect of intermittent versus continuous bladder catheterization on labor duration and postpartum urinary retention and infection: a randomized trial. *J Clin Anesth.* 2008; 20 (8): 567-572. doi: 10.1016/j.jclinane.2008.06.009.
- \*Fakih, MG, George C, Edson BS, Goeschel CA, Saint, S. Implementing a national program to reduce catheter-associated urinary tract infection: a quality improvement collaboration of state hospital associations, academic medical centers, professional societies, and governmental agencies. *Infect Control Hosp Epidemiol.* 2013; 34 (10): 1048-1054. doi: 10.1086/673149.
- Fakih MG, Krein SL, Edson B, Watson SR, Battles JB, Saint S. Engaging health care workers to prevent catheter-associated urinary tract infection and avert patient harm. *Am J Infect Control.* 2014; 42 (10 Suppl): S223-S229. doi: 10.1016/j.ajic.2014.03.355.
- Fink R, Gilmartin H, Richard A, Capezuti E, Boltz M, Wald H. Indwelling urinary catheter management and catheter-associated urinary tract infection prevention practices in Nurses Improving Care for Healthsystem Elders hospitals. *Am J Infect Control.* 2012; 40 (8): 715-720. doi: 10.1016/j.ajic.2011.09.017.
- Gamage B, Varia M, Litt M, Pugh S, Bryce E. Finding the gaps: an assessment of infection control surveillance needs in British Columbia acute care facilities. *Am J Infect Control.* 2008; 36 (10): 706-710. doi: 10.1016/j.ajic.2008.06.004.
- Hsu V. Prevention of health care-associated infections. *Am Fam Physician.* 2014; 90 (6): 377-82. <http://www.aafp.org/afp/2014/0915/p377.html>
- Kachare SD, Sanders C, Myatt K, Fitzgerald TL, Zervos EE. *Toward eliminating catheter-associated urinary tract infections in an academic health center.* *J Surg Res.* 2014; 192 (2): 280-285. doi: 10.1016/j.jss.2014.07.045
- Maharaj D. Puerperal pyrexia: a review. Part I. *Obstet Gynecol Surv.* 2007; 62 (6): 393-399.
- Maharaj D. Puerperal Pyrexia: a review. Part II. *Obstet Gynecol Surv.* 2007; 62 (6): 400-6.
- Saint S, Fowler KE, Sermak K, et al. Introducing the No Preventable Harms campaign: Creating the safest health care system in the world, starting with catheter-associated urinary tract infection prevention. *Am J Infect Control.* 2015; 43 (3): 254-259. doi: 10.1016/j.ajic.2014.11.016. <http://www.ajicjournal.org/article/S0196-6553%2814%2901356-X/abstract>





Saint S, Gaies E, Fowler KE, Harrod M, Krein SL. Introducing a catheter-associated urinary tract infection (CAUTI) prevention guide to patient safety (GPS). *Am J Infect Control*. 2014; 42 (5): 548-50. doi: 10.1016/j.ajic.2013.12.019.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4006283/>

Salvatore S, Salvatore S, Cattoni E, et al. Urinary tract infections in women. *Eur J Obstet Gynecol Reprod Biol*. 2011; 156 (2): 131-136. doi: 10.1016/j.ejogrb.2011.01.028.

Shuman EK, Chenoweth CE. Recognition and prevention of healthcare-associated urinary tract infections in the intensive care unit. *Crit Care Med*. 2010; 38 (8 Suppl): S373-S379. doi: 10.1097/CCM.0b013e3181e6ce8f.

Wagenlehner FM, Cek M, Naber KG, Kiyota H, Bjerklund-Johansen TE. Epidemiology, treatment and prevention of healthcare-associated urinary tract infections. *World J Urol*. 2012; 30 (1): 59-67. doi: 10.1007/s00345-011-0757-1.

### **Nursing Interventions for the Prevention of UTI**

Alexaitis I, Broome B. Implementation of a nurse-driven protocol to prevent catheter-associated urinary tract infections. *J Nurs Care Qual*. 2014; 29 (3): 245-252. doi: 10.1097/NCQ.0000000000000041.

Fuchs MA, Sexton DJ, Thornlow DK, Champagne MT. Evaluation of an evidence-based, nurse-driven checklist to prevent hospital-acquired catheter-associated urinary tract infections in intensive care units. *J Nurs Care Qual*. 2011; 26 (2): 101-109. doi: 10.1097/NCQ.0b013e3181fb7847.

