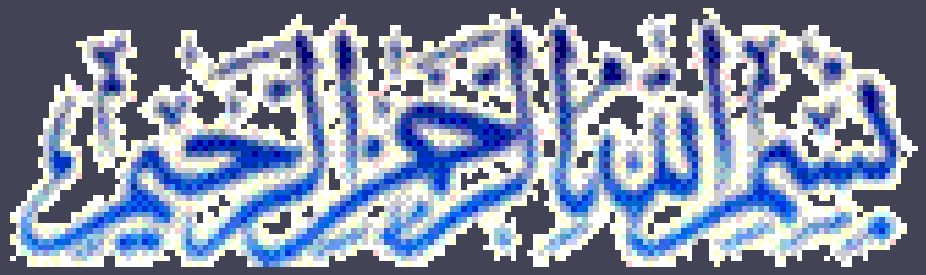


SSI Prevention

through a Best Practice

Oct. 25th

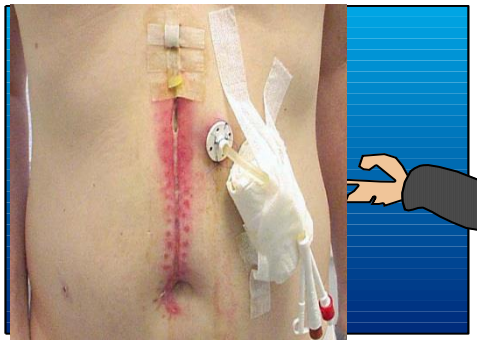
2019

Mohamad Hamad
Infection Control Manager
VPS Healthcare, UAE.

Objectives

- Upon completion of this presentation, you will be able to know:

1. Definition of SSI
2. Type of SSI
3. Is There a Risk For Developing SSI?
4. How to Prevent SSI?



Introduction

- A recent prevalence study found that SSIs were the most common HAI, of all HAIs among hospitalized patients

- Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk

SSI Definition

NHSN has developed standardized definitions for Quality Metrics & surveillance criteria for SSIs…by these criteria, SSIs are defined as:

Infection occurs in the wound created by an invasive surgical procedure & reported within **30 days** after the operative procedure if no implant is left in place or within **90 Days** if implant (prosthetic heart valve, hip prosthesis, mechanical heart, non human vascular graft) is in place as **SSI &** the infection appears to be related to the operative procedure.

2019, NHSN System used by the Centers for Disease Prevention and Control, Chapter No.: 9 (SSI)
https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

NHSN National Healthcare Safety Network

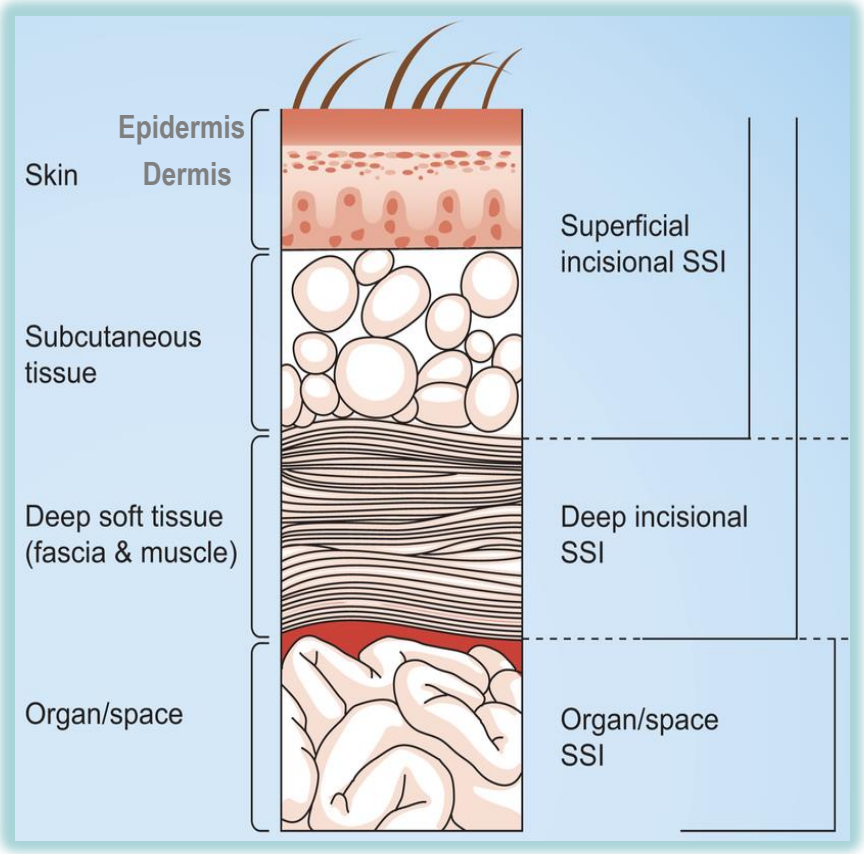
SSI Categories (Types of SSI)

The NHSN has developed standardized categories, which are classified as:

A. Superficial Incisional SSI (SIP/SIS):
Involves Skin & subcutaneous tissues of the incision Occur within 30 Days of Surgery.

