Fall 12-13-2019

Use of a Prevention Bundle to Reduce Colon Surgical Site Infections

Stephanie Kimberly Leong
sleong2@dons.usfca.edu

Use of a Prevention Bundle to Reduce Colon Surgical Site Infections

Stephanie Leong BSN, RN, CIC

University of San Francisco

NURS 653 Internship Fall 2019

Abstract

Site Infections (SSIs) are the second highest amongst healthcare-associated infections (HAIs). SSI rates are disproportionally higher among colon surgeries, resulting in significant complications with adverse clinical and economic impacts (Keenan et al., 2014). The overall upward trend in SSI rates, including the increase colon SSI rates in 2018 called for immediate action in a 120-bed community medical center. A multidisciplinary team was assembled to implement an improvement initiative using evidence-based guidelines. An evidence-based care bundle was designed and implemented to prevent and reduce colon SSI rates. There are seven process measures: the use of chlorhexidine wipes preoperatively, hair clipping outside the operating room, weight-based antibiotics, normothermia, antibiotic redosing, surgical skin prep and glucose monitoring. The outcome measure is to achieve a consistent standardized infection ratio (SIR) of less than one for three out of four quarters by the end of the 2nd quarter of 2020. Only one SSI for colon surgery was identified to date for 2019, compared to four identified in 2018. There was a 75% decrease of colon SSIs. Our institution had a high proportion of SSI cases represented in colorectal cases. With the implementation of a prevention bundle, the rate of SSIs in colon surgery significantly decreased.

Introduction

The community medical center has been providing healthcare since 1949. The120-bed medical center employs more than 1,700 staff and is comprised of four medical campuses in three communities: South San Francisco, San Bruno, and Daly City (Kaiser Permanente, 2019). The medical center is known as a Bariatric Surgery Center of Excellence and Cancer Treatment Center (Kaiser Permanente, 2019). The institution provides a wide range of specialized services including colorectal surgery, head and neck surgery, and musculoskeletal surgery. For over three years, the overall SSI rates have continued to be above national benchmark at the medical center, indicating that more infections were observed than predicated.

Problem Description

The estimated incidence of surgical site infection (SSI) is 110,000 to 370,000 annually in the United States, accounting for greater than 20% of healthcare associated infections (HAIs). The estimated deaths associated with SSIs each year is 8,205 (Klevens et al., 2007). The financial burden of an SSI is substantial, costing approximately between 3.5 and 10 billion dollars annually for all SSIs in the United States (Zimlichman et al., 2013). Moreover, SSIs are associated with readmissions and increase length of hospitalization, estimating an additional 11 days. Approximately over half of SSIs are preventable by application of evidence-based strategies (Berríos-Torres et al., 2017). The care bundle methodology is an accepted practice for prevention of SSIs, which originated with the Institute for Healthcare Improvement (IHI) in 2001 (Tanner et al., 2015)

SSI rates are disproportionately higher among patients following colon and rectal surgeries, ranging from 15% to 30% (Keenan, 2014). Therefore, reduction in SSIs for colon and rectal surgeries became a national quality improvement initiative by the Centers for Medicare and Medicaid Services (CMS) and the Centers for Disease Control and Prevention (CDC). The initiative focuses on improving adherence to evidence-based practices set by the Surgical Care Improvement Project (SCIP). Public reporting of process, outcome, and other quality improvement measures is now required, and reimbursements for treating SSIs are being reduced or denied (Berríos-Torres et al., 2017). Hospitals are also required to report rates of colon SSIs to the CDC's National Healthcare Safety Network (NHSN). In addition, colon procedure SSIs tie into reimbursement through the CMS's Hospital Acquired Condition (HAC) Reduction program.

For the calendar year of 2018, the colon SSI rate increased from the previous two years (See appendix Q). There was a total of four colon SSI cases with an standardized infection ratio (SIR) at 1.458, which is above the organization's target SIR goal of less than 1.0. Due to the economic impact and increase of SSI rates over three years, the medical center began to implement the SSI prevention measure bundle at the end of 2018 and beginning of 2019. In efforts to reduce rates of complications and SSI rates in colon surgery, the prevention bundle implemented includes: the use of chlorhexidine wipes preoperatively, hair clipping outside the operating room, weight-based antibiotics, normothermia, antibiotic redosing, surgical skin prep and glucose monitoring. The organization's goal is to reduce not only SSIs in colon surgery, but overall SSIs with a SIR goal of less than 1.0. With the implementation of the prevention bundle, the organization will reduce patient harm, readmissions, length of hospital stay, and health care cost.

Available Knowledge

The search for evidence was initiated using the problem, intervention, comparison, and outcome, time (PICOT) framework to establish the following clinical question: SSIs in colon surgery (P), with colorectal SSI bundle (I), compared (C) to patients missing elements of the colorectal bundle, decrease colorectal SSI rates (O), by the end of 2nd quarter of 2020 (T)?

A systematic search was conducted using these databases: Cochrane database, CINAHL, PubMed, SCOPAS, and Evidenced-Based Journals and key words: *surgical site infection, SSI, bundle, prevention, and colon surgery*. Twenty-six articles were found, and duplications were excluded. Evidence was narrowed down to the strongest evidence that was most relevant to the PICOT question.

Hoang et al. (2019) conducted a prospective study to determine the value of implementing a colorectal bundle on SSI rates. The sample of the study was drawn from a tertiary care affiliated university hospital in which a total of 1351 patients underwent colorectal surgeries (CRS) between 2011 and 2016. Patients were grouped into pre-implementation (Group A, January 1, 2011 to December 31, 2012), implementation (Group B, January 1, 2013 to December 31, 2014) and post-implementation (Group C, January 1, 2015 to December 31, 2016). The outcome measures were superficial SSI, deep SSI, wound separation and total SSI. The study showed a significant decrease when comparing Group B and Group C in superficial SSI (6.6% versus (vs) 4%, P = 0.017), deep incisional SSI (3.7% vs 1.1%, P = 0.002) and total infection (10.9% vs 4.7%, P = 0.0001). Additionally, when comparing Group A with Group C, there was significant decrease in superficial SSIs (6.1% vs 4%, P = 0.02), deep incisional SSI (2.6% vs 1.1%, P = 0.04), and total infection (9.4% vs 4.7%, p = 0.003).

The Hoang et al. (2019) study also evaluated the compliance with the bundle elements. The total audits in Group B and Group C were 335 and 459, respectively. The study found when comparing the two groups that there was an increase in compliance with re-dosing of intraoperative antibiotics (38% vs 75%, $P < 0.05$), utilization of closing tray (95% vs 99.4%, $P = 0.00012$), and changing of gowns and gloves at closing (95% vs 99.4%, $P = 0.00012$). The two main limitations noted were: 1) compliance may differ on a case by case basis with a larger institution, and 2) greater volume of laparoscopy and lower rectal cancer cases in Group C may have had an impact on the SSI reduction rates observed. However, the study offered evidence that small changes can lead to significant decreases in surgical site infections.

