Infection prevention in the OR: Establishing a safe operating room with a 7S bundle

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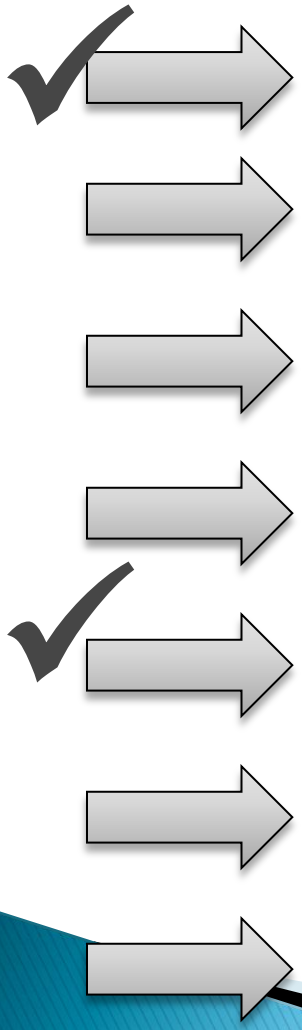
www.7sbundle.com
www.workingtowardzero.com

Objectives

- Understand the steps in the 7 S Bundle approach to prevent surgical site infections
- Describe the benefits of using a 0.05% chlorhexidine irrigation prior to incision to prevent contamination that may lead to a SSI.
- Identify how to collaborate with vendors who can compliment existing infection prevention initiatives in the operating room

7 “S” bundle to prevent SSI



SAFETY – Safe Operating Room

SCREEN – Screening pre-op for MRSA & MSSA

SHOWERS – Showers with CHG night before and morning of surgery

SKIN PREP – Skin Prep with alcohol based antiseptics (CHG, Iodophor)

SOLUTION – Surgical Irrigation with 0.05% CHG

SUTURES – Suturing with antibacterial sutures

SKIN CLOSURE – Sealing the incision with incisional adhesive or covering it with an antimicrobial dressing to prevent exogenous contamination

#1 – Safe operating room

Is Your OR Safe?: Contamination risks in the operating room

- ✓ Traffic control, number of surgeons, staff, reps, visitors in the OR
- ✓ Improper surgical attire resulting in skin cells/organisms into environment from uncovered arms, hair, back of neck
- ✓ Improperly maintained air handling systems, filtration
- ✓ Hair clipping in the operating room
- ✓ Inadequate surgical prophylaxis (selection, dosing, timing)
- ✓ Inadequate room turnover and terminal cleaning procedures
- ✓ Inadequate surgical technique and handling of tissues
- ✓ Improper instrument cleaning/sterilization process, lack of use of enzymatic solution
- ✓ Improper use of biological indicators
- ✓ Contamination from storage of supplies, supply bins, carts, tables, stationary equipment

Follow AORN recommended practices
www.aorn.org – IPs should join and have access

- ✓ Preoperative Patient Skin Antisepsis
- ✓ Environmental Cleaning in the Perioperative Setting
- ✓ Surgical Tissue Banking
- ✓ Surgical Hand Antisepsis
- ✓ Cleaning and Care of Instruments and Powered Equipment
- ✓ Cleaning and Care of Surgical Instruments
- ✓ Cleaning and Processing of Flexible Endoscopes
- ✓ High Level Disinfection
- ✓ Cleaning and Processing Anesthesia Equipment
- ✓ Sterilization in the Perioperative Setting
- ✓ Hand Hygiene in the Perioperative Setting
- ✓ Prevention of Transmissible Infections in Perioperative Settings
- ✓ Surgical attire
- ✓ Sharps Safety

Surgical attire

- Typically, individuals shed more than 10 million particles from their skin every day
- Approximately 10% of skin squames carry viable microorganisms, causing a person to shed nearly 1 million microorganisms from their bodies each day
- AORN "Recommended practices for surgical attire" Section IV.a. states that:

> *"a clean, low-lint surgical head cover or hood that confines all hair and covers scalp skin should be worn. The head cover or hood should be designed to minimize microbial dispersal. Skullcaps may fail to contain the side hair above and in front of the ears and hair at the nape of the neck."*

Scrubs and jackets in OR

- *"Facility approved, clean, and freshly laundered surgical attire should be donned in a designated dressing area of the facility upon entry or reentry to the facility" ….AORN*
- If scrubs are worn into the institution from outside, they should be changed before entering semi-restricted or restricted areas to minimize the potential for contamination (eg, animal hair, cross contamination from other uncontrolled environments)
- Home laundering of surgical attire is not recommended
- Non scrubbed personnel should wear long sleeved jackets that are buttoned or snapped closed during use. Complete closure of the jacket avoids accidental contamination of the sterile field. Long-sleeved attire is advocated to prevent bacterial shedding from bare arms and is included in the Occupational Safety and Health Administration (OSHA) regulation for the use of personal protective equipment (PPE)"

Environmental cleaning and disinfection

- Evaluate and observe between case cleaning procedures
- Bed should be the last thing cleaned – often it is the first!
- Terminal cleaning procedures on evening / night shift
- Sufficient staff to terminally clean all OR rooms each day?

New UV Technology for Operating Rooms

Air filtered through UV light unit that replaces fluorescent lighting "scrubs the air"

Ultraviolet-C room decontaminator

Narrow spectrum UV safe for patient and staff exposure during continuous use

Contact precautions in the OR

- AORN 2012 –Recommended Practices for Transmissible Infections in Perioperative Services
  - Contact precautions will be initiated in the OR for patients with:
    - MRSA colonization or infection
    - Vancomycin-resistant *Enterococcus* (VRE)
    - CRE
    - *C Difficile*
    - A large amount of wound drainage.

