Central Line Blood Stream Infection

Rationale and Recommendation from Staff

- Infection inclusion
  - Impact
    - CDC estimates 200,000 per year
    - Increased mortality (~14,000-28,000 deaths) [1]
    - Increased cost (~ additional $3,700-29,000)[1]
    - Process changes can lead to quality improvement[1]
  - Recommended for reporting
    - National organizations
      - AHRQ (with support from AARP, Consumer's Union, SEIU, NAHDO and 17 others)
      - APIC (Association for Professionals in Infection Control and Epidemiology)
      - CDC
      - CMS
    - 63% of states require as part of reporting
  - Collection methods
    - Readily available collection and risk adjustment methodology through National Healthcare Safety Network (CDC)
    - Over 50% of state use NHSN as collection method
    - Ability for adjustment of collection schedule
      - NHSN only requires 1 month per location of data
    - Training and support provided by NHSN staff
    - Requires minimal technology changes from the facility (i.e., internet connection)

Staff Recommendation to Committee

- Central line blood stream infection should be implemented in year 1 of the reporting program for hospitals
- NHSN is the most appropriate, scientifically valid method to collect CLABSI data

[1] Institute for Healthcare Improvement, Getting Started Kit: Prevent Central Line Infections, 2007.

- Collection Location/unit of hospital (defined by NHSN)
    - Recommends targeted unit collection
        - ICU
        - Specialty care units (i.e. hematology, oncology, transplant wards)
        - NICU
        - Inpatient locations (general medical/surgical wards)

Rank of units by CL days (NHSN)	Rank of CLABSI rate (NHSN)	By inclusion of Oregon hospitals with type of unit (AHA survey, 2005)
Medical/Surgical ICU (~326,000)	Burn ICU (6.8/1,000 CL days)	Medical/Surgical wards (57)
Medical ICU (~170,000)	Peds Medical/Surgical ICU (5.3/1,000 CL days)	Medical/Surgical ICU (47)
Surgical ICU (~137,000)	Trauma ICU (4.6/1,000 CL days)	NICU (8)
Peds Medical/Surgical ICU (~48,000)	Neurosurgical ICU (3.5/1,000 CL days)	Peds Medical/Surgical ICU (3)

Staff Recommendation to Committee

- Collection in Medical/Surgical ICU (most CL days, most inclusive of hospitals)
- Collection in Peds Medical/Surgical & NICU (high rate location)
- For hospitals not included
    - Committee develop a collection format using IHI guidelines for CLABSI bundle process measures to be submitted on identical schedule
- Committee outline collection outside of designated ICUs

v03
12/12/2006

Getting Started Kit:
Prevent Central Line Infections

How-to Guide

A national initiative led by IHI, the 5 Million Lives Campaign aims to dramatically improve the quality of American health care by protecting patients from five million incidents of medical harm between December 2006 and December 2008. The How-to Guides associated with this Campaign are designed to share best practice knowledge on areas of focus for participating organizations. For more information and materials, go to www.ihi.org/IHI/Programs/Campaign.

This How-to Guide is dedicated to the memory of David R. Calkins, MD, MPP (May 27, 1948 – April 7, 2006) -- physician, teacher, colleague, and friend -- who was instrumental in developing the Campaign's science base. David was devoted to securing the clinical underpinnings of this work, and embodied the Campaign's spirit of optimism and shared learning. His tireless commitment and invaluable contributions will be a lifelong inspiration to us all.

The Institute for Healthcare Improvement (IHI) is a not-for-profit organization leading the improvement of health care throughout the world. IHI helps accelerate change by cultivating promising concepts for improving patient care and turning those ideas into action. Thousands of health care providers participate in IHI's groundbreaking work.

Campaign Donors

The 5 Million Lives Campaign is made possible through the generous leadership and support of America's Blue Cross and Blue Shield health plans. IHI also acknowledges the leadership and support of the Cardinal Health Foundation, and the support of the Blue Shield of California Foundation, the Aetna Foundation, Rx Foundation, Baxter International, Inc., and Abbott Fund.

BlueCross BlueShield Association
An Association of Independent Blue Cross and Blue Shield Plans

Cardinal Health Foundation

This initiative builds on work begun in the 100,000 Lives Campaign, supported by Blue Cross Blue Shield of Massachusetts, the Cardinal Health Foundation, the Rx Foundation, the Gordon and Betty Moore Foundation, The Colorado Trust, the Blue Shield of California Foundation, the Robert Wood Johnson Foundation, Baxter International, Inc., The Leeds Family, and the David Calkins Memorial Fund.

Scientific Partners

Several organizations have generously acted as scientific partners and advisors in our work on this intervention. They include:

Association for Professionals in Infection Control and Epidemiology

Centers for Disease Control and Prevention

Society for Healthcare Epidemiology of America

Society of Critical Care Medicine

Don't miss…

- Tips and Tricks [pp. 32-33]

Tips for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups on IHI.org

- Frequently Asked Questions [pp. 34-36]

Questions about how to implement each intervention, with helpful, practical answers from IHI content experts

- Patients and Families Fact Sheet [pp. 37-38]

Information to help patients and their families in obtaining effective treatment and assisting medical professionals in the delivery of care

Goal

Prevent catheter-related bloodstream infections by implementing the five components of care called the "central line bundle."

Defining the Problem of Interest

Any discussion of decreasing infection rates for central venous catheters (CVCs) should start with a clear definition of a catheter-related bloodstream infection. Typically, most experts and improvement teams have relied upon the definitions provided by the National Nosocomial Infections Surveillance System (NNIS) at the Centers for Disease Control (CDC). This program has been replaced recently by a new initiative, the National Healthcare Safety Network (NHSN). The problem of interest is that of *primary catheter-associated bloodstream infections*. These are bloodstream infections in which the specific site is *either* laboratory confirmed bloodstream infections *or* clinical sepsis. NHSN has defined a central line as a catheter whose tip terminates in a great vessel. The great vessels include the aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, and common femoral veins. Femoral lines are therefore considered central lines. Similarly, peripherally inserted central catheter (PICC) lines are also central catheters. (For details on the required definitions, please refer to Appendix C: Measurement Information Forms.)

The Case for Preventing Catheter-Related Bloodstream Infections

- Central venous catheters (CVCs) are being used increasingly in the inpatient and outpatient setting to provide long-term venous access. CVCs disrupt the integrity of the skin, making infection with bacteria and/or fungi possible. Infection may spread to the bloodstream and hemodynamic changes and organ dysfunction (severe sepsis) may ensue, possibly leading to death. Approximately 90% of the catheter-related bloodstream infections (CR-BSIs) occur with CVCs.

  Mermel LA. Prevention of intravascular catheter-related infections. *Ann Intern Med*. 2000;132(5):391-402.

- Forty-eight percent of intensive care unit (ICU) patients have central venous catheters, accounting for about 15 million central-venous-catheter-days per year in ICUs. Approximately 5.3 central line infections (often termed catheter-related bloodstream infections) occur per 1,000 catheter days in ICUs. The attributable mortality for such central line infections is approximately 18%. Thus, probably about 14,000 deaths occur annually due to central line infections. Some estimates put this figure as high as 28,000 deaths per year.

Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients. Excess length of stay, extra costs, and attributable mortality. JAMA. 1994;271:1598-1601.

Saint S. Chapter 16. Prevention of intravascular catheter-related infection. Making health care safer: a critical analysis of patient safety practices. AHRQ evidence report, number 43, July 20, 2001.

Berenholtz SM, Pronovost PJ, Lipsett PA, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. Crit Care Med. 2004;32:2014-2020.

- In addition, nosocomial bloodstream infections prolong hospitalization by a mean of 7 days. Estimates of attributable cost per bloodstream infection are estimated to be between $3,700 and $29,000.

Soufir L, Timsit JF, Mahe C, Carlet J, Regnier B, Chevret S. Attributable morbidity and mortality of catheter-related septicemia in critically ill patients: a matched, risk-adjusted, cohort study. Infect Control Hosp Epidemiol. 1999;20(6):396-401.

The Central Line Bundle

Care bundles, in general, are groupings of best practices with respect to a disease process that individually improve care, but when applied together result in substantially greater improvement. The science supporting each bundle component is sufficiently established to be considered the standard of care.

The central line bundle is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually.

The central line bundle has five key components:

1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
5. Daily review of line necessity, with prompt removal of unnecessary lines

This is not intended to be a comprehensive list of all elements of care related to central lines; rather, the bundle approach to a small group of interventions promotes teamwork and collaboration. Other elements of care, such as daily site care and selection of dressing material, may be recommended in guidelines from the CDC and others. These are not excluded for any purpose other than to have a bundle that is focused.

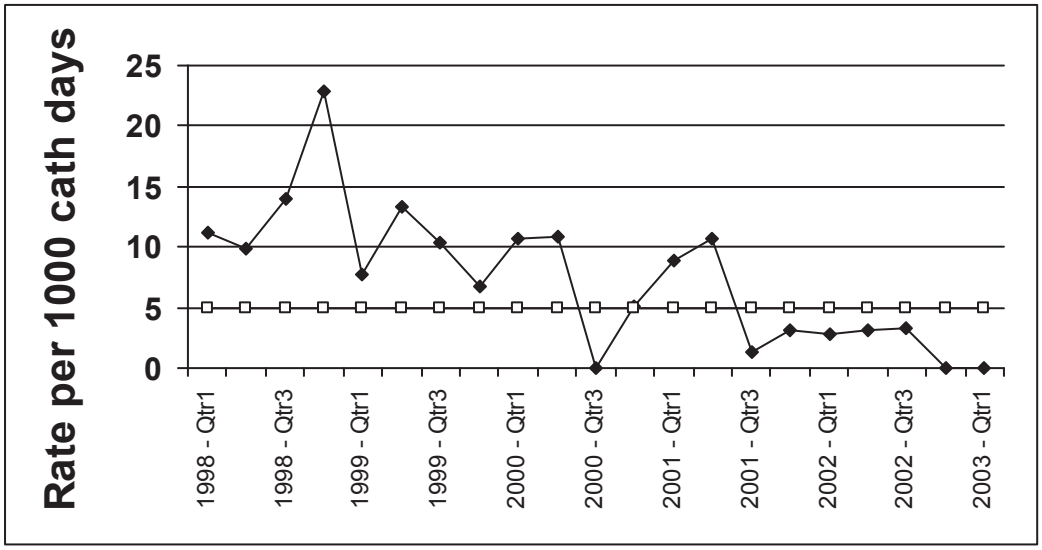
Initial testing of the central line bundle occurred in intensive care units. Many hospitals have since spread the work to other areas of the hospital where central lines are inserted. Teams should check for guidelines from clinical expert panels for other areas before spreading the bundle; for example, the American Society of Anesthesiologists has published guidelines for insertion of lines in the operating room; these contain many of the same elements as the bundle.

Compliance with the central line bundle can be measured by simple assessment of the completion of each item. The approach has been most successful when all elements are executed together, an "all or none" strategy.

Potential Impact of the Central Line Bundle

Application of the central line bundle has demonstrated striking reductions in the rate of central line infections in many hospitals. Berenholtz et al. demonstrated that ICUs that have implemented multifaceted interventions similar to the central line bundle have nearly eliminated CR-BSIs.

Berenholtz SM, Pronovost PJ, Lipset PA, et al. Eliminating catheter-related bloodstream infection in the intensive care unit. *Critical Care Medicine*. 2004;32:2014-2020.



The success of these interventions is perhaps due to a combination of the mindfulness that develops when regularly applying the elements of the bundle and the particular bundle elements themselves. For example, two studies have shown that the application of maximal barrier precautions substantially reduces the odds of developing a bloodstream infection.

Author/date	Design	Catheter	Odds Ratio for infection w/o MBR
Mermel 1991	Prospective Cross-sectional	Swan-Ganz	2.2 ($p<0.03$)
Raad 1994	Prospective Randomized	Central	6.3 ($p<0.03$)

Mermel et al. demonstrated that the odds ratio was 2.2 times greater for infection without maximal barrier precautions, while Raad et al. demonstrated a 6.3 times greater likelihood for infection without precautions.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med*. 1991;91(3B):197S-205S.

Raad, II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol*. 1994;15(4 Pt 1):231-238.

Preventing Catheter-Related Bloodstream Infections – Five Components of Care

1. Hand hygiene

One way to decrease the likelihood of central line infections is to use proper hand hygiene. Washing hands or using an alcohol-based waterless hand cleaner helps prevent contamination of central line sites and resultant bloodstream infections.

O'Grady NP, Alexander M, Dellinger EP, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. *MMWR Recomm Rep.* Aug 9 2002;51(RR-10):1-29.

When caring for central lines, appropriate times for hand hygiene include:

- Before and after palpating catheter insertion sites (Note: Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained.)
- Before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter
- When hands are obviously soiled or if contamination is suspected
- Before and after invasive procedures
- Between patients
- Before donning and after removing gloves
- After using the bathroom

» What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on hand hygiene. These changes, taken together, support the implementation of the central line bundle. Some of these changes are:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement, including hand hygiene, are executed for each line placement.
- Include hand hygiene as part of your checklist for central line placement.
- Keep soap/alcohol-based hand hygiene dispensers prominently placed and make universal precautions equipment, such as gloves, only available near hand sanitation equipment.
- Post signs at the entry and exits to the patient room as reminders.
- Initiate a campaign using posters including photos of celebrated hospital doctors/employees recommending hand hygiene.
- Create an environment where reminding each other about hand hygiene is encouraged.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

2. Maximal barrier precautions

A key change to decrease the likelihood of central line infections is to apply maximal barrier precautions in preparation for line insertion.

For the operator placing the central line and for those assisting in the procedure, maximal barrier precautions means strict compliance with hand hygiene and wearing a cap, mask, sterile gown, and gloves. The cap should cover all hair and the mask should cover the nose and mouth tightly. These precautions are the same as for any other surgical procedure that carries a risk of infection.

