PROJECT NAME: Reducing Deep Sternal Wound Infections

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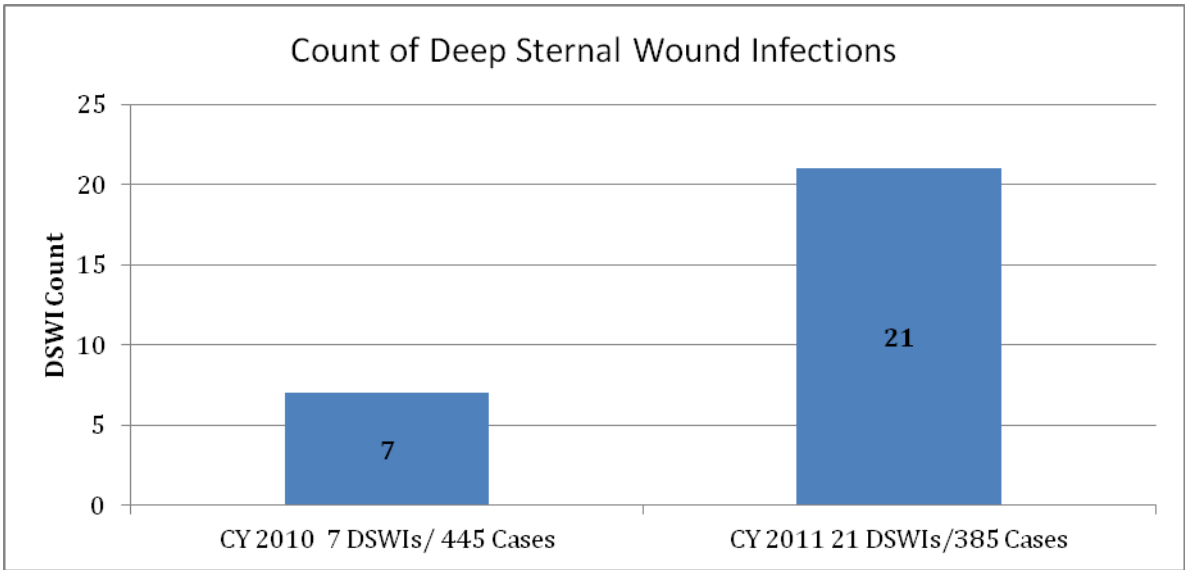
Project Category:
Patient Safety, Effectiveness

Overview:

We initiated the project in February 2012 in several areas at UT Southwestern Medical Center: Cardiovascular operating rooms (CVORs), pre-op holding unit, Cardiothoracic Intensive Care Unit (CVICU) and Cardiothoracic non-ICU. Our improvement project team was multidisciplinary, including bedside nurses, physicians, midlevel providers, medical students, clinical documentation and informatics specialists, pharmacists, data analysts, administrators, executive leaders, and infection control practitioners.

The Department of Health and Human Services (HHS) defines Healthcare-associated infections (HAIs) as infections that people acquire while they are receiving treatment for medical or surgical conditions in a healthcare setting. HAIs are among the leading causes of death in the United States.[1]Surgical site infections are the second most frequent healthcare associated infections among all hospitalized patients, and are responsible for substantial mortality and morbidity. Deep sternal wound infections (DSWIs) are a subset of surgical site infections (SSIs). Our DSWI rate was 5.45% in CY 2011.

Figure 1: Count of deep sternal wound infections at UT Southwestern



Aim Statement (max points 150):

DSWI is a serious clinical complication in thoracic surgery, causing significant morbidity and mortality among patients undergoing cardiothoracic surgery. In addition, DSWIs are important economic factors for the hospital and health-care system. We believe that nearly all DSWIs are preventable.

Our aim is to reduce our DSWI rate from 5.45% to < 1% by Q4 CY 2012 for sternotomy and “re-do” sternotomy patients. The scope of our project includes all open-heart surgery patients at UT Southwestern with median sternotomy.

UT Southwestern is committed to reducing the number of healthcare associated infections (HAIs) by 50% of the 2011 rate by the end of CY 2012. This project is well aligned with organizational priorities.

Measures of Success:

Patient outcomes are the primary measure of success:achieving and sustaining a DSWI rate of <1% SSI Rate. The numerator is all patients who developed deep sternal wound infections and the denominator is all cardiac surgery patients with median sternotomy. Secondary measures of success are process measures: adherence to standardized best practice bundle elements in the preoperative, intraoperative, and postoperative phases of care.

