Preventing Catheter-Associated Urinary Tract Infections (CAUTI) in Acute Care Settings

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No conflicts of interest to disclose

Hosted by Prof. Elaine Larson
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Objectives

- List essential strategies for preventing CAUTI in adults in acute care settings
- Compare and contrast CAUTI prevention guidelines
- Describe gaps in the current evidence base
- Identify challenges in conducting CAUTI surveillance
- Relate CAUTI incidence to antimicrobial resistance

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1. Incidence and Importance
2. Definitions of CAUTI
3. Pathogenesis
4. Guidelines
5. Strategies for Prevention
6. Challenges in Surveillance
7. Gaps in Evidence

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1. **Incidence and Importance**
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Incidence

- Widely considered the most common healthcare-associated infection (HAI) in hospitals[1]
  - Estimated UTI rates in US hospitals 1990-2002
    - >560,000 UTI per year
    - 3.38% of adults and children in ICUs will develop UTI
    - UTI comprise 34% of all HAI
- 80% are catheter-associated[2]
- 25% of patients have a urinary catheter placed at some time during their hospital stay[3]

1. Klevens RM, Edwards JR, Richards CL, Jr., et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep. Mar-Apr 2007;122(2):160-166.
2. Krieger JN, Kaiser DL, Wenzel RP. Urinary tract etiology of bloodstream infections in hospitalized patients. Journal of Infectious Diseases. Jul 1983;148(1): 57-62.
3. Saint S, Wiese J, Amory JK, et al. Are physicians aware of which of their patients have indwelling urinary catheters? Am J Med. Oct 15 2000;109(6): 476-480.

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Newer Prevalence Study

Magill SS, Hellinger W, Cohen J, et al. Prevalence of healthcare-associated infections in acute care hospitals in Jacksonville, Florida. Infect Control Hosp Epidemiol. Mar 2012;33(3):283-291.

- 9 hospitals in the state of Florida
- UTI 2nd most common HAI
- Comprise 15.5% of all HAI in US hospitals
- Reduction may be because asymptomatic bacteriuria was excluded from the National Healthcare Safety Network (NHSN) definition of CAUTI in 2009

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Latest NHSN Report – 2011

Dudeck MA, Horan TC, Peterson KD, et al. National Healthcare Safety Network report, data summary for 2011, device-associated module. Am J Infect Control. Apr 2013;41(4):286-300

- Pooled mean CAUTI rates 0 to >4 per 1,000 catheter days
  – Neurosurgical ICUs (4.5)
  – Burn ICUs (4.1) and wards (4.8)
  – Long-term rehab units (7.1)
- Pooled mean device utilization ratio 3% to >70%
  – Medical-surgical ICUs (54-69%)
  – Neurologic and neurosurgical ICUs (71% and 70%)
  – Trauma ICUs (79%)
  – Long term rehab units (7%)

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SUTI Rates: ICU vs. Ward

Weber DJ et al. Incidence of CAUTI and non-catheter associated UTI in a healthcare system. ICHE 2011;32(8):822-823

- CAUTI rates in step-down units and wards were similar to ICUs
- CAUTI rates in rehab units were especially high
- Non-catheter associated UTI comprised 27.8% of all UTI

TABLE 1. Incidence of Catheter-Associated and Non-Catheter-Associated Symptomatic Urinary Tract Infection by Hospital Service and Location, University of North Carolina, 2006–2009

Hospital unit	No. of CAUTIs	No. of catheter-days	CAUTI rate/1,000 device-days	CAUTI rate, 95% CI	No. of UTIs	No. of patient-days at risk[a]	UTI rate/1,000 patient-days at risk	UTI rate, 95% CI
Medicine ICU	133	35,431	3.75	3.15, 4.43	6	3,069	1.96	0.79, 4.07
Medicine step-down and ward	128	40,323	3.17	2.65, 3.77	84	154,750	0.54	0.44, 0.67
Surgery ICU	300	62,430	4.81	4.28, 5.37	9	8,445	1.07	0.52, 1.96
Surgery step-down and ward	389	88,648	4.39	3.96, 4.85	111	175,667	0.63	0.52, 0.76
Pediatric ICU	50	11,052	4.52	3.39, 5.92	77	72,761	1.06	0.84, 1.32
Pediatric ward	25	5,173	4.83	3.19, 7.03	38	112,788	0.34	0.24, 0.46
Rehabilitation ward	43	4,249	10.12	7.41, 13.51	60	31,478	1.91	1.47, 2.44
Psychiatric ward	NA	NA	NA	NA	26	85,928	0.30	0.20, 0.44
Total	1,068	247,306	4.32	4.06, 4.58	411	644,886	0.64	0.58, 0.70

NOTE. CAUTI, catheter-associated urinary tract infection; CI, confidence interval; UTI, non-catheter-associated urinary tract infection; ICU, intensive care unit; NA, not applicable.
[a] Number of patient-days at risk = total patient-days − total catheter-days.

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International CAUTI Rates

Rosenthal VD, Bijie H, Maki DG, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009. Am J Infect Control. Jun 2012;40(5):396-407.

- International Nosocomial Infection Control Consortium (INICC)
- Data for 2004 – 2009 from 422 ICUs in 36 countries
- Pooled mean 6.3 CAUTI per 1,000 catheter-days
- Compared to US at that time:
  – Similar device utilization ratios (DUR)
  – CAUTI rates significantly higher in INICC
  – More antimicrobial resistance in INICC
    - Methicillin-resistant *S. aureus* (MRSA)
    - Extended-spectrum β-lactamase producers
    - *P. aeruginosa* resistant to fluoroquinolones
    - Less vancomycin-resistant enterococci

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Recent Reduction in INICC Hospitals

Rosenthal VD, Todi SK, Alvarez-Moreno C, et al. Impact of a multidimensional infection control strategy on catheter-associated urinary tract infection rates in the adult intensive care units of 15 developing countries: findings of the International Nosocomial Infection Control Consortium (INICC). Infection. Oct 2012;40(5):517-526.