B. Deep Incisional SSI (DIP/DIS) : Involve Deeper soft tissues (fascial or muscle layers) Occur within 30 Days of Surgery, Implants within 90 days

C. Organ/Space SSI: Any part of the anatomy (organ or space) other than incised body wall layers, that was opened or manipulated during an operation. Occur within 30 Days of Surgery, Implants within 90 days



2019, NHSN System used by the Centers for Disease Prevention and Control, Chapter No.: 9 (SSI)
https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

NHSN National Healthcare Safety Network

Is There a Risk For Developing SSI?

Risk: 2%	Risk: 5%-15%	Risk: > 15%	Risk: > 30%
			
Class: 1 Clean Wound	**Class: 2 Clean/Contaminated Wound**	**Class: 3 Contaminated Wound**	**Class: 4 Dirty/Infected Wound**

Prophylactic antibiotics indicated

Therapeutic antibiotics

ACS NSQIP
AMERICAN COLLEGE OF SURGEONS
NATIONAL SURGICAL QUALITY IMPROVEMENT PROGRAM

American College of Surgeons, National Surgical Quality Improvement Program® (ACS NSQIP®)

Source: Zinn, 2012

Association for Professionals in Infection Control & Epidemiology (APIC)

SSI !!!

780,000
SSIs occur each year[3]

account for **20%**
of all health care-associated infections in U.S. hospitals.[2]

4.4% **35,000**
SSIs develop annually after orthopedic surgery[4]

1.05%
estimated **8,205**
annual deaths caused by SSIs[2]

2.5%
up to **20,000**
knee and hip replacement patients contract an SSI[4]

2012, Available at www.ihi.org and **OR Connection Magazine, SSI Following Orthopedic Surgery**

2012, APIC, Guide to the Elimination of Orthopedic Surgical Site Infections
http://www.apic.org/Resource_/EliminationGuideForm/34e03612-d1e6-4214-a76b-e532c6fc3898/File/APIC-Ortho-Guide.pdf

Is there a SSI Prevention Bundle to get us to zero

The program monitored compliance with the Joint Commission NPSG 07.05.01.

7S bundle project was implemented and used in 2012 till now by UHS hospitals to reduce/prevent SSI.

JCI NPSG.07.05.01: Implementing evidence-based practices for preventing surgical site infections

How to Prevent SSI?

It is very Essential and important to Establishing a Culture of Safety:

7 "S" Bundle to Prevent SSI

1. SAFETY – is your OPERATING ROOM safe?
2. SCREEN – are you screening for risk factors and presence of MRSA & MSSA
3. SHOWERS – do you have your patients cleanse their body the night before and morning of surgery with CHLORHEXIDINE (CHG)?
4. SKIN PREP – are you prepping the skin with alcohol based antiseptics such as CHG or Iodophor?
5. SOLUTION - are you irrigating the tissues prior to closure to remove exogenous contaminants? Are you using CHG?
6. SUTURES – are you closing tissues with antimicrobial sutures?
7. SKIN CLOSURE – are you sealing the incision or covering it with an antimicrobial dressing to prevent exogenous contamination?

7 S Bundle AORN and APIC Poster 2016.pd

www.7sbundle.com

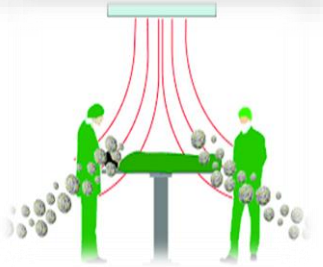
#1 Safe Operating Room

How to Evaluate whether you have a safe OR?

1. **Traffic control:** number of staff in room

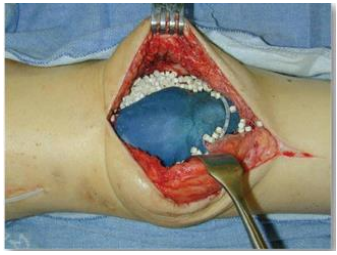
2. **AC:** Air handling systems, filtration, Cleaning of grills, Temperature, Humidity

3. **SCIP:** Surgical prophylaxis, Hair clipping, Body Warmers *(Pre-Op & Post Op: For Cell Function & Wound Healing),* Oxygenation *(For Wound Healing),* Foley catheter removal within <48 hrs



4. **TD:** Between cases, room turnover and daily
5. **Surgical technique and handling of tissues:** use of wound protector/retractor to prevent field contamination

6. **Sterilization:** Instrument cleaning/sterilization process, biological indicators



7. **Storage of supplies:** clean supply bins, carts, tables, stationary, equipment

CENTERS FOR DISEASE CONTROL AND PREVENTION

Seropian, 1971

Pre-operative Shaving/Hair Removal

(Outside OR)

Method of hair removal

Razor	= 5.6% SSI rates
Depilatory (Clipper)	= 0.6% SSI rates
No hair removal	= 0.6% SSI rates

Timing of hair removal

Shaving immediately before	= 3.1% SSI rates
Shaving ≤ 24 hours before	= 7.1% SSI rates
Shaving >24 hours before	= 20% SSI rates

Multiple studies show

Clipping immediately before operation associated with lower SSI risk than shaving or clipping the night before operation

#2 Screening for MRSA and MSSA

How to Consider screening patients undergoing inpatient surgery?

Patients who carry Staph Aureus & MRSA in their nares or on their skin are more likely to develop Staph Aureus SSIs.

