

Prevention of Surgical Site Infections/Periprosthetic Joint Infections

A Ten Step Approach

Javad Parvizi, MD, FRCS

Professor of Orthopaedic Surgery

Acibadem University

Founder, International Joint Center



Effective Strategies



JAMA Surgery | Special Communication

Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017

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Clinical Review & Education

AAOS

AMERICAN ACADEMY OF
ORTHOPAEDIC SURGEONS

Diagnosis and Prevention of Periprosthetic Joint Infections

Evidence-Based Clinical Practice Guideline

Adapted by:

The American Academy of Orthopaedic Surgeons Board of Directors
March 11, 2019



Infection Control & Hospital Epidemiology (2023), 1–26
doi:10.1017/ice.2023.67

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update

Michael S. Calderwood MD, MPH^{1,a}; Deverick J. Anderson MD, MPH^{2,a}; Dale W. Bratzler DO, MPH³; E. Patchen Dellinger MD⁴; Sylvia Garcia-Houchins RN, MBA, CIC⁵; Lisa L. Maragakis MD, MPH⁶; Ann-Christine Nyquist MD, MSPH⁷; Kiran M. Perkins MD, MPH⁸; Michael Anne Preas RN, MS, CIC⁹; Lisa Saiman MD, MPH¹⁰; Joshua K. Schaffzin MD, PhD¹¹; Marin Schweizer PhD¹²; Deborah S. Yokoe MD, MPH¹³; and Keith S. Kaye MD, MPH^{14,b}

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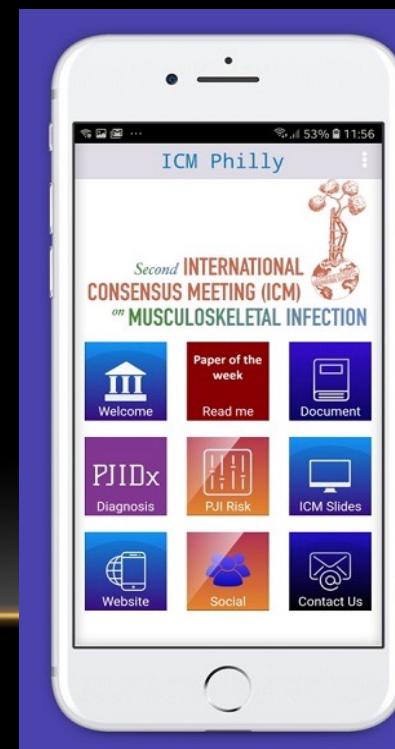


How-to Guide: Prevent Surgical Site Infection for Hip and Knee Arthroplasty

Prevent surgical site infection for hip and knee arthroplasty by implementing the interventions recommended in this guide.

Second International Consensus on Periprosthetic Joint Infection

July 25-27, 2018



Download
ICM Philly App



Proceedings of
the International
Consensus Meeting
on Periprosthetic
Joint Infection

Chairs:

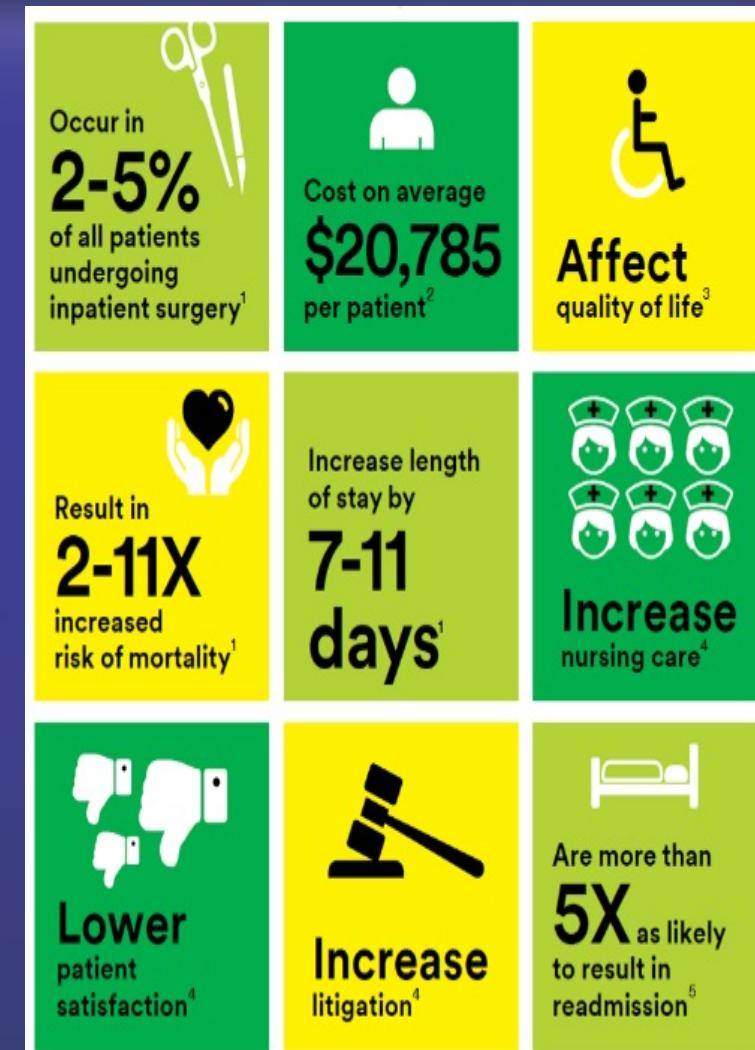
Javad Parvizi, MD, FRCS
Thorsten Gehrke, MD