- Interventional study of hospitals in 40 cities in 15 countries
  – Multidimensional CAUTI prevention strategy included a bundle of measures, education, and surveillance with feedback
  – CAUTI rates declined from 7.86 to 4.95 per 1,000 catheter days (RR=0.63, 95% CI 0.55-0.72)

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Temporal Trends in US Hospitals

Burton DC et al. Trends in CAUTI in Adult ICU US, 1990-2007. ICHE 2011; 32(8):748-756

- 1990-2007 NNIS/NHSN data
  – ICUs: Med-surg, medical, surgical, cardiac, cardiothoracic
- CAUTI rates declined significantly across most ICUs
- **19-67% declines in symptomatic UTI in all types of units**
  – 18-35% between 2000-2007 in all types of units except CT
- 29-72% decline in asymptomatic bacteriuria (ASB) in all types of units
- DUR unchanged

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Morbidity and Cost

- Excess length of stay (LOS)
  – 1 to 2 days extra LOS for symptomatic CAUTI patients[1]
  – 12 days crude excess LOS for ICU patients with CAUTI[2]
- Secondary bacteremia
  – Incidence varies from 4%[1] to 0.4%[3]
- Cost
  – 2009 estimate per CAUTI: US $862 – $1,007[4]
  – 2000 estimate per bacteremic UTI: US $2,836[1]

1. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. Am J Infect Control. 2000;28(1):68-75.
2. Rosenthal VD, Bijie H, Maki DG, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009. Am J Infect Control. Jun 2012;40(5):396-407.
3. Tambyah PA, Maki DG. Catheter-associated urinary tract infection is rarely symptomatic: a prospective study of 1,497 catheterized patients. Archives of Internal Medicine. Mar 13 2000;160(5):678-682.
4. Bryan CS, Reynolds KL. Hospital-acquired bacteremic urinary tract infection: epidemiology and outcome. Journal of Urology. Sep 1984;132 (3):494-498.

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Mortality

- Estimated >13,000 associated deaths/year in the US[1]
- Crude unadjusted excess mortality for patients with CAUTI in INICC was 7.3% (95% CI 5.7 – 9.1)[2]
- Mortality among hospitalized patients with CAUTI OR=2.8 (95%CI 1.5-5.1) after adjusting for age, severity of illness, duration of catheterization and other factors[3,4]
- Mortality due to nosocomial bacteremic UTI 12.7%[5]

1. Klevens RM, Edwards JR, Richards CL, Jr., et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep. Mar-Apr 2007;122(2):160-166
2. Rosenthal VD, Bijie H, Maki DG, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009. Am J Infect Control. Jun 2012;40(5):396-407.
3. Platt R, Polk BF, Murdock B, Rosner B. Mortality associated with nosocomial urinary-tract infection. New England Journal of Medicine. Sep 9 1982;307(11):637-642.
4. Platt RP, B. F.; Murdock, B.; Rosner, B. Reduction of mortality associated with nosocomial urinary tract infection. Lancet. 1983;1(8330):893-897
5. Bryan CS, Reynolds KL. Hospital-acquired bacteremic urinary tract infection: epidemiology and outcome. Journal of Urology. Sep 1984;132(3):494-498. 13

Antimicrobial Resistance

- Large reservoir of multi-drug resistant organisms creates a risk for cross-infection[1,2]
- CAUTI and ASB promote inappropriate use of antimicrobials[3,4]

1. Maki DGT, P. A. Engineering out the risk for infection with urinary catheters. Emerging Infectious Diseases. // 2001;7(2):342-347.
2. Wagenlehner FM, Krcmery S, Held C, et al. Epidemiological analysis of the spread of pathogens from a urological ward using genotypic, phenotypic and clinical parameters. International Journal of Antimicrobial Agents. Jun 2002;19(6):583-591.
3. Dalen DM, Zvonar RK, Jessamine PG. An evaluation of the management of asymptomatic catheter-associated bacteriuria and candiduria at The Ottawa Hospital. The Canadian journal of infectious diseases & medical microbiology = Journal canadien des maladies infectieuses et de la microbiologie medicale / AMMI Canada. May 2005;16(3):166-170.
4. Cope M, Cevallos ME, Cadle RM, Darouiche RO, Musher DM, Trautner BW. Inappropriate treatment of catheter-associated asymptomatic bacteriuria in a tertiary care hospital. Clinical Infectious Diseases. May 1 2009;48(9):1182-1188
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Quality Indicator

- Joint Commission 2012 National Patient Safety Goal 07.06.01 obliges hospitals to implement evidence based practices to prevent CAUTI[1]
- DHHS Action Plan to Prevent HAI 2009 includes a 5-year goal to reduce CAUTI by 25%[2]
- CMS will begin public reporting of CAUTI rates in 2014 through its Hospital Inpatient Quality Reporting Program based on data gathered in accordance with NHSN criteria
- Non-payment for CAUTI has had little financial impact on hospitals[3]

1. The Joint Commission. R3 Report Requirement, Rationale, Reference: Catheter-Associated Urinary Tract Infections. 2011. http://www.jointcommission.org/assets/1/18/R3_Report_Issue_2_9_22_11_final.pdf. Accessed May 21, 2013.
2. DHHS. HHS Action Plan To Prevent Healthcare-Associated Infections. 2009.
3. Meddings JA, Reichert H, Rogers MA, Saint S, Stephansky J, McMahon LF. Effect of nonpayment for hospital-acquired, catheter-associated urinary tract infection: a statewide analysis. Annals of Internal Medicine. Sep 4 2012;157(5):305-312.
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Effect of Nonpayment for Preventable Infections in U.S. Hospitals
Lee GM et al. NEJM 2012; 367:1428-1437