For the patient, applying maximal barrier precautions means covering the patient from head to toe with a sterile drape, with a small opening for the site of insertion.

In two studies, the odds of developing a central line infection increased if maximal barrier precautions were not used. For pulmonary artery catheters, the odds ratio for developing infection was more than two times greater for placement without maximal barrier precautions. A study of similar design found that this rate was six times higher for placement of central line catheters.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med.* Sep 16 1991;91(3B):197S-205S.

Raad, II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol*. Apr 1994;15(4 Pt 1):231-238.

» What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on maximal barrier precautions. These measures, taken together, support the implementation of the central line bundle. Some of these changes include:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement are executed for each line placement.
- Include maximal barrier precautions as part of your checklist for central line placement.
- Keep equipment stocked in a cart for central line placement to avoid the difficulty of finding necessary equipment to institute maximal barrier precautions.
- If a full-size drape is not available, apply two drapes to cover the patient. Or consult with the operating room staff to determine how to procure full-size sterile drapes, since these are routinely used in surgical settings.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

3. Chlorhexidine skin antisepsis

Chlorhexidine skin antisepsis has been proven to provide better skin antisepsis than other antiseptic agents such as povidone-iodine solutions.

Maki DG, Ringer M, Alvarado CJ. Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *Lancet*. 1991 Aug 10;338(8763):339-343.

Chaiyakunapruk N, Veenstra DL, Lipsky BA, Saint S. Chlorhexidine compared with povidone-iodine solution for vascular catheter-site care: a meta-analysis. *Ann Intern Med*. 2002 Jun 4;136(11):792-801.

The technique, for most kits, is as follows:

- Prepare skin with antiseptic/detergent chlorhexidine 2% in 70% isopropyl alcohol.
- Pinch wings on the chlorhexidine applicator to break open the ampule. Hold the applicator down to allow the solution to saturate the pad.
- Press sponge against skin, apply chlorhexidine solution using a back-and-forth friction scrub for at least 30 seconds. Do not wipe or blot.
- Allow antiseptic solution time to dry completely before puncturing the site (~ 2 minutes).

» What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process and changes that allowed them to improve performance on chlorhexidine skin antisepsis. These measures, taken together, support the implementation of the central line bundle. Some of these changes include:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement are executed for each line placement.
- Include chlorhexidine antisepsis as part of your checklist for central line placement.
- Include chorhexidine antisepsis kits in carts or grab bags storing central line equipment. Many prepared central line kits include povodine-iodine kits and these must be avoided.
- Ensure that solution dries completely before attempting to insert the central line.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

4. Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters in adults

Percutaneously inserted catheters are the most commonly used central catheters. In a recent prospective observational study assessing catheters placed by a critical care medicine department in a university teaching hospital, the site of insertion did not alter the risk of infection. The authors concluded that the site of insertion was not a risk factor for infection when experienced physicians insert the catheters, strict sterile technique is used, and trained intensive care unit nursing staff perform catheter care.

Deshpande KS, Hatem C, Ulrich HL, et al. The incidence of infectious complications of central venous catheters at the subclavian, internal jugular, and femoral sites in an intensive care unit population. *Crit Care Med*. 2005;33:13.

Other studies have shown that in less controlled environments, the site of insertion is a risk factor for infection. Mermel et al. were able to demonstrate that the great majority of infections develop at the insertion site. Other risk factors included use of the jugular insertion site over the subclavian site. In addition, for use of total parenteral nutrition, McCarthy demonstrated a similar effect.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med.* Sep 16 1991;91(3B):197S-205S.

McCarthy MC, Shives JK, Robison RJ, Broadie TA. Prospective evaluation of single and triple lumen catheters in total parenteral nutrition. *J Parenter Enteral Nutr.* 1987 May-Jun;11(3):259-262.

Three studies indicate a lower risk of infection with subclavian placement:

- Richet H, Hubert B, Nitemberg G, et al. Prospective multicenter study of vascular-catheter-related complications and risk factors for positive central-catheter cultures in intensive care unit patients. *J Clin Microbiol*. 1990;28:2520.
- Collignon P, Soni N, Pearson I, et al. Sepsis associated with central vein catheters in critically ill patients. *Intensive Care Med*. 1988;14:227.
- Merrer J, Jonghe BD, Golliot F, et al. Complications of femoral and subclavian venous catheterization in critically ill patients. A randomized controlled trial. JAMA. 2001;286:700.

Given that teams undertaking this initiative may not yet have the processes in place to duplicate the conditions found in the Deshpande study, whenever possible the subclavian line site should be preferred over the jugular and femoral sites for non-tunneled catheters in adult patients. This recommendation is based solely on the likelihood of reducing infectious complications. Subclavian placement may have other associated risks. The bundle requirement for *optimal site selection* suggests that other factors (e.g., the potential for mechanical complications, the risk of subclavian vein stenosis, and catheter-operator skill) should be considered when deciding where to place the catheter. In these instances, teams are considered compliant with the bundle element as long as they use a rationale construct to choose the site.

The core aspect of site selection is the risk/benefit analysis by a physician as to whether the subclavian vein is most appropriate for the patient. There will be occasions when the physician determines that the risks of using the subclavian vein outweigh the benefits and a different vessel is selected. For the purposes of bundle compliance, if there is dialogue among the clinical team members as to the selection site and rationale, and there is documentation as to the reasons for selecting a different vessel, this aspect of the bundle should be considered as in compliance. It is not the intent of the bundle to force a physician to take an action that he or she feels is not clinically appropriate.

» What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on optimal insertion site. These measures, taken together, support the implementation of the central line bundle. Some of these changes include:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement are executed for each line placement.
- Include optimal site selection as part of your checklist for central line placement with room to note appropriate contraindications, e.g., bleeding risks.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

5. Daily review of central line necessity with prompt removal of unnecessary lines

Daily review of central line necessity will prevent unnecessary delays in removing lines that are no longer clearly needed for the care of the patient. Many times, central lines remain in place simply because they provide reliable access and because personnel have not considered removing them. However, it is clear that the risk of infection increases over time as the line remains in place and that the risk of infection decreases if the line is removed.

The CDC guidelines state that "catheter replacement at scheduled time intervals as a method to reduce CR-BSI has not lowered rates of infection." Additionally, routine replacement is "not necessary for catheters that are functioning and have no evidence of causing local or systemic complications." The guidelines further note that "replacement of temporary catheters over a guidewire in the presence of bacteremia is not an acceptable replacement strategy, because the source of infection is usually colonization of the skin tract from the insertion site to the vein."

O'Grady NP, Alexander M, Dellinger EP, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. *MMWR Recomm Rep.* Aug 9 2002;51(RR-10):10.

≫ What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on daily review of necessity. These measures, taken together, support the implementation of the central line bundle. Some of these changes include:

- Include daily review of line necessity as part of your multidisciplinary rounds.
- State the line day during rounds to remind all as to how long the line has been in, e.g., “Today is line day 6.”
- Include assessment for removal of central lines as part of your daily goal sheets.
- Record time and date of line placement for record keeping purposes and evaluation by staff to aid in decision making.

Forming the Team

IHI recommends a multidisciplinary team approach to patient care in the ICU. Improvement teams should be heterogeneous in make-up, but homogeneous in mindset. The value of bringing diverse personnel together is that all members of the care team are given a stake in the outcome and work to achieve the same goal.

All the stakeholders in the process must be included, in order to gain the buy-in and cooperation of all parties. For example, teams without nurses are bound to fail. Teams led by nurses and therapists may be successful, but often lack leverage; physicians must also be part of the team.

Some suggestions to attract and retain excellent team members include using data to define and solve the problem; finding champions within the hospital who are of sufficiently high profile and visibility to lend the effort immediate credibility; and working with those who want to work on the project rather than trying to convince those that do not.

The team needs encouragement and commitment from an authority in the intensive care unit. Identifying a champion increases a team's motivation to succeed. When measures are not improving fast enough, the champion re-addresses the problems with staff and helps to keep everybody on track toward the aims and goals.

Eventually, the changes that are introduced become established. At some point, however, changes in the field or other changes in the ICU will require revisiting the processes that have been developed. Identifying a "process owner," a figure who is responsible for the functioning of the process now and in the future, helps to maintain the long-term integrity of the effort.

Setting Aims

Improvement requires setting aims. An organization will not improve without a clear and firm intention to do so. The aim should be time-specific and measurable; it should also define the specific population of patients that will be affected. Agreeing on the aim is crucial; so is allocating the people and resources necessary to accomplish the aim.

An example of an aim that would be appropriate for reducing CR-BSIs can be as simple as, “Decrease the rate of CR-BSIs by 50% within one year by achieving greater than 95% compliance with the central line bundle.”

Teams are more successful when they have unambiguous, focused aims. Setting numerical goals clarifies the aim, helps to create tension for change, directs measurement, and focuses initial changes. Once the aim has been set, the team needs to be careful not to back away from it deliberately or "drift" away from it unconsciously.

Using the Model for Improvement

In order to move this work forward, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.

- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

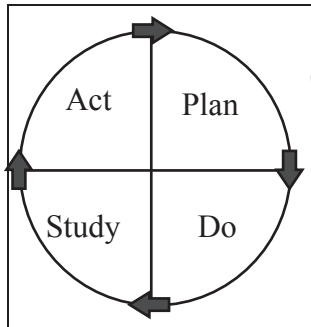
Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, test medication reconciliation on admissions first.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement on www.IHI.org

PDSA WORKSHEET

CYCLE: 1 **DATE: 6/10/05**



Project: Central Line Infections

Objective for this PDSA Cycle: Test the use of a central line bundle checklist to increase compliance with central line bundle elements.

PLAN:

Questions: How can we ensure total compliance with the central line bundle?

Predictions: Using a central line bundle checklist will help ensure total compliance with all elements of the central line infection bundle appropriate for patient.

Plan for change or test – who, what, when, where:
What: Use a central line bundle checklist.
Who: Bonnie (nurse), Stan (physician)
Where: Patient chart
When: Tomorrow

Plan for collection of data – who, what, when, where:

Who: Bonnie (nurse)
What: Compliance with all central line bundle elements.
When: At line insertion
Where: Patient chart

DO:

Carry out the change or test. Collect data and begin analysis.

STUDY:

Complete analysis of data:

How did or didn't the results of this cycle agree with the predictions that we made earlier?

Summarize the new knowledge we gained by this cycle:

ACT:

List actions we will take as a result of this cycle:

Plan for the next cycle (adapt change, another test, implementation cycle?):

Getting Started

Hospitals will not successfully implement the central line bundle overnight. If you do, chances are that you are doing something sub-optimally. A successful program involves careful planning, testing to determine if the process is successful, making modifications as needed, re-testing, and careful implementation.

- Select the team and the venue. It is often best to start in one ICU. Many hospitals will have only one ICU, making the choice easier.
- Assess where you stand presently. What precautions are taken presently when placing lines? Is there a process in place? If so, work with staff to begin preparing for changes.
- Contact the infectious diseases/infection control department. Learn about your catheter-related bloodstream infection rate and how frequently the hospital reports it to regulatory agencies.
- Ensure that all of the needed equipment and supplies for compliance with the bundle are available at the point of care before testing.
- Organize an educational program. Teaching the core principles to the ICU staff will open many people's minds to the process of change.
- Introduce the central line bundle to the staff.

First Test of Change

Once a team has prepared the way for change by studying the current process and educated the affected parties, of the next step is to begin testing the central line bundle at your institution.

- Begin using the bundle with one patient from the time of catheter placement.
- Work with each nurse who cares for the patient to be sure they are able to follow the bundle and implement the checklist and daily goals sheet.
- Make sure that the approach can be carried over from shift to shift to eliminate gaps in teaching and utilization.
- Process feedback and incorporate suggestions for improvement.
- Once the bundle has been applied to one patient and subsequent shifts, increase utilization to the remainder of the ICU.
- Engage in additional PDSA cycles to refine the process and make it more reliable.
- After achieving reduction in CR-BSI in the pilot ICU, spread the changes to other ICUs, and eventually to other places in the hospital where central lines are inserted.

Measurement

See Appendix C for specific information regarding the recommended process and outcomes measures for preventing central line infections.

Measurement is the only way to know whether a change represents an improvement. There are two measures of interest for central line catheter-related bloodstream infections.

1. Central line catheter-related bloodstream infection rate per 1000 central line-days

The first measure is a rate. In this case, for a particular time period, we are interested in the total number of cases of CR-BSIs. For example, if in February there were 12 cases of CR-BSIs, the number of cases would be 12 for that month. We want to be able to understand that number as a proportion of the total number of days that patients had central lines. Thus, if 25 patients had central lines during the month and each, for purposes of example, kept their line for 3 days, the number of catheter days would be 25 x 3 = 75 for February. The CR-BSI Rate per 1000 catheter days then would be (12/75) x 1000 = 160.

$$\frac{\text{Total no. of CR-BSI cases}}{\text{No. of catheter days}} \times 1000 = \textit{CR-BSI rate per 1000 catheter days}$$

2. Central Line Bundle Compliance

The second measure is an assessment of how well the team is adhering to the central line bundle. Our experience has been that teams begin to demonstrate improvement in outcomes when they provide all five components of the central line bundle. Therefore, we choose to measure the compliance with the entire central line bundle, not just parts of the bundle.