Cleaning / sterilization of instruments
www.aami.org – IPs should join and access standards

- Expect both TJC and CMS to spend a lot of time in Central Sterile Processing during Surveys
- Assure IFUs from manufactures are located in CSS (not the managers office) – online software best option
- Challenges with instruments
  - Lumens, grooves, sorting, hand cleaning, disassembly required – massive kits
  - Many instruments cannot be disassembled
  - Correct use of Biologic Indicators
- Pre-soaking and rinsing of tissue and blood from the instruments in the operating room before sent to decontamination with enzymatic

#5 – Chlorhexidine Irrigation

"The Solution to Pollution is Dilution"

Incisions are vulnerable to bacterial contamination before wound closure

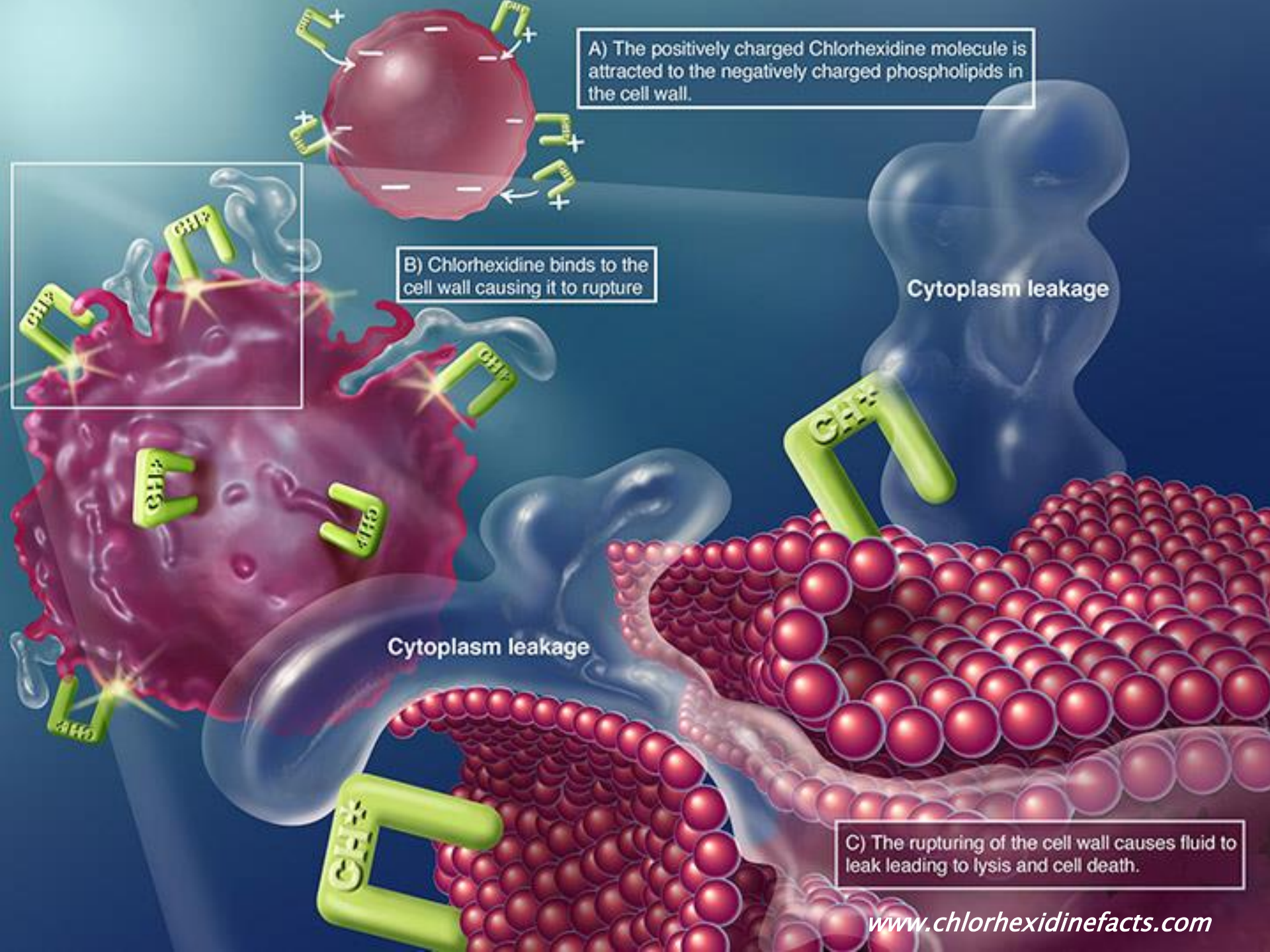
- **OR activities during wound closure**
  - Resident, Physician Assistant or Nurse Practitioner work on incision
  - Circulating Nurse counts sponges and starts room breakdown
  - Scrub Technician starts breaking down tables and preparing instruments for Central Processing
  - Anesthesia move in and out of room
  - Instrument representative & visitors might leave room

Air settling plates in the operating room at the last hour of a total joint case

Chlorhexidine Gluconate (CHG)

- CHG is a broad-spectrum biocide effective against Gram-positive bacteria, Gram-negative bacteria and fungi[1]
- CHG inactivates microorganisms with a broader spectrum than other antimicrobials (e.g. antibiotics) – has a quicker kill rate than other antimicrobials (e.g. povidone-iodine, PI)[2]
- It has both bacteriostatic and bactericidal mechanisms of action – kills by destabilizing the cell membrane within 20-30 second of application[3, 4]
- Unlike PI, CHG is not affected by the presence of body fluids such as blood

1. Edmiston et al. *Am J Infect Control* 2013;41:49
2. McDonnell et al. *Clin Microbiol Rev* 1999;12:147
3. Mangram et al. *Am J Infect Control* 1999;27:97
4. Genuit et al. *Surg Infect* 2001;2:5
5. Lim et al. *Anaesthesia Intensive Care* 2008;36:4


A) The positively charged Chlorhexidine molecule is attracted to the negatively charged phospholipids in the cell wall.
B) Chlorhexidine binds to the cell wall causing it to rupture
Cytoplasm leakage
Cytoplasm leakage
C) The rupturing of the cell wall causes fluid to leak leading to lysis and cell death.
www.chlorhexidinefacts.com

Is 0.05% CHG an Effective Agent for Intraoperative Irrigation?