Use of Quality Tools (examples in Appendix)

Our project team used several quality tools throughout the entire project

- Project charter (Figure 4)
  - Kept the team focused and clarify what is expected of the team
  - Helped sustain project alignment with our organizational priorities
  - Provided milestones that gave the team a sense of accomplishment as the project evolved.
  - Provide opportunities for the team and sponsors to reflect and learn what is really occurring
  - Moved the project forward, on schedule.
- Detailed process maps helped the multidisciplinary team understand the complexity of the various processes in several areas such as the operating room, intensive care unit (ICU), post-ICU floor and pre-op holding. Detailed process maps helped the team appreciate what actually occurs in the processes of care. (Figures 5, 6,8).
- Check sheet. (Figure 7)
  - Provided a structured prepared form for collecting and analyzing data. Enabled the project team perform a gap analysis and study actual performance with evidence-based best practices
  - Bar charts and histograms were used to provide feedback to the team (Figures 9,10)
- Brainstorming sessions were used to get team input regarding factors that contributed to DSWI

    - Nominal group technique in the brainstorming session, which enabled all members to contribute their ideas to the session
    - Affinity diagram to sort and synthesize a large amount of data and ideas from the brainstorming sessions. We arranged the data into meaningful groups so we could clearly "see" what we had.
- Fishbone diagram based on the affinity sort. (Figure 11)
- The Failure Modes and Effects Analysis exercise helped the team identify specific ways in which the standardized processes might fail and helped us develop countermeasures focused on the specific failures that were identified (Figure 13)
- CAPA (Corrective Action/Preventive Action) methodology is being used to develop improvements to our processes to eliminate or prevent the causes of non-conformities or other undesirable situations through
        - Process Redesign
        - Training and education/ modification of existing training programs
        - Improvements to maintenance and cleaning schedules

Interventions:

Our improvement team used the DMAIC method to guide the quality improvement project.

Define 2/22-3/14

The project charter and the detailed process maps helped to define the issues. We used a checklist to gather data on the defects (errors and non-conformance with best practices) and their possible causes.

Measure: 3/14-5/11

A trained observer with extensive experience in the CVOR, CVICU, and post-ICU floor observed 40 cases. We collected baseline data in three phases of care: pre-operative, intra-operative, and post-operative care. She used the standardized checklist with scripted observations.

Analyze 3/30-6/9

We analyzed our data, and quantified the failures. In addition to objective data, we collected subjective information, listening to the voice of the customer (VOC) interviewing frontline caregivers with questions such as, "what makes it difficult to conform to best practices?" We organized the potential causes of failure and organized cause and effect relationships. Deeper analysis enabled us to develop potential solutions.

Improve 6/4-7/7

We developed standard practices, with documentation requirements The team worked to standardize processes and definitions in order to develop an explicit vocabulary, as a reference for the CV Team. Figure 9. The team developed checklists to embed in the EMR with data elements that were searchable and could enable the capture of process measures.

Prior to fully implementing the interventions, the project team used the FMEA to assess the risk of failure and identify the most important areas for improvements. We listed all the improved steps in a process flow chart. For each step in the process, the team listed anything that could go wrong: the “failure modes.” For every failure mode, the team identified all the possible causes and effects of the failure, determined the likelihood of an occurrence, likelihood of detection, and the severity a failure; then calculated the risk priority number. (Figure 13)

Control 7/1-ongoing

We are in the process of completing our CAPA. For each failure and cause, we are developing process controls to reduce or eliminate the occurrence of the failure such as

- Embedded check lists in the enhance the detection of a failure
- Identify early warning signs and modifiable risk factors that increase the risks of harm
- briefing & debriefing, standardized hand-offs,
- flagging modifiable risk factors preoperatively

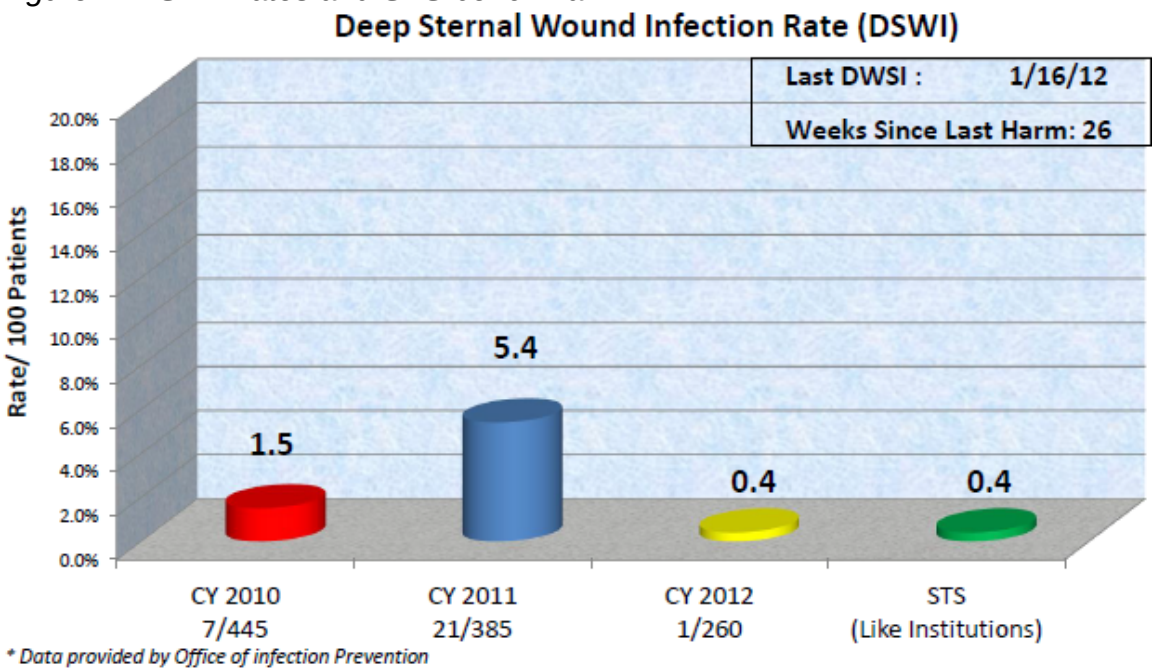
Solutions included the development of simplified, yet comprehensive standardized electronic order sets. Electronic order sets were built with embedded checklists that covered best practices, helped to enforce conformance. A guiding principle adopted by the team was to make the correct way the easiest way, and make it difficult to choose incorrect or risky processes.

