Drop a Bundle and Save: Reducing Surgical Site Infections Across Surgical Populations

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Introduction

Each year approximately 26.6 million inpatient surgical procedures are performed in the United States, and data analysis from the National Center for Health Statistics[1] and the National Healthcare Safety Network (NHSN) indicates 250,000 to 1 million surgical site infections (SSIs) develop each year. Patients who develop an SSI have a >60% greater risk of being admitted to an intensive care unit, and are 15 times more likely to experience readmission within 30 days of discharge. SSIs are known to increase patient morbidity, mortality,[2] accounts for an excess of 3.7 million hospital days, and have an estimated $1.6 billion economic impact[3] on the US healthcare system.

Studies have shown that a patient's own microbial flora is the primary etiologic factor in cardiac-related SSIs,[4,5] with greater than 50% of infections attributed to *Staphylococcus aureus* or coagulase-negative *Staphylococcus epidermidis*.[6-12] It is well documented that patients undergoing cardiac and vascular surgery are at an increased risk for development of SSIs,[13,14] and studies have shown mortality rates in this patient population are significantly increased (17.3% versus 3.0%, *P*<0.0001).[15]

Prevention of SSIs has come to the forefront of infection prevention initiatives, and preventive measures have been recommended by best practice guidelines[13,16,17] and other infection prevention initiatives. The Surgical Care Improvement Project (SCIP)[18] was initiated to ensure the adherence to basic principles of infection prevention, antimicrobial prophylaxis, and surgical care. SCIP[17] recommends the following interventions:

- Appropriate use of antibiotics
- Appropriate hair removal
- Controlled 6 am postoperative serum glucose in major cardiac surgery patients

Despite participation in SCIP and documented adherence with SCIP initiatives, surgical site infection (SSI) rates for cardiac surgeries exceeded national benchmarks at our 271-bed community hospital in 2006. A quality improvement intervention was undertaken to ensure all prevention practices were up to date based on evidence-based guidance.

Methods

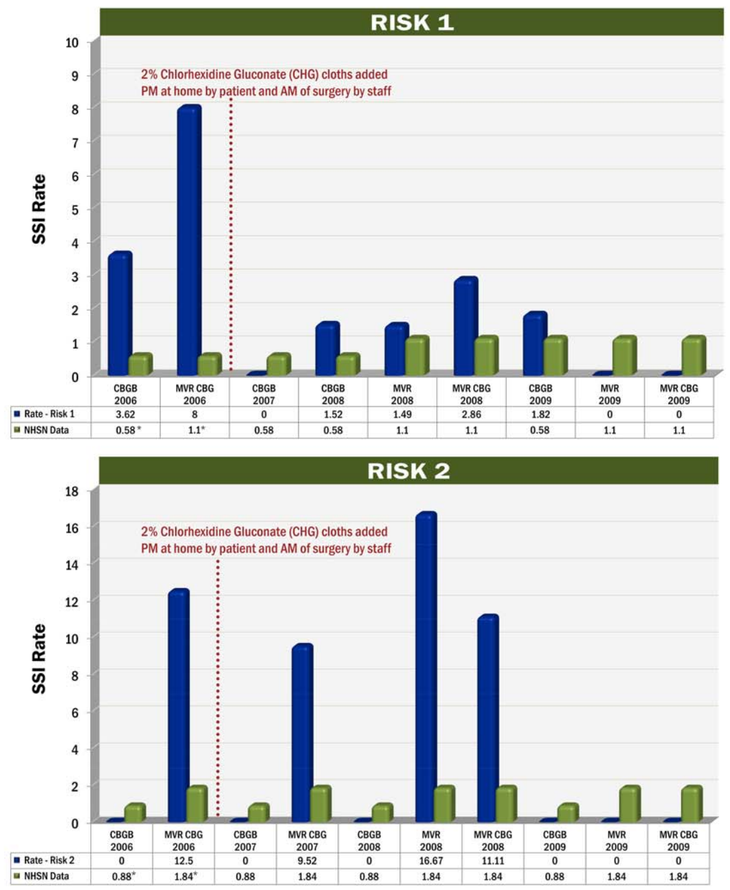
A multidisciplinary team was selected to carry out the quality improvement initiative. The team consisted of a cardiothoracic surgeon, cardiologist, anesthesiologist, infection control practitioner, pharmacist, clinical nurse specialist, and a staff nurse from the Clinical Action Team.