- Killing-curve analysis – MDRO surgical pathogens
- Log-reduction *in-vitro* mesh model – MDRO
- *In-vivo* abdominal mesh MRSA infection model

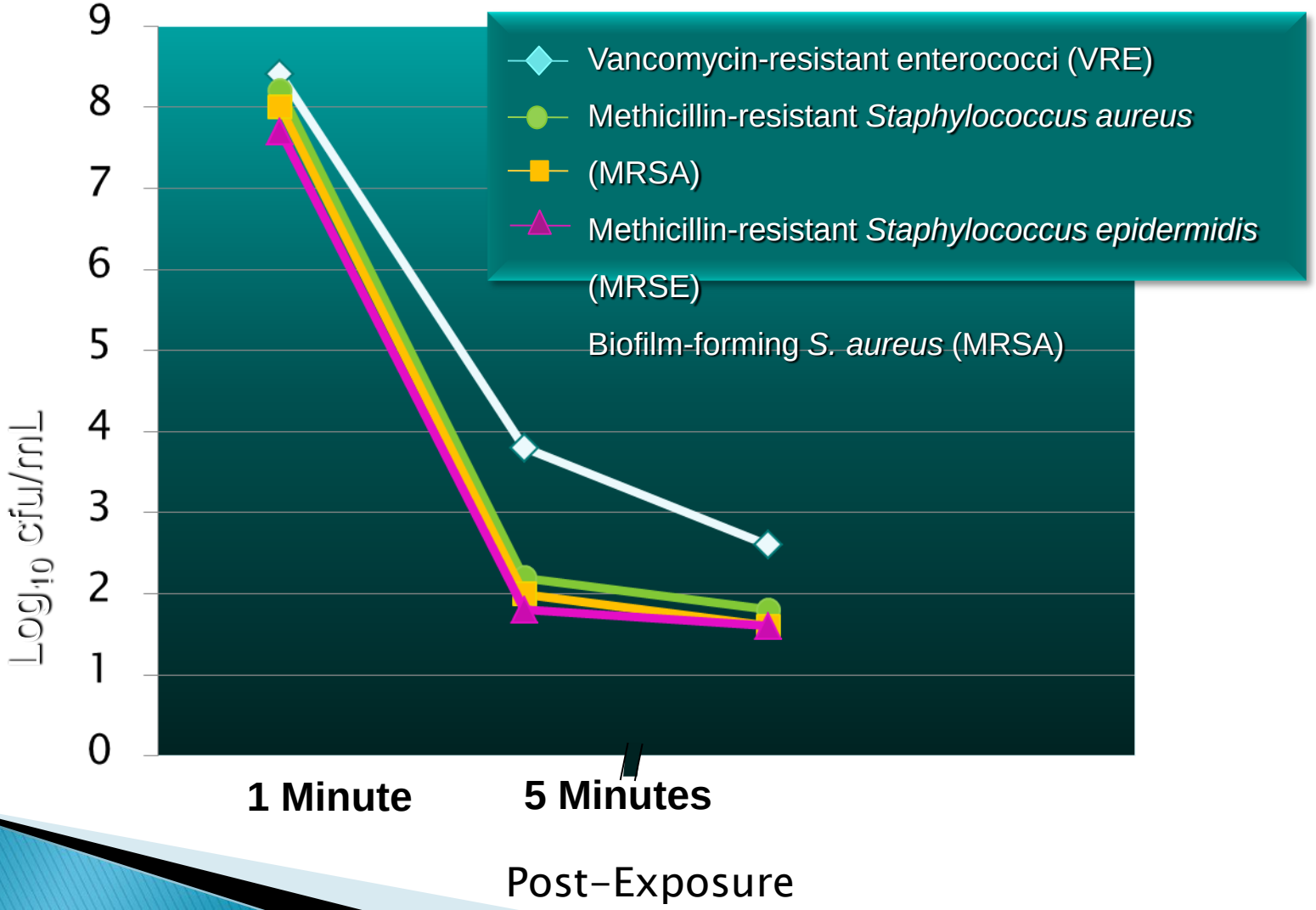
1. *In-Vitro* Time-Kill Kinetics

Methodology

- Clinical Gram-positive and Gram-negative multi-drug resistant surgical isolates were selected for study.
- A standardize microbial inoculum (8.1-9.2 $\log_{10}$ cfu/mL) was exposed to 0.05% CHG at 1, 5 and 30 minutes – At each interval, a neutralization agent was added to each tube and time-kill kinetics performed to assess cell viability
- Viable microbial cell counts were reported as $\log_{10}$ cfu/mL
- All testing was performed in triplicate and results averaged

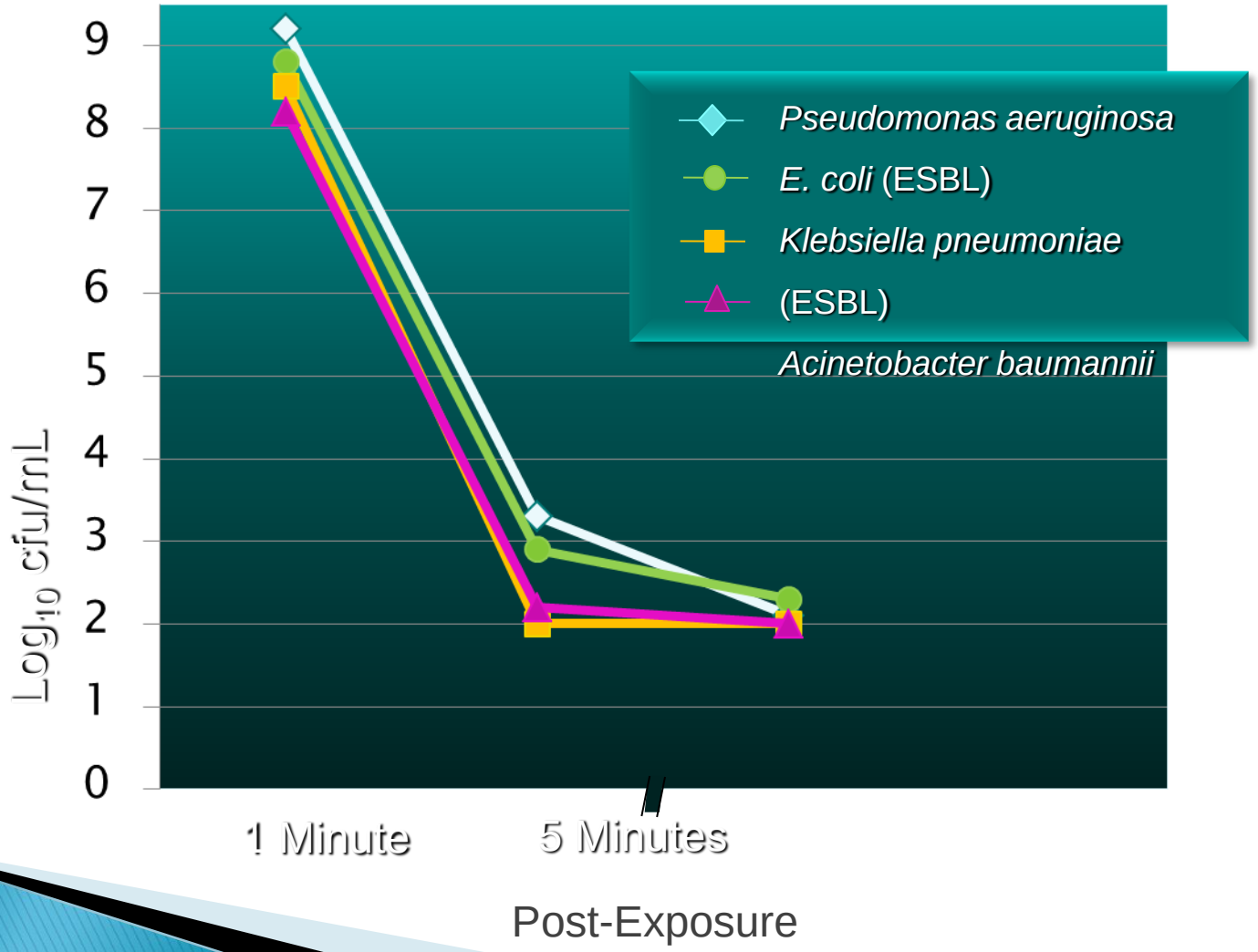
A. Edmiston et al. *Am J Infect Control* 2013;41:49

