Appendix A. Search Strategy

(Source: Ranji et al. 2007)

#1
targets QI strategies that tend to be multi-factorial using relevant MeSH terms and title words
Patient-Centered Care [mh] or Progressive Patient Care [mh] or Critical Pathways [mh] or Delivery of Health Care, Integrated [mh] or Patient Care Team [mh] or Behavior Control [mh] or ((coordination [tw] or coordinated [tw] or Multifactorial [tw] or Multi-factorial [tw] or Multicomponent [tw] or Multi-component [tw] or multidisciplinary [tw] or multi-disciplinary [tw] or interdisciplinary [tw] or interdisciplinary [tw] or integrated [tw] or community-based [tw] or organized [tw] or comprehensive [tw]) and program*[tw] or care [tw] or approach [tw] or intervention [tw] or strategy[tw] or strategies [tw] or management [tw] or managing [tw] or center*[tw])) or Organization and Administration [mh] or bundle*[tw]

#2
targets TQM and CQI
Total Quality Management [mh] OR Quality control [mh] OR TQM [tw] OR CQI [tw] OR (quality [tw] AND (continuous [tw] OR total [tw]) AND (management [tw] OR mprovement [tw]))

#3
targets provider education
Education, Continuing [mh] OR Education, Nursing [mh] OR Education, Medical [mh] OR Inservice Training [mh] OR Programmed Instruction [mh] OR ((Education [tw]AND Continuing [tw]) AND (medical [tw] OR professional* [tw] OR nursing [tw] OR physician* [tw] OR nurse* [tw])) OR (outreach [tw] AND (visit* [tw] OR educational [tw]) OR (academic [tw] AND detailing [tw]))

#4
targets diffusion of innovation
Diffusion of Innovation [mh] OR (Diffusion [ti] AND (Innovation [ti] OR technology [ti]))

#5
targets audit & feedback, reminder systems, and financial incentives
Medical audit [mh] OR ((Audit [tw] OR feedback [tw] OR compliance [tw] OR adherence [tw] OR training [tw]) AND (improvement* [tw] OR improving [tw] OR improves [tw] OR improve [tw] OR guideline* [tw] OR practice* [tw] OR medical [tw] OR provider* [tw] OR physician* [tw] OR nurse* [tw] OR clinician* [tw] OR academic [tw] OR visit* [tw])) OR Reminder Systems [mh] OR Reminder* [tw] OR ((financial [tw] OR economic [tw] OR physician* [tw] OR patient*) AND incentive* [tw]) OR Reimbursement Mechanisms [mh] or Guideline Adherence [mh] OR practice guidelines [mh]

#6
Medical Informatics [mh] OR computer [tw] OR (decision [tw] AND (support [tw] or analysis [tw]))

#7
All QI studies
#1 or #2 or #3 Or #4 or #5 or #6

#8
Surgical site infection terms
Surgical wound infection[mh] OR surgical site infection*[tiab] OR postoperative infection*[ti] OR postsurgical infection*[ti] OR wound infection*[ti] OR sternal wound infection*[tiab] OR postoperative[ti] OR postsurgical[ti]

#9
Combination of QI terms with SSI terms
#7 AND #8

#10
RCT search
Randomised [ti] OR Randomized [ti] OR Controlled [ti] OR intervention [ti] OR evaluation [ti] OR impact [ti] OR effectiveness [ti] OR Evaluation [ti] OR Studies [ti] OR study [ti] Comparative [ti] OR Feasibility [ti] OR Program [ti] OR Design [ti] OR Clinical Trial [pt] OR Randomized Controlled Trial [pt] OR Epidemiologic Studies [mh] OR Evaluation Studies [mh] OR Comparative Study [mh] OR Feasibility Studies [mh] OR Intervention Studies [mh] OR Program Evaluation [mh] OR Epidemiologic Research Design [mh]

#11
Meta-analysis, systematic review search
((meta-analysis [pt] OR meta-analysis [tw] OR metanalysis [tw]) OR ((review [pt] OR guideline [pt] OR consensus [ti] OR guideline* [ti] OR literature [ti] OR overview [ti] OR review [ti] OR Decision Support Techniques [mh]) AND ((Cochrane [tw] OR Medline [tw] OR CINAHL [tw] OR (National [tw] AND Library [tw])) OR (handsearch* [tw] OR search* [tw] OR searching [tw]) AND (hand [tw] OR manual [tw] OR electronic [tw] OR bibliographi* [tw] OR database* OR (Cochrane [tw] OR Medline [tw] OR CINAHL [tw] OR (National [tw] AND Library [tw])))))) OR ((synthesis [ti] OR overview [ti] OR review [ti] OR survey [ti]) AND (systematic [ti] OR critical [ti] OR methodologic [ti] OR quantitative [ti] OR qualitative [ti] OR literature [ti] OR evidence [ti] OR
evidence-based [ti]))) BUTNOT (editorial [pt] OR comment [pt] OR letter [pt])

#12
All original research
#10 OR #11

#13
Combination of QI terms with SSI terms, limited to original research only
#9 AND #12

#14

#SSI/QI search limited to English only
#13 AND Limits: English

#15
CLABSI search (restrict to English only)
(Catheterization, Central Venous [MeSH] OR central line*[ti] OR central venous catheter*[ti]) AND (Cross infection [mh] OR bacteremia [mh] OR nosocomial [tiab] OR "healthcare associated"[tiab] OR "hospital acquired"[tiab] OR bundle[tiab])

#16
VAP search (restrict to English only)
(Respiration, Artificial[mh] OR mechanically ventilated*[ti] OR intubated*[ti] OR mechanical ventilation*[ti] or ventilator associated*[ti]) AND (Cross infection [mh] OR bacteremia [mh] OR nosocomial [tiab] OR "healthcare associated"[tiab] OR "hospital acquired"[tiab] OR bundle[tiab])

#17
UCUTI search (restrict to English only)
(Urinary catheterization[mh] OR urinary catheter*[tiab]) AND (Cross infection [mh] OR bacteremia [mh] OR nosocomial [tiab] OR "hospital-acquired"[tiab] OR healthcareassociated"[tiab] OR bundle[tiab])

Supplemental searches
#S1
Nosocomial infection systematic reviews (limited to English only)
Cross infection[mh] AND systematic[sb]

#S2
Handwashing systematic reviews (limited to English only)
Handwashing[mh] AND systematic[sb]

#S3
Author searches
Pronovost p[au] OR Gastmeier P[au] OR Gyssens IC[au]

Appendix B. List of Excluded Studies

[No Author]. Case study. Implementing IHI's six interventions: contributing to the campaign to save 100,000 lives. Joint Commission Perspectives on Patient Safety 2006 6(2):9-10. Exclusion Codes: COMMENTARY

[No Author]. New York hospitals cut central line infections in half. Perform Improv Advis 2006 10(6):61-7. Exclusion Codes: NOT RELEVANT OUTCOME

[No Author]. Using computer's data to guide OR QI. OR Manager 2006 22(7):18. Exclusion Codes: GUIDELINE

[No Author]. Decreasing surgical site infections in ambulatory care: using data to identify and address issues. Joint Commission Perspectives on Patient Safety 2007 7(2):9. Exclusion Codes: NOT RELEVANT QUESTION

[No Author]. Hospital factors bigger than patient severity of illness: HAIs 'not necessarily inevitable'. Hospital Infection Control 2007 34(1):3-3. Exclusion Codes: COMMENTARY

[No Author]. Link seen between working conditions, infections: higher staffing numbers yield improved outcomes. Healthcare Benchmarks & Quality Improvement 2007 14(9):106-108. Exclusion Codes: COMMENTARY

[No Author]. Ventilator-associated pneumonia. Crit Care Nurse 2008 28(3):83-5. Exclusion Codes: GUIDELINE

[No Author]. Antimicrobial prophylaxis for surgery. Treat Guidel Med Lett 2009 7(82):47-52. Exclusion Codes: GUIDELINE

[No Author]. Intervention leads to reduction in central venous catheter-associated blood stream infections for pediatric patients. AHRQ Research Activities 2009 (351):4-5. Exclusion Codes: COMMENTARY

[No Author]. Quality improvement collaborative fails to improve infection preview articleention in surgical patients. AHRQ Research Activities 2009 (344):6-6. Exclusion Codes: LETTER

[No Author]. Meta-analysishodology for a study of structured co-management of high-risk postoperative patients in a teaching hospital. Crit Care Resusc 2010 12(4):277-86. Exclusion Codes: NOT RELEVANT QUESTION

A, B. J., Rijnders. Replacement of intravascular catheters to preview articleent infection: Evidence still missing while the question may become irrelevant. Critical Care Medicine 2010 38(4):1208-1209. Exclusion Codes: EDITORIAL

Abdel-Galil, K. The WHO Surgical Safety Checklist: are we measuring up? British Journal of Oral and Maxillofacial Surgery 2010 48(5):397-398. Exclusion Codes: LETTER

Abouzari, M., Sodagari, N., Hasibi, M., Behzadi, M., Rashidi, A. Re: Nonshaved cranial surgery in black Africans: a short-term prospective preliminary study (Adeleye and Olowookere, Surg Neurol 2008;69-72). Effect of hair on surgical wound infection after cranial surgery: a 3-armed randomized clinical trial. Surgical Neurology 2009 71(2):261-262. Exclusion Codes: NOT RELEVANT OUTCOME

Acosta-Escribano, J., Fernandez-Vivas, M., Grau Carmona, T., Caturla-Such, J., Garcia-Martinez, M., Menendez-Mainer, A., Solera-Suarez, M., Sanchez-Paya, J. Gastric versus transpyloric feeding in severe traumatic brain injury: A prospective, randomized trial. Intensive Care Medicine 2010 36(9):1532-1539. Exclusion Codes: NOT RELEVANT INTERVENTION

Agrawal, S., Williams, A. Implementing the ventilator bundle from Patient Safety First to improve critical care. Nurs Times 2009 105(36):19. Exclusion Codes: GUIDELINE

Aguilar-Nascimento, J. E., Marra, J. G., Slhessarenko, N., Fontes, C. J. Efficacy of National Nosocomial Infection Surveillance score, acute-phase proteins, and interleukin-6 for predicting postoperative infections following major gastrointestinal surgery. Sao Paulo Med J 2007 125(1):34-41. Exclusion Codes: NOT RELEVANT INTERVENTION

Aguilar-Nascimento, J. E., Salomao, A. B., Caporossi, C., Diniz, B. N. Clinical benefits after the implementation of a multimodal perioperative protocol in elderly patients. Arq Gastroenterol 2010 47(2):178-83. Exclusion Codes: NOT RELEVANT INTERVENTION

al Awa, B., de Wever, A., Almazrooa, A., Habib, H., al-Noury, K., el Deek, B., el Hati, T., Devreux, I. The impact of accreditation on patient safety and quality of care indicators at King Abdulaziz University Hospital in Saudi Arabia. Research Journal of Medical Sciences 2011 5(1):43-51. Exclusion Codes: NOT RELEVANT QUESTION

Al Raiy, B., Fakih, M. G., Bryan-Nomides, N., Hopfner, D., Riegel, E., Nenninger, T., Rey, J., Szpunar, S., Kale, P., Khatib, R. Peripherally inserted central venous catheters in the acute care setting: a safe alternative to high-risk short-term central venous catheters. American Journal of Infection Control 2010 38(2):149-153. Exclusion Codes: NOT RELEVANT QUESTION

Alberato, Holly Delatte., Rosalind, Steele-Moses, Susan, Murphree, Paul. Decreasing urinary tract infections one indwelling catheter at a time: a hospital based skilled nursing unit performance improvement program. Pelican News 2010 66(4):8-8. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Alexandrou, E., Spencer, T., Davidson, P. Nursing central line service preview articleents catheter related infections. Australian Nursing Journal 2008 15(11):49-49. Exclusion Codes: EDITORIAL

Alexiou, V. G., Ierodiakonou, V., Dimopoulos, G., Falagas, M. E. Impact of patient position on the incidence of ventilator-associated pneumonia: a Meta-analysisa-analysis of randomized controlled trials. J Crit Care 2009 24(4):515-22. Exclusion Codes: META-ANALYSIS

Al-Momany, N. H., Al-Bakri, A. G., Makahleh, Z. M., Wazaify, M. M. B. Adherence to international antimicrobial prophylaxis guidelines in cardia surgery: A Jordanian study demonstrates need for quality improvement. Journal of Managed Care Pharmacy 2009 15(3):262-271. Exclusion Codes: NOT RELEVANT OUTCOME

Al-Momany, N. H., Al-Bakri, A. G., Makahleh, Z. M., Wazaify, M. M. Adherence to international antimicrobial prophylaxis guidelines in cardiac surgery: a jordanian study demonstrates need for quality improvement. Journal of Managed Care Pharmacy 2009 15(3):262-271. Exclusion Codes: EDITORIAL

Alsaghir, A. H., Martin, C. M. Effect of prone positioning in patients with acute respiratory distress syndrome: a Meta-analysisa-analysis. Crit Care Med 2008 36(2):603-9. Exclusion Codes: META-ANALYSIS

Al-Tawfiq, J. A., Abed, M. S. Decreasing ventilator-associated pneumonia in adult intensive care units using the Institute for Healthcare Improvement bundle. Am J Infect Control 2010 38(7):552-6. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Aly, H., Badawy, M., El-Kholy, A., Nabil, R., Mohamed, A. Randomized, controlled trial on tracheal colonization of ventilated infants: can gravity preview articleent ventilator-associated pneumonia? Pediatrics 2008 122(4):770-4. Exclusion Codes: NOT RELEVANT QUESTION

Amarasingham, R., Pronovost, P. J., Diener-West, M., Goeschel, C., Dorman, T., Thiemann, D. R., Powe, N. R. Measuring clinical information technology in the ICU setting: application in a quality improvement collaborative. J Am Med Inform Assoc 2007 14(3):288-94. Exclusion Codes: NOT RELEVANT INTERVENTION

Anderson, D. J., Kaye, K. S., Classen, D., Arias, K. M., Podgorny, K., Burstin, H., Calfee, D. P., Coffin, S. E., Dubberke, E. R., Fraser, V., Gerding, D. N., Griffin, F. A., Gross, P., Klompas, M., Lo, E., Marschall, J., Mermel, L. A., Nicolle, L., Pegues. Strategies to preview articleent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 2008 29 Suppl 1:S51-61. Exclusion Codes: GUIDELINE

Anderson, Deverick J., Miller, Becky A., Chen, Luke F., Adcock, Linda H., Cook, Evelyn, Cromer, A. Lynn, Louis, Susan, Thacker, Paul A., Sexton, Daniel J. The network approach for preview articleention of healthcare-associated infections: long-term effect of participation in the duke infection control outreach network. Infection Control & Hospital Epidemiology 2011 32(4):315-322. Exclusion Codes: NO BASELINE DATA

Anderson, D. J., Miller, B. A., Chen, L. F., Adcock, L. H., Cook, E., Cromer, A. L., Louis, S., Thacker Ii, P. A., Sexton, D. J. The network approach for preview articleention of healthcare-associated infections: Long-term effect of participation in the Duke Infection Control Outreach Network. Infection Control and Hospital Epidemiology 2011 32(4):315-322. Exclusion Codes: DUPLICATE STUDY/PATIENT POPULATION

Andrews, A., Valente, A. Accelerating best care in Pennsylvania: the Hazleton General Hospital experience. American Journal of Medical Quality 2008 23(4):259-265. Exclusion Codes: COMMENTARY

Ang, L., Laskar, R., Gray, J. W. A point preview articlealence study of infection and antimicrobial use at a UK children's hospital. Journal of Hospital Infection 2008 68(4):372-374. Exclusion Codes: NOT RELEVANT OUTCOME

Anthony, T., Murray, B. W., Sum-Ping, J. T., Lenkovsky, F., Vornik, V. D., Parker, B. J., McFarlin, J. E., Hartless, K., Huerta, S. Evaluating an evidence-based bundle for preview articleenting surgical site infection: a randomized trial. Arch Surg 2011 146(3):263-9. Exclusion Codes: NOT RELEVANT QUESTION

Apisarnthanarak, A., Srichomkwun, P., Sutepvarnon, A., Bailey, T. C., Fraser, V. J. The long-term outcomes of an antibiotic control program with and without education [6]. Clinical Infectious Diseases 2007 45(9):1245-1247. Exclusion Codes: NOT RELEVANT QUESTION

Apisarnthanarak, A., Suwannakin, A., Maungboon, P., Warren, D. K., Fraser, V. J. Long-term outcome of an interventionto remove unnecessary urinary catheters, with and without a quality improvement team, in a Thai tertiary care center. Infect Control Hosp Epidemiol 2008 29(11):1094-5. Exclusion Codes: LETTER

Arabi, Y., Haddad, S., Hawes, R., Moore, T., Pillay, M., Naidu, B., Issa, A., Yeni, B., Grant, C., Alshimemeri, A. Changing sedation practices in the intensive care unit--protocol implementation, multifaceted multidisciplinary approach and teamwork. Middle East J Anesthesiol 2007 19(2):429-47. Exclusion Codes: NOT RELEVANT INTERVENTION

Arriaga, A. F., Lancaster, R. T., Berry, W. R., Regenbogen, S. E., Lipsitz, S. R., Kaafarani, H. M. A., Elbardissi, A. W., Desai, P., Ferzoco, S. J., Bleday, R., Breen, E., Kastrinakis, W. V., Rubin, M. S., Gawande, A. A. The better colectomy project: Association of evidence-based best-practice adherence rates to outcomes in colorectal surgery. Annals of Surgery 2009 250(4):507-512. Exclusion Codes: NOT RELEVANT OUTCOME

Astle, C. M., Jensen, L. A trial of EXSEPT for hemodialysis central venous catheters. Nephrology Nursing Journal 2005 32([5]):517-525. Exclusion Codes: NOT RELEVANT QUESTION

Augustyn, B. Ventilator-associated pneumonia: risk factors and preview articleention. Crit Care Nurse 2007 27(4):32-6, 38-9; quiz 40. Exclusion Codes: REVIEW ARTICLE

B, A. L., Webb, Flagg, R. L., Fink, A. S. Reducing surgical site infections through a multidisciplinary computerized process for preoperative prophylactic antibiotic administration. American Journal of Surgery 2006 192(5 SPEC. ISS.):663-668. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Babayan, R. K. Improving surgical site infections: Using national surgical quality improvement program data to institute surgical care improvement project protocols in improving surgical outcomes. Journal of Urology 2011 185(2):541. Exclusion Codes: LETTER

Balamongkhon, B., Thamlikitkul, V. Implementation of chlorhexidine gluconate for central venous catheter site care at Siriraj Hospital, Bangkok, Thailand. Am J Infect Control 2007 35(9):585-8. Exclusion Codes: NOT RELEVANT QUESTION

Balonov, K., Miller, A. D., Lisbon, A., Kaynar, A. M. A novel Meta-analysishod of continuous measurement of head of bed elevation in ventilated patients. Intensive Care Med 2007 33(6):1050-4. Exclusion Codes: NOT RELEVANT QUESTION

Banerjee, S., Shen, B., Baron, T. H., Nelson, D. B., Anderson, M. A., Cash, B. D., Dominitz, J. A., Gan, S. I., Harrison, M. E., Ikenberry, S. O., Jagannath, S. B., Lichtenstein, D., Fanelli, R. D., Lee, K., van Guilder, T., Stewart, L. E. Antibiotic prophylaxis for GI endoscopy. Gastrointest Endosc 2008 67(6):791-8. Exclusion Codes: GUIDELINE

Barie, P. S. Breaking with tradition: Evidence-based antibiotic prophylaxis of open fractures. Surgical Infections 2006 7(4):327-329. Exclusion Codes: GUIDELINE

Barie, P. S. Infection control practices in ambulatory surgical centers. JAMA - Journal of the American Medical Association 2010 303(22):2295-2297. Exclusion Codes: LETTER

Barria, R. M., Lorca, P., Munoz, S. Randomized controlled trial of vascular access in newborns in the neonatal intensive care unit. J Obstet Gynecol Neonatal Nurs 2007 36(5):450-6. Exclusion Codes: NOT RELEVANT INTERVENTION

Barrow, C. A patient's journey through the operating department from an infection control perspective. J Perioper Pract 2009 19(3):94-8. Exclusion Codes: EDITORIAL

Barwolff, S., Sohr, D., Geffers, C., Brandt, C., Vonberg, R. P., Halle, H., Ruden, H., Gastmeier, P. Reduction of surgical site infections after Caesarean delivery using surveillance. J Hosp Infect 2006 64(2):156-61. Exclusion Codes: NOT RELEVANT INTERVENTION

Battistella, M., Bhola, C., Lok, C. E. Long-term follow-up of the Hemodialysis Infection Preview articleention with Polysporin Ointment (HIPPO) study: A quality improvement report. American Journal of Kidney Diseases 2011 57(3):432-441. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Behta, M., Ross, B., Hong, F., Chaudhry, R., Hyman, S., Fracaro, M., Forman, B., Cooper, M., Boyer, A., Barrows, R. Automated identification, tracking and reporting of central line-associated blood streams infection to comply with required New York Not relevant statistical analysise reporting. AMIA Annu Symp Proc 2007:869. Exclusion Codes: NOT RELEVANT INTERVENTION

Beldi, G., Bisch-Knaden, S., Banz, V., Muhlemann, K., Candinas, D. Impact of intraoperative behavior on surgical site infections. Am J Surg 2009 198(2):157-62. Exclusion Codes: focus on preview articleentative intervention

Bellissimo-Rodrigues, F., Bellissimo-Rodrigues, W. T., Viana, J. M., Teixeira, G. C. A., Nicolini, E., Auxiliadora-Martins, M., Passos, A. D. C., Martinez, E. Z., Basile-Filho, A., Martinez, R. Effectiveness of oral rinse with chlorhexidine in preview articleenting nosocomial respiratory tract infections among intensive care unit patients. Infection Control and Hospital Epidemiology 2009 30(10):952-958. Exclusion Codes: NOT RELEVANT QUESTION

Bernstein, J., Meller, M. M. Antimicrobial prophylaxis to preview articleent surgical site infection. J Bone Joint Surg Am 2006 88(5):1149-50; discussion 1150-2. Exclusion Codes: LETTER

Berra, L., Cressoni, M., Li Bassi, G., Kolobow, T., Panigada, M., Zanella, A. Continuous lateral rotation therapy to preview articleent ventilator-associated pneumonia: the neglected effects of gravity on pathogenesis of ventilator-associated pneumonia. Crit Care Med 2010 38(3):1018-9; author reply 1019. Exclusion Codes: NOT RELEVANT INTERVENTION

Berriel-Cass, D., Adkins, F. W., Jones, P., Fakih, M. G. Clinical excellence series. Eliminating nosocomial infections at Ascension Health. Joint Commission Journal on Quality & Patient Safety 2006 32(11):612-620. Exclusion Codes: DUPLICATE STUDY/PATIENT POPULATION

Betts, P., Brink, S., Silink, M., Swift, P. G., Wolfsdorf, J., Hanas, R. Management of children and adolescents with diabetes requiring surgery. Pediatr Diabetes 2009 10 Suppl 12:169-74. Exclusion Codes: GUIDELINE

Bigsby, E., Lindsay, W., Pentlow, A., Kwok, D., Bannister, G. C. Communication and adherence to prophylactic antibiotic guidelines in patients with a proximal femoral fracture. J Hosp Infect 2010 76(2):185-7. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Bingham, M., Ashley, J., De Jong, M., Swift, C. Implementing a unit-level intervention to reduce the probability of ventilator-associated pneumonia. Nurs Res 2010 59(1 Suppl):S40-7. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Birch, P., Ogden, S., Hewson, M. A randomised, controlled trial of heparin in total parenteral nutrition to preview articleent sepsis associated with neonatal long lines: the Heparin in Long Line Total Parenteral Nutrition (HILLTOP) trial. Arch Dis Child Fetal Neonatal Ed 2010 95(4):F252-7. Exclusion Codes: NOT RELEVANT QUESTION

Bizzarro, M. J., Sabo, B., Noonan, M., Bonfiglio, M., Northrup, V., Diefenbach, K. A quality improvement initiative to reduce central line-associated bloodstream infections in a neonatal intensive care unit. Infection Control & Hospital Epidemiology 2010 31(3):241-248. Exclusion Codes: DUPLICATE STUDY/PATIENT POPULATION

Blot, F., Gachot, B., Nitenberg, G. Are urokinase rinses needed to reduce catheter-related bloodstream infections when standard preview articleentive guidelines are observed? J Clin Oncol 2008 26(14):2415-6; author reply 2416. Exclusion Codes: EDITORIAL

Blot, S., Labeau, S., Vandijck, D. Implementation of guidelines for the preview articleention of ventilator-associated pneumonia. Am Surg 2008 74(2):183-4; author reply 184. Exclusion Codes: LETTER

Bonello, R. S., Fletcher, C. E., Becker, W. K., Clutter, K. L., Arjes, S. L., Cook, J. J., Petzel, R. A. An intensive care unit quality improvement collaborative in nine Department of Veterans Affairs hospitals: reducing ventilator-associated pneumonia and catheter-related bloodstream infection rates. Joint Commission Journal on Quality & Patient Safety 2008 34(11):639-645. Exclusion Codes: NOT RELEVANT STATISTICAL ANALYSIS

Bonten, M. J. Preview articleention of ventilator-associated pneumonia: bugs or drugs? Am J Respir Crit Care Med 2010 182(8):993-4. Exclusion Codes: EDITORIAL

Bopp, M., Darby, M., Loftin, K. C., Broscious, S. Effects of daily oral care with 0.12% chlorhexidine gluconate and a standard oral care protocol on the development of nosocomial pneumonia in intubated patients: a pilot study. J Dent Hyg 2006 80(3):9. Exclusion Codes: NOT RELEVANT QUESTION

Borghesi, A., Stronati, M. Strategies for the preview articleention of hospital-acquired infections in the neonatal intensive care unit. Journal of Hospital Infection 2009 71(1):96-97. Exclusion Codes: LETTER

Boriboonhirunsarn, D., Lauwahutanont, P., Kaewmanee, K., Hangsubcharoen, M., Uppagan, R., Makanantakosol, S. Usage of prophylactic antibiotics in uncomplicated gynecologic abdominal surgery in Siriraj hospital. J Med Assoc Thai 2007 90(6):1068-73. Exclusion Codes: NOT RELEVANT INTERVENTION

Borschel, D. M., Chenoweth, C. E., Kaufman, S. R., Hyde, K. V., VanDerElzen, K. A., Raghunathan, T. E., Collins, C. D., Saint, S. Are antiseptic-coated central venous catheters effective in a real-world setting? Am J Infect Control 2006 34(6):388-93. Exclusion Codes: NOT RELEVANT INTERVENTION

Bouadma, L., Mourvillier, B., Deiler, V., Derennes, N., Le Corre, B., Lolom, I., Regnier, B., Wolff, M., Lucet, J. C. Changes in knowledge, beliefs, and perceptions throughout a multifaceted behavioral program aimed at preview articleenting ventilator-associated pneumonia. Intensive Care Med 2010 36(8):1341-7. Exclusion Codes: NOT RELEVANT QUESTION

Bouadma, L., Mourvillier, B., Deiler, V., Le Corre, B., Lolom, I., Regnier, B., Wolff, M., Lucet, J. C. A multifaceted program to preview articleent ventilator-associated pneumonia: impact on compliance with preview articleentive measures. Crit Care Med 2010 38(3):789-96. Exclusion Codes: DUPLICATE STUDY/PATIENT POPULATION

Bowater, R. J., Stirling, S. A., Lilford, R. J. Is antibiotic prophylaxis in surgery a generally effective intervention? Testing a generic hypothesis over a set of Meta-analysis a-analyses. Ann Surg 2009 249(4):551-6. Exclusion Codes: META-ANALYSIS

Bowton, D. L. Resolution of ventilator-associated pneumonia: is my patient getting better? Crit Care Med 2010 38(1):308-9. Exclusion Codes: EDITORIAL

Boyer, D. R., Steltzer, N., Larrabee, J. H. Implementation of an evidence-based bladder scanner protocol. J Nurs Care Qual 2009 24(1):10-6. Exclusion Codes: NOT RELEVANT QUESTION

Bozikis, M. R., Braun, B. I., Kritchevsky, S. B. How accurately are starting times documented in the medical record? Implications for surgical infection preview articleention performance measurement. Infection Control and Hospital Epidemiology 2010 31(3):307-309. Exclusion Codes: NOT RELEVANT OUTCOME

Brandt, C., Sohr, D., Behnke, M., Daschner, F., Ruden, H., Gastmeier, P. Reduction of surgical site infection rates associated with active surveillance. Infect Control Hosp Epidemiol 2006 27(12):1347-51. Exclusion Codes: NOT RELEVANT INTERVENTION

Brandt, C., Hott, U., Sohr, D., Daschner, F., Gastmeier, P., Ruden, H. Operating room ventilation with laminar airflow shows no protective effect on the surgical site infection rate in orthopedic and abdominal surgery. Ann Surg 2008 248(5):695-700. Exclusion Codes: NOT RELEVANT INTERVENTION

Brandt, C., Ruden, H., Gastmeier, P. Protective Effect of HEPA-Filtered Operating Room Air Ventilation With or Without Laminar Airflow on Surgical Site Infections. Ann Surg 2009. Exclusion Codes: NOT RELEVANT INTERVENTION

Brilli, R. J., Sparling, K. W., Lake, M. R., Butcher, J., Myers, S. S., Clark, M. D., Helpling, A., Stutler, M. E. The business case for preview articleenting ventilator-associated pneumonia in pediatric intensive care unit patients. Jt Comm J Qual Patient Saf 2008 34(11):629-38. Exclusion Codes: NOT RELEVANT INTERVENTION

Brito, V., Niederman, M. S. Standardized care for nosocomial pneumonia is a valuable tool to improve patient outcomes: How do we get intensivists to listen? Critical Care Medicine 2009 37(1):350-352. Exclusion Codes: COMMENTARY

Brokenshire, E., Plank, L. D., Gillanders, L. K., McIlroy, K., Parry, B. R. Adult total parenteral nutrition at Auckland City Hospital: a 6-year review articleiew. N Z Med J 2009 122(1297):17-24. Exclusion Codes: NOT RELEVANT INTERVENTION

Brooke, B. S., Meguid, R. A., Makary, M. A., Perler, B. A., Pronovost, P. J., Pawlik, T. M. Improving surgical outcomes through adoption of evidence-based process measures: intervention specific or associated with overall hospital quality? Surgery 2010 147(4):481-90. Exclusion Codes: NOT RELEVANT QUESTION

Brun-Buisson, C. Preview articleenting ventilator associated pneumonia. BMJ 2007 334(7599):861-2. Exclusion Codes: EDITORIAL

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Appendix C. Evidence Tables

Appendix Table C1: Study characteristics for VAP which control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Apisarnthanarak, Thailand - 2007	Controlled interrupted time series	VAP	Tertiary care or university hospital	Medical Intensive Care Unit Coronary Care Unit	2004 - 2006	36	CDC definition was used. Baseline period (Period 1) was from January 1, 2003 through December 31, 2003. Intervention (Period 2) was implemented from January 1, 2004 through December 31, 2004. Follow-up period (Period 3) was from January 1, 2005 through December 31, 2006. The surgical ICU and coronary care unit served as controls.
Berenholtz, United States - 2011	Simple before-after	VAP	More than one hospital of different types	Medical Intensive Care Unit Mixed ICU, Surgical/Trauma ICU, Cardiac ICU	2004 - 2006	30	CDC definition was used. 112 ICUs from 72 hospitals participated. March 2004 ICUs began implementing patient safety interventions.
Bouadma, France - 2010	Interrupted time series	VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2005 - 2008	30	VAP definition is spelled out on page 1117. Baseline period was from January 1, 2002 through September 30, 2005. Intervention was implemented from October 1, 2005 through December 31, 2005. Follow-up period was from January 1, 2006 through June 30, 2008. Baseline period for VAP rates was 45 months long while baseline period for compliance was one time point before the intervention.
DePalo, United States - 2010	Simple before-after	CLABSI;VAP		coronary ICU, respiratory ICU, intermediate care ICU, neurosurgery ICU, trauma ICU	2005 - 2008	27	23 adult ICUs total. All ICUs in Rhode Island were included. CLABSI Education intervention began November 2005. Baseline data collected January 2006 to March 2006 which was during the intervention period. Education intervention for VAP began March 2006. CLABSI and VAP Intervention dates: April 1, 2006 to June 30 2008.
Dubose, United States - 2010	Simple before-after	VAP	Tertiary care or university hospital	Trauma ICU		14	CDC/NNIS definition was used. Specific dates were not given. First month was used as baseline for process measures and year prior to study was used as baseline for infection rates.
Hawe, United Kingdom - 2009	Interrupted time series	VAP	Community hospital with residents	Medical/Surgical ICU	2007 - 2007	10	Hospitals in Europe Links for Infection Control Surveillance (HELICS) definition was used. Passive Implementation was from September 2005 through February 28, 2007. Active Implementation was from March 1, 2007 through December 31, 2007.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Kulvatunyou, Thailand - 2007	Simple before-after	VAP			2003 - 2003	12	Used CDC definition. Baseline period was from July 1, 2002 through June 30, 2003. The intervention was given April 2003. Follow-up period was from July 1, 2003 through June 30, 2004.
Marra, Brazil - 2009	Interrupted time series	VAP	Tertiary care or university hospital	Medical/Surgical ICU	2001 - 2008	90	CDC definition was used. Phase 1 was from March 2001 through December 2002. Phase 2 was from January 2003 through December 2006. Phase 3 was from January 2007 through September 2008.
Mori, Japan - 2006	Simple before-after	VAP	Tertiary care or university hospital	medical-surgical ICU	1997 - 2002	59	Baseline: January 1995 to December 1996; Intervention: January 1997 to December 2002.
Omrane, Canada - 2007	Simple before-after	VAP	Tertiary care or university hospital	Mixed ICU	2004 - 2005	6	Definition from Zack et al (Crit Care Med 2002; 30: 2407-12) and Babcock et al (Chest 2004; 125: 2224-31) was used. Baseline period was from November 8, 2003 through May 8, 2004. The education and protocol was initiated in October 2004. The follow-up period was from November 8, 2004 through May 8, 2005.
Papadimos, United States - 2008	Interrupted time series	VAP	Tertiary care or university hospital	Surgical Intensive Care Unit	2004 - 2005	54	CDC definition was used. Baseline period was from January 1, 2003 through December 31, 2003. The Pre-FASTHUG period was from January 1, 2004 through December 31, 2004. The post-FASTHUG period was from January 1, 2005 through June 30, 2007. Infection rates were not reported for the overall pre-intervention period. It is broken into 2 time periods.
Prospero, Italy - 2008	Simple before-after	VAP	Tertiary care or university hospital	Medical/Surgical ICU	2006 - 2006	4	CDC definition was used. Baseline period was from January 2006 through April 2006. The intervention was given in April of 2006. Post-intervention period was from May 2006 through August 2006.
Scales, Canada - 2011	RCT – Location	CLABSI;VAP	More than one hospital of different types	Medical/Surgical ICU	2005 - 2007	4	15 ICUs, one per hospital, took part in this study. All hospitals were community hospitals. Trial ran from November 1, 2005 to October 31, 2006. From December 1, 2006 through August 31, 2007, ICU's received interventions that they had not received during the trial. The study design details are outlined in Scales et al. Implement Sci 2009; 4:5.; Only adherence rates
Zaydfudim, United	Controlled	VAP	Tertiary care	Surgical Intensive	2007 - 2008	12	Pre-intervention period was from January 2005

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
States - 2009	interrupted time series		or university hospital	Care Unit			through June 2007. Post-intervention period was from August 2007 through July 2008.

Appendix Table C1: Study characteristics for CLABSI which control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Apisarnthanarak, Thailand - 2010	Interrupted time series	CLABSI	Tertiary care or university hospital	All units of the hospital	2006 - 2008	24	Although this is a Thai study, CDC definitions of CLABSI were used.; Baseline: July 1, 2005, to June 30, 2006; Intervention: July 1, 2006, to June 30, 2007 -CLABSI bundle only; July 1, 2007, to June 30, 2008 - CLABSI bundle with intensified hand hygiene intervention; Central venous catheters (CVCs) were placed by internists, intensivists, surgeons, and resident physicians throughout all units in the hospital.
Barsuk, United States - 2009	Controlled before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit	2006 - 2008	16	CDC/NNIS definitions were used.
Costello, United States - 2008	Interrupted time series	CLABSI	Quaternary Care Pediatric Institution	Pediatric Cardiac Intensive Care Unit	2005 - 2006	24	CDC/NHSN definition was used. Baseline: April 2004 to December 2004. Partial Intervention: January 2005 to March 2006. Full Intervention: April 2006 to December 2006.
DePalo, United States - 2010	Simple before-after	CLABSI;VAP		coronary ICU, respiratory ICU, intermediate care ICU, neurosurgery ICU, trauma ICU	2005 - 2008	27	23 adult ICUs total. All ICUs in Rhode Island were included. CLABSI Education intervention began November 2005. Baseline data collected January 2006 to March 2006 which was during the intervention period. Education intervention for VAP began March 2006. CLABSI and VAP Intervention dates: April 1, 2006 to June 30 2008.
Duane, United States - 2009	Simple before-after	CLABSI	Tertiary care or university hospital	Surgical trauma intensive care unit (STICU)	2004 - 2006	30	Study was prospectively conducted in three sequential "groups": Group 1 (pre-protocol): Jan 2003 - June 2004; Group 2 (Post-protocol): July 2004-June 2005; up 3 (Post-protocol, amplified): Jan 2003-June 2004. CDC definition BSI was used.
Khouli, United States - 2011	Controlled before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit, Surgical Intensive Care Unit	2007 - 2009	6	CDC/NNIS definitions were used.
McKee, United States - 2008	Simple before-after	CLABSI	Tertiary care or university hospital	Pediatric Intensive Care Unit	2004 - 2006	31	CDC/NNIS definitions were used.
Miller, United States - 2010	Interrupted time series	CLABSI	More than one hospital of different types	Pediatric Intensive Care Unit	2006 - 2007	11	CDC definition was used.
Perez Parra,	Controlled	CLABSI	Tertiary care	Medical, General	2006 - 2007	9	Used CDC definition (Horan, 2004). roll-plate

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Spain - 2010	before-after		or university hospital	postsurgery, Cardiac postsurgery ICU			technique of Maki et al (N Engl J Med 1977; 296: 1305 1309) and interpretative criteria for culturing CVC tip samples
Pronovost, United States - 2010	Simple before-after	CLABSI	More than one hospital of different types	Adult ICUs	2004 - 2005	36	CDC definition was used. 90 adult ICUs from 61 hospitals participated. March 2004 was the beginning of the intervention implementation. Baseline rate was taken during March through May 2004 from ICUs that had not started implementation of the interventions yet.
Scales, Canada - 2011	RCT – Location	CLABSI;VAP	More than one hospital of different types	Medical/Surgical ICU	2005 - 2007	4	15 ICUs, one per hospital, took part in this study. All hospitals were community hospitals. Trial ran from November 1, 2005 to October 31, 2006. From December 1, 2006 through August 31, 2007, ICU's received interventions that they had not received during the trial. The study design details are outlined in Scales et al. Implement Sci 2009; 4:5.; Only adherence rates
Schulman, United States - 2011	Simple before-after	CLABSI	More than one hospital of different types	NICU	2007 - 2009		CDC definitions for CLABSI.; 18 Regional Perinatal Care Center (RPC) NICUs.
Seguin, France - 2010	Simple before-after	CAUTI;CLABSI	Tertiary care or university hospital	Surgical Intensive Care Unit	2006 - 2007	9	International definitions were used. Baseline period was from August 2005 through May 2006. Patients were only followed while in the ICU.
Zingg, Switzerland - 2009	Simple before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit, Surgical Intensive Care Unit Cardiovascular ICU, Trauma ICU, Neurosurgery ICU	2004 - 2004	5	CDC/NHSN definition was used. Baseline was from September 2003 through December 2003. Took place in 5 ICUs at 1 hospital.

Appendix Table C1: Study characteristics for SSI which control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Burkitt, United States - 2009	Simple before-after	SSI	one surgical unit in one Veterans Affairs hospital	Operating Room pharmacy	2001 - 2004	12	Only adherence rates reported, no SSI. Interventions were rolled out over the course of several yrs. 2000 is a pre-period for all interventions. In 2001-2002, an intervention to reduce MRSA was initiated. In 2002-2003, this evolved into an intervention to improve antibiotic administration. SSI rates are presented for all yrs, comparing all yrs data, but with special analysis performed comparing 2004 data to the previous yrs since 2004 was the 1st yr after all interventions were implemented.
Hedrick, United States - 2007	Simple before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit	2004 - 2005	10	Many interventions were rolled out at different times during the course of the study period, some implemented while the pre-data was being collected. Because of this overlap, the effect of the intervention may be underestimated. SSI defined according to Surgical Wound Infection Task Force guidelines, which is a modification of the CDC criteria.
Kaimal, United States - 2008	Simple before-after	SSI	Tertiary care or university hospital	Operating Room	2006 - 2007	12	Uncertain how SSI defined.; 1 Institution, 1316 term C-Sections. They define the pre-period from Jan03-Mar05 and that is the baseline. There is an in-between period, from Mar05-Jun06, when they tried several interventions that they say did not work, so they tried a new intervention beginning in Jun06. The post-period is Jun06-Jun07 and they compare this period of time to the baseline, Jan03-Mar05
Kao, United States - 2010	Stepped wedge (non-randomized)	SSI	Tertiary care or university hospital	Operating Room Pre-op area	2007 - 2009	14	The study design was a modified step-wedge design which they called a staggered cohort design. One hospital received the intervention at the beginning, and then 6 months later, the second hospital received the intervention. Hospital 1 had 14 months of follow-up and hospital 2 had 6 months of follow-up. Uncertain how SSI were defined.
Kritchevsky, United States - 2008	RCT – Location	SSI	More than one hospital of different types	Operating Room varied among intervention hospitals	2003 - 2005	18	No SSI rates reported, only adherence rates.; 44 Acute Care Hospitals
Mannien, Netherlands - 2006	Interrupted time series	SSI	More than one hospital of different types	Operating Room	2001 - 2002	11	Follow-up time varied for different hospitals, 6-11 mos. Pre-intervention period from January 2000 to November 2001; CDC definition was used
Trussell, United States - 2008	Simple before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit Pre-op area	-		The study took place in a 39-month period, with the intervention implemented "in the middle". No dates were given. SSI determined using NNIS definition.

Appendix Table C1: Study characteristics for CAUTI which control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Apisarnthanarak, Thailand - 2007	Interrupted time series	CAUTI		Medical Inpatient Ward, Surgical Inpatient Ward, ICU	2005 - 2006	12	Baseline: July 1, 2004 - June 30, 2005; f/u: July 1, 2005 - June 30, 2006; NNIS definition used for UTI.
Crouzet, France - 2007	Simple Before-after	CAUTI	Tertiary care or university hospital	neurosurgery, cardiovascular surgery, orthopedic surgery, neurology, and geriatric departments	2005 - 2005	3	Study consisted of 3-month prospective observational phase followed by a 3-month prospective intervention phase (1 Jan 2005 - 30 June 2005). CDC's definition of CAUTI was used. There is no overall CAUTI rate, just early and late CAUTI.
Loeb, Canada - 2008	RCT – Patient	CAUTI	More than one hospital of different types	General Inpatient Ward (non-ICU)	2004 - 2006	30	CDC definition was used to define symptomatic UTI.; Trial conducted among patients admitted to one of seven general medical units in 3 hospitals. Cultures were taken 7 days after UC removal.
Seguin, France - 2010	Simple before-after	CAUTI;CLABSI	Tertiary care or university hospital	Surgical Intensive Care Unit	2006 - 2007	9	International definitions were used. Baseline period was from August 2005 through May 2006. Patients were only followed while in the ICU.

