



衛生防護中心
Centre for Health Protection

Recommendations on Prevention of Catheter-associated Urinary Tract Infection

2nd Edition

**Scientific Committee on Infection Control, and
Infection Control Branch, Centre for Health Protection,
Department of Health**



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Background

The Recommendations on Prevention of Catheter-associated Urinary Tract Infection (CAUTI) represent the third accomplishment of The Scientific Committee on Infection Control (SCIC) in the promulgation of preventive measures for the four major systems - namely, surgical site infection, intravascular catheter associated bloodstream infection, ventilator-associated pneumonia and catheter-associated urinary tract infection. It is believed that the recommendations presented in this report will provide guidance on good practice for the prevention of Catheter-associated Urinary Tract Infection, which would ideally set the standard of care in Hong Kong.

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Recommendations on Prevention of Catheter-associated Urinary Tract Infection

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Introduction

Urinary catheter is a commonly used device for different patients in various healthcare settings. Their use may put patients at increased risk of catheter-associated urinary tract infection (CAUTI). Indwelling urinary catheter, as a foreign body, allows bacteria to colonize and enter the body. It is well established that the duration of catheterization is directly related to risk for developing a CAUTI. With a catheter in place, the daily risk of developing bacteriuria ranges from 3% to 7%. (1) CAUTIs account for a significant proportion (up to 30-40%) of healthcare-associated infections which in turn may have great financial impact to the healthcare system. (2-4)

Other non-infective negative outcomes associated with catheter use include nonbacterial urethral inflammation, urethral strictures, mechanical trauma, patient discomfort and mobility impairment. (1)

2. The most effective strategy to prevent CAUTI is prompt removal of unnecessary urinary catheters. If the use of catheter is deemed necessary, care should be taken to minimize unnecessary manipulation, prevent trauma and maintain a closed, patent and non-kinked system. Further well-designed studies are needed to generate high quality evidence regarding types and techniques of catheterization. (5-8)

3. This recommendation provides the principles for best practice of urinary catheter care to healthcare professionals. It can serve as a model in formulation of strategies, programmes and plans for prevention of CAUTIs in individual institutions.

1. Education, Training and Competence Assessment

- 1.1 Educate staff on the preventive insertion and maintenance measures of CAUTIs in the orientation program and the in-service refresher training. (1,3,9–12)
- 1.2 Ensure health care personnel, who are involved in urinary catheter insertion or care, are trained and competent to perform the procedure with aseptic technique. (1,3,9–14)
- 1.3 Keep an updated written Standard Operating Procedures (SOP) on urinary catheter care. (1,12,15)
- 1.4 Provide clear instruction to patients and caregivers on proper care of the urinary catheter and drainage system. (11,16)

2. Avoid Unnecessary Urinary Catheterization

- 2.1 Limit the use of indwelling urinary catheters to patients with strong clinical indication and that the benefits outweigh the risks of CAUTI and its complications. (3,13–21)
- 2.2 **Do not use** indwelling urinary catheter for the following purposes: (13)
 - 2.2.1 as a means to obtain urine specimen when the patient can void voluntarily.
 - 2.2.2 as a substitute for nursing care in incontinent patients.
- 2.3 **Restrict** the use of indwelling urinary catheter for the following purposes (1,3,10,16,20,22,23)
 - 2.3.1 to relieve urinary obstruction and/or acute urinary retention.
 - 2.3.2 to monitor urine output in critically ill patients, where calculation of input and output is important.
 - 2.3.3 to aid in urologic surgery.
 - 2.3.4 in urinary incontinent patients with open wounds or skin graft in the sacral and/or perineal area.
 - 2.3.5 in terminally ill patients, as request for comfort care.
- 2.4 Consider use of alternative methods with lower infection risk, such as suprapubic catheterization, condom catheters, intermittent urethral catheterization, or use of disposable nappies as far as possible in appropriate patients. (1,3,11,13–19,21)

Condom catheter is appropriate for non-cognitively impaired male patients with minimal post-void residual urine. (24)

- 2.5 Use of bedside ultrasound to assess post-voiding residual volume can prevent a significant proportion of patients (including post-operative) from unnecessary catheterization. (1,3,11,24). Efforts should be initiated to train doctors and nurses to use bedside ultrasound.