Edmiston et al. (2018) conducted a systematic review on supporting evidence of an incision closure bundle for CRS. The authors indicated there was a compelling body of evidence that demonstrates the effectiveness of surgical care bundles in reducing the risk of SSI after CRS. Upon review, a 2017 meta-analysis that reviewed 23 studies (17,557 patients) reported outcomes from the use of surgical care bundles (Zywot et al., 2017). The researchers noted an SSI risk reduction of 40% ($P < .001$), with a 44% reduction of superficial SSIs ($P < .001$) and a 34% reduction of organ and space SSIs ($P = .048$). Bundles that included sterile closure trays, mechanical bowel preparation with oral antibiotics, and pre-closure glove changes demonstrated significantly greater SSI risk reduction. However, they did not find any studies addressing the standardization of the entire process of incision closure, beginning with the use of irrigation. Upon their review, there were two evidence-based interventions that have a well-documented risk-reduction potential that were omitted in the bundles: use of antiseptic-coated suture and 0.05% chlorhexidine gluconate (CHG) surgical irrigation (Edmiston et al., 2018).

Edmiston et al. (2018) concluded that evidence-based components of an incision closure bundle composed of a glove and sterile instrument set change, irrigation with 0.05% chlorhexidine solution, use of triclosan-coated sutures, removal of surgical drapes after applying postoperative dressings, use of topical skin adhesive or an antiseptic dressing, and distribution of comprehensive postoperative patient instructions could provide an opportunity to improve outcomes after CRS.

Keenan et al. (2014) conducted a retrospective study of institutional clinical and cost data to determine the effect of a preventive SSI bundle on SSI rates and costs in CRS. The study period was January 1, 2008 through December 31, 2012, and outcomes were assessed and compared before and after implementation of the bundle on July 1, 2011. Of 559 patients in the study, 346 (61.9%) and 213 (38.1%) underwent their operation before and after implementation of the bundle, respectively. There were characteristic differences between the pre-implementation and post-implementation group. The median age was older in the pre-bundle group (62.2 vs 58.7 years, $P = .04$). There was a higher percentage of patients in the pre-bundle group who received preoperative radiation therapy (19.1% vs 12.2%, $P = .04$). In contrast, a lower percentage of patients in the pre-bundle group had received recent chemotherapy (5.5% vs 14.6%, $P < .001$) and the proportion of laparoscopic cases was lower in the pre-bundle group (38.4% vs 58.7%, $P < .001$). Group were matched to account for the differences, which generated 212 patients. There was no significant difference observed in patient demographics, baseline characteristics, or procedure-specific factors between the matched groups (Keenan et al., 2014). Evaluation of outcomes indicated a significant reduction in superficial SSIs (19.3% vs 5.7%, $P < .001$) and postoperative sepsis (8.5% vs 2.4%, $P = .009$) in the post-bundle period (Keenan et al., 2014). There were no significant differences observed in deep SSIs, organ-space SSIs, wound

disruption, length of stay, 30-day readmission, or variable direct costs between the matched groups (Keenan et al., 2014). The authors also performed a subgroup analysis of patients with vs without superficial SSI occurrence during the post-bundle period. Superficial SSI occurrence was associated with a 35.5% increase in variable direct costs ($13 253 vs $9779, $P = .001$, $R^2 = 0.504$) and a 71.7% increase in length of stay (7.9 vs 4.6 days, $P < .001$, $R^2 = 0.359$) for the index admission (Keenan et al., 2014). Despite the limitations of the study, the article showed that the preventive SSI bundle can effectively reduce the SSI rates in elective CRS and reduce healthcare cost.

Tanner et al. (2015) conducted a meta-analysis of quasi-experimental studies, randomized control trials, and cohort studies to assess the effectiveness of care bundles to reduce SSIs in CRS. There were 95 articles reviewed with 16 studies that evaluated the effect of implementing care bundles among patients undergoing colorectal surgery on SSIs (Tanner et al., 2015). This meta-analysis, which included 8,515 patients, revealed an SSI rate of seven percent for the patient cohort who utilized a care bundle, and 15.1 percent in the non-care bundle cohort. The Tanner et al. study represented the first meta-analysis to date that examined the use of a surgical care bundle to reduce SSI in CRS. Most of the studies reviewed had used a care bundle of evidence-based interventions that compromised of appropriate antibiotic management, appropriate hair removal, maintenance of normothermia, and glycemic control. These “core” elements are mandated by CMS for all patients undergoing CRS. There were two main limitations noted: 1) failure of the uniformity of SSI data collection, and 2) failure to report use of care bundles. The authors of review noted that evaluating the compliance rate of the bundle intervention was an issue throughout the review because the bundle interventions were implemented prior to the introduction of the full surgical care bundle. Moreover, the authors

reported that implementing an effective SSI surgical care bundle requires the healthcare organization to commit both fiscally and logistically to cover staff time, effort, and consumables (Tanner et al., 2015). The review suggested that a multidisciplinary approach using evidenced-based practices will result in a reduced risk of infection in the colorectal patient population (Tanner et al. 2015).

Crolla et al. (2012) conducted a prospective quasi-experimental study to measure the effects of SSI rates after implementing a bundle of care based on the criteria from the CDC in a large teaching hospital. Variables were examined using a univariate Fishers exact test or T-test. Those variables with a p value of 0.2 were included in a logistical regression analysis. A Kaplan Meier survival analysis was used to compare mortality. A total of 1,537 CRS was performed during the study period from June 2009 through October 2011. The increased use of the bundle correlated with the decrease of SSIs. There was a statistically significant difference found in the six month mortality rate in patients with no SSI ($p<0.001$), versus the patient with an SSI (Crolla et al., 2012). The implementation of the bundle was associated with a decrease in SSI of 36 percent (Crolla et al., 2012). The recommendation was that a bundle should be limited to three to five evidenced based interventions. In addition, all bundle elements should be followed for every patient, which creates a culture of safety. Compliance helps to cultivate a culture of safety in the operating space-by decreasing infection rate and improving patient safety (Crolla et al., 2012).

The Johns Hopkins Nursing Evidenced-Based Practice (JHNEBP) Research Appraisal Tool (Johns Hopkins Hospital/The Johns Hopkins University, 2012) was utilized to critically appraise the level and strength of studies in this search. The articles revealed a level of evidence

between level II and III, and appraisal levels between A and B, indicating good quality (see Appendix A). SSIs in colon surgery are a complex problem with multiple variables that are specific to patients and patient populations, surgical practice and process. The different types of studies used for this project includes prospective, systematic review, retrospective, and meta-analysis of quasi experimental randomized control trials and cohort studies, which all demonstrated that the use of evidence-based bundle practices lower SSI rates in colon surgeries.