Does using Mupirocin eradicate *Staph Aureus* nasal carriage? YES Evidence Based.

- **Short-term nasal Mupirocin (4-7 days) is an effective method for Staph aureus Eradication**
- **90% success at one week**
- **1% develop mupirocin resistance**

#3 Shower pre-op

Instruct patients who will undergo inpatient surgery to bath with soap and water, CHG liquid soap or CHG

Studies show that repeated use of CHG soap enhances the ability of CHG to reduce bacterial counts on the skin before surgery.

Patients should be instructed to cleanse the body the night before and morning of surgery with either CHG solution or CHG wash cloths.

Professional Guidelines

- CDC - Strongly Recommended (Category 1B) that patients shower with an antiseptic agent before undergoing an elective surgical procedure.
- 2008 AORN Guidelines for Preoperative Skin Antisepsis - Patients undergoing open class I surgical procedures below the chin should have two (2) preoperative showers with CHG before surgery, when appropriate.
- SHEA/IDSA Compendium: SSI Prevention Practice Recommendation - To gain maximum antiseptic effect of Chlorhexidine, it must be allowed to dry completely and not be washed off.

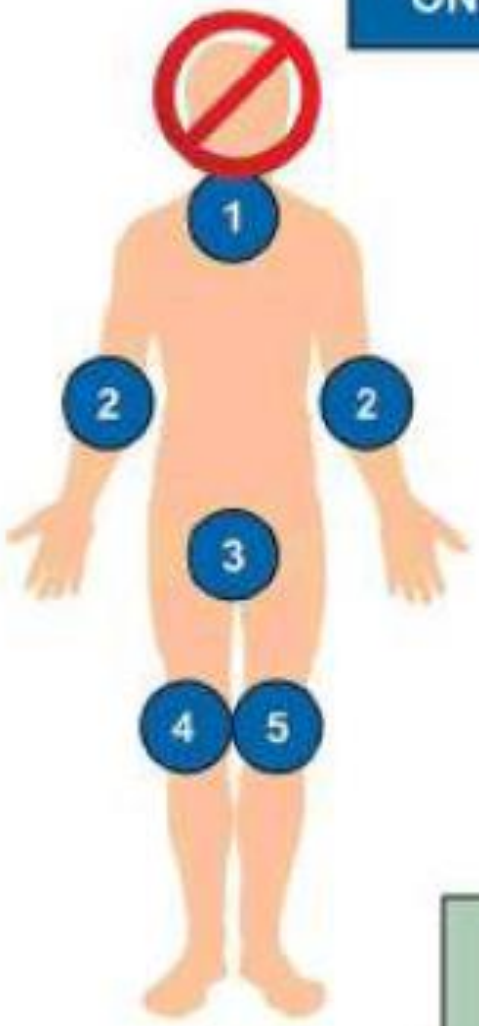
- SSI rate prior to intervention – 3.2%
- SSI rate post intervention – 1.6% 50% reduction

Lipke VL, Hyott AS. AORNJ 2010';62:288-296

7 S Bundle AORN and APIC Poster 2014.pd

2017, AORN GUIDELINES

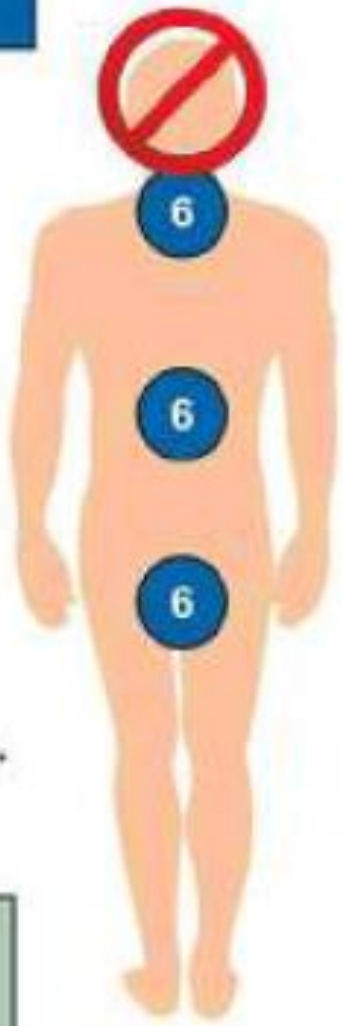
ONLY USE CHG CLOTHS *BELOW* THE JAWLINE



Front

1. Neck, shoulders, and chest.
2. Both arms and hands.
3. Abdomen then groin and perineum.
4. Right leg and foot.
5. Left leg and foot.
6. Back of neck, back, and then buttocks.

Skin may feel sticky for a few minutes.
Do NOT wipe off. Allow to air dry.