Time-Kill Log Reduction – Selective Gram-Positive MDR Surgical Pathogens



Edmiston et al. *Am J Infect Control* 2013;41:49

Time-Kill Log Reduction – Selective Gram-Negative MDR Surgical Pathogens



A. Edmiston et al. *Am J Infect Control* 2013;41:49

2. Impact of 0.05% Chlorhexidine Gluconate (CHG) on Microbial Adherence to Surgical Mesh

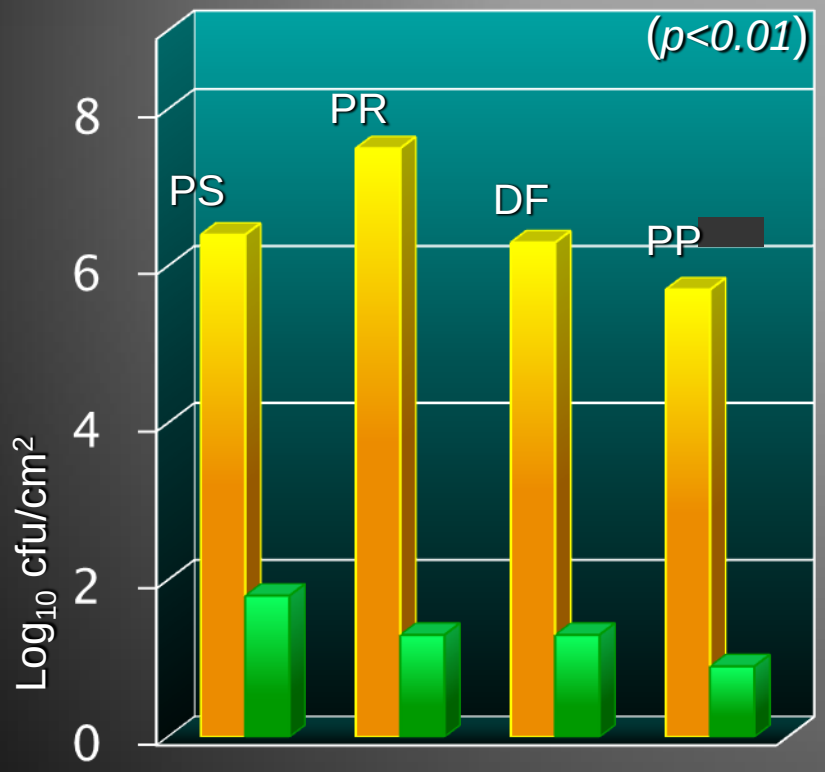
Methodology

- Clinical Gram-positive and Gram-negative surgical isolates were selected for study
- Selective mesh segments (1-cm^2) were immersed in standardized suspension (8.0 Log_{10} cfu/mL) for 5 minutes, followed by washing (2X)
- Test mesh placed in 0.05% CHG for 60 seconds and gently agitated, controls samples were placed in normal saline and agitated (60 seconds) – test segments were placed in neutralizing solution to inactivate CHG
- Test and control mesh segments were sonicated for 2-minutes, serially diluted, plated to TSA and incubated for 48-hrs (35^oC)
- Microbial recovery expressed as Log_{10} cfu/cm^2 – mesh segments were processed in triplicated and counts averaged

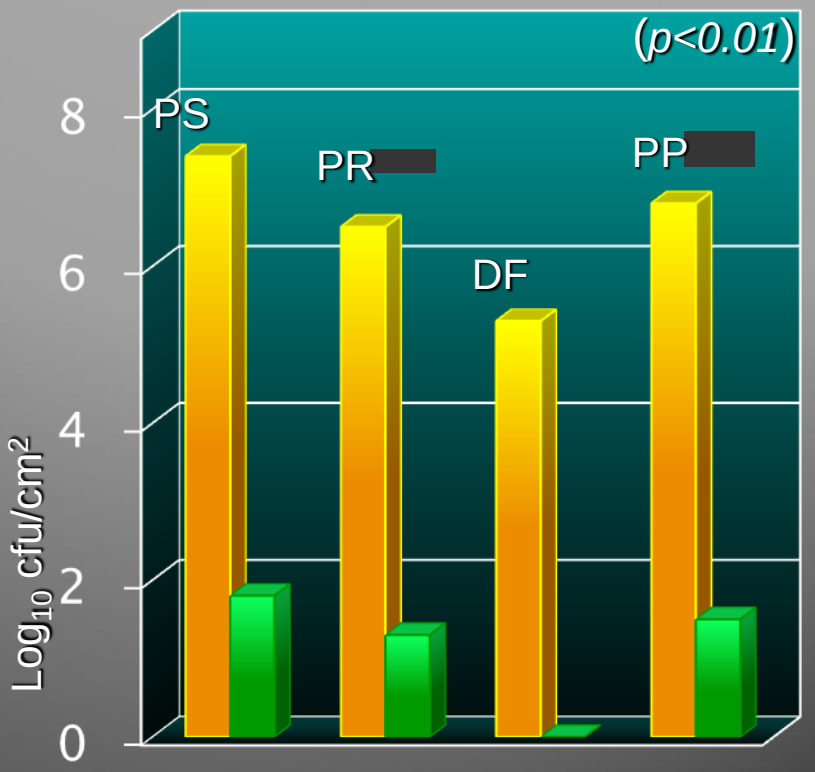
A. Edmiston et al. *Am J Infect Control* 2013;41:49