The project leaders and key staff members are revising policies and creating standardized procedures that integrate the improvements.

The team created an audit plan and a standardized audit tool with a checklist format. Medical Students, infection control practitioners, quality coordinators, and others perform audits through direct observation using the audit tool. The team is in the process of developing training videos and simulation studies with team members and front line care providers.

Results

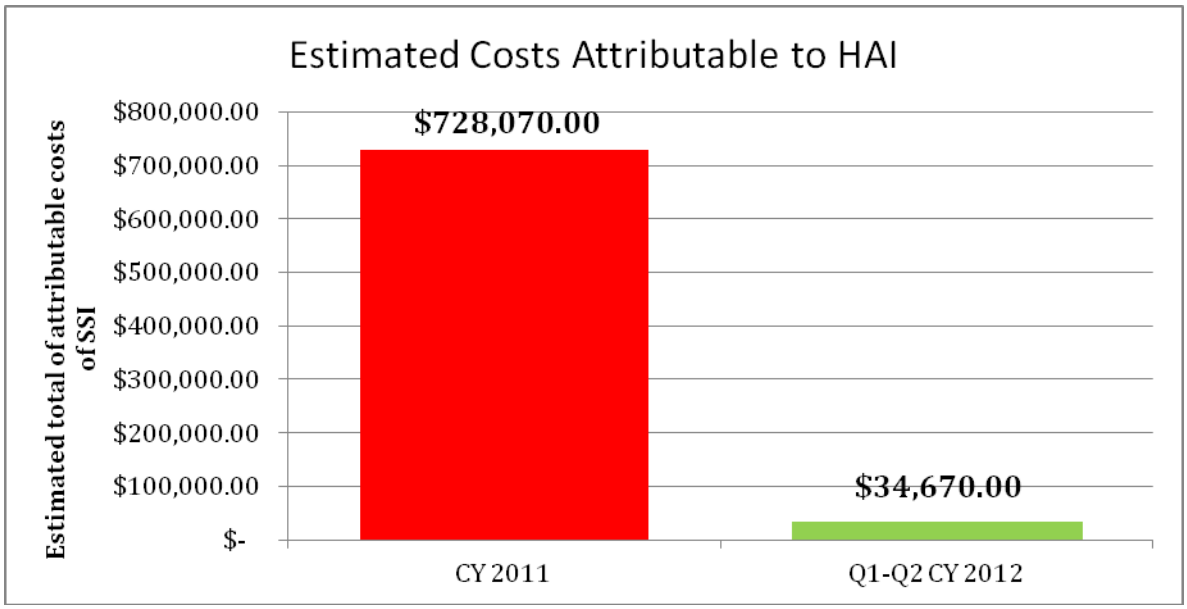
Figure 2. DSWI Rates and STS benchmark



** Data provided by Office of infection Prevention*

Revenue Enhancement /Cost Avoidance /Generalizability

Figure 3: Cost avoidance based on the CDC guidelines of average attributable costs of HAI adjusted to 2007 dollars using CPI for inpatient hospital services[1]



Conclusions and Next Steps

We are still in the process of collecting process data, and acknowledge our preliminary results may be the result of the Hawthorne effect, yet we believe that the sustainability of our improvements is achievable. Doing the right thing at the right time every time is at the core of delivering the best care. The tools were essential to helping us understand the true reasons why patients are placed at risk. The insights, participation and ownership of staff who know how processes really work and the risks patients face is critical. The project team worked diligently to preserve a constant awareness of the systems and processes that affect patient care. Our improvement tools prevented the team form arriving at overly simplistic explanations of why and how failures occur in order to prevent and mitigate harm to our patients.