3. Shorten the Duration of Indwelling Urinary Catheterization

Establish a system to ensure the urinary catheter is removed promptly when it is no longer indicated. (1,3,4,10,11,13,14,17,19,22,25–27)

- 3.1 Develop evidence-based criteria for indications of continuous urinary catheterization. (1,3)
- 3.2 Assess and document clearly the indication for continuous urinary catheterization on daily basis. (1,3) Educate all healthcare personnel and then use reminders (electronic or paper) of presence of urinary catheter and criteria for continued use for physicians and nurses. (1)
- 3.3 Nurse to remind physician to remove the catheter if it is no longer indicated. Physician should document justification for continued use if indication not meeting listed criteria. (1,3)
- 3.4 Consider use of automatic urinary catheter stop order whenever applicable. (1,3)
- 3.5 Restrict indications for placement or duration of catheterization are major components to prevent CAUTI. Routine use of indwelling bladder catheters for surgical procedures of short duration, such as caesarean section is not recommended. (1,28,29)

4. Proper Hand Hygiene and Using of Gloves

- 4.1 Practice hand hygiene immediately before insertion of the catheter and before and after any manipulation of the catheter site or apparatus. (1,3,9,10,13,16)
- 4.2 Decontaminate hands and wear a new pair of clean gloves before manipulating each patient's catheter. Sterile gloves must be worn for catheter insertion. (1,3,11,13,15)
- 4.3 Change gloves between patients to prevent cross-infection. (15,16)

5. Aseptic Urinary Catheter Insertion

- 5.1 Ensure the catheter is inserted by trained and competent persons (e.g. health care workers, family members or patients). (12–14,16,19,21)
- 5.2 Maintain aseptic technique during catheter insertion. (1,10,13,14,16)
- 5.3 Use sterile equipment and supplies: use single-use packet of sterile lubricant jelly, sterile urinary catheter, sterile gloves and sterile drape. (1,3,12–14) Do not reprocess/sterilize used urinary catheters for re-use. (12)
- 5.4 Use appropriate antiseptic solution to clean the peri-urethral skin thoroughly before insertion. (1,3,10,13,14)
- 5.5 Minimize the risk of urethral trauma
 - 5.5.1 Use the smallest possible size, good drainage urinary catheter unless otherwise clinically indicated. (1,10,11,13,15,16)
 - 5.5.2 Apply adequate lubricant on the catheter before insertion. (1,10,11,13,15,16)
 - 5.5.3 Ensure the catheter is always firmly secured to prevent in-and-out movement and urethral traction to decrease catheter dislodgement and meatal erosion. (1,3,13,21,30,31)

6. Maintain Unobstructed Urine Flow

- 6.1 Prevent kinking or sagging of the urinary catheter to ensure unobstructed flow of urine. (3,9,10,13)
- 6.2 Prevent retrograde flow of urine from collection bag to the bladder.
 - 6.2.1 Keep the drainage bag below the level of bladder and connecting tube at all times. The outlet should never rest on the floor. (3,9,11,13,32)
 - 6.2.2 Clamp the drainage tube before raising the drainage bag above bladder level. (12)
 - 6.2.3 Do not allow the drainage bag to be overfilled (never more than three-quarters full). (3,11,33)

7. Maintain a Sterile and Closed Urinary Drainage System

- 7.1 Minimize opening and manipulating the catheter and the drainage system. (1,3,10,11,13,14,16,19)
- 7.2 Do not re-use the drainage bag. (12)
- 7.3 During emptying of the drainage bag:
 - 7.3.1 Use a designated urine-collecting container for each patient.