Rationale

Theoretical framework: Kotter's model of change is an effective way to implement and sustain change successfully. The eight steps for transforming organizations include: 1) Establish a sense of urgency 2) Create a powerful coalition 3) Develop a strategy and vision 4) Communicate the change vision 5) Empower action 6) Generate short-term wins 7) Consolidate gains and create more change, and 8) Make it a part of the culture (Aziz, 2017). Kotter's theory is more salient in healthcare today as the healthcare system is evolving, with its focus shifting towards quality improvement initiatives and patient outcomes. The first step of creating a sense of urgency involves helping people to see the need for change and the importance of acting. The second step is to create a group that has the influence to lead the change within the organization. A clear vision must be developed to help direct the change effort and provide guidance on how the change will be achieved. Communication is key to ensure support and acceptance of the change. It is vital to involve key stakeholders to remove any barriers and perform activities aligned with the vision. Celebrating short-term wins and recognizing those involved in a visible manner can boost morale and develop people as change agents. Finally, the new approaches must be embedded into the organization's culture for sustained change (Aziz, 2017). Kotter's change

theory steps were used for this project. The multidisciplinary team created a sense of urgency and developed a strategy to take action in reducing SSIs in colon surgery at KP SSF.

Specific Project Aim

The aim of this project is to decrease SSIs in patients undergoing colon procedures by increasing adherence of the prevention measure bundle guidelines to 85% by the end of 2nd quarter of 2020. By working on this process, the outcome is to achieve a standardized infection ratio (SIR) of less than one for three out of four quarters by the end of 2nd quarter of 2020.

Methods

Context

The strategy utilized to decrease SSI in colon surgery was to implement a bundle of process measures to achieve a reduction in colorectal SSIs. The IHI Model for Improvement (MFI) framework was utilized to create standard workflows and decrease variation to ensure all patients received all the elements of the bundle. The microsystem assessment of the Perioperative Department was completed using Dartmouth Microsystem Assessment tool (Institute for Healthcare Improvement, 2016).

The Perioperative department currently has a total of 66 staff members that include 34 full time registered nurses (RNs) (majority with a bachelor's degree), 12 per diem RNs, nine surgical technicians, three per diem surgical technicians, seven patient care technicians, and one unit assistant. Recently, the perioperative director and manager for Hospital Ambulatory Surgery (HAS)/Post-Anesthesia Care Unit (PACU) and Operating Room (OR) permanent positions have been filled. There are five operating rooms, and six patient spaces in the perioperative unit and post-anesthesia care unit (PACU). The total volume of NHSN surgical procedures performed in

the medical center is approximately 1200 to 1600 cases annually, of which 64 to 80 are colon surgeries. There is a total of 17 general surgeons**,** including one primary colorectal surgeon and seven head and neck surgeons. Huddles occur every morning at the start of each day to discuss scheduled patients including quality improvement and safety practices. Multidisciplinary rounds occur daily to discuss scheduled cases and the needed equipment, surgical instruments and implants specific to the scheduled cases.

The continous struggle of not meeting the SSI national benchmark performance and the increase rate of SSI in colon surgery created a sense of urgency to review evidence-based guidelines and implement the prevention bundle in order to prevent and reduce SSI rates. The bundle was developed based on the literature review and the recommendations of the American College of Surgeons, the World Health Organization, and CDC (Peacock, 2018) (See Appendix B). A communication plan was established for the bundle implementation, need for an SSI multidisciplinary team, and tracking of bundle element compliance (See Appendix C).

Several efforts have been established prior to the implementation of the prevention bundle to decrease colon surgeries. The strategies included the use of a closure tray, changing gloves prior to closing, wound protectors, and implementation of a robust terminal cleaning process in the operating room suites. The cleaning process for the instruments used in colon surgery will be evaluated in the sterile process decontamination area. The project will ensure that all prevention bundle elements and evidence-based practices are implemented to decrease the colon surgical site infection rates and improve patient safety.

The team conducted a Strengths, Weakness, Opportunities, and Threats Analysis (SWOT) (see Appendix D) to determine areas of focus for potential threats and barriers. Potential weaknesses include documentation challenges, inconsistent practices and processes,

and leadership turnover, while a real threat is work stoppage and CHG product backorder. An existing gap includes normothermia documentation with temperature being obtained, however not documented. Currently, nurses are auditing the documentation of the patient's temperature intraoperative to postoperative daily.

The average adjusted additional cost for an SSI is $35,000. The average adjusted length of stay for an SSI is 10 days. The cost of stay per day is $3,500. The estimated adjusted cost saving by implementation of the project is $665,000 annually. The estimated projected cost of the colon SSI reduction project is $12,500 for one year, which includes key stakeholder who are salaried and cost for education materials. With the improvement costs deducted, there will be an overall savings of $652,500. This project presents promising financial gains for the organization. There are also non-financial impacts, which include preventing patient harm, length of stay, readmission rates, and health care cost. The project also increases staff awareness and confidence to provide the best evidence-based practices. The analysis of return on investment (ROI) supports the rationale to approve the SSI project (See appendix E).

Interventions

To execute the improvement project initiative, the multidisciplinary team, including physician champions (Anesthesia, Surgery, Infectious Disease), perioperative leaders, frontline perioperative staff, an infection prevention program manager, a quality nurse consultant, and a nurse educator, was assembled. The three phases of the project included: preparation, planning and implementation. In the preparation phase, the team met to review roles and project objectives. In the planning phase, the team addressed barriers, scheduled future meetings, identified initial test of change, and mapped the current workflow. The implementation phase

included finalizing workflow changes, developing the plan for spread, and mapping the new workflow.

The seven prevention bundle elements include: the use of chlorhexidine wipes preoperatively, hair clipping outside the operating room, weight-based antibiotics, normothermia, antibiotic redosing, surgical skin prep and glucose monitoring. Educational materials for every identifed bundle of prevention measures to reduce SSI risk in colon surgery was shared with staff. An assessment of the equipment and supplies needed to implement the prevention bundles was performed.

The multidisciplinary team also developed a standardized audit tool to drilldown on all identified SSI cases (See Appendix F) and implemented a tracking log for actionable findings. The Surgical Quality Safety (SQS) Committee was formed in January 2019, and the interventions of the bundle are being measured and reported out on a monthly basis at the SQS Committee. The project charter (see Appendix G-O) was created to describe the performance improvement rationale, timeline, goals, barriers, and anticipated resources to which the team will commit. After 16 weeks of preparation, planning, and implementing test of change, the SSI rates in colon surgery will be monitored and process measure metrics tracked monthly.

Measures

All bundle elements were listed as separate process measures. The process measure documentation was pulled directly from the electronic medical record (EMR). The medical center uses the operational dashboard and medical record level reports as measurement strategy needed to understand opportunities and improve outcomes (See Appendix N). The outcome measure will be the SSI rate in colon surgery**,** which will be reported from NHSN. NHSN is one

of the nation's most widely used healthcare-associated infection (HAI) tracking systems under CDC.

Ethical Considerations

The responsibility of the nurse is to always uphold the values and ethics of the profession. Their primary commitment is to the patient. The nurse advocates, protects, and promotes health and safety of the patient (American Nurses Association, 2015). Nurses are accountable to provide optimum, respectful, and dignified patient care, while executing implementation of evidence-based practices. These values are shared by Kaiser Permanente, and the Jesuit Catholic values that are integrated in the curriculum for the University of San Francisco.