Appendix

Examples of quality tools

Figure 4.Excerpt from DSWI Project Charter

Project Title	Reducing Surgical Site (Deep Sternal Wound) Infections in Cardiac Surgery patients	**Start Date:**	**Feb. 22.2012**	
Strategic Alignment	Clinical Effectiveness: Eliminate Healthcare Associated Infections (HAI)			
/ Problem Statement	System-wide incidence has not improved. >20/385 (continue to monitor until 12/31/2012)			
Project Objective / AIM	Over the next calendar year, reduce incidence deep sternal wound infections to <1% for patients with sternotomy and "re-do" sternotomy			
Benefit	Reduce incidence of healthcare associated conditions, improve patient outcomes, reduce potentially avoidable costs			
Scope	All open heart surgery patients at UT Southwestern with median sternotomy from one week prior to day of surgery (DOS) through one year following primary DOS			
Project Goals	**Goal(s)**	**Measure**	**Baseline**	**Target**
	1) Deep sternal wound infections will be sustained at or below 1% in 2012/Q4	SSI Rate based on NHSN standards	CY 2011 rate	<4% Q1, <3% Q2, < 2% Q3
	2) Compliance with modifiable risk factors for deep sternal wound infections will be >95%	Selected process measures for each segment	Final % "yes" for each segment using DSWI profile	95% "Yes for each segment using DSWI profile
	3) Executive attendance at meetings focusing on safety defects, infrastructure development and implementation of best practice will be >90%.	Attendance of AVP and above *or designee* at monthly CUSP (CVOR, ICU, Floor) mtgs, CSTS oversight and Joint conferences (3x/yr)	CY 2011	>50% Q1 >75% Q2 >90% Q3
Process Owner(s)	Heart, Lung and Vascular Service Line team			
Key Stakeholders	Infectious Disease Physicians, CVTS, Pulmonary and Cardiology Interns, Residents and Fellows, Infection Prevention and Control, Pathology/Transfusion Medicine, Radiology, PT & Cardiac Rehab, Pharmacy, Endocrinology, Environmental Services, Central Sterile Processing,			
Risks	Patient harm, increased avoidable costs, undesirable institutional reputation			
Constraints / Barriers	Executive engagement, Financial resources, physician buy-in, care team buy-in, staff education			