Time-Kill Log Reduction on Synthetic Mesh Following Contamination and 1-Minute Exposure to 0.05% Chlorhexidine Gluconate (CHG)

PS = polyester (soft)
PR = polyester (rigid)
DF = dual facing polyester and absorbable film
PP = polyester and polyglactin acid



MRSA – Biofilm producer



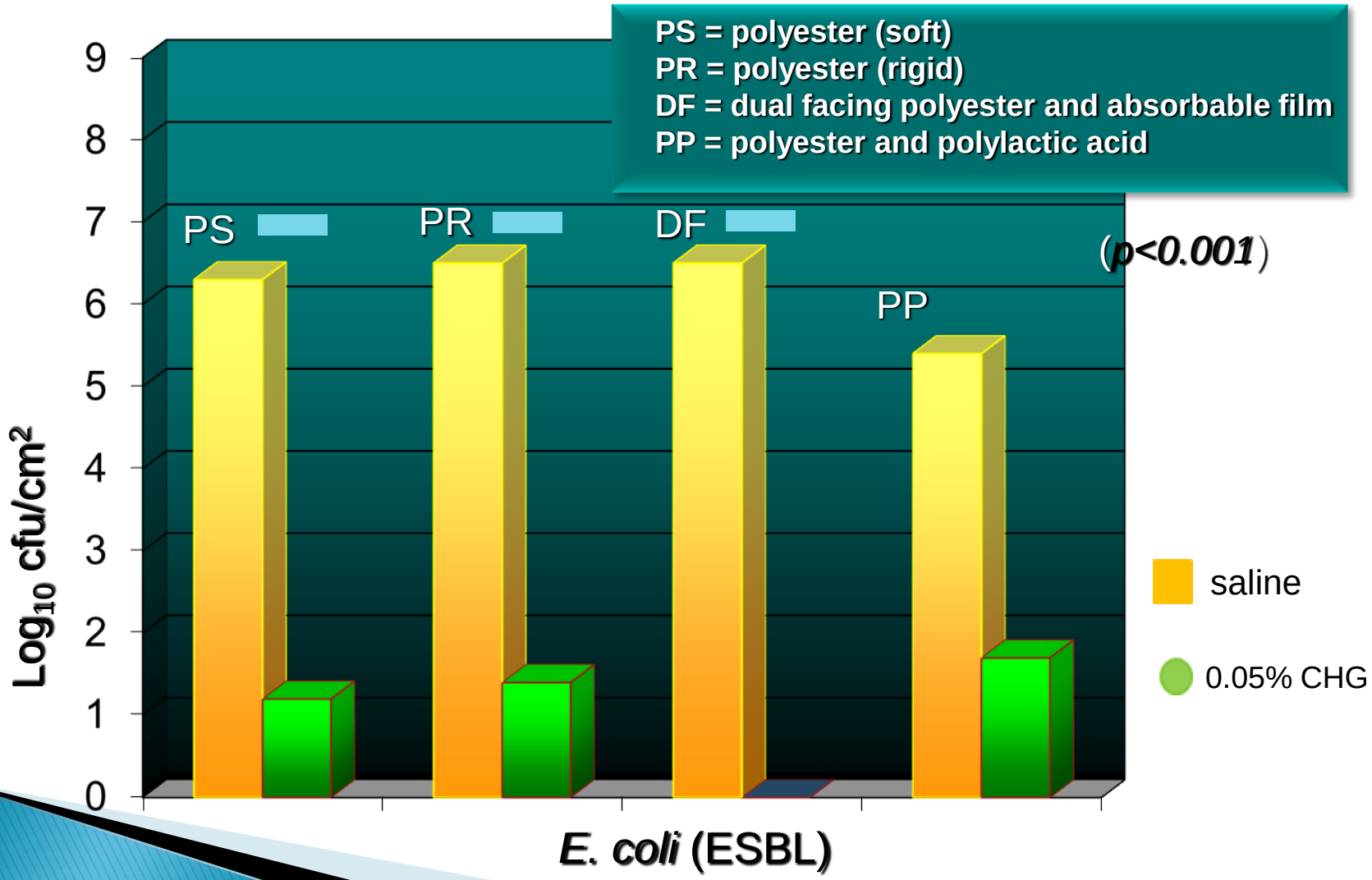
S. aureus (MRSA)

saline

0.05% CHG

Edmiston et al. *Am J Infect Control* 2013;41:49

Time-Kill Log Reduction on Synthetic Mesh Following Contamination and 1-Minute Exposure to 0.05% Chlorhexidine Gluconate (CHG)