Back

4 Skin prep – dual combined antiseptics

Use alcohol based skin preps products with long lasting residual effect

Two types of preoperative skin preparations that combine alcohol (which has an immediate and dramatic killing effect on skin bacteria) with long-acting antimicrobial agents appear to be more effective at preventing SSI than povidone-iodine (an Iodophor) alone:

- **Iodophor plus Alcohol**
- **Chlorhexidine plus Alcohol**

2017, AORN GUIDELINES

Institute for Healthcare Improvement (IHI): Prevention of SSI: Use Alcohol based antiseptics 2012

7 S Bundle AORN and APIC Poster 2014.pd

Skin Antiseptic Agents Commonly used for Pre-Op skin preparation

AORN Guideline for Preoperative Patient Skin Antisepsis

Antiseptic agent	Rapidity of action	Persistent activity
Alcohol	Excellent	None
CHG	Moderate	Excellent
PI	Moderate	Minimal
CHG w/alcohol	**Excellent**	**Excellent**
PI w/alcohol	Excellent	Moderate

AORN
Association of periOperative Registered Nurses

2017, AORN GUIDELINES

AORN: Association of periOperative Registered Nurses

#5 Solution to pollution is dilution

Flush contaminants before closure

CHG Irrigant leaves a persistence antimicrobial action in the tissue

New CHG surgical irrigate - meets American College of Emergency Physicians (ACEP) guidelines for wound irrigation volume and pressure.

Chlorhexidine Gluconate at a low concentration of 0.05% has demonstrated antimicrobial efficacy and persistence in laboratory testing.

The mechanical action effectively loosens and removes wound debris in compound fractures and tissues.

Safe for mucous membranes – approved by FDA

CHG is applied directly to the surgical wound bed to cleanse & remove debris from the area.

CHG Irrigant leaves a 2 week antimicrobial action in the tissue

Fry D. Topical Antimicrobials and the Open Surgical Wound Surg Infec Vol 17, No 5 2016

Reduction in Colon Surgical Site Infections using CHG Irrigant Solution

Maureen Spencer, RN, BSN, M.Ed., CIC | Jacqueline Christie, RN, BSN, MPH, CIC
Patricia Tyrrell, RN, BSN, CNOR | Gail Pietrzyk, DNP, RN, CNOR
UHS of Delaware, Inc. a subsidiary of Universal Health Services Inc., King of Prussia, PA

AORN #138 Boston
April, 2017

Month - Year	August 2015	September 2015	October 2015	November 2015	December 2015	January 2016	February 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	September 2016	October 2016	November 2016
Rate/100 Procedures	5.88	6.21	3.24	2.13	2.65	3.47	4.37	3.33	1.28	1.49	2.43	1.05	2.24	2.01	3.18	1.09

Clinical Issue:

- Colon surgical site infections (SSIs) have one of the highest rates of healthcare acquired infections that can lead to increased morbidity and mortality and use of hospitals resources
- Numerous clinical interventions with varying levels of supporting evidence have been implemented:
  - Appropriate antibiotic prophylaxis,
  - Normo-thermia,
  - Appropriate hair removal,
  - Glycemic control
  - Wound protectors
  - Mechanical bowel preparation.
- For this project a surgical irrigating solution, using a 0.05% chlorhexidine gluconate antiseptic was introduced in a 26-facility acute care system starting in June 2015.

Pre-Implementation: May 2015

- Manufacturer of the CHG irrigation solution visit the hospitals with the highest standardized infection ratio (SIR) for Colon SSI to educate perioperative nursing staff and physicians.

Implementation:

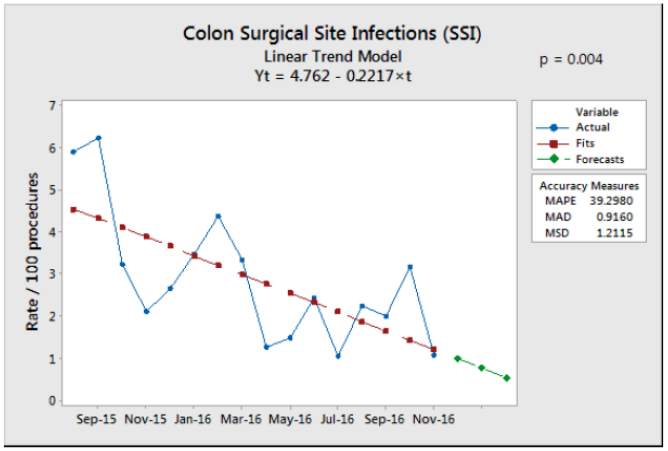
- Each Operating Room site purchased product
- Clinical Specialist contacted the OR Director and were assigned the week to visit for in-service education.
- The procedure involved irrigating the tissues after the fascia was closed with the 450ml of CHG, leaving it in the tissues for 1 minute, followed by a rinse with the 450ml of saline.

The Product Change: Irrisept CHG Irrigant

- A wound debridement and cleansing system that contains 0.05% Chlorhexidine Gluconate (CHG) in sterile water for irrigation
- Mechanism of action:
  - Mechanical action removes bacteria and debris without harming underlying tissues.
  - Bottle design allows users to control the delivery pressure of the solution through manual bottle compression. Grasping the bottle firmly, the user can control the direction and pressure needed to help remove bacteria, particulate and debris.
- Irrisept has successfully completed testing for acute systemic toxicity, cytotoxicity, neurotoxicity, skin irritation and immune allergic response.

Implications for Perioperative Nursing:

- Replaces the use of antimicrobial irrigations, such as cefazolin, vancomycin, bacitracin and polymixin.
- Facilitates compliance with hospital antimicrobial stewardship
- Pre-packaged design is more efficient for preparation and dispensing to field
- Pharmacy no longer mixing irrigations
- Since CHG is a biocide and can efficiently attach to tissues it creates a residual antibacterial effect that can last for many days in the tissues.