Figure 5: Process Map Example: sources of patient entry into the system

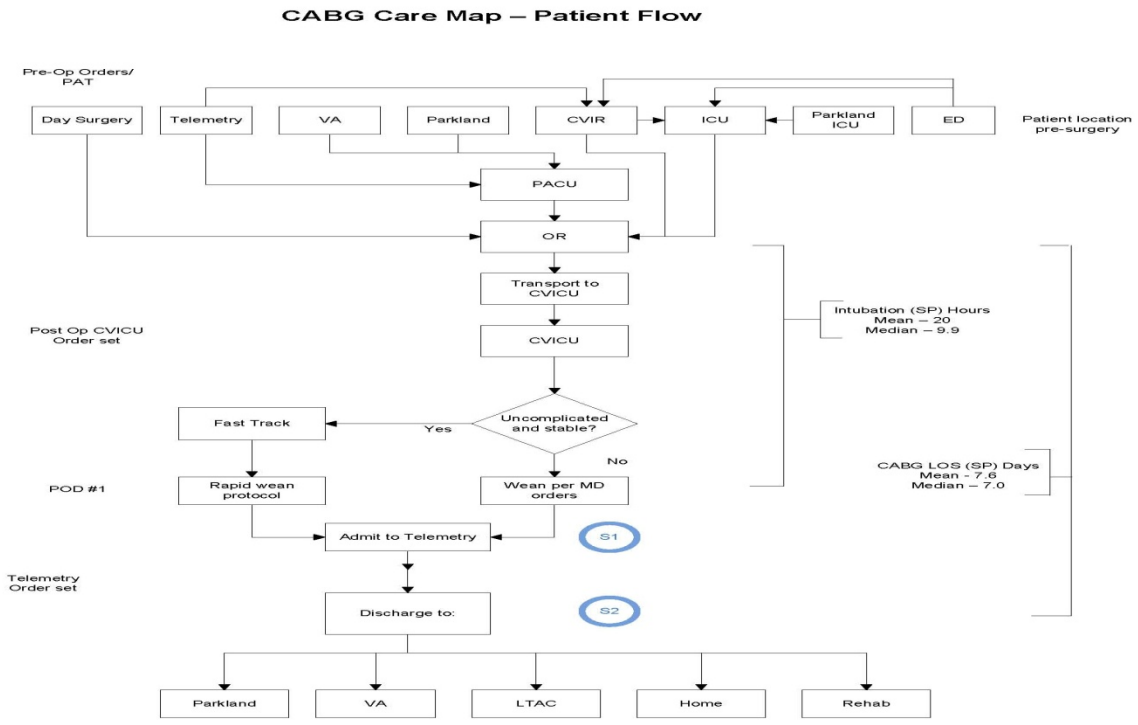


Figure 6: Process Map of the patient journey

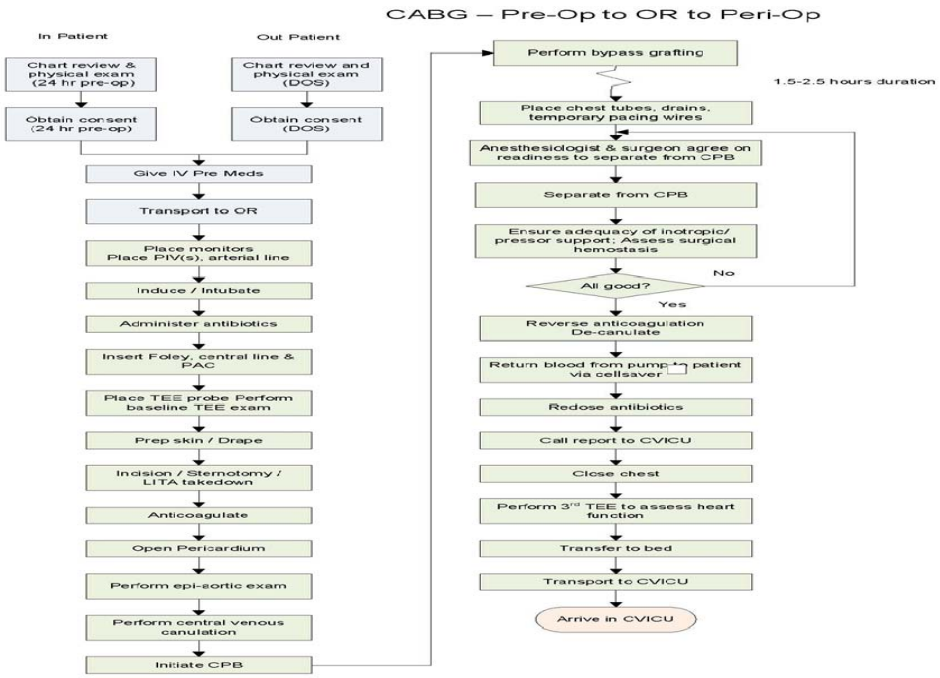


Figure 7: Check Sheet used to observe baseline compared to best practices

Deep Sternal Wound Infection Prevention
Profile

Adm. Date _____ Procedure _____

Proced. Date _____

MRN _____ Parkland Patient? ☐ Yes ☐ No

Best Practice Segment	Major steps associated with best practice			Current Practice & Notes
Top Pre-op	**Pre-op Measures**			
	CHG Showers x 2			
	Clipped outside OR	☐ Yes	☐ No	
	Nasal Swabbing w/Mupirocin:2 days pre-op	☐ Yes	☐ No	
	Presence of infection: antibiotics documented			
	Identified Pre-op risk factors			
	Female Gender	☐ Yes	☐ No	
	White race	☐ Yes	☐ No	
	BMI> 30	☐ Yes	☐ No	
	Diabetes	☐ Yes	☐ No	
	HbA1c tested	☐ Yes	☐ No	
	Creatinine > 1.3	☐ Yes	☐ No	
	Dialysis	☐ Yes	☐ No	
	Pre-op Hb tested	☐ Yes	☐ No	
	CHF	☐ Yes	☐ No	
	PVD	☐ Yes	☐ No	
	COPD	☐ Yes	☐ No	
	Cardioshock	☐ Yes	☐ No	
	MI	☐ Yes	☐ No	
	CVA	☐ Yes	☐ No	
	Hosp >5d	☐ Yes	☐ No	
	NHSN risk score >1		☐ No	
Top Intra-op	**Intra-op Measures**			
	Adequate Env. Decontamination	☐ Yes	☐ No	
	Debriefing Performed	☐ Yes	☐ No	
	Sink Scrub – Anes & CVTS	☐ Yes	☐ No	
	# of breaks in Hand Hygiene			
	Abx selection and dose			
	Abx (mins) *started* prior to incision			
	Abx re-dose hrs after initial			
	Standard Prep/Drape used	☐ Yes	☐ No	
	# of breaks in Aseptic technique			
	# of entry & exits in OR			
	# individuals enter/exit OR			
	IV insulin started for BG>150	☐ Yes	☐ No	
	CVTS Faculty scrubbed until skin closure	☐ Yes	☐ No	
	Intra-op Risk Factors	☐ Yes	☐ No	
	ASA status	☐ Yes	☐ No	
	Briefing (include fac.laundered scrubs)	☐ Yes	☐ No	
	Urgent/Emergent	☐ Yes	☐ No	
	Redo Sternotomy	☐ Yes	☐ No	
	Re-exploration	☐ Yes	☐ No	
	Concomitant (combined) Surgery	☐ Yes	☐ No	
	CPB Time (mins)			
	Skin to Skin Time (mins)			
	RBCs transfused	☐ Yes	☐ No	# of units:
	IABP placed	☐ Yes	☐ No	
	Surgery duration > 5 hours (75th NHSN %)	☐ Yes	☐ No	
Top Post-op	**Post-op Measures**			
	Glycemic control until d/c	☐ Yes	☐ No	
	Standardize wound care (dressing until 48hrs, etc)	☐ Yes		
	Antibiotic d/c @ 48hrs	☐ Yes	☐ No	
	Maintain normothermia (T>36°C)	☐ Yes	☐ No	
	Handoff checklist	☐ Yes	☐ No	
	Nasal mupirocin con't 3 days post-op	☐ Yes	☐ No	
	Post-op Risk Factors			
	Mediastinal clot	☐ Yes	☐ No	
	Chest Tube Drains > 48 hrs	☐ Yes	☐ No	
	CI <2L/min	☐ Yes	☐ No	
	Levophed > 0.03 mcg/kg/hr	☐ Yes	☐ No	
	Vasopressin > 0.02units/min	☐ Yes	☐ No	

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Figure 8: Improved Processes, Critical Elements of Best Practice