- Disinfect the container and keep it dry after each use. (3,10–12,33,34)
- 7.3.2 Perform hand hygiene and wear clean gloves for the procedure. (11,12,33) Gloves should be removed and hand hygiene should be performed immediately afterwards. (11)
- 7.3.3 Disinfect the outlet of the drainage bag with alcohol before and after each opening. (9,33)
- 7.3.4 Prevent the outlet of drainage bag from touching the collecting container while emptying. (3,13,33)
- 7.4 Changing of urinary bag:
 - 7.4.1 Change the urinary drainage bag according to the manufacturer's recommendation and/or when the urinary catheter is changed or the bag leaks. (17)
 - 7.4.2 Follow the manufacturer's recommendation on frequency of changing of catheter valve. (33)
 - 7.4.3 Disinfect the catheter-tubing junction before disconnecting the drainage system. (10)

8. Individualized Catheter Change Intervals

- 8.1 Do not change the urinary catheter at routine, fixed intervals for all patients. (3,10,11,13) The optimal time for changing the urinary catheter depends on the manufacturers' instructions and patients' characteristics. Some patients form deposits in the catheter lumen quicker than others and they may require more frequent catheter changes. (12,33,35) It is preferable to change the catheter before blockage is anticipated to occur. (15,33,36)
- 8.2 Replace the catheter whenever it is contaminated, e.g. accidental opening. (21)

9. Good Meatal Care

- 9.1 Routine daily cleansing with soap and water is adequate to maintain good hygiene of the meatal area. Use of antiseptic solution is unnecessary. (1,3,10–13,37)
- 9.2 Keep the peri-urethral area clean and dry. (12)
- 9.3 Remove gross debris from the catheter tubing during bathing or showering. (3,11,14,33)
- 9.4 Additional cleansing is indicated for patients with diarrhoea or incontinence. (19)

10. Aseptic Urine Specimen Collection

- 10.1 Apply aseptic technique; perform hand hygiene and wear clean gloves for urine collection. (3,33)
- 10.2 To collect a small volume urine sample or urine for culture:
- 10.2.1 Disinfect the sampling port or distal end* of the urinary catheter with appropriate disinfectant (70% alcohol) and allow time (>30 seconds) for the disinfectant to dry/work before puncture. (1,9,12)
*Never puncture silicone urinary catheters with a needle as it cannot reseal over the puncture holes. (21)
 - 10.2.2 Use a sterile small size syringe to aspirate urine. (10,12,13)
- 10.3 Follow point 7.3 aseptic procedures for collecting large volume urine sample from urinary drainage bag, e.g. urine electrolytes analysis. (9,10,13) However, collecting the urine sample from the drainage bag is unsuitable for culture purposes.

11. Avoid Bladder Washout

- 11.1 Do not perform bladder washout or irrigation as a means to prevent infection. (3,10–13,33)
- 11.2 Remove and replace a blocked catheter rather than attempting bladder washout. (12,13,33)
- 11.3 When bladder irrigation is necessary, e.g., prevention of blood clot formation after bladder or prostate surgeries:
- 11.3.1 Perform the procedure in a closed irrigation and drainage system with a three-way catheter to decrease the frequency of opening. (10)
 - 11.3.2 Use sterile irrigation solutions and administration set.
 - 11.3.3 Manipulate the system with aseptic technique. Before each change or disconnection, thoroughly disinfect the junction with alcohol and allow it to dry. (10)
- 11.4 Ensure adequate hydration in patients with indwelling urinary catheters to dilute the urine and make it acidic to prevent or dissolve the encrustation. (33)

12. Role of Antimicrobial Agents

- 12.1 Routine prophylactic antibiotics for urinary catheterization are not

recommended, as it increases the risk of emergence of antimicrobial-resistant bacteria. (1,15)