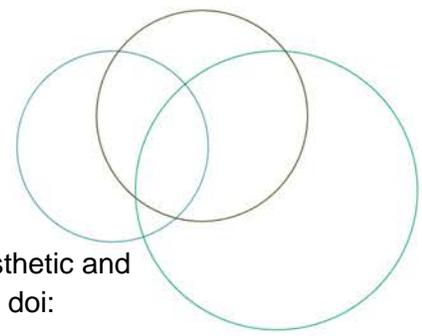
Oman KS, Makic MB, Fink R, et al. Nurse-directed interventions to reduce catheter-associated urinary tract infections. *Am J Infect Control*. 2012; 40 (6): 548-553. doi: 10.1016/j.ajic.2011.07.018.

\*Parry MF, Grant B, Sestovic M. Successful reduction in catheter-associated urinary tract infections: focus on nurse-directed catheter removal. *Am J Infect Control*. 2013; 41 (12): 1178-1181. doi: 10.1016/j.ajic.2013.03.296.

Willson M, Wilde M, Webb ML, et al. Nursing interventions to reduce the risk of catheter-associated urinary tract infection: part 2: staff education, monitoring, and care techniques. *J Wound Ostomy Continence Nurs*. 2009; 36 (2): 137-154. doi: 10.1097/01.WON.0000347655.56851.04.

Wan H, Hu S, Thobaben M, Hou Y, Yin T. Continuous primary nursing care increases satisfaction with nursing care and reduces postpartum problems for hospitalized pregnant women. *Contemp Nurse*. 2011; 37 (2): 149-59. doi: 10.5172/conu.2011.37.2.149.

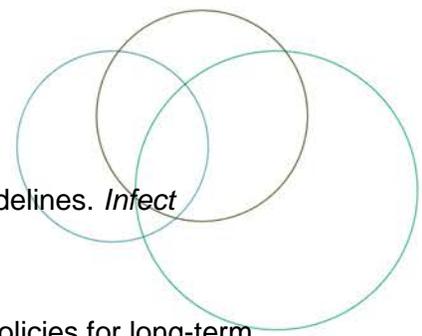




## Catheter Use

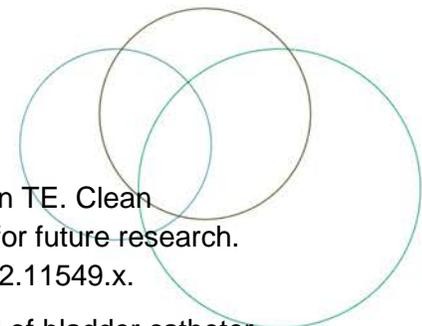
- Baldini G, Bagry H, Aprikian A, Carli F. Postoperative urinary retention: anesthetic and perioperative considerations. *Anesthesiology*. 2009; 110 (5): 1139-1157. doi: 10.1097/ALN.0b013e31819f7aea.  
<http://anesthesiology.pubs.asahq.org/article.aspx?articleid=1924171>
- Bernard MS, Hunter KF, Moore KN. A review of strategies to decrease the duration of indwelling urethral catheters and potentially reduce the incidence of catheter-associated urinary tract infections. *Urol Nurs*. 2012; 32 (1): 29-37.
- Chenoweth C, Saint S. Preventing catheter-associated urinary tract infections in the intensive care unit. *Crit Care Clin*. 2013; 29 (1): 19-32. doi: 10.1016/j.ccc.2012.10.005.
- Feneley RC, Kunin CM, Stickler DJ. An indwelling urinary catheter for the 21st century. *BJU Int*. 2012; 109 (12): 1746-1749. doi: 10.1111/j.1464-410X.2011.10753.x.  
<http://onlinelibrary.wiley.com/doi/10.1111/j.1464-410X.2011.10753.x/abstract;jsessionid=ECF7516D59CF56C08FD08C74015FEF6B.f04t01>
- Healy EF, Walsh CA, Cotter AM, Walsh SR. Suprapubic compared with transurethral bladder catheterization for gynecologic surgery: a systematic review and meta-analysis. *Obstet Gynecol*. 2012; 120 (3): 678-687. doi: 10.1097/AOG.0b013e3182657f0d.
- \*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 (6): 816-820. doi: 10.1007/s11606-008-0620-2.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2517898/>
- Lusardi G, Lipp A, Shaw C. Antibiotic prophylaxis for short-term catheter bladder drainage in adults. *Cochrane Database Syst.Rev*. 2013; 7: CD005428. doi: 10.1002/14651858.CD005428.pub2.
- Marschall J, Carpenter CR, Fowler S, Trautner BW, CDC Prevention Epicenters Program. Antibiotic prophylaxis for urinary tract infections after removal of urinary catheter: meta-analysis. *BMJ*. 2013; 346: f3147. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3678514/> [Erratum in *BMJ*. 2013; 347: f5325].
- \*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 (5): 550-560. doi: 10.1086/655133.  
<http://cid.oxfordjournals.org/content/51/5/550.long>
- Newman DK, Willson MM. Review of intermittent catheterization and current best practices. *Urol Nurs*. 2011; 31 (1): 12-28, 48.
- Nicolle LE. Catheter associated urinary tract infections. *Antimicrob Resist Infect Control*. 2014; 3: 23. doi: 10.1186/2047-2994-3-23. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4114799/>