On a given day, select all the patients with central lines and assess them for compliance with the central line bundle; or, if you are using data collection cards, review all cards (or a random sample, if there are many). If even one element is missing, the case is not in compliance with the bundle. For example, if there are 7 patients with central lines, and 6 have all 5 bundle elements completed than 6/7 (86%) is the compliance with the central line bundle. If all 7 had all 5 elements completed, compliance would be 100%. If all seven were missing even a single item, compliance would be 0%. This measure is always expressed as a percentage.

$$\frac{\text{No. with ALL 5 elements of central line bundle}}{\text{No. with CVCs on the day of the sample}} = \textit{reliability of bundle compliance}$$

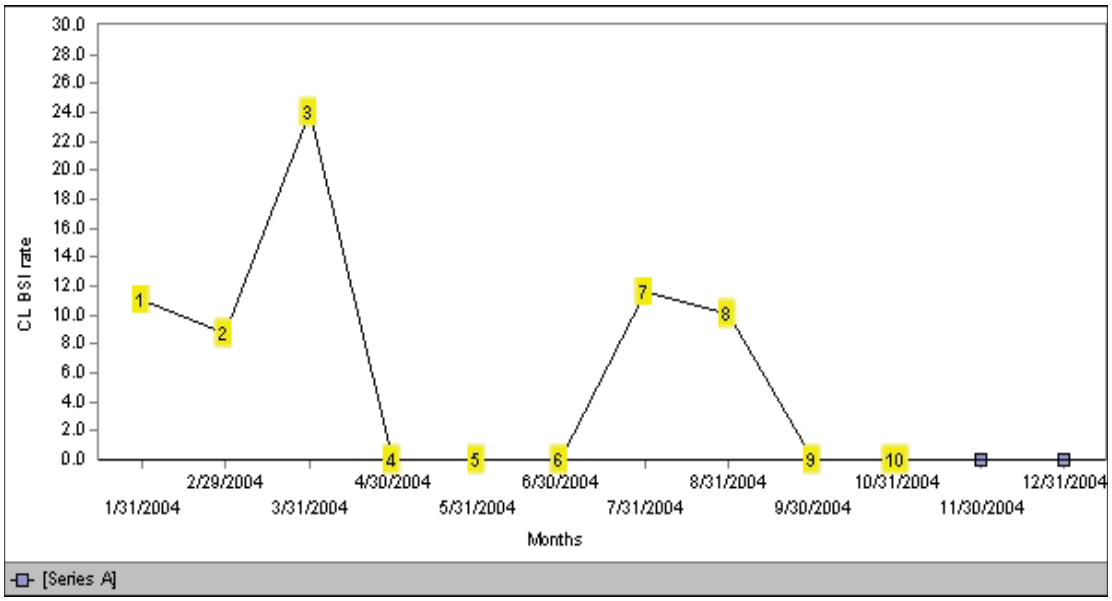
If you are starting your bundle work in one intensive care unit, which is recommended, then initially collect data on this measure for that ICU only. Remember that this is data for improvement, not hospital-wide infection surveillance, so it is acceptable to collect data for one unit or even a random sample within that unit to start.

Track Measures over Time

Improvement takes place over time. Determining if improvement has really occurred and if it is a lasting effect requires observing patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement. Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- They give direction as you work on improvement and information about the value of particular changes.

Example: Our Lady of Lourdes Hospital (Binghamton, NY)



The reductions here are clearly visible over time. During the course of one year, the rate of CR-BSIs decreased three-fold.

Barriers That May Be Encountered

- **Fear of change**

All change is difficult. The antidote to fear is knowledge about the deficiencies of the present process and optimism about the potential benefits of a new process.

- **Communication breakdown**

Organizations have not been successful when they failed to communicate with staff about the importance of central line care, as well as when they failed to provide ongoing teaching as new staff become involved in the process.

- **Physician and staff "partial buy-in" (i.e., "Is this just another flavor of the week?")**

In order to enlist support and engage staff, it is important to share baseline data on CR-BSI rates and to share the results of improvement efforts. If the run charts suggest a large decrease in CR-BSIs compared to baseline, issues surrounding "buy-in" tend to fade.

Work To Achieve a High Level of Compliance

The experience of the hospitals that have used the central line bundle thus far has been that the greater the level of compliance with *all* of the items in the bundle, the better the reduction in the CR-BSI rate.

Of course, compliance is only as good as the element that is least adhered to in the bundle. The Johns Hopkins Hospital's experience with compliance with some elements of central line care analogous to the central line bundle is depicted below:

Intervention:	**Compliance**:
Hand hygiene	62%
Chlorhexidine antiseptic at the procedure site	100%
Draped the entire patient in a sterile fashion	85%
Used a hat, mask, and sterile gown	92%
Used sterile gloves	100%
Sterile dressing applied	100%

Berenholtz SM, Pronovost PJ, Lipsett PA, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. *Crit Care Med.* Oct 2004;32(10):2014-2020.

Note that, for Johns Hopkins Hospital, bundle compliance cannot be higher than 62%, given the score obtained for hand-washing. Aiming for a high level of compliance will improve outcomes and prevent infections.

Tips for Gathering Data

Implementing a central line checklist at the time of insertion will help to ensure a reliable process. Nurses should be empowered to supervise the preparations using the checklist prior to line insertion and to stop the process if necessary. (See Appendix A.)

Use a form that allows you to record your efforts and track your success. In addition to helping improvement teams create run charts each month, a contemporaneous record documenting line placement and site care can help with prompting early removal. The decision as to whether the form becomes a permanent part of the medical record, or is simply used as a data collection tool, must be made locally at each hospital.

These strategies are particularly effective if used in conjunction with a Daily Goals assessment sheet. (See Appendix B.) This form can be completed during daily rounds on the patient. Many organizations implement the central line bundle in tandem with the ventilator bundle to improve systematic care to patients in ICUs. (For information on the ventilator bundle, see the Getting Started Kit for “Prevent Ventilator-Associated Pneumonia.”)

Tips and Tricks: Central Line Infection

More than 3,000 hospitals across the US have been working hard to implement the Campaign interventions. Here are some of the "tips and tricks" for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups on IHI.org.

- ***Customize the program***.

Making this initiative fit into the patterns and habits at your institution is essential. Teams will be most effective if they engage doctors, nurses, and other staff to work with them to develop key aspects of implementation. For example, it is critical that teams make the review of daily necessity a part of the daily goal sheets. In order to know if a line is truly necessary, the best-performing teams will develop their own standard criteria and work to apply this routinely to all cases in their institution. Once this has been established, all stakeholders will share a common understanding of exactly when a line is truly necessary or simply a convenience. Similar arrangements and customizations can be made for other aspects of the bundle, such as criteria for optimal site selection.

- ***Measure, but do not become pre-occupied with measurement***.

Working on preventing central line infections (or any clinical performance program) requires measurement, but measurement should not become the pre-occupation of the teams engaging in the work. While feedback on performance and compliance may drive further efforts forward, if teams become too focused on measurement details it can hinder the overall program. It is best to design rules that assist your team in making your plans work; for example, assign credit for completion of bundle elements in cases where your team has determined there are true contraindications to bundle elements. Undue attention to unusual cases or special circumstances will impede success. Plan for the majority.

- ***Decide early about the method of data collection you will use***.

Some teams have preferred to use a sampling approach to assess compliance with the central line bundle; for example, some teams use spot checks of compliance three times per week, whereas other teams have chosen daily assessments of compliance at designated times. Regardless of the method, be sure to maintain the standard over time for accurate results.

- ***Emphasize compliance with all elements of the bundle***.

Approach this work with the knowledge that “picking and choosing” bundle elements will

not work. Discourage the tendency to select interventions that seem easy at the expense of more difficult options also included in the bundle. Your aim is 100% compliance with every bundle element for every patient – partial compliance is the equivalent of non-compliance.

- ***Post updates to results regularly and prominently***.

Enthusiasm for the project will wane over time if clinical staff perceive that the leadership's enthusiasm has diminished. It is essential to update all involved staff on the work on the monthly level of compliance and the monthly change in central line infection rates. Not only will this show dedication to the project, but when momentum becomes apparent, clinical staff will be aware of the progress.

- ***Apply the bundle elements in a way that makes sense.***

The goal of the bundle is not to force a clinician to do anything that may be clinically inappropriate or cause harm in a unique situation. The elements apply to most patients, but there will always be exceptions. Deal with these in a way that makes sense. For example, if a patient is claustrophobic and panics about being under drapes, then modify the placement of drapes so that the patient is at ease and the site is protected; it's not beneficial to the patient to induce a panic attack. When exceptional situations arise, the key is for the team to discuss the elements, devise a sensible plan, and document it accordingly. Give credit for meeting the bundle element in such cases.

Frequently Asked Questions: Central Line Infection

Can I implement most of the central line bundle but exclude some items?

While this is possible, it is not recommended. In fact, the goal of bundling therapies together aims to create a linkage between practices that makes the overall process more effective. Certainly, in terms of monitoring compliance with the ventilator bundle, "picking and choosing" items would be unwise.

The definition of a primary central line infection is confusing. What is the standard definition?

The definition used in the rate measure is well described in the Measure Information Forms (MIFs) at the end of this document. The key to the numerator is to track *primary catheter-associated bloodstream infections*. Bloodstream infections are considered to be associated with a central catheter if the line was in use during the 48-hour period before development of the bloodstream infection. These catheter-associated bloodstream infections must be *either* laboratory confirmed *or* the patient must meet criteria for clinical sepsis. Specific definitions of laboratory confirmed infections are noted in the MIFs. Clinical sepsis can be defined as a site of suspected infection and two or more generalized signs and symptoms of infection (formerly known as SIRS criteria). Clinical sepsis can be distinguished from the syndrome "severe sepsis," which adds organ dysfunction, such as hypotension or onset of renal failure. In general, the threshold to establish clinical sepsis is lower than that for severe sepsis.

For more specific definitions of clinical sepsis, see: Levy MM, Fink MP, Marshall JC, Abraham E, Angus D, Cook D, Cohen J, Opal SM, Vincent JL, Ramsay G;. SCCM/ESICM/ACCP/ATS/SIS. 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. *Crit Care Med*. 2003 Apr;31(4):1250-1256.

What is a central line?

Typically, most experts and improvement teams have relied upon the definitions provided by the National Nosocomial Infections Surveillance System (NNIS) devised by the Centers for Disease Control (CDC). This program has been replaced recently by a new initiative, the National Healthcare Safety Network (NHSN). NHSN has defined a central line as a catheter whose tip terminates in a great vessel. The great vessels include the aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, and common femoral veins. Neither the type of line alone nor the site of insertion can determine if a line is a central line. If the line terminates in a great vessel, it is a central line.

Are femoral lines central lines? Are they included in the bundle?

Yes. Femoral lines qualify as central lines because they terminate in a great vessel as defined by NHSN. Their placement should be guided by the parameters of the central line bundle. See above.

Are PICC lines central lines? Are they included in the bundle?

Peripherally inserted central catheters (PICC) lines terminate in a great vessel. Because neither the site of insertion nor the type of line alone can determine whether a catheter is a central line, the peripheral site of insertion does not exempt the line from the central line bundle.

Why are subclavian lines preferred over PICC lines if the standard is lowest infection risk?

Data is still lacking on infection rates for PICC lines in acute care settings as opposed to chronic or home care settings. The most recent evidence suggests that infection rates rival those of subclavian or internal jugular catheters placed in the acute care setting. No head-to-head comparison has yet been done to make a definitive conclusion. In addition, PICCs are more vulnerable to thrombosis and dislodgment, and are less useful for drawing blood specimens. Moreover, PICCs are not advisable in patients with renal failure and impending need for dialysis, in whom preservation of upper-extremity veins is needed for fistula or graft implantation given a possibly greater risk of subclavian vein stenosis.

Safdar N, Maki DG. Risk of catheter-related bloodstream infection with peripherally inserted central venous catheters used in hospitalized patients. *Chest*. 2005 Aug;128(2):489-495.

Gonsalves CF, Eschelman DJ, Sullivan KL, DuBois N, Bonn J. Incidence of central vein stenosis and occlusion following upper extremity PICC and port placement. *Cardiovasc Intervent Radiol*. 2003 Mar-Apr;26(2):123-127. Epub 2003 Mar 6.

Does everyone in the room need to gown and glove when a central line is placed, or just the nurse assisting the procedure directly and dropping items onto the sterile field?

The best advice is that the placement of a central line should be considered analogous to a surgical procedure. In the operating room, anyone who comes into contact with the sterile field wears maximal barrier precautions. This includes any assistants in direct contact with the field and most certainly the scrub nurse directly assisting in the procedure. To that end, any assistant in direct contact with or dropping items onto the field should be similarly gowned, gloved, etc., as in a surgical situation.

Why is a full-size drape essential for maximal barrier precautions?

Studies that demonstrate the effectiveness of maximal barrier precautions have employed a full-size drape. These studies show dramatic reductions in risk when maximal barrier precautions are used. It is not possible to clearly parse out the effect of a full-size drape from these trials versus the other components of maximal barrier precautions such as gowns, gloves, eyewear, etc. In the absence of such information and given striking results of interventions that include a full-size drape, not using the larger drape could only add an unnecessary element of risk to an otherwise simple procedure. Using the analogy to surgery as cited immediately above, it would be unimaginable for a patient to undergo any surgical procedure in the operating room without a full-size drape in place.

I read that the central line bundle as written is designed to apply only to patients in the ICU. I want to include patients in the emergency room and the PACU. Why do you advise to use the bundle only in the ICU?

The reason for recommending application of the central line bundle only in the ICU has more to do with improvement methods and less to do with the utility of the intervention. It was originally tested with ICU teams working to improve teamwork and communication for improved outcomes. IHI hoped that by starting in the ICU hospitals would become expert in application of the bundle in one location, develop the skill and manpower to translate the practice to other areas of the hospital, and ultimately do so. In general, IHI recommends starting small and spreading changes to larger domains over time. There is no reason not to apply the central line bundle in all areas that central lines are placed and where you can gain the cooperation of staff. However, it may be wiser to perfect the practice in one location than to launch an overly broad initiative that might fail before it begins. Be sure to check for

guidelines from clinical expert panels related to other locations before spreading; for example, the American Society of Anesthesiologists has published guidelines for insertion in the operating room that are very similar to this bundle.

How can you compare central line infection rates between institutions?

The practice of comparing rates of disease entities or patterns of therapy across institutions is commonly known as "benchmarking." Benchmarking, while presently utilized by many oversight agencies to track performance, may not be a valid method to compare performance between facilities because of differences in patient population, resource availability, or severity of illness.