Disclosures

- The following presentation is made on behalf of BD and contains the opinions of, and personal surgical techniques practiced by Dr. Parvizi. The opinions and techniques presented herein are for informational purposes only and the decision of which techniques to use in a particular surgical application should be made by the surgeon based on the individual facts and circumstances of the patient and previous surgical experience.
- Consult BD product labels and inserts for any indications, contraindications, hazards, warnings, precautions and instructions for use.
- Dr. Parvizi is a paid consultant for BD.
- BD-64364

Surgical site infections (SSIs) are a immense burden on healthcare, providers and patients



1. Anderson, D., et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. *Infection Control and Hospital Epidemiology*. 2014; 35(6), 605-627. doi:1. Retrieved from <http://www.jstor.org/stable/10.1086/676022 doi:1>

2.. Zimlichman E, Henderson D, Tamir O, et al. Health Care-Associated Infections: A Meta-analysis of Costs and Financial Impact on the U.S. Health Care System. *JAMA Internal Medicine*, Dec. 9/23, 2013, 173(22), 2042-2044.

3. Whitehouse et al. The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: adverse quality of life, excess length of stay, and extra cost. *Infect Control Hosp Epidemiol*. 2002; 23(4):183-189.

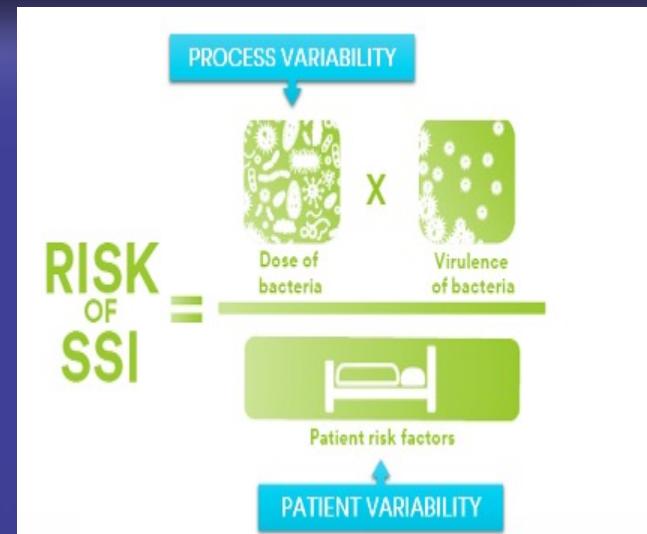
4. Prevention and treatment of surgical site infection. NICE Clinical Guidelines <https://www.nice.org.uk/guidance/cg74/evidence/full-guideline-242005933 Published October 22, 2008. Accessed December 13, 2016.>

5. Kirkland KB, et al. The impact of surgical-site infections in the 1990s: Attributable mortality, excess length of hospitalization, and extra costs. *Infect Control Hosp Epidemiol*. Nov 1999;20(11):722-724

Risk of Infection

Conceptual Formula

- According to the CDC's conceptual formula for SSI Risk, SSIs are impacted by the number of microbes that contaminate an incision during surgery¹
- Most surgical site infections are caused by contamination of an incision with microbes from the patient's own skin
- The skin can contain over 1,000,000 bacteria per sq cm²
- It can take as few as 10 microbes per sq cm* to cause a surgical site infection³



