

# Achieving Zero Coronary Artery Bypass Graft Surgical Site Infections for over Four Years: Our Experience Utilizing Bundle Elements, Education, and Audits

Mohamed Adawee, Ara Pridjian, Linnea Eifert, Chaney Manarin, Viviana Snyder

Infection Prevention and Epidemiology Department, Sparrow Health System, Lansing, USA

Email: [adawi\\_mohd@yahoo.com](mailto:adawi_mohd@yahoo.com)

**How to cite this paper:** Adawee, M., Pridjian, A., Eifert, L., Manarin, C. and Snyder, V. (2022) Achieving Zero Coronary Artery Bypass Graft Surgical Site Infections for over Four Years: Our Experience Utilizing Bundle Elements, Education, and Audits. *Open Journal of Epidemiology*, 12, 102-106. <https://doi.org/10.4236/ojepi.2022.122009>

**Received:** February 24, 2022

**Accepted:** March 14, 2022

**Published:** March 17, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

**Background:** Surgical site infections (SSI) are expensive and potentially deadly infections; however, with evidence-based infection prevention techniques many can be prevented. The purpose of this quality improvement project is to describe our hospital's experience achieving zero coronary artery bypass graft (CABG) deep incisional and organ/space SSI incidences from October 2016-July 2021. **Methods:** To prevent CABG deep incisional and organ/space SSI incidences our Infection Prevention and Epidemiology Department along with the Cardiothoracic and Vascular Surgery Department established SSI prevention bundle elements, continuous education, and monthly audits. **Results:** From quarter one of 2015 through quarter three of 2016 there were three deep incisional or organ/space SSI cases out of 317 CABG procedures. From quarter four of 2016 through quarter two of 2021 there have been 625 CABG procedures, zero of which developed into deep incisional or organ/space SSI incidences. CABG SSI prevention bundle element compliance ranged from 88.2% to 99.6% and operating room environment of care compliance was 94%. **Conclusion:** Our results show overall improvements in our quarterly CABG SSI SIR from quarter one of 2015 to quarter two of 2021. This experience demonstrates the importance of complying with SSI prevention bundle elements, education, and auditing in reducing and maintaining zero CABG deep incisional and organ/space incidences for over four years.

## Keywords

SSI, CABG, Infection

## 1. Introduction

Surgical site infections (SSI) are a substantial cause of morbidity, prolonged hospitalization, re-admissions, and even death [1]. The incidence of SSI after surgery is about 1% - 3% and they account for about 35% - 40% of all nosocomial infections in surgical patients [2] [3]. The Centers for Disease Control and Prevention (CDC) describe three types of SSI: superficial incisional, deep incisional and organ or space SSI [1]. In 2017, it was approximated that 160,000 to 300,000 SSI incidences occurred in the United States; half of which the CDC deemed preventable using evidence-based strategies [4] [5].

Coronary artery bypass grafting (CABG) is an SSI-prone procedure. CABG surgeries are conducted to improve poor blood flow to the heart by taking a healthy blood vessel from the leg, arm, or chest and connecting it below or above the blocked arteries in the heart [6]. There are two types of CABG procedures, those with both chest and donor site incisions (CBGB) and those with only a chest incision (CBGC). SSI incidences occur when microbes enter the incision site via contact with contaminated things such as hands or surgical instruments, germs in the air, or bacteria already on the body migrating to the wound [7]. The purpose of this quality improvement project is to describe our experience achieving zero CBGB and CBGC deep incisional and organ/space SSI incidences from October 2016-July 2021.

## 2. Methods

To prevent CABG deep incisional and organ/space SSI incidences our Infection Prevention and Epidemiology Department along with the Cardiothoracic and Vascular Surgery Department established SSI prevention bundle elements, continuous education, and monthly audits.

### *Bundle Elements*

SSI prevention bundle elements are pre-operative, peri-operative, and post-operative steps that are required to achieve the best results. We follow the CDC's SSI prevention bundle checklist recommendations. Pre-operative bundle elements include Methicillin-resistant *Staphylococcus aureus* (MRSA) screening and nasal decolonization. Antiseptic prophylaxis via CHG soap or wipes are used for bathing the night before or morning of the procedure, antimicrobial prophylaxis is administered one to two hours before surgery, the patient's hair is removed using clippers, and skin is further prepped with a CHG scrub. Glycaemic, normothermia, and oxygenation levels are monitored peri-operatively and post-operatively. Wound care with dressing changes at least every 24 hours is conducted, and antibiotics are typically administered for up to 24 hours after surgery.