Fortunately, none of the work required to *improve* the care of patients receiving central lines requires a comparison of rates between institutions. You are not required to report rates to IHI, for instance. In addition, as long as you establish methods in your institution to determine the patterns and methods of your regular data collection, your results will be consistent over time with respect to your own performance and your own improvement, which is our primary interest. Presumably, any improvements you make would be reflected in any benchmarking work that you do for other agencies.

Remember to benchmark based on improvement, rather than just by comparing rates. If you learn of a hospital that has significantly improved, based on data and using the same measure over time, then learn from their work! Even if they are using a different definition from your hospital or treat some different populations, there will still be value in finding out what practices and changes they used to achieve their results.

What are the inclusion and exclusion criteria for application of the central line bundle? For the individual bundle elements?

No specific exclusion criteria exist, but good clinical judgment should be exercised in conjunction with a close reading of the evidence cited in the How-to Guide. Likewise, no specific inclusion criteria are available. Instead, teams interested in improving their performance should develop these standards in conjunction with their clinical staff and apply them uniformly over time. In so doing, teams will have an accurate standard whereby they can measure their own progress in comparison to the only standard that is truly meaningful: their own data.

As an example, some institutions have decided that the central line bundle cannot be applied in emergent settings such as the ER. Accordingly, they have created policies and procedures to re-site those lines if a patient is subsequently admitted to a critical care unit. Policies such as this are best left to the discretion of the individual institutions.

Workable inclusion criteria, exclusion criteria, measurement systems, and protocols all require customization at the local level to be effective. The only key factor in all of these decisions is that the standards, once decided, are adhered to over time.

Have a question for our Central Line Infection faculty expert? Post it to the Central Line Infection web discussion.

Looking for advice from other organizations like yours? Ask a Campaign Mentor Hospital! The organizations on the Campaign Mentor Hospitals list have volunteered to provide support, advice, clinical expertise, and tips to hospitals seeking help with their implementation efforts.

What You Need to Know about Central Line Infections (CLI):
A Fact Sheet for Patients and Their Family Members

Patients who need frequent intravenous (IV) medications, blood, fluid replacement and/or nutrition may have a central venous catheter (or "line") placed into one of their veins. This line can stay in place for days and even weeks.

Catheter-related bloodstream infections (CR-BSI):

Lines are often very helpful. But sometimes they cause infections when bacteria grow in the line and spreads to the patient's bloodstream. This is called a "catheter-related bloodstream infection" (CR-BSI). It is very serious and 20 percent (or 1 out of 5) of patients who get CR-BSI die from it.

A bundle of 5 care steps to prevent CR-BSI:

Doctors and nurses can help prevent CR-BSI by using a bundle of 5 "care steps." Hospitals find that when all 5 of these steps are done that there are almost no cases of CR-BSI. The bundle of care steps are:

- Using proper hand hygiene. Everyone who touches the central line must wash their hands with soap and water or an alcohol cleanser, even if gloves are worn.
- Wearing maximal barrier precautions. The person who inserts the line should be in sterile clothing – wearing a mask, gloves, and hair covering. The patient should be fully covered with a sterile drape, except for a very small hole where the line goes in.
- Cleaning the patient's skin with "chlorhexidine" (a type of soap) when the line is put in.
- Finding the best vein to insert the line. Often, this is the subclavian vein (in the chest) which is not as likely to get an infection as veins in the arm or leg.
- Checking the line for infection each day. The line should be taken out only when needed and not on a schedule.

How patients and family members can help:

- Watch the hospital staff to make sure they wash their hands before and after working with the patient. Do not be afraid to remind them to wash their hands!
- Ask the doctors and nurses lots of questions before you agree to a line. Questions can include: Which vein will you use to put in the line? How will you clean the skin when the line goes in? What steps are you taking to lower the risk of infection?
- Make sure the doctors and nurses check the line every day for signs of infection. They should only replace the line when needed and not on a schedule.

Learn more about central line infections as they relate to the 5 Million Lives Campaign at www.ihi.org.

5 Million Lives Campaign

The 5 Million Lives Campaign is a national initiative to dramatically improve the quality of American health care. The Institute for Healthcare Improvement (IHI) and its partners seek to engage thousands of U.S. hospitals in an effort to reduce harm for five million American patients between December 2006 and December 2008. This ambitious work builds upon the great energy and commitment shown by hospitals during the 100,000 Lives Campaign, a national, IHI-led initiative focused on reducing unnecessary mortality and that ran from December 2004 to June 2006. Complete details, including materials, contact information for experts, and web discussions, are on the web at http://www.ihi.org/IHI/Programs/Campaign/.

Appendix A: Central Line Insertion Checklist (Virginia Mason Medical Center)

Central Line Insertion Standard Work and Safety Checklist
Date: ____/____/____ **Start time**: _____
Location:_____
Catheter Type: ☐ Dialysis ☐ Central Venous ☐ PICC ☐ Pulmonary Artery
Number of Lumens: ☐ 1 ☐ 2 ☐ 3 ☐ 4
Insertion Site: **Jugular:** ☐ R ☐ L **Upper Arm:** ☐ R ☐ L
Subclavian: ☐ R ☐ L **Femoral:** ☐ R ☐ L
Reason for Insertion: ☐ New Indication ☐ Elective ☐ Emergent ☐ Replace Malfunctioning Catheter
Procedure Provider:_____**ProcedureAssistant:**_____
☐ Attending MD ☐ Housestaff ☐ IV Therapist ☐ IV Therapist ☐ RN

Standard Work Before, During, and After Procedure		**YES Or True**	***YES*** *(After Reminder)*	NA
PROCEDURE PREP	➢ ***Patient has NO allergy to Heparin***	☐		
	➢ ***Patient's latex allergy assessed & procedure plan modified PRN***	☐		
	➢ ***Consent form completed & in chart*** *(exception Code 4)*	☐		
	➢ ***Perform Procedural Pause*** *Perform patient ID X 2*	☐	☐	
	Announce the procedure to be performed	☐	☐	
	Mark / assess site	☐	☐	
	Position patient correctly for procedure	☐	☐	
	Assemble equipment/verify supplies (including ultrasound, unless insertion is subclavian)	☐	☐	
	Verify all medication & syringes are labeled	☐	☐	
	➢ ***Confirm that all persons in room cleanse hands?*** (ASK, if unsure)	☐	☐	
	➢ ***Central line cart utilized?***	☐	☐	
	➢ ***Prep Procedure site*** *Chloraprep 10.5 ml applicator used*	☐	☐	
	Dry: 30 second scrub + 30 second dry time ***OR***	☐	☐	☐
	Wet: 2 minute scrub + 1 minute dry time	☐	☐	☐
	➢ ***Used large drape to cover patient?***	☐	☐	
	➢ ***Transducer set-up for all jugular and subclavian line insertions***	☐	☐	☐
DURING	➢ **Wear sterile gloves, hat, mask with eyeshield, and sterile gown? (all must be worn)**			
	Procedure provider	☐	☐	
	Procedure assistant	☐	☐	
	➢ ***Did patient and all other persons in the room wear a mask?***	☐	☐	
	➢ ***Maintain sterile field?***	☐	☐	
	➢ ***Was ultrasound guidance used for all jugular & femoral insertions?***	☐	☐	☐ subclavian
	➢ ***Venous placement confirmation via:***			
	pressure transducer w/ monitor ***OR***	☐	☐	☐
	manometry	☐	☐	☐
	➢ ***Type of solution used to flush/dosage:*** _____			
	➢ ***Catheter caps placed on lumens?***	☐	☐	
	➢ ***Catheter sutured in place?***	☐	☐	
	➢ ***Position confirmation*** *Fluoroscopy* ***OR***	☐	☐	☐
	Chest X-ray ordered	☐	☐	☐ femoral

A F T E R	➢ ***Was sterile technique maintained when applying dressing?***	☐	☐	
	➢ ***Was dressing dated?***	☐	☐	
	➢ ***Catheter position confirmed by:***			
	Already confirmed during procedure via fluoroscopy (see above), **OR**	☐	☐	☐
	Chest X-ray findings	☐	☐	☐ femoral

RN Procedure Note:

MD Procedure Note:

PATIENT Label

VIRGINIA MASON MEDICAL CENTER
Central Line Insertion Standard Work and Safety Checklist

Feedback on Pilot Form

1. How easy was this form to use?

2. Are there any important elements that should be added (please specify)?

3. Are there elements of the form that you think should be excluded (please specify)?

4. Other suggestions for improvements:

5. Other comments

Name:_____

Appendix B

Daily Goals

Patient Name _____ Room Number_____ Date_____/_____/_____

---Initial as goals are reviewed ----

GOAL	NOTES	0700-1500	1500-2300	2300-0700
What needs to be done for the patient to be discharged from the ICU?				
What is this patient's greatest safety risk?				
Pulmonary/Ventilator: HOB 30 degrees or greater				
Sedation Vacation and Assessment of Readiness to Extubate				
PUD Prophylaxis				
DVT Prophylaxis				
Cardiac Rhythm, Hemodynamics				
Volume Status, net goal for 12 MN				
Neuro/Pain Mgt/Sedation				
GI/ Nutrition/Bowel Regimen				
Mobilization/OOB				
ID, Cultures, Drug levels				
Medication changes (Can any be discontinued?)				
Tests/Procedures Today				
Review scheduled labs. Can any be discontinued?				
Morning labs and PCXR				
Consultations				
Can central lines or other catheters/tubes be DC'd?				
Attending up to date?				
Family Updated?				
Any social issues to address?				
Emotional/spiritual issues addressed?				
Skin Care Addressed?				
Code Status Addressed?				
Advanced Directive in place?				
Parameters for calling MD				

Appendix C: Recommended Intervention-Level Measures

The following measures are relevant for this intervention. The Campaign recommends that you use some or all of them, as appropriate, to track the progress of your work in this area. In selecting your measures, we offer the following advice:

1. Whenever possible, use measures you are already collecting for other programs.
2. Evaluate your choice of measures in terms of the usefulness of the results they provide and the resources required to obtain those results; try to maximize the former while minimizing the latter.
3. Try to include both process and outcome measures in your measurement scheme.
4. You may use measures not listed here, and, similarly, you may modify the measures described below to make them more appropriate and/or useful to your particular setting; however, be aware that modifying measures may limit the comparability of your results to others'. (Note that hospitals using different or modified measures should not submit those measure data to IHI.)
5. Remember that posting your measure results within your hospital is a great way to keep your teams aware of progress and motivated. Try to include measures that your team will find meaningful, and that they would be excited to see.

Process Measure(s):

Central Line Bundle Compliance
Owner: **IHI** Owner Measure ID: **N/A** Measure Information: **[Campaign MIF]** Comments: • Note that this measure is the same as that used in the 100,000 Lives Campaign, although, in preparation of the launch of the 5 Million Lives Campaign, some edits have been made to clarify the instructions.

Outcome Measure(s):

Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days
Owner: **IHI** Owner Measure ID: **N/A** Measure Information: **[Campaign MIF]** Comments: • Note that this measure is the same as that used in the 100,000 Lives Campaign, although, in preparation of the launch of the 5 Million Lives Campaign, some edits have been made to clarify the instructions.

Alignment with Other Measure Sets:

Measure Name	**JCAHO**	**CDC**
Central Line Bundle Compliance		
Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days	√[1]	√[2]

[1] Matches a measure in the JCAHO National Hospital Quality Measures ICU Measure Set: ICU-4. JCAHO has stopped data collection on these measures but still endorses them; more info can be found here.

[2] The number of central line catheter-related bloodstream infections per 1000 ventilator days is the standard measure for surveillance by the CDC, and the definitions used in our measure match those in the CDC's NHSN Central Line-Associated Bloodstream Infection (CLABSI) Event definition, which can be found here.

NHSN Patient Safety Component
Estimated Average Annual Paperwork Burden*

Item	Description	Responses per hospital	Minutes per response	Total burden (hours)
A	Monthly reporting plan	1	35	0.6
OO	NHSN registration form	1	5	0.1
R	Facility contact information	1	10	0.2
S	Patient Safety Component annual survey	1	30	0.5
T	Agreement to participate and consent	1	15	0.3
U	Group contact information	1	5	0.1
	Total estimated reporting burden			1.7
	Estimated FTE burden			0.00

* - Federal Register, Nov. 21, 2007 (vol. 72, no. 224, p. 65578-65580)

Overview

Teresa C. Horan, MPH
Division of Healthcare Quality Promotion

SAFER • HEALTHIER • PEOPLE™

Target Audience

- This training is designed for those who will collect and analyze Patient Safety Component data or enroll a hospital into NHSN

  This includes:
  - NHSN Facility Administrator
  - Patient Safety Primary Contact
  - Infection Control Professional (ICP)
  - Epidemiologist
  - Microbiologist
  - Pharmacist
  - Data entry staff

Target Audience

- Outpatient dialysis center users should attend the dialysis training session on Dec 5, 2006

Objectives

1. Describe NHSN and its purposes
2. Define the authority and confidentiality protections for NHSN
3. Identify the requirements for participating in the Patient Safety Component
4. Describe the NHSN surveillance methodology
5. List the modules of the Patient Safety Component
6. Explain key terms used in the Patient Safety Component
7. Describe the Monthly Reporting Plan

National Healthcare Safety Network (NHSN)

- NHSN is an internet-based surveillance system that integrates the surveillance systems previously managed separately in the Division of Healthcare Quality Promotion (DHQP) at CDC
  - National Nosocomial Infections Surveillance (NNIS) system
  - Dialysis Surveillance Network (DSN)
  - National Surveillance System for Healthcare Workers (NaSH)

Purposes of NHSN

- Collect data from a sample of US healthcare facilities to permit valid estimation of the
  - magnitude of adverse events among patients and healthcare personnel
  - adherence to practices known to associated with prevention of healthcare-associated infections (HAI)
- Analyze and report collected data to permit recognition of trends

Purposes of NHSN

- Provide facilities with risk-adjusted data that can be used for inter-facility comparisons and local quality improvement activities
- Assist facilities in developing surveillance and analysis methods that permit timely recognition of patient and healthcare personnel safety problems and prompt intervention with appropriate measures
- Conduct collaborative research studies with members

Authority and Confidentiality for NHSN

- Public Health Service Act (42 USC 242b, 242k, and 242m(d))
- Confidentiality Protection
  - Sections 304, 306, and 308(d) of the PHS Act

"The information contained in this surveillance system that would permit identification of any individual or institution is collected with a guarantee that it will be held in strict confidence, will be used only for the purposes stated, and will not be disclosed or released without the consent of the individual, or the institution in accordance with Sections 304, 306, and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d))."