- 398 hospitals participating in NHSN
- Interrupted time-series analysis
- Compared the rate of change of CAUTI before and after the policy implementation (Jan 2006-Oct 2008 versus Nov 2008 – Mar 2011)
  - Used VAP as a negative control since VAP was not a CMS-targeted infection
- Decreasing rates of CAUTI were observed well before the CMS policy was implemented
- **No evidence that the CMS non-reimbursement policy had any measurable effect on infection rates**
- Authors' interpretation:
  - Attention was already focused on HAI prevention before the CMS disincentives
  - Financial stake was low

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CAUTI are Nurse Sensitive Outcomes

- Thought to be more highly related to the quantity and quality of nursing care than to medical care or institutional characteristics[1]
- Endorsed as a nursing-sensitive outcome by the National Quality Forum[2,3]
- Association with nurse burnout[4]
  - Pennsylvania hospitals
  - Incidence of UTI 8.6/1,000 patients
  - 10% decrease in a hospital's composition of high-burnout nurses was associated with a decrease of 0.82 UTI per 1,000 patients (p=0.03), after controlling for staffing, nurse characteristics, and hospital characteristics

1. Montalvo I. The National Database of Nursing Quality Indicators. Online J Issues Nurs. 2007;12(3).
2. Kurtzman ET, Corrigan JM. Measuring the contribution of nursing to quality, patient safety, and health care outcomes. Policy Polit Nurs Pract. Feb 2007;8(1):20-36.
3. National Quality Forum. National Voluntary Consensus Standards for Nursing-Sensitive Care: An Initial Performance Measure Set. 2004.
4. Cimiotti JP, Aiken LH, Sloane DM, Wu ES. Nurse staffing, burnout, and health care-associated infection.[Erratum appears in Am J Infect Control. 2012 Sep;40(7):680]. Am J Infect Control. Aug 2012;40(6):486-490.
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Asymptomatic Bacteriuria (ASB)

- Prevalence
  - Women of childbearing age: 2%[1]
  - Elderly: men 6%, women 18%[2]
  - Institutionalized elders: men 15-25%, women 25-50%[3]
  - Patients with catheters: 8% per day during the first week[4] virtually 100% by 30 days
- >90% of patients with 'CAUTI' are asymptomatic[5]
- No association of fever and/or leukocytosis with bacteriuria in trauma ICU patients[6]

1. Nassaji M, Ghorbani R. Asymptomatic bacteriuria in users of low-dose combined oral contraceptives. Eur J Contracept Reprod Health Care. Aug 2011;16(4):307-310.
2. Boscia JA, Kobasa WD, Abrutyn E, Levison ME, Kaplan AM, Kaye D. Lack of association between bacteriuria and symptoms in the elderly. Am J Med. Dec 1986;81(6):979-982.
3. Ariathianto Y. Asymptomatic bacteriuria - prevalence in the elderly population. Aust Fam Physician. Oct 2011;40(10):805-809.
4. Garibaldi RA, Burke JP, Dickman ML, Smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterization. New England Journal of Medicine. Aug 1 1974;291(5):215-219.
5. Tambyah PA, Maki DG. Catheter-associated urinary tract infection is rarely symptomatic: a prospective study of 1,497 catheterized patients. Archives of Internal Medicine. Mar 13 2000;160(5):678-682
6. Golob JF, Jr., Claridge JA, Sando MJ, et al. Fever and leukocytosis in critically ill trauma patients: it's not the urine. Surgical Infections. Feb 2008;9(1):49-56.

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ASB Screening and Treatment

- Routine screening and treatment for ASB not recommended except
  - Pregnant women
  - Urologic procedures/surgery [1,2]
- Treatment of ASB in catheterized patients is not recommended except
  - Women with ASB that persists 48h after catheter removal[2]
- Non-treatment of ASB has been suggested as a national quality performance measure[3]
- In 2009, NHSN removed asymptomatic bacteriuria from its definition of CAUTI

1. U. S. Preventive Services Task Force. Screening for asymptomatic bacteriuria in adults: U.S. Preventive Services Task Force reaffirmation recommendation statement.[Summary for patients in Ann Intern Med. 2008 Jul 1;149(1):137; PMID: 18591630]. Annals of Internal Medicine. Jul 1 2008;149(1):43-47.
2. Nicolle LE, Bradley S, Colgan R, et al. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults.[Erratum appears in Clin Infect Dis. 2005 May 15;40(10):1556]. Clinical Infectious Diseases. Mar 1 2005;40(5):643-654.
3. Gross PA, Patel B. Reducing antibiotic overuse: a call for a national performance measure for not treating asymptomatic bacteriuria. Clinical Infectious Diseases. Nov 15 2007;45(10):1335-1337.

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Symptomatic UTI

Centers for Disease Control and Prevention. Surveillance for Urinary Tract Infections: Protocols CAUTI Event 2013 Corrections, Clarifications, and Additions. Accessed 2013 05 21 at http://www.cdc.gov/nhsn/PDFs/pscManual/7pscCAUTIcurrent.pdf

Current NHSN definition for adults includes:
- Healthcare-associated
  - All elements of the infection criteria were first present together on or after hospital day 3
  - All elements used to meet the criterion occurred no more than 1 calendar day apart
- Catheter-associated
  - Indwelling urethral catheter
  - Not in-out catheterization, not suprapubic, not condom
  - Indwelling catheter was in place for >2 calendar days when all elements of the UTI criteria were first present together AND the catheter was in place on the date of the event or the day before