Surgical safety and the prevention of infection is comprehensive and spans the continuum of care. The role of the nurse is to ensure patient safety and implement evidence-based SSI prevention strategies. The project aims to improve outcomes for our patients and to ensure all patients receive standard surgical site infection prevention measures. The project's strategic initiative to prevent SSIs in colon surgery will improve care delivery and prevent harm that could negatively impact the well-being of the patients and the communities we serve. This project has been determined to meet the standards of a non-research evidenced based practice change. (See Appendix H). There are no conflicts of interest identified for this project.

Results

The strategy utilized to decrease SSI rates in colon surgery was to implement the evidence-based prevention bundle elements combined with consistent practice in order to achieve the aim of the project. The planning of the project was initiated in the beginning of this year with the development of the timeline (Appendix O). The project is currently in between the

standardization and sustainability stages. The seven bundle elements include: the use of chlorhexidine wipes preoperatively, hair clipping outside the operating room, weight-based antibiotics, normothermia, antibiotic redosing, surgical skin prep and glucose monitoring. The prevention bundle elements were embedded into the new workflow of the perioperative phases: preoperative, intraoperative, and postoperative (See Appendix J). In the preoperative phase, the prevention bundle elements include: use of chlorhexidine wipes, normothermia, glucose monitoring, and hair clipping. A more in depth workflow was created for the preoperative phase (See Appendix K). In the operative phase, the elements include: weight-based antibiotics, surgical skin prep, and antibiotic redosing. In the postoperative, elements include normothermia and glucose monitoring.

Current data shows as the prevention bundle was implemented, the process measures have helped reduce colon SSIs by 75% compared to last year (See Appendix R). So far, there is a total of one colon SSI event compared to four colon SSI events last year. This year, there was a total of four colon SSI events that were infected present at time of surgery (PATOS) and is not included in the SIR. The aim of this project is to achieve colorectal SSI SIR of less than one for three out of four quarters by increasing adherence of the prevention measure bundle guidelines to 85% by the end of 2nd quarter of 2020. Overall, all bundle compliance is currently at 80.7% in October, which is still not meeting target goal of 85% (See Appendix S). However, the use of CHG wipes in the preoperative has improved from 84% to 87.1% compliance in March compared to October 2019. No significant improvements in the following metrics from March compared to October 2019 for: first antibiotics metric, surgical skin prep, hair clipping, antibtioics redosing, and normothermia postoperatively. There was 100% compliance in glucose monitroing for all patients in preoperative and postoperative for

patients within the SSI surgical populations who are diabetic or staying overnight or had a preoperative blood sugar above 180 in October 2019.

The project began with the following process measures based on the literature. Contextual factors that interacted with our interventions included the operating environment, cleaning of the instruments in the Sterile Processing Department, traffic in the OR, surgical attire, and laminal air flow. There are other metrics that were added to the high level report to be monitored such as: carbon monoxide, preoperative weight, and postoperative warming, which includes only patients within the SSI population with a postoperative temperature less than 96.8 Fahrenheit or missing postoperative tempearture. There is still an opportunity to work on the process metrics such as use of CHG wipes in preoperative and postoperative warming, and antibiotics redosing. All the other process measures seem to be hardwired into the perioperative workflows.

Discussion

Summary

The aim of this project is to reduce the SSI rates in colon surgeries by implementation of theevidenced-based prevention bundle, while being measured and evaluated. So far, with the increased compliance of the process measure, there seems to be a correlation with the reduction of SSI rates in colon surgery. The data of the process measures helps the team understand and identify the opportunities for improvement. The study of the results in colon surgery SSI rates will be at the end of 2nd quarter of 2020. The effectiveness of the prevention bundle in correlation to the SSI rates in colon surgery will be evaluated.

Key Findings

There were several key findings from the project. The first key finding is the importance of executive, physician, and leadership support to effectively implement process measures and ensure transformational change with sustainability. The focus of implementing and improving the process measures can drive quality improvement and positive patient outcomes.

In addition, engaging and involving the team, frontline staff and anesthesia group in developing and standardizing workflows is essential. The frontline staff and the key stakeholders are the experts in their daily workflow. They should have the opportunity to voice concerns and decide on the best workflow to provide the best quality care to the patients.This would also increase sustainability.

Another key finding is creating a tracking system of the identified opportunities when discussing the process metrics and drilling down on an SSI case was found to be extremely helpful. The tracking system includes the opportunity, accountable person to help champion the opportunity, status of completion, and actions taken. The tracker is a helpful tool to use when reporting out the opporunties for improvement to the SQS Committee.

Lessons Learned

The implementation of evidence-based practices with the goal of failure free operation is essential in order to improve patient outcomes. Developing a clear communication plan and expectation of the team's role when an SSI is identified was key . Establishing real-time data, continuous support and collaboration from leadership was an essential factor in the project. The real-time data helped the team and leadership understand the compliance of the metrics and identified any actionable opportunities needed in order to reach our goal. The creation of the high level workflows helped front line staff with standardization of processes, especially when rolling out several bundle elements at a time.

There were other factors besides the implementation of the prevention bundle that could correlate to the reduction of the SSI rate in colon surgery that are already in place such as mechanical bowel preparation with oral antibiotics prior to surgery, closure tray, and changing of gloves prior to closure. There were identified issues with documentation of temperature and actions were taken immediately to improve process measure with the anesthesia group to ensure accurate temperatures were being documented into the charts.

Executive and leadership support with a dedicated multidisciplinary team are essential contribution to successful change. The team established and scheduled meetings to accommodate the surgerons availability to obtain high level of participation and engagement. Other contributing factors include real time data feedback, SQS committee oversight of SSI prevention initiative, and established high level workflows for standardization and sustainability.

Conclusions

The project was to implement and sustain prevention bundle elements in order to reduce SSI in colon surgery. The bundle would not only be used for colon surgery patients, but for all surgical patient population to prevent SSIs. With the educational materials and established workflows, the Perioperative Department will continue to sustain the process measures to prevent SSIs. The data on the evidence-based process measures will continue to be monitored and reported out on a monthly basis. Transparency and realtime data feedback helps the team understand the progess and improve on the processes. New methods need to be advanced to reduce SSIs in colorectal surgery (Fry, 2013). The area of colonic preparation needs innovative efforts in the development of effective methods for prevention and less recapitulation of studies that have limited value in advancing the outcomes of care (Fry, 2013). A multifaceted SSI prevention approach is needed in order to reduce SSIs and improve patient outcomes.

References

American Nurses Association. (2015, January). Code of Ethics PDF. Retrieved November 6, 2019, from https://www.nursingworld.org/coe-view-only.