Initially, a literature review was performed,[10,14,19-24] which assisted the team in updating all SSI prevention efforts. The results of the literature review revealed a need for an enhanced bundle of care incorporating the following interventions:

- Tight glucose control
- Additional skin antisepsis
- Additional antibiotic prophylaxis and empiric treatment (systemic and oral)
- Consistent adherence to a SSI bundle approach

A longitudinal project timeline is represented in Figure 1 and shows the different SSI prevention efforts which were implemented.

Figure 2. Mercy Comparisons to NHSN Report Data*



* Edwards JR, Peterson KD, Andrus ML, et al. National healthcare Safety Network (NHSN) Report, data summary for 2006 through 2007, issued November 2008. Am J Infect Control. 2008;36:609-626.

Evaluation

Study Data Compared to NHSN Report Data

NHSN SSI rates were used as comparators for the study data. SSI rates by year, endpoint and risk category are summarized for comparison. Fisher's exact tests were used for analysis of these data. The statistically significant findings are summarized here. In 2006, CBGB risk 1, MVR CBG risk 1 and risk 2 showed statistically significantly higher SSI rates than NHSN. Specifically, CBGB risk 1 group in 2006 had a statistically significantly higher SSI rate than NHSN, 8/221 (3.62) vs. 527/91007 (0.58) respectively, *P*<.001. MVR CBG risk 1 group in 2006 had a statistically significantly higher SSI rate than NHSN, 2/25 (8.00) vs. 238/21555 (1.10) respectively, *P* = .03. MVR CBG risk 2 group in 2006 had a statistically significantly higher SSI rate than NHSN, 3/24 (12.50) vs. 131/7130 (1.84) respectively, *P* = .01. See Figure 2.

Study Data By Year and Risk Category

SSI rates by year and risk category for PVBY are summarized for comparison in Figure 3. (The CDC benchmark rate of 6.98 was used as a comparator for the study data. Binomial tests were used for the analysis of the PVBY data.) No statistically significant decrease was found for PVBY risk 0, 1 or 2.

PVBY LLE data for 2008 and 2009 was also compared (see Figure 3). The chi-square test was used for analysis. In 2008, there was a rate of 9.02 (11/122) compared to 2.73 (3/110) in 2009, *P* = .04. There was a statistically significant decrease of 69.7% in the SSI rate from 2008 to 2009 for PVBY LLE.

Figure 3. PVBY SSI Rate by Year and Risk Category

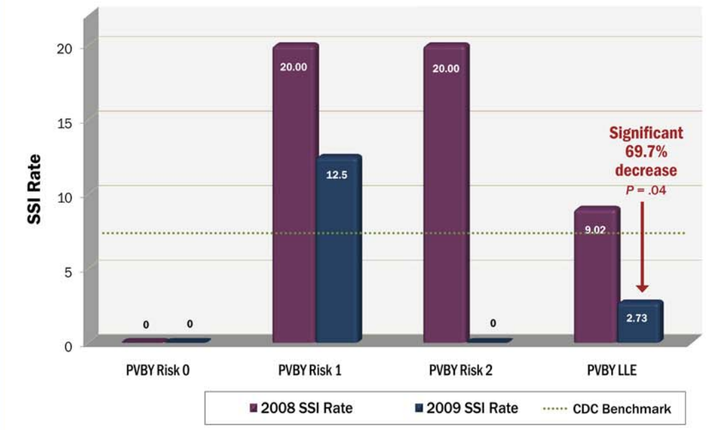
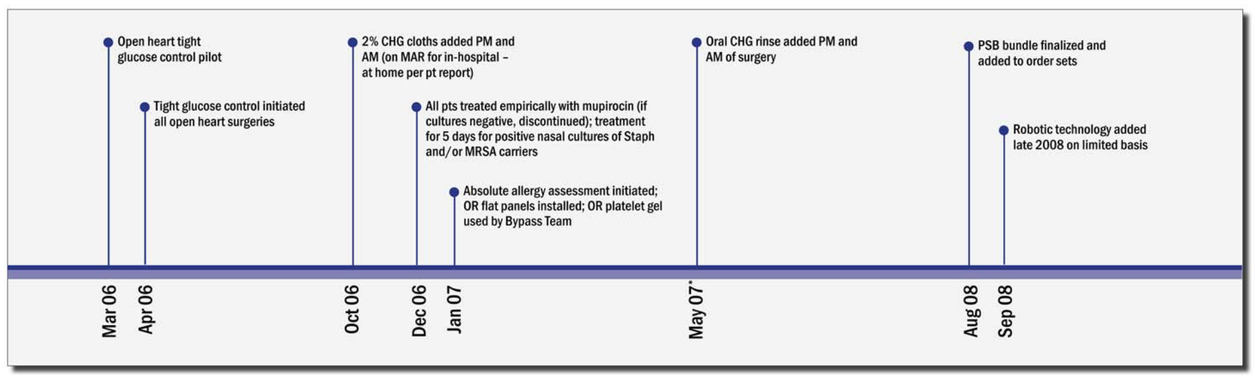