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Symptomatic UTI Continued

Centers for Disease Control and Prevention. Surveillance for Urinary Tract Infections: Protocols CAUTI Event 2013 Corrections, Clarifications, and Additions. Accessed 2013 05 21 at http://www.cdc.gov/nhsn/PDFs/pscManual/7pscCAUTIcurrent.pdf

- Symptoms (at least 1)
  - Fever >38.0° C
  - Suprapubic (SP) tenderness
  - Costovertebral angle (CVA) tenderness
  - If voiding: urgency, frequency or dysuria

- Positive culture
  - Urine culture $\geq 10^5$ CFU/mL with $\leq$ 2 species of microorganisms OR
  - Urine culture >10^3 to <10^5 CFU/mL with $\leq$ 2 species of microorganisms AND urinalysis positive for 1 of the following:
    - Leukocyte esterase and/or nitrates
    - Pyuria (>10 WBCs/mm^3 or >3 WBCs/hpf unspun urine)
    - Microorganisms seen on Gram stain of unspun urine

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Asymptomatic Bacteremic UTI (ABUTI)

- Current NHSN definition for adults[1]
  - NO fever, SP or CVA tenderness, urgency, frequency, or dysuria
  - Urine culture $\geq 10^5$ CFU/mL with < 2 species of microorganisms
  - Blood culture with $\geq$1 matching uropathogen
- The logic of the NHSN designation ABUTI has been questioned[2]
  - Scant evidence that patients with ASB develop secondary BSIs
  - It is possible that patients with BSI from another source (e.g., central line) will also have bacteria in their urine
- Need to capture bacteremic CAUTI in patients who cannot communicate their symptoms

1. Centers for Disease Control and Prevention. Surveillance for Urinary Tract Infections: Protocols CAUTI Event 2013 Corrections, Clarifications, and Additions. Accessed 2013 05 21 at http://www.cdc.gov/nhsn/PDFs/pscManual/7pscCAUTIcurrent.pdf
2. Anderson DJ, Freeman J, Sexton DJ. Recent changes in the NHSN definition for UTI: for better AND worse. Am J Infect Control. Feb 2010;38(1):81-82; author reply 82-83.

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Pathogenesis

- Normal barriers to infection are negated by the catheter
  - Urethral meatus is open
  - Urethra is not flushed by a urine stream
  - Bladder may be incompletely emptied
  - Mechanical trauma
- 2 paths for bacteria entry
  - Extraluminal
    - Accounts for 66% of CAUTI [1]
      - Found no difference between men and women
  - Intraluminal

1. Tambyah PA, Halvorson KT, Maki DG. A prospective study of pathogenesis of catheter-associated urinary tract infections. Mayo Clinic Proceedings. Feb 1999;74(2):131-136.

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Two Pathways

Stamm WE. Catheter-associated urinary tract infections: Epidemiology, pathogenesis, and prevention. Am J Med. 1991;91(3 B): 65S-71S

Periurethral (extraluminal)

- Mechanism of infection for majority of bacteriuria episodes in women
- Fecal flora colonize the periurethral area and enter the urinary tract
- At insertion or by capillary action
- Periurethral colonization does not routinely lead to bacteriuria
  - Takes >72 hours

Intraluminal

- Mechanism of infection for majority of bacteriuria episodes in men
- Cross-contamination of the drainage system
- Bacteria in drainage bag can be found in the bladder after 24-48 hours
- Very common in patients not on antimicrobials
- In the bladder, the concentration of microorganisms quickly increases
- 100 cfu/mL to >100,000 cfu/mL in <24 hours

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Biofilms

Stamm WE. Catheter-associated urinary tract infections: Epidemiology, pathogenesis, and prevention. Am J Med. 1991;91(3 B):65S-71S
Saint S, Chenoweth CE. Biofilms and catheter-associated urinary tract infections. Infect Dis Clin North Am. Jun 2003;17(2):411-432

- Bacteria attach to and coat the catheter surface
  - Proteus
  - Pseudomonas spp.
- Bacteria secrete an extracellular matrix
- Host urinary proteins and salts become incorporated into the matrix
- Bacteria within the biofilm grow more slowly than planktonic bacteria
- Bacterial cultures of planktonic bacteria may or may not reflect what is growing in the biofilm
- The presence of biofilm inhibits the activity of antimicrobials and host defenses

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Scanning Electron Microscopy of Biofilm

Ganderton L, Chawla J, Winters C, Wimpenny J, Stickler D. Scanning electron microscopy of bacterial biofilms on indwelling bladder catheters. Eur J Clin Microbiol Infect Dis. Sep 1992;11(9):789-796

- Urethral catheters in place 3 – 83 days (mean 35 days)
- Biofilm on 44/50 catheters
- No relationship between duration of catheterization and the extent of biofilm formation
- Biofilms are thicker and more well developed on the inner surface of the catheter than on the outer surface
- Layers of bacterial cells up to about 400 cells deep in the matrix

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Microorganisms

- In short-term catheterization mostly single organisms
- Common organisms in CAUTI; NHSN 2006-2007[1]
  - E. coli 21%
  - C. albicans 14%
  - P. aeruginosa 10%
  - K. pneumoniae 8%
  - E. faecium 6%
- Hematogenous seeding of the urinary tract[2,3]
  - Especially S.aureus and Candida spp.

1. Hidron AI, Edwards JR, Patel J, et al. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006-2007.[Erratum appears in Infect Control Hosp Epidemiol. 2009 Jan;30(1):107]. Infect Control Hosp Epidemiol. Nov 2008;29(11):996-1011.
2. 40. Lee BK, Crossley K, Gerding DN. The association between Staphylococcus aureus bacteremia and bacteriuria. Am J Med. Aug 1978;65(2):303-306.
3. 41. Baraboutis IGT, E. P.; Lepinski, J. L.; Papakonstantinou, I.; Papastamopoulos, V.; Skoutelis, A. T.; Johnson, S. Primary Staphylococcus aureus urinary tract infection: the role of undetected hematogenous seeding of the urinary tract. Eur J Clin Microbiol Infect Dis. Sep 2010;29(9):1095-1101.