Appendix Table C2: Patient characteristics for VAP which control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Apisarnthanarak, Thailand - 2007	VAP	Educational Program	Provider Education	Intervention Team	Nurses, Respiratory Therapists	1	pre: 470; post1: 482; post2: 952
Berenholtz, United States - 2011	VAP	Comprehensive Unit-Based Safety Program (CUSP)	Organizational Change, Provider Education	Team of Frontline Staff	All Clinical Staff	72	
Berenholtz, United States - 2011	VAP	VAP Bundle and Daily Goal Sheets	Audit and Feedback, Organizational Change, Patient Education, Provider Education	Local ICU Improvement Team	All Clinical Staff	72	
Bouadma, France - 2010	VAP	Multifaceted Prevention Program	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary Task Force	All Clinical Staff	1	pre: 856; post1: 74; post2: 835
DePalo, United States - 2010	CLABSI;VAP	VAP Education Program and Bundle				11	
Dubose, United States - 2010	VAP	Quality Rounds Checklist (QRC)	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	All Clinical Staff	1	pre: 577; post: 570
Hawe, United Kingdom - 2009	VAP	Active Implementation	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Study Staff	All Clinical Staff	1	passive: 374; active: 215
Hawe, United Kingdom - 2009	VAP	Passive Implementation	Organizational Change	Critical Care Development Group	All Clinical Staff	1	374
Kulvatunyou, Thailand - 2007	VAP	Educational Program		Study Staff		1	Pre-intervention: 85; Post-intervention: 89
Marra, Brazil - 2009	VAP	VAP Bundle	Audit and Feedback, Organizational Change, Provider Education	Study Staff	All Clinical Staff	1	

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Mori, Japan - 2006	VAP	Oral Care Intervention	Organizational Change	Study Staff	Patients Dentists	1	pre: 414; post: 1,248
Omrane, Canada - 2007	VAP	VAP Prevention Protocol	Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	All Clinical Staff	1	pre: 349; post: 360
Papadimos, United States - 2008	VAP	FASTHUG protocol	Audit and Feedback, Organizational Change	Intensivist-led Critical Care Team	All Clinical Staff	1	pre: 1315; post: 1653
Prospero, Italy - 2008	VAP	Educational Program	Provider Education	Hospital Hygiene Service	All Clinical Staff	1	pre: 104; post: 81
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP	Audit and Feedback, Provider Education, Provider Reminder Systems	Study Staff	All Clinical Staff	15	intervention: 4651; control: 4618
Zaydfudim, United States - 2009	VAP	VAP Electronic Dashboard	Audit and Feedback, Organizational Change, Provider Reminder Systems	Critical care team	All Clinical Staff	1	

Appendix Table C2: Patient characteristics for CLABSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Apisarnthanarak, Thailand - 2010	CLABSI	Period 3: Intensified hand hygiene promotion plus CLABSI bundle	Audit and Feedback, Organizational Change, Provider Education	Multidisciplinary Team	All clinical staff	1	pre: 1115; post1: 1050; post2: 1204
Barsuk, United States - 2009	CLABSI	CVC Insertion Simulation	Provider Education	Study Staff	Medical Residents	1	
Costello, United States - 2008	CLABSI	Full Intervention: Pediatric Multidisciplinary CLABSI Bundle	Audit and Feedback, Financial incentives, Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	Nurses, Physicians	1	pre: 911; post1: 1472; post2: 936
DePalo, United States - 2010	CLABSI;VAP	CLABSI Education Program and Bundle		Rhode Island Quality Institute		11	
Duane, United States - 2009	CLABSI	Group 3: Central venous line (CVL) protocol + CVL supply cart + nurse education + nurse checklist and nurse empowerment	Organizational Change, Provider Education, Provider Reminder Systems	Study Staff	Nurses, Physicians	1	Group 1: 135; Group 2: 194; Group 3: 213
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	Provider Education	Study Staff	Medical Residents	1	
McKee, United States - 2008	CLABSI	CLABSI education, cart, checklist, and nurse empowerment	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Study Staff	Nurses, Physicians	1	
Miller, United States - 2010	CLABSI	Bundle - CLABSI	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	All Clinical Staff	27	
Perez Parra, Spain - 2010	CLABSI	CLABSI Education	Provider Education	Study Staff	Nurses, Physicians Residents and nursing students	1	

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Pronovost, United States - 2010	CLABSI	Conceptual Model - CDC CLABSI Bundle	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	MHA Keystone Center for Patient Safety and Quality, ICU team	All Clinical Staff	61	
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP	Audit and Feedback, Provider Education, Provider Reminder Systems	Study Staff	All Clinical Staff	15	intervention: 4651; control: 4618
Schulman, United States - 2011	CLABSI	Bundle - CLABSI	Organizational Change, Provider Education, Provider Reminder Systems	Study staff	All Clinical Staff	18	
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration	Provider Reminder Systems	Study Staff	Nurses, Physicians	1	pre: 676; post: 595
Zingg, Switzerland - 2009	CLABSI	Educational Program for catheter care and hand hygiene	Organizational Change, Provider Education	Study Staff	All Clinical Staff	1	pre: 499; post: 500

Appendix Table C2: Patient characteristics for SSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Burkitt, United States - 2009	SSI	Toyota Production System- approprate antibiotic choice and duration	Organizational Change, Provider Education, Provider Reminder Systems	Administration	All Clinical Staff pharmacists	1	pre: 2550; post:1779
Hedrick, United States - 2007	SSI	bundle - antibiotic prophylaxis	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	multidisciplinary team	All Clinical Staff pharmacists	1	pre: 379; post: 390
Hedrick, United States - 2007	SSI	bundle - normothermia	Organizational Change	multidisciplinary team	All Clinical Staff	1	pre: 379; post: 390
Hedrick, United States - 2007	SSI	bundle - glucose control	Organizational Change	multidisciplinary team	All Clinical Staff	1	pre: 379; post: 390
Kaimal, United States - 2008	SSI	implement policy on timing of antibiotic prophylaxis	Organizational Change	task force comprised of physicians, nurses, administrators, and personnel from hospital infection control service	All Clinical Staff pharmacists	1	pre: 800; post: 516
Kao, United States - 2010	SSI	extended timeout for 2 hospitals, 1 with added education, 1 with added preop checklist	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	multidisciplinary team from 2 hospitals	All Clinical Staff	2	HOSP 1: pre: 119; period 1: 100; period 2: 97; period 3: 115; HOSP 2: pre: 92; period 1: 206; period 2: 154; period 3: 169
Kritchevsky, United States - 2008	SSI	joining a quality improvement collaborative	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	investigators who designed TRAPE (Trial to Reduce Antimicrobial Prophylaxis Errors)	All Clinical Staff pharmacists	feedback only: 22; feedback and intervention: 22	pre feedback only: 2234; pre feedback and intervention: 2213; post feedback only: 2238; post feedback and intervention: 2225
Mannien, Netherlands - 2006	SSI	Optimized antibiotic prophylaxis	Audit and Feedback, Organizational Change, Provider Education	The CHIPS study group	All Clinical Staff	12	pre: 1668; post: 1953

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Trussell, United States - 2008	SSI	protocol pathway for appropriate antibiotic use, hair removal, and glucose control	Organizational Change, Provider Education, Provider Reminder Systems	Team of cardiovascular surgeons, intensivists, clinical nurse specialists, and infection control personnel	All Clinical Staff	1	pre: 808; post: 674

Appendix Table C2: Patient characteristics for CAITI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Apisarnthanarak, Thailand - 2007	CAUTI	Daily physician reminders to remove unnecessary catheter		Intervention team		1	Pre: 1105; post: 1307
Crouzet, France - 2007	CAUTI	Physician reminder to remove catheter beginning on day 4	Provider Reminder Systems	Study Staff	Nurses, Physicians	1	pre: 141; post: 93
Loeb, Canada - 2008	CAUTI	Stop orders for indwelling urinary catheters	Organizational Change, Provider Reminder Systems	Study Staff	Nurses, Physicians	3	control: 345; study: 347
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration	Provider Reminder Systems	Study Staff	Nurses, Physicians	1	pre: 676; post: 595

Appendix Table C3: Intervention characteristics for VAP which control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Apisarnthanarak, Thailand - 2007	VAP	Feedback of baseline data was first given to the MICU staff and an action plan was developed. In period 2, an educational program began and was continuously monitored throughout period 3. A 10-page self-study module was given to the MICU staff to be completed. Before and after administration of the self-study module a 20 question exam was given. Staff who scored below an 80% were required to retake the module. The self-study module was encouraged for all nurses and respiratory staff, but not deemed mandatory. In addition to the educational module, posters, fact sheets, and in-service training sessions for nurses and respiratory therapists were used. The educational program was repeated every 6 months during periods 2 and 3 for the nurses and respiratory therapists. In-service sessions were provided for the first 3 months during period 2, then during month 6, and then every 6 months after that by the infectious disease specialist and focused on VAP prevention practices. Attendance was highly encouraged, but not mandatory. The surgical ICU and coronary care unit were used as controls and did not receive any new interventions for reducing VAP.		The baseline data was given to the MICU staff as feedback. The intervention team required MICU staff who scored under 80% to retake the educational module
Berenholtz, United States - 2011	VAP	Toolkit was provided along with a slideshow to educate and engage all ICU staff. The VAP bundle implemented included HOB elevation > 30 degrees, appropriate sedation, stress ulcer prophylaxis, deep vein thrombosis prophylaxis, and daily assessment for extubation. Local ICU Improvement teams were trained through semimonthly conference calls, coaching by study investigators, and semiannual statewide meetings. Improvement teams were instructed to partner with their hospital's infection preventionist to help with data collection. ICU Improvement teams posted compliance and VAP rates in the ICU to engage ICU staff. Study investigators reviewed published guidelines for VAP prevention and other supportive evidence during conference calls to educate local ICU teams. The toolkit given to the teams also included a one page "fact-sheet" summary and references to be used to educate their staff. ICU staff used a standardized tool, "Daily Goals" checklists to execute the intervention. Teams were		Monthly compliance and VAP rates were supplied to the ICU improvement teams. ICUs received de-identified reports from other participating ICUs as well to compare their performance.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		advised to make protocols and standard order sets. Families were told to ask whether the patient was receiving the bundle items. Teams received monthly compliance and VAP rates for their ICU and all other participating ICUs. The reports were de-identified.		
Bouadma, France - 2010	VAP	A multidisciplinary task force was formed which included five physicians and five nurses. They reviewed the literature and recent guidelines for preventing VAP and designed an educational program to promote 8 target recommendations among ICU nursing staff. The task force developed a 3-hour mandatory slide presentation with interactive discussion. Each participant was given a booklet with summary information. This was repeated for every 24 new employees. Screen savers were used as reminders and posters were put up around the ICU. Oral care, HOB elevation, and hand hygiene were some of the targeted preventive measures. A simple color-coded visual reminder was placed at the head of the bed to help staff visualize the optimal bed position.		Five performance assessments took place at baseline, 1 month, 6 months, 12 months, and 24 months. They were conducted by ten MICU physicians, nurses, and head nurses not affiliated with caring for ICU patients. After each assessment feedback was given to the MICU staff during regular meetings in the form of graphs documenting compliance and VAP rates. Screensavers also displayed these rates.
DePalo, United States - 2010	CLABSI;VAP	11 hospitals with 23 ICU units total; one of the hospitals have 4 ICU units and another have 10 units. The JHQSRG served as consultants communicating content for the educational sessions and conference calls. The content and coaching calls reinforced strategies. Education program content: educating staff on the science of safety, identifying hazards, identifying senior executive partners, learning from defects and implementing teamwork tools. Team members were empowered with the ability to stop procedures if safety was compromised. The CLABSI best-practice strategies targeted the clinician's use of five evidence-based behaviors recommended by the CDC, identified as being the most effective at reducing CLABSI. These behaviors included hand-washing, using full barrier precautions when inserting central access catheters, chlorhexidine skin-cleansing, avoiding the femoral site if possible and removing unnecessary catheters. All unit teams educated their bedside staff to best practice strategies and implemented processes by the end of the first quarter.		Throughout study period, teams received feedback on infection rates by accessing database reports and review with the project manager. Subcommittees had quarterly conference calls with physician champions.
Dubose, United States - 2010	VAP	A multidisciplinary team reviewed best-practices data and chose 16 prophylactic measures, 4 of which were for VAP.		Monthly feedback meetings were conducted by the multidisciplinary team and used to relay compliance and VAP

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		Then a tool was designed, the Quality Rounds Checklist (QRC), to quantify these prevention measures. The on-duty trauma ICU fellow and ICU team used the QRC daily during rounds to assess if compliance to the VAP bundle was being met. Nurses were in charge of pain assessment, restraint need, oral care, and daily CVC site evaluation. The nurse manager was in charge of checking completion of these measures. The QRC was also used to check compliance. Any components that were deemed non-compliant were highlighted for immediate correction. New fellows were trained in the appropriate use of the QRC. Regular in-services were conducted for the nursing staff discussing the importance of the prophylactic measures. A monthly multidisciplinary meeting was held to assess systemic deficiencies and develop strategies to improvement those areas. The fellow was in charge of presenting the data at the monthly meetings. From these meetings changes such as nursing and staff education on HOB elevation, laminated signs in patient rooms reminding providers of HOB elevation were initiated.		rates from the previous month as well as discuss changes that could improve compliance and infection rates.
Hawe, United Kingdom - 2009	VAP	Educational workshops started in March 2007 and covered various topics pertaining to VAP. The evidence base for the bundle was discussed. Written material was distributed for self-study. Compliance and VAP rates were displayed on the walls of the ICU and at multidisciplinary educational meetings. The pattern of VAP acquisition was frequently updated and discussed at educational meetings as well. When barriers to providing the bundle were met an iterative process to improve these took place. Adherence to the bundle was also promoted during daily rounds to increase collective ownership.		Compliance rates and VAP rates were hung up around the ICU as well as presented at educational meetings.
Kulvatunyou, Thailand - 2007	VAP	The educational program was modeled after Zack et al's paper, Crit Care Med 2002; 30: 2407-12. A 1-hour formal lecture was given to the ICU nursing staff. They were also given a handout with information about VAP. A 10 question pre-, post-lecture exam was given before and after the initial lecture and the second formal lecture six months later. Daily formal discussion rounds were also implemented and posters were hung up around the ICU.		
Marra, Brazil - 2009	VAP	During phase 1, a CDC VAP bundle was implemented and audited twice annually by the study staff. The bundle		Monthly feedback on compliance was given during all three phase. Posters around the ICU also provided feedback on VAP

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		included HOB elevation, no routine changing of humidified ventilator circuits, periodically draining and discarding condensate, and changing the heat-and-moisture exchangers. Study staff provided compliance feedback to all ICU staff through email. During phase 2, immediate correction of non-compliance was added to the aspects of phase 1. Feedback was still being provided. During phase 3,the hospital CEO decided zero tolerance for VAP. In response, the study staff intensified QI efforts monthly. The IHI VAP bundle (HOB elevation, daily sedation vacations, peptic ulcer prophylaxis, deep vein thrombosis prophylaxis, and daily assessment of extubation) was also implemented, staff education was initiated, and posters were hung around the ICU displaying compliance rates. In October 2007, oral care was added to the bundle. In February 2008, continuous aspiration of subglottic secretions was implemented. The bundle was monitored each weekday by an ICU nurse. The nurse would intervene at the same time if the bundle was found to be non-compliant.		rates and compliance
Mori, Japan - 2006	VAP	The oral status of patients in the oral care group was assessed at the time of admission to the ICU by a dentist or nurse working in the ICU, and an oral care nursing plan was established. Oral care was provided three times daily or once in every nursing shift as follows: 1. Check vital signs, then increase cuff pressure of the tracheal tube to 100 mmHg, and provide suction to remove oropharyngeal secretions in the oral cavity and portion of the trachea above the cuff. 2. Position the patient's head to the side and have the patient open his/her mouth; observe inside the oral cavity and assess the condition of soft and hard tissues. 3. Cleanse the oral cavity using a swab soaked in 20-fold diluted povidone-iodine gargle. 4. Cleanse the oral cavity using a tooth brush carefully and rinse with 300 ml weakly acidic water (rinsing alone is performed for patients without teeth and those with bleeding tendency). 5. Repeat cleansing of the oral cavity using a swab soaked in 20-fold diluted povidone-iodine gargle. 6. Provide suction of the oral cavity and portion of the trachea above the cuff and restore the cuff pressure. VAP detected within 48–96 h after the start of mechanical ventilation was defined as early-onset VAP (E-VAP), and		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		VAP developing beyond 96 h after the start of mechanical ventilation was defined as late-onset VAP (L-VAP). VAP was suspected when a new, persistent, or progressive infiltrating shadow was observed on chest radiography at least 48 h after the start of mechanical ventilation, and when two of the following criteria were met: temperature higher than 38°C, leukocyte count higher than 10,000/mm3, or presence of purulent respiratory tract secretions. VAP was definitively diagnosed when a specimen of bronchoscopic tracheobronchial secretions was subjected to semi-quantitative culture and a result of 1+ (corresponding to 104–105 cfu/mL on quantitative culture) or more was confirmed.		
Omrane, Canada - 2007	VAP	Nurses, respiratory therapists, intensivists, and pharmacists were involved in developing and implementing the protocol. The VAP protocol focused on nutrition, patient positioning, hand hygiene, stress ulcer prophylaxis, and ventilator circuit. A laminated copy of the protocol was included in the patient's chart. At the time of introduction of the protocol an educational session was held. In addition to the protocol, 12 in-service trainings were held for all ICU staff the two weeks preceding the protocol adoption. Additional in-service programs were held throughout the study period. Posters were also hung around the ICU.		Two investigators evaluated protocol compliance and provide feedback to the ICU staff.
Papadimos, United States - 2008	VAP	FASTHUG is an acronym for daily evaluation of Feeding, Analgesia, Sedation, Thromboembolic prophylaxis, elevation of the Head of the bed, Ulcer prophylaxis, and Glucose control. Oral care and hand hygiene were also a part of the protocol. In November 2003 an intensivist-led critical care team model was adopted in the SICU. The team consisted of faculty physicians, anesthesiologists, surgery residents, medical students, nurses, a pharmacist, and respiratory therapists. In 2004, interventions were asked to be implemented, but not enforced except for hand washing. Hand washing was highly enforced by 'secret shoppers' (infection control department officials pretending to not be from the IC department). In 2005, FASTHUG was added to the daily patient evaluation and emphasized during rounds by the critical care team. Its information was used to adjust daily patient care plans.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Prospero, Italy - 2008	VAP	In March 2006, the ICU staff contacted the Hospital Hygiene Service for help with improving their infection control practices. In April an educational program on CDC Guidelines for preventing VAP was presented to all physicians and nurses. During April and May alcohol-based hand sanitizer was introduced to the ICU staff.		
Scales, Canada - 2011	CLABSI;VAP	The 15 ICUs were split into 2 groups and were randomized to receive an intervention while acting as a control for an ICU in the other group. There were 3 phases, each phase was 4 months long. Each ICU received a different intervention in each phase. At the end of the trial, the ICUs would received the interventions that they acted as controls for in 3 month phases. This was called the decay-monitoring period. A central coordinating office conducted the interventions, disseminated the educational and promotional materials, arranged videoconferences, and analyzed the data. All participating ICUs were given videoconference equipment. An expert advisory panel generated a list 15 best practices which were given to the ICU directors. The ICU directors rated which ones they found most applicable and the top six were the ones implemented in this study. For each best practice, a bibliography of relevant literature was generated and presented in easy-to-read bulletins. A content expert provided the interactive educational sessions through videoconference. The presentations were available on a website for reference. ICUs were also encouraged to provide their own in-services and educational programs. Process measures were audited daily and monthly feedback reports were given to the ICU staff. De-identified information for all participating hospitals were included in the feedback reports. ICUs were encouraged to use posters and lapel pins to remind clinicians of the best practices. Examples of pre-printed order sets and checklists were also supplied to the ICUs. The Ontario Telemedicine Network videoconferencing infrastructure was used to provide the educational sessions from the content experts, conduct monthly network meetings, and host training sessions for data collectors and site educators.		Monthly feedback reports were provided to each ICU. The report included identified data for the ICU and de-identified data for the rest of the participating ICUs.
Zaydfudim, United	VAP	An electronic dashboard was designed to display real-time		The dashboard allows for instant compliance feedback and ICU

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
States - 2009		VAP compliance for each parameter. If the parameter was green then it was in compliance. If it was yellow then the parameter was soon due. If it was red then the parameter was not in compliance. The dashboard was the screensaver for all of the computers in the ICU. Compliance with dashboard parameters were reviewed twice daily at during rounds. Physician and nursing leadership received daily compliance reports. The VAP bundle had been initiated in January 2002 in this ICU, but had poor compliance and no change in VAP rates. The respiratory therapist team was in charge of performing spontaneous breathing trials. The sedation score goal was set by the critical care team. Bedside nurses were in charge of titrating the sedatives in order to achieve sedation score goal. Bedside nurses also implemented HOB elevation, oral care, and hypopharyngeal suctioning.		leadership were given daily compliance reports.

Appendix Table C3: Intervention characteristics for CLABSI which control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Apisarnthanarak, Thailand - 2010	CLABSI	Each intervention and baseline period consisted of 12 months. From June 1 to 30, 2006, the team provided feedback on baseline data to the hospital nursing staff and physician, and an action plan was developed. During period 2 (July 1, 2006, to June 30, 2007), alcohol- based hand rub (75% isopropyl alcohol) dispensers were attached to the rails of all patient beds, and the CA-BSI prevention bundle was implemented. Components of CA BSI bundle included (1) hospital-wide HCW education on proper hand hygiene practices following the World Health Organization's (WHO) ''Five Moments for Hand Hygiene'' campaign,9 (2) education of physicians on the use of maximum sterile barrier precautions during CVC insertion, (3) use of a chlorhexidine- based skin preparation, (4) optimization of CVC insertion practices (e.g., avoidance of femoral insertion sites), and (5) daily review of the need for CVC in each patient. The CVC dressing was changed every 48 hours if using a gauze dressing and tape and every 7 days if using a transparent dressing. The educational program on hand hygiene and maximum sterile barrier precautions consisted of a single 45-minute interactive educational session and was repeated every 4 months. During period 3 (July 1, 2007, to June 30, 2008), an intensified hand hygiene intervention was introduced. As part of this education, all HCWs were required to demonstrate proper hand hygiene practice and confirm adequate practice with the fluorescence dye test. After the presentation, we distributed a hand hygiene fact sheet. All patients admitted to the hospital were prospectively followed by the intervention team, comprising the head nurse, an ICS, an infectious disease consultant, and a hospital epidemiologist, throughout the entire study period.		During the period 3, feedback on hand hygiene compliance rates and maximum sterile barrier precaution use were provided to each nursing unit through a monthly infection control newsletter and posters. Feedback was not available for health care workers during the period 2.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Barsuk, United States - 2009	CLABSI	Residents in the simulator-trained group took a baseline test (pretest) in CVC insertion using a simulator and a 27-item CVC skills checklist. Subsequently, these residents completed 2-two hour education sessions. The first hour contained a videotaped lecture on the technique, indications, contraindications, and complications of CVC insertion and a step-by-step demonstration of CVC insertion technique. Evidence-based guidelines for CRBSI reduction were emphasized (hand washing, full sterile barrier technique, chlorhexidine skin preparation, avoidance of the femoral site, and prompt CVC removal). The remaining 3 hours of education featured training with an ultrasonographic device and the opportunity for deliberate practice on the simulator with focused feedback. After training, residents underwent a posttest using the CVC skills checklist and were expected to meet or exceed a minimum passing score (MPS) set by an expert panel in both internal jugular and subclavian CVC insertion. Residents who did not achieve the MPS underwent more deliberate practice and were retested until the MPS was reached. Traditionally trained internal medicine and emergency medicine residents attended a lecture series on bedside procedures at the beginning of the academic year and did not undergo training on the CVC simulator. Central venous catheter patient care bundles were used throughout NMH during the study period. The bundles mandate sterile technique, full barrier drapes, and insertion site disinfection with chlorhexidine, 2%, according to recommendations of the Institute for Healthcare Improvement (IHI). In the last 4 months of the 32-month study period, chlorhexidine impregnated bodywipes were used for most patients in the MICU.		During the simulator training, residents were given very focused feedback on their technique. If the residents didn't meet or exceed the minimum passing score, they underwent more practice and retested.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Costello, United States - 2008	CLABSI	Partial intervention period (January 2005 through March 2006): A CICU based infection control nurse position (0.75 full-time equivalent) was established to facilitate the intervention. The manager of the hospital's infection control program provided mentoring and instruction critical to the development of this position. This nurse collaborated closely with the hospital's infection control staff members and assumed primary responsibility for prospective CLABSI surveillance, instruction during educational sessions, and implementation of evidence-based practice changes. Mandatory, detailed, educational sessions regarding CLAB prevention were conducted for all CICU nursing and physician staff members and included PowerPoint presentations, a 15-page handout, question-and answer periods and, for nursing staff members, hands-on demonstrations of CVL access and maintenance techniques. A CVL insertion bundle (January 2005) was implemented in the CICU, cardiac catheterization laboratory, and cardiac operating rooms. Insertion bundle consisted of the following steps: Whether CVL necessity was confirmed with attending physician; CVL checklist for insertion was reviewed; Use of hand hygiene before donning and after removing gloves; Use of CVL insertion kit with maximal sterile barriers (Skin antisepsis: 2% chlorhexidine if patient of EGA of >37 wk or 70% alcohol X 3 if patient of EGA of <37 wk) and an included CVL insertion "observer" with a documented signature for sign-off. March 2005, both the access and maintenance bundle were initiated standardizing the technique for maintaining and changing CVL dressings. The access bundle emphasized sterile technique, including a 10-second alcohol scrub before each entry into a CVL hub. (Exact details of access and maintenance bundles on page 918 of paper). A hand hygiene campaign was simultaneously implemented. A daily goal sheet that emphasized the timely removal of	As part of a 3 year contract BCBS-MA offered financial incentives for decrease in CLABSI rates. Year 1 was used to establish a baseline. Year 2 and 3 had target rates. BCBS-MA received quarterly rolling average CLABSI rates and audited 20 charts per quarter.	CLABSI rates were provided to CICU physicians and nurses through educational sessions, morbidity and mortality conferences, electronic communications, and bedside rounds.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		CVLs once they were no longer clinically needed was introduced for use during morning rounds. Feedback on infection rates and reminders regarding compliance with existing initiatives were commonly provided during bedside rounds; feedback of current CLABSI rates and initiatives was provided to all CICU physician and nursing staff members through educational sessions, morbidity and mortality conferences, and electronic communications. Compliance with use of the CVL insertion bundle was assessed for all percutaneous CVLs placed in the cardiac operating rooms. Compliance with use of the CVL insertion and maintenance bundles was assessed when the unit based infection control nurse was available (three 12-hour shifts per week) for the procedure of all 2005 and quarterly during 2006. Medical staff members were generally aware that compliance with use of CVL insertion and maintenance bundles was being assessed. Compliance with hand hygiene in the CICU was assessed by trained observers on a periodic basis throughout the study period. Compliance was deemed adequate when hand hygiene was performed by a health care provider before the provider touched a patient or any invasive device, before the provider donned gloves, after the provider removed gloves, and before the provider left the patient room. Medical staff members generally were not aware that compliance with hand hygiene was being assessed. Compliance with use of the CVL access bundle was not assessed.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
DePalo, United States - 2010	CLABSI;VAP	11 hospitals with 23 ICU units total; one of the hospitals have 4 ICU units and another have 10 units. The JHQSRG served as consultants communicating content for the educational sessions and conference calls. The content and coaching calls reinforced strategies. Education program content: educating staff on the science of safety, identifying hazards, identifying senior executive partners, learning from defects and implementing teamwork tools. Team members were empowered with the ability to stop procedures if safety was compromised. The CLABSI best-practice strategies targeted the clinician's use of five evidence-based behaviors recommended by the CDC, identified as being the most effective at reducing CLABSI. These behaviors included hand-washing, using full barrier precautions when inserting central access catheters, chlorhexidine skin-cleansing, avoiding the femoral site if possible and removing unnecessary catheters. All unit teams educated their bedside staff to best practice strategies and implemented processes by the end of the first quarter.		Throughout study period, teams received feedback on infection rates by accessing database reports and review with the project manager. Subcommittees had quarterly conference calls with physician champions.
Duane, United States - 2009	CLABSI	In Group 2, the CVL protocol included minimizing CVL use, removal of the CVL ASAP, elimination of routine CVL changes and guidewire exchanges, strict universal precautions including maximal barrier precautions, and an educational program for rotating STICU residents. Group 3 (amplified protocol) included the CVL protocol from Group 2 plus a line supply cart, nursing education on the impact of BSI and their role in the prevention of BSI, a nursing checklist to ensure proper sterile technique, and nurse empowerment to stop the line placement in case of any violation of checklist.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Khouli, United States - 2011	CLABSI	Baseline assessment of performance in CVC simulation was conducted first for both groups of residents. Residents then received either training from a 20-minute video or simulation-based training plus video. After completion of training, the residents were scored again. After this, the authors compared rates of CLABSI in the MICU and SICU.		
McKee, United States - 2008	CLABSI	The improvement model included six interventions: 1) administering a pre-intervention survey of PICU attending and fellow physicians and nurses to assess current central catheter insertion practices; 2) implementing an educational intervention to increase provider and nurse awareness of evidence-based infection control practices for inserting and maintaining central catheters; 3) creating a dedicated catheter insertion/procedure cart to make it easier for providers to follow guidelines for sterile central venous catheter insertion; 4) implementing a checklist to ensure adherence to evidence-based guidelines for central catheter insertion and provide independent double-checking of adherence; 5) empowering nurses to stop the procedure if evidence- based guidelines were not followed; and 6) providing real-time weekly feedback to ICU doctors and leaders on performance. The educational program was a web-based training module, similar to the one already being used for the adult ICUs. Attendance was tracked and staff providers were reeducated on proper techniques for maintenance of central catheters, such as changing soiled or nonadherent dressings. The cart was restocked daily by the PICU support staff. An in-service conducted by the PICU nursing administration was provided to the nurses on how to fill out the checklist. Physicians were also educated that this intervention was a partnership between them and the nurses. During insertion of a central catheter, if a guideline is non-		Feedback was given weekly to ICU directors and senior leaders via email. This allowed participants to see each ICU's performance as well as their own.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		compliant, the nurse will ask for it to be corrected and then the procedure can continue. If the physician still does not comply, then they are referred to the PICU medical director. Weekly feedback was sent via email to all ICU directors and senior leaders in the hospital.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Miller, United States - 2010	CLABSI	Each PICU team selected a 'champion' to promote the unit. The multidisciplinary team attended 4 face-to-face learning workshops, over the first year with monthly conference calls and monthly collection of infection data with PICU-wide submission. Implementation of an insertion bundle and a maintenance bundle. The insertion bundle consisted of: washing hands before the procedure, for children aged greater than or equal to 2 mo, chlorhexidine was used scrubbed at the insertion site for 30s with the exception of the groin which was scrubbed for 2 minutes. No iodine skin prep or ointment was used at the insertion site. Insertion cart was prepackaged using full sterile barriers. A checklist was created to empower staff to stop a procedure not following sterile techniques. Use of only polyurethane or Teflon catheters. Insertion training including videos and slides. The maintenance bundle consisted of: daily assessment of whether catheter is needed, catheter-site care, catheter hub, cap and tube care. Both bundles were in line with CDC recommendations.		Monthly collection of CLABSI rates for each PICU were gathered and shared with all 29 PICU.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Perez Parra, Spain - 2010	CLABSI	A short lecture covering the following 10 main points was given 30 times to cover all ICU workers on all shifts: 1. Use of a full sterile sheet when preparing the CVC insertion site, 2. Choice of the subclavian vein as the preferred site of insertion, 3. Use of closed needleless catheter connection systems, 4. Disinfection of clean skin with 2% chlorhexidine gluconate solution before CVC insertion, 5. CVC site dressing regimens, 6. Aseptic technique during CVC care and maintenance (hand washing and use of gloves), 7. Optimal frequency of CVC dressing replacement, 8. Use of parenteral nutrition through a multi-lumen CVC, 9. Management of suspected CLABSI (change avoiding guide wire technique), 10. Replacement of administration sets, needleless systems, and parenteral fluids). A pre-test was given to healthcare staff shortly before the lecture and then 6 months later. No other changes to reduce CLABSI and VAP were implemented at this time.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Pronovost, United States - 2010	CLABSI	An intensive care unit team was formed and included a senior executive, the intensive care unit director and nurse manager, and a physician and nurse in the ICU who can dedicate 20% of their time to the project. Training of the team leaders was accomplished through conference calls every other week, coaching by research staff, and statewide meetings twice a year. The teams received supporting information on the efficacy of each component of the intervention, suggestions for implementing it, and instruction in methods of data collection. During the initial implementation, the individual ICUs implemented 2 cultural interventions and 2 patient safety interventions. These interventions were implemented in 3 month intervals. The interventions were integrated into staff orientation. The ICUs also implemented daily goal sheets to improve communication between clinicians. The intervention was trying to increase compliance with the following CDC recommendations: hand washing, using full-barrier precautions during the insertion of central venous catheters, cleaning the skin with chlorhexidine, avoiding the femoral site if possible, and removing unnecessary catheters. Clinicians were educated on these practices. A central-line cart with necessary supplies was created, a checklist was used to ensure adherence to infection-control practices, and providers were stopped if practices were not being conducted. Removal of catheters were discussed at daily rounds. Teams received feedback on number and rates of CLABSI at monthly and quarterly meetings, respectively.	BCBS-MI supplied a financial incentive if the hospital submitted 90% of their CLABSI data in the first year. In subsequent years, the incentive was based on performance benchmarks created from year 1's data.	Number and rates of CLABSI were given to teams at monthly and quarterly meetings, respectively.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Scales, Canada - 2011	CLABSI;VAP	The 15 ICUs were split into 2 groups and were randomized to receive an intervention while acting as a control for an ICU in the other group. There were 3 phases, each phase was 4 months long. Each ICU received a different intervention in each phase. At the end of the trial, the ICUs would received the interventions that they acted as controls for in 3 month phases. This was called the decay-monitoring period. A central coordinating office conducted the interventions, disseminated the educational and promotional materials, arranged videoconferences, and analyzed the data. All participating ICUs were given videoconference equipment. An expert advisory panel generated a list 15 best practices which were given to the ICU directors. The ICU directors rated which ones they found most applicable and the top six were the ones implemented in this study. For each best practice, a bibliography of relevant literature was generated and presented in easy-to-read bulletins. A content expert provided the interactive educational sessions through videoconference. The presentations were available on a website for reference. ICUs were also encouraged to provide their own in-services and educational programs. Process measures were audited daily and monthly feedback reports were given to the ICU staff. De-identified information for all participating hospitals were included in the feedback reports. ICUs were encouraged to use posters and lapel pins to remind clinicians of the best practices. Examples of pre-printed order sets and checklists were also supplied to the ICUs. The Ontario Telemedicine Network videoconferencing infrastructure was used to provide the educational sessions from the content experts, conduct monthly network meetings, and host training sessions for data collectors and site educators.		Monthly feedback reports were provided to each ICU. The report included identified data for the ICU and de-identified data for the rest of the participating ICUs.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Schulman, United States - 2011	CLABSI	Two bundled were implemented an insertion bundle and a maintenance bundle. The insertion bundle consisted of: creating central line kit or carts to consolidate items necessary for insertion, hand hygiene with appropriate alcohol-based product or antiseptic soap after palpating insertion sites and before and after inserting the central line, use of maximal barrier precautions, disinfecting skin with antiseptic (chlorhexidine 2%, alcohol 70%) before insertion, and using a sterile semipermeable dressing or gauze to cover the insertion site. Maintenance bundle consisted of: hand hygiene with appropriate antiseptic soap or alcohol-based product, evaluation of catheter insertion site daily for infection and dressing integrity, changing damp soiled or loose dressings aseptically and disinfecting site with chlorhexidine, develop and use standard IV tubing setup and changes, maintain aseptic technique when changing IV tubing and when entering the catheter, daily review of catheter necessity with prompt removal. The hospitals also implemented a checklist to promote the bundle behaviors, with workshops geared toward reducing CLABSI as well as periodic surveys and conference calls.		
Seguin, France - 2010	CAUTI;CLABSI	During Period 2, a red square was added to the patient's daily care sheet. The box asked the physician if the CVC or urinary catheter was useful or needed. If the physician marked no then the nurse was instructed to remove the catheter.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Zingg, Switzerland - 2009	CLABSI	All protocols were reviewed and check for completeness and plausibility by two study physicians. An educational program targeting hand hygiene and catheter care was implemented in 4 phases and each phase had 4 modules that were done in a fixed order. Phase 1 was used to train head nurses and nursing instructors through 12 interactive training sessions. Phase 2 included five-45 min general teaching sessions for all ICU nurses in which a short review of the literature and practical demonstrations were provided. Phase 3 included 80-15 min bedside teaching workshops for small groups of ICU nurses. Phase 4 was targeted at physicians and covered hand hygiene more than CVC care. The four modules within each phase were 1) hand hygiene, 2) dressing of the insertion site, 3) manipulation of tubing and stopcocks, and 4) aseptic preparation of infusates. Two infection control nurses were in charge of all of the educational sessions. For hand hygiene, the focus wasn't so much on increased compliance, but and increase proper technique of hand hygiene.		

Appendix Table C3: Intervention characteristics for SSI which control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Burkitt, United States - 2009	SSI	TPS team leader (staff nurse) worked with unit staff to identify obstacles in choosing appropriate antibiotic and duration of perioperative antibiotic. Staff identified 4 key barriers: 1) reliance on computerized bar code medication system that was frequently nonfunctional, 2) lack of antibiotic standardization orders, 3) reliance on paper-based medication records, and 4) monthly new surgical residents responsible for antibiotic orders. An iterative process guided by TPS came up with the following solutions: 1) a backup battery pack was purchased so bar code system always functional, 2) pharmacists developed list of appropriate antibiotics for each procedure based on latest guidelines and approved by head of infectious diseases, 3) guidelines for antibiotic prophylaxis were made available on computerized VA order entry system and printed on cards for all physicians and residents, 4) computerized standing order automatically discontinued antibiotics 24 hrs after surgery. Also, education provided to new attending physicians and residents on a regular basis.		
Hedrick, United States - 2007	SSI	The hospital joined the Surgical Infection Prevention project in 2004. Following participation in the collaborative, a multidisciplinary team formed with members from surgical and anesthesia depts., OR staff, and staff from office of performance improvement, led by team champion. Members met with and had frequent teleconferences with the Virginia Healthcare Quality Center. Team chose target population, defined outcomes and process measures and began collecting baseline data. One person designated to have key accountability for antibiotic prophylaxis measures, which included standardizing administration and duration, documenting on pt charts, providing visible reminders and checklists, and involving pharmacy staff.		Monthly compliance statements were provided to the Virginia Healthcare Quality Center.
Kaimal, United States - 2008	SSI	A task force comprised of physicians, nurses, administrators, and personnel from hospital infection control service was formed to define magnitude of SSI problem among pts undergoing cesarean deliveries and identify solutions. They developed an action plan that included retraining nurses in aseptic technique, instituting a new surgical prep routine, implementing pt warming and oxygen administration guidelines, reducing OR traffic, and improving scrub technique. After 1 yr no change in SSI,	Starbucks cards were offered as incentives to report SSI to task force.	

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		and task force reviewed antibiotic administration and decided to implement policy regarding timing of administration to be prior to incision rather than at cord clamp. The new action plan involved staff from neonatology, anesthesia, and obstetrics to define and implement the change. Communication and dissemination to staff was made verbally and electronically, with multiple messages sent for reinforcement. Nurses became primary communicators of the policy.		
Kao, United States - 2010	SSI	The multidisciplinary teams from 2 hospitals identified barriers to compliance with SCIP antibiotic prophylaxis compliance. Both hospitals incorporated an extended timeout in which antibiotics were administered preoperatively and both provided feedback to faculty. Hospital 1 added educational lectures to the anesthesiologists and surgeons. Hospital 2 added an educational campaign and a preop checklist for nurses to document antibiotic choice. Both hospitals had a standardized preop form prior to the intervention, which standardized which antibiotics were ordered for which procedure. There were 4 phases of the study: 1) baseline, 2) attention only for both hospitals (no intervention used, but SCIP compliance was measured), 3) intervention for hospital 1, attention only for hospital 2, and 4) intervention for both hospitals.		
Kritchevsky, United States - 2008	SSI	Hospitals volunteered to be part of the collaborative, and were then randomized into either a feedback only group or an intervention group which received feedback and an intervention. Hospitals were matched on size, as well as adherence to prophylactic antibiotic timing in the pre period. Two staff members from all hospitals were trained to collect and report the following on a random sample of 100 surgery cases: method of ordering antibiotic, professional background of person ordering antibiotic, pt location when antibiotic administered, professional background of person administering antibiotic, incision times, and antibiotic administration times. The feedback only group received a customized comparative report of 5 performance measures: timing, receipt of antibiotic, duration, selection, and single preoperative dose. The intervention group received the same comparative report, as well as an initial in-person meeting with improvement experts, followed by 8 monthly		Hospitals received a comparative report with 5 performance measures: timing, receipt of antibiotics, duration, selection, and single preoperative dose. Intervenees met twice with quality improvement experts and received advice on interventions to be implemented at individual hospitals.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		telephone calls to share strategies, obstacles, and successes, and then a final in-person meeting with experts with advice on how to overcome obstacles. There were also monthly 90-minute conference calls with all intervention hospitals to share intervention experiences, guidelines, forms, and literature reviews. Both intervention and feedback only groups kept logs on intervention strategies that they implemented at their own facilities. Additional QI strategies were selected by each hospital, and there was substantial overlap in additional QI strategies selected by the feedback only grps and the feedback and intervention collaborative grps. Details available in appendix.		
Mannien, Netherlands - 2006	SSI	As part of the prospective, multisite, Surgical Prophylaxis and Surveillance (CHIPS) project, an optimized and restrictive antibiotic policy based on the national guideline was implemented. The guideline recommends prophylaxes with a single dose of antimicrobial administered intravenously within 30 minutes before the first incision. The hospitals participated voluntarily in CHIPS. The policy was based on the national guideline for surgical prophylaxis issued by the Dutch Working Party on Antibiotic Policy (SWAB). From a previous publication on the CHIPS project (van Kasteren 2005), additional details on the project were described. Following the pre-intervention period, every hospital received feedback on their antibiotic prophylaxis data. Educational mtgs were organized for medical specialists and nurses.		Following the pre-intervention period, participating hospitals received feedback on their antibiotic prophylaxis data.
Trussell, United States - 2008	SSI	A team of cardiovascular surgeons, intensivists, clinical nurse specialists, and infection control personnel constructed a simple protocol pathway to improve timely administration of antibiotics, maintain glucose control, and remove hair appropriately. In the pathway, cardiac anesthesiologists were designated the responsibility of administering antibiotics en route to the OR. Large colored stamps requiring documentation of dosing served as a reminder. Endocrinology and pharmacy staff assisted in devising a protocol wherein all pts were placed on IV insulin post-operative, monitored hourly with finger sticks, and infusion rates adjusted accordingly. Shaving utensils were removed from pre-operative area and replaced with electric clippers and an in-service was conducted for nurses.	The article cited legislation allowing CMS to adjust hospital reimbursement down in pt cases complicated by HAIs, as an incentive to reduce SSIs.	

Appendix Table C3: Intervention characteristics for CAUTI which control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Apisarnthanarak, Thailand - 2007	CAUTI	The intervention team reviewed the literature and collected baseline data. During the time between study periods the intervention team provided feedback from the baseline data to the nurses and physicians. An action plan was developed. Nurse-generated daily reminders were given to physicians to remove unnecessary urinary catheters. Nursing staff identified patients with indwelling catheters >= 3 days and notified investigators. If catheterization was determined to be inappropriate by an ID physician, a physician from the intervention team held a bedside discussion with the treating physician regarding reasons for catheterization and the possibility of discontinuing it, upon which the treating physician made a decision. This intervention was promoted at monthly staff meetings. The intervention team held monthly meetings to discuss problems and to identify modifiable risk factors for each patient who developed CAUTI in the previous month.		Feedback on the baseline data were given to nursing staff and physician by the intervention team prior to the initiation of the intervention. No feedback mechanism existed during the intervention period.
Crouzet, France - 2007	CAUTI	Nursing staff reminded physicians to remove any unnecessary urinary catheter after four days of the catheter being in situ and on a daily basis thereafter.		
Loeb, Canada - 2008	CAUTI	Prior to beginning the trial, information sessions were conducted for nursing staff on participating units to introduce them to the study and explain the stop orders. Attending physicians received a letter notifying them of the stop orders. Prewritten orders were placed in the chart of participants randomized to the stop-order group. Stop orders listed the following six criteria as acceptable for a urinary catheter: urinary obstruction, neurogenic bladder and urinary retention, urological surgery, fluid challenge for acute renal failure, open sacral wound care for incontinent patients, and comfort care for urinary incontinence in terminal illness. Nurses were required to review participants' medical history and the results of any tests ordered by the attending physician to determine if the required criteria were met and remove catheters in their absence. The research nurse did regular follow-up with nursing staff to ensure that the automatic stop orders were followed.		
Seguin, France - 2010	CAUTI;CLABSI	During Period 2, a red square was added to the patient's daily care sheet. The box asked the physician if the CVC or urinary catheter was useful or needed. If the physician marked no then the nurse was instructed to remove the catheter.		

Appendix Table C4: Study context for VAP which control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Apisarnthanarak, Thailand - 2007	VAP	Pratumthani, Thailand/3 8-Bed ICUs; 450 bed hospital					The intervention team consisted of a representative from the hospital administration, an infectious disease physician, a clinical microbiologist, a MICU physician, a MICU chief nurse, 2 infection control specialists, and a hospital epidemiologist. The infectious disease specialists were in charge of the staff in-service trainings throughout the study period.	The educational program was self-directed.
Berenholtz, United States - 2011	VAP	Michigan/112 ICUs	Larger and teaching hospitals saw a slower decline in VAP rates than small or non-teaching hospitals. By the end of the follow-up period VAP rates were comparable across all contexts		This study was a part of the Keystone Project. There was also work to improved patient safety culture and communication in these ICUs. Some hospitals may have been implementing VAP preventive measures as well.		An ICU Improvement Team was made in all the participating ICUs to help keep the ICU working to the study goals. The team consisted of the ICU director, ICU nurse manager, an ICU physician and nurse, and the senior hospital executive.	The study investigators made a website with all the toolkits, educational materials, as well as other useful information for the ICU improvement teams.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Bouadma, France - 2010	VAP	Paris, France/1000 bed hospital			HAI surveillance since 1995; alcohol rub introduced in 2000; standardized weaning protocol introduced in 2001; ongoing long-term program to improve hand-hygiene and precautions for controlling multi-drug resistant bacteria		A standardized weaning protocol was implemented in the ICU in 2001 and was not changed during the study period. Heat and moisture exchangers were changed every 7 days or when visibly soiled, and keeping the same ventilator circuit in a given patient unless visibly soiled or malfunctioning. HAI surveillance in the ICU has occurred since 1995. The multidisciplinary included four intensivists, one infection control physician, three ICU nurses, and two infection control nurses.	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
DePalo, United States - 2010	CLABSI;VAP	Rhode Island/263 beds in 23 adult ICUs in 11 hospitals		They used the Michigan Keystone collaborative approach which found that it was more efficient to centralize the technical work such as data collection and evidence summaries, but have individual hospital units work out how to implement the preventive strategies.	One unit in a mid-size hospital and one unit in the smallest hospital began using silver-coated endotracheal tubes to help reduce VAP during the course of the project. 3 ICUs added antibacterial-impregnated catheters to their CLABSI reducing strategies.	The Michigan Keystone Project, pay-for-performance, regulatory measures, and mandated infection reporting all had some influence on the initiation and propagation of this project.	The multidisciplinary team consisted of the following leaders: MD and nurse leaders of each ICU, CEO of each hospital. The CEO provided a formalized commitment letter.	funding was provided for a shared database across hospitals and to pay for speakers at the learning sessions
Dubose, United States - 2010	VAP	Los Angeles, CA/				Medicare declining to reimburse for HAI-related costs.	The multidisciplinary team included intensivists, trauma surgeons, nursing staff, and a biostatistician. The multidisciplinary team made the QRC and chose the prevention measures on the QRC. The fellow was in charge of presenting the data at the monthly meetings.	
Hawe, United Kingdom - 2009	VAP	Livilands Stirling, UK/S/MICU serves a population of about 270,000					Hand hygiene campaign, basic infection control techniques, and a CLABSI prevention intervention were already in place in the hospital. The ICU had an ongoing culture	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							supporting staff education.	
Kulvatunyou, Thailand - 2007	VAP	Bangkok, Thailand/1000 hospital beds					The study staff had also implemented a ventilator weaning protocol during the study period.	All nurses were given an educational pamphlet.
Marra, Brazil - 2009	VAP	Sao Paulo, Brazil/38 bed medical-surgical ICU				Hospital CEO expressed zero tolerance for VAP in phase 3.	An ICU nurse was in charge of monitoring compliance daily.	
Mori, Japan - 2006	VAP	Chuou Chiba, Japan/			Semi-recumbent patient positioning, use of an endotracheal tube with a suction port for subglottic secretion drainage, use of closed tracheal suction devices, and non-use of H2 blockers for stress ulcer prophylaxis were preformed at different frequencies before and after the introduction of oral care.		Dentists examined for oral care at admission. Nurses provided oral care.	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Omrane, Canada - 2007	VAP	Montreal, Canada/24 bed mixed ICU					Nutrition, stress ulcer prophylaxis, hand hygiene, and change in ventilator circuit were already in place, but added to the protocol for emphasis. The team that designed and implemented the protocol consisted of respiratory therapists, intensivists, pharmacists, and nurses.	A laminated copy of the protocol was included in every patient chart.
Papadimos, United States - 2008	VAP	Toledo, OH/319 bed hospital			Hand hygiene was already being strictly enforced throughout the entire hospital.	Authors mentioned IHI's 100,000 Lives campaign's and the JCAHO's goal of reducing HAI rates.	The establishment of the intensivist-led critical care team was to promote teamwork and communication between the disciplines to improve patient care.	
Prospero, Italy - 2008	VAP	Ancona, Italy/917 bed hospital					Hospital Hygiene Service had come up with the educational program for the ICU staff.	
Scales, Canada - 2011	CLABSI;VAP	Ontario, Canada/15 ICUs (range of ICU beds: 4-19)	ICUs that had a dedicated intensivist staff, more than 10 staffed ICU beds, and had not collected previous data for quality purposes had higher compliance with HOB elevation.			The Ministry of Health and Long-Term Care sought proposals for development and evaluation of strategies to improve effectiveness of care in Ontario's healthcare system.	A panel of experts and ICU directors were used to decide on the best practices to be implemented in this study. Content experts were in charge of the interactive educational sessions. Site educators gave in-services and ICU-specific educational programs. A central coordinating office was in charge of distributing	The interactive educational sessions were posted on the website. Guidelines were summarized into easy-to-read formats.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							all of the intervention materials, scheduling meetings, and analyzing data.	
Zaydfudim, United States - 2009	VAP	Nashville, TN/832 bed hospital			The CDC VAP prevention recommendations were already being implemented.		The respiratory therapist team was in charge of performing spontaneous breathing trials. The sedation score goal was set by the critical care team. Bedside nurses were in charge of titrating the sedatives in order to achieve sedation score goal. Bedside nurses also implemented HOB elevation, oral care, and hypopharyngeal suctioning.	Since the hospital uses electronic medical records, there are computers all throughout the ICU and the dashboard is displayed on every computer.