REFERENCES

Edmiston C, et al. Reducing the risk of surgical site infections: Does chlorhexidine gluconate provide a risk reduction benefit? American Journal of Infection Control 41 (2013) S49-S55

Barne S, Spencer M, et al. Surgical wound irrigation: A call for evidence-based standardization of practice. American Journal of Infection Control 42 (2014) 525-9

Moyer H, Minter J. Salvage of an Infected Below-Knee Amputation with Chlorhexidine and Bi-Layer Dermal Matrix: A Case Report. Surgical Infections Case Reports 2016

Fry D. Topical Antimicrobials and the Open Surgical Wound. SURGICAL INFECTIONS Volume 17, Number 5, 2016

True or False

Antibiotic irrigation of the surgical tissues with Cefazolin, Vancomycin, Gentamicin, Bacitracin and Polymixin has evidence based research that shows a reduction in SSIs when used.

No evidence that Bacitracin/Polymixin irrigations reduce rate of SSI

1. Kalteis T, Lehn N, Schroder HJ, Schubert T, Zysk S, Handel M, Grifka J. Contaminant seeding in bone by different irrigation methods: an experimental study. J Orthop Trauma. 2005;19:591-6.
2. Fletcher N, et al: Prevention of perioperative infections. J Bone Joint Surg Am. 2007;89:1605-1618

American Journal of Infection Control 42 (2014) 525

Contents lists available at ScienceDirect

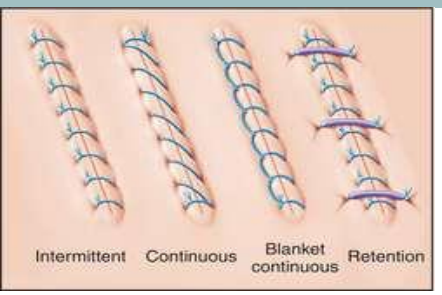
American Journal of Infection Control

journal homepage: www.ajicjournal.org

Practice forum

Surgical wound irrigation: A call for evidence-based standardization of practice

Sue Barnes RN, BSN, CIC[a], Maureen Spencer RN, MEd, CIC[b], Denise Graham[c], Helen Boehm Johnson MD[d,*]

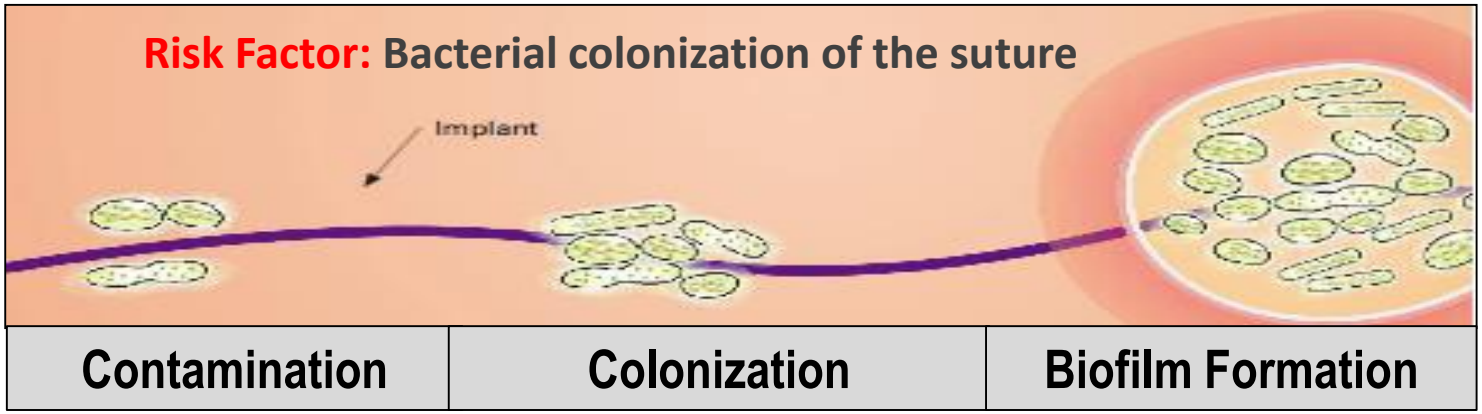


#6 Sutures – antimicrobial

Are you closing tissues with antimicrobial sutures?