Edmiston et al. *Am J Infect Control* 2013;41:49

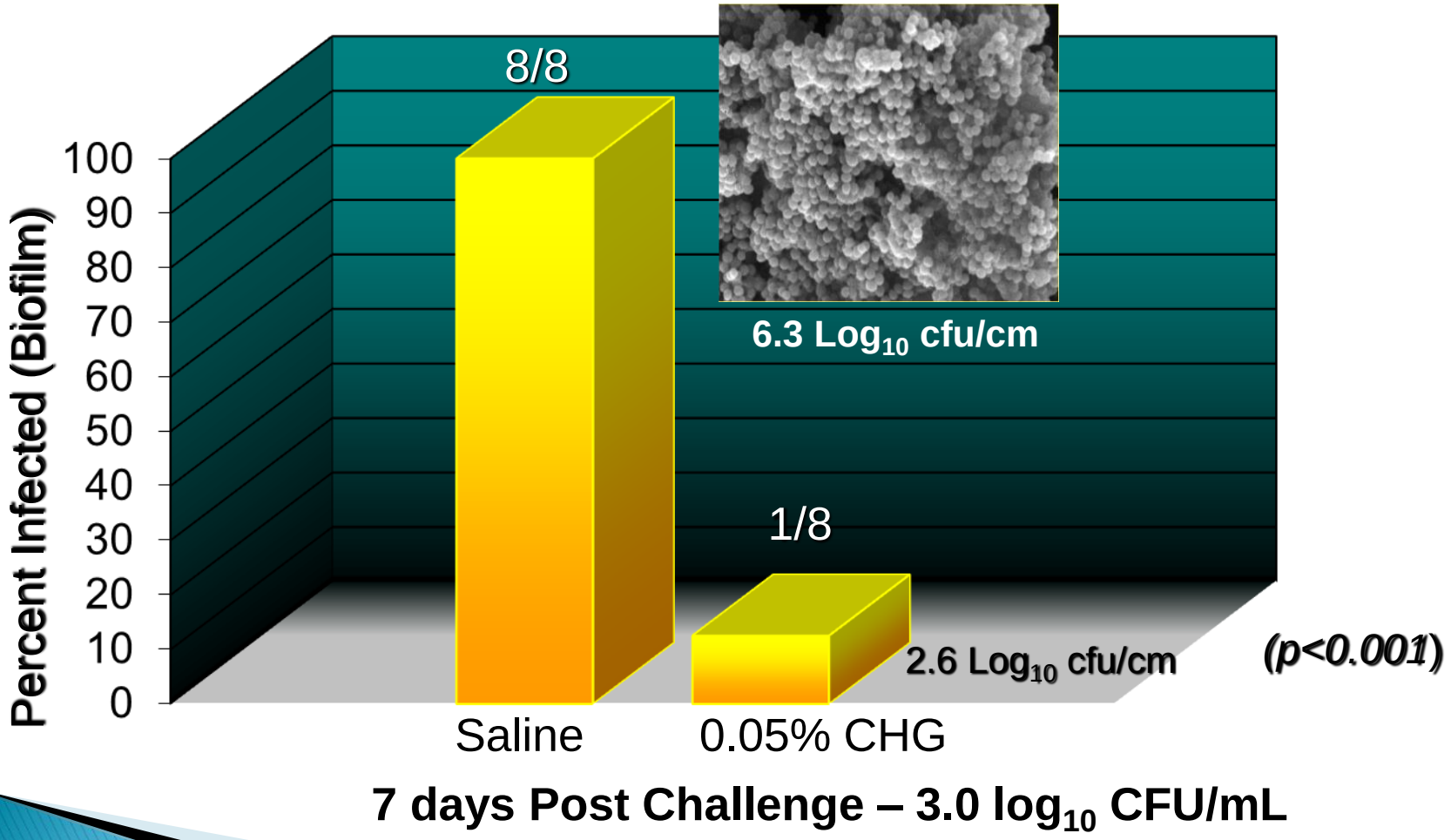
3. Impact of Intraoperative Saline and 0.05% CHG Irrigation on Resolution of MRSA Infected Animal Mesh Model

Methodology – Study approved by institutional animal welfare committee

- 1-cm x 2-cm abdominal (ventral midline) defect created in 16 Sprague-Dawley rats (Isoflurane/Rimadyl) followed by aseptic repair with polypropylene mesh – secured with 4 interrupted sutures
- Mesh segments contaminated (15-minutes) with 3.0 Log_{10} cf/mL MRSA
- 8 segments irrigated 2X (60-sec) with normal saline / 8 segments irrigates (60-sec) with 0.05% CHG plus normal saline (60-sec) – irrigation volumes identical (200-mL)
- Incision closed (proline) and wound protected with coflex
- Animal observed daily – At 7-days animals were sacrificed (CO_2), mesh aseptically removed, segments sonicated, serially plated to TSA, incubated for 48-hrs at 35°C.
- Microbial recovery expressed as Log_{10}cfu/cm mesh

A. Edmiston et al. *Am J Infect Control* 2013;41:49

Impact of Intraoperative Saline and 0.05% CHG Irrigation on Resolution of MRSA Contaminated Polypropylene Mesh – Sprague-Dawley Animal Model



7 days Post Challenge – 3.0 log_{10} CFU/mL

Edmiston, ACS 2013

Irrigation of Incisions With 0.05% Chlorhexidine Reduces Surgical Site Infections in Colorectal Surgery

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INTRODUCTION

Surgical site infections (SSIs) are the costliest hospital associated infections among hospitalized patients.[1-4] In the US, approximately 300,000 SSIs occur yearly, representing 13% of healthcare associated infections.[5] Surgical site irrigation is controversial and various solutions have been reported and used in an attempt to reduce infection.[4] However, there is little clinical evidence to support use of antimicrobial agents in wound irrigation when other measures such as appropriate perioperative antibiotics are used. While there is a paucity of information on the effect of wound irrigation with chlorhexidine gluconate (CHG), much is known about its benefits for skin preparation. CHG has a wide range of activity against gram positive and negative bacteria, fungi, and viruses.[6] Currently there is no formal recommendation or substantial evidence to support the practice of surgical wound irrigation prior to skin closure nor has the use of CHG irrigation in colorectal surgery been well investigated. Therefore the purpose of our study was to evaluate the effectiveness of 0.05% CHG irrigation in reducing abdominal surgical site infections in colorectal surgery.

STUDY DESIGN/SETTING

Retrospective review of abdominal operations performed by a group of three subspecialized colorectal surgeons at a large, tertiary, teaching hospital was performed.

METHODS

A consecutive 7 month trial period where 0.05% CHG solution was used to irrigate surgical incisions, as well as the consecutive 7 month period prior. The study extended from Jan 1, 2013 to Feb 28, 2014. One surgeon used CHG irrigation in all operations whereas the other two surgeons did not use CHG irrigation consistently. Procedures and SSIs were classified using NHSN surgical procedure codes and infection event surveillance definitions. SSI rates for each surgeon were calculated and compared using student's t-test.

RESULTS

A total of 196 qualifying cases were performed prior to CHG intervention and 197 during the trial period. A total of 27 SSIs occurred in each of the time periods. Table 1 demonstrates the number and rates of SSIs occurring during each time period and the difference between surgeons.