Appendix Table C4: Study context for CLABSI which control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Apisarnthanarak, Thailand - 2010	CLABSI	Thammasat University Hospital/500 bed hospital	Intervention worked in a "resource-limited" setting. All cases were reviewed by same ICS throughout the study. There was no significant difference among the various nursing units with respect to adherence.		Interventions to reduce MDR A baumannii transmission in ICUs middle of period 1.		All patients admitted to the hospital were prospectively followed by an intervention team comprised of the head nurse, an Infection Control Specialist, an infectious disease consultant, and a hospital epidemiologist during both intervention periods. The intervention team however, provided feedback during period 3 only.	
Barsuk, United States - 2009	CLABSI	Chicago, IL/897 bed hospital			Catheter care bundles were used throughout the study in both ICUs.	CMS has refused reimbursing HAI-associated costs.	During the last 4 months of the post-intervention period, chlorhexidine impregnated body wipes were used on most patients in the MICU.	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Costello, United States - 2008	CLABSI	Boston, Massachusetts/24 ICU beds			March 2005, hospital participated in the Child Health Corporation of America national collaborative to reduce CLABSI		The cardiovascular program nosocomial infection committee consisted of representatives from the CICU's medical and nursing staff, cardiac anesthesia service, cardiac surgery service, cardiac catheterization laboratory, inpatient cardiac floor, and outpatient cardiac clinic and the hospital's Division of Infectious Diseases, infection control program, respiratory therapy service, and pharmacy. A new position was made in the ICU to accommodate the change being made to increase patient safety culture. Also, hospital administration provided a commitment to this effort.	Infection control nurse was available (three 12-hour shifts per week) for all of 2005 and quarterly during 2006. administrative support was provided by the hospital's program for safety and quality.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
DePalo, United States - 2010	CLABSI;VAP	Rhode Island/263 beds in 23 adult ICUs in 11 hospitals		They used the Michigan Keystone collaborative approach which found that it was more efficient to centralize the technical work such as data collection and evidence summaries, but have individual hospital units work out how to implement the preventive strategies.	One unit in a mid-size hospital and one unit in the smallest hospital began using silver-coated endotracheal tubes to help reduce VAP during the course of the project. 3 ICUs added antibacterial-impregnated catheters to their CLABSI reducing strategies.	The Michigan Keystone Project, pay-for-performance, regulatory measures, and mandated infection reporting all had some influence on the initiation and propagation of this project.	The multidisciplinary team consisted of the following leaders: MD and nurse leaders of each ICU, CEO of each hospital. The CEO provided a formalized commitment letter.	funding was provided for a shared database across hospitals and to pay for speakers at the learning sessions
Duane, United States - 2009	CLABSI	Richmond, VA/			All lines placed were antibiotic-coated catheters. There was also a simultaneous initiative to decrease antimicrobial therapy.	CMS eliminates reimbursement for HAI-related costs.	Nurses were empowered to stop procedures if the protocol was not being met.	CVL protocol, nursing checklist, line supply cart were all added to the standard of care.
Khouli, United States - 2011	CLABSI	New York, NY/885 bed hospital		Simulation training allows for repetitive and deliberate practice in a realistic and interactive environment that can provide feedback on performance and mistakes.				

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
McKee, United States - 2008	CLABSI	Baltimore, MD/926 bed hospital; 22-bed PICU					Nurses were able to stop any procedure not adhering to CLABSI control guidelines. Study staff was trying to emphasize that placement of central catheters was a partnership between physicians and nurses.	The central line cart was mobile so it could be rolled into the patients room when needed. The checklists were placed on the cart so they were easy to find.
Miller, United States - 2010	CLABSI	Multi-center/29 ICUS in 27 hospitals; 10-16 bed ICU: 12; 17-27 bed ICU: 13; 28-36 bed ICU: 4	Physicians were more involved with central line insertion while nurses were more involved with maintenance. Risk factors differ in pediatric and adult populations.	Small tests of change were used to achieve quality improvement		This study was a part of the QI collaborative of the National Association of Children's Hospitals and Related Institutions (NACHRI).	Each unit appointed a 'champion' to steer QI intervention in the PICU. The multidisciplinary team included a senior PICU leader/physician champion, QI leaders, infectious disease physicians, PICU nursing leaders, and/or infection control professionals.	
Perez Parra, Spain - 2010	CLABSI	Madrid, Spain/60 beds in 3 study ICUs						

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Pronovost, United States - 2010	CLABSI	Michigan state/61 hospitals	Teaching status and hospital size were found to be non-significantly associated to CLABSI, p=0.35 and p=0.33, respectively. Clinicians identified the following as important to sustaining the project: 1) continued feedback, 2) improvements in safety culture, 3) belief that CLABSI is preventable, 4) Involvement of senior leaders, 5) a shared goal rather than competition to reduce infection rates.	The comprehensive unit-based safety program was used to improve patient safety culture and compliance with evidence-based interventions. In an earlier publication, Pronovost et al. state that employees are guided by an organization-wide commitment to safety, in which each member upholds their own safety norms and those of their coworkers. (Ref 10)	An intervention for VAP was taking place simultaneously in this network of hospitals	The IOM report 'To Err is Human' motivated the beginning of this project to transform patient safety culture in healthcare settings.	A team that included a senior executive, the intensive care unit director and nurse manager, and a physician and nurse from the ICU was formed at each hospital.	A central-line cart and checklist were made available to increase compliance.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Scales, Canada - 2011	CLABSI;VAP	Ontario, Canada/15 ICUs (range of ICU beds: 4-19)	ICUs that had a dedicated intensivist staff, more than 10 staffed ICU beds, and had not collected previous data for quality purposes had higher compliance with HOB elevation.			The Ministry of Health and Long-Term Care sought proposals for development and evaluation of strategies to improve effectiveness of care in Ontario's healthcare system.	A panel of experts and ICU directors were used to decide on the best practices to be implemented in this study. Content experts were in charge of the interactive educational sessions. Site educators gave in-services and ICU-specific educational programs. A central coordinating office was in charge of distributing all of the intervention materials, scheduling meetings, and analyzing data.	The interactive educational sessions were posted on the website. Guidelines were summarized into easy-to-read formats.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Schulman, United States - 2011	CLABSI	New York State/18 NICUs	Creating a culture wherein the NICU staff, a physician 'champion', and the ICPs consider themselves a single team working to prevent CLABSI seemed to produce greater improvement. Authors also mentioned that there was a lot of variability from NICU to NICU and that was most likely due to influence of context.			In 2007, New York mandated reporting of CLABSI rates in all ICUs.	Having 2 staff members in charge of central line placement, changing catheter tubes by nursing pairs, and assessing daily need of central line seemed to yield greater improvement.	Placing hand sanitizer dispensers at each bedside seemed to increase adherence to hand hygiene practices.
Seguin, France - 2010	CAUTI;CLABSI	Rennes, France/60-bed ICU			CVC and urinary catheter management did not change during this study period.			The box was added to the paperwork already being used for tracking patient care.
Zingg, Switzerland - 2009	CLABSI	Zurich, Switzerland/960 bed hospital	MICU had significantly higher CLABSI rates than the SICU for both phases of the study.		Use of maximal sterile barriers and skin disinfection with povidine-iodine and octenidine were already being implemented.		Two infection control nurses were in charge of all of the educational sessions. A standardized protocol for catheter care was created.	

Appendix Table C4: Study context for SSI which control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Burkitt, United States - 2009	SSI	Pittsburgh, PA/36 bed surgery unit; 146 bed tertiary care for veterans	Improvements across the 5 classes of surgery differed. The TPS focused their efforts on the more common surgical procedures. Most common were orthopedic, so those physicians had more discussions with the TPS team and also had the high-test compliance percentages.	In the TPS model, frontline work groups identify problems, experiment with possible solutions, measure the results, and implement strategies to improve quality, resulting in a "ground up" rather than "top down" approach.	This intervention evolved from efforts to reduce MRSA.		TPS team leader was a staff nurse, who worked with all staff to identify problems and develop solutions.	All staff are involved. Battery packs were purchased and a computerized medication system was available.
Hedrick, United States - 2007	SSI	Charlottesville, VA/547 bed hospital; 29,000 admissions/yr				In 2003, Virginia Healthcare Quality Center (VHQC) asked medical centers in the state to choose a target population for which they want to lower SSI rates. The VHQC began this program in response the CMS Surgical Infection Prevention project.	A multidisciplinary team defined the scope of the problem and designed interventions to lower SSI rates. Specific nurses were designated responsible for implementation.	coordination among multiple disciplines, designated enforcers of intervention were assigned, standardization of procedures

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Kaimal, United States - 2008	SSI	San Francisco, CA/		Systems of pt care are complex and require multidisciplinary problem-solving in order to make improvements. Understanding the nature of the system and the roles of the participants is essential for policy change.	The authors had tried some initial policy changes regarding retraining RNs, new surgical prep, supplemental O2, pt warming, and improving scrub technique, but none had lowered the SSI rate prior to the intervention of this study.		A multidisciplinary task force worked with members of different depts. Nurses were designated as communicators and enforcers of the policy change.	The policy change was communicated verbally and electronically.
Kao, United States - 2010	SSI	both hospitals in Houston, TX/2 county hospitals	Hospital 1 scored lower on the Safety Attitudes Questionnaire in safety domains and teamwork compared to hospital 2. Hospital 1 had lower compliance with antibiotic timing, but had better compliance with antibiotic discontinuation and overall compliance compared to hospital 2. Hospital 1 had higher SSI rates compared to hospital 2.		A standardized antibiotic form was available to both hospitals prior to intervention, however it was not implemented extensively.	Preintervention data had been reported previously as part of a study on factors predicting compliance with SSI prophylaxis guidelines. The hospitals' district was collecting SSI rates from hospitals during the study period, so lowering SSI was a concern. Hospital 2 had proportionately more abdominal vascular cases.	In hospital 2, nurses were responsible for completing a pre-op checklist.	multidisciplinary team, standardized forms

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Kritchevsky, United States - 2008	SSI	/44 acute care hospitals		Quality improvement collaborative bring together groups of practitioners in a series of meetings to share and implement practical solutions for rapid improvement of processes for which the gap between knowledge and practice in health care is substantial.		During the study, there was national interest in the antibiotic prophylaxis process because of the creation of SIP (National Surgical Infection Prevention Project) by the Centers for Medicare and Medicaid Services. During study period, antibiotic prophylaxis use improved nationally.	2 staff from each hospital were trained to collect data, then each hospital was responsible for developing their own intervention strategies.	The collaborative requires extensive involvement from multidisciplinary staff. There were no details on the specific interventions that each hospital chose to implement.
Mannien, Netherlands - 2006	SSI	The Netherlands/<400 beds: 3 hospitals; 400-800 beds: 6 hospitals; >800 beds: 3 hospitals			All hospitals were part of a larger national surveillance network that monitored nosocomial infections, PREZIES.		The CHIPS study group developed the antibiotic recommendations and provided each hospital with an audit report at the start of the intervention. The study group also organized educational mtgs for medical specialists and nurses.	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Trussell, United States - 2008	SSI	Phoenix, AZ/					For the antibiotic prophylaxis arm of the pathway, cardiac anesthesiologists were designated responsibility of following the protocol. Nurses were responsible for maintaining glucose control through the whole ICU stay and for appropriate hair removal.	The protocol pathway is relatively non-labor intensive, requires no pt compliance, includes emergency cases, and places no added stress to surgeons. Glucose control did place a heavier labor burden on ICU nurses.

Appendix Table C4: Study context for CAUTI which control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Apisarnthanarak, Thailand - 2007	CAUTI	Pratumthani, Thailand/450 hospital beds			hospitalwide quality improvement program for prevention VAP		Multidisciplinary intervention team organized and consisted of a representative from hospital admin, an ID physician, a clinical microbiologist, 2 internists, 2 infection control specialists, chief nurses from all units, and an epidemiologist. Ongoing routine infection control policies included aseptic catheter insertion technique, use of closed urinary catheters, and education of nursing staff of catheter use.	
Crouzet, France - 2007	CAUTI	Besancon, France/1205 bed hospital	Inconsistencies in results (significant decrease in the duration of catheterization in orthopedic and CV surgery departments vs. the other 3) between various departments were observed.		Closed drainage was maintained in all patients following insertion of catheter.		Nurses were now asked to remind physicians daily to assess the necessity of the patient's catheter.	
Loeb, Canada - 2008	CAUTI	Hamilton, Ontario, Canada/7 medical units in 3 hospitals					Nurses were required to review patients' medical history and any test results to determine if the required criteria were met and remove catheters in their absence. The research nurse did regular f/u with nursing staff to ensure that the automatic stop orders were followed.	Prewritten stop orders listing 6 urinary catheter criteria were available for nurses to place in patient charts.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Seguin, France - 2010	CAUTI;CLABSI	Rennes, France/60-bed ICU			CVC and urinary catheter management did not change during this study period.			The box was added to the paperwork already being used for tracking patient care.

Appendix Table C5a: Infection rate outcomes for VAP which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Apisarnthanarak, Thailand - 2007	VAP	Educational Program	MICU: 20.6; SICU: 5.4; CCU: 4.4	post1 MICU: 8.5; post1 SICU: 5.6; post1 CCU: 4.8; post2 MICU: 4.2; post2 SICU: 5.5; post2 CCU: 4.6;	MICU pre vs. post1 Student's ttest: p=0.002; MICU post1 vs. post2 ttest: p=0.07; SICU pre vs. post1 ttest: p=0.227; SICU post1 vs. post2 ttest: p=0.82; CCU pre vs. post1 ttest: p=0.481; CCU post1 vs. post2 ttest: p=0.20	infections/1000 device-days	36
Berenholtz, United States - 2011	VAP	VAP Bundle and Daily Goal Sheets	median: 5.5	post1 median: 0; post2 median: 0	Wilcoxon rank sum post1 vs baseline and post2 vs baseline for medians: p<0.001; ; post1 vs baseline incidence rate ratio: 0.51 (95% CI .41-.65); post2 vs baseline: .29 (95% CI .24-.34)	infections/1000 device-days	30
Bouadma, France - 2010	VAP	Multifaceted Prevention Program	overall: 22.6; 1st VAP episode: 26.1	overall: 13.1; 1st VAP episode: 14.9	overall p<0.001; 1st VAP episode p<0.001	infections/1000 device-days	30
DePalo, United States - 2010	CLABSI, VAP	CLABSI Education Program and Bundle	median CLABSI Q1 2006: 1.95; median VAP Q1 2006: 0.58	median CLABSI Q2 2008: 0; median VAP Q2 2008: 0	mixed model: comparison of 1st 4 quarters to last 4 quarters: CLABSI: p=0.003; VAP: p=0.075	Infections/1000 device-days	27
Dubose, United States - 2010	VAP	Quality Rounds Checklist (QRC)	12.41	8.74; VAP rate (%) for fully compliant QRC: 3.5%; VAP rate (%) for partially compliant: 13.4%	After multivariable adjustments for age, GCS score, ISS and mechanism of injury the mean difference in VAP rate was 6.65 (95% CI 4.04-9.27) with a p-value of 0.008; Chi-square for full vs partial compliant VAP p=.04	infections/1000 device-days	12

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Hawe, United Kingdom - 2009	VAP	Active Implementation	19.2	7.5		infections/1000 device-days	10
Kulvatunyou, Thailand - 2007	VAP	Educational Program	39.7	10.5; Intervention OR = 9.03 (95% CI 3.94-20.67)	non-parametric bootstrap test with 10000 resamples: p< 0.001; logistic regression: p<0.001	Infections/1000 ventilator-days	12
Marra, Brazil - 2009	VAP	VAP Bundle		Phase 1: 16.4 (SD 7.6); Phase 2: 15.0 (SD 9.2); Phase 3: 10.4 (SD 8.1)	0.05	Infections/1000 ventilator-days	78
Mori, Japan - 2006	VAP	Oral Care Intervention	10.4	3.9	chi square, p>0.001	infections/1000 device-days	59
Omrane, Canada - 2007	VAP	VAP Prevention Protocol	25.0	22.3	Chi-square: p< 0.001; Crude RR for post vs pre-intervention VAP: 0.90 (95% CI 0.87-0.92); Adjusted RR for post vs pre-intervention VAP: 0.86 (95% CI 0.71-1.05)	infections/1000 device-days	6
Papadimos, United States - 2008	VAP	FASTHUG protocol	19.3	post1: 16.6; post2: 7.3	p< 0.01	infections/1000 device-days	24
Prospero, Italy - 2008	VAP	Educational Program	36.9	22.5	Student's ttest: p=0.049; Rate ratio: 0.61; Unadjusted Cox regression Hazard Ratio: 0.761 (p-value 0.087); Adjusted HR for period 2: 0.70 (p-value = 0.03)	infections/1000 device-days	4
Scales, Canada - 2011	CLABSI, VAP	Bundle - CLABSI, VAP					

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Zaydfudim, United States - 2009	VAP	VAP Electronic Dashboard	15.2	9.3	t test, p=0.01	infections/1000 device-days	12

Appendix Table C5a: Infection rate outcomes for CLABSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-cost	Post-cost	Cost statistical analysis	Savings due to intervention	Savings statistical analysis
Apisarnthanarak, Thailand - 2010	CLABSI	Period 3: Intensified hand hygiene promotion plus CLABSI bundle	medical:16 (SD 7.6); surgical: 11 (SD 5.4); ICU: 17 (SD 6.5); other units: 9 (SD 3.6)	post1 medical: 6.8 (SD 3.5); post1 surgical: 5.5 (SD 2.4); post1 ICU: 7.1 (SD 3.9); post1 other units: 5.2 (SD 1.1); post2 medical: 1.5 (SD 0.4); post2 surgical: 0.08 (SD 0.1); post2 ICU: 2.1 (SD 1.1); post2 other units: 0.9 (SD 0.2)	all t-test: p<0.05; See segmented results below	mean infections/1000 device-days	12 and 24 months
Barsuk, United States - 2009	CLABSI	CVC Insertion Simulation	MICU traditional: 3.2; SICU traditional: 4.86	MICU simulation-based: 0.5; SICU traditional: 5.26	Poisson Regression: IRR=0.16; 95% CI, 0.05-0.44, p=0.001 (comparison reflects post-MICU vs pre-MICU and SICU)	infections/1000 device-days	16
Costello, United States - 2008	CLABSI	Full Intervention: Pediatric Multidisciplinary CLABSI Bundle	mean: 7.8 (95% CI 5.6-10.5)	post1 mean: 4.7 (95% CI 3.4-6.3); post2 mean: 2.3 (95% CI 1.2-3.8)	post1 Wald test: p=0.029; post2 Wald test: p=0.0002	infections/1000 device-days	24
DePalo, United States - 2010	CLABSI, VAP	CLABSI Education Program and Bundle	median CLABSI Q1 2006: 1.95; median VAP Q1 2006: 0.58	median CLABSI Q2 2008: 0; median VAP Q2 2008: 0	mixed model: comparison of 1st 4 quarters to last 4 quarters: CLABSI: p=0.003; VAP: p=0.075	Infections/1000 device-days	27

Study	Infection	Intervention(s)	Pre-cost	Post-cost	Cost statistical analysis	Savings due to intervention	Savings statistical analysis
Duane, United States - 2009	CLABSI	Group 3: Central venous line (CVL) protocol + CVL supply cart + nurse education + nurse checklist and nurse empowerment	16.5	Group2: 15.0; Group3: 7.7	Poisson regression of quarterly infection rates Group1 vs. Group3 p<0.0001; Group2 vs. Group3 p<0.004; Group1 vs. Group2 p=0.08	infections/1000 device-days	Group2: 12; Group3: 6 (18 mos since CVL protocol implementation)
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	video: 3.6; simulation; 3.5	video: 3.4; simulation; 1.0	Poisson Regression incidence rate ratio: 0.30 (95% CI: 0.10-0.91) p=0.03	infections/1000 device-days	
McKee, United States - 2008	CLABSI	CLABSI education, cart, checklist, and nurse empowerment	Monthly mean: 5.2	Monthly mean before faulty PDMV was recognized: 6.6; Monthly mean for non-contaminated post-intervention period: 2.7	Poisson regression p<0.05; Statistical process control chart methodology p=0.07	infections/1000 device-days	31
Miller, United States - 2010	CLABSI	Bundle - CLABSI	mean: 5.4 (95% CI 4.5-6.4)	mean: 3.1 (95% CI 2.4-4.0)	Hierarchical regression: relative rate=0.57, 95%CIs 0.45-0.74, p<0.0001	infections/1000 device-days	12
Perez Parra, Spain - 2010	CLABSI	CLABSI Education	Overall: 4.22; General SICU: 3.4; Cardiac SICU:	Overall: 2.94; General SICU: 5.3	Wilcoxon rank sum test: Overall: p=0.03; General SICU: p=0.05; Cardiac SICU: p=0.12; MICU: p=0.31; Poisson Regression: RR= 0.69 (95% CI 0.44-1.08), p= 0.11	infections/1000 device-days	9

Study	Infection	Intervention(s)	Pre-cost	Post-cost	Cost statistical analysis	Savings due to intervention	Savings statistical analysis
Pronovost, United States - 2010	CLABSI	Conceptual Model - CDC CLABSI Bundle	median: 2.7 (IQR 06.-4.8)	Implementation median: 1.6 (IQR 0-4.4); 0-3mos post-implementation median: 0 (IQR 0-3); 34-36mos post-implementation median: 0 (IQR 0-1.2)	generalized linear latent and mixed models Implementation IRR: 0.81 (95% CI 0.61-1.08); 0-3mos IRR: 0.68 (95% CI 0.53-0.88); 34-36mos IRR: 0.34 (95% CI 0.24-0.48)	infections/1000 device-days	36
Scales, Canada - 2011	CLABSI, VAP	Bundle - CLABSI, VAP					
Schulman, United States - 2011	CLABSI	Bundle - CLABSI	old CDC definition mean: 6.4; new CDC definition mean: 3.5	new CDC definition 2.1	Chi-square result (unit of analysis NICU) p<.0005 for both definitions; Poisson regression old definition risk ratio: 0.33 (95% CI 0.27-0.41) p<.0005; Poisson regression new definition risk ratio: 0.6 (95% CI 0.48-0.75) p<.0005	infections/1000 device-days	10
Seguin, France - 2010	CAUTI, CLABSI	Physician reminder of catheter duration	CLABSI: 2.8; CAUTI: 5.0	CLABSI: 0.7; CAUTI: 4.9	Adjusted CLABSI Poisson Regression: p=0.051; Adjusted CAUTI Poisson Regression: p=0.938	infections/1000 device-days	9
Zingg, Switzerland - 2009	CLABSI	Educational Program for catheter care and hand hygiene	overall: 3.9; MICU: 9; SICU: 3	overall: 1.0; MICU: 3.9; SICU: 0.2	chi square: overall p<0.001, MICU vs SICU p<0.001 for both periods; Cox, overall HR=4.47 (95% CI 1.86-10.2, p<0.001)	infections/1000 device-days	5

Appendix Table C5a: Infection rate outcomes for SSI which control for secular trend or confounding..

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Burkitt, United States - 2009	SSI	Toyota Production System- approprate antibiotic choice and duration					
Hedrick, United States - 2007	SSI	bundle - glucose control	9.2%	5.6%	p=0.07	infection/100 operations	10
Hedrick, United States - 2007	SSI	bundle - normothermia	9.2%	5.6%	p=0.07	infection/100 operations	10
Hedrick, United States - 2007	SSI	bundle - antibiotic prophylaxis	9.2%	5.6%	t-test, p=0.07	infection/100 operations	10
Kaimal, United States - 2008	SSI	implement policy on timing of antibiotic prophylaxis	for all cesarean deliveries: 6.4; for cesarean deliveries before labor: 2.7; for cesarean deliveries during labor: 10.6	for all cesarean deliveries: 2.5; for cesarean deliveries before labor: 1.1; for cesarean deliveries during labor: 4.2	for all cesarean deliveries, chi square: p=0.002; for cesarean deliveries before labor, chi square: p=0.16; for cesarean deliveries during labor, chi square: p=0.005. logistic regression overall SSI: adjusted OR = 0.33, 95% CI=0.14-0.77	infection/100 cesarean deliveries	12

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Kao, United States - 2010	SSI	extended timeout for 2 hospitals, 1 with added education, 1 with added preop checklist	hosp 1 pre: 1.7%; hosp 2 pre: 3.3%; hosp 1 period 1: 11%; hosp 2 period 1: 1.5%; hosp 2 period 2: 0.6%	hosp 1 period 2: 2.1%; hosp 1 period 3: 4.3%; hospital 2 period 3: 0%	No pre/post statistical analysis on SSI Patients operated on at hospital 2 were less likely to develop an SSI compared with those at hospital 1 (odds ratio [OR], 0.23; 95% confidence interval [CI], 0.10--0.56; P = .001).	infection/100 procedures	hospital 1: 12; hospital 2: 6
Kritchevsky, United States - 2008	SSI	joining a quality improvement collaborative					
Mannien, Netherlands - 2006	SSI	Optimized antibiotic prophylaxis	5.4% (95% CI 4.3-6.5%)	4.5% (95% CI 3.6-5.4%)	logistic regression, p=0.22	percentage of procedures with SSIs	6-11
Trussell, United States - 2008	SSI	protocol pathway for appropriate antibiotic use, hair removal, and glucose control	3.5%	1.5%	t test, p=0.001; stepwise logisitic regression results: post-protocol OR and 95% CI: 0.21 (0.09-0.51), p=.001	infections/100 operations	estimate: 13

Appendix Table C5a: Infection rate outcomes for CAUTI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-cost	Post-cost	Cost statistical analysis	Savings due to intervention	Savings statistical analysis
Apisarnthanarak, Thailand - 2007	CAUTI	Daily physician reminders to remove unnecessary catheter	Mean(SD): overall: 21.5 (5.5); medical: 21.5 (10); surgical: 19.4 (5.4); ICU: 23.4 (13.7)	Mean(SD): overall: 5.2 (2.1); medical: 6.5 (4.3); surgical: 7.8 (6.1); ICU: 3.5 (6.4)	t test, all $p<0.05$	Infections/1000 catheter-days	12
Crouzet, France - 2007	CAUTI	Physician reminder to remove catheter beginning on day 4	Late CAUTI (>4 days): 12.3; Early CAUTI: 7.8	Late CAUTI (>4 days): 1.8; Early CAUTI: 13.9	LCAUTI log rank test: p=0.03; ECAUTI log rank test: p=0.13	infections/1000 device-days	3
Loeb, Canada - 2008	CAUTI	Stop orders for indwelling urinary catheters		study: 19%; control: 20%	RR=0.94, 95% CI 0.66-1.33, p=0.71	Frequency of infections	
Seguin, France - 2010	CAUTI, CLABSI	Physician reminder of catheter duration	CLABSI: 2.8; CAUTI: 5.0	CLABSI: 0.7; CAUTI: 4.9	Adjusted CLABSI Poisson Regression: p=0.051; Adjusted CAUTI Poisson Regression: p=0.938	infections/1000 device-days	9

Appendix Table C5b: Adherence outcomes for VAP which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Apisarnthanarak, Thailand - 2007	VAP	Educational Program	HOB elevation: 45%; Mean percentage of correct answers: 78.5%	post1 HOB elevation: 80%; post2 HOB elevation: 84%; Mean percentage of correct answers: 90.8%	post1 Chi-square: p<0.05; post2 Chi-square: p<0.05; mean percentage Chi-square: p<0.001	36
Berenholtz, United States - 2011	VAP	VAP Bundle and Daily Goal Sheets	composite: 32%	post1 composite: 75%; post2 composite: 84%	Pearson Chi-square post1 vs baseline and post2 vs baseline: p<0.001	30
Bouadma, France - 2010	VAP	Multifaceted Prevention Program	hand hygiene: 68%; glove and gown use: 80%; HOB elevation: 5%; oral care: 47%	hand hygiene: 67%; glove and gown use: 82%; HOB elevation: 58%; oral care: 90%	hand hygiene p=0.70; glove and gown use p=0.80; HOB elevation p<0.0001; oral care p< 0.0001	24
DePalo, United States - 2010	CLABSI;VAP	CLABSI Education Program and Bundle	Complete Bundle VAP: 60%	Complete Bundle VAP: 78%	p=<0.0001	27
Dubose, United States - 2010	VAP	Quality Rounds Checklist (QRC)	HOB: 35.2%; peptic ulcer prophylaxis: 76.2%; thrombolytic prophylaxis: 91.4%; sedation holiday: 77.8%	HOB: 93.2%; peptic ulcer prophylaxis: 90.4%; thrombolytic prophylaxis: 93.5%; sedation holiday: 94.0%		12
Hawe, United Kingdom - 2009	VAP	Active Implementation		post1 full compliance: 0%; post2 full compliance: 48%; post3 full compliance: 54%	p<0.0001	10
Kulvatunyou, Thailand - 2007	VAP	Educational Program				
Marra, Brazil - 2009	VAP	VAP Bundle		Phase 1 HOB Elevation: 74.1%; Phase 2 HOB Elevation: 89.5%; Phase 3 HOB Elevation: 96.8%; Phase 3 Daily sedation vacation: 98.9%; Phase 3 oral care: 100%		
Mori, Japan - 2006	VAP	Oral Care Intervention				
Omrane, Canada - 2007	VAP	VAP Prevention Protocol				

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Papadimos, United States - 2008	VAP	FASTHUG protocol				
Prospero, Italy - 2008	VAP	Educational Program				
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP	intervention HOB elevation: 50.2%; intervention CLABSI bundle: 10%; intervention daily spontaneous breathing trial: 78.8%; control HOB elevation: 80.1%; control CLABSI bundle: 31%; control daily spontaneous breathing trial: 90.9%	intervention HOB elevation: 89.6%; intervention CLABSI bundle: 70.6%; intervention daily spontaneous breathing trial: 85.1%; control HOB elevation: 90.2%; control CLABSI bundle: 51.7%; control daily spontaneous breathing trial: 89%	Ratio of random effects ORs (active OR/control OR) for: HOB elevation: 3.12 (95% CI .79-12.41); CLABSI bundle: 17.55 (95% CI 4.72-65.26);daily spontaneous breathing trials: 1.04 (95% CI 0.21-5.03); overall: 2.79 (95% CI 1.00-7.74, p=0.049)	4-12
Zaydfudim, United States - 2009	VAP	VAP Electronic Dashboard		post1: 39%; post2: 89%	linear regression,p<0.001	12

Appendix Table C5b: Adherence outcomes for CLABSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Apisarnthanarak, Thailand - 2010	CLABSI	Period 3: Intensified hand hygiene promotion plus CLABSI bundle	overall complete maximal sterile barrier: 45%; Chlorhexidine skin prep: 42%; Avoid femoral catheter: 50%	post1 overall complete maximal sterile barrier: 80%; post2 overall complete maximal sterile barrier: 81%; post1 chlorhexidine skin prep: 75%; post2 chlorhexidine skin prep: 77%; post1 avoid femoral catheter: 64%; post2 avoid femoral catheter: 66%	all t-test: p<0.05	12 and 24 months
Barsuk, United States - 2009	CLABSI	CVC Insertion Simulation				
Costello, United States - 2008	CLABSI	Full Intervention: Pediatric Multidisciplinary CLABSI Bundle		post1 insertion bundle: 87%; post1 maintenance bundle: 85%; post1 hand hygiene: 38%; post2 insertion bundle: 94%; post2 maintenance bundle: 99%; post2 hand hygiene: 85.5%	insert bundle χ2/Fishers exact: p=<0.001; maintenance bundle χ2/Fishers exact: p=0.004; hand hyg χ2/Fishers exact: p=< 0.001	24
DePalo, United States - 2010	CLABSI;VAP	CLABSI Education Program and Bundle	Complete Bundle VAP: 60%	Complete Bundle VAP: 78%	p=<0.0001	27
Duane, United States - 2009	CLABSI	Group 3: Central venous line (CVL) protocol + CVL supplycart + nurse education + nurse checklist and nurse empowerment		% compliant with checklist: Oct 2005: 97.6%; March 2006: 98%; June 2006: 100%		Oct 2005: 3; Mar 2006: 9; June 2006: 12
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	median sterile technique score: video: 13.0; simulation: 12.5	median sterile technique score: video: 18.0; simulation: 22.0	Wilcoxon signed rank test difference in total score b/w groups phase 1: p<0.95; Wilcoxon signed rank test difference in total score b/w groups phase 2; p<.001	

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
McKee, United States - 2008	CLABSI	CLABSI education, cart, checklist, and nurse empowerment		Cases needed prompting by nurse: to wash hands before procedure: 0%; have all hair under cap, sterile gown, and sterile gloves: 3%; chlorhexidine skin prep: 3%; large sterile drape: 5%; Apply sterile dressing after procedure: 0%		
Miller, United States - 2010	CLABSI	Bundle - CLABSI		October 2007: Insertion bundle: 84%; Maintenance bundle: 82%	Hierarchical regression model: Maintenance bundle on CLABSI relative rate=0.41, 95%CI 0.2-0.85, p=0.017	12
Perez Parra, Spain - 2010	CLABSI	CLABSI Education				
Pronovost, United States - 2010	CLABSI	Conceptual Model - CDC CLABSI Bundle				
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP	intervention HOB elevation: 50.2%; intervention CLABSI bundle: 10%; intervention daily spontaneous breathing trial: 78.8%; control HOB elevation: 80.1%; control CLABSI bundle: 31%; control daily spontaneous breathing trial: 90.9%	intervention HOB elevation: 89.6%; intervention CLABSI bundle: 70.6%; intervention daily spontaneous breathing trial: 85.1%; control HOB elevation: 90.2%; control CLABSI bundle: 51.7%; control daily spontaneous breathing trial: 89%	Ratio of random effects ORs (active OR/control OR) for: HOB elevation: 3.12 (95% CI .79-12.41); CLABSI bundle: 17.55 (95% CI 4.72-65.26);daily spontaneous breathing trials: 1.04 (95% CI 0.21-5.03); overall: 2.79 (95% CI 1.00-7.74, p=0.049)	4-12
Schulman, United States - 2011	CLABSI	Bundle - CLABSI				

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration	median CVC duration: 5 days (IQR 3-9 days); median UC duration: 5 (IQR 3-11); median time to CVC removal: 9 (95% CI 8-10); median time to UC removal: 14 (95% CI 12-15)	median CVC duration: 4 (3-7); median UC duration: 4 (IQR 3-8); median time to CVC removal: 7 (95% CI 6-8); median time to UC removal: 8 (95% CI 6-9)		9
Zingg, Switzerland - 2009	CLABSI	Educational Program for catheter care and hand hygiene	overall hand hygiene: 59.1%; proper hand disinfection: 22.5%; hand hygiene before patient contact: 26%; hand hygiene after patient contact: 21%	overall hand hygiene: 65%; proper hand disinfection: 42.6%; hand hygiene before patient contact: 45%; hand hygiene after patient contact: 56%	chi square: overall p=0.47; proper disinfection p=0.003; hand hygiene before patient contact p=0.007; hand hygiene after patient contact p<0.001	5

Appendix Table C5b: Adherence outcomes for SSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Burkitt, United States - 2009	SSI	Toyota Production System- approprate antibiotic choice and duration	appropriate selection and duration: 2000: 25.5%; 2001: 29.8%; 2002: 23.4%; 2003: 27.4%	appropriate selection and duration: 2004: 44.0%	adjusted p from logistic regression, p<0.01	12
Hedrick, United States - 2007	SSI	bundle - glucose control	glucose control: 54%	glucose control: 36%	p<=.05	10
Hedrick, United States - 2007	SSI	bundle - normothermia	85%	90%	NS	10
Hedrick, United States - 2007	SSI	bundle - antibiotic prophylaxis	appropriate antibiotic selection: 89%; appropriate antibiotic timing: 89%; appropriate discontinuation of antibiotics: 93%	appropriate antibiotic selection: 97%; appropriate antibiotic timing: 97%; appropriate discontinuation of antibiotics: 92%%	appropriate antibiotic selection and appropriate antibiotic timing: chi square, p<0.05; appropriate discontinuation of antibiotics: NS	10
Kaimal, United States - 2008	SSI	implement policy on timing of antibiotic prophylaxis				
Kao, United States - 2010	SSI	extended timeout for 2 hospitals, 1 with added education, 1 with added preop checklist	overall compliance: hosp 1: 42%; hosp 2: 26%	overall compliance: post 1: hosp 1:70%, hosp 2: 68%; post 2: hosp 1: 80%, hosp 2: 69%	overall combined compliance, chi square: p=.003; separated by post periods, after post 1, chi square: p=<.001, after post 2, NS	hospital 1: 12; hospital 2: 6
Kritchevsky, United States - 2008	SSI	joining a quality improvement collaborative	For intervention grp: timing: 76.3; receipt of antibiotic: 97.4; duration: 51.3; selection: 93.8; single dose: 85.1; overall: 38.2	For intervention grp: timing: 83.2; receipt of antibiotic: 98.9; duration: 69.5; selection: 94.7; single dose: 80.2; overall: 57.2	For intervention grp: adjusted change: timing: 6.7 (0.2-13.1); receipt of antibiotic: 1.1 (0.0-1.9); duration: 21.3 (12.5-30.1); selection: 0.5 (-0.9-1.9); single dose: -4.6 (-10.3-1.2); overall: 20.3 (12.0-28.6)	

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Mannien, Netherlands - 2006	SSI	Optimized antibiotic prophylaxis	inappropriate abx admin: 93.5%; admin abx after incision: 46.8%; inappropriate timing of abx: 51.8%	inappropriate abx admin: 37.5%; admin abx after incision: 31.4%; inappropriate timing of abx: 39.4%	segmented time series analysis: all p<0.01	6-11
Trussell, United States - 2008	SSI	protocol pathway for appropriate antibiotic use, hair removal, and glucose control	timing of antibiotics: 81%; glucose control: no pre-measurement since protocol was new; shaving: 60%	timing of antibiotics: 94%; glucose control: 100%; shaving: 20%	timing of antibiotics, t test: p=0.001; glucose control: NA; shaving: t-test, p=0.001	estimate: 13

Appendix Table C5b: Adherence outcomes for CAUTI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Apisarnthanarak, Thailand - 2007	CAUTI	Daily physician reminders to remove unnecessary catheter				
Crouzet, France - 2007	CAUTI	Physician reminder to remove catheter beginning on day 4				
Loeb, Canada - 2008	CAUTI	Stop orders for indwelling urinary catheters				
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration	median CVC duration: 5 days (IQR 3-9 days); median UC duration: 5 (IQR 3-11); median time to CVC removal: 9 (95% CI 8-10); median time to UC removal: 14 (95% CI 12-15)	median CVC duration: 4 (3-7); median UC duration: 4 (IQR 3-8); median time to CVC removal: 7 (95% CI 6-8); median time to UC removal: 8 (95% CI 6-9)		9

Appendix Table C5c: Cost/Savings outcomes for VAP which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Apisarnthanarak, Thailand - 2007	VAP	Educational Program	MICU Hospitalization cost/patient: $466 (SD $108); SICU hospitalization cost/patient: $399 (SD 93); CCU hospitalization cost/patient: $404	post1 MICU hosp cost/patient: $293 (SD 88); post1 SICU hosp cost/patient: $384 (SD 95); post1 CCU hosp cost/patient: $401 (SD 104); post2 MICU hosp cost/patient: $254 (SD 92); post2 SICU hosp cost/patient: $395 (sd 83); post2 CCU hosp cost/patient: $415	MICU pre vs. post1: p<0.001; MICU pre vs. post2: p<0.001		
Berenholtz, United States - 2011	VAP	VAP Bundle and Daily Goal Sheets					
Bouadma, France - 2010	VAP	Multifaceted Prevention Program					
DePalo, United States - 2010	CLABSI;VAP	CLABSI Education Program and Bundle				Cumulative cost savings: $2,016,592	
Dubose, United States - 2010	VAP	Quality Rounds Checklist (QRC)		Hospital charges for fully compliant QRC: $143,554; Hospital charges for partially compliant QRC: $311,930	Student's t or Mann-Whitney U test p-value <0.001		
Hawe, United Kingdom - 2009	VAP	Active Implementation					
Kulvatunyou, Thailand - 2007	VAP	Educational Program					
Marra, Brazil - 2009	VAP	VAP Bundle					
Mori, Japan - 2006	VAP	Oral Care					

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
		Intervention					
Omrane, Canada - 2007	VAP	VAP Prevention Protocol					
Papadimos, United States - 2008	VAP	FASTHUG protocol					
Prospero, Italy - 2008	VAP	Educational Program					
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP					
Zaydfudim, United States - 2009	VAP	VAP Electronic Dashboard					

Appendix Table C5c: Cost/savings outcomes for CLABSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Apisarnthanarak, Thailand - 2010	CLABSI	Period 3: Intensified hand hygiene promotion plus CLABSI bundle					
Barsuk, United States - 2009	CLABSI	CVC Insertion Simulation					
Costello, United States - 2008	CLABSI	Full Intervention: Pediatric Multidisciplinary CLABSI Bundle				$236,000-$782,000	
DePalo, United States - 2010	CLABSI;VAP	CLABSI Education Program and Bundle				Cumulative cost savings: $2,016,592	
Duane, United States - 2009	CLABSI	Group 3: Central venous line (CVL) protocol + CVL supply cart + nurse education + nurse checklist and nurse empowerment				Group2 (vs. Group1): $19,615.70 hospital charges per patient; Group3 (vs. Group1): $28,391.87 hospital charges per patient	
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training					
McKee, United States - 2008	CLABSI	CLABSI education, cart, checklist, and nurse empowerment					
Miller, United States - 2010	CLABSI	Bundle - CLABSI					
Perez Parra, Spain - 2010	CLABSI	CLABSI Education					
Pronovost, United States - 2010	CLABSI	Conceptual Model - CDC CLABSI Bundle					

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Scales, Canada - 2011	CLABSI;VAP	Bundle - CLABSI, VAP					
Schulman, United States - 2011	CLABSI	Bundle - CLABSI					
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration					
Zingg, Switzerland - 2009	CLABSI	Educational Program for catheter care and hand hygiene					

Appendix Table C5c: Cost/savings outcomes for SSI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Burkitt, United States - 2009	SSI	Toyota Production System-approprate antibiotic choice and duration				LOS not significantly different among all yrs. Significance found between 2003 and 2004, but significance disappeared after adjustment for surgical procedure, admission source, age, comorbidities.	
Hedrick, United States - 2007	SSI	bundle - glucose control					
Hedrick, United States - 2007	SSI	bundle - normothermia					
Hedrick, United States - 2007	SSI	bundle - antibiotic prophylaxis					
Kaimal, United States - 2008	SSI	implement policy on timing of antibiotic prophylaxis					
Kao, United States - 2010	SSI	extended timeout for 2 hospitals, 1 with added education, 1 with added preop checklist					
Kritchevsky, United States - 2008	SSI	joining a quality improvement collaborative					
Mannien, Netherlands - 2006	SSI	Optimized antibiotic prophylaxis				35% decrease in use of prophylactic antibiotics and 25% decrease in antibiotic costs per procedure	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Trussell, United States - 2008	SSI	protocol pathway for appropriate antibiotic use, hair removal, and glucose control					

Appendix Table C5c: Cost/savings outcomes for CAUTI which control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Apisarnthanarak, Thailand - 2007	CAUTI	Daily physician reminders to remove unnecessary catheter	Hospitalization per patient, mean(SD): $366 (62)	Hospitalization per patient, mean(SD): $154 (34)	t test, p<0.001		
Crouzet, France - 2007	CAUTI	Physician reminder to remove catheter beginning on day 4					
Loeb, Canada - 2008	CAUTI	Stop orders for indwelling urinary catheters					
Seguin, France - 2010	CAUTI;CLABSI	Physician reminder of catheter duration					

Appendix Table C6: Quality ratings for VAP which control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
DePalo, United States - 2010	CLABSI;VAP	No	Yes*	Yes	Yes	Yes	Yes	Yes*	Yes	Yes		No	No	Yes							TRUE	non-parametric methods		TRUE	Mixed effects model with Poisson distribution	hospital size, teaching status, effect of multiple ICUs within hospitals, repeated quarterly measures, and device-days

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kulvatunyou, Thailand - 2007	VAP	Uncertain	Uncertain	Yes	Yes	Yes	No	No	Yes	Yes		No	No	No							TRUE	t-test, chi-square test, Wilcoxon rank sum test, multiple logistic regression, and non-parametric bootstrap test		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Berenholtz, United States - 2011	VAP	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	Wilcoxon Rank-Sum and Pearson chi-square test		TRUE	Generalized Linear latent and Mixed Models with a Poisson distribution	teaching status, hospital size, ICU type
Dubose, United States - 2010	VAP	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Yes	No	Yes							TRUE	Student's t-test; Mann-Whitney U test; chi-square test; Fisher's exact test		TRUE	Multivariable Logistic Regression	Age > 55; Glasgow Score < 8; Injury Severity Score > 20; mechanism of injury

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Hawe, United Kingdom - 2009	VAP	No	Yes	Yes	No	No	No	Yes	No	Yes		No	Yes	Yes							TRUE	chi-square, Mann-Whitney U-test		FALSE		
Apisarnthanarak, Thailand - 2007	VAP	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	No	Yes							TRUE	Chi-square test; Fisher exact test; interrupted time series with segmented regression analysis		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Bouadma, France - 2010	VAP	No	Yes	Uncertain	Yes	No	No	Yes	Uncertain	Yes		Yes	Yes	Yes							TRUE	Wilcoxon Rank-sum Test; Fisher's exact test; segmented Poisson regression; Cox proportional hazards		TRUE	Cox proportional hazards	gender, having a fatal disease, arterial catheter before VAP, and study period

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Omrane, Canada - 2007	VAP	No	Uncertain	Uncertain	No	Yes	No	No	No	Yes		Yes	No	No							TRUE	Student's t-test, Wilcoxon rank sum test, chi-square test, and Poisson regression	Poisson regression was adjusted for age, gender, APACHE II Score, GCS Score, service the patient originated from (surgical, trauma, etc)	FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Papadimos, United States - 2008	VAP	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes		Yes	No	No							TRUE	Wilcoxon rank sum test, Auto-regressive integrated moving average (ARIMA) model, t-test, and chi-square test		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Prospero, Italy - 2008	VAP	No	No	Yes	No	Yes	No	No	Yes	Yes		Yes	No	No							TRUE	Student's t-test and time-dependent Cox regression	Cox was controlled for SAPS II score, APACHE II score and being a trauma patient	FALSE		
Zaydfudim, United States - 2009	VAP	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		Yes	Yes	Yes							TRUE	t-test, Wilcoxon rank sum test, linear regression, piecewise		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
																						linear regression				

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Mori, Japan - 2006	VAP	No	Yes	Uncertain	Yes	Yes	No	No	No	Yes		No	No	No							TRUE	Fischer's exact, Mann-Whitney U-test, Wilcoxon 2-sided test		TRUE	Logistic Regression	Semi-recumbent patient positioning, use of an endotracheal tube with a suction port for subglottic secretion drainage, use of closed tracheal suction devices, and non-use of H2 blockers for stress ulcer prophylaxis

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Scales, Canada - 2011	CLABSI;VAP	No	Yes	No	No	Yes	Yes								No	Yes		Uncertain	No	Yes	FALSE			TRUE	generalized linear mixed model with random effects	group, time, group*time (interaction term)
Marra, Brazil - 2009	VAP	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Yes	No	Yes							TRUE	Chi-square test, ANOVA, segmented regression of interrupted time series		FALSE		

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?