### *Education*

Computer-based education on SSI prevention is completed upon hire for new employees then annually. There is also a Nurse Educator that reminds employees of infection prevention importance and procedures; scrubbing instead of painting CHG on a patient is especially focused on.

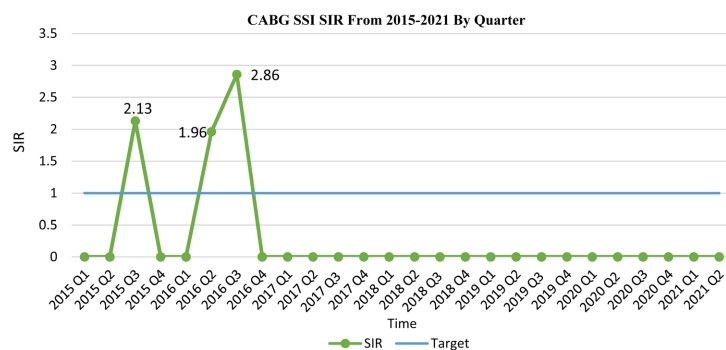
Additionally, monthly multidisciplinary workgroup meetings are conducted that consist of an Infection Preventionist, Surgeon Champion, Peri-op Manager, Certified Nurse Specialist, Nurse Educator, Performance Improvement Specialists, and Information Technology Specialist. Together we assess which SSI prevention elements are in place and determine which bundle elements are in alignment with evidence-based national guidelines. These meetings reinforce the importance of infection prevention in surgical procedures and give team members the opportunity to discuss any concerns while also learning from each other as everyone brings different expertise to the group.

#### *Audits*

Our infection prevention team conducts monthly audits on each CABG SSI prevention bundle element through electronic medical record reviews, direct observation, and interviewing caregivers. The operating rooms where CABG procedures take place are routinely rounded on in-depth as part of the environment of care annual audits. During that investigation, the Joint Commission guidelines on factors such as environmental management and disinfection, sharps safety, hand hygiene, instrument inspection, personal protective equipment, positive air pressure, and limited room traffic are all evaluated for compliance. Each infection prevention item is marked as either compliant or non-compliant and totalled at the end to determine a facility's compliance score. The completed checklist with comments on findings and recommendations is sent to the manager of the department and a follow-up evaluation is scheduled to determine progress.

### 3. Results

From quarter one of 2015 through quarter three of 2016 there were 317 CABG procedures, three of which developed into deep incisional or organ/space SSI cases. From quarter four of 2016 through quarter two of 2021 there have been 625 procedures, zero of which developed into CABG deep incisional or organ/space SSI incidences. See **Figure 1** for the corresponding CABG SSI standardized infection ratio (SIR) by quarter.



**Figure 1.** Coronary artery bypass graft surgical site infections by a quarter from 2015 to 2021. Legend: In mid-2015 through the end of 2016 our hospital had higher than predicted CABG SSI incidences. Upon implementing CABG SSI prevention bundle elements, education, and audits our infections dropped and sustained at zero.

CABG SSI prevention bundle element compliance on 275 procedures from December 2018-July 2021 was audited. Pre-operatively, CHG scrubbing was 98.4% compliant, CHG bathing was 88.2%, antibiotics were 93.5%, and hair removal was 99.6% compliant. MRSA screening was 97.2% compliant and post-operative normothermia was 96.3% compliant. In 2020, audits from the operating rooms discovered 65 out of 69 (94%) environment of care checklist items to be compliant.

#### 4. Discussion

Our results show overall improvements in our quarterly CABG SSI SIR from quarter one of 2015 to quarter two of 2021. Initially, two small spikes in CABG SSI incidences occurred however, by quarter four of 2016 the CABG SIR decreased to zero. This period of no CABG SSI incidences has been maintained for the following 57 months.