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Risk factors for CAUTI

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. Clinical Infectious Diseases. Mar 1 2010;50(5):625-663.

- Duration of catheterization
- Female gender
- Absence of systemic antibiotics
- Positive urethral meatal culture results
- Microbial colonization of the drainage bag
- Catheter inserted outside the operating room
- Catheter care violations (system opened)
- Rapidly fatal underlying illness
- Older age
- Diabetes mellitus
- Elevated serum creatinine at the time of catheterization

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Guidelines and More Guidelines

Conway LJ, Larson EL. Guidelines to prevent catheter-associated urinary tract infection: 1980 to 2010. Heart Lung. May 2012;41(3): 271-283.

- **CDC**: Wong ES. Am J Infect Control. **1983**;11(1):28-36.
- **NHS**: Pratt RJ et al. Journal of Hospital Infection. **2001**;47 Suppl:S3-82.
- **NHS**: Pratt RJ et al. Journal of Hospital Infection. **2007**;65 Suppl 1:S1-64.
- **EAU/UAA**: Tenke P et al. International J of Antimic Agents. 2008;31:S68-78.
- **SHEA/IDSA**: Lo E et al. Infect Control Hosp Epidemiol. **2008**;29:S41-50.
- **WOCN**: Parker D et al. J Wound Ostomy Continence Nurs. **2009**;36(1):23-34.
  - Willson M et al. J Wound Ostomy Continence Nurs. 2009;36(2):137-154.
  - Parker D et al. J Wound Ostomy Continence Nurs. 2009;36(2):156-159.
- **IDSA**: Hooton TM et al. Clinical Infectious Diseases. **2010**;50(5):625-663.
- **HICPAC**: Gould CV et al. Infect Control Hosp Epidemiol. **2010**;31(4):319-326.

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Evidence for Recommendations

Conway LJ, Larson EL. Guidelines to prevent catheter-associated urinary tract infection: 1980 to 2010. Heart Lung. May 2012;41(3): 271-283.

- Many guidelines but little evidence
  - In the SHEA/IDSA guideline, only 3 positive recommendations and 4 proscriptions are based on good evidence from >1 properly randomized, controlled trial
  - In the HICPAC guideline, no 1A recommendations for acute care settings
- Unanimous recommendations across all guidelines:
  - Minimize catheter use and duration
  - Insert catheters using aseptic technique and sterile equipment
  - Maintain a closed, sterile drainage system

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Newer and Divergent Recommendations

Newer Recommendations

- 2001; strategies to remove the catheter as soon as possible
- 2001; use portable bladder scanners to rule out retention
- 2008; use silver alloy catheters in select patients
- 2009; use antimicrobial-impregnated catheters in select patients
- 2009; use pre-connected catheter and collection system with sealed junctions

Divergent Recommendations

- Hydrophilic catheters for intermittent catheterization
  - Moderately disapproved IDSA 2010
  - Weakly recommended HICPAC 2010
- Meatal cleaning before insertion
  - Antiseptic, CDC 1983
  - Sterile saline, Epic 2001, 2007
  - No recommendation, HICPAC 2009
- If the closed system is violated
  - Replace the collecting system using aseptic technique, CDC 1983, SHEA 2008
  - Replace the catheter and collecting system, HICPAC 2009

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Adoption of Recommendations

Conway LJ, Pogorzelska M, Larson E, Stone PW. Adoption of policies to prevent catheter-associated urinary tract infections in United States intensive care units. Am J Infect Control. Oct 2012;40(8):705-710.

- 250 (57%) of 441 US hospitals provided data on 415 ICUs
- No widely-used CAUTI prevention policy

Does your ICU have a written policy in place?	Policy in Place % (n)	Compliance is Tracked % (n)	Compliance With Policy % (n)		
			Always (≥95%)	Usually, Sometimes or Rarely/Never	Don't Know
Clinician use of portable bladder **ultrasound** scanner for determining post void residual	25.9 (106/409)	18.9 (20)	10.0 (2)	15.0 (3)	75.0 (15)
Condom catheters for men	20.0 (82/410)	8.6 (7)	14.3 (1)	85.7 (6)	0 (0)
Urinary catheter reminder or **stop order**	12.4 (51/410)	31.4 (16)	31.3 (5)	56.3 (9)	12.5 (2)
Nurse-initiated urinary catheter discontinuation	9.5 (39/409)	12.8 (5)	40.0 (2)	20.0 (1)	40.0 (2)
At least 1 policy	42.2 (174/410)	22.4 (39)	15.4 (6)		

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Adoption of Recommendations

Conway LJ, Pogorzelska M, Larson E, Stone PW. Adoption of policies to prevent catheter-associated urinary tract infections in United States intensive care units. Am J Infect Control. Oct 2012;40(8):705-710.