All_Consist	Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut	Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut	Are any important primary outcomes missing from the results?
All_FundSource	Is the Source of funding Identified?
AdherenceReported	If infection rates reported, did study also report adherence rates?
InfectionCDC	If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6: Quality ratings for CLABSI which control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
DePalo, United States - 2010	CLABSI; VAP	No	Yes*	Yes	Yes	Yes	Yes	Yes*	Yes	Yes		No	No	Yes							TRUE	non-parametric methods		TRUE	Mixed effects model with Poisson distribution	hospital size, teaching status, effect of multiple ICUs within hospitals, repeated quarterly measures, and device-days
Schulman, United States - 2011	CLABSI	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes		Uncertain	Yes	No							TRUE	Chi-Squared		TRUE	stepwise Poisson regression	NICU

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Miller, United States - 2010	CLABSI	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Uncertain	Yes	Yes							FALSE			TRUE	Generalized Linear Model (log-link); Hierarchical regression modeling for compliance comparison	Geographic region; average length of stay; bed capacity
McKee, United States - 2008	CLABSI	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Uncertain	Yes	Yes							TRUE	Poisson regression		TRUE	Statistical process control chart	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Khouli, United States - 2011	CLABSI	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes		Uncertain	No	Yes							TRUE	Fischer Exact Test for all-or-none analysis. Two-sample t-test was used to compare scores between intervention periods		TRUE	GLM for CRBSI rate, likelihood of infection by ICU type used Poisson regression model.	
Apisarnthanarak, Thailand - 2010	CLABSI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	2 tailed Chi Square or Fisher exact test		TRUE	Segmented regression	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
																						used, student t-test				
Barsuk, United States - 2009	CLABSI	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes		No	No	No							FALSE			TRUE	Poisson regression	ICU location and period
Duane, United States - 2009	CLABSI	No	No	Yes	Uncertain	No	No	Yes	Yes	Yes		No	Yes	Yes							TRUE	Wilcoxon rank sum, fisher's exact, ANCOVA		TRUE	Logistic, Poisson regression	CVL protocol, Injury Severity Score

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Seguin, France - 2010	CAUTI; CLABSI	Uncertain	Yes	No	No	No	Yes	Yes	No	Yes		Uncertain	No	Yes							TRUE	Chi-square test, Fisher's exact test, Student's t-test, Wilcoxon rank sum test, ANOVA		TRUE	logistic regression, Poisson regression, time-to-event analysis	age, SAPS-II score, and admissions diagnosis

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Costello, United States - 2008	CLABSI	Uncertain	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes		Uncertain	Yes	Yes							TRUE	Chi-Square test, Fisher's exact tests, Wald test		TRUE	Interrupted time series segmented regression (data transformed)	Time and study period

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Perez Parra, Spain - 2010	CLABSI	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes		Yes	Yes	No							TRUE	Chi-square test, Fisher Exact Test, T-test, Wilcoxon rank sum test		TRUE	Poisson Regression	Authors mention controlling for confounding effects and secular trends but do not describe model.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Scales, Canada - 2011	CLABSI; VAP	No	Yes	No	No	Yes	Yes								No	Yes		Uncertain	No	Yes	FALSE			TRUE	generalized linear mixed model with random effects	group, time, group*time (interaction term)
Pronovost, United States - 2010	CLABSI	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes		Yes	No	No							TRUE	Generalized linear latent and mixed models with Poisson distribution	teaching status and hospital size	FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Zingg, Switzerland - 2009	CLABSI	No	Yes	Yes	No	No	No	Yes	Yes	Yes		Uncertain	No	Yes							TRUE	chi-square test, Wilcoxon rank sum test		TRUE	Cox proportional hazards model	period, sex, stay in medical ICU, diabetes, McCabe fatal <6 mo, Charlson score>3, SAPS score, cardiosurgery, intubation, insertion in ER or ICU

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
All_Consist Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut Are any important primary outcomes missing from the results?
All_FundSource Is the Source of funding Identified?
AdherenceReported If infection rates reported, did study also report adherence rates?
InfectionCDC If infection rates reported, was CDC/NNIS* methodology used?

DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6: Quality ratings for SSI which control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Hedrick, United States - 2007	SSI	No	Yes	Yes	No	No	No	Yes	Yes		Yes	Uncertain	No	Yes							TRUE	student's t-test for continuous variables; chi-sq with Yates correction for dichotomous variables		TRUE	stepwise logistical regression with Wald statistic	operative site, laparoscopy, age, hypoalbuminemia, BMI, wound classification, ASA score, operative time
Kaimal, United States - 2008	SSI	Yes	Yes	Uncertain	Yes	Yes	Yes	No	Uncertain		Yes	Uncertain	No	No							TRUE	chi-square		TRUE	logistic regression	labor, previous cesarean, parity, age, BMI, diabetes, chorioamnionitis, strep B culture status

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kritchevsky, United States - 2008	SSI	No	Yes	Yes	Yes	Yes	Yes								Yes	Yes		No	Uncertain	Uncertain	FALSE			TRUE	jackknife design	type of surgery, hospital size, region
Trussell, United States - 2008	SSI	No	Yes	Yes	Yes	No	No	Yes	Yes		Yes	Uncertain	No	Yes							TRUE	t-test or Mann-Whitney for continuous variables; Fisher exact test for categorical variables		TRUE	stepwise logistic regression	diabetes, gender, NNIS wound class

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kao, United States - 2010	SSI	No	Yes	Uncertain	Yes	No	Yes	Yes	Uncertain		No	No	Yes	Yes							TRUE	chi-sq for categorical; ANOVA for continuous		TRUE	general linear modeling to look at interaction effect between hosp and level of intervention	
Mannien, Netherlands - 2006	SSI	No	Yes	Yes	Yes	No	Yes	Yes	Yes		Yes	Yes	Yes	Yes							TRUE	Chi-square, Student t test, segmented time series analysis		TRUE	segmented time series analysis; Logistic regression, non-linear mixed model analysi	Sex, age (>=65 yrs), university hospital, Duration of surgery (>P75), ASA classification (>=3)

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
																									s	
Burkitt, United States - 2009	SSI	No	Yes	Yes	Yes	Yes	Yes					No	No								TRUE	chi-sq for categorical variables; Wilcoxon rank sum for continuous variables		TRUE	logistic regression	type of surgical procedure, admission source, age, # comorbid conditions

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
All_Consist Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?

All_PrimOut	Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut	Are any important primary outcomes missing from the results?
All_FundSource	Is the Source of funding Identified?
AdherenceReported	If infection rates reported, did study also report adherence rates?
InfectionCDC	If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6: Quality ratings for CAUTI which control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Apisarnthanarak, Thailand - 2007	CAUTI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	Yes	Yes							TRUE	chi-squared, fisher's exact test, student t-test		TRUE	interrupted time series with segmented regression analysis; pearson correlation	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Crouzet, France - 2007	CAUTI	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	chi-squared, t-test, ANOVA		TRUE	KM analysis with log-rank test; logistic regression	age, sex, duration of catheterization, systemic antibiotic administration for diseases other than UTI, repeated catheter replacement, study intervention

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Loeb, Canada - 2008	CAUTI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No		N/A	N/A	N/A	Yes	Yes		Yes	No		TRUE	chi-square test, Student's t-test		TRUE	logistic regression	male sex, diabetes, intervention, and antibiotic exposure
Seguin, France - 2010	CAUTI;CLABSI	Uncertain	Yes	No	No	No	Yes	Yes	No	Yes		Uncertain	No	Yes							TRUE	Chi-square test, Fisher's exact test, Student's t-test, Wilcoxon rank sum test, ANOVA		TRUE	logistic regression, Poisson regression, time-to-event analysis	age, SAPS-II score, and admission diagnosis

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?

All_Consist	Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut	Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut	Are any important primary outcomes missing from the results?
All_FundSource	Is the Source of funding Identified?
AdherenceReported	If infection rates reported, did study also report adherence rates?
InfectionCDC	If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C1-LQ: Study characteristics for VAP which do not control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Abbott, United States - 2006	Simple Before-after	VAP	More than one hospital of different types	Medical Intensive Care Unit, Surgical Intensive Care Unit Burn ICU, Trauma ICU	2004 - 2004	3	CDC/NNIS definition was used. Baseline was from April 2002 through June 2002. 5 ICUs within 2 hospitals participated.
Assanasen, - 2008	Simple Before-after	CLABSI;VAP	Tertiary care or university hospital	Medical Intensive Care Unit, Surgical Intensive Care Unit	2004 - 2006	24	CDC definitions were used. Baseline period was from April 2004 through June 2004
Berriel-Cass, United States - 2006	Simple Before-after	CLABSI;VAP	More than one hospital of different types	Medical Intensive Care Unit, Surgical Intensive Care Unit Cardiac ICU; Cardiovascular ICU; Medical/Surgical ICU	2004 - 2006	23	CDC/NNIS definition was used.; 1 hospital, with a MICU, SICU, Cardiac ICU and Cardiovascular ICU, implemented the CLABSI bundle and the other, with a Medical/Surgical ICU and Cardiovascular ICU, implemented the VAP bundle. In total there were 6 ICUS. Baseline CLABSI: July 2003 to January 2004. Baseline VAP: January 2003 to January 2004.
Bigham, United States - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Pediatric Intensive Care Unit	2005 - 2005	28	CDC/NNIS definition was used. Pre-implementation period was from January 1, 2004 through December 31, 2004. Implementation period was from January 1, 2005 through August 31, 2005. Post-implementation period was from September 1, 2005 through December 31, 2007.
Bird, United States - 2010	Simple Before-after	VAP	Tertiary care or university hospital	Trauma/General Surgery ICU, Subspecialty surgery ICU	2006 - 2009	31	CDC definition was used. Baseline period was from March 1, 2006 through September 30, 2006. The implementation and follow-up period was from October 1, 2006 through May 31, 2009. Study included 2 ICUs.
Blamoun, United States - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2004 - 2007	30	Baseline: 2003 to 2004 for a total of 18 months.
Bloos, Germany - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Surgical Intensive Care Unit	2005 - 2005	4	Clinical Pulmonary Infection Score (CPIS) was used. Baseline period (Audit I) was from June 2005 through September 2005. The intervention was implemented from October 2005 through November 2005. Follow-up period (Audit II) was from March 2006 through June 2006
Cocanour, United States - 2006	Simple Before-after	VAP	Tertiary care or university hospital	Shock Trauma ICU (STICU)	2002 - 2003	12	NNIS definition was used. Baseline period was from January 2002 through May 2002. VAP bundle began in June 2002. Audit and

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
							feedback began in October 2002. Follow-up period was from June 2002 through June 2003.
Garcia, United States - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2002 - 2004	24	CDC definition was used. Baseline: January 1, 2001, to December 31, 2002.
Heimes, United States - 2011	Simple Before-after	VAP	Tertiary care or university hospital	Trauma ICU	2004 - 2008	54	CDC definition was used. Baseline period was from January 2003 through December 2003. Implementation period was January 2004 to December 2005. Strict implementation of the VAP protocol was from January 2006 through June 2008. Record 58600 was published in 2007 and only presents d
Jain, United States - 2006	Simple Before-after	CAUTI;CLABSI;VAP	Hospital type unspecified	Medical/Surgical ICU	2002 - 2003	12	CDC definitions were used. Baseline period was from October 2000 through September 2002.
Jimenez, United States - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Neurosurgical ICU	2007 - 2007	4	Infection rates were not observed. 14 consecutive days in July/August 2007 were used as pre-intervention adherence and 14 consecutive days in December 2007 were used as post-intervention adherence
Landrum, Afghanistan - 2008	Simple Before-after	VAP	Combat Support Hospital	Mixed ICU	2006 - 2006	6	CDC definition is used. This is a USO field hospital. Baseline period was from May 1, 2006 through May 31, 2006; Intervention period was from June 1, 2006 through August 31, 2006; Targeted surveillance took place in November and December of 2006
Quenot, France - 2007	Simple Before-after	VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2001 - 2003	24	Definition is spelled out on pg 2033. Baseline period is from May 1999 through May 2001. The intervention period was from December 2001 through December 2003.
Rogers, Ireland - 2010	Simple Before-after	CLABSI;VAP	More than one hospital of different types	Neonatal ICU		6	CDC definition was used. Years of the study period were not included. 6 months of baseline data collection occurred, then a 3 month intervention then 6 more months of post-intervention surveillance took place.
Rosenthal, Argentina - 2006	Simple Before-after	VAP	More than one hospital of different types	Medical/Surgical ICU, Coronary ICU	2002 - 2002	12	CDC definition was used. Baseline period (Phase 1) was from January 2001 through December 2001. The Intervention/Follow-up period (Phase 2) was from January 2002 through December 2002.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Ross, United States - 2007	Simple Before-after	VAP	Tertiary care or university hospital	Surgical Intensive Care Unit Pulmonary/Medicine ICU, Vascular Surgery ICU, Cardiothoracic Surgery ICU, Neurosurgery ICU, Trauma ICU		2	CDC/NNIS definition was used. No dates were reported.
Sona, United States - 2009	Simple Before-after	VAP	Tertiary care or university hospital	Surgical Intensive Care Unit	2004 - 2005	12	NNIS criteria were used to diagnose VAP. Pre-intervention period was from June 2003 through May 2004. The post-intervention period was from June 2004 through May 2005.
Venkatram, United States - 2010	Simple Before-after	CAUTI;CLABSI;VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2005 - 2007	36	CDC/NNIS definitions were used. 2004 was the pre-intervention period for CLABSI and CAUTI. 2005 was the pre-intervention period for VAP.

Appendix Table C1-LQ: Study characteristics for CLABSI which do not control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Assanasen, - 2008	Simple Before-after	CLABSI;VAP	Tertiary care or university hospital	Medical Intensive Care Unit, Surgical Intensive Care Unit	2004 - 2006	24	CDC definitions were used. Baseline period was from April 2004 through June 2004
Berriel-Cass, United States - 2006	Simple Before-after	CLABSI;VAP	More than one hospital of different types	Medical Intensive Care Unit, Surgical Intensive Care Unit Cardiac ICU; Cardiovascular ICU; Medical/Surgical ICU	2004 - 2006	23	CDC/NNIS definition was used.; 1 hospital, with a MICU, SICU, Cardiac ICU and Cardiovascular ICU, implemented the CLABSI bundle and the other, with a Medical/Surgical ICU and Cardiovascular ICU, implemented the VAP bundle. In total there were 6 ICUS. Baseline CLABSI: July 2003 to January 2004. Baseline VAP: January 2003 to January 2004.
Bhutta, United States - 2007	Simple Before-after	CLABSI	Tertiary care or university hospital	Pediatric Intensive Care Unit	1998 - 2003	36	Baseline: 1994-1997 with 1997 rate compared to end of follow-up rate in 2005. Stepwise intervention starting November 1998 with the introduction of maximal barrier precautions followed with catheters impregnated with antibiotics in July 1999, an annual hand washing campaign in March 2000, physical barriers between patients beds in new units in April 2003 and Chlorhexidine skin disinfectant in May 2003. The Raad and Hanna's definition for blood stream infection with catheters was used (see citation number 17).
Bizzarro, United States - 2010	Simple Before-after	CLABSI	Tertiary care or university hospital	NICU	2007 - 2007	15	NHSN definitions used. Baseline: July 1, 2005 to June 30, 2007. Intervention: July 1, 2007 to December 31, 2007. Follow-up: January 1, 2008 to March 31, 2009.
Galpern, United States - 2008	Simple Before-after	CLABSI	Community hospital with residents	Medical Intensive Care Unit, Surgical Intensive Care Unit	2005 - 2007	19	CDC/NNIS definition was used. Baseline: February 2005 to June 2005 (5 months). Intervention: July 2005 to April 31, 2007. Information available in this study is very vague.
Guerin, United States - 2010	Simple Before-after	CLABSI	Tertiary care or university hospital	Hospital-wide	2008 - 2009	12	CLABSI definition by CDC/NHSN was used. Baseline: October 1, 2006, to September 30, 2008. Post-intervention period: October 1, 2008, to September 30, 2009
Jain, United States - 2006	Simple Before-after	CAUTI;CLABSI;VAP	Hospital type unspecified	Medical/Surgical ICU	2002 - 2003	12	CDC definitions were used. Baseline period was from October 2000 through September 2002.
Jeffries, United States	Simple Before-	CLABSI	More than one hospital	Pediatric Intensive Care Unit Cardiac ICU	2005 - 2005	12	CDC/NNIS definition was used. 26 hospitals participated. Baseline was July 2004 through

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
- 2009	after		of different types				March 2005. Intervention was April 2005 through December 2005.
Khouli, United States - 2011	Simple Before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit, Surgical Intensive Care Unit	2007 - 2009	6	CDC/NNIS definitions were used.
Koll, United States - 2008	Simple Before-after	CLABSI	More than one hospital of different types	adult ICUs	2005 - 2008	33	49 adult ICUs at 36 hospitals in partnership with GNYHA and UHF. A minimum of 3 months of baseline data were required at each hospital. The intervention period was from July 2005 to March 2008. CDC/NHSN definitions of CLABSI were used.
Lobo, Brazil - 2010	Controlled Before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit	2005 - 2007	17	CDC/NNIS definitions were used.
Marra, Brazil - 2010	Simple Before-after	CLABSI	Tertiary care or university hospital	Medical-Surgical ICU, step-down units	2005 - 2009		No Baseline period. Two intervention phases: phase 1, March 2005 to March 2007 and phase 2, April 2007 to April 2009. No Follow-up period. CDC definitions were used. Study was never reviewed by the IRB. One medical surgical ICU and two step-down units in the same hospital.
Render, United States - 2006	Simple Before-after	CLABSI	More than one hospital of different types	Medical Intensive Care Unit	2004 - 2005	24	CDC definition for CLABSI was used. 10 hospitals were randomized to either CLABSI or SSI project in the first year and then adding the alternative project in year 2. The CLABSI project began in 4 hospitals (ICUs) in 2004 and continued for 2 years. However, the post intervention data are only reported for 2004 (vs. 2003 as the baseline).
Rogers, Ireland - 2010	Simple Before-after	CLABSI;VAP	More than one hospital of different types	Neonatal ICU		6	CDC definition was used. Years of the study period were not included. 6 months of baseline data collection occurred, then a 3 month intervention then 6 more months of post-intervention surveillance took place.
Sannoh, United States - 2010	Simple Before-after	CLABSI	Tertiary care or university hospital	Neonatal ICU	2006 - 2007	13	CDC definitions used.; Baseline: June 2005 to end of January 2006 Intervention: February 2006 (1 month education program adherence measured before and after then organizational and policy changes) to March 2007.
Santana, Brazil - 2008	Simple Before-	CLABSI	Tertiary care or university	2 medical-surgical ICU's	2005 - 2005	4	Baseline: September 2004 to December 2004; Intervention: January 2005 to March 2005;

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
	after		hospital				Follow-up: April 2005 to July 2005. NNIS definitions were used.
Shannon, United States - 2006	Simple Before-after	CLABSI	Tertiary care or university hospital	Medical Intensive Care Unit Cardiac Intensive Care	2003 - 2006	34	Preintervention period from July 2002 to June 2003.
Venkatram, United States - 2010	Simple Before-after	CAUTI;CLABSI;VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2005 - 2007	36	CDC/NNIS definitions were used. 2004 was the pre-intervention period for CLABSI and CAUTI. 2005 was the pre-intervention period for VAP.
Warren, United States - 2006	Simple Before-after	CLABSI	More than one hospital of different types	Medical Intensive Care Unit, Surgical Intensive Care Unit Mixed ICUs	2002 - 2003	15	12 ICUs and 1 bone marrow transplantation unit at 6 academic medical centers participating in the CDC Prevention Epicenter Program. Baseline: Jan 2002 until intervention began 5-7 months later. The intervention was implemented over a 3-month period in each unit. F/u data collection lasted anywhere from 15-18 months after the intervention in each study unit (until Dec 2003). CDC definition was used.
Wicker, United States - 2011	Simple Before-after	CLABSI	Tertiary care or university hospital	Neonatal ICU	2005 - 2008	48	patients were preterm infants with birth weight <=1500. Baseline from January 2001 to December 2004.
Yilmaz, Turkey - 2007	Simple Before-after	CLABSI	Tertiary care or university hospital	Hospital-wide	2004 - 2004	6	CDC definition was used.; Pediatric patients were excluded from this study.

Appendix Table C1-LQ: Study characteristics for SSI which do not control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Acklin, Switzerland - 2011	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Pre-op area	2000 - 2001	12	Authors used CDC definitions for SSI.
Awad, United States - 2009	Simple Before-after	SSI	Tertiary care or university hospital	General Inpatient Ward (non-ICU), Operating Room	2006 - 2007	24	MRSA bundle initiated in 1 medical unit in Oct 2006, and hospital-wide by Oct 2007
Berenguer, United States - 2010	Simple Before-after	SSI	Tertiary care or university hospital	General Inpatient Ward (non-ICU), Operating Room, Surgical Intensive Care Unit	2007 - 2008	12	SSI defined using NSQIP guideline
Berry, United States - 2009	Simple Before-after	SSI	Tertiary care or university hospital Tertiary/Quaternary	Operating Room, Surgical Intensive Care Unit Pre-operative-area	2006 - 2007	12	Reducing surgical site infections was a small part of a larger new system called ProvenCare in which methods to provide evidence-based recommended care were initiated. Uncertain what infection definition was used.
Carles, France - 2006	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room hospital pharmacy		2	No SSI rates reported, only adherence rates.
Forbes, Canada - 2008	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room pre-op unit	2006 - 2007	11	SSI defined by CDC criteria.
Gomez, Argentina - 2006	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Pre-op area	2002 - 2005	36	CDC definition used to identify SSI.
Graf, Germany - 2009	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit	2006 - 2008	27	In addition to the prospective study, the investigators conducted a case-control study to identify risk factors for deep sternal surgical site infections. Because this part of the study was not quality improvement, I only abstracted information relating to the prospective study. SSI were defined using the CDC criteria.
Hermsen, United States - 2008	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room	2005 - 2006	9	Pre-intervention period March through August 2005. No SSIs measured, only adherence rates. Study is a mixture of retrospective (pre period) and prospective (post period).
Ichikawa, Japan - 2007	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room	2004 - 2005	15	Pre-intervention period was from January to December 2003. SSIs defined by CDC guidelines.
Kable, Australia - 2008	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Pre-op area	1999 - 2000	6	SSIs defined by New South Wales Hospital Infection Epidemiology and Surveillance Unit.
Kramer,	Simple	SSI	Tertiary care or	General Inpatient	2005 - 2006	18	Deep sternal wound infection defined by Northern New

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
United States - 2008	Before-after		university hospital	Ward (non-ICU), Operating Room, Surgical Intensive Care Unit			England Cardiovascular Diseases Study Group
Liau, Singapore - 2010	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Post-anesthesia care unit	2006 - 2007	24	SSIs classified using CDC definitions.
Martin, United States - 2010	Simple Before-after	SSI	Tertiary care or university hospital	dermatology office affiliated with university	2008 - 2008	8	Uncertain how SSI defined.
Nemeth, United States - 2010	Simple Before-after	SSI	Pre-op area		2006 - 2006	0.16	Only a 5 day post-intervention period. No SSI's measured, only timely antibiotic administration measured.
Ozgun, Turkey - 2010	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit	2007 - 2007	3	Definition unclear.; No SSI rates reported, only adherence rates.; Baseline: between November 2006 to January 2007. Intervention: January 2007 to September 2007. Education program lasted for "more than 1 month." The post-intervention period began 1 month after the intervention ended so November 2007 to January 2008 to coincide with the same months as the pre-intervention period. Surgical procedures are distributed among the following disciplines: orthopedic surgery, vascular surgery, skin and deep tissue surgery, and endocrine and abdominal surgery including intestinal, gynecologic, and urologic procedures.
Parker, United States - 2007	Simple Before-after	SSI	Tertiary care or university hospital	Pre-op area	2005 - 2006	8	Infection rates not reported. Retrospective audit from 2001-2005 gave baseline compliance rate.
Pastor, United States - 2010	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit Pre-op area	2007 - 2008	14	SSI defined by NNIS criteria.
Paull, United States - 2010	Simple Before-after	SSI	Veterans Health Administration hospitals	Operating Room Pre-op area	2009 - 2010	12	No SSI rates reported, only adherence rates.
Potenza, United States - 2009	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room, Surgical Intensive Care Unit Pre-op area	2006 - 2008	27	No SSI rates reported, only adherence rates.
Rauk, United States - 2010	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Pre-op area	2006 - 2006	6	Definition for SSI uncertain.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Shimoni, Israel - 2009	Simple Before-after	SSI	Hospital - type not specified	Operating Room	2007 - 2007	12	Definition of infection not given. Month of intervention not stated. Pre and post intervention periods only defined as 2006 and 2007.
Suchitra, India - 2009	Simple Before-after	CAUTI;SSI	More than one hospital of different types		2004 - 2005	6	Preintervention was 6 months from January 2004 to end of June 2004
Takahashi, Japan - 2010	Simple Before-after	SSI	Tertiary care or university hospital	15 different surgical departments	2007 - 2007	3	Describes outcome as 'isolation of p. aeruginosa among all gram-negative organisms and isolation of MRSA among all gram-positive organisms'. pre-intervention period from Feb 2006 to April 2006.
Wax, United States - 2007	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room	2005 - 2005	10	Baseline was from June 2004 to December 2004
Whitman, United States - 2008	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room	2006 - 2007	18	Period 1 was from March 2005 through December 2005. This is the baseline and was used for comparisons with period 2, 3 and 4. Only adherence rates reported, no SSI rates.
Willemsen, Netherlands - 2007	Simple Before-after	SSI	Tertiary care or university hospital	Operating Room Pre-op area	2006 - 2006	2	No SSI rates reported, only adherence rates.
Zvonar, Canada - 2008	Simple Before-after	SSI	Tertiary care or university hospital	Pre-op area	2003 - 2005	39	Infection rates were not reported. Baseline was from Jan 2002 through March 2002.

Appendix Table C1-LQ: Study characteristics for CAUTI which do not control for secular trend or confounding.

Study	Study Design	Infection	Healthcare Setting	Clinical Setting	Intervention Years	Follow-up (months)	Comment
Gokula, United States - 2007	Simple Before-after	CAUTI	Community hospital with residents	Emergency Department	2003 - 2003	24	Definition used is unclear.
Jain, United States - 2006	Simple Before-after	CAUTI;CLABSI;VAP	Hospital type unspecified	Medical/Surgical ICU	2002 - 2003	12	CDC definitions were used. Baseline period was from October 2000 through September 2002.
Rothfeld, United States - 2010	Simple Before-after	CAUTI	Non-teaching community hospital	Definitive observation unit, telemetry unit		5	Definition used is spelled out on page 569. No dates were provided. There was a 7 month control period and a 5 month intervention period.
Stephan, Switzerland - 2006	Controlled Before-after	CAUTI	Tertiary care or university hospital	orthopedic and abdominal surgery departments	2002 - 2004	7	Preintervention from November 2001 to January 2002; Phase 1 follow up from March to June 2002; Phase 2 follow up from April to June 2004. "Infections were prospectively identified according to standard definitions" which were not specified
Suchitra, India - 2009	Simple Before-after	CAUTI;SSI	More than one hospital of different types		2004 - 2005	6	Preintervention was 6 months from January 2004 to end of June 2004
Venkatram, United States - 2010	Simple Before-after	CAUTI;CLABSI;VAP	Tertiary care or university hospital	Medical Intensive Care Unit	2005 - 2007	36	CDC/NNIS definitions were used. 2004 was the pre-intervention period for CLABSI and CAUTI. 2005 was the pre-intervention period for VAP.
Wald, United States - 2011	Simple Before-after	CAUTI	Tertiary care or university hospital	Orthopedic surgery unit, general surgery unit	2008 - 2008	4	Baseline period: Sept 1, 2007 - Jan 31, 2008; F/u period: April 1, 2008 - July 31, 2008. The definition for CAUTI was based on that used by the NHSN and included both symptomatic CAUTI and symptomatic bacteriuria.

Appendix Table C2-LQ: Patient characteristics for VAP which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Abbott, United States - 2006	VAP	Academic Center of Evidence-based Practice (ACE) Star Model	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary Team	All Clinical Staff	2	total: 106
Assanasen, - 2008	CLABSI;VAP	Feedback Program	Audit and Feedback	Hospital Infection Control Professionals	Nurses, Physicians	1	
Berriel-Cass, United States - 2006	CLABSI;VAP	CLABSI Bundle	Audit and Feedback, Organizational Change, Provider Education	Administration Infection Control Department	Nurses, Physicians	1	
Berriel-Cass, United States - 2006	CLABSI;VAP	VAP Bundle	Audit and Feedback, Organizational Change, Provider Education	Administration Multidisciplinary rounds (MDR) team	All Clinical Staff	1	
Bigham, United States - 2009	VAP	VAP Bundle	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Critical Care Unit Quality Improvement Collaborative-VAP Prevention Collaborative	Nurses, Respiratory Therapists	1	pre: 617; post1: 447; post2: 1782
Bird, United States - 2010	VAP	VAP Bundle	Audit and Feedback, Organizational Change, Provider Reminder Systems	Multidisciplinary Team	Nurses	1	
Blamoun, United States - 2009	VAP	Expanded VAP bundle	Organizational Change	Study staff	Nurses, Respiratory Therapists	1	
Bloos, Germany - 2009	VAP	Educational Program	Audit and Feedback, Organizational Change, Provider Education	Multidisciplinary Team (Change Team)	Nurses, Physicians	1	pre: 133; post: 141
Cocanour, United States - 2006	VAP	VAP Bundle	Audit and Feedback, Organizational Change, Patient Education, Provider Education	Multidisciplinary Team	All Clinical Staff	1	
Garcia, United States - 2009	VAP	VAP Education and Oral Care Protocol	Organizational Change, Provider	VAP Prevention Team	Nurses, Physicians, Respiratory Therapists	1	pre: 779; post: 759

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
			Education		Anesthesiologists		
Heimes, United States - 2011	VAP	VAP Prevention Protocol (VAPP)	Audit and Feedback, Organizational Change, Provider Education	Study Staff	All Clinical Staff	1	pre: 215; post1: 240; post2 : 241
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	Audit and Feedback, Organizational Change	Administration	All Clinical Staff	1	
Jimenez, United States - 2009	VAP	VAP Bundle	Audit and Feedback, Provider Education, Provider Reminder Systems	Study Staff	All Clinical Staff	1	pre: 102; post: 86
Landrum, Afghanistan - 2008	VAP	Infection Control Protocol	Organizational Change, Provider Education	ICU Staff	All Clinical Staff	1	total: 475
Quenot, France - 2007	VAP	Nurse-Implemented Sedation Protocol	Organizational Change	Multidisciplinary Team	Nurses	1	pre: 226; post: 197
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	Provider Education	Multidisciplinary team	All Clinical Staff	5	
Rosenthal, Argentina - 2006	VAP	Multifaceted Infection Control Program	Audit and Feedback, Provider Education	Study Staff	All Clinical Staff	2	pre: 435; post: 366
Ross, United States - 2007	VAP	Educational Program	Audit and Feedback, Provider Education	Study Staff	Nurses Certified Nurse Assistants	1	pre: 55; post:61
Sona, United States - 2009	VAP	Oral Care Protocol	Audit and Feedback, Organizational Change, Provider Education	Quality Improvement Team	Nurses	1	pre: 777; post: 871
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle	Audit and Feedback, Organizational Change, Patient Education, Provider Education	Health and Hospital Corporation (HHC) Collaborative	All Clinical Staff	1	pre: 1096; post: 3749

Appendix Table C2-LQ: Patient characteristics for CLABSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Assanasen, - 2008	CLABSI;VAP	Feedback Program	Audit and Feedback	Hospital Infection Control Professionals	Nurses, Physicians	1	
Berriel-Cass, United States - 2006	CLABSI;VAP	CLABSI Bundle	Audit and Feedback, Organizational Change, Provider Education	Administration Infection Control Department	Nurses, Physicians	1	
Berriel-Cass, United States - 2006	CLABSI;VAP	VAP Bundle	Audit and Feedback, Organizational Change, Provider Education	Administration Multidisciplinary rounds (MDR) team	All Clinical Staff	1	
Bhutta, United States - 2007	CLABSI	Bundle CLABSI	Organizational Change, Provider Education, Provider Reminder Systems	Administration	All Clinical Staff	1	
Bizzarro, United States - 2010	CLABSI	Bundle - CLABSI	Audit and Feedback, Organizational Change, Promotion of Self-Management, Provider Education	Multidisciplinary Team	postdoctoral neonatology fellows	1	pre: 417; post: 159
Galpern, United States - 2008	CLABSI	CLABSI Bundle	Audit and Feedback, Organizational Change, Provider Education	Multidisciplinary team	Nurses, Physicians	1	
Guerin, United States - 2010	CLABSI	Post-insertion CVC care bundle	Organizational Change, Provider Education	Administration	Nurses	1	
Jain, United States - 2006	CAUTI;CLABSI;VA	IMPACT initiative	Audit and Feedback, Organizational Change	Administration	All Clinical Staff	1	

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
	P						
Jeffries, United States - 2009	CLABSI	CVC Insertion and Maintenance Bundle	Audit and Feedback, Organizational Change, Provider Education	Children's Health Corporation of America directors and advisors from National Initiative for Children's Healthcare Quality advisors	Nurses, Physicians	26	
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	Provider Education	Study Staff	Medical Residents	1	
Koll, United States - 2008	CLABSI	Central line bundle	Audit and Feedback, Organizational Change, Provider Education	Interdisciplinary team at each participating hospital, steering committee of GNYHA Infection Control Work Group	All Clinical Staff	36	
Lobo, Brazil - 2010	CLABSI	Continuous Education	Audit and Feedback, Provider Education, Provider Reminder Systems	Study Staff	Nurses, Physicians	1	pre: 141; post: 41
Lobo, Brazil - 2010	CLABSI	Single lecture	Provider Education	Study Staff	All Clinical Staff	1	pre: 378; post: 262
Marra, Brazil - 2010	CLABSI	IHI Bundle - CLABSI	Audit and Feedback, Organizational Change, Provider Reminder Systems	Study Staff	Nurses, Physicians	1	
Render, United States - 2006	CLABSI	CLABSI bundle	Audit and Feedback, Organizational Change, Provider Reminder Systems	Administration Each hospital's CEO and leaders identified a project leader and team members (often led by hospital infection control professionals and consisted of the nurse manager of the ICU, staff nurses, a physician champion, and a supply manager)	Nurses, Physicians	10	
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	Provider Education	Multidisciplinary team	All Clinical Staff	5	

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Sannoh, United States - 2010	CLABSI	Bundle - CLABSI	Audit and Feedback, Provider Education, Provider Reminder Systems	Study Staff	All Clinical Staff	1	pre: 163; post: 210
Santana, Brazil - 2008	CLABSI	Education	Provider Education	Unclear, study staff	All Clinical Staff	1	total: 186
Shannon, United States - 2006	CLABSI	Toyota Production System adaptation	Organizational Change, Provider Education	Multidisciplinary team	All Clinical Staff	1	pre: 1067; post1: 1798; post2: 1829; post3: 1832
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle	Audit and Feedback, Organizational Change, Patient Education, Provider Education	Health and Hospital Corporation (HHC) Collaborative	All Clinical Staff	1	pre: 1096; post: 3749
Warren, United States - 2006	CLABSI	Multifaceted, education-based intervention	Provider Education	Multi-center research team (CDC Prevention Epicenter Program)	Nurses, Physicians	6	
Wicker, United States - 2011	CLABSI	Comprehensive Infection Control Measures	Audit and Feeback, Organizational Change, Provider Education	NICU staff	NICU staff	1	pre: 334; post: 303
Yilmaz, Turkey - 2007	CLABSI	Education	Audit and Feedback, Organizational Change, Provider Education	Not specified, study staff	All Clinical Staff	1	pre: 241; post: 193

Appendix Table C2-LQ: Patient characteristics for SSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Acklin, Switzerland - 2011	SSI	bundle - antibiotic prophylaxis, skin prep, sterile dressing	Audit and Feedback, Provider Education	independent hospital epidemiology team	Nurses, Physicians	1	pre: 217; post: 153
Awad, United States - 2009	SSI	MRSA bundle	Organizational Change, Provider Education	not specified who initiated intervention plans and implementation	All Clinical Staff	1	
Berenguer, United States - 2010	SSI	implementing SCIP measures	Organizational Change, Provider Education	Administration	All Clinical Staff	1	pre: 113; post: 84
Berry, United States - 2009	SSI	ProvenCare	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Geisinger Health System	All Clinical Staff	3	pre: 137; post: 117
Carles, France - 2006	SSI	surgical antibiotic prophylaxis kit (SAPK)	Organizational Change	department of anesthesiology	hospital pharmacists, anesthesiologists;	1	pre: 210; post: 210
Forbes, Canada - 2008	SSI	bundle - antibiotic administration in OR, pre-printed order form to standardize choice of antibiotic, monthly performance figures posted in OR	Audit and Feedback, Organizational Change, Provider Education	Surgical Site Infection Working Group at McMaster University	All Clinical Staff	1	pre: 105; post: 103
Forbes, Canada - 2008	SSI	bundle - glucose control by screening all pts prior to surgery, administering weight-based regimen of insulin to diabetics, monthly performance figures posted in OR	Audit and Feedback, Organizational Change, Provider Education	Surgical Site Infection Working Group at McMaster University	All Clinical Staff	1	pre: 105; post: 103
Forbes, Canada - 2008	SSI	bundle - maintain normothermia by warming OR to 22 C, standardizing IV warmers and forced air devices, monthly performance figures posted in OR	Audit and Feedback, Organizational Change, Provider Education	Surgical Site Infection Working Group at McMaster University	All Clinical Staff	1	pre: 105; post: 103
Gomez, Argentina - 2006	SSI	automatic stop prophylaxis form	Organizational Change, Provider Education, Provider Reminder Systems	multidisciplinary team	All Clinical Staff	1	pre: 3496; post: 3982
Graf, Germany - 2009	SSI	bundle - SSI	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder	infection control team	All Clinical Staff	1	pre: 3150; post: 980

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
			Systems				
Hermsen, United States - 2008	SSI	Standardized order form	Audit and Feedback, Organizational Change, Provider Education	Study staff	Nurses, Physicians Pharmacists	1	pre: 406; post: 396
Ichikawa, Japan - 2007	SSI	Implementation of Antibiotic Protocols	Audit and Feedback, Provider Education	Infection Control Team, Study Staff	Nurses anesthesiologists, attending surgeons	1	pre: 721; post: 1313
Kable, Australia - 2008	SSI	bundle - antibiotic prophylaxis	Provider Education, Provider Reminder Systems	researchers of the Newcastle Surgical Outcomes Study of Adverse Events	All Clinical Staff	2	pre: 659; post: 518
Kramer, United States - 2008	SSI	nomogram for glycemic control	Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	Nurses, Physicians	1	pre: 1677; post: 1388
Liau, Singapore - 2010	SSI	bundle - antibiotic, glucose control, clippers, normothermia	Organizational Change, Provider Education, Provider Reminder Systems	multidisciplinary team	All Clinical Staff	1	post: 2408
Martin, United States - 2010	SSI	surgical wear changes in Mohs surgery	Organizational Change	physician	Nurses, Physicians	1	pre: 365; post: 585
Nemeth, United States - 2010	SSI	Education program	Provider Education, Provider Reminder Systems	Study staff	Anesthesia, nursing and surgical staff	1	baseline: 97; intervention: 193
Ozgun, Turkey - 2010	SSI	antibiotic prophylaxis education	Provider Education	not specified who carried out educational intervention	Nurses, Physicians	1	pre: 312; post: 322
Parker, United States - 2007	SSI	Six Sigma methodology and antibiotic prophylaxis	Organizational Change, Provider Education, Provider Reminder Systems	Multidisciplinary team	All Clinical Staff	1	pre: 615; post: 1716
Pastor, United States - 2010	SSI	task force to meet SCIP process measures	Organizational Change, Provider Education	multidisciplinary task force	All Clinical Staff	1	pre: 238; post: 253
Paull, United States - 2010	SSI	The Briefing Guide (BiG)	Organizational Change, Provider Education, Provider Reminder Systems	Veterans Health Administration National Center for Patient Safety (NCPS)	All Clinical Staff	74	
Potenza, United States - 2009	SSI	bundle - antibiotic prophylaxis	Organizational Change, Provider Education, Provider Reminder Systems	Team assembled to respond to SCIP guidelines	All Clinical Staff	1	total: 1359
Potenza,	SSI	bundle - normothermia	Organizational Change,	a team addressing SCIP	All Clinical Staff	1	1359

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
United States - 2009			Provider Education, Provider Reminder Systems	guidelines			
Potenza, United States - 2009	SSI	bundle - glucose control	Organizational Change, Provider Education, Provider Reminder Systems	a team to address SCIP guidelines	All Clinical Staff	1	1359
Potenza, United States - 2009	SSI	bundle - appropriate hair removal	Organizational Change, Provider Education, Provider Reminder Systems	team responding to SCIP guidelines	All Clinical Staff	1	1359
Rauk, United States - 2010	SSI	bundle - skin prep and instrument sterilization	Organizational Change, Provider Education	multidisciplinary team	All Clinical Staff	1	pre: 441; post: 436
Shimoni, Israel - 2009	SSI	Empowering surgical nurses	Organizational Change	heads of the obstetrics and anesthesia departments	Nurses		pre: 1104; post: 1089
Suchitra, India - 2009	CAUTI;SSI	Education Program	Provider Education	staff study	Nurses, Physicians ward aides	3	pre: 1125; post: 1119
Takahashi, Japan - 2010	SSI	Departmental Education	Audit and Feedback, Organizational Change, Provider Education	Antimicrobial stewardship team, study staff	All Clinical Staff	1	pre: 1627; post: 1627
Wax, United States - 2007	SSI	Electronic reminder for provider	Provider Reminder Systems	Study staff	anesthesia practitioners	1	pre: 4987; post: 9478
Whitman, United States - 2008	SSI	Multiple 'forced functions'	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Temple University Hospital administration, surgical chairs, study staff	Nurses, Physicians residents, faculty	1	total: 1622
Willemsen, Netherlands - 2007	SSI	standardized antibiotic protocol	Organizational Change, Provider Education	multidisciplinary team	All Clinical Staff	1	pre: 153; post: 147
Zvonar, Canada - 2008	SSI	Appropriate antibiotic prophylaxis administration	Audit and Feedback, Organizational Change, Provider Education	Multidisciplinary team	All Clinical Staff Anesthesiology providers	1	

Appendix Table C2-LQ: Patient characteristics for CAUTI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Type of QI Strategy	Interventionists	Participants	Number of Hospitals	Number of Patients
Gokula, United States - 2007	CAUTI	Education and indications checklist	Audit and Feedback, Organizational Change, Provider Education, Provider Reminder Systems	Study Staff	Nurses, Physicians	1	pre: 100; post: 100
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	Audit and Feedback, Organizational Change	Administration	All Clinical Staff	1	
Rothfeld, United States - 2010	CAUTI	Appropriate Catheter Use Protocol	Organizational Change, Provider Education	Study Staff	Nurses	1	
Stephan, Switzerland - 2006	CAUTI	CAUTI guidelines, education and posters	Audit and Feedback, Provider Education	Study staff, Multidisciplinary team	All Clinical Staff	1	pre: 280; post1: 259; post2: 300
Suchitra, India - 2009	CAUTI;SSI	Education Program	Provider Education	staff study	Nurses, Physicians ward aides	3	pre: 1125; post: 1119
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle	Audit and Feedback, Organizational Change, Patient Education, Provider Education	Health and Hospital Corporation (HHC) Collaborative	All Clinical Staff	1	pre: 1096; post: 3749
Wald, United States - 2011	CAUTI	Audit and feedback on catheter duration	Audit and Feedback, Provider Education	Study Staff	Nurses	1	orthopedic pre: 206; orthopedic post: 290; general pre: 167; general post: 183