Table 1:

	Surgeon 1: Consistent Use of CHG	Surgeons 2 & 3: Inconsistent Use of CHG	p-value
Pre-intervention Period SSIs/Cases (Rate)	13/67 (19%)	14/129 (11%)	0.32
CHG Trial Period SSIs/Cases (Rate)	7/58 (12%)	20/139 (14%)	0.0002
p-value	0.013	0.0137	

American Society Colorectal Surgeons (ASCRS) June 2015

Figure 1:

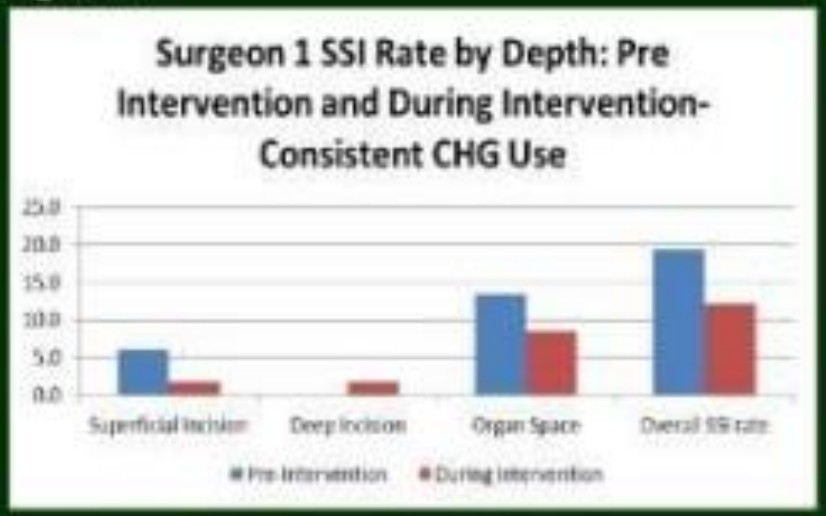
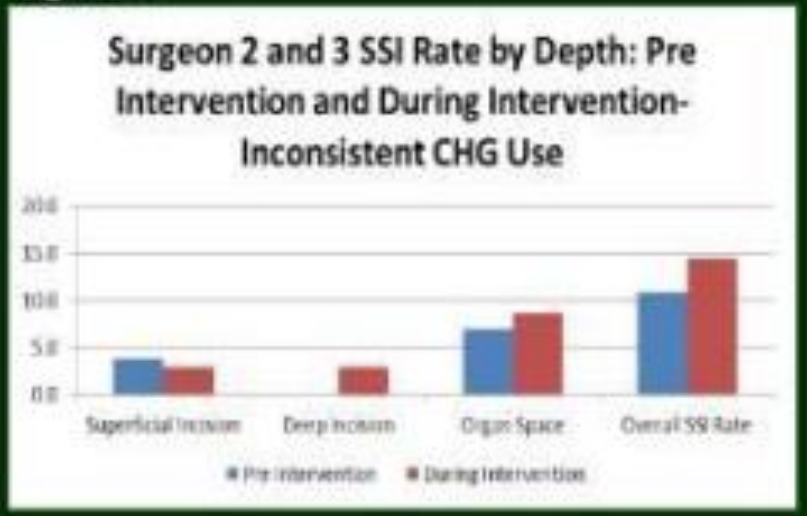


Figure 2:



CONCLUSION

Our study demonstrates utility in the consistent use of 0.05% CHG irrigation for reducing SSIs in colorectal operations. A statistically significant decrease in SSIs was found for a surgeon using CHG in all cases during the intervention period. In addition, though there was no statistically significant difference between overall SSIs at baseline, there was a statistically significant decrease in SSIs for the surgeon using CHG in all cases during the intervention period when compared to the other surgeons. Although this was a small study, each participating surgeon served as their own control and could be compared across the group. A well powered prospective study should be performed to corroborate these preliminary findings.

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2. Lewis SS, Moehring RW, Chen LF, Sexton DJ, Anderson DJ. Assessing the relative burden of hospital-acquired infections in a network of community hospitals. Infect Control Hosp Epidemiol 2013;34(11):1229–1230.
3. Zimlichman E, Henderson D, Tamir O, et al. Health care–associated infections: a meta-analysis of costs and financial impact on the US health care system. JAMA Intern Med 2013;173(22):2039–2046.
4. Donald E. Fry. "The Prevention of Surgical Site Infection in Elective Colon Surgery," Scientifica, vol. 2013, Article ID 896297, 19 pages, 2013. doi:10.1155/2013/896297
5. Twomey, Carolyn, RN, BSN. The Surgical Healthcare-Associated Infection: Uncovering the Truth about Surgical Irrigation. Accessed at www.infectioncontroltoday on December 8, 2014
6. Edmiston, Charles E. et al. 1.Reducing the risk of surgical site infections: Does chlorhexidine gluconate provide a risk reduction benefit? American Journal of Infection Control , Volume 41 , Issue 6 , S49 - S55

Conclusions

- *In-vitro* time-kill kinetics studies documented a >6-log reduction when selective drug-resistant surgical isolates were exposed for 1-5 minutes to 0.05% CHG
- 0.05% CHG was effective (>5-log reduction, $p<0.01$) at resolving selective Gram-positive (biofilm-positive) and Gram-negative pathogens from the surface of synthetic mesh segments
- 0.05% CHG was effective (82.5% reduction, $p<0.001$) in reducing the risk of an MRSA biofilm-mediated mesh infection in an *in-vivo* animal model
- Current clinical experience has documented 0.05% to be safe in selective surgical practices
- Clinical studies are warranted documenting its evidence-based benefit as an effective SSI risk reduction strategy

IRRISEPT®

Finally, an alternative to saline irrigation

The first and only FDA-cleared cleansing and debridement system, containing

0.05% Chlorhexidine Gluconate (CHG) in Water for Irrigation

IrriSept O.R. (sterile packaging)

Custom designed applicators facilitate cleansing for a variety of applications

SplatterGuard®

LT SplatterGuard®

IrriProbe®

IRRISEPT®

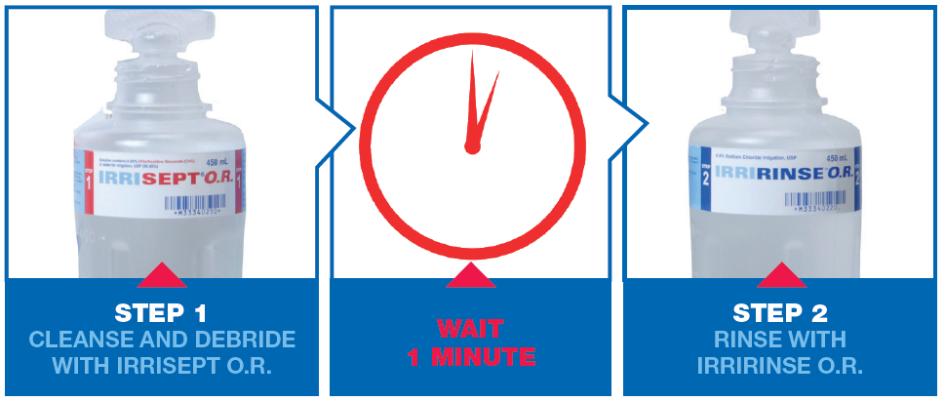
Easy to Use: Two-Step Delivery System

IrriSept is indicated for use on wounds

Contraindications and Warnings:

Do not use on patients allergic to Chlorhexidine Gluconate (CHG)

Keep away from the eyes and ear canals; if there is contact with these areas, rinse out promptly and thoroughly with water or normal saline



Indications for Use

Surgical Wounds (as a final rinse before closure)

- Orthopedic Surgery
- General Surgery
- Plastics & Reconstructive Surgery
- Cardiothoracic Surgery
- Neurologic Surgery

Surgical Site Infections (SSI)

Skin & Soft Tissue Infections (SSTI)

Delayed closures

Abscesses

Deep traumatic wounds

Dehiscence

Pilonidal cysts

Puncture wounds

Burns

“Road rash” abrasions

Lacerations

Chronic Wounds

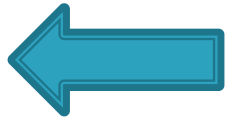
Collaborating with vendors

UHS Experience with Irrisept

- Instituted the use of the 7 S Bundle in 2012
- 2013 started implementing in facilities with high SSI rates
- May 2015 – collaboration with Irrisept clinical specialists to visit facilities
- Education done with surgeons on appropriate use of Irrisept
- 2016 – Collaboration with corporate Antimicrobial Stewardship Committee to explore the inappropriate use of antibiotic irrigations that could result in antimicrobial resistance and/or cases of anaphylaxis associated with Bacitracin irrigation

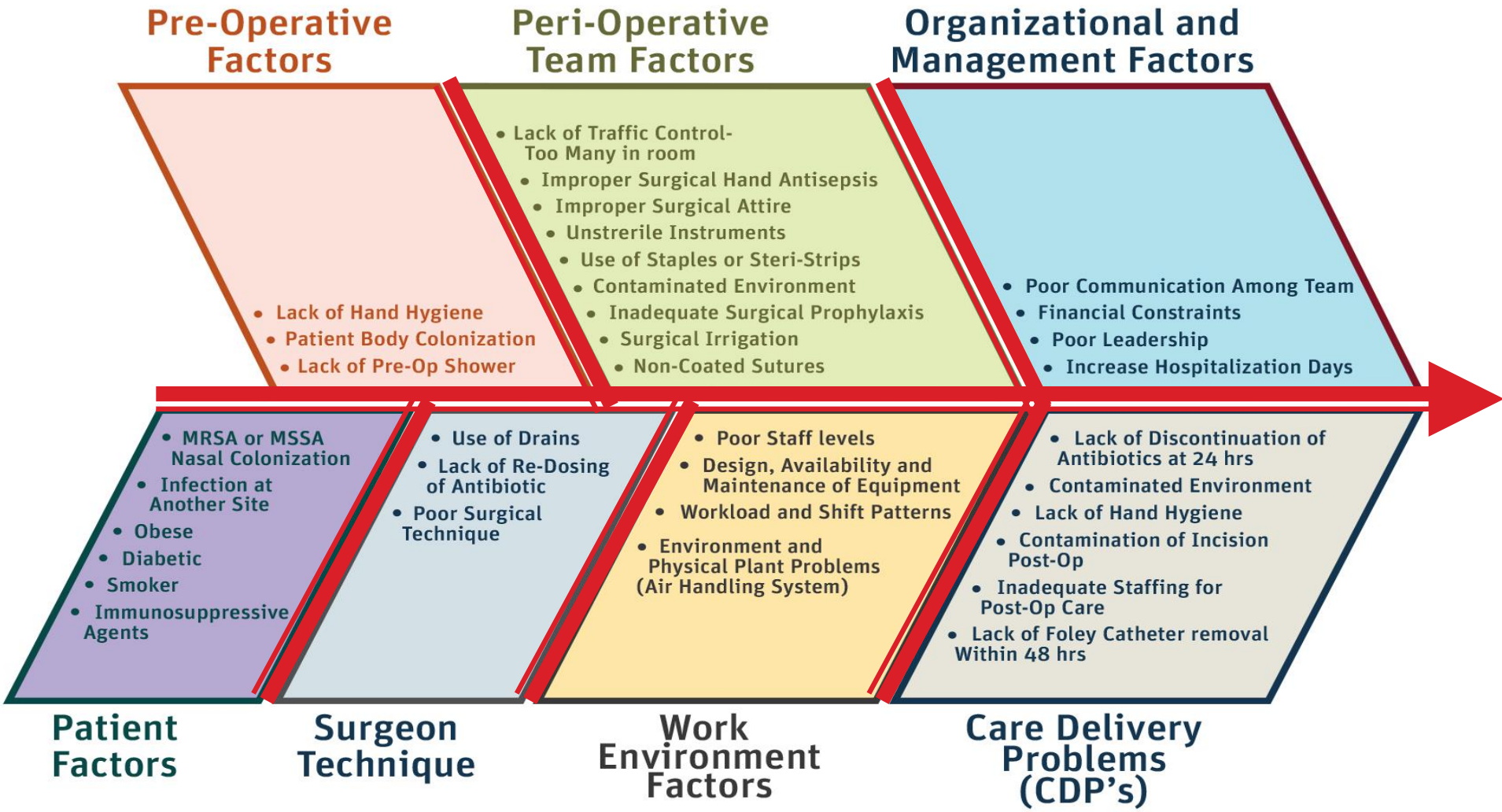
7 S Bundle Implementation Survey – January 2016

1. Safe OR	
EOC Rounds	75%
Wound Protectors	40%
2. Screening for MRSA	
Screening for MRSA	70%
Partial compliance	25%
Not screening (1)	5%
3. Chlorhexidine Showers	95%
4. Alcohol Based Antiseptics	
Chloroprep	95%
Duraprep	75%
5. Surgical Irrigation	
Bacitracin/Polymixin	70%
Cefazolin	50%
Vancomycin	30%
Irrisept (CHG)	75%
Other	40%
6. Antimicrobial Sutures	70%
7. Incisional Adhesive/Dressings	
Dermabond incisional adhesive	100%
Silver Dressing	65%



Conclusion

Many risk factors influence SSI



Surgical infection prevention team

- Senior leadership and surgeons – Must be involved and lead the effort
- Structured program with clearly defined goal of zero tolerance for HAIs and ZERO HARM intent
- Communication – effective and consistent
- Ongoing and creative education
- Financial support to Infection Prevention program
- Use process improvement tools – (fishbone, pareto, mind-mapping)

Thank you