12.2 Routine antibiotics for asymptomatic catheter-associated bacteriuria is not recommended as it promotes antimicrobial resistance and *C. difficile* infection, unless in high risk patients such as pregnant women or before urological surgery in which visible mucosal bleeding is anticipated. (1,21,24,28)

12.3 Routine application of topical antibiotics to the catheter, urethra or meatus is not recommended. (15)

12.4 Addition of antibacterial solutions to drainage bags is not recommended. (15,37)

13. Type of Catheter

13.1 Select the type and gauge of urinary catheter based on assessment of the patient's individual characteristics including age, allergy history, gender, history of UTI, patient's preference, previous catheter history and reason of catheterization. (38)

13.2 Use of antimicrobial impregnated or antiseptic-coated urinary catheter as an infection preventive measure is not routinely recommended. (6,7,15,38–43). These catheters should only be considered if the CAUTI rate does not decrease after implementing a comprehensive CAUTI prevention bundle. (3,7,13,16)

14. Documentation and Monitoring

14.1 Maintain proper documentation in the patient's medical record on clinical parameters, such as the need for catheterization, who inserted the catheter, the date and time of catheter insertion, care and removal of catheter. (1,3,10,17) This is important for all patients, but particularly important at the time of patient discharge or transfer. (11)

14.2 Monitor all urinary catheterized patients for signs and symptoms of CAUTI.

15. Surveillance and Quality Improvement Programs

15.1 Maintain a surveillance system to monitor for symptomatic CAUTI. CAUTI rate is usually reported as per 1,000 catheter-days. (3,11,18,44)

Analysis of surveillance data should take into account that when the use of urinary catheters is reduced, CAUTI rate may paradoxically increase. (1)

- 15.2 Routine bacteriologic monitoring in urinary catheterized patients is not recommended as an infection control measure. (10,13,14,24)
- 15.3 Regularly feedback of performance measures and surveillance results to physicians, nurses and the hospital or nursing management. (1,3,33,45,46) Performance measures include:
 - 15.3.1 Compliance with documentation of catheter insertion & removal date.
 - 15.3.2 Compliance with documentation of indication for catheter placement.
 - 15.3.3 Compliance with the standard procedure.
 - 15.3.4 Compliance with CAUTI prevention bundle.
- 15.4 Continue to identify chances of quality improvement on CAUTI. (1,3,5,16,33,47) Use CAUTI PREVENTION BUNBLE to reduce urinary catheter utilization and its complications. (1,3,11,16)
- 15.5 Use standardized criteria, such as NHSN definitions or clinical criteria, to identify patients who have a CAUTI.(1,3,13,48–51)

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Appendix I: Hong Kong Bundle to Prevent CAUTI

1. The indication for urinary catheter needs to be reviewed daily
2. Nurse to remind physician stop catheter when no longer indicated
3. Implement auto-stop reminder whenever applicable
4. Observe hand hygiene before and after urinary catheter care and use aseptic technique for insertion of catheter
5. Consider using bedside ultrasound to screen for post-voiding residual urine volume before insertion of catheter in selected groups of patients

Appendix II: Reminder to wean off Indwelling Urinary Catheter (IUC) - Sample

Patient Gum Label

Date of insertion of catheter (day 0): _____

Please tick the indication(s) of IUC for this patient daily. If none of the indications is present, the catheter should be removed.

| Indication | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|-------|-------|-------|-------|-------|-------|-------|
| To relieve urinary obstruction and/or acute urinary retention | | | | | | | |
| To monitor urine output in critically ill patients | | | | | | | |
| To aid in urologic surgery | | | | | | | |
| Patient has urinary incontinence with open wounds and/or skin graft in sacral or perineal areas | | | | | | | |
| To improve comfort for terminally ill patient | | | | | | | |
| Staff Signature (Physician/Nurse) | | | | | | | |

Remark: Use a new form if continuous urinary catheterization is indicated.