Consider the use of antimicrobial impregnated sutures

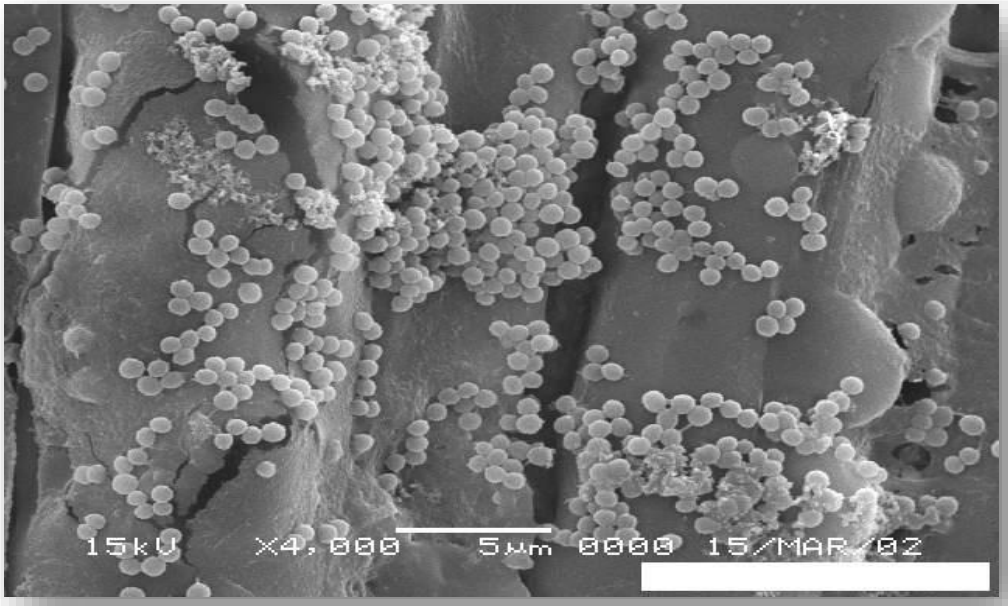
- **Like all foreign bodies, sutures can be colonized by bacteria:**
  - Implants provide nidus for attachment of bacteria
  - Bacterial colonization can lead to biofilm formation
  - Biofilm formation increases the difficulty of treating an infection[1]



On an implant, such as a suture, it takes only 100 staphylococci per gram of tissue for an SSI to develop[2]

1. *Edmiston C, et al. Microbiology of Explanted Suture Segments from Infected and Noninfected Surgical Patients. Journal of Clinical Microbiology. February 2013 Volume 51 Number 2 p. 417–421*
2. *Mangram AJ et al. Infect Control Hosp Epidemiol.1999;27:97-134..*

Potential for Contamination of Sutures



Suture with Staphylococcus colonies

Air settling plates in the operating room at the last hour of a total joint case from the anesthesia cart, bovie cart, computer

This is a picture of bacterial adherence to non–Triclosan-coated suture material.

World Health Organization

American College of Surgeons
Inspiring Quality: Highest Standards, Better Outcomes
100+years

WHO and American College of Surgeons - Recommend Antimicrobial Coated Sutures

4.22 Antimicrobial-coated sutures

Recommendation

The panel suggests the use of triclosan-coated sutures for the purpose of reducing the risk of SSI, independent of the type of surgery.
(Conditional recommendation, moderate quality of evidence)

SPECIAL ARTICLES

American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update

Kristen A Ban, MD, Joseph P Minei, MD, FACS, Christine Laronga, MD, FACS, Brian G Harbrecht, MD, FACS, Eric H Jensen, MD, FACS, Donald E Fry, MD, FACS, Kamal MF Itani, MD, FACS, E Patchen Dellinger, MD, FACS, Clifford Y Ko, MD, MS, MSHS, FACS, Therese M Duane, MD, MBA, FACS

*"Numerous studies have demonstrated decreased risk of SSI with use of **triclosan** (Benzocaine) antibiotic suture compared with standard suture, including multiple randomized, controlled trials".*

#7 Skin adhesive or antimicrobial gauze dressings

Are you sealing the incision or covering it with an antimicrobial dressing to prevent exogenous contamination?

Use of incisional adhesive to seal incision post-op

Wounds are most vulnerable to infection in the first 48-72 hours. Until the epithelial barrier is complete (usually within 48 hours), wounds are solely dependent on the wound closure device to maintain integrity.

Use of incisional adhesive to seal incision post-op or cover incision with special dressings with antimicrobial agents (e.g. silver, CHG) for duration of hospitalization.

Effective barriers must maintain their integrity for the first 48 hours.

1. Fine and Musto. Wound healing. In: Mulholland et al. Greenfield's Surgery: Scientific Principles and Practice. 4th ed. 2005.
2. Bhende et al. Surg Infect (Larchmt). 2002;3:251-257.

BMJ

RESEARCH

Sutures Versus Staples for skin closure in Orthopedic surgery: Meta-analysis

Toby O Smith, research physiotherapist in orthopaedics, honorary lecturer, Debbie Sexton, senior orthopaedic physiotherapist, Charles Mann, consultant orthopaedic surgeon, Simon Donell, consultant orthopaedic surgeon, honorary professor in musculoskeletal disorders

In Orthopedic surgery the risk of infection **after staple closure** was three times the risk **with suture closure**; after hip surgery the risk was four times greater.

To minimize wound infection, orthopedics surgeons should close wounds with sutures rather than staples.

March 16th 2010 issue of the BMJ

Results of the implementation of 7S Bundle

- A total of 330 wound closure observations across 162 surgical procedures were observed.
- Surgical staple usage was highest among OB/GYN and Orth.
- Topical skin adhesive (TSA) usage had a wide variation in application techniques, applying more layers than required.
- Topical skin adhesive was often covered with unnecessary dressings.
- Evaluation of hip, knee, colon and hysterectomy rates in 2015 showed a 37.5% reduction in the participating hospitals through April 2015.

file:///C:/Users/user/Downloads/aorn_2016_-_wound_prevalence_study_-_161092_corp_aorn_poster_pdf3.pdf

Challenges in the Post-op Patient

- Incision collects fluid, Serum, blood, Growth medium for organisms, Small dehiscence
- Body fluid contamination from bedpans/commodes
- Heavy perspiration common with obese patients
- Friction and sliding - skin tears and blisters
- Itchy skin - due to pain medications - skin breakdown

Other Issues….