Appendix Table C3-LQ: Intervention characteristics for VAP which do not control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Abbott, United States - 2006	VAP	The researchers used the Academic Center of Evidence-based Practice Star Model to guide and implement evidence-based practices. The 5 stages of knowledge transformation used are 1) knowledge discovery, 2) evidence summary, 3) translation into practice recommendations, 4) integration into practice, and 5) evaluation. For knowledge discovery, monthly meetings were held by critical care clinicians to brainstorm strategies to reduce and prevent VAP. Collaboration with a nearby hospital also took place. For evidence summary, a systematic review was conducted and published. From that, the researchers found 5 EBPs that have been shown to be most effective against VAP, 1) HOB elevation, 2) oral care, 3) condensate management, 4) hand hygiene, and 5) proper glove use. The summarized evidence was then interpreted and combined with clinical expertise and theoretical guides and then contextualized to the patient population and setting. The researchers used the PRECEDE-PROCEED and diffusion of innovation models to integrate the aforementioned EBPs into clinical practice. The PRECEDE-PROCEED model was used to evaluate predisposing factors such as attitudes, beliefs, and perceptions that motivate people to change. The diffusion of innovation model was used to evaluate elements of innovation that facilitate change at the unit level. A multidisciplinary education team was formed. The nurses, techs, and respiratory therapists were given a self-learning packet about VAP at orientation. Staff physicians, residents, interns, respiratory therapists, and housekeeping staffed were briefed on the EBP changes. Educational storyboards were developed and displayed. The storyboards contained the EBPs, audit data, as well as the change process. Reminders placed at every bedside. One-on-one bedside teachings and verbal reminders were used to reinforce the change. Weekly email reminders with audit data were sent to all staff. Frequent communication with hospital leadership took place.		Feedback was provided through storyboard posters and weekly emails.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Assanasen, - 2008	CLABSI;VAP	During phase 2, the nurse managers and physician directors received unit-specific quarterly feedback on compliance and infection rates via email from the hospital's infection control professionals. It also contained trends and compliance targets for each process measure. The nurse director of epidemiology and infection control provided informal feedback to unit leaders. During phase 3, dashboard-like posters were hung in ICU staff only areas. They displayed quarterly compliance and infection rates. Compliance was color coded. Poor compliance was red, borderline compliance was yellow and adequate compliance was green. The poster also had a brief summary of infection control practices to improve compliance. Target compliance rates were also displayed. A self-administered questionnaire was given at the end of the study to assess changes in behavior.		During phase 2, the nurse managers and physician directors received unit-specific quarterly feedback on compliance and infection rates via email. It also contained trends and compliance targets for each process measure. The nurse director of epidemiology and infection control provided informal feedback to unit leaders. During phase 3, dashboard-like posters were hung in ICU staff only areas. They displayed quarterly compliance and infection rates. Compliance was color coded. Poor compliance was red, borderline compliance was yellow and adequate compliance was green.
Berriel-Cass, United States - 2006	CLABSI;VAP	The infection control department met with the senior vice president of quality and the hospital CEO to describe the process to improve patient care and reduce costs. Senior leadership's support was key to ensuring availability of resources and enhancing the visibility of the initiative. The infection control department put together the educational component for physicians and nurses, with its medical director providing education to physicians, and the infection control practitioners (ICPs) providing it to nursing. ICPs educated rotating resident physicians in the ICU monthly. The educational program addressed many issues relating to CLABSI such as best practices, morbidity, mortality, cost, definitions, new tools being used, and potential barriers to implementation. Best practices that were included in the bundle were avoiding femoral lines, use of chlorhexidine for skin preparation, hand hygiene, and maximum sterile barrier use. A checklist was developed for CL insertions that would be utilized to assess compliance with this protocol. The checklist forced compliance with the components of the procedure by not allowing the operator to proceed without following the best practices. The		The ICPs rounded in the ICUs daily to collect the checklist and provide feedback if the form was missing information or not completed correctly. Monthly CLABSI rates were given to each ICU. Unit rates were compared to historical rates as well as NNIS rates.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		checklist did not allow "no" as one of the answers. The two options were either "yes" or "yes after correction." Nursing and physician champions were designated. The nursing champion was defined as a nurse well known in the ICU who was involved in training nurses on his or her unit on using the checklist to document the correct placement of central catheters and was responsible for compliance with the checklist on all lines placed. The unit nurse manager acted as the nurse champion and supported the nurses' stopping of the procedure at any time if the physician was not complying with the established protocol. The physician champion was chosen based on being well known in the ICU, being involved in training residents for catheter placement, directing in-services for resident physicians (medical and surgical) on appropriate line placement and the use of the tool, and serving as a contact person if problems occur between operator (physician) and nursing. ICP's rounded in the ICU daily to collect the checklist and provide feedback if the form was missing information or not completed correctly. All components of the bundle needed to be present or the operator was considered noncompliant. To decrease barriers, a central line cart was also made that contained the necessary supplies for insertion.		
Berriel-Cass, United States - 2006	CLABSI;VAP	An implementation team was established to develop changes and goals. The team was called the MDR team. The MDR team educated the charge nurses who in turn educated the staff on their shifts. The ICU managers attended nurse orientation to educate the new nurses on MDR, bundles, and other changes in the ICU. The same approach was used with all new employees and with continuing education for staff. Physicians were educated on the changes underway and were encouraged to participate. Impediments to educating all staff included the use of traveling nurses and temporary staff as well as the normal turnover rate among staff nurses. The MDR team designed a daily goal sheet, developed a VAP bundle, defined methodology for data collection		The ICU staff nurse measured DVT and PUD prophylaxis compliance and reported findings in the daily MDR meeting. If no order was obtained for the appropriate prophylaxis, the staff nurse followed up with the physician to determine why prophylaxis was omitted. The daily goal sheet was used to document recommended changes or feedback that needed to be communicated to the physician and other team members. Staff nurses also reported compliance with oral care at the MDR meetings.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		and reporting, and determined an implementation date. An IHI VAP bundle was implemented and consisted of HOB elevation, deep vein thrombosis prophylaxis, peptic ulcer disease prophylaxis, oral care every two hours, and hand washing. Sedation vacation and the weaning protocol were implemented later. The ICU staff nurse measured DVT and PUD prophylaxis compliance and reported findings in the daily MDR meeting. If no order was obtained for the appropriate prophylaxis, the staff nurse followed up with the physician to determine why prophylaxis was omitted. Kits containing the material for every-two-hour oral care were placed in the patient room each morning and inventoried the next day by the staff nurse to determine use. Compliance was reported in the daily meeting.		
Bigham, United States - 2009	VAP	A multidisciplinary task force, the Critical Care Unit Quality Improvement Collaborative-VAP Prevention Collaborative, was established and defined specific aims for VAP reduction. The collaborative included physicians, nurses, respiratory therapists, infection control staff, and quality improvement consultants. Using IHI recommendations, a targeted literature review, and intra-institutional expert clinician consensus, a pediatric-specific VAP bundle was designed. Implementation of the bundle was led by the PICU respiratory therapist. Nurses and respiratory therapists used rapid cycles of change (Plan-Do-Study-Act) to find the best methods to achieve reliable compliance with the bundle. Clinical staff education and implementation of the VAP bundle occurred midway through the implementation period. VAP bundle included hand hygiene, HOB elevation, mouth care, oral suction, changing soiled catheters, ventilator circuit inspection, and draining condensate. In addition, the use of bundle compliance checklists were used to educate, remind, and measure compliance with the bundle. These were later incorporated into the standard documentation. Oral care packages were placed in each patient room to make more convenient and serve as a reminder. Posters were		Monthly ICU leadership meetings were held to review data and make changes if necessary. Posters in the ICU also displayed compliance rates, VAP rates, and "days" since last VAP case. The authors say appropriate disciplinary actions were still being evaluated.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		placed around the ICU displaying compliance rates, VAP rates, and "days since" last VAP. Real time reporting of VAP cases was initiated. ICU leadership was notified within a day of the VAP diagnosis. Monthly ICU leadership meetings were used to review the data and guide and facilitate the work of the frontline staff. VAP bundle education was added to the orientation for float nursing staff. Compliance was also added to leadership and staff evaluations. Periodically compliance was assessed at random and unannounced.		
Bird, United States - 2010	VAP	A multidisciplinary team was organized and a VAP bundle was implemented that included HOB elevation, daily sedation break, daily assessment for extubation, peptic ulcer prophylaxis, and deep vein thrombosis prophylaxis. Compliance was assessed twice daily by the respiratory care service. Monthly a multidisciplinary team reviewed the compliance data and supplied feedback to the nursing staff.		Data was reviewed monthly by a multidisciplinary team and feedback was provided to the SICU nursing staff
Blamoun, United States - 2009	VAP	Procedures done during and prior to baseline and then more highly enforced at the intervention: Patients are screened for infection on admission and monitored for signs of developing infection after admission. Criteria for infection surveillance include temperature; 90 beats/min respiratory rate or 20 breaths/min or PaCO2 # 32 mmHg, and white cell count of 12,000 cells/mm3 or . 10% bands. The decision is based on the presence of 2 or more of these criteria. The protocol also includes the use of broad-spectrum antibiotics until the pathogen is isolated. Patients suspected of sepsis on admission or first temperature spike.100.4 degrees F (whichever comes first) are immediately tested for pathogens. The laboratory technician provides a prompt verbal alert to the nurse caring for the patient on the detection of any pathogens, followed by notification of the physician by the nurse and decision regarding initiation of treatment. Implementation of negative pressure, airborne, droplet, or contact isolation precautions, depending on the patient's symptoms and suspected		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		organisms. The patient is placed in a specially designated isolation room with negative pressure used for respiratory isolation, including airborne and droplet isolation. The use of gloves, gowns, and face shields before expected contact with patients on contact isolation is strictly enforced, as is the use of face masks for patients on respiratory isolation. Canisters are readily available for dull objects contaminated with body fluids, and designated ''sharps'' containers are made available for contaminated sharps. All central venous access lines are placed under complete sterile conditions, and lines that had been placed under emergency (non-sterile) conditions are replaced on admission to the MICU. Daily inspection and care of lines are instituted to prevent catheter-related infections. Nasal swabs are performed for all patients in the MICU to screen for nasal MRSA colonization. A hand washing procedure is in place for patients on isolation that mandates hand washing before and after patient contact by any and all health care personnel. For patients not on isolation, staff can use a sterilizing, alcohol-based gel. ''Hands-free'' faucets are installed on sinks in patient rooms. Nurse VAP Bundle components: Use of an oropharyngeal cleansing kit (Q-Care; Sage Products, Cary, IL) every 4 hours, Frequent (every 4 hours) suctioning of both the oropharynx and the endotracheal tube. Respiratory-therapists VAP Bundle procedures: Use of the "Sedation Vacation" (SV) on a daily basis. Trial of spontaneous breathing (SBT) after use of the SV by changing the ventilator mode to a pressure support setting of 5 cm H2O for 30 to 120 minutes. Obtaining and documenting weaning parameters during the SBT, including respiratory rate, tidal volume, negative inspiratory force, and minute ventilation, to assess the readiness for weaning. Notification of the intensivist when the patient is considered to have passed the SBT and is extubated. Early tracheostomy (, 12 days) for patients repeatedly failing SBT, especially those expected to be ventilator-dependent for an extended period, and		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		tracheostomy for all patients beyond 12 days. Head-of-bed elevation of 30 degrees to 45 degrees for all patients on ventilators. (CDC Guidelines approved)		
Bloos, Germany - 2009	VAP	A change team was formed. During Audit I a specially trained task force visited patients' rooms randomly between 8AM and 8PM and recorded compliance to modified-IHI VAP bundle. The change team taught all nurses and residents through daily seminars about the VAP bundle as well as gave feedback from Audit I. The VAP bundle included lung protective ventilation for patients with acute lung injury (ALI), HOB elevation, stress ulcer prophylaxis, and deep vein thrombosis prophylaxis. Red marks were put on the walls to indicate the correct HOB elevation. Prescriptions for prophylaxis had to be made by physicians and administration had to be signed by a nurse to be considered compliant. The change team monitored daily compliance and individually trained nurses and staff that were still non-compliant after 2 months. Audit II was conducted in the same manner as Audit I.		Feedback was given by the change team for the 2 months following the education program. Individual nurses and residents were trained again if the bundle was not being implemented correctly.
Cocanour, United States - 2006	VAP	A VAP bundle, which included HOB elevation, peptic ulcer prophylaxis, endotracheal tube suctioning, hand washing (includes use of alcohol-based hand sanitizer), oral care, use of personal protective gear, use of sleeved Yankauers, changing nasogastric irrigation fluids daily, chlorhexidine baths twice weekly revised insulin control protocol were implemented first under the advisement of a multidisciplinary team. A daily audit/feedback program was implemented three months after the bundle began due to low compliance rates. The infection control practitioner (ICP) evaluated each patient daily for compliance with the bundle components. Feedback was given weekly to the STICU staff by the ICP. In-service education programs were provided by the ICP. Posters, graphs, and charts were also used to relay information. Patient families were educated and encouraged to provide simple care. Faculty were		The Infection Control Practitioner gave weekly compliance feedback and provided in-service education accordingly.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		given monthly infection rates and weekly compliance rates. Faculty were encouraged to remind residents and nurses to comply with bundle components. Residents had a monthly orientation where the VAP bundle was reviewed.		
Garcia, United States - 2009	VAP	During baseline two experienced infection control professionals used staff interviews and observations of practice to identify barriers to best practice in VAP prevention. Respiratory therapists, nurses, and physicians were included in the review. During baseline MICU protocols required "standard" oral care, which included suctioning of the oral cavity with suction catheters or Yankauer suctioning devices and glycerin swabs for tissue and lip care. No specific time frames for using these items was established. Dental care products were not used for patients receiving mechanical ventilation. The infection control department held a series of meetings with staff from the MICU, ED, materials management, and performance department. Information from the interviews and a review of policies and available products for patient care was shared. A list of oral care needs was made and actions needed to make this successful were outlined. The education program was conducted by the infection control professionals and covered the following topics: morbidity, mortality, and costs associated with VAP; MICU rates vs. national benchmarks; procedure and timing of hand washing; intubation procedures; review of protocols for ventilator circuits, closed suction devices, and changes of heat moisture exchange filters; medication administration; care of equipment; review of weaning protocols; and review of policies addressing elevating the head of the bed. The infection control committee and the products evaluation and standardization committee approved the implementation of a comprehensive oral and dental care system in which nurses were supposed to use on all ventilated patients. Nursing knowledge of the protocol details was tested twice per year as part of the nursing education competency requirements.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Heimes, United States - 2011	VAP	VAPP protocol included HOB elevation, oral care, extubation assessment, use of nasogastric tubes, sedation holiday, stress ulcer prophylaxis, ventilator weaning, and deep vein thrombosis prophylaxis. Later on the protocol was enforced daily through rounds by trauma ICU case manager and infection control officer and documented in the patients' charts. Respiratory therapists attempted weaning from ventilation daily. Physicians made the final decision on extubation of the patient.	The authors mention the Deficit Reduction Act and the financial incentives to implement quality improvement programs	
Jain, United States - 2006	CAUTI;CLABSI;VAP	Physician led multidisciplinary rounds were initiated in October 2002. The team included in these rounds consisted of the patient's nurse, ICU charge nurse, pharmacist, dietician, respiratory therapist, case manager, social worker, physical therapist, and palliative care nurse. This team would set daily goals and use trigger tools to define adverse ICU events. Daily bed flow meetings were also implemented which happened twice daily. They were 20 minutes long and discussed facility status, intervention priorities, historical data, and daily goal setting. The meeting was led by the administrative house supervisor. After October 2002 bundles for VAP, CLABSI, and CAUTI were implemented. The bundles were developed using published guidelines, CDC recommendations, and local staff recommendations. Feedback was provided to the physicians.	Intensivists were reimbursed for doing rounds.	Feedback was provided to physicians.
Jimenez, United States - 2009	VAP	A 1 week educational program on IHI ventilator bundle protocol included lectures, pamphlets, and reminder cards. The bundle included HOB elevation, sedation vacations, peptic ulcer prophylaxis, and deep vein thrombosis prophylaxis. Feedback was provided to the nursing staff and their supervisor through graphs and reports.		Staff was provided graphical feedback at unknown time points
Landrum, Afghanistan - 2008	VAP	A VAP bundle was implemented (HOB elevation, oral care, and daily sedation holiday) in addition to placing alcohol-based hand sanitizer at each bedside, requiring hand washing before and after patient contact, wearing gloves and gowns when treating a patient with certain pathogens, reducing use of certain medications, cleaning equipment on		Infectious disease physician inspected the facility daily and gave feedback as needed

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		a regular basis as well as after each patient transfer. Preprinted forms for all ICU admissions were created to track these added measures. Antibiotic control measures were also implemented. Staff education of nurses and physicians was done and reeducation occurred on a regular basis during daily morning briefings. The infectious disease physician inspected the facility multiple times a day providing education and reinforcement of procedures.		
Quenot, France - 2007	VAP	The protocol was designed by a multidisciplinary team of nurses and physicians. The staff was then trained on how to use the protocol. The bedside nurse first administers the sedative according to the physicians' prescription. Every 3 hours, level of sedation and dose of sedative given was to be documented on the patient's chart. The nurse would adjust the dose if necessary unless poor tolerance or no improvement occurs. Then the physician is alerted. Nurses were given a table with the doses of sedative to be administered according to weight, previous doses given, and adjustments to occur later on.		
Rogers, Ireland - 2010	CLABSI;VAP	A multidisciplinary team designed an educational package to promote hand hygiene in addition to current infection control measures. A 3 month education intervention included a presentation of evidence-based hand hygiene guidelines, new infection related posters, and demonstration of a six step hand hygiene technique using Glo Germ. Questionnaires were also sent out to ICU staff before and after the intervention to compare attitudes, knowledge and personal practices associated with hand hygiene.		
Rosenthal, Argentina - 2006	VAP	During phase 1, active surveillance of VAP without feedback was carried out. 1 hour educational programs were given monthly from the last 2 months of Phase 1 all the way through Phase 2. Attendance was not mandatory. Each program was self-contained and covered 1997 CDC Nosocomial Pneumonia Prevention Guidelines. Monthly feedback was also provided to ICU staff during		Monthly VAP rates were given to the ICU staff at the infection control meetings in the form of bar charts.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		Phase 2. Feedback was also presented at infection control meetings in the form of bar charts. A formal report was forwarded to the administrators of each ICU.		
Ross, United States - 2007	VAP	The literature was reviewed to develop an evidence-based education program for oral care and a competency checklist. Critical care nurse specialists used the Oral Assessment Guide (OAG) to assess oral hygiene. These were conducted unannounced and during both shifts in all units. The assessments occurred eleven times over a one week period during the pre- and post-intervention periods. The educational program consisted of posters highlighting the best-practice oral care protocol, storyboards outlining the role of oral care in preventing VAP, and research studies to show the evidence supporting the protocol changes. Storyboards were used for self-learning as well as for individualized and small group in-services. The critical care nurse specialists or the unit based educators provided the education programs. The storyboards were posted on the hospital's intranet. Nurses and CNAs were required to complete the competency checklist with observed performance of the oral care protocol. Direct feedback was given on their performance. 2 months later the assessments took place again.		All of the nurses and CNAs in every ICU were required to complete the oral care protocol while being observed. Critical care nurse specialists provided feedback afterwards.
Sona, United States - 2009	VAP	A preprinted order set was designed and placed in the admissions packet. The attendings and fellows were educated on the protocol through QI meetings. All incoming residents were also updated on the oral care protocol and order set. Clinical nurse specialists (CNS) and nurse educators educated the ICU nursing staff on the oral care protocol and the documentation in three groups. The nurses were given pictorials displaying the oral care protocol. These pictorials were laminated and paced in resource manuals at every patient's bedside. The two CNSs audited compliance rates through a biweekly review of the medication administration and oral care supplies. If a patient did not have an order for the oral care protocol, the		The two CNSs audited compliance rates through a biweekly review of the medication administration and oral care supplies. If a patient did not have an order for the oral care protocol, the medical team was approached to get one. If the patient did have an order, but the protocol had not been performed then the CNS would discuss it with the patient's nurse.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		medical team was approached to get one. If the patient did have an order, but the protocol had not been performed then the CNS would discuss it with the patient's nurse. VAP rates were reported monthly at the unit's multidisciplinary QI meeting.		
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical care units, and respiratory therapy and nursing supervisors. The directors of critical care met monthly and emphasized the use of the bundle strategies. Data from the participating hospitals was shared both on the critical care collaborative website as well as during learning sessions. Focused learning sessions were conducted by intensivists periodically. The MICU director served as the champion and held monthly sessions for all ICU staff to reinforce the procedures involved in the bundled approach. Nurses collected compliance data and shared it with the MICU team at the performance improvement committee meetings. Data was also shared with other HHC hospitals. 'Zero Infection Rate' certificates were given by the infection control staff monthly as positive feedback. A CAUTI bundle was implemented in January 2005. It included daily assessment of need, sterile technique when inserting, and use of silver-coated catheters. In addition nurses monitored for breaches in infection control. The MICU nurse was also empowered to stop a procedure if there was a deviation from the recommendations. Evaluation of the necessity of the urinary catheter was integrated into the daily goals and discussed at bedside rounds daily.		The ICU was awarded monthly 'Zero Infection Rate' certificates based on outcomes by the infection control staff. Nurses collected compliance data and shared it at the MICU performance improvement committee meetings.

Appendix Table C3-LQ: Intervention characteristics for CLABSI which do not control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Assanasen, - 2008	CLABSI;VAP	During phase 2, the nurse managers and physician directors received unit-specific quarterly feedback on compliance and infection rates via email from the hospital's infection control professionals. It also contained trends and compliance targets for each process measure. The nurse director of epidemiology and infection control provided informal feedback to unit leaders. During phase 3, dashboard-like posters were hung in ICU staff only areas. They displayed quarterly compliance and infection rates. Compliance was color coded. Poor compliance was red, borderline compliance was yellow and adequate compliance was green. The poster also had a brief summary of infection control practices to improve compliance. Target compliance rates were also displayed. A self-administered questionnaire was given at the end of the study to assess changes in behavior.		During phase 2, the nurse managers and physician directors received unit-specific quarterly feedback on compliance and infection rates via email. It also contained trends and compliance targets for each process measure. The nurse director of epidemiology and infection control provided informal feedback to unit leaders. During phase 3, dashboard-like posters were hung in ICU staff only areas. They displayed quarterly compliance and infection rates. Compliance was color coded. Poor compliance was red, borderline compliance was yellow and adequate compliance was green.
Berriel-Cass, United States - 2006	CLABSI;VAP	The infection control department met with the senior vice president of quality and the hospital CEO to describe the process to improve patient care and reduce costs. Senior leadership's support was key to ensuring availability of resources and enhancing the visibility of the initiative. The infection control department put together the educational component for physicians and nurses, with its medical director providing education to physicians, and the infection control practitioners (ICPs) providing it to nursing. ICPs educated rotating resident physicians in the ICU monthly. The educational program addressed many issues relating to CLABSI such as best practices, morbidity, mortality, cost, definitions, new tools being used, and potential barriers to implementation. Best practices that were included in the bundle were avoiding femoral lines, use of chlorhexidine for skin preparation, hand hygiene, and maximum sterile barrier use. A checklist was developed for CL insertions that would be utilized to assess compliance with this protocol. The checklist forced compliance with the components of the procedure by not allowing the operator to proceed without following the best practices. The checklist did not allow no as one of the answers. The two options were either yes or yes after correction. Nursing and physician champions were designated. The nursing champion was defined as a nurse well known in the ICU who was involved in training nurses on his or her unit on using the checklist to		The ICPs rounded in the ICUs daily to collect the checklist and provide feedback if the form was missing information or not completed correctly. Monthly CLABSI rates were given to each ICU. Unit rates were compared to historical rates as well as NNIS rates.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		document the correct placement of central catheters and was responsible for compliance with the checklist on all lines placed. The unit nurse manager acted as the nurse champion and supported the nurses' stopping of the procedure at any time if the physician was not complying with the established protocol. The physician champion was chosen based on being well known in the ICU, being involved in training residents for catheter placement, directing in-services for resident physicians (medical and surgical) on appropriate line placement and the use of the tool, and serving as a contact person if problems occur between operator (physician) and nursing. ICP's rounded in the ICU daily to collect the checklist and provide feedback if the form was missing information or not completed correctly. All components of the bundle needed to be present or the operator was considered noncompliant. To decrease barriers, a central line cart was also made that contained the necessary supplies for insertion.		
Berriel-Cass, United States - 2006	CLABSI;VAP	An implementation team was established to develop changes and goals. The team was called the MDR team. The MDR team educated the charge nurses who in turn educated the staff on their shifts. The ICU managers attended nurse orientation to educate the new nurses on MDR, bundles, and other changes in the ICU. The same approach was used with all new employees and with continuing education for staff. Physicians were educated on the changes underway and were encouraged to participate. Impediments to educating all staff included the use of traveling nurses and temporary staff as well as the normal turnover rate among staff nurses. The MDR team designed a daily goal sheet, developed a VAP bundle, defined methodology for data collection and reporting, and determined an implementation date. An IHI VAP bundle was implemented and consisted of HOB elevation, deep vein thrombosis prophylaxis, peptic ulcer disease prophylaxis, oral care every two hours, and hand washing. Sedation vacation and the weaning protocol were implemented later. The ICU staff nurse measured DVT and PUD prophylaxis compliance and reported findings in the daily MDR meeting. If no order was obtained for the appropriate prophylaxis, the staff nurse followed up with the physician to determine why prophylaxis was omitted. Kits containing the material for every-two-hour oral care were placed in the patient room each morning and inventoried the next day by the staff nurse to determine use. Compliance was reported in the daily meeting.		The ICU staff nurse measured DVT and PUD prophylaxis compliance and reported findings in the daily MDR meeting. If no order was obtained for the appropriate prophylaxis, the staff nurse followed up with the physician to determine why prophylaxis was omitted. The daily goal sheet was used to document recommended changes or feedback that needed to be communicated to the physician and other team members. Staff nurses also reported compliance with oral care at the MDR meetings.
Bhutta, United States - 2007	CLABSI	Stepwise introduction of interventions designed to reduce infection rates, including maximal barrier precautions, transition to antibiotic impregnated central venous catheters, annual hand washing campaigns, and changing the skin disinfectant from povidone-iodine to chlorhexidine.		An indicator is displayed, showing status with regard to the desired intervention. A simple color scheme of red, yellow, and green represents various states of compliance

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
				with process steps. Red indicates out of compliance, yellow indicates in compliance but the item is coming due, and green indicates compliance. A grace period is built in to each item to allow for patient variability. The dashboard was designed to aid in supporting clinician work flow. Online checklists began in 2007; The nursing staff completed checklists for each ventilated patient at least two times per day to document compliance with VAP reduction strategies. Nursing leadership periodically audited compliance, and followed up with staff if targeted compliance levels were not achieved or if the checklists were not completed. The CAUTI tracking system in early 2008 provided real-time reports of urinary catheter insertion dates and duration on a patient-by-patient basis, with color-coded visual cues identifying those patients having extended duration of catheterization.; Infection control staff reported quarterly data to the nursing and medical directors of the unit.
Bizzarro, United States - 2010	CLABSI	Mandatory yearly lectures, hands-on training sessions, and observed competency assessments for proper CVC placement and management techniques for all new personnel. Those who are formally trained may independently perform and assist in the training of incoming personnel. Mandatory yearly lecture, hands-on training session, and observed competency assessments for proper hand washing and aseptic techniques for CVC placement and management for all new personnel. Povidone iodine with 70% isopropyl alcohol for cutaneous antisepsis and dressing changes. Dressings are not to be changed routinely and are to be changed only under		Rates of CLABSI were reported quarterly to the staff in graphic and tabular form, and post initiative data were compared with pre-initiative and NHSN data. A daily chart was kept in the NBSCU staff room to display the number of days between consecutive cases of CLABSI in

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		the following conditions: when the integrity of the dressing is compromised; when the dressing is visibly soiled; and/or when the catheter position needs to be readjusted (out only). Daily discussion during attending physician rounds regarding need for CVC; removal of CVC the day before or the day neonate achieves complete enteral feeding; ensure removal of surgical lines within 48 hours of discontinuation of use. Surveillance conducted and made available to the staff quarterly; the CVC Initiative Committee meets semiannually, at a minimum, to review data and new medical literature and to update protocols.		the NBSCU.
Galpern, United States - 2008	CLABSI	Resident physicians and nurses were educated on bloodstream-infection--control practices, which included discussions about proper hand washing, use of full-barrier precautions during the central line insertion, appropriate preparation of the skin with ChloraPrep, avoiding the femoral site if possible, and early removal of all central lines. Organizational change: A central line cart was created that contained all the equipment needed to comply with evidence-based guidelines for central line insertions. A policy was instituted that required nurses to assist in central line insertion. Previously, central lines were placed by the critical care physicians without assistance, unless requested. All central lines were secured using a 3.0 silk stitch. They did not use a noninjurious method, such as the stat lock mechanism. After placement of the central line, a form was filled out by the physician and nurse to ensure the protocol was not violated. On a daily basis, justification for the need of the central line needed to be documented in the chart. If no justification could be found, the central line was removed by the physician. A trained infection-control nurse examined each patient every day to determine whether a bloodstream infection had occurred to remove the possibility that another health-care provider might not report the infection. Data were collected on a monthly basis, which included the number of critical-care beds in use at the time, the number of catheters placed, the number of days the catheters were left in place expressed as catheter days, and the number of line-associated infections. Data were reported to the directors of the surgical and medical ICUs, which allowed for real-time feedback to the staff on how the intervention was proceeding. No change in the materials was used during the time of the study. The catheter kits, drapes, gowns, gloves, and caps were all kept the same during the study period.		On a monthly basis feedback to the staff was provided as a means of data on the number of critical-care beds in use at the time, the number of catheters placed, the number of days the catheters were left in place expressed as catheter days, and the number of line-associated infections.
Guerin, United States - 2010	CLABSI	During the intervention period, an IV team was assembled to provide insertion and site care for PICC lines as well as monitoring site care and dwell time for all IVs in the hospital. The nursing staff created and implemented (by each nursing unit's IV champion) a post insertion care bundle consisting of daily inspection of the insertion site; site care if the dressing was wet, soiled, or had not been changed for 7 days; documentation of ongoing need for the catheter; proper application of a chlorohexidine gluconate-impregnated sponge at the		The hands-on training was followed by a competency evaluation, in which each nurse was required to demonstrate competence in catheter insertion site and hub care.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		insertion site; performance of hand hygiene before handling the intravenous system; and application of an alcohol scrub to the infusion hub for 15 seconds before each entry. A 4-hour hands-on training class in techniques for accessing and caring for all IV catheters was mandatory for all nursing staff. This training was followed by a competency evaluation, in which each nurse was required to demonstrate competence in catheter insertion site and hub care.		
Jain, United States - 2006	CAUTI;CLABSI;VAP	Physician led multidisciplinary rounds were initiated in October 2002. The team included in these rounds consisted of the patient's nurse, ICU charge nurse, pharmacist, dietician, respiratory therapist, case manager, social worker, physical therapist, and palliative care nurse. This team would set daily goals and use trigger tools to define adverse ICU events. Daily bed flow meetings were also implemented which happened twice daily. They were 20 minutes long and discussed facility status, intervention priorities, historical data, and daily goal setting. The meeting was led by the administrative house supervisor. After October 2002 bundles for VAP, CLABSI, and CAUTI were implemented. The bundles were developed using published guidelines, CDC recommendations, and local staff recommendations. Feedback was provided to the physicians.	Intensivists were reimbursed for doing rounds.	Feedback was provided to physicians.
Jeffries, United States - 2009	CLABSI	Based on Associates in Process Improvement model. Included recommendation from CDC guidelines, published studies, and IHI save 100,000 lives campaign. Baseline data was collected and shared with the teams at each hospital. Qualitative feedback on hospital-specific improvements were distributed monthly. 9 month improvement project followed by 12 month follow up. 2 bundles insertion and maintenance each composed of 5 categories of improvement. Insertion: Hand hygiene Hand hygiene consistent with local guidelines and/or policies, Dressings Apply transparent semipermeable dressing (use gauze only with bleeding and/or oozing), Sterile barrier Maximum sterile barrier (large sterile drape, sterile gloves, sterile gown, cap, and mask), Sterile technique throughout, Prepare skin with antiseptic and/or detergent chlorhexidine gluconate 2% except for patients with a contraindication. Maintenance: Hand hygiene consistent with local guidelines and/or policies, Replace dressing if it becomes damp, loosened, or visibly soiled; apply transparent semipermeable dressing (use gauze only with bleeding and/or oozing), Aseptic gloves and sterile dressing, Aseptic technique throughout, Prepare skin with antiseptic and/or detergent chlorhexidine gluconate 2% except for patients with contraindication.		Feedback was given to teams with monthly qualitative reports including: self-assessment, barriers, success, lessons learned, next steps and hospital-specific feedback providing information on next steps.
Khouli, United States	CLABSI	Baseline assessment of performance in CVC simulation was conducted first for both groups of residents. Residents then received either training from a		

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- 2011		20-minute video or simulation-based training plus video. After completion of training, the residents were scored again. After this, the authors compared rates of CLABSI in the MICU and SICU.		
Koll, United States - 2008	CLABSI	Needs assessment identified need for regional, systematic improvement in central line practices. Buy-in from hospital leadership was a requirement for participation in this intervention. A real-time question and answer web portal for study participants and staff was created to share information and technical resources. On-call technical experts were available to provide clinical guidance and inform practitioners why these central line procedures were being adopted. Site-visits were conducted to monitor compliance with the bundle. Interdisciplinary teams met weekly initially and then monthly to discuss implementation of CLABSI bundle and to reassess strategies (or in place of meetings some hospitals had monthly or weekly goals posted). HICPAC CLAB central line bundle (hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection, daily review of line necessity). Data were reported to hospital CEOs quarterly and to the CLABSI teams monthly.		Data were reported to hospital CEOs quarterly and to the CLABSI teams monthly.
Lobo, Brazil - 2010	CLABSI	3 study periods: baseline, pre-intervention and intervention. Survey was administered to ICU staff covering hand hygiene, cvc insertion, dressing, handing and replacement. Observation of hand hygiene practices was conducted by nurses with a checklist. ICUs were assigned to one of two groups, an individual lecture or continuous lectures on the infection control practices observed to be lacking in each ICU.		Feedback was given monthly during the intervention period and provided staff with information on BSI rates; during the pre-intervention period staff were informed about problems found during the nurses' direct observation
Marra, Brazil - 2010	CLABSI	Study consisted of two phases, the first phase included insertion of catheters through a new venipuncture into the subclavian, jugular, or femoral vein using full sterile-barrier precautions and 2% chlorhexidine preparation for antisepsis. The next phase continued the processes in phase one and randomly audited a small sample of patients monthly undergoing central line insertion. A central catheter insertion cart, hand hygiene intervention, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection with avoidance of the femoral vein for central venous access in adults and a daily review of line necessity. This bundle was monitored by nurses and doctors and nurses had the opportunity to stop any procedure deviating from the bundle guidelines.		Phase 1: Each year, a convenience sample of patients was chosen for whom catheter insertion and catheter dressings were directly observed by assigned nurses. Feedback was provided via e-mail on compliance with these processes for the ICU team (doctors and nurses). Phase 2: Interventions were audited once monthly at random intervals in a small sample of patients undergoing central line insertion and the IHI bundle and feedback was provided via

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
				email. In addition, posters were provided in the ICU and SDU with bar graphs displaying compliance with process of care measures.
Render, United States - 2006	CLABSI	The process change-oriented intervention included a CVC insertion checklist that offered binary choices (yes/no) for hand washing, chlorhexidine use, bed sized sterile drape, and use by the operator of a cap/mask/sterile gown/sterile gloves during insertion, as well as date and site of catheter. The checklist was completed by nurses as the physician prepares for the procedure, acting as both a teaching and a measurement tool. The team leaders also modified the prepackaged insertion trays, removing betadine and small drape and replacing them with an "accessory pack" with a large drape, a sterile gown, gap and mask. The pack was accessed with the checklist on a central line cart, making it easy to do it right. To promote sustained practice change, hospital committees at the senior leadership level (clinical executive board) also approved written policies that matched the best practices to codify the practice change. Certain communication strategies were used to enforce the practice changes (but the paper does not state the specifics) such as a reminder poster on CVC insertion used by 5 of the 10 hospitals that were participating in the 2-year CLABSI-SSI prevention project. Project leadership reported outcomes of the project to the GCHC infection control and patient safety committees. Twice a year, project leadership informed the hospital CEOs of the results of the project, which compared local process adherence and outcomes to the mean of the group. The project leaders organized the work-learning-reporting cycles at each site which included at minimum one test of change every month and met monthly with project leadership and reported their experience using presentation slides in small groups to share effective strategies, solve problems together, etc. Then each project leader reported processes and outcomes to the unit staff, posting monthly project presentation slides on a bulletin board throughout the unit. Results were also reported in the hospital newsletter.		Then each project leader reported processes and outcomes to the unit staff, posting monthly project presentation slides on a bulletin board throughout the unit. Results were also reported in the hospital newsletter. Feedback reports also included other hospitals.
Rogers, Ireland - 2010	CLABSI;VAP	A multidisciplinary team designed an educational package to promote hand hygiene in addition to current infection control measures. A 3 month education intervention included a presentation of evidence-based hand hygiene guidelines, new infection related posters, and demonstration of a six step hand hygiene technique using Glo Germ. Questionnaires were also sent out to ICU staff before and after the intervention to compare attitudes, knowledge and personal practices associated with hand hygiene.		
Sannoh, United States	CLABSI	Neonatal ICU central venous catheter database created, new catheter hub policy including: the surface area of the needleless port and the outer surface		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
- 2010		of the stop cork or Luer-lock threads of the catheter hub were scrubbed in a circular motion with friction using2%chlorhexidine in 70%isopropyl alcohol (ChloraPrep Sepp, CareFusion, Leawood, KS) for 10 seconds and allowed to dry for 30 seconds. The catheter hub care protocol also mandated standard hand hygiene, the use of clean gloves, and the establishment of sterile fields with 4'' 3 4'' gauze under the catheter port and the syringes used to access the hub with medications and flushing solution. The new catheter dressing change policy was to change dressings only when soiled, instead of routine weekly changes. A DVD containing 15-minute lectures demonstrating catheter hub care was viewed in multiple sessions by staff and made available on the hospital NICU website. Catheter hub care checklists were present at every bedside to remind the healthcare team of the protocol, and a CVC cart was placed with hygiene materials in each room. Hand hygiene campaigns were reinforced at this time.		
Santana, Brazil - 2008	CLABSI	Healthcare personnel were evaluated with a pre-test first. Next fact sheets and posters were distributed to healthcare personnel. Performance of 1-hour lectures by an expert infection control nurse regarding CLABSI were given to hospital staff.	Audit and feedback of infection rates	
Shannon, United States - 2006	CLABSI	The AGH working group drew on a local community resource, the Pittsburgh Regional Health Initiative (PRHI) to learn about process improvement techniques rooted in the Toyota Production System (Lean thinking). AGH physicians, nurses, and infection control practitioners received five days of intensive training at PRHI in the improvement system called Perfecting Patient Care (PPC) and then applied those principles in clinical practice. The team, headed by the chairman of the department of medicine, also included unit directors, infection control nurses, ICU nurses, and staff from PRHI. The team began by looking at individual infections, case by case, reviewing charts of the 1,753 persons admitted to the MICU and CCU between July 2002 and June 2003, during which conventional approaches were employed. With a clearer sense of the frequency, types, and consequences of CLABs in its MICU and CCU, the team began observing staff to determine how lines were actually placed and maintained. Each occurrence was examined to its root cause as close as possible to receipt of a positive lab culture (range, 3–24 hours; average, 6 hours, including weekends). The root cause team investigating each occurrence included the infection control nurse, the physician of record, and the residents, fellows, and nurses caring for the patient. The team was headed by the chairman of the department of medicine. The team developed a countermeasure that required new trainees		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		(nurses and doctors) to be educated in a multidisciplinary training exercise using patient simulators with the guidance of physician mentors and nursing staff.		
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical care units, and respiratory therapy and nursing supervisors. The directors of critical care met monthly and emphasized the use of the bundle strategies. Data from the participating hospitals was shared both on the critical care collaborative website as well as during learning sessions. Focused learning sessions were conducted by intensivists periodically. The MICU director served as the champion and held monthly sessions for all ICU staff to reinforce the procedures involved in the bundled approach. Nurses collected compliance data and shared it with the MICU team at the performance improvement committee meetings. Data was also shared with other HHC hospitals. 'Zero Infection Rate' certificates were given by the infection control staff monthly as positive feedback. A CAUTI bundle was implemented in January 2005. It included daily assessment of need, sterile technique when inserting, and use of silver-coated catheters. In addition nurses monitored for breaches in infection control. The MICU nurse was also empowered to stop a procedure if there was a deviation from the recommendations. Evaluation of the necessity of the urinary catheter was integrated into the daily goals and discussed at bedside rounds daily.		The ICU was awarded monthly 'Zero Infection Rate' certificates based on outcomes by the infection control staff. Nurses collected compliance data and shared it at the MICU performance improvement committee meetings.
Warren, United States - 2006	CLABSI	The intervention took place in two-folds: 1) updating existing CVC insertion and care policies, and 2) educating staff (didactic lectures for physicians and nurses using a slideshow, self-study module with accompanying 24-question pretest and posttest, and fact sheets and posters highlighting proper techniques for CVC insertion and care placed in the units). The primary messages of the intervention material were as follows: (1) the subclavian vein is the preferred insertion site for a non-tunneled CVC, and the femoral vein is the least desirable site; (2) catheters should be inserted using maximal sterile barrier precautions; (3) catheter insertion site dressings should be kept clean, dry, and intact; and (4) catheter dressings should be properly dated, to ensure regular dressing changes.		Before and after the 9-page self-study module, the physicians and nurses were required to take a 24-question pretest and posttest.
Wicker, United States - 2011	CLABSI	NICU staff held an infection control meeting, which consisted of various disciplines within the hospital, and formed an infection control task force. The NICU infection control task force consisted of neonatologists, pediatric infectious disease specialists, respiratory therapists, the NICU clinical director, NICU staff nurses, the NICU educator, and a pediatric surgeon. The task force reviewed the current practice guidelines and the literature for infection		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		control in the neonatal population and, based on best practices, formulated comprehensive infection control measures. Comprehensive control measures included hand hygiene, prevention of catheter-related infections, education, and environmental infection control measures. The hand hygiene portion included: 1. a hand-washing campaign, 2. prohibiting wearing jewelry (except wedding band) or artificial nails. Prevention of catheter related infections included: 1. IV practice guidelines and education program for all NICU staff, 2. dedicated central line management team, 3. limited blood draws through the catheters, 4. daily assessment of Catheter site, 5. reinforce early removal of central lines, 6. limited the number of vascular puncture and heel sticks by clustering laboratory tests. Education included: 1. focused education for new residents, 2. mandatory infectious disease education to all registered nurses in NICU, 3. mandatory learning packets for all pool and agency nurses, 4. reinforce judicious use of antibiotics, 5. early feeding with breast milk. Environmental included1. Applied keyboard covers on all computers 2. Replaced counter-mounted Corian (DuPont, Wilmington, DE) sinks (attached aprons collected standing water) with freestanding ceramic sinks 3. Instituted daily bleaching of all sinks 4. Obtained individual stethoscopes, bandage scissors, and hemostats 5. Removed all stuffed animals from beds 6. Instructed unit secretary/nurse associates on protocol for bedside use and sterilization of instruments between infants 7. Eliminated all food and drink from direct patient care areas 8. Implemented use of Styrofoam containers to warm formula/breast milk with infant's name identified on container		
Yilmaz, Turkey - 2007	CLABSI	The study involved the following 3 periods: pre-education, education, and post-education. In pre-education, patients were monitored daily. During the education period physicians, interns and RNs were trained to prevent catheter-related infection. And during the post-education period, patients were again monitored. Monitoring followed CDC criteria.	HCWs who scored <80 on the post-education test had to be retrained and retested;	Catheter insertion and follow-up activities were observed and corrections were made on the spot. Monthly CLABSI rates were also provided to the healthcare staff;

Appendix Table C3-LQ: Intervention characteristics for SSI which do not control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Acklin, Switzerland - 2011	SSI	When a spike in SSI following hip fracture surgery occurred, the hospital began a bundle intervention. Using evidence from international guidelines, an independent hospital epidemiology team developed internal guidelines, provided continuing education of staff, limited traffic in OR, standardized disinfection of surgical site, observed standard perioperative procedures and provided feedback to staff. An expert in quality improvement was hired to implement the interventions. Infection rate were regularly reported at internal grand rounds.		Infection rates were reported at internal grand rounds. A feedback session for all staff was organized. When one OR nurse had an increased association with SSIs, he/she was instructed separately about the intervention measures.
Awad, United States - 2009	SSI	A MRSA bundle was initiated, which involved: 1) nasal screening of pts at admission, transfer, discharge, 2) contact isolation of positive pts, 3) standardized hand hygiene, 4) cultural transformation campaign with staff and leadership engagement thru positive deviance, and 5) ongoing monitoring of process and outcome measures. To implement this bundle, clinical staff were educated. Outcome measures were tracked on each unit, and data updated monthly. meetings with all staff were held to discuss unit data, including swab rates on admission, transfer, and discharge, # positive pts, and hand hygiene compliance.	The authors cite CMS's consideration of adding MRSA to the list of conditions for nonpayment.	Monthly meetings in each unit were held to discuss swab rates, # positive pts, and hand hygiene compliance.
Berenguer, United States - 2010	SSI	The hospital decided to enroll in the National Surgical Quality Improvement Program (NSQIP). The NSQIP receives the following data from trained nurses of enrolled hospitals: pre-operative risk factors, post-operative occurrences, mortality reports, SSI, and pt statistics. The NSQIP then generates a 12-mon biyearly report in which enrolled hospitals can compare their statistics with each other. When this hospital received their report, they were in the 4th quartile compared to other hospitals. They began using SCIP as a means to improve their outcomes. Nurses and physicians were trained on appropriate antibiotic choice, timing,	The hospital wanted to improve their statistics in the NSQIP reports, in comparison to the other hospitals.	