Source: CDC

If we can reduce the number of microorganisms, we can reduce the risk of infection

*

1. CDC Guideline For Prevention Of Surgical Site Infection, 1999 http://www.cdc.gov/ncidod/dhqp/gl_surgicalsite.html

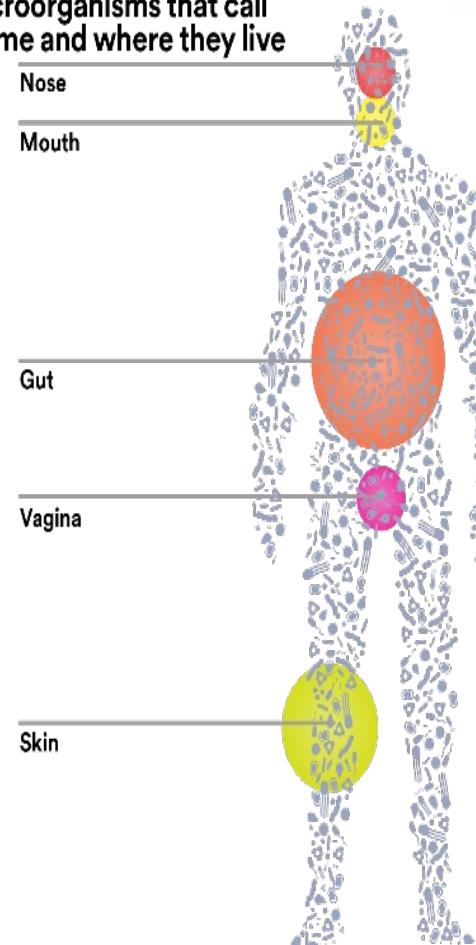
2. Percival SL, Emanuel C, Cutting KF, Williams DW. Microbiology of the skin and the role of biofilms in infection. *Int Wound J.* 2012;9:14-32.

3. Feldman G, et al. Recent advances in the basic sciences: osteoarthritis, infection, degenerative disc disease, tendon repair and inherited skeletal diseases. In: Austin MS, Klein GR, ed. *Recent Advances in Orthopedics*. Philadelphia, PA Jaypee Medical Inc; 2014: 256.