Data Collection and Reporting Requirements for Patient Safety Component

1. Submit a Monthly Reporting Plan to inform CDC which, if any, of the patient safety modules will be used for that month
2. Adhere to the selected module's protocol(s) exactly as described in the *NHSN Manual: Patient Safety Component Protocol*

Data Collection and Reporting Requirements for Patient Safety Component

continue

3. Use surveillance methodology as described in the Protocol (detailed in the next section)
4. Report events and appropriate summary or denominator data indicated on the Plan to CDC within 30 days of the end of the month

Data Collection and Reporting Requirements for Patient Safety Component

continue

5. Submit data for at least one module for a minimum of 6 months of the calendar year
6. Complete an annual survey for your facility
7. Pass quality control acceptance checks that assess the data for completeness and accuracy

Data Collection and Reporting Requirements for Patient Safety Component

continue

8. Agree to report to state health authorities adverse event outbreaks identified in the facility by the surveillance system and about which you are contacted by CDC.

Failure to comply with these requirements will result in removal from the NHSN

Staffing Requirements for Participating in the PS Component

- There are no specific FTE requirements, but a trained Infection Control Professional (ICP) or Hospital Epidemiologist should oversee the HAI surveillance program
- Other personnel can be trained to
  - Screen for events (e.g., infections)
  - Collect denominator data
  - Collect infection prevention practices (process measure) data
  - Enter data
  - Analyze data

NHSN Surveillance Methodology

- Active
- Patient-based
- Prospective
- Priority-directed
- Risk-adjusted rates
- Incidence rates

NHSN Surveillance Methodology

ACTIVE vs. PASSIVE

- **ACTIVE** Trained personnel use standard definitions and a variety of data sources to identify events

- **PASSIVE** Personnel, such as staff nurses, not trained to do surveillance report events

NHSN Surveillance Methodology

PATIE□T□□ASE□ vs. □A□□□AT□□□□□ASE□

- **PATIE□T□□ASE□** Monitoring patients for events, risk factors, and procedures and practices related to patient care
  - Visit patient care areas
  - Review patient charts
  - Discuss with caregivers
- **□A□□□AT□□□□□ASE□** Case-finding based solely on positive lab findings

NHSN Surveillance Methodology

P□□SPECTIVE vs. □ET□□SPECTIVE

- **P□□SPECTIVE** Monitoring patients while still in the institution; includes post-discharge period for SSI

- **□ET□□SPECTIVE** Case-finding based solely on chart review after patient discharged

NHSN Surveillance Methodology

P□I□ □IT□□I□ECTE□ vs. C□ □P□E□E□SIVE

- **P□I□ □IT□□I□ECTE□** Objectives for surveillance are defined and focused on specific events, processes, organisms, and/or patients/populations

- **C□ □P□E□E□SIVE** Continuous monitoring of all patients for all events and/or processes

NHSN Surveillance Methodology

□IS□ □A□ □□STE□ vs. C□□□E □ATES

- **□IS□ □A□ □□STE□** Rates are controlled for variations in the distribution of major risk factor(s) associated with an event's occurrence
  - Comparison of rates is useful
- **C□□□E** Rates assume equal distribution of risk factors for all events
  - Comparison of rates not recommended

NHSN Surveillance Methodology

I□CI□E□CE □ATES vs. P□EVA□E□CE □ATES

- **I□CI□E□CE** (I)
  New events in a population occurring during some defined time period

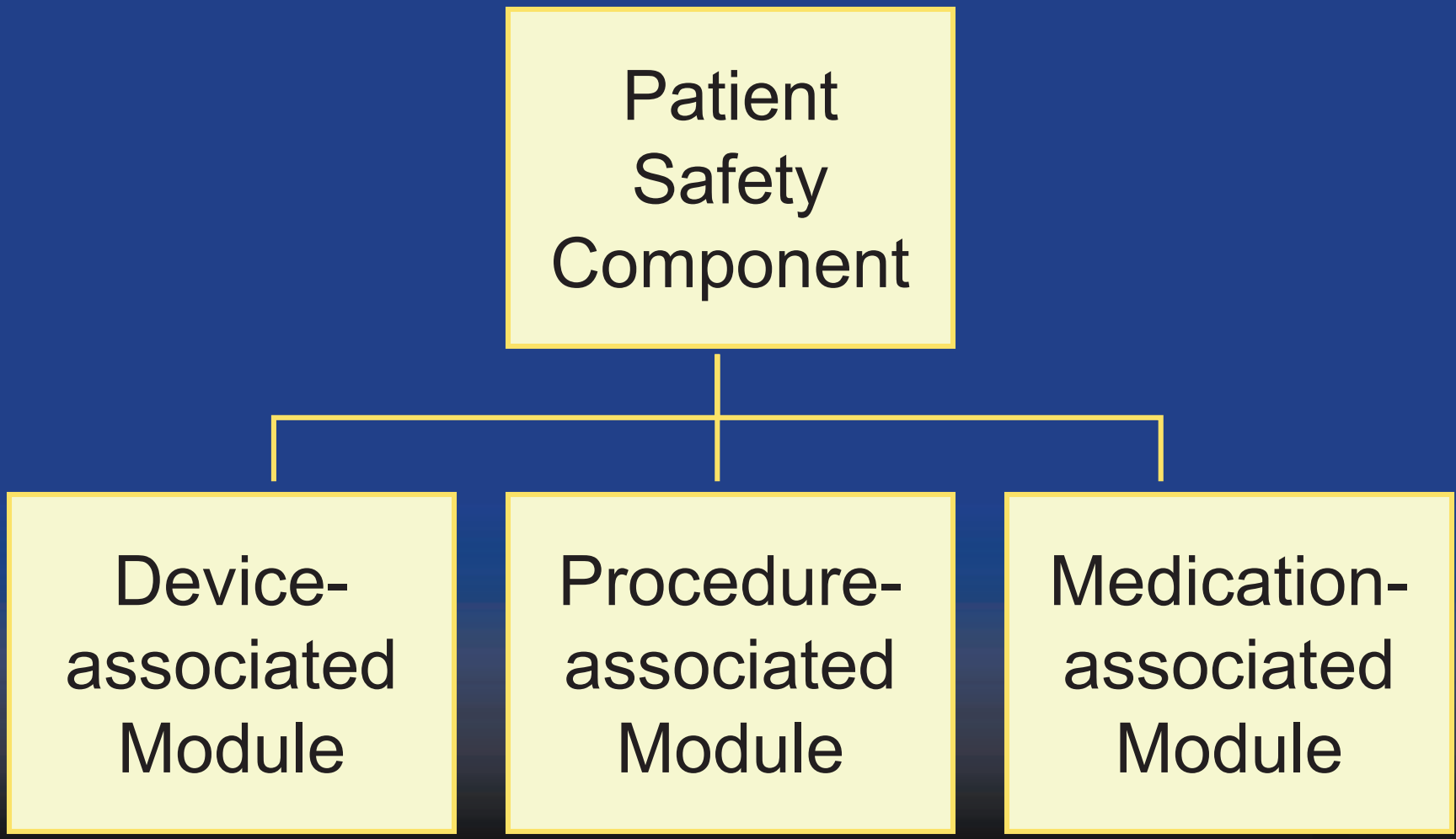
$$I = \frac{\text{new events}}{\text{population during time period}}$$

- **P□EVA□E□CE** (P)
  All events in a population occurring at either a point in time (P_{point}) or during some defined time period (P_{period}).

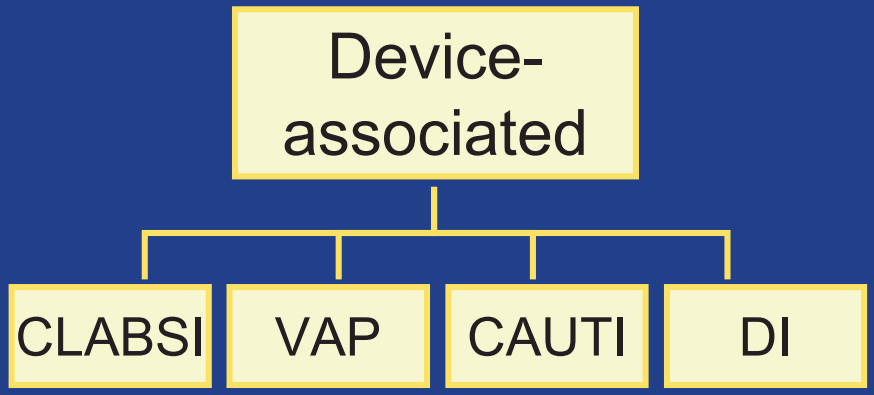
$$P_{point} = \frac{\text{new and existing events}}{\text{population at a point in time}}$$

$$P_{period} = \frac{\text{new and existing events}}{\text{population during time period}}$$

Patient Safety Component Modules



Patient Safety Component Modules



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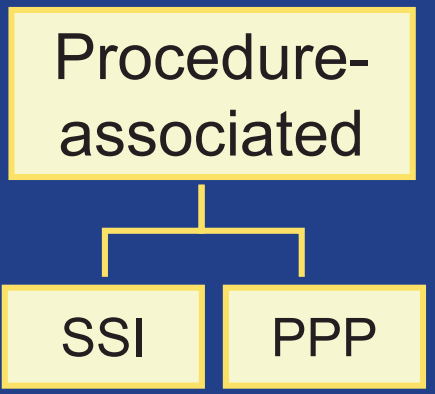
*Training on Dec 5, 2006

Patient Safety Component Modules



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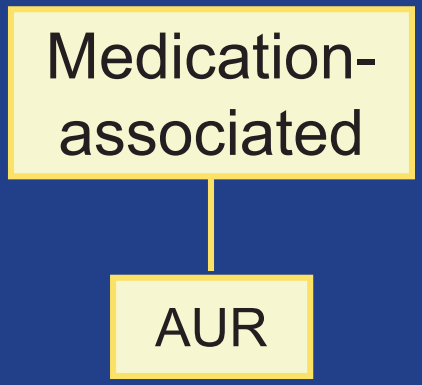
PPP P[illegible]s [illegible]

*Training on Nov 16, 2006

Patient Safety Component Modules



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*Training on Nov 16, 2006

Patient Safety Component Key Terms

- HAI
- NHSN Location
  - 80% Rule
- Attribution of HAI
  - Facility-level
  - Location-level for device-associated HAI
  - Procedure-level for procedure-associated HAI

NHSN Key Terms can be found in the *NHSN Manual: Patient Safety Component Protocol*

Healthcare-associated Infection (HAI)

- A localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that
  - Occurs in a patient in a healthcare setting and
  - Was not present or incubating at the time of admission, unless the infection was related to a previous admission
- When the setting is a hospital, meets the criteria for a specific infection (body) site as defined by CDC
- When the setting is a hospital, may also be called a nosocomial infection

NHSN Location

- In the Patient Safety Component, it is the patient care area where a patient was assigned
  - when exposed to the agent that led to the development of the event or
  - when patient care practice under surveillance was performed
- Location is used to stratify device-associated infection rates
- A location may treat patients for more than one clinical service

NHSN Location

80% Rule

- The specific NHSN Location is determined by the type of patients receiving care
- 80% of the patients must be of a consistent type to classify the location as that specific type

EXAMPLE
If 80% of patients on a ward are pediatric patients with orthopedic problems, the location is designated as an Inpatient Pediatric Orthopedic Ward

EXCEPTION
For patient care areas where the mix of medical and surgical patients is approximately equal, use the combined medical/surgical location designation

NHSN Location

- A list of standard CDC Locations can be found in the *NHSN Manual: Patient Safety Component Protocol*
- Each monitored facility location is “mapped” to one standard CDC Location
- For instructions on setting up locations in NHSN, attend the training “Facility Start Up”, on Dec 7, 2006

Attribution of HAI

- Once an HAI is identified, the next step is to determine the level of attribution
- The three levels of attribution are:
  - Facility-Level
  - Location-Level
  - Procedure-Level

Attribution of HAI: Facility-Level

- When a patient is admitted to a facility with an HAI, determine whether or not to attribute the HAI to this facility.