- Predictors of adopting at least 1 prevention policy (n=174 [42%])
  - >500 beds (OR 0.52; 95%CI 0.33-0.86)
  - IC Director always has access to key decision makers for planning (OR 2.41; 95% CI 1.56-3.72)
- Found no significant difference in mean CAUTI rates for ICUs with at least 1 policy in place compared with those with no policy (p=0.84)
- Unable to assess a possible association between compliance with CAUTI prevention policy and CAUTI rates

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Strategies for Preventing CAUTI

- Minimize catheter use and duration
- Insert catheters using aseptic technique and sterile equipment
- Maintain a closed, sterile drainage system
- Apply administrative controls

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HICPAC Recommendation Scale

1A: a strong recommendation supported by high-quality to moderate-quality evidence suggesting net clinical benefits or harms

1B: a strong recommendation supported by low-quality evidence suggesting net clinical benefits or harms, or an accepted practice (e.g., aseptic technique) supported by low to very low quality evidence

1C: a strong recommendation required by state or federal regulations

2:     a weak recommendation supported by any quality evidence suggesting a trade-off between clinical benefits and harms

*HICPAC priority

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Strategies for Preventing CAUTI

1. **Minimize catheter use and duration**
3. Insert catheters using aseptic technique and sterile equipment
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Minimize Catheter Use

Indications for use

- Acute urinary retention or obstruction
- Frequent, accurate measurement of urine output in critically ill patients
- Perioperative in select procedures
- Urologic surgery
- Prolonged duration of surgery
- Anticipated to receive large-volume infusions
- Intra-operative monitoring of urine output
- Sacral or perineal wound healing in incontinent patients
- Prolonged immobilization under conditions such as unstable spine or pelvic fracture
- Patient comfort at the end of life

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Minimize Catheter Use

- Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI or mortality from catheterization such as women, the elderly, and patients with impaired immunity (1B)
- Avoid use of catheters for management of incontinence (1B)*
- Use catheters in operative patients only as necessary (1B)

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Alternatives

- Condom catheters in cooperative male patients (2)
- Suprapubic (SP) catheters (Unresolved)
  - Cochran review and meta-analysis by Niël-Weise & van den Broek updated 2009
    - For short-term bladder drainage in adults in hospital
    - Compared to patients with an SP catheter, those with urethral catheters had
      - More bacteriuria (RR=2.60, 95%CI 2.12-3.18)
      - More frequent recatheterization (RR=4.12, 95%CI 2.94-7.56)
      - More discomfort (RR=2.98, 95%CI 2.31-3.85)
      - Little cost data

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Alternatives

- Intermittent "in/out" catheterization in patients with spinal cord injury or bladder emptying dysfunction (2)
  - Perform intermittent catheterization at regular intervals to prevent bladder overdistension (1B)
  - Use a portable ultrasound device to assess urine volume (2)
    - Establish indications for use
    - Train staff
    - Ensure equipment is properly cleaned and disinfected between patients (1B)
  - Cochran review and meta-analysis by Niël-Weise & van den Broek updated 2009
    - For short-term bladder drainage in adults in hospital
    - Compared to patients with an indwelling urethral catheter, those with intermittent catheterization had fewer cases of bacteriuria (RR 2.90, 95%CI 1.44-5.84)

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Minimize Duration of Use

- Remove the catheter ASAP post-op, preferably within 24 hours (1B)*
- It is not uncommon for physicians to be **un**aware that a patient is catheterized[1]
  - On average, physicians were unaware of catheterization for 28% of catheterized patients, and 41% of inappropriately catheterized patients
  - Catheterization was more likely to be appropriate if respondents were aware of the catheter (OR=3.7; 95%CI 2.1-6.7, P <0.001)

- Reminders
- Automatic stop orders
- Nurse-driven protocols for removal
- Clamping prior to removal is unnecessary (2)

1. Saint S, Wiese J, Amory JK, et al. Are physicians aware of which of their patients have indwelling urinary catheters? Am J Med. Oct 15 2000;109(6): 476-480

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Minimize Duration of Use

Cochran review by Griffiths & Fernandez updated 2009
- For adults with short-term indwelling urethral catheters
- Following a urological procedure or surgery, remove the catheter at midnight instead of in the morning
  - Longer times to first void
  - Larger volumes at first void
  - Shorter LOS
  - No difference in the need for recatheterization
- Removing the catheter sooner rather than later
  - Lower risk of infection
  - Shorter LOS
  - Higher risk of voiding problems
- Not enough evidence to assess the effects of clamping prior to removal
- Not enough evidence to assess the effects of prophylactic alpha adrenergic blockers on the incidence of recatheterization

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Strategies for Preventing CAUTI

- Minimize catheter use and duration
- **Insert catheters using aseptic technique and sterile equipment**
- Maintain a closed, sterile drainage system
- Apply administrative controls

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Insert Catheters Using Aseptic Technique and Sterile Equipment

- Use the smallest bore possible (2)
- Use antimicrobial/antiseptic-impregnated catheters if a comprehensive strategy to reduce CAUTI is not working (1B)
- Cochran review by Schumm & Lam updated 2010
  - For short-term catheterization of adults in acute care settings
  - Compared to standard catheters, silver alloy catheters significantly reduce the incidence of ASB
    - At 1 week RR=0.54, 95% CI 0.43-0.67
    - At 2 weeks RR=0.64, 95% CI 0.51-0.80
  - Compared to standard catheters, antibiotic impregnated catheters lower the rate of ASB at 1 week
    - Minocycline/rifampicin RR=0.36, 95% CI 0.18-0.73
    - Nitrofurazone RR=0.52, 95% CI 0.34-0.78

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Insert Catheters Using Aseptic Technique and Sterile Equipment

- Use aseptic technique (1B)*
- Use sterile equipment (1B)*
  – Sterile gloves, drape, sponges, lubricant (1B)
  – Solutions antiseptic vs. sterile water (Unresolved)
- Secure to prevent movement and urethral traction (1B)

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Strategies for Preventing CAUTI

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- Insert catheters using aseptic technique and sterile equipment
- **Maintain a closed, sterile drainage system**
- Apply administrative controls

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Closed and Sterile

- Maintain a closed drainage system (1B)*
  – Use pre-connected and sealed junctions (2)
  – If the system is disconnected, contaminated, or leaking, replace the catheter and collecting system (1B)
- Hand hygiene immediately before and after any manipulation of the catheter or apparatus (1B)
- Use standard precautions during any manipulation of the catheter or collecting system (1B)
- Sample urine aseptically (1B)
  – Small volumes from the sampling port (1B)
  – Large volumes from the drainage bag (1B)