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		and duration. Razors were removed from ORs and replaced with clippers. Anesthesiologists and surgeons were educated on post-operative normothermia and bodywarming devices were made available. Surgeons were alerted to the hospital's high SSI rate and were encouraged to take the lead and become active participants in the quality safety team.		
Berry, United States - 2009	SSI	ProvenCare's goal is to deliver evidence-based recommended care to elective CABG pts. A steering committee was formed composed of senior leaders and a process improvement specialist. A cardiac surgeon was assigned within the clinical effectiveness division as the clinical improvement specialist whose role was to facilitate and coordinate the initiative. The initiative had 3 phases: review and validate best practice evidence, redesign processes, and implement new processes. CABG guidelines class I and IIa from American College of Cardiology/American Heart Association were reviewed in a series of consensus-building meetings of all Geisinger cardiac surgeons. This resulted in 19 clinically applicable recommendations and 40 measurable process elements. Those relating to SSI are preoperative antibiotics and tight perioperative glucose control. A multidisciplinary team was formed in each hospital, consisting of a physician, a cardiac physician asst, critical care nurse, OR nurse, cardiac rehabilitation tech, electronic health record programmer, and clinical process improvement specialist. The team assessed current process flows for CABG pts, determined which best practices were already in place, and redesigned the process to incorporate best practices not already in place. The Study-Act-Plan-Do process was used to standardize intra-operative glycemic control. Cardiac surgeons chose 110 mg/dl or greater as the trigger to start insulin infusion. Certified registered nurse anesthetists (CRNA) posted insulin protocol in OR and a daily feedback	As a part of the existing hospital setting policy physician compensation was tied to physician performance and compliance. Also, all HCW's were made aware that compliance with each of the process elements (as a team and as individuals)would be followed and that real-time feedback would be given so this would affect their performance;	When a lapse in adhering to new process measures occurred, the clinical improvement specialist worked with staff responsible for lapse and reinforced the new process measure.; Real-time feedback was able to be done due to the robust measurement strategy (A standardized abstraction tool that graphically depicts the sequential delivery of care and highlights defects) so any variation or ''failure'' was fed back to the responsible care provider and the improvement team on the day it occurred (as the clinical improvement specialist was notified for each new patient entering the process and the abstracted data tool was in use at a time in parallel to the care being provided);

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		mechanism was put in place to alert CRNA of adherence. Director of anesthesia reviewed protocol with all anesthesia personnel. Details on system for preoperative antibiotics were not provided. The electronic health record was adopted to include: clinical decision support, care flow maps, and history and physical templates. Performance data on all 40 process measures were continually monitored so that any process defect was quickly identified and immediately redesigned. Within 3 months, 100% reliability of process measures was achieved.		
Carles, France - 2006	SSI	Weekly, the anesthesiologists created lists with pt name, type of surgery, and date of surgery and sent the list to the hospital pharmacy. Pharmacists prepared personalized surgical antibiotic prophylaxis kits (SAPK) with pt name, antibiotic to be given, and instruction sheet specifying dose, times of administration, and duration of antibiotic. SAPKs were delivered to the operating room on the morning of the planned surgery.		
Forbes, Canada - 2008	SSI	Three multidisciplinary working groups, one for each bundle, met to design new practice protocols. Members of the depts. of surgery, anesthesia, and perioperative nursing tested the new protocols prior to implementation. The new plans were introduced thru academic rounds and in-services. An OR nurse and a nurse from same-day surgery were study champions, acting as resources to other staff. The antibiotic bundle included: location of antibiotic administration was changed from the admissions unit to the OR. Preprinted, preoperative order forms were designed to standardize the choice of antibiotic. The plan was introduced to attending and house staff during rounds, and to nurses through a series of in-services. Before implementing the previously mentioned interventions, each working group conducted independent tests of change.		Monthly performance figures were posted in the OR.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Gomez, Argentina - 2006	SSI	A multidisciplinary team of pharmacists and infection control personnel developed an automatic stop prophylaxis form which included pt info, surgery info, level of bacterial contamination of surgery, and surgeon name. The form had a checklist for antibiotic recommendations so the physician can check which antibiotic was to be administered. The forms were then sent to pharmacy and every morning, pharmacy checked the forms and stopped the antibiotic prophylaxis if the surgery had been completed. If physician wanted to extend antibiotics, he/she could call pharmacy for extension. Educational programs were presented to different surgical teams, nursing, and pharmacy staff on guidelines and how to use form. Each physician also received a 1 hr one-on-one instruction on antibiotic guidelines so that consensus was reached.		
Graf, Germany - 2009	SSI	When a rising incidence of deep sternal surgical site infections occurred, an infection control team was formed, including cardiac surgeons and nurses, anesthesiologists, technicians, ward physicians and nurses, and members of the infection control dept. The team developed a bundle of prevention strategies to be implemented. The bundle of prevention strategies included using hair clippers instead of shaving, administering antibiotic prophylaxis after 1st venous puncture during operation preparation, use of antiseptic body scrub, and bacterial decolonization measures. A pt-specific information sheet was created describing appropriate infection control measures before cardiac surgery, a standard operation protocol for infection control measures was implemented, and successful application of the infection control measures was documented using a rubber stamp in the pts' files. Frequent education of physicians and residents from participating departments was conducted together, allowing for discussions on the practicality of prevention measures, optimizing		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		the working process. Continuous feedback of SSI rates were provided to staff.		
Hermsen, United States - 2008	SSI	An order form for surgical antimicrobial prophylaxis was developed according to published guidelines, the hospital formulary and local prevalence of antimicrobial resistance. It was designed to assist in the choice, dose and duration of use of antibiotics. It also included guidelines for weight-based dosing and alternatives for patients with allergies. The form was made mandatory for all adult, elective, inpatient surgical procedures. Physicians, pharmacists and nurses were educated about the form and the Surgical Infection Prevention (SIP) program via written communication, posters, and presentations. Feedback was given to medical staff throughout the study.		
Ichikawa, Japan - 2007	SSI	Study staff created antibiotic protocols for the management of infections in children. The protocol includes the type of antibiotic, timing of antibiotics and dosing of Antibiotics for different disease/operations for different wound types. The infection control team (ICT) determined the choice of Antibiotics, its route of administration, and duration of use. The pre and intra-operative Antibiotics were administered exclusively by anesthesiologists at tracheal intubation or soon after intubation just before final positioning on the table. This was confirmed by the operating room nursing staff or attending surgeons. If an infection was detected, the ICT advised other staff about the protocols, adequate wound care management, and treatment.		If an infection was identified, a meeting was arranged for the ICT to advise other staff about protocols, wound care, and treatment.
Kable, Australia - 2008	SSI	An interdisciplinary approach was taken to implementing antibiotic prophylaxis measures. Protocols for each surgery type were designed using guidelines, and approved by the Director of Microbiology and Infectious Diseases and the Director of Pharmacy. The protocols were inserted in the medical records of the corresponding pts by the pre-op staff. Staff were educated on the study and the protocols during		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		training sessions.		
Kramer, United States - 2008	SSI	A continuous insulin infusion (CII) order set, was developed in 2004, but nurses found it cumbersome and difficult to use. The form was designed to avoid hypoglycemia. The cardiac team, led by a multidisciplinary quality improvement group, worked with graduate students to devise a new CII. The team focused on the clinical microsystem and nursing workflow. A color-coded nomogram for CII orders which fit on one page, was developed. The group also coordinated weekly intensive in-service sessions that stressed the dangers of hyperglycemia and the lesser dangers of hypoglycemia, and the nomogram was explained and feedback from the frontline users (nurses) was obtained. There was widespread acceptance of the new form by all nurses (OR, cardiothoracic ICU, general ICU), all of which would use the nomogram.		
Liau, Singapore - 2010	SSI	A project team was assembled consisting of surgeons, anesthesiologists, OR attendants, OR nurses, post-anesthesia care unit nurses (PACU), ward nurses, and ward physicians. The team identified factors causing SSI and voted for the following factors to work on: antibiotic prophylaxis, hypoglycemia, hair removal, and normothermia. Hair removal: shavers replaced clippers, reminder signs were posted, pts instructed not to shave preoperatively, OR attendants trained to use clippers, and the team worked with the purchasing dept to ensure a continuous supply of clippers. Antibiotic prophylaxis: The Department of Surgery Prophylactic Antibiotic Guideline was developed based on international guidelines, agreed upon by surgeons, pharmacists, and infection control, and distributed to all staff for reference and compliance. Signs and posters on the guideline were posted, and drugs were stocked accordingly. Glucose control: PACU and ward nursing officers were tasked to monitor and		Following the successful pilot study, hospital leadership spread the news to the rest of the surgical disciplines. Within 2 yrs, other subspecialties (breast, urology, vascular, endocrine, and orthopedics) adopted similar practices.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		control blood glucose concentrations postoperatively. Normothermia: Warmed intravenous fluids, higher temp in OR, and use of warming blankets throughout entire operation were strategies employed. A pilot study was conducted and upon positive results, the full study was implemented. The operation workflow was modified to embed all of these changes.		
Martin, United States - 2010	SSI	The following changes in surgical wear were implemented: 1) during stages and reconstruction, staff wore surgical caps to contain hair and no jewelry except smooth wedding rings were allowed, 2) during removal, staff scrubbed with CHG and alcohol and wore sterile gloves and pts draped with sterile towels and sterile dressing applied, and 3) during reconstruction, staff scrubbed with CHG and alcohol and wore sterile gloves and gowns.		
Nemeth, United States - 2010	SSI	One month of education of the anesthesia, nursing and surgical staffs, and the inclusion of the question "Has the antibiotic been administered within the correct time frame?" added to the verification of patient identity, operative procedure, and surgical site during the pre-operative 'time out'.		
Ozgun, Turkey - 2010	SSI	Pre-intervention data was collected on antibiotic prophylaxis use. This data was analyzed and shared with physicians and residents. General and branch meetings were held to educate the surgeons, residents, and nurses on antibiotic prophylaxis. Topics discussed included choice of antibiotic, timing of administration, and duration. Specific problems and misuses that were detected in the pre-intervention data were discussed separately within each branch. If surgeons could not attend meetings, they were caught up to the study individually. Guideline documents were distributed to staff and posters were hung around the hospital.		Misuses of antibiotics detected in the pre-intervention data were discussed separately within each surgery branch.
Parker, United States - 2007	SSI	The Six Sigma approach is a data-driven, quality improvement methodology developed by Motorola and improved by GE. It is used to		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		improve outcomes by reducing process variability. A 10-member multidisciplinary team consisting of physician process champions, nurses, a hospital epidemiologist, and an outcome administrator were assigned a 3M "black belt" mentor responsible for team building and overall project management. All team members participated in a two month Six Sigma "green belt" training to learn the tools and concepts necessary to begin this quality improvement project. A process map was made to help outline the critical steps involved in increasing compliance with antibiotic prophylaxis. The intervention aimed to reinforce use of standardized preoperative order forms, eliminate administration of antibiotic prophylaxis in the surgical admissions preoperative area, and send antibiotics and IV tubing to the OR. A 1 week education program preceded the beginning of the project. The education program targeted all clinicians that might interact with the patient. In 2005, an electronic anesthesia record keeping system (ARKS) was instituted in the main ORs. ARKS acts as a decision support tool to remind the anesthesia provider to administer the antibiotics at an optimal time. ARKS also displays a reminder to give a second dose if the first dose was given >60 min prior to incision.		
Pastor, United States - 2010	SSI	A multidisciplinary task force was convened to implement changes and monitor compliance with SCIP process measures. The task force consisted of surgeons, anesthesiologists, infection control personnel, and intra-operative nurses. The committee identified and assisted in overcoming the following obstacles: obtaining certain antibiotics inside operating room, availability of warming blankets in preoperative area, tracking of temp and glucose readings in nursing and recovery room flow sheets. The task force also provided in-service education for all staff on the SCIP process measures.		
Paull, United	SSI	The NCPS initiated a Medical Team Training		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
States - 2010		(MTT) Program in VHA hospitals. In each facility, a nurse educator from NCPS worked with a hospital leader (chief of surgery, nurse manager) to develop a plan for preoperative briefing and postoperative debriefing. Instructors from NCPS then held learning sessions for physicians, nurses, residents, and allied health care personnel working in the OR, post-anesthesia care unit, ICU, and surgery clinics. In addition to providing instruction on pre-operative briefings and post-operative debriefings, the sessions also gave examples of checklists. Over 12.000 providers underwent training. Each facility developed their own checklist, using either paper, slider board, poster, whiteboard, electronic, or other. One item on the checklist was a reminder to administer antibiotic prophylaxis within 60 min of incision. Prophylactic antibiotic use was then reviewed retrospectively in 45 +/- 7 charts/facility pre checklist and in 33 +/- 6 charts/facility post checklist.		
Potenza, United States - 2009	SSI	In response to SCIP guidelines, a team consisting of members from each specialty, as well as nursing and pharmacy, convened. A lead performance improvement nurse and a data analyst were designated for technical and logistical organization, data abstraction, and analysis. The team core met monthly to review data and the whole team met quarterly. Charts were reviewed for compliance with 9 SCIP guidelines. The team identified barriers to compliance with antibiotic prophylaxis, normothermia, appropriate hair removal, and glucose control. First, they educated all staff on the project and the goals and emphasized the need to standardize their approaches to basic surgical issues. Next, methods to address the 9 SCIP guidelines were developed. The methods covered 3 main areas: people, process, and systems. To improve antibiotic prophylaxis compliance, there was a gradual agreement among key surgical personnel on antibiotic		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		selection and a standard policy for timing of administration was set. The pharmacy created a system to deliver approved antibiotics and anesthesia stocked them on carts. Surgical house staff and faculty were given laminated cards with SCIP guidelines including antibiotic choices. ORs also have antibiotic listings for quick reference. Anesthesiologists, responsible for administering antibiotics, were empowered to question antibiotic choice, and the anesthetic worksheet was revised to include SCIP guidelines, which improved documentation.		
Rauk, United States - 2010	SSI	A team consisting of administrators, staff, physicians, and infection control personnel met to identify potential causes of SSI after cesarean deliveries. Next the team developed a preoperative skin preparation protocol. The new protocol included using 2% CHG clothes preoperatively on all pts undergoing c-section as well as all pts with prolonged labor or other risk for c-section. The clothes were no-rinse. Staff were instructed on use of the clothes, proper attire, room setup, skin coverage, and sterile technique. A video was made to demonstrate these techniques and a knowledge assessment tool was developed. The team also developed a quick reference sheet on the clothes. Flash sterilization of instruments was eliminated. All sterilization was done at central surgical supply and availability of enough surgical instruments was provided so that flash sterilization was no longer necessary.		Following educational instruction, a knowledge base assessment tool ensured the staff understood the instructions.
Shimoni, Israel - 2009	SSI	The epidemiology nurse and hospital's infections disease consultant persuaded heads of obstetrics and anesthesia departments to empower 6 operating room nurses to ensure that the 13 anesthesiologists give 1g or 2g of cefazolin (1 g if under 80 kg weight and 2 g if 80 kg or more) after cord clamping of caesarean births.		
Suchitra, India - 2009	CAUTI;SSI	An education program was conducted at the respective hospitals by a trained microbiologist.		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		Small groups comprising of 10-15 staff were allowed to attend the education program, which extended for 2.5 to 3 h and was conducted as two sessions for the sake of convenience. It was conducted during the duty hours of the staff. The topics covered were hand washing, waste disposal, skin disinfection, universal precautions, hospital-acquired infections and prevention of infections. The sessions were interactive and the HCW were encouraged to ask questions.		
Takahashi, Japan - 2010	SSI	An antimicrobial stewardship team from the department of Infection Control and Prevention consisting of an infection control doctor and certified pharmacist prepared manuals with a physician from each department and chief surgeons in each department on the appropriate use of antimicrobial prophylaxis. The appropriateness of AMP was determined by the "Guideline for prevention of SSI, 1999" established by HICPAC and "Guidelines for implementation of clinical studies on surgical antimicrobial prophylaxis (2007)". A manual was created for each of the 15 surgical departments outlining the correct use of antimicrobial prophylaxis (AMP). Nurses administered AMP in the pre-intervention period under the direction of a surgeon while an anesthesiologist administered AMP in the operating suite during the post intervention period. After the post-intervention period, each department received feedback of its AMP data discussed with surgeons, anesthetists, pharmacists, microbiologists and nurses. Educational meetings were organized for medical staff. Persons implementing feedback and educational meeting were not specified.		Study staff provided feedback of AMP data to departments surgeons, anesthetists, pharmacists, microbiologists, and nurses
Wax, United States - 2007	SSI	an interactive visual reminder for prophylactic antibiotic administration was activated in the anesthesia information management system (AIMS) in nearly all anesthetizing locations. An event icon with the wording "Prophylactic Antibiotics Given" would appear between the	The surgical Care Improvement project mandate to publicly report surgical antibiotic selection/timeliness and pay-for-performance initiatives by payers as well as accrediting organizations and competitive forces in the market place	Practitioners with low compliance rates were interviewed. It was found that some had custom AIMS configurations that suppressed the antibiotic reminder and some felt that it was redundant to have to document seeing the reminder as well as document the actual administration of the antibiotic.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		"Position/Prep Start" and "Procedure/Surgery Start" icons. The event icon could then be acknowledged or ignored.	were noted as motivating factors to increase compliance.	
Whitman, United States - 2008	SSI	The hospital-wide Performance Improvement Committee reviewed hospital-specific data and challenged the university surgical faculty to improve compliance with antibiotic prophylaxis guidelines. In spring 2005, surgical chairs began developing a protocol for antibiotic selection for operations performed in their respective departments. In January 1, 2006 they then implemented a surgical scheduling order form in which specialty-specific antibiotic prophylaxis was listed on the physician form to aid in the appropriate selection of antibiotics. In July 2006, the Temple University Hospital (TUH) adopted a policy mandating physician admission orders be available to the preadmission testing area (PAT) a the time of preadmission appointment to ensure orders for antibiotics were on the chart the day of admission. From Sept. 2006 through November 2006 TUH required administration of prophylactic antibiotics before the patient could leave the preparation and hold area. From December 2006 to June 2007, the Department of Anesthesia assumed responsibility for administering ordered antibiotic prophylaxis in the operating suite at the time of "universal timeout". In order to promote timely cessation of antibiotic prophylaxis, the hospital's associate director for perioperative services (first author) educated residents and faculty at each of the department's routinely scheduled monthly resident educational meetings. In September 2006, a separate pathway for ordering "prophylactic antibiotics" was added to the electronic medical record, although the pathway could be bypassed. Hospital reports were reviewed monthly by the TUH SCIP committee and also presented at the operating room executive committee meeting.	Surgical Care Improvement Project requiring all Medicare participating hospitals to report specific data about antibiotic prophylaxis	Data acquisition was overseen by the medical record abstractors' director (coauthor) and reports reviewed by the TUH SCIP committee
Willemsen,	SSI	This hospital was founded after a merger of 3		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Netherlands - 2007		hospitals, and different antibiotic guidelines from before the merger were used by different staff. A multidisciplinary team of microbiologists and pharmacists created a standardized guideline which was approved by all surgeons and anesthetists. The guideline included information on antibiotic choice, dosage, and timing. The project coordinator educated all staff involved in perioperative antibiotic prophylaxis, which included nurses, pharmacy assistants, and anesthesia technicians. All antimicrobials in supply closets were switched in the ORs and on the wards, to only those recommended in the guideline.		
Zvonar, Canada - 2008	SSI	Following the baseline audit a multidisciplinary team was formed. The team recommended that antibiotics be given at time of anesthesia administration. To facilitate delivery, in June 2003, pre-mixed pre-op doses of antibiotics were sent to the OR with the patient's chart and were also made available in the OR suites. Also patients with BMI>30 or weight>90kg, received a larger dose of antibiotics. The surgeon was to confirm that antibiotic prophylaxis was administered prior to incision. Antibiotics were also to be given intra-operatively for surgeries >3-4 hours. The second audit in 2004 showed some barriers so changes to the protocol were made. Nurses and pharmacists were allowed to automatically substitute larger doses for patients with BMI>30 or weight>90kg. Antibiotic prophylaxis was also added to the pre-op checklist. A list of surgeries requiring prophylaxis and recommended agents was created. Allergy and cross-allergy education also took place. In March 2005, a pre-op time out was implemented. This was used to verify that the patient, procedure, and surgical site were all correct as well as to ensure antibiotic prophylaxis was administered.		The data from the audit was used to make changes to the protocol.

Appendix Table C3-LQ: Intervention characteristics for CAUTI which do not control for secular trend or confounding.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
Gokula, United States - 2007	CAUTI	6 educational sessions were held by the PI for all the ED staff. These focused on baseline rates, appropriate use of indwelling catheters, and the problems associated to overuse. The nursing director also held weekly sessions to educate and remind the nurses about appropriate use during this time period. A urinary catheter indication sheet (UCIS) was created and attached to the catheter trays. It was a list of the acceptable indications for catheter use and nurses were asked to fill it out before inserting catheters. ED staff was also reminded at weekly department meetings about the UCIS. The sheets were collected weekly by the PI.		The educational sessions began with a presentation of the baseline rates.
Jain, United States - 2006	CAUTI;CLABSI;VAP	Physician led multidisciplinary rounds were initiated in October 2002. The team included in these rounds consisted of the patient's nurse, ICU charge nurse, pharmacist, dietician, respiratory therapist, case manager, social worker, physical therapist, and palliative care nurse. This team would set daily goals and use trigger tools to define adverse ICU events. Daily bed flow meetings were also implemented which happened twice daily. They were 20 minutes long and discussed facility status, intervention priorities, historical data, and daily goal setting. The meeting was led by the administrative house supervisor. After October 2002 bundles for VAP, CLABSI, and CAUTI were implemented. The bundles were developed using published guidelines, CDC recommendations, and local staff recommendations. Feedback was provided to the physicians.	Intensivists were reimbursed for doing rounds.	Feedback was provided to physicians.
Rothfeld, United States - 2010	CAUTI	Nurses were educated on the use of superabsorbent adult diapers and pads. A wound care nurse was conferred with for patient's with decubitus ulcers. This nurse had the authority to advise physicians to replace the urinary catheter. Indications for catheter use were made clear and if a patient had none of these indications then a request was submitted to the physician to discontinue the catheter use.		
Stephan, Switzerland - 2006	CAUTI	Multifaceted, multidisciplinary intervention that combined tailored, locally developed guidelines, education sessions and posters with a visual display of the guidelines. The guidelines outlined criteria for the placement and management of urinary catheters in the operating room, post-anesthesia care unit and surgical ward. These guidelines were approved by the orthopedic department chair, senior nurses, and senior anesthetists of our institution. Rotating resident anesthetists		

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		were individually instructed. After an educational presentation on the epidemiology and prevention of UTI, guidelines were endorsed by nursing staff. Additional information was also given individually to nurses and physicians upon request. A4-format posters illustrating the guidelines and endorsed by the orthopedic department senior staff (department chair, senior nurse, and chief anesthetist) and the hospital infection control program director were displayed in all operating rooms dedicated to orthopedic procedures, the post-anesthesia care unit and orthopedic nursing staff offices.		
Suchitra, India - 2009	CAUTI;SSI	An education program was conducted at the respective hospitals by a trained microbiologist. Small groups comprising of 10-15 staff were allowed to attend the education program, which extended for 2.5 to 3 h and was conducted as two sessions for the sake of convenience. It was conducted during the duty hours of the staff. The topics covered were hand washing, waste disposal, skin disinfection, universal precautions, hospital-acquired infections and prevention of infections. The sessions were interactive and the HCW were encouraged to ask questions.		
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical care units, and respiratory therapy and nursing supervisors. The directors of critical care met monthly and emphasized the use of the bundle strategies. Data from the participating hospitals was shared both on the critical care collaborative website as well as during learning sessions. Focused learning sessions were conducted by intensivists periodically. The MICU director served as the champion and held monthly sessions for all ICU staff to reinforce the procedures involved in the bundled approach. Nurses collected compliance data and shared it with the MICU team at the performance improvement committee meetings. Data was also shared with other HHC hospitals. 'Zero Infection Rate' certificates were given by the infection control staff monthly as positive feedback. A CAUTI bundle was implemented in January 2005. It included daily assessment of need, sterile technique when inserting, and use of silver-coated		The ICU was awarded monthly 'Zero Infection Rate' certificates based on outcomes by the infection control staff. Nurses collected compliance data and shared it at the MICU performance improvement committee meetings.

Study	Infection	Intervention Specifics	Positive or Negative Incentives	Feedback or consequences given to interveners/intervenees
		catheters. In addition nurses monitored for breaches in infection control. The MICU nurse was also empowered to stop a procedure if there was a deviation from the recommendations. Evaluation of the necessity of the urinary catheter was integrated into the daily goals and discussed at bedside rounds daily.		
Wald, United States - 2011	CAUTI	An educational program was developed for and delivered by the principal investigator to the nursing staff (1/2 hour CE credit, a brain-storming session, and brief evaluation of the session followed). Following an audit of postoperative urinary catheter duration, feedback was given to each unit's nursing staff.	1/2 hour CE credit for nurses attending the educational program	Following an audit of postoperative urinary catheter duration, feedback was given to each unit's nursing staff

Appendix Table C4-LQ: Study context for VAP which do not control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Abbott, United States - 2006	VAP	Southwestern United States/	Hospital 2 had added a dentist and dental hygienist to their team and may have contributed to the significant increase in oral care adoption while Hospital 1 did not see much of a change.	The researchers used the ACE star model, PRECEDE-PROCEED model, and diffusion of innovation model to develop the protocol in this study.			A multidisciplinary education team was developed and consisted of clinical nurse specialists, staff physicians, infection control officers, staff nurse team "champions," critical care educators, respiratory therapists, and unit clinical staff as process facilitators.	
Assanasen, - 2008	CLABSI;VAP	Richmond, VA/820 bed hospital		Literature suggests that medical practitioners are more likely to change their behavior if they have received feedback			Infection control professionals were responsible for observing compliance and providing feedback. Nurses were responsible for HOB elevation while nursing directors oversaw compliance of this. CVCs were done by house staff and monitored by the attending physician.	
Berriel-Cass, United States - 2006	CLABSI;VAP	Detroit, Michigan/607 bed hospital	Physician support was greater for the CLABSI center than the VAP center.			Ascension Health issued a call to action for decreasing preventable injuries among patients of their hospitals. Hospital participated in the IHI Critical Care Collaborative.	ICPs helped with educating the ICU staff. Nursing champion was defined as a nurse well known in the ICU who was involved in training nurses on his or her unit on using the checklist to document the correct placement of central	Physician champions are available if problems occur between operator (physician) and nursing. The hospitals used a system wide website to share their

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							catheters and was responsible for compliance with the checklist on all lines placed. The unit nurse manager acted as the nurse champion and supported the nurses' stopping of the procedure at any time if the physician was not complying with the established protocol. The physician champion was chosen based on being well known in the ICU, being involved in training residents for catheter placement, directing in-services for resident physicians (medical and surgical) on appropriate line placement and the use of the tool, and serving as a contact person if problems occur between operator (physician) and nursing.	experiences, educational materials, and tools they developed with other Ascension Health hospitals.
Berriel-Cass, United States - 2006	CLABSI;VAP	Birmingham, Alabama/338 bed hospital	VAP hospital does not have an intensivist program, most patients on mechanical ventilation are managed by pulmonary			Hospital participated in the IHI Critical Care Collaborative.	Multidisciplinary rounds team consisted of nursing staff, pharmacy, infection control, case management, social workers, dietary, respiratory, chaplain, transporters, quality	Complete oral care kits for every two hours of care were placed in the patients room each morning. The hospitals used a system

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			physicians. VAP hospital had less physician support.				managers, and a representative from CVICU, who would eventually spread the process changes to that unit. Charge nurses educated the staff on their various shifts. Nurses were asked to document compliance and discuss at the MDR daily meetings.	wide website to share their experiences, educational materials, and tools they developed with other Ascension Health hospitals.
Bigham, United States - 2009	VAP	Cincinnati, OH/475 bed hospital		The respiratory therapists and nurses used rapid cycle tests of change (Plan-Do-Study-Act) to establish the best methods to achieve high reliability compliance for each bundle component. This cycle promoted ownership and buy-in to the project by the bedside practitioners.		Authors mention HAIs as a means of disqualifying providers from receiving Medicaid or Medicare reimbursements.	A VAP Prevention Collaborative was established to oversee the changes to decrease VAP rates. The collaborative included physicians, nurses, respiratory therapists, infection control staff, and quality improvement consultants.	
Bird, United States - 2010	VAP	Boston, MA/626 bed hospital	TICU had a higher VAP rate than the SICU before the intervention. The authors		A handwashing campaign, blood glucose control protocols, a chlorhexidine gluconate mouthwash	CMS is no longer reimbursing HAI-related costs.	Respiratory care service was responsible for measuring compliance to the bundle. The infection control team was in	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			attribute this to the higher risk of VAP in trauma patients. The TICU had a higher rate of compliance the SICU. The authors say this may be due to the fact that the TICU staff initiated the VAP bundle project.		protocol, and continuous aspiration of subglottic secretions were also being implemented.		charge of diagnosing VAP. Daily assessment of bundle goals and order entry took place by the multidisciplinary team which was comprised of physicians, NPs, SICU nurses, and pharmacists. SICU nurses were responsible for HOB elevation and sedation breaks.	
Blamoun, United States - 2009	VAP	Paterson, New Jersey/750 bed hospital, 18-beds in MICU.			Existing infrastructure (see intervention specifics for full list) was maintained at baseline and enforced in study	Institute for Healthcare Improvement's "100,000 Lives Campaign"	The laboratory technician provides a prompt verbal alert to the nurse caring for the patient on the detection of any pathogens; Respiratory therapists maintained a specialized protocol for procedures. Nurses were involved in procedures however it is not clear as to specific duties.	
Bloos, Germany - 2009	VAP	Jena, Germany/50 bed surgical ICU			Handwashing before dealing with patients, daily oral care, and sterile tracheal suctioning were already in place in critical care areas of the hospital.		The change team was made up of the ICU manager, ICU consultants (physicians), and interested ICU residents and nurses. Change team designed educational program, conducted	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							the audits, and supplied feedback.	
Cocanour, United States - 2006	VAP	Houston, TX/690 bed hospital	The STICU nursing staff turnover decreased from 22% in the baseline period to 4% in the follow-up period.		Infection control practitioner (ICP) monitored HAIs in the unit a few times a week.	The hospital had joined the IHI and Voluntary Hospital Association (VHA) efforts to improve ICU care.	The multidisciplinary team included the hospital's director of performance improvement, STICU medical director, infection control practitioner assigned to the STICU, the STICU PharmD, the STICU respiratory supervisor, the STICU nursing director, the STICU nursing manager, and senior nursing leaders from all shifts. After the start of the study the ICP began monitoring infections daily. A tight glucose control project was also taking place in the STICU during this study.	Infection control practitioner, nursing manager or senior nursing leaders were in the ICU on a daily basis and available for clarification of expectations and positive reinforcement. The STICU Infection Control Guidelines were published and made available to the STICU staff.
Garcia, United States - 2009	VAP	Brookdale, New York/427 bed hospital			Existing standard QI procedures included: Changes in the ventilator circuit every 7 days, replacement of the heat moisture exchange filter every 24 hours, closed suction catheter changes every 24 hours (suctioning performed every 2		The VAP Prevention Task Force was a multidisciplinary team comprised of nursing and physician staffs of the MICU, nurse educators, anesthesiologists, and staff from the emergency, materials management, and performance improvement departments. Nurses	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
					hours or as needed), use of a 30º semi-recumbent positioning protocol when medically feasible, administration of stress ulcer prophylaxis, and use of an active weaning protocol. Compliance with these interventions for the full study period ranged from 90% to 100%.		were responsible for carrying out the oral care protocol. Infection control professionals conducted staff interviews and observations of practice to identify barriers as well as conducted the education programs.	
Heimes, United States - 2011	VAP	Kansas City, KN/				The authors discuss that the reduction in Medicare reimbursement made the study worthwhile.	The study reappropriated responsibilities to existing staff members. The IC officer and ICU case manager were used to track compliance and diagnose VAP. The physicians were not allowed to contest the VAP diagnosis.	
Jain, United States - 2006	CAUTI;CLABSI;VAP	DeSoto, MS/28 ICU beds			Hospital administration and nursing leadership pushed for quality improvement initiatives in 2003. No specifics are given.	The hospital joined the IHI project to improve patient safety and outcomes	The house supervisor was relieved of some of her duties with bed flow through the bed flow meetings. Physicians took a more active role in daily patient care through leading the multidisciplinary rounds.	
Jimenez,	VAP	San Juan,					Deep vein thrombosis	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
United States - 2009		Puerto Rico/232 bed hospital					prophylaxis was already a high priority in the NSICU.	
Landrum, Afghanistan - 2008	VAP	Air Force Theater Hospital in Iraq/					The infectious disease physician inspected the facility and provided education and reinforcement when needed.	Forms tracking compliance with new practices were added to the patient charts.
Quenot, France - 2007	VAP	Dijon, France/11 bed medical ICU			VAP bundle was already being used (Oral care, HOB elevation, hand hygiene)		The multidisciplinary team consisted of physicians and nurses and were in charge of developing the protocol and training the staff. Nurses were now given more responsibility and control over managing patients' sedation level.	
Rogers, Ireland - 2010	CLABSI;VAP	Northern Ireland/53 ICU beds in total	There was a very wide range in staffing (3 units were under-staffed) and bed occupancy (58%-132%). The authors note that these are both associated with increased infection rates and these differences may have led to the non-				The authors note partnering with lead medical staff, nurse managers, Advanced Neonatal Nurse Practitioners, infection control teams, lab staff, and the regional Neonatal Nursing Benchmarking Group was key to the success of this project.	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			significant changes in infections rates.					
Rosenthal, Argentina - 2006	VAP	Buenos Aires, Argentina/330 bed hospital			Infection Control Department already existed. A vigorous campaign for hand hygiene was also in place during the study.			
Ross, United States - 2007	VAP	Winston Salem, NC/854 bed hospital			Oral care products were already being stocked in the hospital, but not being utilized by the staff.		Critical care nurse specialists trained the educators and also provided the education program in some of the units. They were also in charge of providing feedback to the nurses and CNAs.	The storyboards were posted on the hospital's intranet to increase accessibility.
Sona, United States - 2009	VAP	St. Louis, MO/1344 bed hospital			During both the control and intervention period the hospital had implemented the CDC Guidelines for Preventing Healthcare-Associated Pneumonia.		CNSs were given the ability to audit oral care orders and make sure nurses were implementing the protocol on eligible patients.	The pictorial of the oral care technique was laminated and posted at every patient's bedside.
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	New York, New York/20 ICU beds		Their model was based on the SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) approach. Authors note		The hospital was a part of the Health and Hospital Corporation network.	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical	Data from all participating hospitals was available on the critical care collaborative website.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
				this theory may have contributed to the consistent and sustained change and decline in HAIs.			care units, and respiratory therapy and nursing supervisors. The MICU director served as the champion and held monthly sessions about the importance of bundles. MICU nurses were given the following responsibilities: collecting compliance data, completing the CLABSI bundle checklist, stopping a procedure if there was a deviation from the recommendations, and monitoring for any breaches in infection control.	

Appendix Table C4-LQ: Study context for CLABSI which do not control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Assanasen, - 2008	CLABSI;VAP	Richmond, VA/820 bed hospital		Literature suggests that medical practitioners are more likely to change their behavior if they have received feedback			Infection control professionals were responsible for observing compliance and providing feedback. Nurses were responsible for HOB elevation while nursing directors oversaw compliance of this. CVCs were done by house staff and monitored by the attending physician.	
Berriel-Cass, United States - 2006	CLABSI;VAP	Detroit, Michigan/607 bed hospital	Physician support was greater for the CLABSI center than the VAP center.			Ascension Health issued a call to action for decreasing preventable injuries among patients of their hospitals. Hospital participated in the IHI Critical Care Collaborative.	ICPs helped with educating the ICU staff. Nursing champion was defined as a nurse well known in the ICU who was involved in training nurses on his or her unit on using the checklist to document the correct placement of central catheters and was responsible for compliance with the checklist on all lines placed. The unit nurse manager acted as the nurse champion and supported the nurses' stopping of the procedure at any time if the physician	Physician champions are available if problems occur between operator (physician) and nursing. The hospitals used a system wide website to share their experiences, educational materials, and tools they developed with other Ascension Health hospitals.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							was not complying with the established protocol. The physician champion was chosen based on being well known in the ICU, being involved in training residents for catheter placement, directing in-services for resident physicians (medical and surgical) on appropriate line placement and the use of the tool, and serving as a contact person if problems occur between operator (physician) and nursing.	
Berriel-Cass, United States - 2006	CLABSI;VAP	Birmingham, Alabama/338 bed hospital	VAP hospital does not have an intensivist program, most patients on mechanical ventilation are managed by pulmonary physicians. VAP hospital had less physician support.			Hospital participated in the IHI Critical Care Collaborative.	Multidisciplinary rounds team consisted of nursing staff, pharmacy, infection control, case management, social workers, dietary, respiratory, chaplain, transporters, quality managers, and a representative from CVICU, who would eventually spread the process changes to that unit. Charge nurses educated the staff on their various shifts. Nurses were	Complete oral care kits for every two hours of care were placed in the patients room each morning. The hospitals used a system wide website to share their experiences, educational materials, and tools they developed with other Ascension Health hospitals.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							asked to document compliance and discuss at the MDR daily meetings.	
Bhutta, United States - 2007	CLABSI	Arkansas Children's Medical/292 bed children's tertiary hospital					Multidisciplinary team consisted of a group of pediatric clinicians including the director of infection control, critical care nurses, infectious diseases specialists, and critical care medicine physicians. The hospital's medical director served as a senior leader and advocate for this project. The multidisciplinary group identified the problem, created a data collection system to measure baseline performance and ongoing improvement, and created a data reporting system that allowed all stakeholders to understand the extent of the problem and gauge the effects of changes in practice. Infection control staff reported quarterly data to the nursing and medical	Trolleys with supplies for insertion or other invasive procedures were available at patients bedsides and restocked by technicians.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							directors of the unit.	
Bizzarro, United States - 2010	CLABSI	Yale, New Haven/54 Bed Level IIIc NICU			Participation in the National Healthcare Safety Network.	Participation in the National Healthcare Safety Network (They were required to report rates at certain times and compare them with benchmarks and once they reviewed the comparisons they formed a committee to start intervention).	Multidisciplinary team comprised of 20 representatives (physicians, neonatal nurse practitioners, physician assistants, registered nurses, and a hospital infection control practitioner) was formed for the training of fellows. Multidisciplinary team representatives inspected dressings and addressed deviations from protocol with individual staff members. A physician and 2 nurses, who would be present in the NBSCU during both daytime and nighttime hours, were identified to lead the effort. During patient rounds daily discussions were undertaken concerning the duration of time a CVC had been in place and whether its use was still vital.; Fellows who are formally trained may independently	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							perform and assist in the training of incoming personnel.	
Galpern, United States - 2008	CLABSI	Brooklyn, New York/628 bed hospital				The hospital was a part of the Greater New York Hospital Association Quality Improvement Collaborative.	The multidisciplinary team included the Head of the Surgical ICU as the team leader, nurse managers from the ICU, and 2 infection-control nurses. Data were collected by a trained, hospital based infection-control practitioner. Nurses were now asked to help with placement of CVCs.	
Guerin, United States - 2010	CLABSI	Denver, CO/10-bed MICU; 13-bed SICU			The CVC insertion bundle (without the post-insertion care bundle) had already been implemented since 2006. There were also other standard infection control practices ongoing at the time of the study intervention implementation.		An IV team was assembled to provide insertion and site care of PICCs as well as monitoring of site care and dwell time of all IV catheters throughout the hospital.	
Jain, United States - 2006	CAUTI;CLABSI;VAP	DeSoto, MS/28 ICU beds			Hospital administration and nursing leadership pushed for quality improvement initiatives in 2003. No specifics are given.	The hospital joined the IHI project to improve patient safety and outcomes	The house supervisor was relieved of some of her duties with bed flow through the bed flow meetings. Physicians took a more active role in	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							daily patient care through leading the multidisciplinary rounds.	
Jeffries, United States - 2009	CLABSI	>10 locations in the United States/26 hospitals						
Khouli, United States - 2011	CLABSI	New York, NY/885 bed hospital		Simulation training allows for repetitive and deliberate practice in a realistic and interactive environment that can provide feedback on performance and mistakes.				
Koll, United States - 2008	CLABSI	New York/36 hospitals; 56% had 400 beds, 22% had 300-399 beds, 19% had 200-299 beds, 3% had < 200 beds.	Compliance with CLAB bundle;			In 2005 the Greater New York Hospital Association board of governors became industry leaders in supporting the public reporting of HAI's.	Materials management staff played a pivotal role in implementing the hospitals' all-inclusive central-line insertion kits. In this sense, the collaborative broke new ground by including materials managers as an essential part of the quality improvement team. Hospital leadership committed to and played an active role in trying to achieve	Hospital teams encountering resistance from physicians and other clinicians relied on the "expert-on-call," (an infectious disease physician consultant) to provide guidance and customized solutions, as well as to educate clinicians about reasons for

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							the theoretical limit of “zero” tolerance for CLABs.; Change from individual 'infection practitioner' to multidisciplinary team containing ICU physicians, nursing staff, ICPs, representatives where central-lines were placed.	practice changes and CLABs bundle adoption. Within the first year this "expert-on-call" also made site visits at 3/4 of the hospitals to help out and be available. ; Collaborative web-site with interactive forum available to share information, ask question, share technical resources, and retrieve immediate responses from peers on central-line best practices.
Lobo, Brazil - 2010	CLABSI	Sao Paulo, Brazil/1 hospital with 2 ICUs participating		Increased education on catheter infection control practices will reduce the rate of CLABSI infection and increase adherence to these practices.				

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Marra, Brazil - 2010	CLABSI	Sao Paulo, Brazil/One 38-bed med-surg ICU and two 20-bed SDU's			CDC Guidelines for adhering to skin antisepsis and sterile barrier precautions when inserting CVC		In phase 1 and 2, attending physicians (eg, surgery doctors), ICU doctors, or ICU medical residents inserted the catheters through a new venipuncture, into the subclavian, jugular, or femoral vein using full sterile barrier precautions and 2% chlorhexidine preparation for skin antisepsis per CDC guidelines. Decision to remove catheter was made solely by the patient's physician. Phase 2: central line bundle was monitored everyday by ICU and SDU nurses and doctors. The ICU and SDU nurses intervened in this process at the same time that performance monitoring was occurring at the bedside if noncompliance with an element of the bundle was detected. Implementation of an ICU doctor's group to	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							remove the unnecessary catheters everyday. Once a day, an ICU doctor (not on clinical duty) checked all the ICU patients with central lines and asked the ICU doctors (on duty) if each central line was necessary. The same strategy was performed in the SDUs, except in these units there were nurses who questioned SDU doctors (on duty) about central line necessity.	
Render, United States - 2006	CLABSI	Metropolitan area of Cincinnati/9 hospitals with 21 ICUs		Team used work-learning-reporting cycles to problem solve and find effective strategies.	The Greater Cincinnati Health Council (GCHC) represented 35 hospital members and members of the council's patient safety and pharmacy work groups standardized implementation of surgical site marking and abbreviation use in medical orders and records.	The Greater Cincinnati Health Council (GCHC) asked for commitment from 9 healthcare systems to fund a project to reduce HAIs.	The project leaders organized the work-learning-reporting cycles at each site which included at minimum one test of change every month and met monthly with project leadership and reported their experience using presentation slides in small groups to share effective strategies, solve problems together, etc. The nursing manager of the intervention ICU was part of the project	CVC insertion checklist and the "accessory pack" (large drape, cap, mask, sterile gown and glove) - both placed within the central line cart - were available.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							team at each hospital. The hospital committees at the senior leadership level also approved written policies to promote sustained practice change. The infection control practitioner was often times the project lead within the hospital.	
Rogers, Ireland - 2010	CLABSI;VAP	Northern Ireland/53 ICU beds in total	There was a very wide range in staffing (3 units were under-staffed) and bed occupancy (58%-132%). The authors note that these are both associated with increased infection rates and these differences may have led to the non-significant changes in infections rates.				The authors note partnering with lead medical staff, nurse managers, Advanced Neonatal Nurse Practitioners, infection control teams, lab staff, and the regional Neonatal Nursing Benchmarking Group was key to the success of this project.	
Sannoh, United States - 2010	CLABSI	Westchester Medical Center, New York Medical College/50-bed NICU		CVC hub infections occur at the insertion site and disinfection of all vascular			Hand hygiene campaign	Educational DVD made available on the NICU Web site for the health care team to view at any

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
				hubs, needleless connectors, injection ports before access, and adherence to sterile technique will reduce the incidence of CLABSI infection.				time. A CVC care cart was placed in each room to facilitate ready access to cleaning materials. Catheter hub care checklists were at every bedside to remind the health care team of the steps of the protocol.
Santana, Brazil - 2008	CLABSI	Sao Paulo, Brazil/26 beds between 2 ICUs						
Shannon, United States - 2006	CLABSI	Pittsburgh, PA/778 bed hospital		They used the Toyota Production System adapted to health care - Perfecting Patient Care. They find this method employed in organizations such as Toyota and Alcoa have helped achieve superior levels of quality, productivity, efficiency,	It was noted that traditional QI approaches based on CDC guidelines were previously employed		Multidisciplinary teams of infection control nurses, physicians, residents, fellows and nurses were created and led by the chairman of the department of medicine	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
				flexibility and safety.				
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	New York, New York/20 ICU beds		Their model was based on the SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) approach. Authors note this theory may have contributed to the consistent and sustained change and decline in HAIs.		The hospital was a part of the Health and Hospital Corporation network.	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical care units, and respiratory therapy and nursing supervisors. The MICU director served as the champion and held monthly sessions about the importance of bundles. MICU nurses were given the following responsibilities: collecting compliance data, completing the CLABSI bundle checklist, stopping a procedure if there was a deviation from the recommendations, and monitoring for any breaches in infection control.	Data from all participating hospitals was available on the critical care collaborative website.
Warren, United States -	CLABSI	St. Louis, MO; Baltimore, MD; Iowa City, IA;	Among individual units, there was		Several of the 6 participating hospitals had	HICPAC/CDC's recommendation for hospitals to		Fact sheets on proper CVC insertion

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
2006		New York, NY; Richmond, VA; Chicago, IL; Atlanta, GA/mean # of bed hospital: 775 (range: 427-1385)	variability in the impact of the intervention among the various units, possibly yielding the variable effects. Change in CVC insertion and care practice that best correlated with a reduction in the infection rate was the degree to which an individual unit reduced the proportion of non-tunneled catheters inserted in the femoral vein.		implemented other interventions (i.e., bundling of supplies and/or procedure carts or hand-on training of staff). One ICU instituted an education-based intervention at the start of the pre-intervention period of this study. 5 units were using antimicrobial-impregnated catheters at the start of the study.	implement education programs that teach proper CVC insertion and maintenance techniques		techniques were placed in the units in places that staff were likely to see and read them.
Wicker, United States - 2011	CLABSI	Camden, NJ/35-bed NICU			mentions in discussion that improvement in technology and other unidentified factors may have contributed to the reduction of late onset blood infections in the unit		he NICU infection control task force consisted of neonatologists, pediatric infectious disease specialists, respiratory therapists, the NICU clinical director, NICU staff nurses, the NICU educator, and a pediatric surgeon.	mandatory learning packets were given to all pool and agency nurses
Yilmaz, Turkey - 2007	CLABSI	Trabzon, Turkey/495 bed hospital	Increase HCWs understanding of CLABSI risk factors;					Educational information was put in a 20-page booklet and

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
								given to all of the HCWs; Information and training were made available to all 113 involved clinical staff.