Microbiome

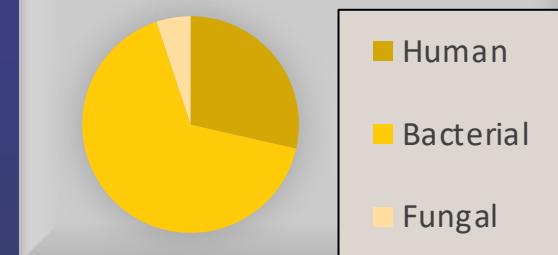
Meet Your Microbiome

the microorganisms that call
you home and where they live

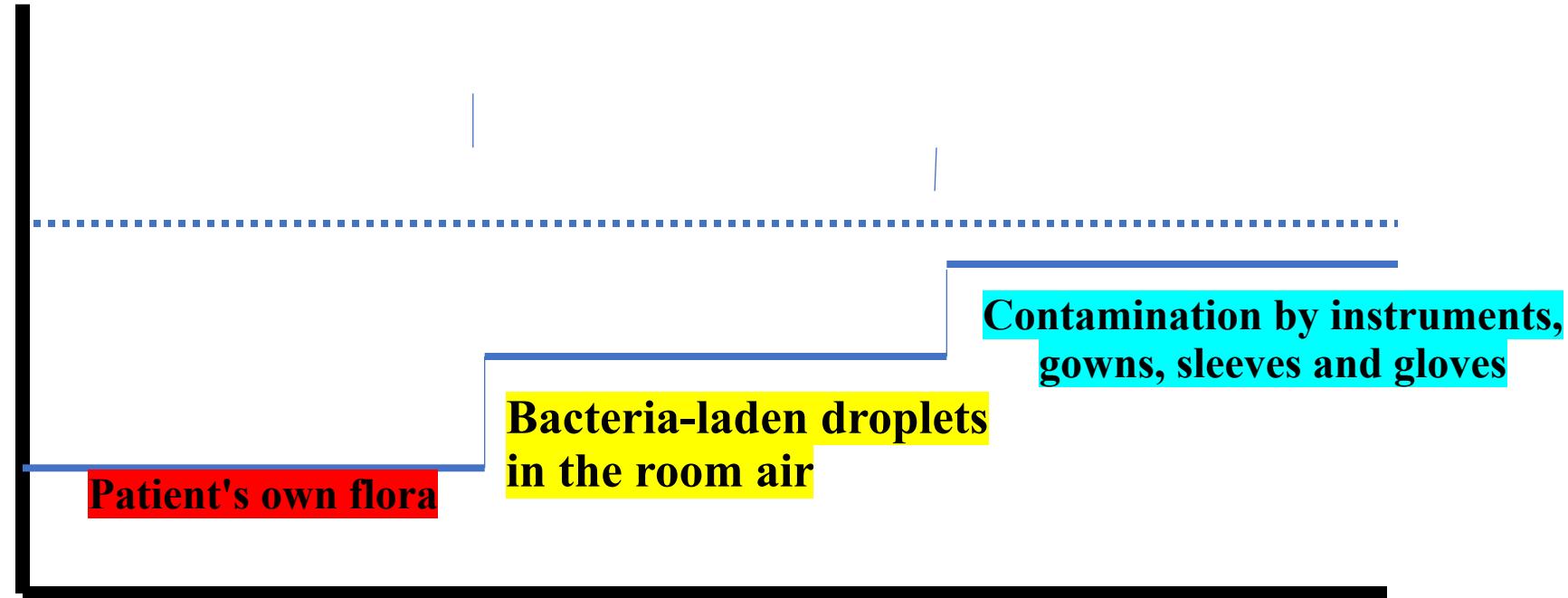


37 Trillion Human
Cells
100 Trillion
Microbial Cells

Kinds of cells
in the
human body

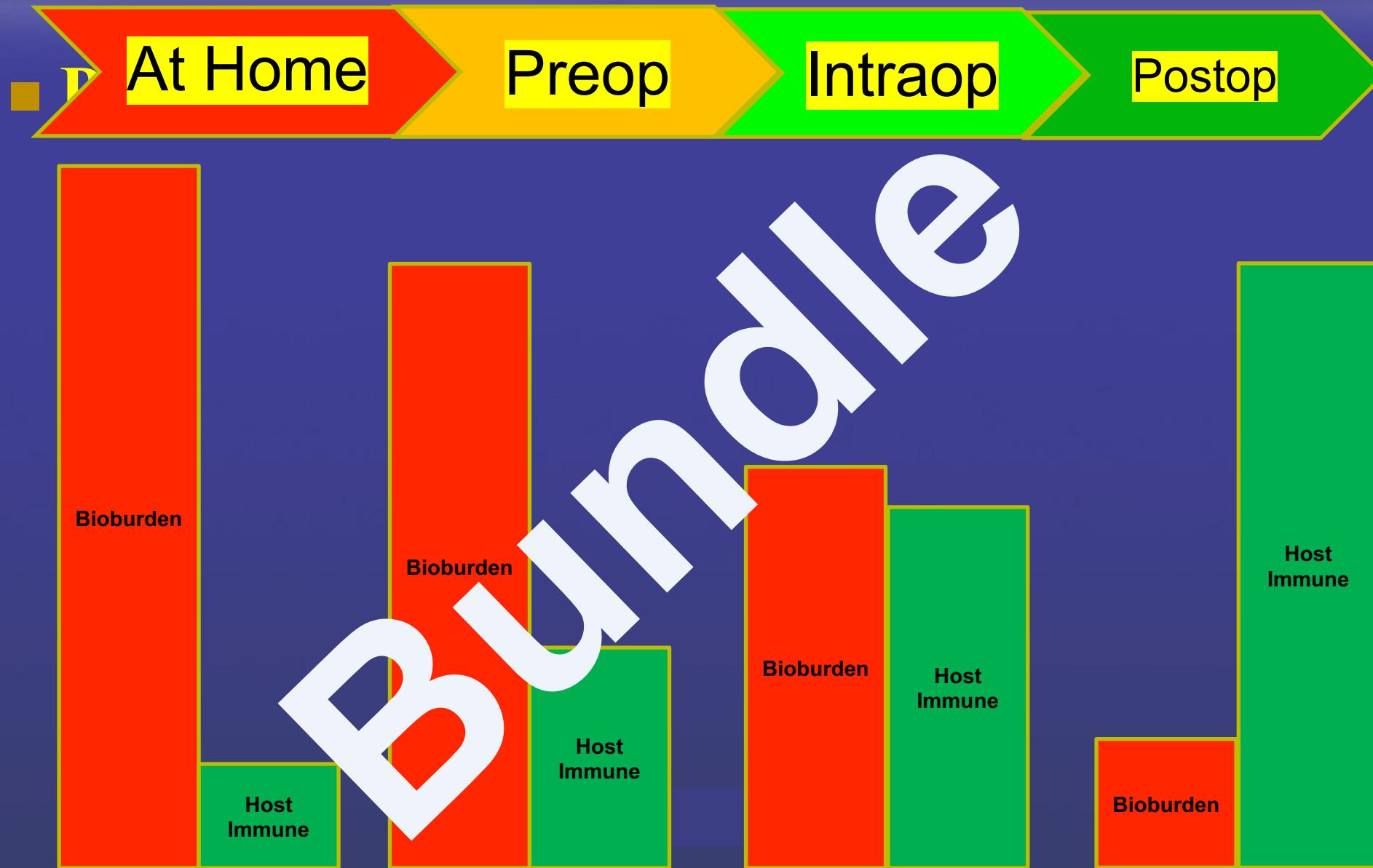


BioBurden



Three main sources of microbes

SSI prevention is all about bundle



Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Question: What are the absolute and relative contraindications to elective primary total joint arthroplasty, with respect to SSI and PJI risk?

RESEARCHED BY:



Richard Iorio MD



Optimize Patient

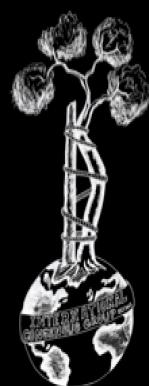
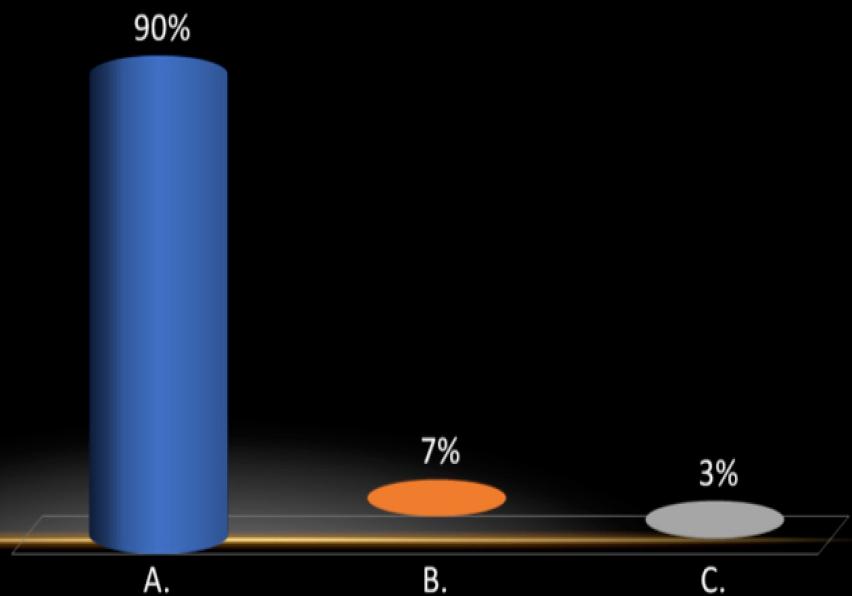
- Anemia
- Smoking
- Obesity
- Chronic diseases
- Vitamin D def

Second International Consensus on Periprosthetic Joint Infection

Recommendation: Elective joint arthroplasty is contraindicated in patients with an infectious lesion in extremity until the infection is resolved. Total joint arthroplasty needs to be deferred in patients with uncontrolled conditions, such as diabetes, malnutrition, chronic kidney disease as so on that are known to increase the risk of SSI/PJI.

Level of Evidence: Strong

- A. Agree
- B. Disagree
- C. Abstain



Second International Consensus on Periprosthetic Joint Infection

G-33 What is the most accurate marker for assessing glycemic control that best predicts SSI/PJI?