Environmental Contamination from Colonized Patients and Cross Contamination from Staff

- Poor hand hygiene
- Inadequate environmental discharge disinfection
- Inadequate terminal disinfection of isolation/precaution rooms
- Contamination of shared equipment
- Contamination of workstations on wheels

Pathogens survive on surfaces

Organism	Survival period
Clostridium difficile	35- >200 days.[2,7,8]
Methicillin resistant *Staphylococcus aureus* (MRSA)	14- >300 days.[1,5,10]
Vancomycin-resistant Enterococcus (VRE)	5[illegible] days.[illegible]
Escherichia coli	>150- 480 days.[7,9]
Acinetobacter	150- >300 days.[7,11]
Klebsiella	>10- 900 days.[6,7]
Salmonella typhimurium	10 days- 4.2 years.[7]
Mycobacterium tuberculosis	120 days.[7]
Candida albicans	120 days.[7]
Most viruses from the respiratory tract (eg: corona, coxsackie, influenza, SARS, rhino virus)	Few days.[7]
Viruses from the gastrointestinal tract (eg: astrovirus, HAV, polio- or rota virus)	60- 90 days.[7]
Blood-borne viruses (eg: HBV or HIV)	>7 days.[5]

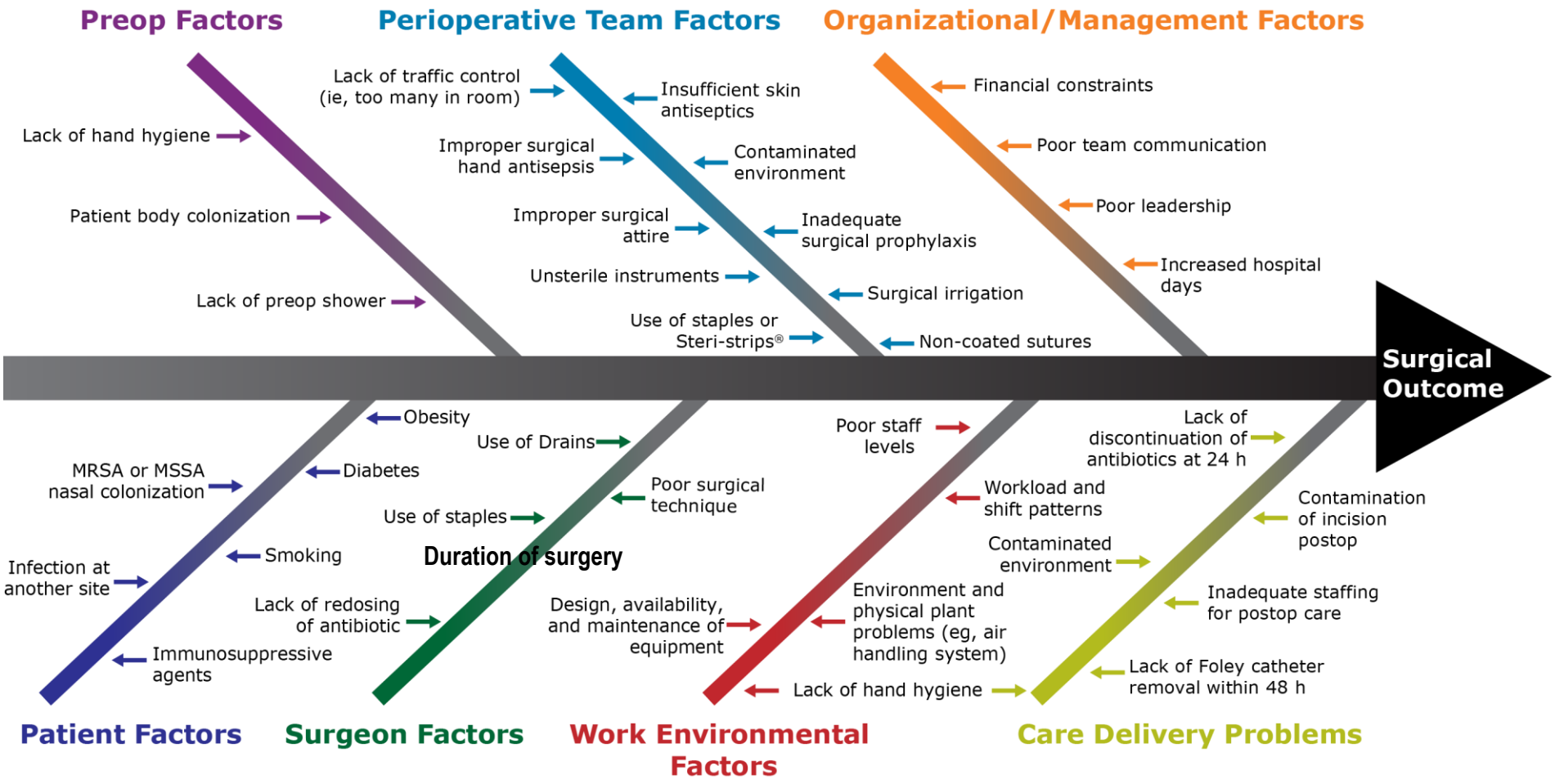
Beard-Pegler et al. 1988.. *J Med Microbiol.* **26**:251-5.
BIOQUELL trials, unpublished data.
Bonilla et al. 1996. *Infect Cont Hosp Epidemiol.* **17**:770-2
Boyce. 2007. *J Hosp Infect.* **65**:50-4.
Duckworth and Jordens. 1990. *J Med Microbiol.* **32**:195-200.
French et al. 2004. *ICAAC.*
7. Kramer et al. 2006. *BMC Infect Dis.* **6**:130.
8. Otter and French. 2009. *J Clin Microbiol.* **47**:205-7.
9. Smith et al. 1995. *J Med.* **27**: 293-302.
10. Wagenvoort et al. 2000. *J Hosp Infect.* **45**:231-4.
11. Wagenvoort and Joosten. 2002. *J Hosp Infect.* **52**:226-7