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Care and Maintenance

- Maintain an unobstructed flow of urine (1B)*
  – Keep collection bag below the level of the bladder
  – Do no allow collection bag to touch the floor
  – Avoid kinks and dependent loops in tubing
- Empty the drainage bag regularly (1B)
  – Use a separate container for each patient
  – Do not allow the spigot to touch the collecting container
- No special urethral meatal care (1B)
  – Only routine perineal cleansing during daily bath
- Avoid routine irrigation (2)
- Avoid routine catheter changes (2)
  – Change the catheter if obstructed (1B)
- Do not routinely screen catheterized patients for ASB (2)

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Antimicrobials

- Do not use systemic prophylaxis routinely (1B)
  – Methenamine for urinary antisepsis (Unresolved)
- Do not treat ASB routinely[1]
  – Patients who are on antimicrobials for other reasons develop bacteriuria less frequently than those not on antimicrobials, but resistance quickly develops and/or bacteriuria recurs
  – Not recommended because of cost, resistance, C. difficile
  – Exceptions
    - Pregnancy
    - Urological procedures/surgery
    - Renal transplantation
- Treat symptomatic UTI
- Change the catheter and take urine and blood cultures before commencing treatment
- Do not use antimicrobials in the drainage bag (2)

1. Nicolle LE, Bradley S, Colgan R, et al. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults.[Erratum appears in Clin Infect Dis. 2005 May 15;40(10):1556]. Clinical Infectious Diseases. Mar 1 2005;40(5):643-654.

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Antimicrobials

Cochran review by Niël-Weise & van den Broek updated 2009

- For short-term catheterization of adults in hospital
- Compared to giving antibiotics when clinically indicated, giving prophylaxis reduced the incidence of symptomatic CAUTI (RR=0.20, 95%CI 0.06-0.66) in female patients after abdominal hysterectomy in 1 trial
- Compared to giving antibiotics when microbiologically indicated, giving prophylaxis reduced the incidence of bacteriuria among medical neurology patients in 2 trials (RR=0.22, 95%CI 0.13-0.39) and surgery patients (data from 3 trials not combined)

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Strategies for Preventing CAUTI

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- **Apply administrative controls**

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Education, Protocols and Supplies

- Ensure only properly trained persons insert and maintain catheters (1B)*
  - Periodic in-service training (1B)
  - Focus educational efforts on OR and ER[1]
    - Most catheters are inserted in the OR (62%) and ER (11%)
    - Catheters placed in the ER are maintained for a significantly longer duration than catheters placed in the OR
- Provide protocols for catheter use, insertion, maintenance, and removal (1B)
- Ensure that supplies are readily available for use (1B)

1. 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. Oct 2012;33(10):1057-1058.

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Quality Improvement Program

- Implement quality improvement programs (1B)
  - Assure appropriate utilization of catheters
  - Identify and remove catheters that are no longer needed
  - Ensure adherence to hand hygiene and proper care of catheters
- Consider surveillance for CAUTI (2)
  - Ensure that there are sufficient trained personnel and technologic support for surveillance (1B)
  - Use a standard surveillance methodology (1B)

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Provide Feedback

Performance feedback to clinicians and administrators (2)*
- Processes
  - Device utilization ratio (catheter days/patient days)*100 (QI)
  - % personnel who have been trained
  - % catheters with an appropriate indication documented
  - % catheters with documented insertion and removal dates
  - % catheters removed within 48 hours of surgery stop time
- Outcomes
  - CAUTI rates per 1,000 catheter days (QI)
  - CAUTI rates per 100 patient days
  - CAUTI rates per 100 catheters inserted

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Improve Guideline Adherence

Cochran review by Flodgren et al 2012
- Interventions to improve adherence to guidelines for prevention of CLABSI, VAP, CAUTI
- Insufficient evidence to determine anything with certainty
- Educational interventions consisting of >1 element, administered repeatedly
- Dedicated personnel

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Institutional Characteristics Associated With Successful HAI Reduction

- Processes are hardwired into daily activities and data is fed back[1]
- Local data is used as one form of credible evidence to influence stakeholders[2]
- Strong professional relationships exist[2]
- A collective focus on patient safety and an affirming emotional context[3]
- Intrinsically motivated champions[4]
- Unambiguous guidelines[5]
  - Who is responsible for guideline adherence
  - What tasks need to be accomplished
  - What methods should be employed
  - What exceptions might be appropriate

1. Sinkowitz-Cochran RL, Garcia-Williams A, Hackbarth AD, et al. Evaluation of organizational culture among different levels of healthcare staff participating in the Institute for Healthcare Improvement's 100,000 Lives Campaign. Infect Control Hosp Epidemiol. Feb 2012;33(2):135-143.
2. Olson CA, Tooman TR, Alvarado CJ. Knowledge systems, health care teams, and clinical practice: a study of successful change. Adv Health Sci Educ Theory Pract. Oct 2010;15(4):491-516.
3. Krein SL, Damschroder LJ, Kowalski CP, Forman J, Hofer TP, Saint S. The influence of organizational context on quality improvement and patient safety efforts in infection prevention: a multi-center qualitative study. Soc Sci Med. Nov 2010;71(9):1692-1701.
4. Damschroder LJ, Banaszak-Holl J, Kowalski CP, Forman J, Saint S, Krein SL. The role of the champion in infection prevention: results from a multisite qualitative study. Qual Saf Health Care. Dec 2009;18(6):434-440.
5. Gurses AP, Seidl KL, Vaidya V, et al. Systems ambiguity and guideline compliance: a qualitative study of how intensive care units follow evidence-based guidelines to reduce healthcare-associated infections. Qual Saf Health Care. Oct 2008;17(5):351-359.