RESEARCHED BY:



Noam Shoat



Kevin Mulhall

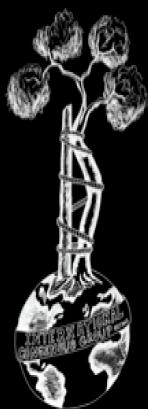
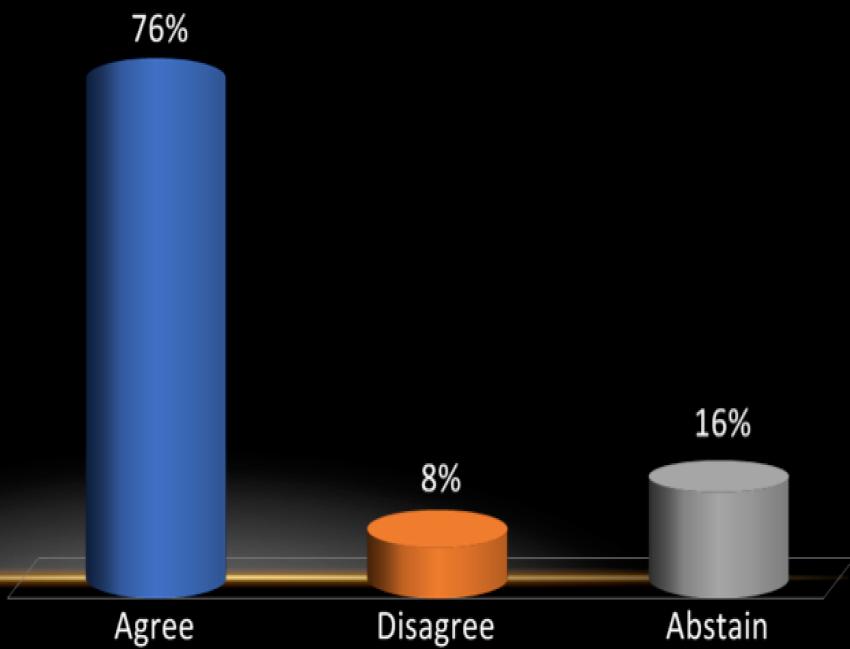


Second International Consensus on Periprosthetic Joint Infection

Recommendation: While there is evidence showing an association between elevated HbA1c and fasting blood glucose and increased risk for subsequent SSI/PJI, this association is not strong. Recent findings suggest that fructosamine in the preoperative period and glucose variability in the immediate postoperative period may provide greater prediction of surgical site infection (SSI) or periprosthetic joint infection (PJI).

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Second International Consensus on Periprosthetic Joint Infection

G-34 What is the threshold for HbA1C
that is predictive of subsequent SSI/PJI
in patients undergoing orthopedic
procedures?

RESEARCHED BY:



Hasan Nahouli

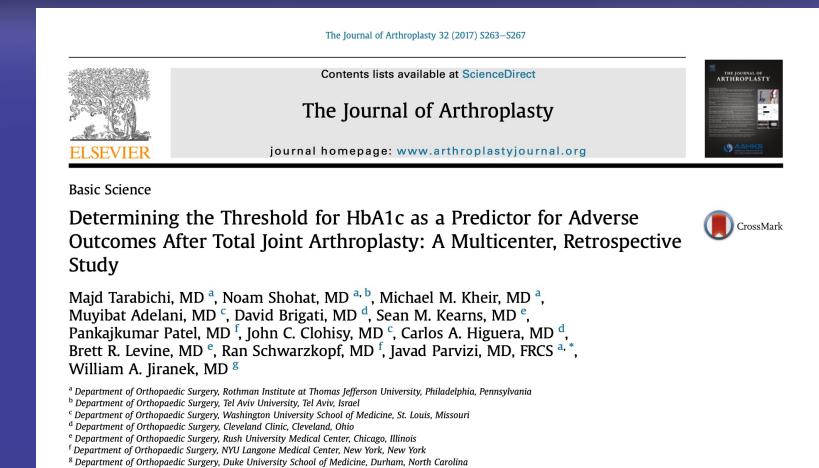
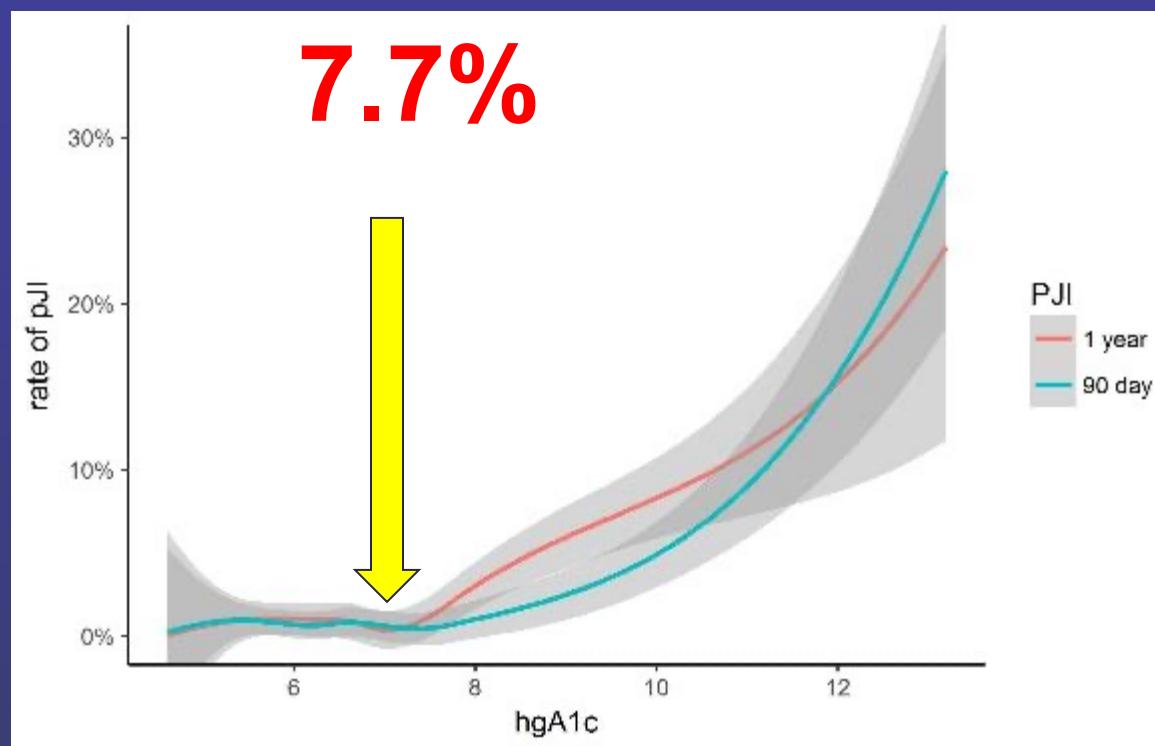
William Jiranek

Brian A Klatt

Majd Tarabichi

Threshold for HbA1C

■ AAHKS Research Group



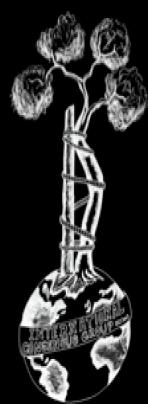
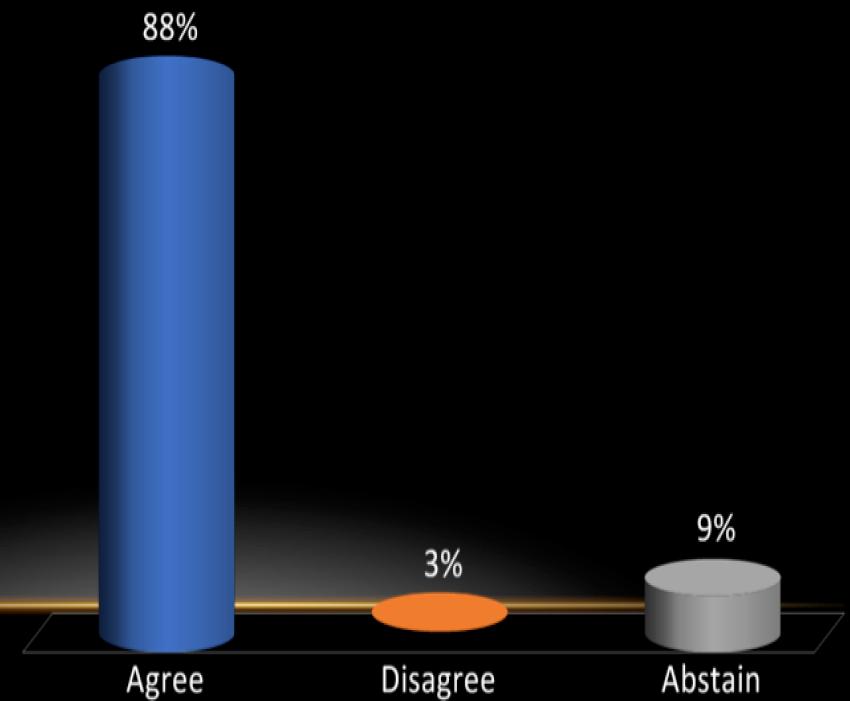
ADA: 7%