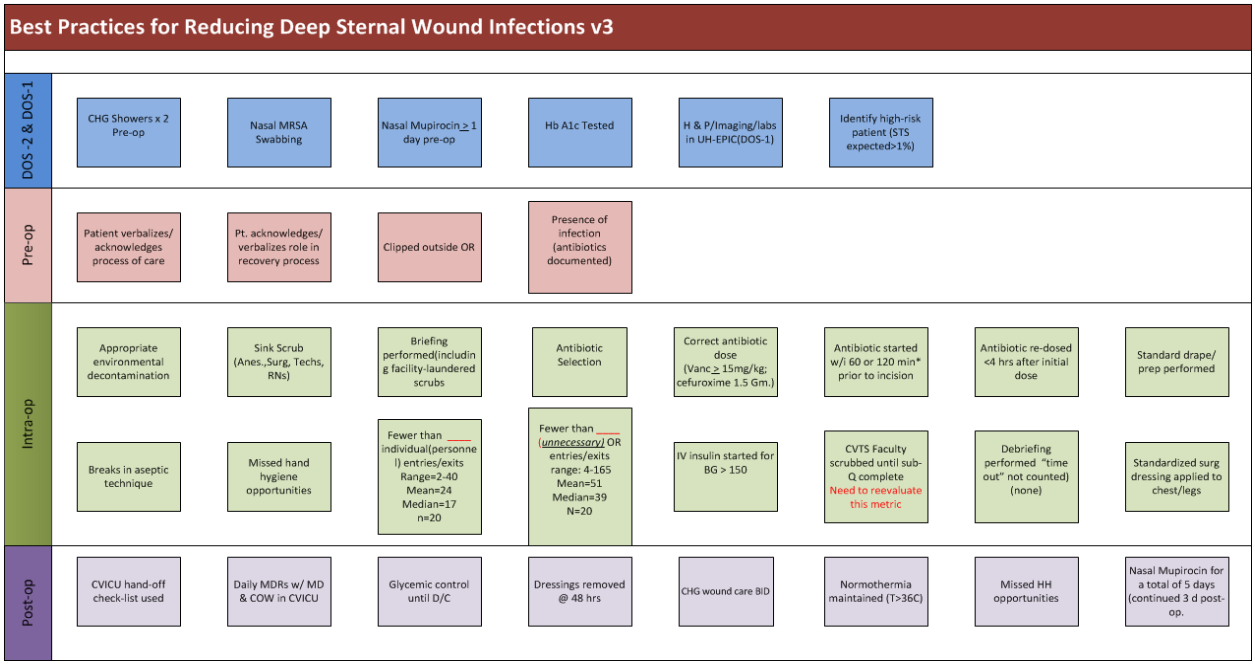

Figure 9: Bar Chart

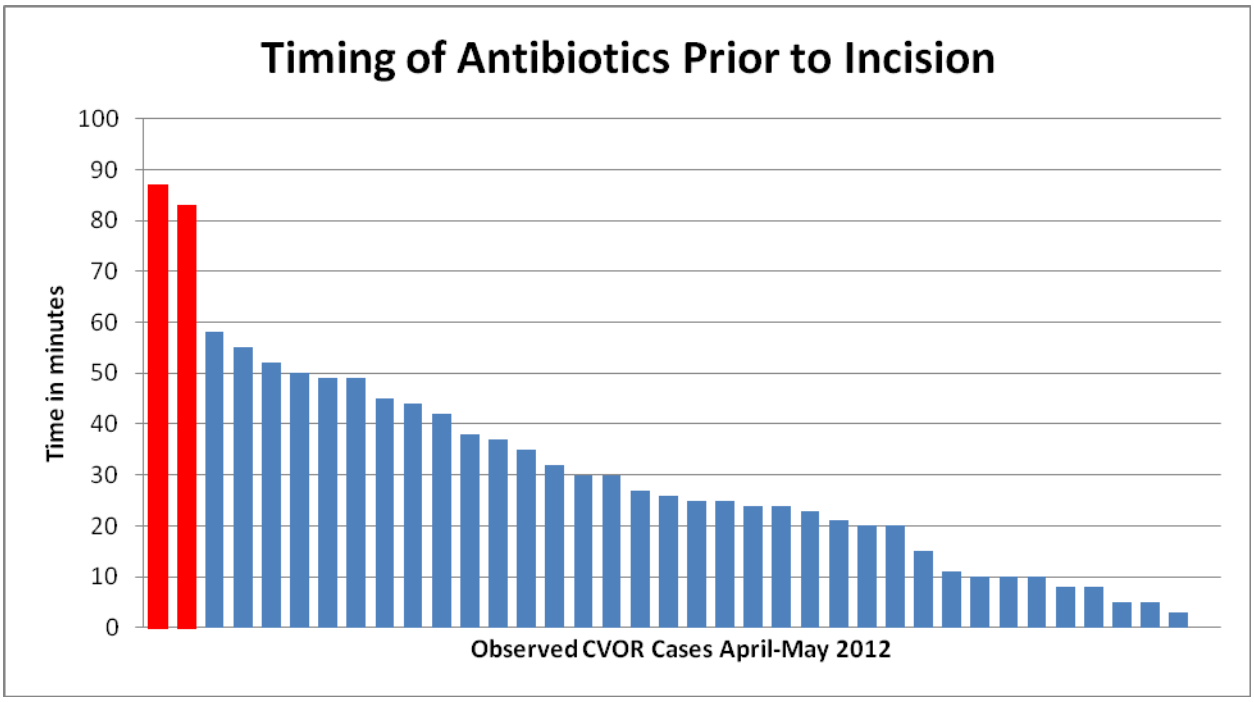

Figure 10: Histogram of traffic in and out of CVOR