  EXAMPLES

  Patient is discharged from Hospital A and returns 15 hours later to Hospital A with an HAI. This is an HAI for Hospital A

  Patient is admitted to Hospital B with an infection which was determined to be attributed to Hospital A. This is an HAI for Hospital A, not Hospital B

Attribution of Procedure-associated HAI: Location-Level

- If the device-associated HAI develops in a patient within 48 hours of transfer from one patient-care area to another in the same facility, the transferring patient care area is the location of attribution

EXAMPLE

Patient with a central line is discharged from the surgical ICU to an orthopedic ward and develops a blood stream infection within 24 hours. This CLA-BSI is attributed to the surgical ICU

Attribution of Procedure-associated HAI

Procedure-associated HAIs are attributed to the procedure NOT the location

Monthly Reporting Plan

- The Monthly Reporting Plan informs CDC which modules a facility is following during a given month
- A facility must enter a Plan for every month of the year, even those in which no modules are followed
- A facility may enter data only for months in which Plans are on file

Monthly Reporting Plan Options

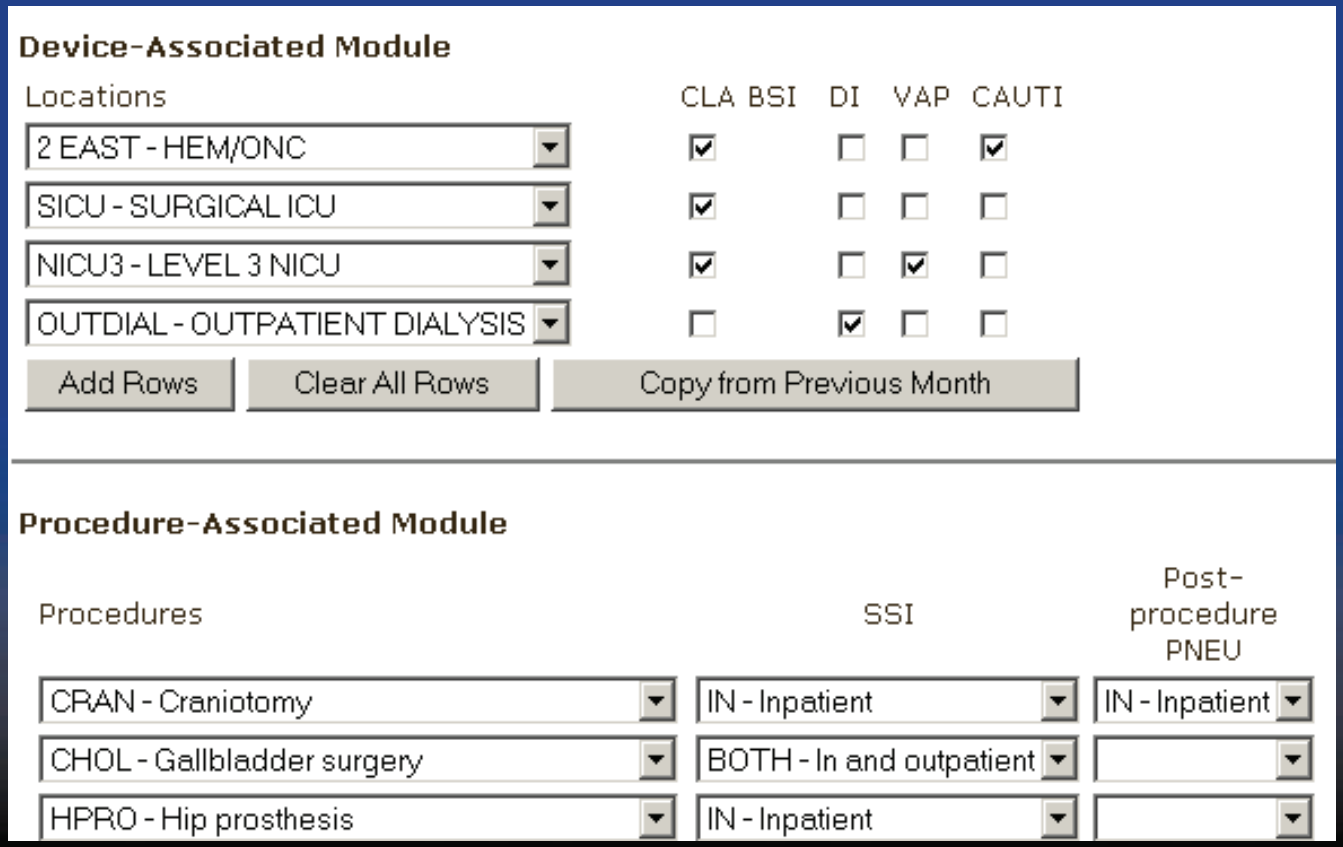
Choose either:

- Enter a Plan that conforms to one or more of the modules of the Patient Safety Component

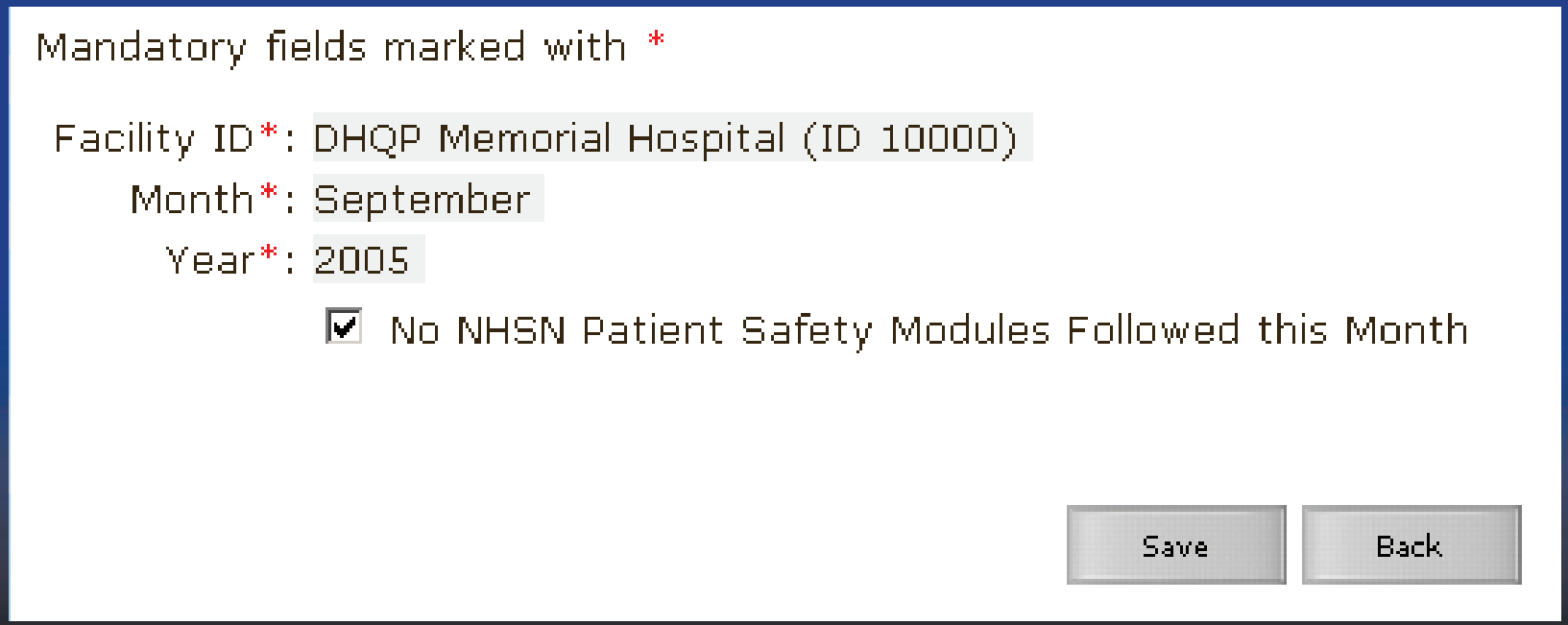
  or

- Enter a “No Patient Safety Modules Followed” option

Example Plan that conforms to modules of the Patient Safety Component



Example Plan that conforms to the "No Patient Safety Modules Followed" option



References

- For more information about these topics, refer to the NHSN website
  - *NHSN Manual: Patient Safety Component Protocol* located at
    ttp:□□ □ □ c□c□□o□nci□o□□□□p□n□□n□mem□er□□□tml
    - Tables of instruction for completing all forms
    - Key terms
    - CDC location codes
    - Operative procedure codes
  - Purposes, data collection requirements and assurance of confidentiality
  - NHSN data collection forms

http://www.cdc.gov/ncidod/dhqp/nhsn_members.html

Surgical Site Infection

Rationale and Recommendation from Staff

- Infection inclusion
  - Impact
    - CDC estimates third most common HAI from NIS (14-16%)[1]
    - 2nd most common type of adverse event in hospitals[2]
    - Increased mortality[2]
    - Increased cost[2]
    - 40-60% preventable[2]
  - Recommended for reporting
    - National organizations
      - AHRQ (for all procedures)
      - American Society of Microbiology
      - CDC
      - The Society for Healthcare Epidemiology of America
    - 63% of states require as part of reporting
      - Only PA requires all surgical procedures but was a staged implementation
      - All other
  - Collection methods
    - Readily available collection and risk adjustment methodology through National Healthcare Safety Network (CDC)
    - Over 50% of states use NHSN as collection method
    - Ability for adjustment of collection schedule
      - NHSN only requires 1 month per location of data
    - Training and support provided by NHSN staff
    - Requires minimal technology changes from the facility (i.e., internet connection)

Surgical Site Infection Conclusion

- Surgical Site Infections for select procedures should be implemented in year 1 of the reporting program for hospitals
- Expansion of procedures should be clearly defined by committee
- NHSN is the most appropriate, scientifically valid method to collect SSI data

[1] CDC, National Healthcare Safety Network Patient Safety Component Protocol, 2007

[2] Institute for Healthcare Improvement, Getting Started Kit: Prevent Central Line Infections, 2007.

- Procedures (defined by NHSN)

Procedure	Surgical patient volume (overall rank)	NIS pooled mean rate (RC 2-3)	Hospitals impacted (>0 observations)
Cesarean Section	13666 (#1)	7.53	52 (91%)
Laminectomy	9857 (#2)	2.26	26 (46%)
Knee replacement	6614(#3)	2.26	49 (86%)
Hip replacement	5645 (#6)	2.52	49 (86%)
CABG (coronary artery bypass) both chest & donor incision	2973 (#15)	5.43	11 (19%)
CABG (coronary artery bypass) only chest incision	2525 (#17)	3.72	11 (19%)
Pacemaker	2642 (#16)	n/a	28 (49%)
Cardiac surgeries	2135 (#19)	2.21	13 (23%)
Thoracic surgeries	1859 (#20)	2.47	41 (72%)

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- Collection of Cesarean Section (highest volume, most inclusive of hospitals, high rate) for year 1
- Collection of CABG (high rate, cost impact, mortality increase)
- Collection of process measures for SSI prevention
    - IHI
    - SCIP

[illegible]

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A national initiative led by IHI, the 5 Million Lives Campaign aims to dramatically improve the quality of American health care by protecting patients from five million incidents of medical harm between December 2006 and December 2008. The How-to Guides associated with this Campaign are designed to share best practice knowledge on areas of focus for participating organizations. For more information and materials, go to www.ihi.org/IHI/Programs/Campaign.

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The 5 Million Lives Campaign is made possible through the generous leadership and support of America's Blue Cross and Blue Shield health plans. IHI also acknowledges the leadership and support of the Cardinal Health Foundation, and the support of the Blue Shield of California Foundation, the Aetna Foundation, Rx Foundation, Baxter International, Inc., and Abbott Fund.

BlueCross BlueShield Association
An Association of Independent Blue Cross and Blue Shield Plans

Cardinal Health Foundation

This initiative builds on work begun in the 100,000 Lives Campaign, supported by Blue Cross Blue Shield of Massachusetts, the Cardinal Health Foundation, the Rx Foundation, the Gordon and Betty Moore Foundation, The Colorado Trust, the Blue Shield of California Foundation, the Robert Wood Johnson Foundation, Baxter International, Inc., The Leeds Family, and the David Calkins Memorial Fund.

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Prevent surgical site infections (SSI) by implementing four components of care:

1. Appropriate use of antibiotics;
2. Appropriate hair removal;
3. Maintenance of postoperative glucose control* for major cardiac surgery patients; and
4. Maintenance of postoperative normothermia* for colorectal surgery patients.

* These components of care are supported by clinical trials and experimental evidence in the specified populations; they may prove valuable for other surgical patients as well.

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Surgical site infections are the second most common type of adverse events occurring in hospitalized patients (Brennan. *N□□n□l□□□Me□*. 1991;324:370-376). Surgical site infections have been shown to increase mortality, readmission rate, length of stay, and cost for patients who incur them. (Kirkland. □*nfect□Control□ Ho□p□□pi□emiol*□1999;20:725). While nationally the rate of surgical site infection averages between two and three percent for clean cases (Class I/Clean as defined by CDC), an estimated 40 to 60 percent of these infections are preventable.

A review of the medical literature shows that the following care components reduce the incidence of surgical site infection: appropriate use of prophylactic antibiotics; appropriate hair removal; maintenance of postoperative glucose control for major cardiac surgery patients; and maintenance of postoperative normothermia for colorectal surgery patients. These components, if implemented reliably, can drastically reduce the incidence of surgical site infection, resulting in the nearly complete elimination of preventable surgical site infection.

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A medical record review of 34,133 charts performed under the auspices of the Centers for Medicare & Medicaid Services (CMS) demonstrated that there is significant opportunity for improvement in surgical site prevention. (Bratzler. □*rc*□ *Sur*□. 2005;140:174-182.) In the area of appropriate antibiotic use, the medical record review found the following:

- Appropriate antibiotic selection occurred in 92.6% of cases;
- Antibiotics were given within one hour of incision time to 55.7% of patients; and
- Prophylactic antibiotics were discontinued within 24 hours of surgery end time for only 40.7% of patients.

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Any improvement process should be driven by leadership, with a commitment to providing adequate resources and attention to the initiative. It is also imperative to involve a multidisciplinary team in the surgical site infection improvement process. Successful teams set clear aims for their work, establish baseline measurements of performance, regularly measure and study the results of their work, and test various process and systems changes over a variety of conditions in order to find the ones that lead to improvement in their particular setting.

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For the purposes of the 100,000 Lives Campaign, the antibiotic process measures are these:

1. Antibiotics within 1 hour before surgical incision*
2. Prophylactic antibiotic consistent with national guidelines (as defined in JCAHO/CMS Specification Manual and SCIP for Measure SCIP-Inf-2)
3. Discontinuation of prophylactic antibiotics within 24 hours after surgery

*Due to the longer infusion time required for vancomycin, it is acceptable to start this antibiotic (e.g., when indicated because of beta-lactam allergy or high prevalence of MRSA) within 2 hours prior to incision.