References

1. Lo E, Nicolle LE, Coffin SE, Gould C, Maragakis LL, Meddings J, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2014 May;35(5):464–79.
2. Burke J, Pombo D. Nosocomial urinary tract infections. In: Mayhall CG, editor. *Hospital epidemiology and infection control*. 4th ed. Baltimore: William & Wilkins; 2012. p.270-85
3. Institute for Healthcare Improvement. How-to Guide: Prevent Catheter-Associated Urinary Tract Infection [Internet]. 2011 [updated 2011 Dec 31; cited 2016 Dec 15]. Available from: <http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventCatheterAssociatedUrinaryTractInfection.aspx>
4. Niël-Weise BS, van den Broek PJ, da Silva EMK, Silva LA. Urinary catheter policies for long-term bladder drainage. *Cochrane Database Syst Rev*. 2012 Aug 15;(8): DOI: 10.1002/14651858.CD004201.pub3.
5. 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 Apr 19;(2): DOI: 10.1002/14651858.CD004374.pub2.
6. Jahn P, Beutner K, Langer G. Types of indwelling urinary catheters for long-term bladder drainage in adults. *Cochrane Database Syst Rev*. 2012 Oct 17;10: DOI: 10.1002/14651858.CD004997.pub3.
7. Lam TBL, Omar MI, Fisher E, Gillies K, MacLennan S. Types of indwelling urethral catheters for short-term catheterisation in hospitalised adults. *Cochrane Database Syst Rev*. 2014 Sep 23;(9): DOI: 10.1002/14651858.CD004013.pub4.
8. Prieto J, Murphy CL, Moore KN, Fader M. Intermittent catheterisation for long-term bladder management. *Cochrane Database Syst Rev*. 2014 Sep 10;(9): DOI: 10.1002/14651858.CD006008.pub3.
9. Leone M, Garnier F, Avidan M, Martin C. Catheter-associated urinary tract infections in intensive care units. *Microbes Infect*. 2004 Sep;6(11):1026–32.
10. Canada Department of National Health and Welfare. *Infection Control Guidelines: Prevention of catheter associated urinary tract infections*. 1988. p.53-62
11. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3: national evidence-based guidelines for preventing healthcare-associated

- infections in NHS hospitals in England. *J Hosp Infect.* 2014 Jan;86 Suppl 1:S1-70.
12. Damani NN. Prevention of infections associated with urinary catheterization. *Manual of Infection Control Procedures.* 2nd ed. London: Greenwich Medical Media; 2003. p.273-82
 13. Centers for Disease Control and Prevention. Guideline for prevention of catheter-associated urinary tract infections 2009 [Internet]. 2009 [cited 2009 Dec 09]. Available from: <https://www.cdc.gov/hai/pdfs/cautiguide2009final.pdf>
 14. Department of Health. Guidelines for preventing infections associated with the insertion and maintenance of short-term indwelling urethral catheters in acute care. *J Hosp Infect.* 2001;47 Suppl 1:S36–43.
 15. Tenke P, Kovacs B, Bjerklund Johansen TE, Matsumoto T, Tambyah PA, Naber KG. European and Asian guidelines on management and prevention of catheter-associated urinary tract infections. *Int J Antimicrob Agents.* 2008 Feb;31 Suppl 1:S68-78.
 16. Health Protection Scotland, National Health Services. Bundle for preventing infection when inserting and maintaining a Urinary Catheter (acute settings). Version 1.0 [Internet]. 2013 [cited 2016 Dec 15]. Available from: <http://www.documents.hps.scot.nhs.uk/hai/infection-control/bundles/cauti/uc-acute-v1.pdf>
 17. Pellowe CM, Pratt RJ, Harper P. Prevention of healthcare –associated infection in primary and community care. *J Hosp Infect.* 2003;55(S2):1–27.
 18. Nicolle LE, SHEA Long-Term-Care-Committee. Urinary tract infections in long-term-care facilities. *Infect Control Hosp Epidemiol.* 2001 Mar;22(3):167–75.
 19. Salgado C, Karchmer T, Farr, BM. Prevention of catheter-associated urinary tract infections. In: Wenzel, RP, editor. *Prevention and control of nosocomial infections.* 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2003.
 20. Apisarnthanarak A, Rutjanawech S, Wichansawakun S, Ratanabunjerdkul H, Patthranitima P, Thongphubeth K, et al. Initial inappropriate urinary catheters use in a tertiary-care center: Incidence, risk factors, and outcomes. *Am J Infect Control.* 2007 Nov;35(9):594–9.
 21. Castle, M, Ajemian, E. Nosocomial urinary tract infections. In *Hospital Infection Control Principles and Practice.* 2nd ed. New York: John Wiley & Sons; 1980. p.80-95