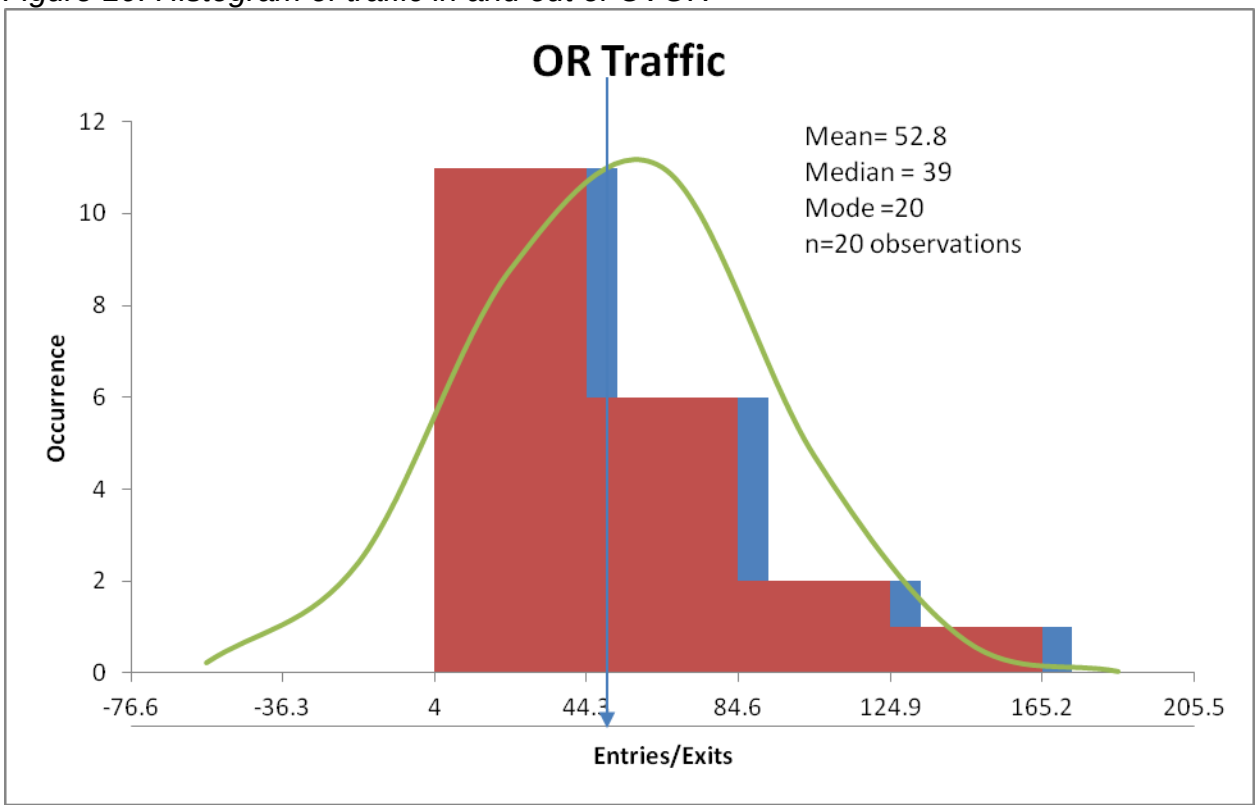

Figure 11: Fishbone Diagram of causes contributing to deep sternal wound infections