[illegible]

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the antibiotic use measures. Some of these changes are:

- Use preprinted or computerized standing orders specifying antibiotic, timing, dose, and discontinuation.
- Change operating room drug stocks to include only standard doses and standard drugs, reflecting national guidelines.
- Reassign dosing responsibilities to anesthesia or holding area nurse to improve timeliness.
- Use visible reminders/checklists/stickers.
- Involve pharmacy, infection control, and infectious disease staff to ensure appropriate timing, selection, and duration.
- Verify administration time during “time-out” or pre-procedural briefing so action can be taken if not administered.

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For many years, it has been known that the use of razors prior to surgery increases the incidence of wound infection when compared to clipping, depilatory use, or no hair removal at all (Seropian. □*m*□□□*Sur*□. 1971;121:251). However, many teams working on this measure find that the use of razors in their own institutions can range from zero to nearly one hundred percent. It is generally recommended that any preoperative hair removal not occur in the operating room itself, as loose hairs are difficult to control. We recommend collecting baseline information on this measure in order to determine current practice. (See Appendix A for detailed information about the measures for this intervention.)

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Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the appropriate hair removal measure. Some of these changes are:

- Ensure adequate supply of clippers and train staff in proper use.
- Use reminders (signs, posters).
- Educate patients not to self-shave preoperatively.
- Remove all razors from the entire hospital.
- Work with the purchasing department so that razors are no longer purchased by the hospital.

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Review of medical literature shows that the degree of hyperglycemia in the postoperative period was correlated with the rate of SSI in patients undergoing major cardiac surgery (Latham□□□*nf□Contr□Ho□p□□pi□emiol*. 2001;22:607; Dellinger. □*nf□Contr□Ho□p□□pi□emiol*. 2001;22:604). Other articles have demonstrated that stringent glucose control in surgical intensive care unit patients reduces mortality (Van den Berghe. *N□□M*. 2001;345:1359).

*NOTE that, for this effort, “glucose control” is defined as serum glucose levels below 200 mg/dl, collected once on each of the first two postoperative days.
**NOTE that tight glycemic control (e.g., using an insulin drip) is often performed in an intensive care setting or equivalent for safety.

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Hospital teams across the United States are developing and testing process and systems changes to improve performance on the postoperative glucose control measure. Some of these changes are:

- Implement a glucose control protocol.
- Develop one protocol to be used for all surgical patients.
- Regularly check preoperative blood glucose levels on all patients to identify hyperglycemia; this is best done early enough that assessment of risk can be completed and treatment initiated if appropriate.
- Assign responsibility and accountability for blood glucose monitoring and control.

Since the best evidence for glucose control as a strategy to reduce SSI is in the cardiovascular surgery population, it is sensible to focus on this high-risk population. Tight glucose control is easier and safer to implement and monitor in an ICU setting.

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The medical literature indicates that patients undergoing colorectal surgery have a decreased risk of surgical site infection if they are not allowed to become hypothermic during the perioperative period (Melling. □*ancet*. 2001;358:876). Anesthesia, anxiety, wet skin preparations, and skin exposure in cold operating rooms can cause patients to become clinically hypothermic during surgery. The relatively limited clinical data are supported by strong theoretical rationale and experimental data. Some experts believe that initial efforts should be directed at colorectal surgery patients until additional clinical studies are performed. However, there is evidence to show that preventing hypothermia is beneficial in reducing other complications, and it clearly is more comfortable for patients. *NOTE that this component of care does not pertain to those patients for whom therapeutic hypothermia is being used (e.g., hypothermic cardioplegia).

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Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the normothermia measure. Some of these changes are:

- Use warmed forced-air blankets preoperatively, during surgery and in PACU.
- Use warmed IV fluids.
- Use warming blankets under patients on the operating table.
- Use hats and booties on patients perioperatively.
- Adjust engineering controls so that operating rooms and patient areas are not permitted to become excessively cold overnight, when many rooms are closed.

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In order to move this work forward, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.

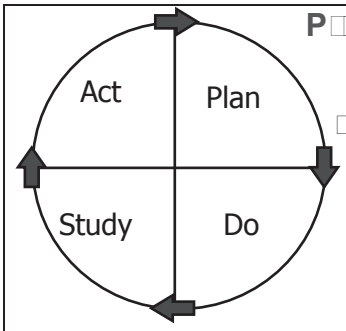
- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, for an entire pilot population or on an entire unit.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement on www.IHI.org

PDSA WORKSHEET [illegible] CREATED [illegible]



Project: SSI - Prophylactic Antibiotic within One Hour before Incision

Overview of this PDSA Cycle: Test administration of antibiotic by anesthesiologists.

PLAN

Questions: Will anesthesiologists agree to administer the antibiotic and document the time?

Predictions: The anesthesiologists will agree. Documentation location may need to be clarified for consistent practice.

Plan for who, what, when, where:
Get an anesthesiologist to volunteer to administer and document one antibiotic dose for first case on Tuesday.

Plan for observations:
- Nurse will record observations and any issues that arise.
- Anesthesiologist will document administration time on preoperative checklist.
- Debrief with anesthesiologist after the surgery is complete.

DO: Conduct the plan. Collect data. Begin analysis.
- Conducted the test on the first surgery on Tuesday morning.
- The anesthesiologist became frustrated because she did not have the pre-op checklist at administration time because the circulating nurse was using it.

STUDY: Complete analysis of the data.

Debrief: Discuss whether the administration time can be documented on the anesthesia record instead of the checklist. The anesthesiologist is willing to try the test again tomorrow.

Summary of what was learned:
Documentation form currently in use is not ideal for use by anesthesiologists if they administer the dose.

Suggested changes to the process:
May need to revise checklist and anesthesia record if tests are successful, so that documentation of administration time is always in the same place.

ACT: Decisions to be made:
Repeat this test tomorrow after drafting a sample revision to anesthesia record.

Plan for implementation:
Run a second PDSA Cycle tomorrow for three scheduled surgeries.

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No single person can create system-level improvements alone. First, it is crucial to have the active support of leadership in this work. The leadership must make patient safety and quality of care strategic priorities in order for any surgical care improvement team to be successful.

Once leadership has publicly given recognition and support (dollars, person-time) to the program, the improvement team can be quite small. Successful teams include a physician (either surgeon, anesthesiologist, or both); an operating room nurse; and someone from the quality department. Each hospital will have its own methods for selecting a core team. The team should use the Model for Improvement to conduct small-scale, rapid tests of the ideas for improvement over various conditions in a pilot surgical population. The team should also track performance on a set of measures designed to help them see if the changes they are making are leading to improvement, and regularly report these measures back to leadership.

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See Appendix A for specific information regarding the recommended process and outcomes measures for surgical site infection prevention.

The recommended outcome measure is “Percent of Clean Surgery Patients with Surgical Infection” (i.e., surgical site infections within 30 days of surgery for patients with Class I / Clean wounds, as defined by CDC and NSQIP for wound classification). If you are just starting this work, this may be a good measure to begin tracking. We are not distinguishing as to whether this is superficial infections only, or also includes deep incision and organ space infections; this should be decided locally for your organization. As your work progresses and you are ready for advanced measures on this topic, consider measures that address the different types of SSIs as well as the other classes of wounds, similar to the data being collected in the National Surgical Quality Improvement Project at the American College of Surgeons (https://acsnsqip.org).

For each process measure, obtain the data via medical record review. (Follow the links in Appendix A for details about data collection.) The process measures recommended by the Campaign are identical to those being used in CMS’s current Surgical Infection Prevention program, JCAHO’s current core measure set, and the Surgical Care Improvement Project (SCIP). Using run charts helps make change over time visible to the team and to the leadership.

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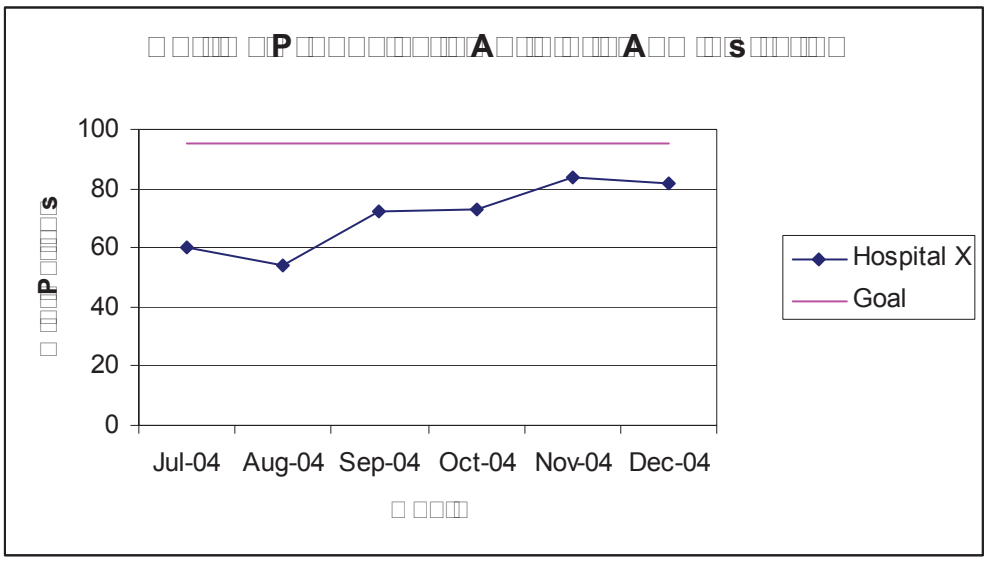
Improvement takes place over time. Determining if improvement has really happened and if it is lasting requires observing patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement.

Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- As you work on improvement, they provide information about the value of particular changes.



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Teams may elect to work on any or all of the four care components: antibiotic use, hair removal, glucose control, and normothermia. A first test of change should involve a very small sample size (typically one patient) and should be described ahead of time in a Plan-Do-Study-Act format so that the team can easily predict what they think will happen, observe the results, learn from them, and continue to the next test.

Example: Administration of preoperative dose of antibiotic

> The team decides to test having the anesthesiologist administer the pre-operative dose of prophylactic antibiotic and document the administration time. They identify an anesthesiologist who supports the idea, and let the anesthesiologist know that they will test this with one case. On their PDSA form, they predict that the surgeon will agree to administer the dose but that documentation may need to be clarified. They then conduct the test. They note that the anesthesiologist becomes frustrated because s/he cannot access the preoperative checklist used for documentation of administration time because it is in use by the circulating nurse. The team's study of the data indicates that they should repeat this test, after first developing an alternative documentation location that will be accessible to the anesthesiologist at the time of administration.
>
> Ideally, teams will conduct multiple small tests of change simultaneously across all four components of care. This simultaneous testing usually begins after the first few tests are completed and the team feels comfortable and confident in the process.

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For surgical site infection, teams will usually choose to begin their improvement process by working with a "pilot" population. This pilot population may be the hip- and knee-replacement patients, for example, or cardiac operations, or gynecologic procedures, etc. It is possible to include the universe of surgical patients in the pilot population, if that number is small (fewer than 50 cases per month). We recommend including at least 50 cases per month in the pilot population in order to increase the ability to measure and detect improvement.

In order to maximize the reduction in overall hospital mortality related to surgical site infections, however, hospitals must spread improvements begun in a pilot population to the universe of surgical populations. Organizations that successfully spread improvements use an organized, structured method in planning and implementing spread across populations, units, or facilities. You can find information about planning, tracking, and optimizing spread at www.ihi.org. (See IHI's Innovation Series white paper, "A Framework for Spread: From Local Improvements to System-Wide Change," downloadable for free at www.ihi.org.)

[illegible]

Teams working on preventing surgical site infection have learned a great deal about barriers to improvement and how to face them. Some common challenges and solutions are:

[illegible]

Solution: Use opinion leaders (physicians) and data and if possible; a business case for the project may help to win leadership support.

[illegible]

Solution: Use physician opinion leaders, review the medical literature, and feed back data on a surgeon-specific level. Remember that physicians may fall anywhere on the "Adoption of Innovations" curve; work first with your early adopters and use their stories to convince the majority.

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More than 3,000 hospitals across the US have been working hard to implement the Campaign interventions. Here are some of the "tips and tricks" for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups on IHI.org.

- Set a narrower range internally for timing of the first dose, e.g., 5-50 minutes prior to incision. This helps account for clocks not in synchrony and allows a small buffer.
- Use 36.5 degrees Celsius as the intervention point for temperature; waiting until 36 degrees is usually too late to prevent hypothermia below that level.
- Measure pre-op blood glucose early enough so that if it is unexpectedly high, a plan of action can be initiated.
- Schedule the times for post-op doses of prophylactic antibiotics in the OR, based on time incision is closed to ensure completion within 24 hours (don't use standard dosing times).
- Measure the SSI interventions as an all-or-nothing measure for each patient.
- Approach the SSI interventions like "mini-bundles" for each phase: pre-op, intra-op, and post-op. Hold each area accountable for their bundle.
- Maintain a reasonable temperature in the OR – not too cold for patients, but not too warm for staff. Ideal seems to be the high 60's Fahrenheit.
- Don't allow operating rooms to get excessively cold overnight when closed.

[illegible]

[illegible]

The idea behind this effort is to leverage known science to improve the care of all our patients—a goal that that your surgeons likely share with the rest of the medical community. There is ample evidence that shaving prior to a surgical procedure is associated with more wound infections than removing hair with clippers or not removing hair at all.
The papers that support this conclusion are sound. You can challenge the studies as not specifically looking at shaving immediately prior to surgery because that study has not yet been done, as most patients are not prepared for surgery that way. There is nearly always a time gap between the shave prep and the incision; this likely varies greatly from institution to institution. Rarely are patients prepped in the operating room itself, as most surgeons (and OR nurses) don't like the idea of loose hair floating around the operating theater. There are obviously exceptions to this, but for the most part patients are prepped outside the OR. It can be inferred from the literature that the time interval between the shaving and the incision is likely related to the wound infection rate. That interval in many cases is not absolutely controllable; cases get delayed or cancelled, putting those patients into a time range (from prep to incision) that we know scientifically is associated with more wound infections.