From the most recent audits on our SSI bundle compliance and operating room, we have concluded that infection prevention measures are being met for CABG procedures. Overall SSI bundle element compliance is relatively high with an average of 83% from December 2018-July 2021. Bundle element compliance was not recorded from March-May 2020 due to limited CABG procedures as a result of the COVID-19 pandemic. Operating rooms were found to be highly compliant. There was some dust and tape residue, but this was quickly resolved upon receiving feedback. All other checklist items for compliance were met.

Other studies have had similar results to our project. For instance, a study by Travis *et al.* on CABG SSI prevention found a team approach and following evidence-based bundle elements to be effective [8]. Furthermore, another study by Hannan *et al.* on reducing cardiac surgery SSI found a 63% reduction rate due to education and CHG [9]. However, there are no studies, to our knowledge, that evaluate the combined use of education, bundle elements, and audits to reduce CABG SSI incidences.

This experience along with other research demonstrates the importance of complying with SSI prevention bundle elements, education, and auditing in reducing and maintaining zero CABG deep incisional and organ/space incidences for over four years. It is important to continue to work toward reducing CABG SSI incidences due to their increased morbidity and mortality rates along with increased cost of care [1] [10]. Additional research is needed to determine the effectiveness of each individual bundle element in CABG SSI prevention.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

#### References

- [1] Centers for Disease Control and Prevention (2021) Surgical Site Infection Event

- (SSI). National Healthcare Safety Network.  
<https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscscsscurrent.pdf>
- [2] Alkaaki, A., Al-Radi, O.O., Khoja, A., Alnawawi, A., Alnawawi, A., Maghrabi, A., Altaf, A. and Aljiffry, M. (2019). Surgical Site Infection Following Abdominal Surgery: A Prospective Cohort Study. *Canadian Journal of surgery. Journal Canadien de Chirurgie*, **62**, 111–117. <https://doi.org/10.1503/cjs.004818>
- [3] Malone, D.L., Genuit, T., Tracy, J.K., Gannon, C. and Napolitano, L.M. (2002) Surgical Site Infections: Reanalysis of Risk Factors. *The Journal of Surgical Research*, **103**, 89-95. <https://doi.org/10.1006/jsre.2001.6343>
- [4] Centers for Disease Control and Prevention (2020) NHSN Reports: 2019 National and State HAI Progress Report SIR Data—Acute Care Hospitals. National Healthcare Safety Network.
- [5] Berríos-Torres, S.I., Umscheid, C.A., Bratzler, D.W., et al. (2017). Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. *The Journal of the American Medical Association Surgery*, **152**, 784-791. <https://doi.org/10.1001/jamasurg.2017.0904>
- [6] Cleveland Clinic (2019) Coronary Artery Bypass Surgery. Cleveland Clinic. <https://my.clevelandclinic.org/health/treatments/16897-coronary-artery-bypass-surgery>
- [7] John Hopkins Medicine (2019) Surgical Site Infections. Health. <https://www.hopkinsmedicine.org/health/conditions-and-diseases/surgical-site-infections#:~:text=Causes%20and%20risk%20factors%20of%20surgical%20site%20infections&text=Germs%20can%20infect%20a%20surgic>
- [8] Travis, J., Carr, B., Saylor, D., King, A., Bence, W., Key, S., et al. (2009) Coronary Artery Bypass Graft Surgery: Surgical Site Infection Prevention. *Journal of Healthcare Quality*, **31**, 16-23. <https://doi.org/10.1111/j.1945-1474.2009.00033.x>
- [9] Hannan, M., O’Sullivan, K., Higgins, A., Murphy, A., McCarthy, J., Ryan, E. and Hurley, J. (2015) The Combined Impact of Surgical Team Education and Chlorhexidine 2% Alcohol on the Reduction of Surgical Site Infection following Cardiac Surgery. *Surgical Infections*, **16**, 799-805. <https://doi.org/10.1089/sur.2015.033>
- [10] Al Salmi, H., Elmahrouk, A., Arafat, A.A., Edrees, A., Alshehri, M., Wali, G., Zabani, I., Mahdi, N.A. and Jamjoom, A. (2019) Implementation of an Evidence-Based Practice to Decrease Surgical Site Infection after Coronary Artery Bypass Grafting. *The Journal of International Medical Research*, **47**, 3491-3501. <https://doi.org/10.1177/0300060519836511>