Aziz A. M. (2017). A change management approach to improving safety and preventing needle stick injuries. *Journal of infection prevention*, *18*(5), 257–262. doi:10.1177/1757177416687829

Berríos-Torres, S. I. (2017, August 01). CDC Guideline for the Prevention of Surgical Site Infection, 2017. Retrieved November 6, 2019, from https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725

Edmiston, C. E., Leaper, D. J., Barnes, S., Jarvis, W., Branden, M., Spencer, M., … Johnson, H. B. (2018). An Incision Closure Bundle for Colorectal Surgery. *AORN Journal*, *107*(5), 552–568. doi: 10.1002/aorn.12120

Fry D. E. (2013). The prevention of surgical site infection in elective colon surgery. *Scientifica*, *2013*, 896297. doi:10.1155/2013/896297

Institute for Healthcare Improvement (IHI). Clinical Microsystem Assessment Tool. Retrieved on November 6, 2019 from http://www.ihi.org/resources/Pages/Tools/ClinicalMicrosystemAssessmentTool.aspx

Hoang, S. C., Klipfel, A. A., Roth, L. A., Vrees, M., Schechter, S., & Shah, N. (2019). Colon and rectal surgery surgical site infection reduction bundle: To improve is to change. *The American Journal of Surgery*, *217*(1), 40–45. doi: 10.1016/j.amjsurg.2018.07.008

Johns Hopkins Hospital/The Johns Hopkins University (2012). research appraisal tool. In S. L. Dearholt & D. Dang (Eds.), Johns Hopkins nursing evidence-based practice: Model and guidelines (2nd ed., pp. 237-240). Indianapolis, IN: Sigma Theta Tau International Honor Society of Nursing.

Kaiser Permanente. (2019). South San Francisco Welcome To South San Francisco Medical Center - Kaiser Permanente. Retrieved November 6, 2019, from https://thrive.kaiserpermanente.org/care-near-you/northern-california/southsanfrancisco/news-events/welcome-to-south-san-francisco-medical-center/.

Keenan, J. E., Speicher, P. J., Thacker, J. K. M., Walter, M., Kuchibhatla, M., & Mantyh, C. R. (2014). The Preventive Surgical Site Infection Bundle in Colorectal Surgery. *JAMA Surgery*, *149*(10), 1045. doi: 10.1001/jamasurg.2014.346

Klevens, R. M., Edwards, J. R., Richards, C. L., Horan, T. C., Gaynes, R. P., Pollock, D. A., & Cardo, D. M. (2007, March). Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Retrieved November 6, 2019, from https://www.ncbi.nlm.nih.gov/pubmed/17357358.

Lutfiyya, W., Parsons, D., & Breen, J. (2012). A colorectal "care bundle" to reduce surgical site infections in colorectal surgeries: a single-center experience. *The Permanente journal*, *16*(3), 10–16.

Peacock, T. (2018). Implementing a Surgical Infection Prevention Practice in an Integrated Healthcare System. Retrieved November 6, 2019, from https://repository.usfca.edu/cgi/viewcontent.cgi?article=1164&context=dnp

Tanner, J., Padley, W., Assadian, O., Leaper, D., Kiernan, M., & Edmiston, C. (2015). Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery, 158(1), 66-77. 10.1016/j.surg.2015.03.009

Zimlichman, E., Henderson, D., Tamir, O., Franz, C., Song, P., Yamin, C. K., … Bates, D. W. (2013, December). Health care-associated infections: a meta-analysis of costs and financial impact on the US health care system. Retrieved November 6, 2019, from https://www.ncbi.nlm.nih.gov/pubmed/23999949.

Zywot, A., Lau, C. S. M., Stephen Fletcher, H., & Paul, S. (2017, November). Bundles Prevent Surgical Site Infections After Colorectal Surgery: Meta-analysis and Systematic Review. Retrieved November 6, 2019, from https://www.ncbi.nlm.nih.gov/pubmed/28620749.

Appendix A

Evaluation Table

Citation	Conceptual Framework	Design/ Method	Sample Setting	Variables Studied and Their Definitions	Measurement	Data Analysis	Findings	Appraisal: Wort
Crolla, R., et al. (2012)	None	Prospective quasi experimental cohort study	1537 Colon Surgeries	Use of bundle of interventions versus no interventions	Surgical Site Infections	Logistic regression	Bundle usage improves Patient Safety and decreases SSI	**Strengths:** Increased compliance for bundle used correlated with decreased SSI **Limitations:** Only one type of surgery was used for this study **Critical Appraisal Tool & Rating:** JHNEBP Level II Quality Rating A
Edmiston et al., (2018)	None	Systematic review	The number of articles reviewed is not listed in the article. There were 88 references listed	Implementation of colorectal incision closure bundle	None	Review with an expert panel	Comprehensive surgical incision closure bundle can improve SSIs in colorectal surgery and improve outcomes.	**Strengths:** To be successful in bundle use you need to measure outcomes and constantly reviewing the evidence for updated literature **Limitations:** Only two guidelines were fully addressed **Critical Appraisal Tool & Rating:** JHNEBP Level III Quality Rating B
Hoang et al. (2019)	None	Prospective study	A tertiary care affiliated	Pre-implementation, implementation, and post-	Superficial SSI, deep SSI, wound separation and total SSI.	Statistical Analysis System 9.4	The use of the bundle was correlated to decrease in SSI	**Strengths:** The study evaluated compliance

			university hospital. N=1351 colorectal surgeries.	implementation of bundle intervention.				with the bundle elements **Limitations:** Results may have been impacted by the greater use of laparoscopy in the post-implementation group and lower percentages of rectal cancer cases performed during this time period. **Critical Appraisal Tool & Rating:** JHNEBP Level II Quality Rating A
Keenan et al., 2014	None	Retrospective cohort study	Academic tertiary referral center. N= 559 colorectal procedures.	Use of bundle of interventions versus no interventions	SSI rate	Pearson χ^2test or Fisher exact test for categorical variables and *t* test for continuous variables	Implementation of the bundle was associated with a reduced rate of postoperative sepsis.	**Strengths:** Study showed increase costs savings associated with SSIs support **Limitations:** The study focused on elective colorectal surgical procedures performed at a single institution and bundle elements of multiple interventions. **Critical Appraisal Tool & Rating:** JHNEBP Level II Quality Rating A
Tanner, J., et al. (2015)	None	Systematic review and Meta-analysis	95 full test articles in 13 separate studies	Use of bundle of interventions versus no interventions	Surgical Site Infections	Cochrane Review Manger	The use of a surgical bundle was correlated	**Strengths:** The first meta-analysis looking at the efficacy of the

						version 5.2	to a decrease in SSI	use of surgical bundles to prevent SSI **Limitations:** Failure of the consistency of SSI data collection, and failure of some studies to report use of care bundles **Critical Appraisal Tool & Rating:** JHNEBP Level II Quality Rating A

Appendix B

Expert Peri-op Recommendations

Prevention Measure	WHO (2016)	ACS (2016)	CDC 2017
Normothermia	x	x	x
Nasal Decolonization (cardiac & ortho)	x	x	x
MBP with antibiotics (colorectal)	x	x	x
Hair removal when necessary (pre-op)	x	x	x
Glucose control	x	x	x
Prophylactic Antibiotic	x	x	x
Pre-op Bathing	x	x	x
Case Cancelation		x	
Smoking Cessation	x	x	x
Enhanced Nutritional Support	x	x	
Surgical Skin Prep	x	x	x
FIO2 >/= 50%	x	x	
Antibiotic Redosing	x	x	x
Surgical Hand Prep	x	x	x
Wound protector (Colorectal and hepatobiliary)	x	x	
Antimicrobial Sutures	x	x	
Clean Closing Tray (Colorectal)		x	
Skin sealants	x		
Normovolaemia	x		x
Laminar Air flow	x		