Further, there is no evidence that shaving immediately prior to surgery is a safe thing to do. There is no evidence that shaving with a razor at any time prior to surgery is ever associated with a lower rate of any type of complication. Shaving immediately prior to incision seems to rest on even softer ground scientifically than shaving the morning of surgery (which we already know is associated with more wound infections because it has been studied). At best, it would be equivalent to using a clipper to remove hair (there is no scientific evidence to think that it is superior and, if anything, it is likely inferior). Why would you take a chance, in this unstudied area, with the patient's outcome?

This line of reasoning has convinced a number of surgeons and organizations across the US and around the world who support the Surgical Care Improvement Project (of which appropriate hair removal is a component), including the following:

American Academy of Orthopedic Surgeons
American Association of Critical Care Nurses
American Association of Nurse Anesthetists
American College of Obstetricians & Gynecologists
American College of Surgeons
American Geriatrics Society
American Hospital Association
American Society of Anesthesiologists
American Society of Colon and Rectal Surgeons
American Society of Health-Systems Pharmacists
American Society of PeriAnesthesia Nurses
Ascension Health
Association of PeriOperative Registered Nurses
Association for Professionals in Infection Control and Epidemiology
Centers for Medicare & Medicaid Services
Centers for Disease Control and Prevention
Infectious Diseases Society of America
Joint Commission on Accreditation of Healthcare Organizations
The Medical Letter
Oklahoma Foundation for Medical Quality
Premier, Inc.
Qualis Health
Sanford Guide
Society for Health Care Epidemiology of America
Society of Thoracic Surgeons
Surgical Infection Society
VHA, Inc

Much of what we do in medicine is based in tradition more than in science. Using a razor to remove hair from the surgical site is based on tradition—there is no science to my knowledge—to support the practice. Hair is removed prior to surgery for convenience/comfort in applying/removing dressings and to aid in wound closure. There may have been a time when it was done in an effort to prevent infection, but it was not based in science. We would be pleased to review any literature that you (or any surgeons) have that supports the continued use of razors to remove hair.

[illegible]

This is a common question, but there are places that have solved it. No razors really means no razors in successful hospitals.

When one uses clippers properly, it is possible to get the same "close shave" as with a razor, but with less risk of cuts to the skin. The important thing is to ensure user training, because clippers in an untrained hand are worse than a razor.

Try to get a neurosurgeon to agree to a small test of change: test removing the hair on one patient with clippers, and see if the surgeon feels that it is acceptable.

[illegible]

In the glucose control measure for cardiac surgery patients, the goal is to include the "serum" glucose level as measured at 6 AM on post-op days 1 and 2 (or closest to it).

The word "serum" has caused some confusion; it has been interpreted as serum analyzed by the lab only (not finger sticks). We have clarified the definition with colleagues at the Surgical Care Improvement Project.

Glucose values for this measure may be obtained from the following:
• Blood sugar
• Fasting glucose
• Finger stick glucose

- Glucometer results
- Glucose
- Non-fasting glucose
- Random glucose
- Serum glucose

[illegible]

Most places are measuring SSI within 30 days and, in general, that has been our recommendation. Most inpatient stays are so short that we must consider the time after discharge, although surveillance is a real challenge.

The core interventions we use in the 100,000 Lives Campaign contribute mostly to preventing infections within 30 days.

[illegible]

A number of hospitals have built the SSI prevention items into their pre-procedural briefing. For example, during the briefing one of the items verified is whether the prophylactic antibiotic has been administered. If it has not, it provides an opportunity to mitigate.

[illegible]

For the purposes of the Campaign, we are using the first temperature on arrival to the PACU, but only in colorectal surgery cases, which aligns with SCIP.

Teams in our SSI Collaborative have been able to achieve >95% of patients with normothermia on arrival in this population and others. They have used the techniques you mention and others, such as adjusting room temperature, preventing pre-op cooling, and hats.

The important and challenging part of this is to prevent hypothermia from occurring in the pre-op or intra-op period (except when deliberately induced for clinical reasons). It takes far more resources to warm patients up than it does to keep them warm.

We are seeing organizations raise the bar on this by measuring temperature throughout the process—pre-, intra-, and post-op—and counting this as an "all-or-nothing." This means they only give themselves credit if all temps are normal. A few have achieved early success!

Have a question for Fran Griffin, our Surgical Site Infection faculty expert? Post it to the Surgical Site Infection web discussion.

Looking for advice from other organizations like yours? Ask a Campaign Mentor Hospital! The organizations on the Campaign Mentor Hospitals list have volunteered to provide support, advice, clinical expertise, and tips to hospitals seeking help with their implementation efforts.

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A Fact Sheet for Patients and Their Family Members

Most patients who have surgery do well. But sometimes patients get infections. This happens to about 3 out of 100 patients who have surgery. Infections after surgery can lead to other problems. Sometimes, patients have to stay longer in the hospital. Rarely, patients die from infections. Patients and their family members can help lower the risk of infection after surgery. Here are some ways:

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Meet with your surgeon.

- Bring an up-to-date list of all the medications you take. Talk with your surgeon about why you take each medication and how it helps.
- Let the surgeon know if you are allergic to any medication and what happens when you take it.
- Tell the surgeon if you have diabetes or high blood sugar, or if family members do.
- Talk about ways to lower your risk of getting an infection. This may include taking antibiotic medicines.

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Take extra good care of your body.

- Do not shave near where you will have surgery. Shaving can irritate your skin which may lead to infection. If you are a man who shaves your face every day, ask your surgeon if it is okay to do so.
- Keep warm. This means wearing warm clothes or wrapping up in blankets when you go to the hospital. In cold weather, it also means heating up the car before you get in. Keeping warm before surgery lowers your chance of getting an infection.

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- Tell the anesthesiologist (doctor or nurse who puts you to sleep for surgery) about all the medications you take. A good way to do this is to bring a written up-to-date medication list with you.

- Let the anesthesiologist know if you have diabetes or high blood sugar, or if family members do. People with high blood sugar have a greater chance of getting infections after surgery.
- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.
- Ask for blankets or other ways to stay warm while you wait for surgery. Find out how you will be kept warm during and after surgery. Ask for extra blankets if you feel cold.
- Ask if you will get antibiotic medicine. If so, find out how many doses you will get. Most people receive only one dose before surgery and are on antibiotics for just one day after surgery, as taking too much can lead to other problems.

[illegible]

[illegible]

The 5 Million Lives Campaign is a national initiative to dramatically improve the quality of American health care. The Institute for Healthcare Improvement (IHI) and its partners seek to engage thousands of U.S. hospitals in an effort to reduce harm for five million American patients between December 2006 and December 2008. This ambitious work builds upon the great energy and commitment shown by hospitals during the 100,000 Lives Campaign, a national, IHI-led initiative focused on reducing unnecessary mortality and that ran from December 2004 to June 2006. Complete details, including materials, contact information for experts, and web discussions, are on the web at http://www.ihi.org/IHI/Programs/Campaign/.

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The following measures are relevant for this intervention. The Campaign recommends that you use some or all of them, as appropriate, to track the progress of your work in this area. In selecting your measures, we offer the following advice:

1. Whenever possible, use measures you are already collecting for other programs.
2. Evaluate your choice of measures in terms of the usefulness of the results they provide and the resources required to obtain those results; try to maximize the former while minimizing the latter.
3. Try to include both process and outcome measures in your measurement scheme.
4. You may use measures not listed here, and, similarly, you may modify the measures described below to make them more appropriate and/or useful to your particular setting; however, be aware that modifying measures may limit the comparability of your results to others'. (Note that hospitals using different or modified measures should not submit those measure data to IHI.)
5. Remember that posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful, and that they would be excited to see.

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Owner: **SCIP** Owner Measure ID: **SCIP**I□□□□□ Measure Information: □□□□□S□□□□□□□□□□□□s□□ □□□□□□□ □□□A□□□□□□□□s□ Comments: • From the link above, scroll down to find the link for SCIP-Inf-1; SCIP-Inf-1a is defined within. • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

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Owner: **SCIP**

Owner Measure ID: **SCIP-Inf-2**

Measure Information: [illegible]

Comments:

- From the link above, scroll down to find the link for SCIP-Inf-2; SCIP-Inf-2a is defined within.
- Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition.
- This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

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Owner: **SCIP**

Owner Measure ID: **SCIP-Inf-3**

Measure Information: [illegible]

Comments:

- From the link above, scroll down to find the link for SCIP-Inf-3; SCIP-Inf-3a is defined within.
- Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition.
- This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

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Owner: **SCIP**

Owner Measure ID: **SCIP-Inf-4**

Measure Information: [illegible]

Comments:

- From the link above, scroll down to find the link for SCIP-Inf-4
- Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition.
- This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

[illegible]
Owner: **SCIP**
Owner Measure ID: **SCIP-Inf-6**
Measure Information: [illegible]
Comments: • From the link above, scroll down to find the link for SCIP-Inf-6 • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

[illegible]
Owner: **SCIP**
Owner Measure ID: **SCIP-Inf-7**
Measure Information: [illegible]
Comments: • From the link above, scroll down to find the link for SCIP-Inf-7 • Note that this measure is the same as that used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the "owner's" measure definition. • This measure is also a recommended intervention-level measure for another Campaign intervention, Reduce Surgical Complications.

Outcome Measure [illegible]:

[illegible]
Owner: **[illegible]**
Owner Measure ID: **[illegible]**
Measure Information: [illegible]
Comments:

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Percent of Surgical Patients with Prophylactic Antibiotic Received within One Hour Prior to Surgical Incision – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Surgical Patients with Appropriate Selection of Prophylactic Antibiotic – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Surgical Patients with Appropriate Prophylactic Antibiotic Discontinuation – Overall Rate	√[1]	√[2]	√[3]	√[4]	
Percent of Major Cardiac Surgical Patients with Controlled Post Operative Serum Glucose	√[1]	√[2]	√[3]		
Percent of Surgical Patients with Appropriate Hair Removal	√[1]	√[2]	√[3]		
Percent of Colorectal Surgical Patients with Normothermia in PACU	√[1]	√[2]	√[3]		
Percent of Clean Surgery Patients with Surgical Infection					√[5]

[1] Matches a measure in the JCAHO National Hospital Quality Measures SCIP Core Measure Set
[2] Matches a measure in the CMS SCIP measure set
[3] Matches a measure in the SCIP measure set
[4] This measure is endorsed by the NQF
[5] The definitions of “clean surgery patient” and “surgical infection” used in this measure are the same as the CDC’s NHSN Surgical Site Infection Event definitions, which can be found here.

		Total hospital beds	Medical Surgical Intensive Care Beds	Pediatric Intensive Care Beds	Other Intensive Care Beds
Facility Name	Adventist Medical Center	252	12	0	0
	Ashland Community Hospital	31	4	0	0
	Bay Area Hospital	129	10	0	0
	Blue Mountain Hospital	68	2	0	0
	Columbia Memorial Hospital	25	4	0	0
	Coquille Valley Hospital	15	2	0	0
	Cottage Grove Comm Hospital	11	0	0	0
	Curry General Hospital	24	3	0	0
	Good Samaritan Reg Med Center	153	12	0	0
	Good Shepherd Healthcare Syst	45	6	0	0
	Grande Ronde Hospital	25	4	0	0
	Harney District Hospital	25	2	0	0
	Holy Rosary Medical Center	49	8	0	0
	Kaiser Sunnyside Medical Ctr	185	13	12	0
	Lake District Hospital	68	1	0	0
	Legacy Emanuel Hosp & Hlth Ctr	401	19	23	14
	Legacy Good Samaritan Hospital	274	28	0	0
	Legacy Meridian Park Hospital	133	16	0	0
	Legacy Mount Hood Medical Ctr	81	10	0	0
	Lower Umpqua Hospital District	53	2	0	0
	McKenzie-Willamette Med Center	105	14	0	0
	Mercy Medical Center	153	7	0	6
	Merle West Medical Center	116	10	0	0
	Mid-Columbia Medical Center	49	6	0	0
	Mountain View Hosp District	59	2	0	0
	OHSU Hospital	443	17	16	0
	Peace Harbor Hospital	21	4	0	0
	Physician's Hospital	39	8	0	0
	Pioneer Memorial Hospital (H)	10	0	0	0

Pioneer Memorial Hospital (P)	25	2	0	0
Providence Hood River Mem Hosp	25	4	0	0
Providence Medford Medical Ctr	128	15	0	0
Providence Milwaukie Hospital	60	6	0	0
Providence Newberg Hospital	36	4	0	0
Providence Portland Med Ctr	409	13	0	0
Providence Seaside Hospital	47	1	0	0
Providence St Vincent Med Ctr	481	16	0	0
Rogue Valley Medical Center	286	16	0	0
Sacred Heart Medical Center	472	35	0	0
Salem Hospital	417	19	0	0
Samaritan Albany Gen Hospital	63	9	0	0
Samaritan Lebanon Comm Hosp	25	4	0	0
Samaritan North Lincoln Hosp	25	4	0	0
Samaritan Pacific Comm Hosp	42	7	0	0
Santiam Memorial Hospital	40	0	0	0
Shriners Hosps for Children	22	0	0	0
Silverton Hospital	48	6	0	0
Southern Coos Hospital	18	0	0	0
St Anthony Hospital	25	0	0	4
St Charles Med Ctr - Redmond	48	6	0	0
St Charles Medical Ctr - Bend	208	18	0	0
St Elizabeth Health Services	75	2	0	0
Three Rivers Community Hosp	98	12	0	0
Tillamook County Gen Hospital	25	0	0	0
Tuality Healthcare	143	9	0	0
Veterans Affairs Med Center	221	14	0	0
Wallowa Memorial Hospital	57	0	0	0

	West Valley Hospital	6	0	0	0
	Willamette Falls Hospital	91	8	0	0
	Willamette Valley Medical Ctr	67	7	0	0