7S Bundle

http://www.7sbundle.com/

As a result of

Many Risk Factors influence SSI



AORN: Association of periOperative Registered Nurses

Recommendations

Establish Multidisciplinary Team

in order to achieve Zero Harm

Team Representative from:

OR, CSSD, IC, QD, Surgeons & Anesthesia, FMS & Safety

To Evaluate:

1. Procedures and Practices
2. Facility Designee and Environment Issues
3. ICRA
4. Infection Rate

Conclusion

SSI is a major problem in surgical patients

A well-implemented SSI prevention plan will serve a pivotal role in supporting high-quality care initiatives by providing systems for monitoring, measuring, and reporting important outcomes for the prevention of SSI.

Therefore, to successfully eradicate the wound infection, it is imperative that the best practice and treatment method is employed.

1. 2019, Procedure-associated Module SSI of NHSN of CDC System, http://www.cdc.gov/nhsn/PDFs/pscManual/17pscNosInfDef_current.pdf

2. 2016, 7S Bundle AORN and APIC Poster 2014.pd
www.7sbundle.com

3. APIC (2010) . Guide to the Elimination of Orthopedic Surgical Site Infections. (http://apic.org/Professional- Practice/Scientific-guidelines)

APIC®
Association for Professionals in Infection Control and Epidemiology

AORN

NHSN
National Healthcare Safety Network

Finally

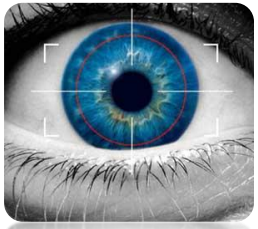
Hospital

Pathogen

HAI & Un-Happy patients

Un-Happy Director

Hospital



Surveillance

No Infection & Happy Patients

Happy Director

MOH'D HAMAD

Infection Control Manager,
VPS Healthcare, UAE.

SSI Criteria (Types of SSI)

1. Superficial Incisional SSI

Must meet one of the following criteria:

1. Purulent drainage from superficial incision
2. Organisms isolated from a culture of:

   fluid or tissue from superficial incision

3. At least 1 sign or symptom of infection :

   pain, tenderness, localised swelling, redness, heat

   and

   Incision deliberately opened by surgeon

   } unless incision is culture-negative

4. Clinicians diagnosis of superficial incisional

Note:

SSI included in the nominator is based on the date of procedure, not the date of event within 30 days of surgical procedure

2019, NHSN System used by the Centers for Disease Prevention and Control, Chapter No.: 9 (SSI)
https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

SSI Criteria (Types of SSI)

2. Deep Incisional SSI

Note:
SSI included in the nominator is based on the date of procedure, not the date of event within 30 days of surgical procedure

Must meet one of the following criteria:

1. Purulent drainage from deep incision
2. Deep incision spontaneously dehisces

   or

   Incision deliberately opened by surgeon in the presence of at least 1 sign or symptom of infection:

   fever (>38 C), pain, tenderness

   unless incision is culture-negative
3. Abscess or other evidence of infection in deep incision: direct examination or re-operation or histopathology or radiology
4. Clinicians diagnosis of deep incisional

2019, NHSN System used by the Centers for Disease Prevention and Control, Chapter No.: 9 (SSI)
https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

SSI Criteria (Types of SSI)

3. Organ/Space SSI

Note:
SSI included in the nominator is based on the date of procedure, not the date of event within 30 days of surgical procedure

Must meet one of the following criteria:

1. Purulent drainage from a drain placed into the organ/space
2. Organisms isolated from a culture of:

   fluid or tissue in the organ/space
3. Abscess or other evidence of infection involving the organ/space: direct examination or re-operation or histopathology or radiology
4. Clinicians diagnosis of organ/space SSI

2019, NHSN System used by the Centers for Disease Prevention and Control, Chapter No.: 9 (SSI)
https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

1. **Safety:** Safe Operating Room
2. **Screen:** Screen for the risk factors & presence of MSSA & MRSA
3. **Shower:** With soap or CHG (Night before surgery & Morning of surgery
4. **Skin Prep:** Using Alcohol Based Antiseptics, Such as CHG/Alcohol or Iodophor/Alcohol
5. **Solution:** Surgical Irrigation Prior to closure to remove exogenous contaminations, Use of CHG irrigant VS antiseptic Irrigations
6. **Suture:** skin closure with coated antimicrobial suture
7. **Skin Closure:** Skin Adhesive to seal incision &/or Antimicrobial Dressing to prevent Exogenous Contamination in post-op period