Appendix C

Communication Plan

Communication Plan				
Stakeholder	Actions Desired	Communication Message	Delivery	By When
Medical Center Senior Leadership	Explain the Initiative Project, expectations and desired outcome.	Overview of the project and cost savings. Expectations of staff and leadership involved, and equipment needed.	In person meeting, email, Infection Control Committee	January 2019
Perioperative Department	Details of the bundle elements	Specifics on project with workflow changes	Staff meeting, huddles, email	February 2019
Perioperative Management Leadership	Explain details of the project implementation, expectations of staff needed,	Specifics on workflow changes and equipment needed for the project	In person with follow up email.	February 2019
Surgical Quality Safety Committee	Updates and tracking of metrics	Progress	Monthly meetings	March 2019
Surgeons	Details of the bundle elements	Specifics needed	Staff meeting and email communication	February 2019

Appendix D

Strengths Weakness Opportunities Threats (SWOT) Analysis

Internal Factors	
Strengths (+)	**Weaknesses (-)**
• Evidence Based • Patient outcomes • Cost savings • Increase reputation e.g. Leapfrog • Buy-in and support among senior leadership, Registered Nurses (RNs), Surgical Tech, Patient Care Technicians (PCTs), Surgeons, Anesthesia, EVS, Quality Specialist, Infection Prevention Program Manager	• Bundle element documentation challenges • Inconsistent practices and processes • Leadership turnover • Workflow changes • One outpatient nurse educator for ambulatory surgery

External Factors	
Opportunities (+)	**Threats (-)**
• Decrease SSIs in colon surgery • Decrease overall SSIs • Decrease length of stay • Decrease Readmissions • Standardizing workflow • Standardizing documentation	• Work stoppage event • Product backorder • New regulations • Lack of resources • Lack of educator in Perioperative Department

Appendix E

Return on Investment (ROI)

Description	**Cost per day**	**Cost per year**
Average adjusted length of stay (LOS) for an SSI = 10 days	Cost per additional hospital day = $3,500	Total savings = $35,000 per SSI
Average incidence of SSIs per year = 19 NHSN SSI events		19 SSI events x 10 days of additional LOS = 190 days 190 days x $3,500 cost per hospital day = $665,000 Total estimated cost saving for SSIs per year = $665,000
Cost of Improvement Initiative		Salaried Key Stakeholders per year = $12,000 Education Material per year = $500 Total= $12,500
Calculated Return of Investment		$665,000 - $12,500 **Total cost savings** = $652,500

Appendix F

SSI Drilldown Audit Tool

Patient Name:	Event Number:
MRN:	Event Type: SSI
DOB:	Event Date:
Age/Gender:	Outpatient Procedure: YES NO
NHSN Procedure Code:	Date of Procedure:
MDRO Infection Surveillance: YES NO	#Days Post Procedure to Infection:
Date of Admission/Location:	Location of Infection:

EVENT DETAILS:

SIP Superficial Incisional Primary DIP Deep Incisional Primary

SIS Superficial Incisional Secondary DIS Deep Incisional Secondary

ORGAN/SPACE: (specify site) _____

Detected:

A During Admission RF Readmission to facility where procedure performed

P Post Discharge Surveillance RO Readmission to facility other than where procedure was performed

Secondary Bloodstream Infection: Yes No	Died: Yes, No SSI Contributed to Death: Yes No
Discharge Date: Discharge Disposition:	Pathogens Identified: Yes No Specify: _____

Brief History of the Case: (Include Signs/Symptoms/MD Diagnosis/Procedures Performed/Radiological Evidence)

PRE-OP

Routine Bath Given Prior to Surgery YES NO	BMI (for C section Patients only)
Hair Removal YES NO	MRSA Screening Done YES NO
Clippers Used YES NO	Date Result POS NEG
CHG Wipes Night Before Surgery YES NO	Pre op ATB Prophylaxis
CHG Wipes Morning of Surgery YES NO	Dose Time
	BMI

INTRA-OP

OR # Wound Class ASA	Incision Time
Skin Prep Agent Chlorhexidine Povidone	Close Time
Allowed to Dry YES NO	Time Incision to Close

Prewarming/Warming YES NO	Blood Glucose
Warming blanket	
SaO2 Oxygen YES NO	Blood Transfusion YES NO
Type	Type
Drains	
Surgeon	Assistant
Anesthesia	Assistant
Temperature	
Scrub Staff	Circulating Staff
Visitors/Trainees in OR YES, NO Number of visitors/trainees	
OR Traffic (if applicable, Number of in and out)	
Implant/s	Manufacturer
Instruments Flashed YES NO	Reason/s for Flashing:
Type	
ABX REDOSING REQUIRED YES NO	
ABX name Dose Time	
POST-OP	
Patient Location	
Post Procedure ATB/Time/Dose	Duration of ATB Prophylaxis
Foley Catheter YES NO	Date of Foley Removal
Temperature YES NO	
Warming Blanket Yes NO	
CHG MouthWash Yes NO	
ADDITIONAL COMMENTS/FINDING	

Appendix G

Project Charter

Global Aim

The aim of the project is to decrease surgical site infections (SSIs) on patients undergoing colon procedures at Kaiser Foundation Hospital South San Francisco (KFH SSF) by increasing adherence of the prevention measure bundle guidelines to 85% by the end of 2nd quarter of 2020. By working on this process, we expect to achieve a standardized infection ratio (SIR) of 1.458 to a consistent SIR of less than 1 for three out of four quarters by the end of 2nd quarter of 2020. The performance improvement project will improve SSI rates in colon surgery, thus decreasing length of hospital stay, readmission, healthcare cost, and improving patient clinical outcomes.

Appendix H

Project Charter

Background

The continual struggle of not meeting SSI national benchmark performance and the increase rate of SSI in colons surgery created a sense of urgency to review evidence-based guidelines and implement the prevention bundle in order to prevent and reduce SSI rates.

The Perioperative department currently has a total of 66 staff members that include 34 full time registered nurses (RNs) (majority with a bachelor's degree), 12 per diem RNs, nine surgical technicians, three per diem surgical technicians, seven patient care technicians, and one unit assistant. Recently, the perioperative director and manager for Hospital Ambulatory Surgery (HAS)/Post-Anesthesia Care Unit (PACU) and Operating Room (OR) permanent positions have been filled. There are five operating rooms, and six patient spaces in the perioperative unit and post-anesthesia care unit (PACU). The total volume of NHSN surgical procedures performed in the medical center is approximately 1200 to 1600 cases annually, of which 64 to 80 are colon surgeries. There is a total of 17 general surgeons**,** including one primary colorectal surgeon and seven head and neck surgeons. Huddles occur every morning at the start of each day to discuss scheduled patients including quality improvement and safety practices. Multidisciplinary rounds occur daily to discuss scheduled cases and the needed equipment, surgical instruments and implants specific to the scheduled cases.