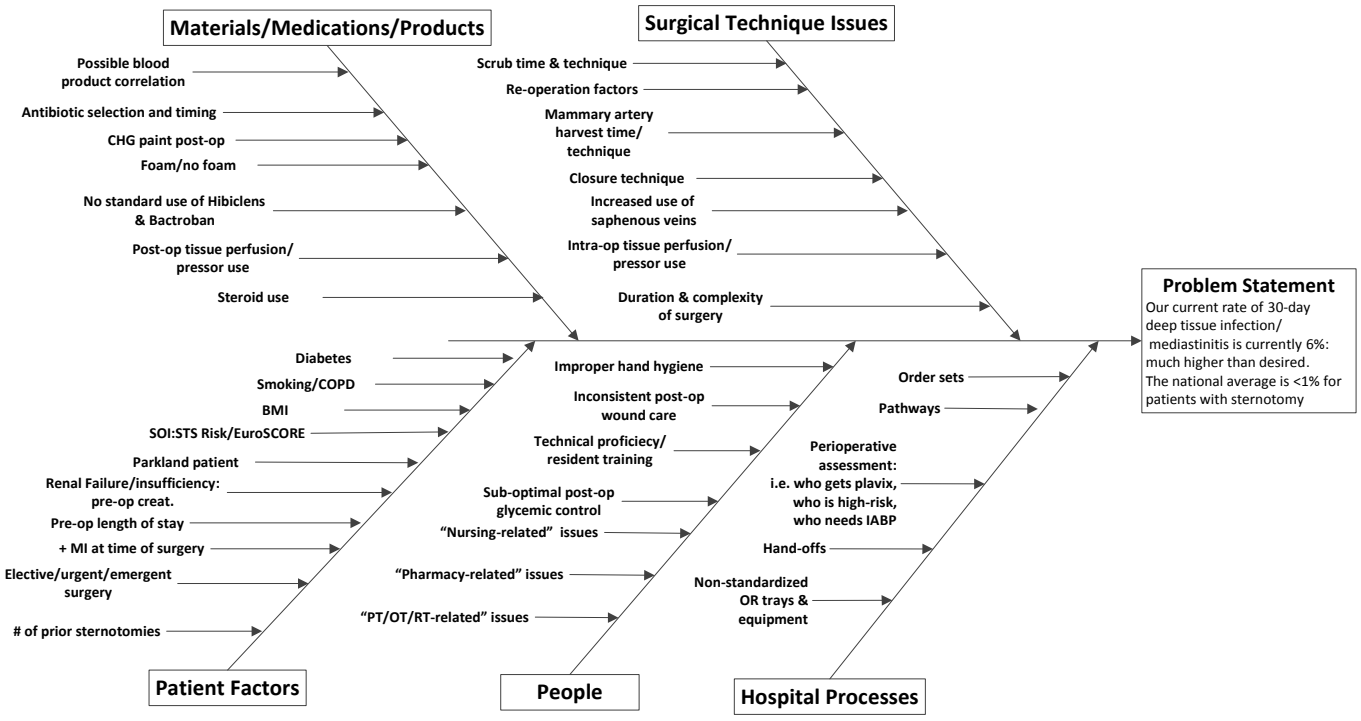

Figure 12: Excerpt from Table of Definitions

		Definition	Proposed method of monitoring	Rationale
Preoperative factors				
	CHG showers x 2	Pt showers with 4 oz CHG the night before and the morning of surgery	Add question to preop check list	Outpts and transferred pts have no other documentation in the chart.
	Nasal MRSA Swabbing	Nasal MRSA swab during inpt stay or within 14 days of surgery	Add question to preop check list	Outpts and transferred pts may have no other documentation in the chart. Allows for inpt documentation of testing done at Parkland
	Nasal Mupirocin night before and morning of surgery	Pt applies mupirocin evening before and morning of surgery	Add question to preop check list	Outpts and transferred pts may have no other documentation in the chart. Allows for inpt documentation of treatment given at home or at Parkland
	HbA1c	HbA1c done within 30 days prior to surgery	Add question to preop check list	Outpts and transferred pts have no documentation of outside lab values.
	H&P/Imaging/labs in EPIC	Ordered labs and imaging studies available in EPIC	Currently on preop check list	Curently done
	Identify high-risk patient (STS expected >1%)	As defined by STS risk assessment scoring	Interface of EPIC and the vendor for STS (Dr. Ring)	No current method of monitoring
Preop				
	Patient verbalizes or acknowledges process of care	Pt states an understanding of need to participate in care, has right to expect hand hygiene,	Add to preop check list	Day of surgery review of expectations
	Patient acknowledges or verbalizes role in recovery process	Pt able to state importance of activity including IS in the post op period	Add to preop check list	Allows for documentation of patient education
	Clipped outside the OR	Clipping occurs within 90 minutes of patient going to the OR	Add to preop check list	
	Presence of infection	Patient has WBC>????, temp >??? Positive cultures? Documentation of endocarditis on echo?	???	This may have to be done manually

Figure 13: Excerpt from FMEA

Process: Reducing Deep Sternal Wound Infections Date: 5/16			Team members: Dr. Meyer, Dr. Greilich, Dr. Ring, Leah Parker RN, Julie Cox RN, Dr. Jessen, Dr. Leach, Terri Dupre RN, Patti French NP, Barbara Hasnain ICP, Dr. Graham					
Process Step	**Potential Failure Mode**	**Potential Failure Cause**	Potential Failure Effects	Occurrence	Detection	Severity	RPN	Recommended Actions to Reduce/Eliminate Failure
DOS -1, -2 CHG Showers x 2 Pre-OP 41% n= 27	**No shower**	No order/no order set						
	1 shower	No standard staff education						
		No showers @ Parkland.						
		No standardized patient education						
DOS -1, -2 Nasal MRSA Swabbing	**Swab not done**	No order/no order set	Infection					
		No standard staff education in day surgery and on the units: UT and Parkland	Inappropriate antibiotics administered					
		No standardized patient education						
DOS -1, -2 Nasal Mupirocin>1 day pre-op 48% n=27	**No swab**	No order/no order set						
	1 Swab	No standard staff education in day surgery and on the units: UT and Parkland						
		No standardized patient education						
DOS-1, -2 HbA1c Tested 85% n=27	**Missing data**	Recent change in practice: HbA1c ordered for all CTS patients						

References

1. Scott Rd. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention, 2009. Division of Healthcare Quality Promotion, National Center for Preparedness, Detection, and Control of Infectious Diseases, Coordinating Center for Infectious Diseases, Centers for Disease Control and Prevention, February 2009.

2. Klevens RM, Edwards J, Richards C, Horan T, Gaynes R, Pollock D, Cardo D. Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002. *Public Health Reports* 2007; 122:160-166.

3. Elixhauser A and Steiner C. Infections with Methicillin-Resistant Staphylococcus Aureus (MRSA) in U.S. Hospitals, 1993–2005. *AHRQ Healthcare Cost and Utilization Project Statistical Brief* 2007; 35:1-10.