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Key Leadership Behaviors

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. Sep 2010;31(9):901-907.

- Cultivate a culture of clinical excellence and effectively communicated it to staff
- Focus on overcoming barriers
- Deal directly with resistant staff or dysfunctional processes
- Inspire employees
- Think strategically while acting locally
- Politick before crucial committee votes
- Leverage personal prestige to move initiatives forward
- Form partnerships across disciplines

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Challenges in CAUTI Surveillance

- The Joint Commission allows for each organization to decide, based on its risk assessment (IC.01.03.01) whether CAUTI is a priority for surveillance
  - A comprehensive program to reduce inappropriate catheter use can be effective but resource intensive[1]
  - A single CAUTI is not estimated to be as costly as a CLABSI, VAP or SSI[2]
  - CAUTI rarely cause sentinel events[3]
- House-wide versus targeted surveillance
  - Neurological patients
  - ICUs?

1. Knoll BM, Wright D, Ellingson L, et al. Reduction of inappropriate urinary catheter use at a Veterans Affairs hospital through a multifaceted quality improvement project. Clinical Infectious Diseases. Jun 2011;52(11):1283-1290.
2. Klevens RM, Edwards JR, Richards CL, Jr., et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep. Mar-Apr 2007;122(2):160-166.
3. Clec'h CS, C.; Francais, A.; Toledano, D.; Fosse, J. P.; Garrouste-Orgeas, M.; Azoulay, E.; Adrie, C.; Jamali, S.; Descorps-Declere, A.; Nakache, D.; Timsit, J. F.; Cohen, Y.; OutcomeRea Study, Group. Does catheter-associated urinary tract infection increase mortality in critically ill patients? Infect Control Hosp Epidemiol. Dec 2007;28(12):1367-1373.

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Denominator Matters

Wright MO, Kharasch M, Beaumont JL, Peterson LR, Robicsek A. Reporting catheter-associated urinary tract infections: denominator matters. Infect Control Hosp Epidemiol. Jul 2011;32(7):635-640.

- Paradoxical increase in CAUTI rates when programs successfully reduce catheter use
  - Device utilization decreased from 0.36 to 0.28 (p=0.001)
  - CAUTI decreased from 28.2 to 23.2 per 10,000 patient days (p=0.02)
  - CAUTI increased from 7.79 to 8.28 per 1,000 catheter days (p=0.47)
- Consider using a patient day denominator or number of catheters inserted

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Numerator Matters

Stamm AM, Bettacchi CJ. A comparison of 3 metrics to identify health care-associated infections. Am J Infect Control. 2012;40(8):688-691.

- Compared 3 metrics to identify HAI
  - Traditional surveillance by 6 experienced IPs
    - Using NHSN definitions and methods
  - Electronic surveillance system (ESS) *MedMined* Care Fusion
  - ICD-9-CM codes
- **Denominator was HAI found by any of the 3 methods**
  - i.e., not all HAI
- 1,000 bed academic medical center
- Gold standard: HAI as determined by 2 physician-authors
- Traditional surveillance was superior in terms of sensitivity, positive predictive value, and rate estimation.

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Detecting CAUTI Using ESS

Landers T, Apte M, Hyman S, Furuya Y, Glied S, Larson E. A comparison of methods to detect urinary tract infections using electronic data. Jt Comm J Qual Patient Saf. Sep 2010;36(9):411-417.

- Developed 7 algorithms
  1. UTI diagnosis (n=2,614) from ICD-9-CM codes 599.xx
  2. Urine culture result >105cfu/mL organisms from a Clinical Data Warehouse
  3. Urine culture result $10^3 – 10^5$cfu/mL organisms and pyuria from CDW
  4. Either 2 or 3 (n=2,773)
  5. Culture 10^5cfu with fever from EHR
  6. Culture 10^3-10^5cfu with fever
  7. Either 5 or 6 (n=1,125)
- Found ICD-9 symptom codes were infrequently used
  - <0.1% of cases had any single CAUTI symptom code
- The sensitivity of ICD-9 codes compared to criteria 7 was 55.6%
- Did not compare the algorithms to NHSN criteria

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**Preventing Catheter-Associated Urinary Tract Infections in Acute Care Settings
Laurie Conway, Columbia University School of Nursing
A Webber Training Teleclass**

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Gaps in Evidence
for CAUTI Prevention Strategies

- Utility of electronic data for CAUTI surveillance and reporting
- Studies targeting symptomatic CAUTI as outcome, rather than ASB
- Use of condom catheters in acute care
- Complications of SP catheter use for short-term urinary drainage
- Context in which automatic stop orders or nurse-directed protocols reduce inappropriate catheter use
- Antiseptic versus sterile water for peri-urethral cleansing during catheter insertion
- Use of bacterial interference with non-pathogenic strains
- Effects of spacial separation of patients with catheters and colonized urine

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Review

Strategies for CAUTI prevention

- Minimize catheter use and duration
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- Thank you to my mentor, Dr. Elaine Larson, RN, PhD, FAAN

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Speaker: Sir Liam Donaldson, World Health Organization

10 June *(FREE Teleclass ... Broadcast live from APIC Conference)*
INFECTION CONTROL DURING DISASTERS
Speaker: Steven Bock, New York City Langone Medical Center
Mie Saijo, Japanese Red Cross Ishinomaki Hospital, Japan

11 June *(British Teleclass)*
EU DIRECTIVE ON THE PREVENTION OF SHARPS INJURIES IN THE HEALTHCARE SECTOR – GETTING THE POINT ACROSS
Speaker: David Halicki, IOSH Manchester & NW Districts Branch

12 June *(South Pacific Teleclass)*
QUALITY AND SAFETY AND INFECTION PREVENTION AND CONTROL
Speaker: Dr Sally Roberts, Auckland Hospital, New Zealand

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