Appendix I

Project Charter

Measures

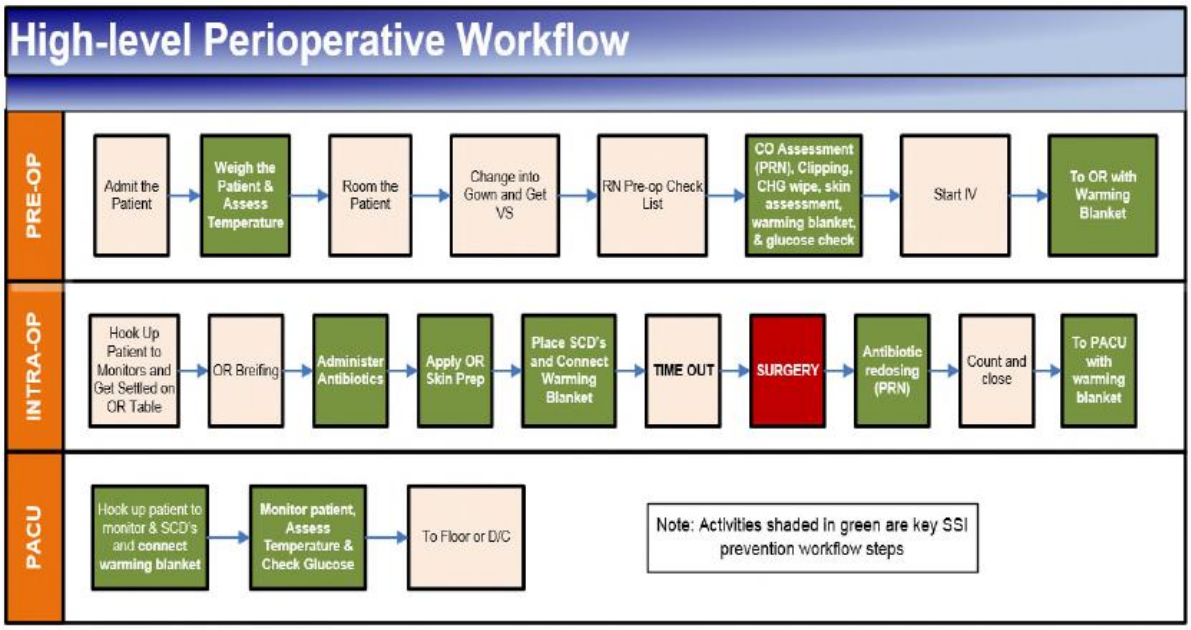
There are seven process measures: The use of chlorhexidine wipes preoperatively, hair clipping outside the operating room, weight-based antibiotics, normothermia, antibiotic redosing, surgical skin prep and glucose monitoring.

The outcome measure is to achieve a consistent standardized infection ratio (SIR) of less than one for three out of four quarters by the end of 2nd quarter of 2020.

Appendix J

Charter

Potential Perioperative Workflow



Appendix K

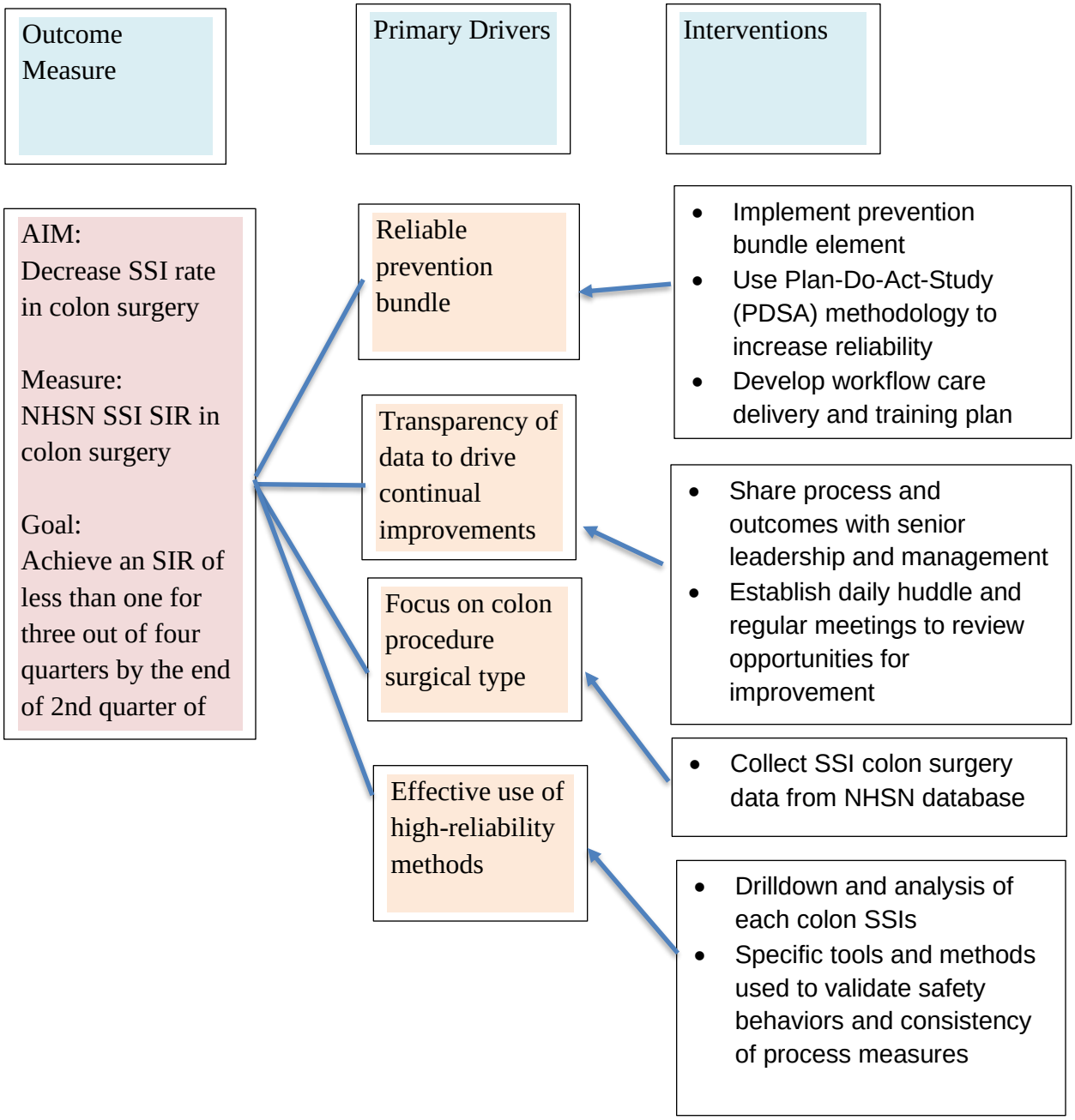
Charter

Detailed Pre-op Workflow

Appendix L

Project Charter

Key Driver Diagram



Appendix M

Project Charter

Sponsors and Team

Sponsor: Chief Nursing Officer and Perioperative Director

Champions: Physicians in Anesthesia and Surgery, Infectious Disease, Perioperative front-line RN, Infection Prevention Program Manager, and Quality Nurse Consultant

Project Leads/Process Owner: Perioperative Director, managers, and perioperative front-line RN

Team Members: Perioperative leaders, perioperative team, surgeons, and anesthesia, Ambulatory Surgery Nurse Educator

Improvement Advisor: Quality Safety Improvement Committee

Appendix N

Project Charter

Measurement Strategy

The process measures are abstracted from the EHR. There is an SSI Facility Comparison Report produced monthly displaying process and outcome measures by Medical Center (See Figure 1). The information included in the report can be used to identify opportunity areas by looking for patterns in the data.