22. Jain P, Parada JP, David A, Smith LG. Overuse of the indwelling urinary tract catheter in hospitalized medical patients. *Arch Intern Med.* 1995 Jul 10;155(13):1425–9.
23. Ireland Health Service Executive. Guidelines for the prevention of catheter associated urinary tract infection. Published on behalf of Strategy for the Control of Antimicrobial Resistance in Ireland (SARI) by Health Protection Surveillance Centre 2011[Internet]. 2011 [cited 2016 Dec 15]. Available from: <https://www.hpsc.ie/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Guidelines/File,12913,en.pdf>
24. Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, 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 Off Publ Infect Dis Soc Am.* 2010 Mar 1;50(5):625–63.
25. Saint S, Wiese J, Amory JK, Bernstein ML, Patel UD, Zemencuk JK, et al. Are Physicians Aware Of Which of Their Patients Have Indwelling Urinary Catheters? *Am J Med.* 2000 Oct 15;109(6):476–80.
26. Huang WC, Wann SR, Lin SL, Kunin CM, Kung MH, Lin CH, et al. Catheter-associated urinary tract infections in intensive care units can be reduced by prompting physicians to remove unnecessary catheters. *Infect Control Hosp Epidemiol.* 2004 Nov;25(11):974–8.
27. 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 Nov;67(3):253–7.
28. El-Mazny A, El-Sharkawy M, Hassan A. A prospective randomized clinical trial comparing immediate versus delayed removal of urinary catheter following elective cesarean section. *Eur J Obstet Gynecol Reprod Biol.* 2014 Oct;181:111–4.
29. Li L, Wen J, Wang L, Li YP, Li Y. Is routine indwelling catheterisation of the bladder for caesarean section necessary? A systematic review. *BJOG Int J Obstet Gynaecol.* 2011 Mar;118(4):400–9.
30. Viant AC, Linton KB, Gillespie WA, Midwinter A. Improved method for preventing movement of indwelling catheters in female patients. *Lancet Lond Engl.* 1971 Apr 10;1(7702):736–7.
31. 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 Nov;34(9):555–60.