Appendix Table C4-LQ: Study context for SSI which do not control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Acklin, Switzerland - 2011	SSI	Switzerland/		Once an adverse event has been identified, immediate rigorous analysis of the circumstances involved needs to be undertaken. This process is time-consuming, needs additional manpower and additional financial resources, and can be psychologically challenging for all involved.			When an increase in SSI occurred, an interdisciplinary team of surgeons, epidemiologists and infectious disease specialists initiated an emergency investigation, which then led to an independent epidemiology team to develop and implement the bundle.	An expert in quality improvement was hired to oversee the implementation of the preventive practices.
Awad, United States - 2009	SSI	Houston, TX/					One component of the MRSA bundle was a cultural transformation campaign with staff and leadership engagement thru positive deviance, and another component was an ongoing monitoring system of the process and outcome measures.	Nasal screening with rapid results (70 minutes for PCR assay) and contact isolation of pts is needed to implement this bundle.
Berenguer, United States - 2010	SSI	Savannah, GA/500 bed hospital			The hospital has a trained nurse to collect data for NSQIP reports.		Surgeons were alerted to the high SSI rates and were encouraged to take the lead and be active participants in following the SCIP guidelines.	The hospital was enrolled in the NSQIP.
Berry, United States -	SSI	rural central and northeastern PA/Geisinger	Geisinger uses clinical microsystem fundamentals as a	Approaches of quality improvement thru	Multiple efforts underway to improve pt	the cardiothoracic surgery	ProvenCare had the unwavering support from system executive leaders.	electronic health record, multidisciplinary

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
2009		system has 650 MDs (6 cardiac surgeons), 500 med students, residents, fellows	foundation of improvement work, so the staff was used to this type of system, making the implementation of the new processes easier.	process redesign and high reliability help address the gap between evidence-based medicine recommendations and actual clinical practice.	safety, guided by Joint Commission's national pt safety goals, and Healthcare Improvement's 100,000 lives initiative.	department had no systematic process for the evaluation and incorporation of evidence-based medicine (EBM) into acute episodic clinical practice. As a result, there was steadily increasing severity of comorbid conditions among patients referred for CABG surgery. Inconsistent clinical practice was present from the preoperative phase through the entire continuum of care (preoperative evaluation through postoperative rehabilitation)	Leadership was engaged from inception of idea thru allocation of necessary resources for implementation.; multidisciplinary improvement team comprised of a physician, cardiac surgery physician assistant, critical care registered nurse, operating theatre registered nurse, cardiac rehabilitation technician, electronic health record programmer, and clinical process improvement specialists	team cooperation

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
						and varying practice patterns increased the probability of error.		
Carles, France - 2006	SSI	Nice, France/	Despite the intervention, 12% still did not receive SAP appropriately. This could have been due to operating room organizational problems or equipment problems causing unexpected delays in either the induction of anesthesia or the time of surgical incision.				Daily SAPK use requires a change in the hospital routine. Anesthesiologists need to get the pt-specific information to the pharmacy in a timely manner so that the pharmacists can prepare the SAPK, and an organized drug-delivery system between the pharmacy and the operating room needs to be set up.	A new system requires coordinated efforts between the operating room and the pharmacy
Forbes, Canada - 2008	SSI	Ontario, Canada/365 bed hospital, >850 elective general surgery procedures/yr		The development of the interventions was through a transparent system, open to critique from all members of the pt care staff, to identify process issues that could prevent the successful delivery of care.			A multidisciplinary team of surgeons, anesthesiologists, nurses, and pharmacists developed interventions. An OR nurse and a same-day surgery nurse acted as study champions, resources to physicians and nurses, provided direction, and confirmed compliance.	staff education and training, OR nurse and same-day surgery nurse were study champions, monthly performance figures posted in OR
Gomez, Argentina - 2006	SSI	Argentina/88 bed hospital	The gynecology and general surgery units had best attendance at the educational workshops and showed the most interest in the automatic				A team consisting of infection control and pharmacy developed form, surgeons completed form and had to call pharmacy if they wanted	multidisciplinary team, automatic stop form

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			stop form. Their adherence rates improved significantly.				to extend antibiotics	
Graf, Germany - 2009	SSI	Hannover, Germany/					The infection control team had the following interdisciplinary members: cardiac surgeons and nurses, anesthesiologists, technicians, ward physicians and nurses, and colleagues from the infection control dept.	Reminders and documentation were in pt charts, and requires cooperation across departments.
Hermsen, United States - 2008	SSI	Nebraska/689 bed hospital			Previous educational efforts for the reduction in the rate of SSI			Education on the form and SIP were provided in written communication and displayed with posters
Ichikawa, Japan - 2007	SSI	Tokyo, Japan/	At this hospital, the Infection Control Team (ICT) is intimately involved in the prevention and management of surgical site infections. The team stresses the importance/necessity of accurate antibiotic administration and meets regularly with nursing and medical staff.				The ICT encourages cooperation between anesthesiologists, OR staff, junior medical staff, and surgeons.	
Kable, Australia - 2008	SSI	Callaghan, Australia and Darlinghurst, Australia/2 teaching hospitals	Despite the high level of physician involvement in protocol development, and many indicating that they appreciated the advantages of using an agreed upon protocol, many surgeons still did not adopt the protocol,				Physicians were involved from the beginning, in developing protocols along with pharmacy and microbiology. Pre-op staff were then responsible for inserting protocols into pts' charts.	Multidisciplinary team developed antibiotic protocols to be placed in pts' charts.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			with dosages and timing differing from the recommendations. There were differences in the adoption of the protocols among the different surgeons. Surgeons who performed cholecystectomies and hysterectomies did not improve compliance as much as surgeons who performed TURP and herniorrhaphies. Surgeons who performed joint arthroplasties were highly compliant in the pre-intervention period and remained so in the post-intervention phase.					
Kramer, United States - 2008	SSI	Portland, ME/600 bed hospital				A blood conservation program was initiated in the same time frame and may have contributed to the lower deep sternal wound infection rate.	Multidisciplinary team worked closely with the nurses who were responsible for the glycemic control of the cardiac pts.	color-coded one page nomogram
Liau, Singapore - 2010	SSI	Singapore/1200 bed hospital	The authors noticed a fluctuation of compliance coincided with medical personnel rotation. This suggests that constant monitoring and publication of good results is necessary to motivate and educate the		Since 2001, the hospital has been training physicians and nurses using the Clinical Practice Improvement		The multidisciplinary team developed the interventions and was responsible for implementing them. Constant monitoring of process measures and positive feedback were given to physicians.	Staff from all disciplines need to be involved. Other than manpower, little associated costs with this intervention.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			staff through the changes.		Program (CPIP) as part of the Staff Learning Need and Clinical Quality Improvement Programs.			
Martin, United States - 2010	SSI	Galveston, TX/					This study took place in a single-surgeon academic Mohs practice and the physician decided to implement the surgical wear changes.	Sterility upgrades for gloves, gowns, and half sheets for draping.
Nemeth, United States - 2010	SSI	Minneapolis, MN/	In the previous yr, the operating team had been exposed to other quality improvement techniques such as signage, education, and informal feedback/encouragement, so they may have been more prepared to respond to this new set of procedural changes than other operating teams.				In the previous year, this group had implemented other quality improvement techniques, including signage, education and informal feedback/encouragement.	a simple form to be used during the "time out" period to indicate if the antibiotic was used in the correct timeframe
Ozgun, Turkey - 2010	SSI	Aydin, Turkey/about 2000 surgical procedures performed each yr	The intervention did not take into account that junior surgeons consult with senior surgeons about antibiotic prescribing practices. Also, some junior surgeons left during the course of the study and new junior surgeons joined the staff and missed receiving the intervention. They would like to target junior surgeons in future				All staff underwent educational training, but surgeons ultimately made the antibiotic prescribing decisions.	educational meetings, guidelines distributed, posters

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			interventions.					
Parker, United States - 2007	SSI	Cleveland, OH/	The patients undergoing vascular surgery did not see a significant improvement in compliance. The authors note that antibiotics were being given either before or during placement of invasive hemodynamic monitors and patient positioning before incision. The cardiothoracic surgical teams had already developed standardized and defined protocols and may be why their compliance was so much higher at baseline.	The Six Sigma approach is a data-driven, quality improvement methodology developed by Motorola and improved by GE. It is used to improve outcomes by reducing process variability.			A 10-member multidisciplinary team consisting of physician process champions, nurses, a hospital epidemiologist, and an outcome administrator. The cardiothoracic surgical teams had already developed standardized and defined protocols.	
Pastor, United States - 2010	SSI	Duarte, CA/				This intervention was implemented in response to the Surgical Care Improvement Project (SCIP), a national health initiative.	A multidisciplinary task force was convened and worked with all staff to identify problems and implement changes.	The task force ensured that supplies (antibiotics, warming blankets, flow sheets) were available to meet SCIP process measures.
Paull, United States - 2010	SSI	74 Veterans Administration Hospitals/130 facilities in Veterans Administration Hospitals		Communication breakdown and teamwork failure can cause human errors leading to patient harm. The use of pre-op briefings and		This study was a part of the Medical team training (MTT) program initiated by the VHA	A nurse educator from NCPS worked with a team leader as well as frontline providers at each VA hospital.	The team at each hospital developed their own surgical checklist, using any of the following: paper, slider board,

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
				post-op debriefings, guided by a checklist can improve communication among health care providers.		National Center for Patient Safety		poster, whiteboard, electronic, or other material.
Potenza, United States - 2009	SSI	San Diego, CA/325 bed hospital	Many surgeons had a strong sense of individuality with their surgical practice, and resisted the group practice model. These surgeons needed to be reassured that the practice changes would be as efficacious as their present practice behaviors. Over time, through educational venues such as morbidity and mortality conferences, an agreement among key surgical personnel developed.		When SCIP guidelines were published, the medical center had begun a perioperative safety initiative called "Crew resource management" which was a requirement of all surgeons and operating room personnel. The project centered on "team responsibility for pt safety, recognized individual fallibility, and promoted peer monitoring. There was an operating room philosophy of teamwork which included a preoperative briefing		There was a lead performance improvement nurse and data analyst who organized the technical and logistical components of the data abstraction and analysis. The committee worked with all staff and in particular, the anesthesiologists became the key staff to implement the antibiotic prophylaxis measures.	a multidisciplinary team, anesthetic worksheet, laminated cards with SCIP guidelines

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
					checklist and a postsurgical time-out.			
Rauk, United States - 2010	SSI	Minneapolis, MN/1868 bed hospital					Multidisciplinary team developed and implemented interventions and an experienced OR educator reviewed and observed surgical site preparation, sterile technique, and documentation.	an educational video was made and sufficient surgical instruments were made available
Shimoni, Israel - 2009	SSI	Netanya, Israel/	Because all medical staff were involved in the policy change, the implementation was accepted without resistance from physicians. Also, this set of nurses were of high quality	Because of nurses' direct contact with pt care activities, they are in the best position to detect and report medication errors. In some situations, nurses are more open to compliance measures than physicians, and nurses maybe more likely to report medical errors.			Noted previous attempts in 2006 to get obstetricians to use antibiotic prophylaxis, empowered 6 nurses with the ability to remind anesthesiologists to administer prophylaxis	
Suchitra, India - 2009	CAUTI;SSI	Karnataka, India/site 1: 400 bed hospital; site 2 size not specified; site 3: 250 bed hospital	Although not statistically tested, the reductions in SSI and hospital UTI rates does not appear to differ much between the 3 sites. All had reductions.					
Takahashi, Japan - 2010	SSI	Nishinomiya, Japan/1044 bed hospital	all departments, except cardiovascular, showed a significant reduction in the duration of AMP. Only 2 departments measured				The antimicrobial stewardship team was made up of an infection control doctor, certified pharmacist and a	15 manuals were distributed to 15 departments - one per department

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			change in rate of SSIs - Incidence of SSIs significantly decreased in the Lower Gastrointestinal Department of Surgery (6 months pre-intervention rate of SSI: 18.4%; 6 months post-intervention: 8.1%; p=.002), but rate of SSI was not statistically different in the Hepatic-biliary Pancreatic Department of Surgery (6 months before: 13.1%; 6 months after intervention: 11.1%; p = 0.673)				physician in each department	
Wax, United States - 2007	SSI	New York, NY/	Significant increases in compliance were seen in the total anesthesiologist population, as well as among anesthesiologists who worked with assistants and those working without assistants. Compliance increased in 80%, declined in 9%, and remained unchanged in 11%.		The hospital's published antibiotic prophylaxis guidelines regarding choice and timing of preoperative antibiotics had been disseminated to the staff before the study period		The electronic reminder was implemented in all anesthetizing locations, so all anesthesiologists were exposed to the intervention.	The electronic prompt was programmed into a pre-existing anesthesia information management system (AIMS)
Whitman, United States - 2008	SSI	Philadelphia, PA/					TUH SCIP committee was comprised of physicians, hospital administrators including representation from anesthesia, surgery, infectious disease, pharmacy, information technology, medical	standardized forms, electronic medical records

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							records, and hospital compliance; Department of Anesthesia assumed responsibility for administering ordered antibiotic prophylaxis in the operating suite at the time of "universal timeout".	
Willemsen, Netherlands - 2007	SSI	Breda, The Netherlands/1370 bed hospital; 3 operating complexes; 11,000 procedures performed annually	Hospital was under increased pressure to be efficient, so pts spent less time in pre-op area, so surgeon did not always have time to decide on antibiotic before pt was placed in OR. This caused delay in antibiotic administration. The new protocol and guideline forced antibiotic decisions before pt placed in OR.				multidisciplinary team got approval of guideline from all surgeons and anesthetists	multidisciplinary team, guideline developed
Zvonar, Canada - 2008	SSI	Ottawa, Canada/1163 bed hospital					A multidisciplinary team consisting of antimicrobial pharmacist, clinical director, clinical managers and nurse educators for per-operative services, pharmacy operations manager, and physicians from surgery anesthesiology, and infection prevention/control. Nurses and pharmacists were allowed to automatic substitute larger doses for the larger patients. Anesthesiologists were asked to administer	

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
							antibiotics when initial anesthesia was given.	

Appendix Table C4-LQ: Study context for CAUTI which do not control for secular trend or confounding.

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
Gokula, United States - 2007	CAUTI	Lansing, MI/550 bed hospital					The nursing director was asked to hold weekly educational meetings for the ED nurses.	The UCISs were placed on the catheter trays for increased visibility.
Jain, United States - 2006	CAUTI;CLABSI;VAP	DeSoto, MS/28 ICU beds			Hospital administration and nursing leadership pushed for quality improvement initiatives in 2003. No specifics are given.	The hospital joined the IHI project to improve patient safety and outcomes	The house supervisor was relieved of some of her duties with bed flow through the bed flow meetings. Physicians took a more active role in daily patient care through leading the multidisciplinary rounds.	
Rothfeld, United States - 2010	CAUTI	Los Angeles, CA/389 bed hospital			The use of silver coated catheters was already in place in this hospital	Center for Medicare and Medicaid labeled CAUTI as a "never event" and discontinued funding for CAUTI related hospital costs	Wound care nurse was given he authority to advise an attending physician to replace a urinary catheter.	
Stephan, Switzerland - 2006	CAUTI	Geneva, Switzerland/					A multidisciplinary team of orthopedic department chair, senior nurse and senior anesthetists was assembled to approve guidelines	Posters with guidelines were displayed in all operating rooms dedicated to orthopedic procedures, post-anesthesia care unit, and orthopedic nursing staff

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
								offices
Suchitra, India - 2009	CAUTI;SSI	Karnataka, India/site 1: 400 bed hospital; site 2 size not specified; site 3: 250 bed hospital	Although not statistically tested, the reductions in SSI and hospital UTI rates does not appear to differ much between the 3 sites. All had reductions.					
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	New York, New York/20 ICU beds		Their model was based on the SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) approach. Authors note this theory may have contributed to the consistent and sustained change and decline in HAIs.		The hospital was a part of the Health and Hospital Corporation network.	The HHC collaborative was comprised of participating institution's medical directors, nursing directors, chiefs of medical and surgical departments, directors of critical care units, and respiratory therapy and nursing supervisors. The MICU director served as the champion and held monthly sessions about the importance of bundles. MICU nurses were given the following responsibilities: collecting compliance data, completing the CLABSI bundle checklist, stopping a procedure if there was a deviation from the recommendations, and monitoring for any breaches in infection control.	Data from all participating hospitals was available on the critical care collaborative website.
Wald, United States - 2011	CAUTI	Aurora, CO/425 bed hospital	CAUTI rate was only decreased in the orthopedic surgery unit which			Recent change in CMS Inpatient Prospective		

Study	Infection	Location/Size	Influence of context on outcomes	Theory behind Patient Safety Practice	Existing Patient Safety Infrastructure	External Factors	Patient Safety Culture at Unit Level	Availability of Intervention materials
			had much higher rates of postoperative catheter duration <3 days at baseline. Authors also noted that the two units had very different practice patterns associated with urinary catheters and that a "one-size-fits-all" approach is most likely not the best.			Payment System whereby hospital-acquired conditions (including CAUTIs) would not be reimbursed for.		

Appendix Table C5a-LQ: Infection rate outcomes for VAP which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Abbott, United States - 2006	VAP	Academic Center of Evidence-based Practice (ACE) Star Model	Hospital 1 Medical ICU FY2001 Q4: 16.95; Hospital 1 Surgical ICU FY2001 Q4: 10.5; Hospital 1 Trauma ICU FY2001 Q4: 16.95; Hospital 2 Trauma ICU FY2001 Q4: 38	Hospital 1 Burn ICU FY2003 Q3: 25; Hospital 1 Burn ICU FY2004 Q3: 7; Hospital 1 Medical ICU FY2004 Q3: 0; Hospital 1 Surgical ICU FY2004 Q3: 4.5; Hospital 1 Trauma ICU FY2004 Q3: 7; Hospital 2 Trauma ICU FY2004 Q2: 20			
Assanasen, - 2008	CLABSI;VAP	Feedback Program					
Berriel-Cass, United States - 2006	CLABSI;VAP	VAP Bundle	mean: 8.2	mean: 3.3	t-test: p= 0.02	infections/1000 device-days	
Bigham, United States - 2009	VAP	VAP Bundle	5.6	post1: 8.8; post2: 0.3	<0.0001	infections/1000 device-days	
Bird, United States - 2010	VAP	VAP Bundle	overall: 10.2; TICU: 10.4; SICU: 10.0	post1 overall: 9.8; post1 TICU: 8.0; post1 SICU: 11.8; post2 overall: 5.8; post2 TICU: 6.1; post2 SICU: 5.0; post3 overall: 3.4; post3 TICU: 2.5; post3 SICU: 4.25	post2 overall p=0.01; post2 SICU p=0.06; post3 overall p=0.004; post3 TICU p=0.01	infections/1000 device-days	
Blamoun, United States - 2009	VAP	Expanded VAP bundle	Median: 14.1 (IQR 12.1-20.6)	Median: 0 (IQR 0-1.1)	95% CI: 10.9 to 20.3 95% CI: 0 to 2.4; p=0.006	infections/1000 device-days	
Bloos, Germany - 2009	VAP	Educational Program	33.1%	32.4%	Chi-square: p=0.68	(infections/Ventilated patients)*100	
Cocanour, United States - 2006	VAP	VAP Bundle	Pre-VAP bundle: 22.3-32.7; Pre-feedback program: 22.3-23.4	Post-feedback program: 0-12.8; May/June 2003: 10.7	p< 0.05	range of monthly Infections/1000 device-days	
Garcia, United States - 2009	VAP	VAP Education and Oral Care Protocol	12.0	8.0	p=0.06	infections/1000 device-days	
Heimes, United States - 2011	VAP	VAP Prevention Protocol (VAPP)	5.2	post1: 2.4; post2: 1.2	post1: p=0.172; post2: p=0.085	infections/1000 device-days	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	CLABSI: 5.9; CAUTI: 3.8; VAP: 7.5	CLABSI: 3.1; CAUTI: 2.4; VAP: 3.2	CLABSI $\chi 2$: p=0.03; CAUTI $\chi 2$: p=0.17; VAP $\chi 2$: p=0.04	infections/1000 device-days	
Jimenez, United States - 2009	VAP	VAP Bundle					
Landrum, Afghanistan - 2008	VAP	Infection Control Protocol	60.6	post1: 31.6; post2: 21.3; post3: 11.1; post4: 11.6; post5: 9.7	trend p=0.029	infections/1000 device-days	
Quenot, France - 2007	VAP	Nurse-Implemented Sedation Protocol	19.3	14.5	p=0.45; Adjusted HR = 0.81 (95% CI 0.62-0.95, p = 0.03)	infections/1000 device-days	
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	overall CLABSI: 25.3; infants < 1000g CLABSI: 28.2; infants between 1001-1500g CLABSI: 17.8; overall VAP: 9.8; infants < 1000g VAP: 10.0; infants between 1001-1500g VAP: 8.3	overall CLABSI: 19.3; infants < 1000g CLABSI: 21.5; infants between 1001-1500g CLABSI: 12.5; overall VAP rate: 6.1; infants < 1000g VAP: 6.7; infants between 1001-1500g VAP: 0	Infants <1000g CLABSI, RR: 0.76, 95% CI:(0.43–1.25) p=0.28; RR for CLABSI infants between 1001-1500g: 0.70 (95% CI 0.14-2.07, p=0.58); RR for VAP all infants: 0.63 (95% CI 0.20-1.47), p=0.30	Infection/1000 device-days	
Rosenthal, Argentina - 2006	VAP	Multifaceted Infection Control Program	51.28	35.52	< 0.003; Rate ratio = 0.69 (95% CI 0.49-0.98)	infections/1000 device-days	
Ross, United States - 2007	VAP	Educational Program		VAP rates decrease by 50%			
Sona, United States - 2009	VAP	Oral Care Protocol	5.2	2.4	p=0.04	infections/1000 device-days	
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	VAP bundle	2.17	0.62	Unadjusted IRR specific stat for p value not specified: 0.29, 95% CI 0.21-0.38 (p<0.0001); IRR adjusted for device utilization specific stat for p value not specified: 0.33, 95% CI 0.08-1.1 (p=0.049)	infections/1000 device-days	

Appendix Table C5a-LQ: Infection rate outcomes for CLABSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Assanasen, - 2008	CLABSI;VAP	Feedback Program					
Berriel-Cass, United States - 2006	CLABSI;VAP	CLABSI Bundle	mean: 9.6	mean: 3.0	t-test: p=0.003	infections/1000 device-days	
Bhutta, United States - 2007	CLABSI	Bundle CLABSI	8.6	3	RR reduction of 75% no stat test mentioned; Incidence of BSI decreased no stat test mentioned (p<0.001; 95% CI: 35% to 126%)	infections/1000 device-days	
Bizzarro, United States - 2010	CLABSI	Bundle - CLABSI	8.44 (95% CI: 6.80-10.46)	1.71 (95% CI: 0.77-3.80)		infections/1000 device-days	
Galpern, United States - 2008	CLABSI	CLABSI Bundle	5.0	0.90	Statistical test not specified: p<0.001	infections/1000 device-days	
Guerin, United States - 2010	CLABSI	Post-insertion CVC care bundle	5.7	1.1	RR type of model not specified: 0.19 (95% CI: 0.06-0.63, p=0.004)	infections/1000 device-days	
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	CLABSI: 5.9; CAUTI: 3.8; VAP: 7.5	CLABSI: 3.1; CAUTI: 2.4; VAP: 3.2	CLABSI $\chi 2$: p=0.03; CAUTI $\chi 2$: p=0.17; VAP $\chi 2$: p=0.04	infections/1000 device-days	
Jeffries, United States - 2009	CLABSI	CVC Insertion and Maintenance Bundle	median: 6.3 (IQR 5.0-8.9)	median: 4.3 (IQR 2.6-7.6)	Wilcoxon rank sum test: p = .032	infections/1000 device-days	
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	video: 3.6; simulation; 3.5	video: 3.4; simulation; 1.0	Poisson Regression incidence rate ratio: 0.30 (95% CI: 0.10-0.91) p=0.03	infections/1000 device-days	
Koll, United States - 2008	CLABSI	Central line bundle	mean CLABSI rate: 4.85	mean CLABSI rate: 2.24	statistical test not specified: p<0.001	infections/1000 device-days	
Lobo, Brazil - 2010	CLABSI	Continuous Education	12	post1: 10.6; post2: 0	$\chi 2$/Fishers exact comparing pre-intervention and	infections/1000 device-days	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
					intervention period: P=.03		
Lobo, Brazil - 2010	CLABSI	Single lecture	16.2	post1: 12.9; post2: 13.7	χ2/Fishers exact comparing pre-intervention and intervention period: p=0.41	infections/1000 device-days	
Marra, Brazil - 2010	CLABSI	IHI Bundle - CLABSI	mean ICU: 6.4 (2.9 SD); mean SDU 4.1 (3.3 SD)	mean ICU: 3.2 (2.5 SD); mean SDU 1.6 (2.4 SD)	ICU Student t-test: p<0.001; SDU Student t-test: p=0.005	infections/1000 device-days	
Render, United States - 2006	CLABSI	CLABSI bundle	1.7	0.4	t-test: p<0.05	infections/1000 device-days	
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	overall CLABSI: 25.3; infants < 1000g CLABSI: 28.2; infants between 1001-1500g CLABSI: 17.8; overall VAP: 9.8; infants < 1000g VAP: 10.0; infants between 1001-1500g VAP: 8.3	overall CLABSI: 19.3; infants < 1000g CLABSI: 21.5; infants between 1001-1500g CLABSI: 12.5; overall VAP rate: 6.1; infants < 1000g VAP: 6.7; infants between 1001-1500g VAP: 0	Infants <1000g CLABSI, RR: 0.76, 95% CI:(0.43–1.25) p=0.28; RR for CLABSI infants between 1001-1500g: 0.70 (95% CI 0.14-2.07, p=0.58); RR for VAP all infants: 0.63 (95% CI 0.20-1.47), p=0.30	Infection/1000 device-days	
Sannoh, United States - 2010	CLABSI	Bundle - CLABSI	UVC: 7/1000; Brovac: 15/1000; PICC : 23/1000; UAC+UVC : 15/1000	UVC: 4/1000; Brovac: 10/1000; PICC : 12/1000; UAC+UVC : 5/1000	UVC OR=0.57 (95% CI 0.17-1.95); Brovac OR=0.60 (95% CI 0.26-1.40); PICC OR=0.47 (95% CI 0.17-0.91) ; UAC+UVC OR=0.33 (95% CI 0.12-0.91)	infections/1000 device-days	
Santana, Brazil - 2008	CLABSI	Education	mean: 9.5	mean: 5.4	OR 0.46 (95% CI 0.21-1.02); Fisher exact test, p=0.04	infections/1000 device-days	
Shannon, United States - 2006	CLABSI	Toyota Production System adaptation	10.5	post1: 1.2; post2: 1.6; post3: 0.39	all Chi-square/Fisher's exact test: p<0.05	infections/1000 device-days	
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CLABSI bundle	10.77	1.04	Unadjusted IRR specific stat for p value not specified: 0.155, 95% CI 0.13-0.18 (p<0.0001); IRR adjusted for device utilization specific stat for p value not specified: 0.09,	infections/1000 device-days	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
					95% CI 0.09-0.23 (p<0.0001)		
Warren, United States - 2006	CLABSI	Multifaceted, education-based intervention	overall: 11.2	overall: 8.9	χ2 relative rate(95% CI): 0.79 (0.67-0.93)	infections/1000 device-days	
Wicker, United States - 2011	CLABSI	Comprehensive Infection Control Measures	late onset CLABSI: 30.8%; general BSI: 37.7%	late onset CLABSI: 19.4%; general BSI: 22.7%	CLABSI: p=.001; general BSI: p<.001	% late onset central line associated BSI of all central line infants	
Yilmaz, Turkey - 2007	CLABSI	Education	8.3	4.7	Chi-square p=0.018; relative risk of 0.57 (95% CI: 0.36-0.92)	infections/1000 device-days	

Appendix Table C5a-LQ: Infection rate outcomes for SSI which do not control for secular trend or confounding..

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Acklin, Switzerland - 2011	SSI	bundle - antibiotic prophylaxis, skin prep, sterile dressing	6.9%	2.0%	t test, p=0.029	infections/100 proximal femur fracture surgeries	
Awad, United States - 2009	SSI	MRSA bundle	MRSA transmissions: 5.8/1000 bed days; MRSA infections: 2.0/1000 BD	MRSA transmissions: 3.0/1000 bed days; MRSA infections: 1.0/1000 bed days	transmission, chi square: p=<.05; infections, chi square: p=.016		
Berenguer, United States - 2010	SSI	implementing SCIP measures	13.3%	8.3%	Fisher exact test, p=0.362	superficial infection/100 colorectal cases	
Berry, United States - 2009	SSI	ProvenCare	0.7%	0.9%	Fisher's exact test: p=1.0	# deep sternal wound infections/CABG	
Carles, France - 2006	SSI	surgical antibiotic prophylaxis kit (SAPK)					
Forbes, Canada - 2008	SSI	bundle - glucose control by screening all pts prior to surgery, administering weight-based regimen of insulin to diabetics, monthly performance figures posted in OR	superficial SSI: 14.3%; organ space infection: 7.6%	superficial SSI: 8.7%; organ space infection: 6.8%	superficial SSI: RR=0.61 (0.28-1.33) p=0.21 organ space infection: RR=0.89 (0.34-2.37) p=0.81		
Forbes, Canada - 2008	SSI	bundle - maintain normothermia by warming OR to 22 C, standardizing IV warmers and forced air devices, monthly performance figures posted in OR	superficial SSI: 14.3%; organ space infection: 7.6%	superficial SSI: 8.7%; organ space infection: 6.8%	superficial SSI: RR=0.61 (0.28-1.33) p=0.21 organ space infection: RR=0.89 (0.34-2.37) p=0.81	pre- and post-adherence rates were for the following time intervals from administration of antibiotic to incision (in minutes): <= 60, 61-120, 121-180, >180	
Forbes, Canada - 2008	SSI	bundle - antibiotic administration in OR, pre-printed order form to standardize choice of antibiotic, monthly performance figures	superficial SSI: 14.3%; organ space infection: 7.6%	superficial SSI: 8.7%; organ space infection: 6.8%	superficial SSI: RR=0.61 (0.28-1.33) p=0.21; organ space infection: RR=0.89 (0.34-2.37) p=0.81		

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
		posted in OR					
Gomez, Argentina - 2006	SSI	automatic stop prophylaxis form	3.2%	1.9%	Relative risk: 0.59, 95% CI:(0.44-0.79), p<.01	infection/100 patients	
Graf, Germany - 2009	SSI	bundle - SSI	3.61%	1.83%	95% CI: 2.98-4.35 95% CI: 1.08-2.90	infection/100 cardiac surgical procedures	
Hermsen, United States - 2008	SSI	Standardized order form					
Ichikawa, Japan - 2007	SSI	Implementation of Antibiotic Protocols	Clean wound: 0.5%; Clean-contaminated wound: 4.0%; Contaminated wound: 29.4%; Dirty-infected wound: 23.8%; total wounds: 3.7%	Clean wound: 0.2%; Clean-contaminated wound: 2.6%; Contaminated wound: 5.8%; Dirty-infected wound: 20.8%; Total wounds: 1.7%	Clean wound, chi square: p=NS; Clean-contaminated wound, chi square: p=NS; Contaminated wound, chi square: p<.01; Dirty-infected wound, chi square: p=NS; Total wounds, chi square: p<.05	percent of infection per wound type	
Kable, Australia - 2008	SSI	bundle - antibiotic prophylaxis	overall: 7.6%	overall: 8.1%; TURP: 5.8%; cholecystectomy: 6.1%; herniorrhaphy: 5.3%; hysterectomy: 18.5%; joint: 7.8%	difference=NS	infection/100 surgeries	
Kramer, United States - 2008	SSI	nomogram for glycemic control	2.6%	1.0%	test not specified, p<.001	infection/100 cardiac surgeries	
Liau, Singapore - 2010	SSI	bundle - antibiotic, glucose control, clippers, normothermia	overall: 3.1%	overall: 0.5%; 2006: 0.6%; 2007: 0.4%	Fisher exact test: p<.001	infection/100 operations	
Martin, United States - 2010	SSI	surgical wear changes in Mohs surgery	2.5%	0.9%	chi square, p=.04; Fisher exact, p=.05	infection/100 tumors	
Nemeth, United States - 2010	SSI	Education program					

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Ozgun, Turkey - 2010	SSI	antibiotic prophylaxis education					
Parker, United States - 2007	SSI	Six Sigma methodology and antibiotic prophylaxis					
Pastor, United States - 2010	SSI	task force to meet SCIP process measures	19%	19%	Pearson, p=0.90	infection/100 operations	
Paull, United States - 2010	SSI	The Briefing Guide (BiG)					
Potenza, United States - 2009	SSI	bundle - glucose control					
Potenza, United States - 2009	SSI	bundle - appropriate hair removal					
Potenza, United States - 2009	SSI	bundle - antibiotic prophylaxis					
Potenza, United States - 2009	SSI	bundle - normothermia					
Rauk, United States - 2010	SSI	bundle - skin prep and instrument sterilization	overall: 7.5%; endometritis SSI: 3%; incision SSI: 4.5%	overall: 1.2%; endometritis SSI: 1.2%; incisional SSI: 0%%	overall $\chi 2$: p<0.001; endometritis SSI $\chi 2$: p=0.06; incisional SSI $\chi 2$: p<0.001	infections/procedures	
Shimoni, Israel - 2009	SSI	Empowering surgical nurses	Infections: 16.8%; Positive cultures: 14.5%	Infections: 12.6%; Positive cultures: 7.3%	Chi-Square Infections: p=0.0048; Chi-Square Positive cultures: p=0.0055; infections Taylor series Relative Risk: 0.75 (95% CI 0.61-0.92); positive cultures	% of infections among caesarean deliveries	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
					Taylor series Relative Risk: 0.38 (95% CI 0.18-0.77)		
Suchitra, India - 2009	CAUTI;SSI	Education Program	SSI: 12.1%; Hospital UTI: 6.6%	SS1: 4.0%; Hospital UTI: 2.7%	SSI, chi square: p<.001; Hospital UTI, chi square: p<.001	Percent SSI and percent hospital acquired UTI	
Takahashi, Japan - 2010	SSI	Departmental Education	p. aeruginosa: 12.6%; MRSA: 11.5%; MRSA among S. aureus: 76%	p. aeruginosa: 7.3%; MRSA: 8.7%; MRSA among S. aureus: 60%	p. aeruginosa, t test: p=.004; MRSA, t test: p=.055; MRSA among S. aureus, t test: p=.006	isolation of p. aeruginosa/all gram-negative organisms; isolation of MRSA/all gram-positive organisms; isolation of MRSA/all S. aureus	
Wax, United States - 2007	SSI	Electronic reminder for provider					
Whitman, United States - 2008	SSI	Multiple 'forced functions'					
Willemsen, Netherlands - 2007	SSI	standardized antibiotic protocol					
Zvonar, Canada - 2008	SSI	Appropriate antibiotic prophylaxis administration					

Appendix Table C5a-LQ: Infection rate outcomes for CAUTI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Gokula, United States - 2007	CAUTI	Education and indications checklist					
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	CLABSI: 5.9; CAUTI: 3.8; VAP: 7.5	CLABSI: 3.1; CAUTI: 2.4; VAP: 3.2	CLABSI $\chi 2$: p=0.03; CAUTI $\chi 2$: p=0.17; VAP $\chi 2$: p=0.04	infections/1000 device-days	
Rothfeld, United States - 2010	CAUTI	Appropriate Catheter Use Protocol	3.2	2.4	statistical test not specified: p<0.10	infections/1000 device-days	
Stephan, Switzerland - 2006	CAUTI	CAUTI guidelines, education and posters	overall: 27.0; orthopedic: 45.8; abdominal: 9.0	post1 overall: 12.0; post1 orthopedic: 18.6; post1 abdominal: 5.6; post2 overall: 21.2	Incidence Density Ratio: overall; .44 (95% CI .24-.81); Orthopedic: .41 (95% CI .20-.70); abdominal: .62 (95% CI .14-2.50)	infections/1000 device-days	
Suchitra, India - 2009	CAUTI;SSI	Education Program	SSI: 12.1%; Hospital UTI: 6.6%	SS1: 4.0%; Hospital UTI: 2.7%	SSI, chi square: p<.001; Hospital UTI, chi square: p<.001	Percent SSI and percent hospital acquired UTI	
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle	6.23	0.63	Unadjusted IRR specific stat for p value not specified: 0.10, 95% CI 0.08-0.19 (p<0.0001); IRR adjusted for device utilization specific stat for p value not specified: 0.09, 95% CI 0.02-0.23 (p<0.0001)	infections/1000 device-days	
Wald, United States - 2011	CAUTI	Audit and feedback on catheter duration	orthopedic: 8.6; general: 6.8	orthopedic: 0; general: 7.5	t test, p=NS	infections/1000 device-days	

Appendix Table C5b-LQ: Adherence outcomes for VAP which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Abbott, United States - 2006	VAP	Academic Center of Evidence-based Practice (ACE) Star Model	overall HOB: 77%; overall oral care: 22%; overall empty condensate: 94%; overall handwashing before pt contact: 8%; overall handwashing afer pt contact: 36%; overall proper glove use: 74%	overall HOB: 69%; overall oral care: 30%; overall empty condensate: 93%; overall handwashing before pt contact: 14%; overall handwashing afer pt contact: 36%; overall proper glove use: 90%	hand washing p<0.0001; glove use p<0.0001	3
Assanasen, - 2008	CLABSI;VAP	Feedback Program	overall HOB: 51%; overall HH: 40%; overall femoral catheter (FC): 13%	overall post1 HOB: 88%; overall post1 HH: 47%; overall post1 FC: 7%; overall post2 HOB: 93%; Overall post2 HH: 71%; overall post2 FC:7%		24
Berriel-Cass, United States - 2006	CLABSI;VAP	VAP Bundle				
Bigham, United States - 2009	VAP	VAP Bundle	post1 HOB: 57%; post1 mouth care: 60%; post1 oral suction: 60%; post1 in-line suction change: 60%; post1 condensate drained: 60%; post1 vent circuit inspected: 60%	post2 HOB: 85%; post2 mouth care: 85%; post2 oral suction: 78%; post2 in-line suction change: 100%; post2 condensate drained: 90%; post2 vent circuit inspected: 85%		24
Bird, United States - 2010	VAP	VAP Bundle		post1 SICU: 63% (95% CI 57-69%); post1 TICU: 53% (95% CI 46-60%); post2 SICU: 78% (95% CI 73-83%); post2 TICU: 85% (95% CI 82-89%); post3 SICU: 81% (95% CI 72-90%); post3 TICU: 91% (95% CI 85-97%)		31
Blamoun, United States - 2009	VAP	Expanded VAP bundle				
Bloos, Germany - 2009	VAP	Educational Program	all patients: 15.0%; patients without acute lung injury (ALI): 22.8%; patients with ALI: 9.9%	all patients: 33.8%; patients without ALI: 47%; patients with ALI: 18.2%	overall chi-square: p< 0.01; patients without ALI chi-square: p< 0.01; patients with ALI chi-square: p<0.01	6
Cocanour, United States - 2006	VAP	VAP Bundle				

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Garcia, United States - 2009	VAP	VAP Education and Oral Care Protocol		at least 80%		
Heimes, United States - 2011	VAP	VAP Prevention Protocol (VAPP)				
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative				
Jimenez, United States - 2009	VAP	VAP Bundle	full compliance: 6%; HOB: 14%; sedation vacation: 67%; peptic ulcer prophylaxis: 93%; deep vein thrombosis prophylaxis: 87%	full compliance: 59%; HOB: 74%; sedation vacation: 72%; peptic ulcer prophylaxis: 95%; deep vein thrombosis prophylaxis: 92%	full compliance, RR: 0.43, OR: 0.04, Pearson: p<0.01; HOB, RR: 0.30, OR: 0.05, p<0.01; sedation vacation, RR: 0.84, OR: 0.77, p>0.05; peptic ulcer prophylaxis, RR: 0.68, OR: 0.66, p> 0.05; deep vein thrombosis prophylaxis, RR: 0.64, OR: 0.61, p> 0.05	4
Landrum, Afghanistan - 2008	VAP	Infection Control Protocol				
Quenot, France - 2007	VAP	Nurse-Implemented Sedation Protocol				
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	24%	53%	Cronbach's alpha: 0.71	6
Rosenthal, Argentina - 2006	VAP	Multifaceted Infection Control Program				
Ross, United States - 2007	VAP	Educational Program	median OAG score: 11	median OAG score: 9	p=0.0002	2
Sona, United States - 2009	VAP	Oral Care Protocol		81%		12
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	VAP bundle				

Appendix Table C5b-LQ: Adherence outcomes for CLABSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Assanasen, - 2008	CLABSI;VAP	Feedback Program	overall HOB: 51%; overall HH: 40%; overall femoral catheter (FC): 13%	overall post1 HOB: 88%; overall post1 HH: 47%; overall post1 FC: 7%; overall post2 HOB: 93%; Overall post2 HH: 71%; overall post2 FC:7%		24
Berriel-Cass, United States - 2006	CLABSI;VAP	CLABSI Bundle				
Bhutta, United States - 2007	CLABSI	Bundle CLABSI	Hand Washing: 47%	Hand Washing: 82%		NR
Bizzarro, United States - 2010	CLABSI	Bundle - CLABSI				
Galpern, United States - 2008	CLABSI	CLABSI Bundle				
Guerin, United States - 2010	CLABSI	Post-insertion CVC care bundle				
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative				
Jeffries, United States - 2009	CLABSI	CVC Insertion and Maintenance Bundle		insertion: Apr-Jun 82.1 (53.1-94.0), Jul-Sept 91.7 (78.0-98), Oct-Dec 93.8 (85.7-100.0); Maintenance: Apr-Jun 85.9 (78.3-100.0), Jul-Sep 98.2 (89.9-100), Oct-Dec 100.0 (94.5-100.0)	Fischer Exact Test: Insertion all P<.001 compared to first 3 months; Maintenance P=.206 for first 3 months compared to second: P=.023 for first 3 months compared to last 3 months	9
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training	median sterile technique score: video: 13.0; simulation: 12.5	median sterile technique score: video: 18.0; simulation: 22.0	Wilcoxon signed rank test difference in total score b/w groups phase 1: p<0.95; Wilcoxon signed rank test difference in total score b/w groups phase 2; p<.001	
Koll, United States - 2008	CLABSI	Central line bundle				
Lobo, Brazil - 2010	CLABSI	Continuous Education	CVC insertion: Hand hygiene before procedure: 100%; Maximal barrier precautions: 100%; Skin antisepsis: 100%; hand hygiene after	CVC insertion: Hand hygiene before procedure: 100%; Maximal barrier precautions: 100%; Skin antisepsis: 100%; hand hygiene after procedure:	Relative Risk: 1.43 (95% CI .83-2.45) p=.37	

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
			procedure: 58%	83%		
Lobo, Brazil - 2010	CLABSI	Single lecture	CVC insertion: Hand hygiene before procedure: 100%; Maximal barrier precautions: 100%; Skin antisepsis: 100%; hand hygiene after procedure: 67%	CVC insertion: Hand hygiene before procedure: 100%; Maximal barrier precautions: 100%; Skin antisepsis: 100%; hand hygiene after procedure: 67%	Relative Risk: NA	
Marra, Brazil - 2010	CLABSI	IHI Bundle - CLABSI				
Render, United States - 2006	CLABSI	CLABSI bundle	sterile drapes: 0%; chlorhexidine: <50%	sterile drapes: 85-95%; chlorhexidine: 80-100%		12
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle	24%	53%	Cronbach's alpha: 0.71	6
Sannoh, United States - 2010	CLABSI	Bundle - CLABSI	mean score: 14 (SD 4)	mean score: 23 (SD 0.7)	chi square: $p<0.05$	12
Santana, Brazil - 2008	CLABSI	Education				
Shannon, United States - 2006	CLABSI	Toyota Production System adaptation				
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CLABSI bundle				
Warren, United States - 2006	CLABSI	Multifaceted, education-based intervention	overall femoral vein insertion site: 12.9%; overall blood at dressing site: 24.6%; overall dated dressing: 26.6%	overall femoral vein insertion site: 9.4%; overall blood at dressing site: 22.2%; overall dated dressing: 34.3%	femoral vein insertion site $\chi 2$ relative ratio: 0.73 (95% CI 0.61-0.88); blood at dressing site $\chi 2$ relative ratio: 0.90 (95% CI 0.81-1.00); dated dressing $\chi 2$ relative ratio: 1.29 (95% CI 1.17-1.42)	15-18
Wicker, United States - 2011	CLABSI	Comprehensive Infection Control Measures				
Yilmaz, Turkey - 2007	CLABSI	Education				

Appendix Table C5b-LQ: Adherence outcomes for SSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Acklin, Switzerland - 2011	SSI	bundle - antibiotic prophylaxis, skin prep, sterile dressing	antibiotic timing: 57.6%	antibiotic timing: 69.9%	chi square, p=0.016	12
Awad, United States - 2009	SSI	MRSA bundle	screening on admission: 94%; screening on discharge: 82%	screening on admission: 95%; screening on discharge: 86%	chi square: p=NS	24
Berenguer, United States - 2010	SSI	implementing SCIP measures	SCIP compliance: 38%	SCIP compliance: 92%		12
Berry, United States - 2009	SSI	ProvenCare		initial: 59%; 3 mos: 100%; 12 mos: 100%		12
Carles, France - 2006	SSI	surgical antibiotic prophylaxis kit (SAPK)	overall: 41%; antibiotic choice error: 28%; dose error: 0%; timing error: 24%; injection after incision: 1%; SAP duration error: 22%	overall: 82%; antibiotic choice error: 3%; dose error: 0.5%; timing error: 12%; injection after incision: 1.6%; SAP duration error: 1.5%	Overall, t test: p<0.001; antibiotic choice error, RR: 0.74, 95% CI: (0.6-0.88), t test: p<0.001; dose error, RR: 1.01 (0.99-1.02) t test: p=NS; timing error, RR: 0.86 95% CI: (0.78-0.98) t test: p=0.003; injection after incision, RR: 0.65 95% CI: (0.11-1	2
Forbes, Canada - 2008	SSI	bundle - glucose control by screening all pts prior to surgery, administering weight-based regimen of insulin to diabetics, monthly performance figures posted in OR	glucose <4 mmol/L: 4.8%; glucose >11 mmol?L: 17.7%	glucose <4 mmol/L: 0.4%; glucose >11 mmol/L: 14.2%	glucose <4 mmol/L, chi square: p<0.003 glucose >11 mmol/L, chi square: p=0.23	11
Forbes, Canada - 2008	SSI	bundle - maintain normothermia by warming OR to 22 C, standardizing IV warmers and forced air devices, monthly performance figures posted in OR	pts with temp >36 C: at start: 53.8%, at end: 60.5%, on arrival at ward: 90.1%	pts with temp >36 C: at start: 54.7%, at end: 97.6%, on arrival at ward: 100%	at start: RR=1.01 (0.77-1.34) p=0.90; at end: RR=1.61 (1.34-1.94) p<0.001; on arrival at ward, chi square: p=0.003	11
Forbes, Canada - 2008	SSI	bundle - antibiotic administration in OR, pre-printed order form to standardize choice of antibiotic, monthly performance figures posted in OR	antibiotic 1: <60min: 5.9%, 61-120min: 48.2%, 121-180min: 36.5%, >180min: 9.4%; antibiotic 2: <60min: 12.1%, 61-120 min: 50%, 121-180min: 29.3%, >180min: 8.6%	antibiotic 1: <60min: 92.6%, 61-120min: 3.2%, 121-180min: 2.1%, >180min: 0%; antibiotic 2: <60min: 93.8%, 61-120min: 1.5%, 121-180min: 0%, >180min: 0%	Only values 92.6% and 93.8% in <60min were significant for both antibiotic 1 and 2, chi square: p<0.001; all other p=NS	11

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Gomez, Argentina - 2006	SSI	automatic stop prophylaxis form	timing: 55%; choice: 74%; duration: 44%	timing: 88%; choice: 87%; duration: 55%	timing: RR 0.27 95% CI:(0.25-0.30) p<.01; choice: RR 0.50 (0.45-0.55) p<.01; duration: RR 0.80 (0.77-0.84) p<.01	36
Graf, Germany - 2009	SSI	bundle - SSI				
Hermsen, United States - 2008	SSI	Standardized order form	compliance with recommendations on form: 25%; appropriate antibiotic: 62.3%; appropriate duration: 77.8%	compliance with recommendations on form: 66%; appropriate antibiotic: 84.9%; appropriate duration: 89.1%	compliance with recommendations, Fisher: p<0.001; appropriate antibiotic, Fisher: p<.001; appropriate duration, Fisher: p<.001	9
Ichikawa, Japan - 2007	SSI	Implementation of Antibiotic Protocols	Correct admin of pre-operative Abs: 67%; post-operative Abs: 100%	Correct admin of pre-operative Abs: 100%; post-operative Abs: 100%		15
Kable, Australia - 2008	SSI	bundle - antibiotic prophylaxis	TURP: 46%; cholecystectomy: 15%; herniorrhaphy: 56%; hysterectomy: 1%; joint arthroplasty: 95%; overall: 46%	TURP: 73%; cholecystectomy: 17%; herniorrhaphy: 70%; hysterectomy: 25%; joint arthroplasty: 95%; overall: 64%	overall: 18%, 95% CI:(12%-23%)	6
Kramer, United States - 2008	SSI	nomogram for glycemic control				
Liau, Singapore - 2010	SSI	bundle - antibiotic, glucose control, clippers, normothermia		timing of antibiotic: 89%; clipper use: 91%; normoglycemia: 76%; normothermia: 44%		24
Martin, United States - 2010	SSI	surgical wear changes in Mohs surgery				
Nemeth, United States - 2010	SSI	Education program	Timely administration: 90%	Timely administration: 85%	p=.223	.16
Ozgun, Turkey - 2010	SSI	antibiotic prophylaxis education	total compliance: 34.3%; incorrect choice: 8%; inappropriate dose: 5%; prolonged use: 35%; appropriate choice, dose, duration: 52%	total compliance: 28.5%; incorrect choice: 6%; inappropriate dose: 0%; prolonged use: 52%; appropriate choice, dose, duration: 42%	total compliance $\chi 2$/Fishers exact: p=0.59; incorrect choice $\chi 2$/Fishers exact: p=0.51; inappropriate dose $\chi 2$/Fishers exact: p<0.001; prolonged use $\chi 2$/Fishers exact: p=0.01; appropriate choice, dose, duration $\chi 2$/Fishers exact: p=0.09	3
Parker,	SSI	Six Sigma methodology	overall: 38%	overall: 86%; orthopedic: 37-87%;	orthopedic p<0.01; colorectal	

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
United States - 2007		and antibiotic prophylaxis		colorectal: 31-89%; gynecologic: 43-92%; vascular: 67-61%	p<0.01; gynecologic p<0.01; vascular p=0.6	
Pastor, United States - 2010	SSI	task force to meet SCIP process measures	global compliance with SCIP measures: 40%; global compliance with all measures: 30%	global compliance with SCIP measures: 68%; global compliance with all measures: 50%	for both measures, Pearson: p<0.001	14
Paull, United States - 2010	SSI	The Briefing Guide (BiG)	antibiotic prophylaxis: 92% +/- 1.5%	antibiotic prophylaxis: 97.0% +/- 0.1%	t test, p=0.01	12
Potenza, United States - 2009	SSI	bundle - glucose control	100%	91%	chi square, p=.19	27
Potenza, United States - 2009	SSI	bundle - appropriate hair removal	100%	100%	chi square, p=NA	27
Potenza, United States - 2009	SSI	bundle - antibiotic prophylaxis	timing: 81%; selection: 89%; discontinuation: 58%	timing: 98%; selection: 100%; discontinuation: 91%	timing, chi square: p=.02; selection, chi square: p=.01; discontinuation, chi square: p=.01	27
Potenza, United States - 2009	SSI	bundle - normothermia	91%	94%	chi square, p=.73	
Rauk, United States - 2010	SSI	bundle - skin prep and instrument sterilization				
Shimoni, Israel - 2009	SSI	Empowering surgical nurses	compliance: 25.2%	compliance: 100%	Chi-Square: p<0.001	12
Suchitra, India - 2009	CAUTI;SSI	Education Program				
Takahashi, Japan - 2010	SSI	Departmental Education	duration of AMP (days): mean 2.42 (SD 1.86); initial dose w/in 1 hr of incision (% of patients): 95%	duration of AMP (days): mean 1.56 (SD 1.53); initial dose w/in 1 hr of incision (% of patients): 100%	duration of AMP, t test: p<0.001; initial dose w/in 1 hr of incision, chi square: p<.001	3
Wax, United States - 2007	SSI	Electronic reminder for provider	82.4%	overall: 89.1%; acknowledged reminder: 93.4%; did not acknowledge reminder: 83.8%	overall, chi square: p<0.01; acknowledged reminder, chi square: p<0.01; did not acknowledge reminder, chi square: p<0.05	10
Whitman, United States - 2008	SSI	Multiple 'forced functions'	abx selection: 76% (95% CI 0.72-0.79); timing of abx admin: 55% (95% CI 0.52-0.58); abx cessation: 60% (95% CI 0.57-0.63)	post1 abx selection: 91% (95% CI 0.89-0.93); post1 timing of abx admin: 78% (95% CI 0.70-0.84); post2 timing of abx admin: 90% (95% CI 0.84-0.94); post3 timing of abx admin: 95% (95% CI 0.91-0.97); abx cessation: 86% (95% CI	abx selection, no statistical tests specified, p<0.001; post1 vs. pre timing of abx admin p<0.001; post1 vs. post2 timing of abx admin: p=0.008; post2 vs. post 3 timing of abx admin p=0.07; abx cessation p<0.001	18