- Nicolle LE. Catheter-acquired urinary tract infection: the once and future guidelines. *Infect Control Hosp Epidemiol.* 2010; 31 (4): 327-329. doi: 10.1086/651092. <http://www.jstor.org/stable/10.1086/651092>
- Niel-Weise BS, van den Broek PJ, da Silva EM, Silva LA. Urinary catheter policies for long-term bladder drainage. *Cochrane Database Syst Rev.* 2012; 8: CD004201. doi: 10.1002/14651858.CD004201.pub3.
- Owen RM, Perez SD, Bornstein WA, Sweeney JF. Impact of surgical care improvement project inf-9 on postoperative urinary tract infections: do exemptions interfere with quality patient care? *Arch Surg.* 2012; 147 (10): 946-953. doi: 10.1001/archsurg.2012.1485.
- Pickard R, Lam T, Maclennan G, et al. Types of urethral catheter for reducing symptomatic urinary tract infections in hospitalised adults requiring short-term catheterisation: multicentre randomised controlled trial and economic evaluation of antimicrobial- and antiseptic-impregnated urethral catheters (the CATHETER trial). *Health Technol Assess.* 2012; 16 (47): 1-197. doi: 10.3310/hta16470. <http://www.journalslibrary.nihr.ac.uk/hta/volume-16/issue-47>
- Pickard R, Lam T, Maclennan G, et al. Antimicrobial catheters for reduction of symptomatic urinary tract infection in adults requiring short-term catheterisation in hospital: a multicentre randomised controlled trial. *Lancet.* 2012; 380 (9857): 1927-1935. doi: 10.1016/S0140-6736(12)61380-4. <http://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2812%2961380-4/abstract>
- Rebmann T, Greene LR. Preventing catheter-associated urinary tract infections: An executive summary of the Association for Professionals in Infection Control and Epidemiology, Inc, Elimination Guide. *Am J Infect Control.* 2010; 38 (8): 644-646. doi: 10.1016/j.ajic.2010.08.003.
- Regev-Shoshani G, Ko M, Crowe A, Av-Gay Y. Comparative efficacy of commercially available and emerging antimicrobial urinary catheters against bacteriuria caused by E. coli in vitro. *Urology.* 2011; 78 (2): 334-339. doi: 10.1016/j.urology.2011.02.063.
- Siddiq DM, Darouiche RO. New strategies to prevent catheter-associated urinary tract infections. *Nat Rev Urol.* 2012; 9 (6): 305-314. doi: 10.1038/nrurol.2012.68.
- Tambyah PA, Oon J. Catheter-associated urinary tract infection. *Curr Opin Infect Dis.* 2012; 25 (4): 365-370. doi: 10.1097/QCO.0b013e32835565cc.
- Tenke P, Koves B, Johansen TE. An update on prevention and treatment of catheter-associated urinary tract infections. *Curr Opin Infect Dis.* 2014; 27 (1): 102-107. doi: 10.1097/QCO.0000000000000031.
- Weber DJ, Kang J, Brown VM, Sickbert-Bennett EE, Rutala WA. Preventing catheter-associated urinary tract infections: hospital location of catheter insertion. *Infect Control Hosp Epidemiol.* 2012; 33 (10): 1057-1058. doi: 10.1086/667771.