32. European Association of Urology. Guidelines on urological infections [Internet]. 2015 [updated 2015 Mar 30; cited 2016 Dec 15]. Available from: <http://uroweb.org/wp-content/uploads/EAU-Guidelines-Urological-Infections-v2.pdf>
33. Banfield K. Catheterization and urinary infection. In: Infection Control Science Management and Practice. London, Philadelphia: Whurr Publishers; 2000. p.242-61.
34. Rutala WA, Kennedy VA, Loflin HB, Sarubbi FA. *Serratia marcescens* nosocomial infections of the urinary tract associated with urine measuring containers and urinometers. *Am J Med.* 1981 Mar;70(3):659–63.
35. Anders, K. The female patient with a catheter. *Womens Health Med.* 2005;2(6):50–3.
36. Evans A, Painter D, Feneley R. Blocked urinary catheters: nurses' preventive role. *Nurs Times.* 2001 Jan 4;97(1):37–8.
37. Lockwood C, Page T, Nurs H, Conroy-Hiller T, Florence Z. Management of short-term indwelling urethral catheters to prevent urinary tract infections. *JBI Reports* 2004;2(8):271-91.
38. National Institute of Health and Care Excellence. Healthcare-associated infections: prevention and control in primary and community care clinical guidelines [CG139] [Internet]. 2012 [cited 2016 Dec 15]. Available from: <https://www.nice.org.uk/guidance/cg139>
39. Stensballe J, Tvede M, Looms D, Lippert FK, Dahl B, Tønnesen E, et al. Infection risk with nitrofurazone-impregnated urinary catheters in trauma patients: a randomized trial. *Ann Intern Med.* 2007 Sep 4;147(5):285–93.
40. 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 Jan 17;144(2):116–26.
41. Srinivasan A, Karchmer T, Richards A, Song X, Perl TM. A prospective trial of a novel, silicone-based, silver-coated foley catheter for the prevention of nosocomial urinary tract infections. *Infect Control Hosp Epidemiol.* 2006 Jan;27(1):38–43.
42. Rupp ME, Fitzgerald T, Marion N, Helget V, Puumala S, Anderson JR, et al. Effect of silver-coated urinary catheters: efficacy, cost-effectiveness, and antimicrobial resistance. *Am J Infect Control.* 2004 Dec;32(8):445–50.
43. Lai KK, Fontecchio SA. Use of silver-hydrogel urinary catheters on the incidence of catheter-associated urinary tract infections in hospitalized patients. *Am J Infect Control.* 2002 Jun;30(4):221–5.

44. Dudeck MA, Edwards JR, Allen-Bridson K, Gross C, Malpiedi PJ, Peterson KD, et al. National Healthcare Safety Network report, data summary for 2013, Device-associated Module. *Am J Infect Control*. 2015 Mar 1;43(3):206–21.
45. Rosenthal VD, Guzman S, Safdar N. Effect of education and performance feedback on rates of catheter-associated urinary tract infection in intensive care units in Argentina. *Infect Control Hosp Epidemiol*. 2004 Jan;25(1):47–50.
46. Saint S, Kowalski CP, Kaufman SR, Hofer TP, Kauffman CA, Olmsted RN, et al. Preventing hospital-acquired urinary tract infection in the United States: a national study. *Clin Infect Dis Off Publ Infect Dis Soc Am*. 2008 Jan 15;46(2):243–50.
47. Goetz AM, Kedzuf S, Wagener M, Muder RR. Feedback to nursing staff as an intervention to reduce catheter-associated urinary tract infections. *Am J Infect Control*. 1999 Oct;27(5):402–4.
48. Bardossy AC, Jayaprakash R, Alangaden AC, Starr P, Abreu-Lanfranco O, Reyes K, et al. Impact and Limitations of the 2015 National Health and Safety Network Case Definition on Catheter-Associated Urinary Tract Infection Rates. *Infect Control Hosp Epidemiol*. 2017 Feb;38(2):239–41.
49. Mullin KM, Kovacs CS, Fatica C, Einloth C, Neuner EA, Guzman JA, et al. A Multifaceted Approach to Reduction of Catheter-Associated Urinary Tract Infections in the Intensive Care Unit With an Emphasis on “Stewardship of Culturing.” *Infect Control Hosp Epidemiol*. 2017 Feb;38(2):186–8.
50. Epstein L, Edwards JR, Halpin AL, Preas MA, Blythe D, Harris AD, et al. Evaluation of a Novel Intervention to Reduce Unnecessary Urine Cultures in Intensive Care Units at a Tertiary Care Hospital in Maryland, 2011-2014. *Infect Control Hosp Epidemiol*. 2016 May;37(5):606–9.
51. Saint S, Greene MT, Krein SL, Rogers MAM, Ratz D, Fowler KE, et al. A Program to Prevent Catheter-Associated Urinary Tract Infection in Acute Care. *N Engl J Med*. 2016 Jun 2;374(22):2111–9.