Figure 1. Bundle Implementation Timeline*



March 2006	Tight glucose control pilot tested for non-diabetic patients initiated during the surgical procedure through the AM of post op day 3; Modified glucose parameters from 100-150 mg/Dl to 80-110 for both diabetic and non-diabetic patients. SCIP defined success at 200 but our tight control was defined as blood glucose 80-110 for both diabetic and non-diabetic patients.
April 2006	Tight glucose control initiated all open heart surgeries
October 2006	2% Chlorhexidine Gluconate (CHG) cloths added PM at home by patient and AM of surgery by staff
December 2006	All patients treated empirically with mupirocin (if cultures negative, discontinued); mupirocin treatment for 5 days for positive nasal cultures of Staph and/or MRSA carriers.
January 2007	Absolute allergy assessment initiated (anesthesiologist reviews presence/absence of cephalosporin allergy as part of their interview on day of surgery). All MRSA carriers received vancomycin with cefuroxime but, if allergic to cephalosporins, quinolone would replace cefuroxime. OR flat panels installed to replace bulky equipment Platelet gel initiated by Cardiac Bypass Team Protocol
May 2007	Oral CHG rinse added PM and AM of surgery – received instructions and product in Heart Link and self administered PM and AM – confirmed by patient self-report.
August 2008	"PSB bundle" automated in order sets and added to Peripheral Vascular Surgeries
September 2008	Robotic technology added late 2008 on limited basis

* All bundles in place May 2007: glucose control, 2% CHG cloths being used, patient screening/treatment if positive for Staph and/or MRSA, Oral CHG rinse

1 National Collaborating Centre for Women's and Children's Health. Surgical site infection: prevention and treatment of surgical site infection. Available at: http://www.nice.org.uk/nicemedia/live/11743/42378/42378.pdf Accessed April 16, 2010.

Key

CHG = chlorhexidine gluconate
MAR = medical administration record
PVBY = peripheral vascular bypass surgery
PSB = perioperative surgical bundle
MRSA = methicillin-resistant *Staphylococcus aureus*

Outcomes

A review of the cumulative cardiac surgery SSI data from 2006 to 2009 revealed a **57.2% relative reduction**.

This multivariate quality improvement project decreased the incidence of SSIs in the cardiac and vascular surgery population in this community hospital. We attribute these positive outcomes to the following key factors:

- **A multidisciplinary team approach and clinical action team champions were key for our successful implementation of the PSB.**
- **Hardwiring the PSB through integration across the continuum of care by automation into the electronic medical record through order-sets, smart links, and "best practice" alerts.**
- **The Cardiac Care Improvement Committee identified strategies to implement the PSB for other at risk populations based on the successful implementation in our cardiac surgery population.**
- **Data analysis comparing our experience to the national benchmarks helped to establish priorities for our Infection Control Plan and the Cardiac Care Improvement Committee.**

Clinical Implications

- **Despite high reliability compliance with the CMS SCIP indicators, our SSI rates were higher than our historic baseline.**
- **There are limited randomized controlled clinical trials demonstrating the impact of our PSB elements for the reduction of SSI.**
- **Our PSB appears to have impacted the SSI rates for both cardiac and peripheral vascular surgery.**
- **Our risk-adjusted cardiac surgery SSI rates were statistically significantly higher in 2006 compared to the NHSN published rates before implementation of the PSB and continue to suggest statistically significant reductions over three years.**
- **Our lower extremity peripheral vascular surgery SSI rate reductions were statistically significant following the implementation of the PSB.**

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