Process Metrics

Facility	Temp in Preop	Weight in Preop	CO Screen completed in Pr..	Warming in Preop	CHG Wipes in Preop	First Antibiotic	Surgical Skin Prep	Hair Clipping in OR	Antibiotic Redose	Temp in Postop	Warming in Postop	Fallout count	Overall Perf. by Facility
SSF	99.7%	96.6%	69.9%	95.3%	87.1%	99.6%	99.7%	4.4%	84.5%	98.6%	52.8%		80.7%

Figure 1.

The outcome measure will be SSI SIR in colon surgery**,** which will be reported from NHSN. NHSN is one of the nation's most widely used healthcare-associated infection (HAI) tracking systems under CDC.

Appendix O

Project Charter

Project Timeline 2019

Description	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Microsystem Assessment												
Aim Statement												
Background												
Measurement Strategy												
Sponsor												
Charter-Team												
Sponsor												
Unit presentation												
Changes to test												
Driver Diagram												
Start Charter												
Collect Data												
Finalize Charter												
Final Presentation												

*Collect Data until 2nd quarterof 2020

Appendix P

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

STUDENT NAME: Stephanie Leong

DATE: 10/5/19 .

SUPERVISING FACULTY: Pamela Pilotin .

Instructions: Answer YES or NO to each of the following statements:

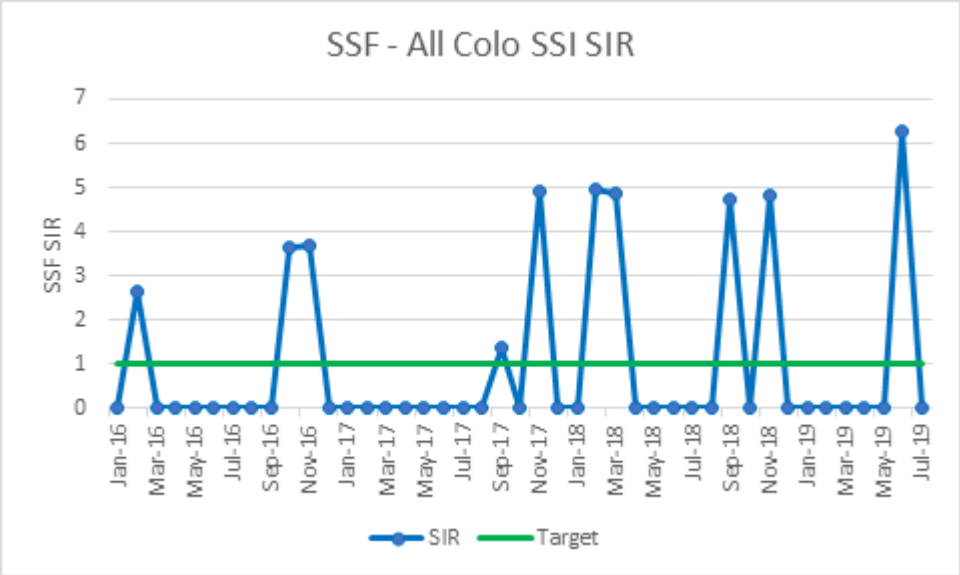
Project Title:	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	X	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	X	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	X	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does **NOT** develop paradigms or untested methods or new untested standards.	X	
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	X	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	X	
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	X	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	X	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: *"This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."*	X	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. IRB review is not required. Keep a copy of this checklist in your files. If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

Appendix Q

Surgical Site Infection in Colon Surgery Standardized Infection Ratio (SIR) 2018

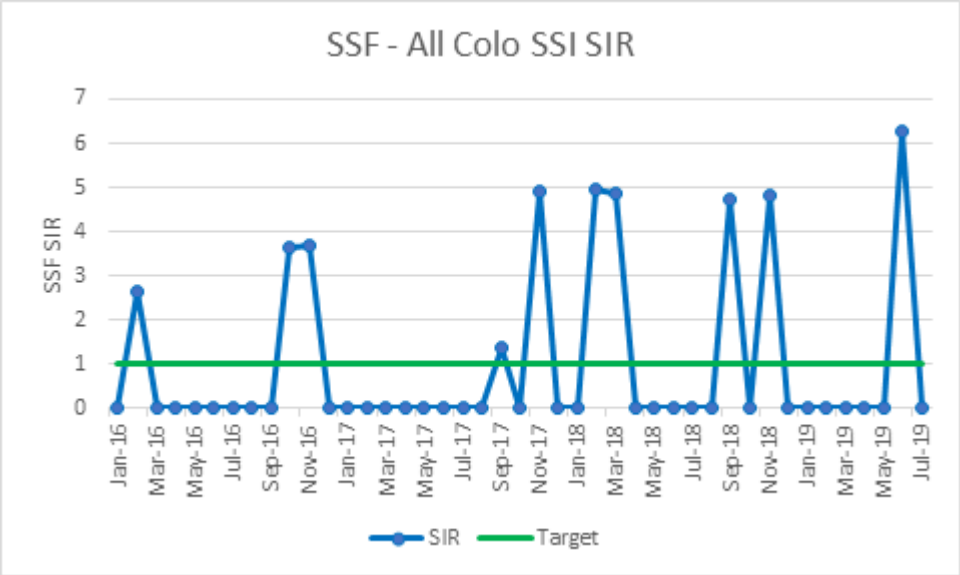


Month	Infections	Predicted # of Infections	SIR
Jan-18	0	0.154	0
Feb-18	1	0.202	4.95
Mar-18	1	0.206	4.85
Apr-18	0	0.244	0
May-18	0	0.202	0
Jun-18	0	0.308	0
Jul-18	0	0.211	0
Aug-18	0	0.453	0
Sep-18	1	0.212	4.72
Oct-18	0	0.186	0
Nov-18	1	0.207	4.83
Dec-18	0	0.158	0

2018	4	2.743	1.458257

Appendix R

Surgical Site Infection in Colon Surgery Standardized Infection Ratio (SIR) 2019



Month	Infections	Predicted # of Infections	SIR
Jan-19	0	0.119	0
Feb-19	0	0.355	0
Mar-19	0	0.36	0
Apr-19	0	0.238	0
May-19	0	0.153	0
Jun-19	1	0.159	6.29
Jul-19	0	0.196	0

2019	1	1.58	0.632911

Appendix S

Process Metrics October 2019

Process Metrics

Facility	Temp in Preop	Weight in Preop	CO Screen completed in Pr..	Warming in Preop	CHG Wipes in Preop	First Antibiotic	Surgical Skin Prep	Hair Clipping in OR	Antibiotic Redose	Temp in Postop	Warming in Postop	Fallout count	Overall Perf. by Facility
SSF	99.7%	96.6%	69.9%	95.3%	87.1%	99.6%	99.7%	4.4%	84.5%	98.6%	52.8%		80.7%