Wyndaele JJ, Brauner A, Geerlings SE, Bela K, Peter T, Bjerklund-Johanson TE. Clean intermittent catheterization and urinary tract infection: review and guide for future research. *BJU Int.* 2012; 110 (11 Pt C): E910-E917. doi: 10.1111/j.1464-410X.2012.11549.x.

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 (6): 542-548.

### Newborn References

Bizzarro MJ. Health care-associated infections in the neonatal intensive care unit: barriers to continued success. *Semin Perinatol.* 2012; 36 (6): 437-44. doi: 10.1053/j.semperi.2012.06.006.

\*\*Bonadio W, Maida G. Urinary tract infection in outpatient febrile infants younger than 30 days of age: a 10-year evaluation. *Pediatr Infect Dis J.* 2014; 33 (4): 342–344. doi: 10.1097/INF.0000000000000110.

\*\*Braga LH, Farrokhyar F, D’Cruz J, Pemberton J, Lorenzo AJ. Risk factors for febrile urinary tract infection in children with prenatal hydronephrosis: A prospective study. *J Urol.* 2015; 193 (5 Suppl): 1766–1771. doi: 10.1016/j.juro.2014.10.091.

Davis KF, Colebaugh AM, Eithun BL, et al. Reducing catheter-associated urinary tract infections: a quality-improvement initiative. *Pediatrics.* 2014; 134 (3): e857-e864. doi: 10.1542/peds.2013-3470. <http://pediatrics.aappublications.org/content/134/3/e857.long>

\*\*Goldman M, Lahat E, Strauss S, et al. Imaging after urinary tract infection in male neonates. *Pediatrics.* 2000;105 (6): 1232–1235.

Graham PL, 3rd. Simple strategies to reduce healthcare associated infections in the neonatal intensive care unit: line, tube, and hand hygiene. *Clin Perinatol.* 2010; 37 (3): 645-653. doi: 10.1016/j.clp.2010.06.005.

\*\*Herz D, Merguerian P, McQuiston L. Continuous antibiotic prophylaxis reduces the risk of febrile UTI in children with asymptomatic antenatal hydronephrosis with either ureteral dilation, high-grade vesicoureteral reflux, or ureterovesical junction obstruction. *J Pediatr Urol.* 2014; 10 (4): 650–654.

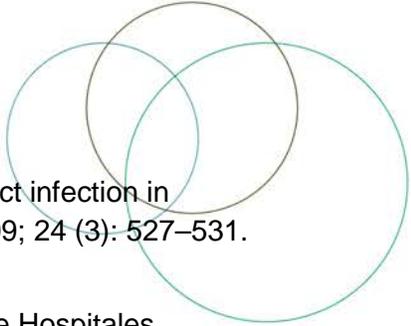
Jagannath VA, Fedorowicz Z, Sud V, Verma AK, Hajebrahimi S. Routine neonatal circumcision for the prevention of urinary tract infections in infancy. *Cochrane Database Syst Rev.* 2012; 11: CD009129. doi: 10.1002/14651858.CD009129.pub2.

Kacker S, Frick KD, Gaydos CA, Tobian AA. Costs and effectiveness of neonatal male circumcision. *Arch Pediatr Adolesc Med.* 2012; 166 (10): 910-8. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3640353/>

\*\*Ismaili K, Lolín K, Damry N, Alexander M, Lepage P, Hall M. Febrile urinary tract infections in 0- to 3-month-old infants: a prospective follow-up study. *J Pediatr.* 2011; 158 (1): 91–94. doi: 10.1016/j.jpeds.2010.06.053.



**HOSPITAL HARM IMPROVEMENT RESOURCE**  
**Urinary Tract Infection**

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- \*\*Levy I, Comarsca J, Davidovits M, Klinger G, Sirota L, Linder N. Urinary tract infection in preterm infants: the protective role of breastfeeding. *Pediatr Nephrol.* 2009; 24 (3): 527–531. doi: 10.1007/s00467-008-1007-7.
- \*\*Sastre JB, Aparicio AR, Cotallo GD, Colomer BF, Hernández MC, Grupo de Hospitales Castrillo. Urinary tract infection in the newborn: clinical and radio imaging studies. *Pediatr Nephrol.* 2007; 22 (10):1735–1741.
- \*\*Tullus K. Vesicoureteric reflux in children. *Lancet.* 2015; 385 (9965): 371–379. doi: 10.1016/S0140-6736(14)60383-4.