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
				0.82-0.89)		
Willemsen, Netherlands - 2007	SSI	standardized antibiotic protocol	timing: 20% after incision	timing: 7% after incision	RR: 0.35 (95% CI: 0.18-0.68), p=.002	2
Zvonar, Canada - 2008	SSI	Appropriate antibiotic prophylaxis administration	appropriate agent: 93.4%; appropriate dose: 72.4%; appropriate administration: 36%	post1 appropriate agent: 92.3%; post1 appropriate dose: 83%; post1 appropriate administration: 67.7%; post2 appropriate agent: 92.5%; post2 appropriate dose: 89.7%; post2 appropriate administration: 78.5%	post1 agent: OR 0.8 (95% CI .4-1.8), p=.64; post1 dose: OR 1.9(95%CI 1.2-3.0), p=.007); post1 admin OR 3.7 (95%CI 2.5-5.5), p<.001; post2 agent OR 1.0 (95%CI .5-2.1), p=.9; post2 dose OR 1.8 (95%CI 0.9-3.2), p=.04; post2 admin OR 1.7 (95CI 1.2-2.6), p.00	

Appendix Table C5b-LQ: Adherence outcomes for CAUTI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention Adherence rate	Post-Intervention Adherence Rate	Adherence Rate Statistical Analysis	Follow-up (months)
Gokula, United States - 2007	CAUTI	Education and indications checklist	appropriate use: 37%	appropriate use: 51%	OR (model not specified): 0.56 (95% CI 0.31, 1.03) p=0.06	12
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative				
Rothfeld, United States - 2010	CAUTI	Appropriate Catheter Use Protocol				
Stephan, Switzerland - 2006	CAUTI	CAUTI guidelines, education and posters		post1: 82.2%; post2: 80.8%		post1: 4; post2: 27
Suchitra, India - 2009	CAUTI;SSI	Education Program				
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle				
Wald, United States - 2011	CAUTI	Audit and feedback on catheter duration				

Appendix Table C5c-LQ: Cost/Savings outcomes for VAP which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Abbott, United States - 2006	VAP	Academic Center of Evidence-based Practice (ACE) Star Model				Hospital 2: $23,000	
Assanasen, - 2008	CLABSI;VAP	Feedback Program					
Berriel-Cass, United States - 2006	CLABSI;VAP	VAP Bundle					
Bigham, United States - 2009	VAP	VAP Bundle					
Bird, United States - 2010	VAP	VAP Bundle				$1,080,000 ($360,000-1,800,000)	
Blamoun, United States - 2009	VAP	Expanded VAP bundle					
Bloos, Germany - 2009	VAP	Educational Program					
Cocanour, United States - 2006	VAP	VAP Bundle			p<.05		
Garcia, United States - 2009	VAP	VAP Education and Oral Care Protocol					
Heimes, United States - 2011	VAP	VAP Prevention Protocol (VAPP)					
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	$3406	$2973			
Jimenez, United States - 2009	VAP	VAP Bundle					
Landrum, Afghanistan - 2008	VAP	Infection Control Protocol					
Quenot, France - 2007	VAP	Nurse-Implemented Sedation Protocol					
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle					
Rosenthal, Argentina - 2006	VAP	Multifaceted Infection Control Program					
Ross, United States - 2007	VAP	Educational Program					
Sona, United States - 2009	VAP	Oral Care Protocol				$140,000-$560,000	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	VAP bundle					

Appendix Table C5c-LQ: Cost/savings outcomes for CLABSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Assanasen, - 2008	CLABSI;VAP	Feedback Program					
Berriel-Cass, United States - 2006	CLABSI;VAP	CLABSI Bundle					
Bhutta, United States - 2007	CLABSI	Bundle CLABSI					
Bizzarro, United States - 2010	CLABSI	Bundle - CLABSI					
Galpern, United States - 2008	CLABSI	CLABSI Bundle					
Guerin, United States - 2010	CLABSI	Post-insertion CVC care bundle					
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	$3406	$2973			
Jeffries, United States - 2009	CLABSI	CVC Insertion and Maintenance Bundle				Estimated 69 CVC-BSI prevented accounting for $2940000 estimated CVC associated savings across all teams	
Khouli, United States - 2011	CLABSI	Simulation-based sterile technique training					
Koll, United States - 2008	CLABSI	Central line bundle					
Lobo, Brazil - 2010	CLABSI	Continuous Education					
Lobo, Brazil - 2010	CLABSI	Single lecture					
Marra, Brazil - 2010	CLABSI	IHI Bundle - CLABSI					
Render, United States - 2006	CLABSI	CLABSI bundle					
Rogers, Ireland - 2010	CLABSI;VAP	Plan-Do-Study-Act (PDSA)cycle					
Sannoh, United	CLABSI	Bundle - CLABSI				$75,920-$161,280	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
States - 2010							
Santana, Brazil - 2008	CLABSI	Education					
Shannon, United States - 2006	CLABSI	Toyota Production System adaptation					
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CLABSI bundle					
Warren, United States - 2006	CLABSI	Multifaceted, education-based intervention					
Wicker, United States - 2011	CLABSI	Comprehensive Infection Control Measures					
Yilmaz, Turkey - 2007	CLABSI	Education					

Appendix Table C5c-LQ: Cost/savings outcomes for SSI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Acklin, Switzerland - 2011	SSI	bundle - antibiotic prophylaxis, skin prep, sterile dressing					
Awad, United States - 2009	SSI	MRSA bundle					
Berenguer, United States - 2010	SSI	implementing SCIP measures					
Berry, United States - 2009	SSI	ProvenCare					
Carles, France - 2006	SSI	surgical antibiotic prophylaxis kit (SAPK)					
Forbes, Canada - 2008	SSI	bundle - glucose control by screening all pts prior to surgery, administering weight-based regimen of insulin to diabetics, monthly performance figures posted in OR					
Forbes, Canada - 2008	SSI	bundle - maintain normothermia by warming OR to 22 C, standardizing IV warmers and forced air devices, monthly performance figures posted in OR					
Forbes, Canada - 2008	SSI	bundle - antibiotic administration in OR, pre-printed order form to standardize choice of antibiotic, monthly performance figures posted in OR					
Gomez, Argentina - 2006	SSI	automatic stop prophylaxis form	$10,679/1000 pt days	$7686/1000 pt days	RR 0.87 (0.86-0.89) p<.01		
Graf, Germany - 2009	SSI	bundle - SSI					
Hermsen,	SSI	Standardized order form	mean cost of abx	mean cost of abx	cost of abx	approximate annual	

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
United States - 2008			prophylaxis per pt: $46; mean cost of hospitalization per pt: $10,792	prophylaxis per pt: $40; mean cost of hospitalization per pt: $11,892	prophylaxis per pt, logistic regression: p=0.02; cost of hospitalization per pt, ANOVA: p=0.83	savings: $30,000, adjusted for age, race, and diagnostic-related grouping	
Ichikawa, Japan - 2007	SSI	Implementation of Antibiotic Protocols					
Kable, Australia - 2008	SSI	bundle - antibiotic prophylaxis	Costs/pt: TURP: $0.68; cholecystectomy: $11.77; herniorrhaphy: $2.51; hysterectomy: $14.36; joint arthroplasty: $19.65; overall: $11.72	Costs/pt: TURP: $0.69; cholecystectomy: $4.14; herniorrhaphy: $1.08; hysterectomy: $6.83; joint arthroplasty: $19.77; overall: $10.53		$1.19/pt; if protocols routinely adopted, cost savings would have been $8.32/pt	
Kramer, United States - 2008	SSI	nomogram for glycemic control					
Liau, Singapore - 2010	SSI	bundle - antibiotic, glucose control, clippers, normothermia				mean cost of SSI estimated at US$1532, and estimating prevention of 63 pts from getting SSI, equals savings of US$97,200 during 2 yr study period	
Martin, United States - 2010	SSI	surgical wear changes in Mohs surgery		Required costs of preventing an infection can be reduced from $672.50 to $250 per infection ($422.50 savings); sterility cost upgrades estimated at $10.76 per case			
Nemeth, United States - 2010	SSI	Education program					
Ozgun, Turkey - 2010	SSI	antibiotic prophylaxis education					
Parker, United States - 2007	SSI	Six Sigma methodology and antibiotic prophylaxis					
Pastor, United States - 2010	SSI	task force to meet SCIP process measures					

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Paull, United States - 2010	SSI	The Briefing Guide (BiG)					
Potenza, United States - 2009	SSI	bundle - glucose control					
Potenza, United States - 2009	SSI	bundle - appropriate hair removal					
Potenza, United States - 2009	SSI	bundle - antibiotic prophylaxis					
Potenza, United States - 2009	SSI	bundle - normothermia					
Rauk, United States - 2010	SSI	bundle - skin prep and instrument sterilization				estimated 4.5 infections less per month for 1 yr, for estimated savings of $54,000 in case-related incremental costs	
Shimoni, Israel - 2009	SSI	Empowering surgical nurses					
Suchitra, India - 2009	CAUTI;SSI	Education Program					
Takahashi, Japan - 2010	SSI	Departmental Education	3 months preintervention: US $127,654	3 months postintervention: US $86,183		estimated annual savings: US $165,900	
Wax, United States - 2007	SSI	Electronic reminder for provider					
Whitman, United States - 2008	SSI	Multiple 'forced functions'					
Willemsen, Netherlands - 2007	SSI	standardized antibiotic protocol				Less expensive antibiotics were in the recommended guidelines, estimated savings using the less expensive antibiotics estimated at US$112,000 for one yr	
Zvonar, Canada - 2008	SSI	Appropriate antibiotic prophylaxis administration					

Appendix Table C5c-LQ: Cost/savings outcomes for CAUTI which do not control for secular trend or confounding.

Study	Infection	Intervention(s)	Pre-intervention infection rate	Post-Intervention Infection Rate	Infection Rate Statistical Analysis	Unit of Measure	Follow-up (months)
Gokula, United States - 2007	CAUTI	Education and indications checklist					
Jain, United States - 2006	CAUTI;CLABSI;VAP	IMPACT initiative	$3406	$2973			
Rothfeld, United States - 2010	CAUTI	Appropriate Catheter Use Protocol					
Stephan, Switzerland - 2006	CAUTI	CAUTI guidelines, education and posters					
Suchitra, India - 2009	CAUTI;SSI	Education Program					
Venkatram, United States - 2010	CAUTI;CLABSI;VAP	CAUTI bundle					
Wald, United States - 2011	CAUTI	Audit and feedback on catheter duration					

Appendix Table C6-LQ: Quality ratings for VAP which do not control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
DePalo, United States - 2010	CLABSI;VAP	No	Yes*	Yes	Yes	Yes	Yes	Yes*	Yes	Yes		No	No	Yes							TRUE	non-parametric methods		TRUE	Mixed effects model with Poisson distribution	hospital size, teaching status, effect of multiple ICUs within hospitals, repeated quarterly measures, and device-days

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kulvatunyou, Thailand - 2007	VAP	Uncertain	Uncertain	Yes	Yes	Yes	No	No	Yes	Yes		No	No	No							TRUE	t-test, chi-square test, Wilcoxon rank sum test, multiple logistic regression, and non-parametric bootstrap test		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Berenholtz, United States - 2011	VAP	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	Wilcoxon Rank-Sum and Pearson chi-square test		TRUE	Generalized Linear latent and Mixed Models with a Poisson distribution	teaching status, hospital size, ICU type
Dubose, United States - 2010	VAP	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Yes	No	Yes							TRUE	Student's t-test; Mann-Whitney U test; chi-square test; Fisher's exact test		TRUE	Multivariable Logistic Regression	Age > 55; Glasgow Score < 8; Injury Severity Score > 20; mechanism of injury

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Hawe, United Kingdom - 2009	VAP	No	Yes	Yes	No	No	No	Yes	No	Yes		No	Yes	Yes							TRUE	chi-square, Mann-Whitney U-test		FALSE		
Apisarnthanarak, Thailand - 2007	VAP	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	No	Yes							TRUE	Chi-square test; Fisher exact test; interrupted time series with segmented regression analysis		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Bouadma, France - 2010	VAP	No	Yes	Uncertain	Yes	No	No	Yes	Uncertain	Yes		Yes	Yes	Yes							TRUE	Wilcoxon Rank-sum Test; Fisher's exact test; segmented Poisson regression; Cox proportional hazards		TRUE	Cox proportional hazards	gender, having a fatal disease, arterial catheter before VAP, and study period

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Omrane, Canada - 2007	VAP	No	Uncertain	Uncertain	No	Yes	No	No	No	Yes		Yes	No	No							TRUE	Student's t-test, Wilcoxon rank sum test, chi-square test, and Poisson regression	Poisson regression was adjusted for age, gender, APACHE II Score, GCS Score, service the patient originated from (surgical, trauma, etc)	FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Papadimos, United States - 2008	VAP	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes		Yes	No	No							TRUE	Wilcoxon rank sum test, Auto-regressive integrated moving average (ARIMA) model, t-test, and chi-square test		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Prospero, Italy - 2008	VAP	No	No	Yes	No	Yes	No	No	Yes	Yes		Yes	No	No							TRUE	Student's t-test and time-dependent Cox regression	Cox was controlled for SAPS II score, APACHE II score and being a trauma patient	FALSE		
Zaydfudim, United States - 2009	VAP	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		Yes	Yes	Yes							TRUE	t-test, Wilcoxon rank sum test, linear regression, piecewise		FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
																						linear regression				

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Mori, Japan - 2006	VAP	No	Yes	Uncertain	Yes	Yes	No	No	No	Yes		No	No	No							TRUE	Fischer's exact, Mann-Whitney U-test, Wilcoxon 2-sided test		TRUE	Logistic Regression	Semi-recumbent patient positioning, use of an endotracheal tube with a suction port for subglottic secretion drainage, use of closed tracheal suction devices, and non-use of H2 blockers for stress ulcer prophylaxis

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Scales, Canada - 2011	CLABSI;VAP	No	Yes	No	No	Yes	Yes								No	Yes		Uncertain	No	Yes	FALSE			TRUE	generalized linear mixed model with random effects	group, time, group*time (interaction term)

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Marra, Brazil - 2009	VAP	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Yes	No	Yes							TRUE	Chi-square test, ANOVA, segmented regression of interrupted time series		FALSE		

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
All_Consist Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut Are any important primary outcomes missing from the results?
All_FundSource Is the Source of funding Identified?
AdherenceReported If infection rates reported, did study also report adherence rates?
InfectionCDC If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate If the study reported infection rates, were process measurements also reported?

CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6-LQ: Quality ratings for CLABSI which do not control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
DePalo, United States - 2010	CLABSI; VAP	No	Yes*	Yes	Yes	Yes	Yes	Yes*	Yes	Yes		No	No	Yes							TRUE	non-parametric methods		TRUE	Mixed effects model with Poisson distribution	hospital size, teaching status, effect of multiple ICUs within hospitals, repeated quarterly measures, and device-days
Schulman, United States - 2011	CLABSI	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes		Uncertain	Yes	No							TRUE	Chi-Squared		TRUE	stepwise Poisson regression	NICU

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Miller, United States - 2010	CLABSI	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Uncertain	Yes	Yes							FALSE			TRUE	Generalized Linear Model (log-link); Hierarchical regression modeling for compliance comparison	Geographic region; average length of stay; bed capacity
McKee, United States - 2008	CLABSI	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes		Uncertain	Yes	Yes							TRUE	Poisson regression		TRUE	Statistical process control chart	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Khouli, United States - 2011	CLABSI	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes		Uncertain	No	Yes							TRUE	Fischer Exact Test for all-or-none analysis. Two-sample t-test was used to compare scores between intervention periods		TRUE	GLM for CRBSI rate, likelihood of infection by ICU type used Poisson regression model.	
Apisarnthanarak, Thailand - 2010	CLABSI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	2 tailed Chi Square or Fisher exact test		TRUE	Segmented regression	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
																						used, student t-test				
Barsuk, United States - 2009	CLABSI	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes		No	No	No							FALSE			TRUE	Poisson regression	ICU location and period
Duane, United States - 2009	CLABSI	No	No	Yes	Uncertain	No	No	Yes	Yes	Yes		No	Yes	Yes							TRUE	Wilcoxon rank sum, fisher's exact, ANCOVA		TRUE	Logistic, Poisson regression	CVL protocol, Injury Severity Score

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Seguin, France - 2010	CAUTI; CLABSI	Uncertain	Yes	No	No	No	Yes	Yes	No	Yes		Uncertain	No	Yes							TRUE	Chi-square test, Fisher's exact test, Student's t-test, Wilcoxon rank sum test, ANOVA		TRUE	logistic regression, Poisson regression, time-to-event analysis	age, SAPS-II score, and admissions diagnosis
Costello, United States - 2008	CLABSI	Uncertain	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes		Uncertain	Yes	Yes							TRUE	Chi-Square test, Fisher's exact tests, Wald test		TRUE	Interrupted time series segmented regression (data transformed)	Time and study period

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Perez Parra, Spain - 2010	CLABSI	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes		Yes	Yes	No							TRUE	Chi-square test, Fisher Exact Test, T-test, Wilcoxon rank sum test		TRUE	Poisson Regression	Authors mention controlling for confounding effects and secular trends but do not describe model.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Scales, Canada - 2011	CLABSI; VAP	No	Yes	No	No	Yes	Yes								No	Yes		Uncertain	No	Yes	FALSE			TRUE	generalized linear mixed model with random effects	group, time, group*time (interaction term)
Pronovost, United States - 2010	CLABSI	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes		Yes	No	No							TRUE	Generalized linear latent and mixed models with Poisson distribution	teaching status and hospital size	FALSE		

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Zingg, Switzerland - 2009	CLABSI	No	Yes	Yes	No	No	No	Yes	Yes	Yes		Uncertain	No	Yes							TRUE	chi-square test, Wilcoxon rank sum test		TRUE	Cox proportional hazards model	period, sex, stay in medical ICU, diabetes, McCabe fatal <6 mo, Charlson score>3, SAPS score, cardiosurgery, intubation, insertion in ER or ICU

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
All_Consist Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut Are any important primary outcomes missing from the results?
All_FundSource Is the Source of funding Identified?
AdherenceReported If infection rates reported, did study also report adherence rates?
InfectionCDC If infection rates reported, was CDC/NNIS* methodology used?

DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6-LQ: Quality ratings for SSI which do not control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Hedrick, United States - 2007	SSI	No	Yes	Yes	No	No	No	Yes	Yes		Yes	Uncertain	No	Yes							TRUE	student's t-test for continuous variables; chi-sq with Yates correction for dichotomous variables		TRUE	stepwise logistical regression with Wald statistic	operative site, laparoscopy, age, hypoalbuminemia, BMI, wound classification, ASA score, operative time
Kaimal, United States - 2008	SSI	Yes	Yes	Uncertain	Yes	Yes	Yes	No	Uncertain		Yes	Uncertain	No	No							TRUE	chi-square		TRUE	logistic regression	labor, previous cesarean, parity, age, BMI, diabetes, chorioamnionitis, strep B culture status

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kritchevsky, United States - 2008	SSI	No	Yes	Yes	Yes	Yes	Yes								Yes	Yes		No	Uncertain	Uncertain	FALSE			TRUE	jackknife design	type of surgery, hospital size, region
Trussell, United States - 2008	SSI	No	Yes	Yes	Yes	No	No	Yes	Yes		Yes	Uncertain	No	Yes							TRUE	t-test or Mann-Whitney for continuous variables; Fisher exact test for categorical variables		TRUE	stepwise logistic regression	diabetes, gender, NNIS wound class

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Kao, United States - 2010	SSI	No	Yes	Uncertain	Yes	No	Yes	Yes	Uncertain		No	No	Yes	Yes							TRUE	chi-sq for categorical; ANOVA for continuous		TRUE	general linear modeling to look at interaction effect between hosp and level of intervention	
Mannien, Netherlands - 2006	SSI	No	Yes	Yes	Yes	No	Yes	Yes	Yes		Yes	Yes	Yes	Yes							TRUE	Chi-square, Student t test, segmented time series analysis		TRUE	segmented time series analysis; Logistic regression, non-linear mixed model analysis	Sex, age (>=65 yrs), university hospital, Duration of surgery (>P75), ASA classification (>=3)

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Burkitt, United States - 2009	SSI	No	Yes	Yes	Yes	Yes	Yes					No	No								TRUE	chi-sq for categorical variables; Wilcoxon rank sum for continuous variables		TRUE	logistic regression	type of surgical procedure, admission source, age, # comorbid conditions

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
All_Consist Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut Are any important primary outcomes missing from the results?
All_FundSource Is the Source of funding Identified?
AdherenceReported If infection rates reported, did study also report adherence rates?
InfectionCDC If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate If the study reported infection rates, were process measurements also reported?
CON_Rand Were study subjects randomized
CON_RandDesc was randomization process described?
CON_NonRandRationale For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor Were outcome assessor blinded to treatment group assignment?
CON_Unit Was a unit of analysis error present?

CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix Table C6-LQ: Quality ratings for CAUTI which do not control for secular trend or confounding.

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQ	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Apisarnthanarak, Thailand - 2007	CAUTI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes		No	Yes	Yes							TRUE	chi-squared, fisher's exact test, student t-test		TRUE	interrupted time series with segmented regression analysis; pearson correlation	

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Crouzet, France - 2007	CAUTI	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes		No	No	Yes							TRUE	chi-squared, t-test, ANOVA		TRUE	KM analysis with log-rank test; logistic regression	age, sex, duration of catheterization, systemic antibiotic administration for diseases other than UTI, repeated catheter replacement, study intervention

Study	Infection	All_Vary	All_Valid	All_Consist	All_PrimOut	All_ImpOut	All_FundSource	AdherenceReported	InfectionCDC	DeviceAdju	postsurveillance	QE_IndependentQI	QE_DataTimePoint	QE_InfectionRate	CON_Rand	CON_RandDesc	CON_NonRandRationale	CON_Assessor	CON_Unit	CON_Corrected	UnivarYN	UnivarModel	UnivarControl	MultivarYN	MultivarModel	MultivarControl
Loeb, Canada - 2008	CAUTI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No		N/A	N/A	N/A	Yes	Yes		Yes	No		TRUE	chi-square test, Student's t-test		TRUE	logistic regression	male sex, diabetes, intervention, and antibiotic exposure
Seguin, France - 2010	CAUTI;CLABSI	Uncertain	Yes	No	No	No	Yes	Yes	No	Yes		Uncertain	No	Yes							TRUE	Chi-square test, Fisher's exact test, Student's t-test, Wilcoxon rank sum test, ANOVA		TRUE	logistic regression, Poisson regression, time-to-event analysis	age, SAPS-II score, and admission diagnosis

All_Vary Did the execution of the study vary from the original protocol?
All_Valid Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?

All_Consist	Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
All_PrimOut	Is the length of followup sufficient to support the evaluation of primary outcomes and harms?
All_ImpOut	Are any important primary outcomes missing from the results?
All_FundSource	Is the Source of funding Identified?
AdherenceReported	If infection rates reported, did study also report adherence rates?
InfectionCDC	If infection rates reported, was CDC/NNIS* methodology used?
DeviceAdju	For CLABSI, VAP, CAUTI: were infection rates adjusted for device utilization?
Postsurveillance	For SSI: was post-discharge surveillance for infections performed?
QE_IndependentQI	Was the intervention performed independent of other QI efforts or other changes?
QE_DataTimePoint	Did the study report data at more than one time point both before and after the intervention?
QE_InfectionRate	If the study reported infection rates, were process measurements also reported?
CON_Rand	Were study subjects randomized
CON_RandDesc	was randomization process described?
CON_NonRandRationale	For non-randomized studies, was rationale for comparison group selection explained?
CON_Assessor	Were outcome assessor blinded to treatment group assignment?
CON_Unit	Was a unit of analysis error present?
CON_Corrected	Was a unit of analysis error present and corrected by appropriate statistical methods?
UnivarYN	Was Univariate Analaysis Conducted?
UnivarModel	What model was used?
UnivarControl	What variables were controlled for?
MultivarYN	Was Multivariate Analysis Conducted?
MultivarModel	What model was used?

Appendix D. Evidence-based Preventive Interventions Used in Study Selection

The following evidence-based preventive interventions, identified from 2007 report (Ranji et al. 2007), HICPAC guidelines, IDSA/SHEA Compendium, and input from the Technical Expert Panel, were used for identifying studies from all settings for inclusion in this evidence review.

All HAIs: Hand hygiene

Surgical site infection:

- appropriate perioperative antibiotic prophylaxis (including appropriate antibiotic selection, timing, and duration) (2007 report)
- perioperative glucose control (2007 report)
- decreasing shaving [or hair removal] of the operative site (2007 report)
- specific technique for clinicians when washing hands prior to surgery (CDC/HICPAC IB)
- treat infections prior to surgery (CDC/HICPAC IA)
- encourage tobacco cessation (CDC/HICPAC IB)
- bathe and prepare skin with antiseptic agent (CDC/HICPAC IB)
- develop policies to manage infected surgical team (CDC/HICPAC IB)
- maintain positive pressure ventilation and minimal 15 air changes per hr during surgery (CDC/HICPAC IB)
- disinfect environmental surfaces (CDC/HICPAC IB)
- sterile instruments and surgical wear (CDC/HICPAC IB)
- after surgery, protect incision with sterile dressing (CDC/HICPAC IB)
- normothermia [recommended by Technical Expert Panel]
- intraoperative administration of oxygen (FIO2), for abdominal or colorectal cases [recommended by Technical Expert Panel]

Central line-associated bloodstream infection:

- adherence to maximal sterile barrier precautions (2007 report)
- use of chlorhexidine for skin antisepsis (2007 report); If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives. (CDC/HICPAC IA)
- avoidance of femoral catheterization (2007 report)
- decontaminate hands before donning sterile gloves when inserting a central intravascular catheter (CDC/HICPAC IB)
- do not use arterial or venous cutdown procedures during insertion (CDC/HICPAC IA)
- do not use organic solvents on skin (CDC/HICPAC IA)
- clean injection ports with 70% alcohol before accessing (CDC/HICPAC IA)
- prepare admixtures using sterile technique (CDC/HICPAC IB)
- do not use in-line filters for infection-control purposes (CDC/HICPAC IA)
- do not administer systemic antimicrobial prophylaxis routinely prior to catheter insertion (CDC/HICPAC IA)
- after insertion, remove nonessential catheters (SHEA/IDSA A-II); Promptly remove any intravascular catheter that is no longer essential (CDC/HICPAC IA)

- After insertion, change dressings and perform site care every 5-7 days and change gauze every 2 days (SHEA/IDSA A-I); Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing. (CDC/HICPAC IB)
- after insertion, use antimicrobial ointments (SHEA/IDSA A-I); Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance. (CDC/HICPAC IB) (Need to resolve inconsistency based on TEP advice.)
- Weigh the risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement) (CDC/HICPAC IA)
- Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis (CDC/HICPAC IA)
- Use a fistula or graft in patients with chronic renal failure instead of a CVC for permanent access for dialysis (CDC/HICPAC IA)
- Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique. (CDC/HICPAC IB)
- Use a CVC with the minimum number of ports or lumens essential for the management of the patient. (CDC/HICPAC IB)
- When adherence to aseptic technique cannot be ensured (i.e. catheters inserted during a medical emergency), replace the catheter as soon as possible, that is, within 48 hours. (CDC/HICPAC IB)
- Maintain aseptic technique for the insertion and care of intravascular catheters. (CDC/HICPAC IB)
- Antiseptics should be allowed to dry according to the manufacturer's recommendation prior to placing the catheter. (CDC/HICPAC IB)
- Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site. (CDC/HICPAC IA)
- Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled. (CDC/HICPAC IB)
- Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower). (CDC/HICPAC IB)
- Ensure that catheter site care is compatible with the catheter material. (CDC/HICPAC IB)
- Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis, depending on the clinical situation of the individual patient. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or bloodstream infection, the dressing should be removed to allow thorough examination of the site. (CDC/HICPAC IB)

- Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. (CDC/HICPAC IB)
- Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection. (CDC/HICPAC IB)
- Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection. (CDC/HICPAC IB)
- Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present. (CDC/HICPAC IB)

Ventilator-associated pneumonia:

- semirecumbent patient positioning (2007 report)
- daily assessment of readiness for ventilator weaning (2007 report)
- perform antiseptic oral care (CDC/HICPAC A-I)

Catheter-associated urinary tract infection

- reduction in unnecessary catheter use (2007 report)
- adherence to aseptic catheter insertion and catheter care (2007 report)
- maintain a closed drainage system and maintain unobstructed urine flow (CDC/HICPAC IB); do not disconnect unless irrigation needed (SHEA/IDSA A-I)

<u>CDC/HICPAC definitions for rating recommendations in above list</u>:

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.
Category IB. Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiologic studies and a strong theoretical rationale.

<u>SHEA/IDSA definitions for rating recommendations in above list</u>:
Strength of recommendation:

A good evidence to support recommendation

Quality of evidence:

I evidence from $\geq$ 1 properly randomized controlled trial

II evidence from $\geq$ 1 well-designed clinical trial w/out randomization; cohort or case-control analytic studies (preferably from > 1 center); multiple time series; or dramatic results from uncontrolled experiments

Appendix E. Items on Data Abstraction Forms

Study and Patient Characteristics Form:

- Authors
- Country
- Year Published
- Infections
- Study Design
- Healthcare Setting
- Clinical Setting
- Intervention Start Year
- Intervention End Year
- Follow-up months
- Comments

Intervention Characteristics Form:

- Intervention
- Comparator
- Number of Hospitals
- Number of Patients
- Number of Patients lost to follow-up
- Number of healthcare staff
- Type of QI strategy
- Clinical Characteristics
- Age
- Age distribution
- Percent Male
- Percent White
- Interventionists
- Participants
- Intervention Specifics
- Intervention expected influence on behavior
- Outcomes
- Comments

Intervention Context Form:

- Were expectations made clear to interveners and intervenees?
- What positive and negative incentives were used?
- Describe feedback or consequences given to interveners and or intervenes?
- Description of theory behind patient safety practice
- Influence of context on processes and outcomes
    - Organizational characteristics

        - Size
        - Location
        - Financial Status
        - Existing patient safety infrastructure
        - External Factors
- Patient safety culture, teamwork, leadership at the unit level
- Availability of implementation and management tools
- Comments

Intervention Outcomes Form:

- Outcome value (95% CI) and statistical results for all outcomes
- Rate of infection
    - Units of Measurement
    - Months since intervention
- Adherence
    - Months since intervention
- Costs
- Savings
- Type of univariate model used and variables controlled for
- Type of multivariate model used and variables controlled for
- Comments

Quality Form:

- Did the execution of the study vary from the original protocol?
- Is the intervention assessed using valid and reliable measures, implemented consistently across all study participants?
- Are outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
- Is the length of follow up sufficient to support the evaluation of primary outcomes and harms?
- Are any important primary outcomes missing from the results?
- Is the source of funding identified?
- If infection rates reported, did study also report adherence rates?
- If infection rate was reported, was CDC/NNIS methodology used?
- For CLABSI, VAP, CAUTI - were infection rates adjusted for device utilization?
- For SSI- was post-discharge surveillance for infections performed?
- Was the intervention performed independent of other QI efforts or other changes?
- Did the study report data at more than one time point both before and after the intervention?
- If the study reported infection rates, were process measurements also reported?
- Were study subjects randomized?
- Was the randomization process described?
- For non-randomized studies, was rationale for comparison group selection explained?
- Were outcome assessor blinded to treatment group assignment?

- Was a unit of analysis error present?
- Was it corrected by appropriate statistical methods?
- Comments

Appendix F. Overview Tables for Articles not Included in Analysis

Table F1: VAP studies not included in analysis

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Assanasen, United States - 2008	pre: 450 post: 2435	Feedback Program	●						
Bigham, United States - 2009	pre: 617 (77) post1: 447 (22) post2: 1782 (3)	VAP Bundle	●		●			●	●
Venkatram, United States - 2010	pre: 549 (5) post: 1165 (3)	VAP bundle	●		●	●		●	
Sona, United States - 2009	pre: 777 (24) post: 871 (10)	Oral Care Protocol	●		●			●	
Garcia, United States - 2009	pre: 779 (67) post: 759 (31)	VAP Education and Oral Care Protocol			●			●	
Rosenthal, Argentina - 2006	pre: 435 (84) post: 366 (54)	Nurse-Implemented Sedation Protocol	●					●	
Gurskis, Lithuania - 2009	pre: 270 (15) post: 322 (6)	VAP Education						●	
Landrum, Afghanistan - 2008	total: 475 (25)	Infection Control Protocol	●		●			●	
Heimes, United States - 2011	pre: 215 (8) post1: 240 (4) post2 : 241 (3)	VAP Prevention Protocol (VAPP)	●		●			●	
Quenot, France - 2007	pre: 226 (34) post: 197 (12)	VAP Bundle			●				
Jain, United States - 2006	pre: (260) post: (70)	IMPACT initiative	●		●				
Bloos, Germany- 2009	pre: 133 (44) post: 141 (45)	Educational Program	●		●			●	
Jimenez, United States - 2009	pre: 102 post: 86	VAP Bundle	●					●	●

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Ross, United States - 2007	pre: 55 post: 61	Multifaceted Infection Control Program	●					●	
Abbott, United States - 2006	pre: (9) post: (9) total: 106 (18)	Academic Center of Evidence-based Practice (ACE) Star Model	●		●			●	●
Berriel-Cass, United States - 2006		VAP bundle	●		●			●	
Bird, United States - 2010		VAP Bundle	●		●				●
Blamoun, United States - 2009		Expanded VAP bundle			●				
Cocanour, United States - 2006		VAP Bundle	●		●	●		●	

Table F2: CLABSI articles not included in analysis

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Lobo, Brazil - 2010	pre: 519 (41) post: 303 (12)	Continuous Education	●					●	●
Venkatram, United States - 2010	pre: 1096 (18) post: 3749 (8)	CLABSI bundle	●		●	●		●	
Shannon, United States - 2006	pre: 1067 (49) post: 1832 (3)	Toyota Production System adaptation			●			●	
Assanasen, United States - 2008	pre: 450 post: 2435	Feedback Program	●						
Warren, United States - 2006	pre: (229) post: (508)	Multifaceted, education-based intervention						●	
Koll, United States - 2008	pre: (364) post: (349)	Central line bundle	●		●			●	
Wicker, United States - 2011	pre: 334 (103) post: 303 (59)	Comprehensive Infection Control Measures	●		●			●	
Bizzarro, United States - 2010	pre: 417 (83) post: 159 (6)	Bundle - CLABSI	●		●		●	●	
Yilmaz, Turkey - 2007	pre: 241 (71) post: 193 (45)	Education	●		●			●	
Sannoh, United States - 2010	pre: 163 (45) post: 210 (35)	Bundle - CLABSI	●					●	●
Gurskis, Lithuania - 2009	pre: 95 (5) post: 108 (2)	CLABSI Education						●	
Marra, Brazil - 2010	pre: (134) post: (64)	IHI Bundle - CLABSI	●		●				●
Santana, Brazil - 2008	total: 186	Education						●	
Rogers, Ireland - 2010	pre: (31) post: (19)	Plan-Do-Study-Act (PDSA) cycle						●	
Guerin, United States - 2010	pre: (25) post: (3)	Post-insertion CVC care bundle						●	

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Jeffries, United States - 2009		CVC Insertion and Maintenance Bundle	●		●			●	
Berriel-Cass, United States - 2006		CLABSI Bundle	●		●			●	
Bhutta, United States - 2007		Bundle CLABSI			●			●	●
Galpern, United States - 2008		CLABSI Bundle	●		●			●	
Jain, United States - 2006		IMPACT initiative	●		●				
Render, United States - 2006		CLABSI Bundle	●		●				●

Table F3: SSI articles not included in analysis

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Wax, United States - 2007	pre: 4987 post: 9478	Electronic reminder for provider							●
Gomez, Argentina - 2006	pre: 3496 (111) post: 3982 (75)	automatic stop prophylaxis form			●			●	●
Graf, Germany - 2009	pre: 3150 (114) post: 980 (80)	bundle - SSI	●					●	●
Takahashi, Japan - 2010	pre: 1627 post: 1627	Departmental Education	●		●			●	
Kramer, United States - 2008	pre: 1677 (44*) post: 1388 (14*)	nomogram for glycemic control			●			●	●
Liau, Singapore - 2010	post: 2408 (12*)	bundle - antibiotic, glucose control, clippers, normothermia			●			●	●
Parker, United States - 2007	pre: 615 post: 1716	Six Sigma methodology and antibiotic prophylaxis			●			●	
Suchitra, India - 2009	pre: 1125 (136) post: 1119 (45)	Education Program						●	
Shimoni, Israel - 2009	pre: 1104 (186) post: 1089 (137)	Empowering surgical nurses			●				
Ichikawa, Japan - 2007	pre: 721 (27) post: 1313 (22)	Implementation of Antibiotic Protocols	●					●	
Whitman, United States - 2008	total: 1622	Multiple 'forced functions'	●		●			●	●
Potenza, United States - 2009	total: 1359	bundle - antibiotic prophylaxis			●				●
Kable, Australia - 2008	pre: 659 (50) post: 518 (42)	bundle - antibiotic prophylaxis			●			●	●
Rauk, United States - 2010	pre: 441 (33) post: 436 (5)	bundle - skin prep and instrument sterilization			●			●	
Hermsen, United States - 2008	pre: 406 post: 396	Standardized order form	●		●			●	●

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Ozgun, Turkey - 2010	pre: 312 post: 322	antibiotic prophylaxis education						●	
Pastor, United States - 2010	pre: 238 (45) post: 253 (49)	task force to meet SCIP process measures			●			●	
Carles, France - 2006	pre: 210 post: 210	surgical antibiotic prophylaxis kit (SAPK)			●				
Acklin, Switzerland - 2011	pre: 217 (15) post: 153 (3)	bundle - antibiotic prophylaxis, skin prep, sterile dressing	●					●	
Nemeth, United States - 2010	pre: 97 post: 193	Education program						●	●
Willemsen, Netherlands - 2007	pre: 153 post: 147	standardized antibiotic protocol			●			●	
Berry, United States - 2009	pre: 137 post: 117	ProvenCare	●		●			●	●
Forbes, Canada - 2008	pre: 105 (superficial: 15*, organ space: 8*) post: 103 (superficial: 9*, organ space: 7*)	bundle - antibiotic administration in OR, pre-printed order form to standardize choice of antibiotic, monthly performance figures posted in OR; bundle - maintain normothermia by warming OR to 22 C, standardizing IV warmers and forced air devices, monthly performance figures posted in OR; bundle - glucose control by screening all pts prior to surgery, administering weight-based regimen of insulin to diabetics, monthly performance figures posted in OR	●		●			●	
Berenguer, United States - 2010	pre: 113 (15) post: 84 (7)	implementing SCIP measures			●			●	
Awad, United States - 2009		MRSA bundle	●		●			●	
Paull, United States - 2010		The Briefing Guide (BiG)			●			●	●
Zvonar, Canada - 2008		Appropriate antibiotic prophylaxis administration	●		●			●	

Table F4: CAUTI articles not included in analysis

Author, Location-Year	Sample Size (Infections)	Intervention	Audit and Feedback	Financial Incentives	Organizational Change	Patient Education	Promotion of Self-Management	Provider Education	Provider Reminder Systems
Stephan, Switzerland - 2006	pre: 280 post: 300	CAUTI guidelines, education and posters	●					●	
Venkatram, United States - 2010	pre: 1096 (18) post: 2669 (5)	CAUTI bundle	●		●	●		●	
Suchitra, India - 2009	pre: 1125 (74) post: 1119 (30)	Education Program						●	
Wald, United States - 2011	pre orthopedic: 206 (3) post orthopedic: 290 (0) pre general: 167 (3) post general: 183 (3)	Audit and feedback on catheter duration	●					●	
Gurskis, Lithuania - 2009	pre: 270 (3) post: 322 (6)	CAUTI Education			●			●	●
Gokula, United States - 2007	pre: 100 post: 100	Education	●					●	●
Rothfeld, United States - 2010	pre: (51) post: (26)	Appropriate Catheter Use Protocol			●			●	
Jain, United States - 2006		IMPACT initiative	●		●				

Appendix G. Details of Interrupted Time Series Analysis

Table G5: Description of interrupted time series results for VAP studies

Author, Country-Year	Outcome	Test	Values	p-value	Comment
Zaydfudim, United States - 2009	Infection rates	t-test	Mean baseline: 15.2		
			Mean post-intervention: 9.3	0.01	
		piecewise linear regression		0.37	The trend during the baseline period is not significantly different than the trend during the post-intervention period.
Apisarnthanarak, Thailand - 2007	MICU Infection rates	t-test	Mean baseline: 20.6		p-values are comparing the subsequent period to baseline.
			Mean post-intervention: 8.5	0.001	
			Mean follow-up: 4.2	<0.001	
		segmented regression	Initial change from baseline to post-intervention: -2.291	0.6307	Difference between the last point in baseline is not significantly different than the first point in post-intervention.
			Initial change from post-intervention to follow-up: -1.594	0.7007	Difference between the last point in post-intervention is not significantly different than the first point in follow-up.
			Difference in trends from baseline and post-intervention: -1.171	0.0018	Trend during post-intervention is significantly different than the trend during baseline.
			Difference in trends from post-intervention and follow-up: -1.115	0.07	Trend during follow-up is marginally significantly different than the trend during post-intervention.
Bouadma, France - 2010	Infection rates	Wilcoxon rank sum test	Overall baseline: 22.6		
			Overall post-intervention: 13.1	<0.001	
		segmented regression	Trend during baseline	0.11	There was a non-significant change in trend during the baseline period.
			Trend during post-intervention	0.001	There was a significant decrease in trend during the post-intervention period.
Marra, Brazil - 2009	Infection rates	ANOVA	Mean baseline: 16.4		
			Mean post-intervention 1: 15.0		

Author, Country-Year	Outcome	Test	Values	p-value	Comment
			Mean post-intervention 2: 10.4	0.05	
		segmented regression	Trend part 1 of Phase 3: 2.59	0.001	There was a significant increase in the trend during the first part of Phase 3.
			Trend during part 2 of Phase 3: -2.30	0.27	There was a nonsignificant change in trend during the second part of Phase 3.
			Trend during part 3 of Phase 3: -0.76	0.18	There was a nonsignificant change in trend during the last part of Phase 3.
Papadimos, United States - 2008	Infection rates	2-tailed z-test/Wilcoxon rank sum test	Overall baseline: 19.3		
			Overall pre-FASTHUG: 16.6	0.62	
			Overall post-FASTHUG: 7.3	<0.01	
		ARIMA model	Baseline vs pre-FASTHUG period	0.5909	Authors combined baseline and pre-FASTHUG periods since they were non-significantly different.
			Combined pre-FASTHUG period vs post-FASTHUG period	0.0004	The mean monthly infection rates are significantly lower in the post-FASTHUG period

Table G6: Description of interrupted time series results for CLABSI studies

Author, Country-Year	Outcome	Test	Values	p-value	Comment
Apisarnthanarak, Thailand - 2007	Medical Ward Infection Rates	t-test	Mean baseline: 16		p-values are comparing subsequent period to baseline.
			Mean post-intervention: 6.8	<0.05	
			Mean follow-up: 1.5	<0.05	
		segmented regression	Initial change from baseline to post-intervention: -7.72	0.03	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Initial change from post-intervention to follow-up: -4.15	0.02	Difference between the last point in post-intervention is significantly different than the first point in follow-up.
			Difference in trends from baseline and post-intervention: -1.18	0.48	Trend during post-intervention is not significantly different than the trend during baseline.
			Difference in trends from post-intervention and follow-up: -1.15	0.07	Trend during follow-up is marginally significantly different than the trend during post-intervention.
	Surgical Ward Infection Rates	t-test	Mean baseline: 11		p-values are comparing subsequent period to baseline.
			Mean post-intervention: 5.5	<0.05	
			Mean follow-up: 0.8	<0.05	
		segmented regression	Initial change from baseline to post-intervention: -8.36	0.001	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Initial change from post-intervention to follow-up: -4.04	0.05	Difference between the last point in post-intervention is significantly different than the first point in follow-up.
			Difference in trends from baseline and post-intervention: 0.08	0.45	Trend during post-intervention is not significantly different than the trend during baseline.
			Difference in trends from post-intervention and follow-up: -0.22	0.40	Trend during follow-up is not significantly different than the trend during post-intervention.
	ICU Infection Rates	t-test	Mean baseline: 17		p-values are comparing subsequent period to baseline.
			Mean post-intervention: 7.1	<0.05	
			Mean follow-up: 2.1	<0.05	

Author, Country-Year	Outcome	Test	Values	p-value	Comment
		segmented regression	Initial change from baseline to post-intervention: -12.25	0.005	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Initial change from post-intervention to follow-up: -8.13	0.001	Difference between the last point in post-intervention is significantly different than the first point in follow-up.
			Difference in trends from baseline and post-intervention: 0.24	0.36	Trend during post-intervention is not significantly different than the trend during baseline.
			Difference in trends from post-intervention and follow-up: -1.54	0.06	Trend during follow-up is marginally significantly different than the trend during post-intervention.
	Other Units Infection Rates	t-test	Mean baseline: 9		p-values are comparing subsequent period to baseline.
			Mean post-intervention: 5.2	<0.05	
			Mean follow-up: 0.9	<0.05	
		segmented regression	Initial change from baseline to post-intervention: -3.36	0.04	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Initial change from post-intervention to follow-up: -1.45	0.14	Difference between the last point in post-intervention is not significantly different than the first point in follow-up.
			Difference in trends from baseline and post-intervention: 0.14	0.24	Trend during post-intervention is not significantly different than the trend during baseline.
			Difference in trends from post-intervention and follow-up: -0.04	0.2	Trend during follow-up is not significantly different than the trend during post-intervention.

Table G7: Description of interrupted time series results for CAUTI studies

Author, Country-Year	Outcome	Test	Values	p-value	Comment
Apisarnthanarak, Thailand - 2007	Overall Infection rates	t-test	Mean baseline: 21.5		
			Mean post-intervention 5.2	<0.001	
		segmented regression	Initial change from baseline to post-intervention: 13.71	<0.001	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Difference in trends from baseline and post-intervention: 0.27	0.5	Trend during post-intervention is not significantly different than the trend during baseline.
	Medical Ward Infection rates	t-test	Mean baseline: 21.5		
			Mean post-intervention 6.5	0.02	
		segmented regression	Initial change from baseline to post-intervention: 11.23	0.04	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Difference in trends from baseline and post-intervention: 0.67	0.24	Trend during post-intervention is not significantly different than the trend during baseline.
	Surgical Ward Infection rates	t-test	Mean baseline: 19.4		
			Mean post-intervention 7.8	0.03	
		segmented regression	Initial change from baseline to post-intervention: 7.61	0.03	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Difference in trends from baseline and post-intervention: 0.97	0.06	Trend during post-intervention is marginally significantly different than the trend during baseline.
	ICU Infection rates	t-test	Mean baseline: 23.4		
			Mean post-intervention 3.5	0.01	
		segmented regression	Initial change from baseline to post-intervention: 11.23	0.003	Difference between the last point in baseline is significantly different than the first point in post-intervention.
			Difference in trends from baseline and post-intervention: 0.67	0.5	Trend during post-intervention is not significantly different than the trend during baseline.