Second International Consensus on Periprosthetic Joint Infection

Recommendation: The upper threshold for HbA1c that may be predictive of subsequent SSI/PJI is most likely to be within the range of 7.5-8%.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain





Serum Fructosamine: A Simple and Inexpensive Test for Assessing Preoperative Glycemic Control

Noam Shohat, MD, Majd Tarabichi, MD, Eric H. Tischler, BA, Serge Jabbour, MD, and Javad Parvizi, MD, FRCS

Investigation performed at The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania

■ THE KNEE SOCIETY

2019 John Insall Award: Fructosamine is a better glycaemic marker compared with glycated haemoglobin (HbA1C) in predicting adverse outcomes following total knee arthroplasty

A PROSPECTIVE MULTICENTER

scientific reports

Check for updates

OPEN Fructosamine is a valuable marker for glycemic control and predicting adverse outcomes following total hip arthroplasty: a prospective multi-institutional investigation

Noam Shohat^{1,2}, Karan Goswami¹, Leigham Breckenridge¹, Michael B. Held³, Arthur L. Malkani⁴, Roshan P. Shah⁵, Ran Schwarzkopf⁶ & Javad Parvizi^{1,2}

Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

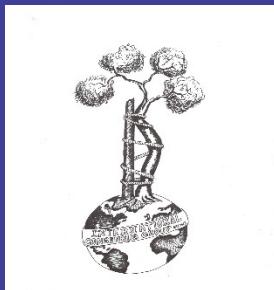
- GI/GU (urine)
- Skin
- Nails
- Oral cavity



Prevention of SSI

Preoperative

■ Hair removal



- Right before surgery
- Clippers and not shaving

CDC

- No recommendation

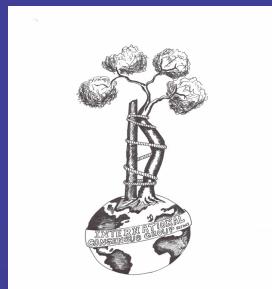


- Do not remove
- If needed, clippers only
(Evidence== moderate)

Prevention of SSI

Preoperative

■ Skin cleansing



- Recommend CHG soap/cloth

CDC

- Soap or antiseptic agent
(Category 1B)



- Good practice to bathe
- Plain soap or antimicrobial
- Not committing to CHG

Moderate

■ Core Section

Antiseptic Prophylaxis

- 8A. Advise patients to shower or bathe (full body) with either soap(antimicrobial or non-antimicrobial) or an antiseptic agent on at least the night before the operative day (Category 1B)

Surgical Skin Preps

History of Skin Preps:

- The first use of an antiseptic skin agent in surgery is credited to the English surgeon, Joseph Lister (1827–1912).

Today:

- There are a variety of skin antiseptic solutions
- No one antiseptic can be used universally¹



ON THE ANTISEPTIC PRINCIPLE OF THE PRACTICE OF SURGERY
BY JOSEPH LISTER, F.R.S.

In the course of an extended investigation into the nature of inflammation, and the healthy and morbid condition of the blood in relation to it, I arrived several years ago at the conclusion that the essential cause of suppuration in wounds is decomposition, brought about by the influence of the atmosphere upon blood or serum retained within them, and, in the case of contained wounds, upon portions of them destroyed by the violence of the injury.
To prevent the occurrence of suppuration with all its attendant risks was an object naturally desirable, but till lately apparently unattainable, since it seemed hopeless to attempt to exclude the oxygen which was universally regarded as the agent by which putrefaction was effected. But when it had been shown by the researches of Pasteur that the specific properties of the atmosphere depended not on the oxygen, or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that decomposition in the injured part might be avoided without excluding the air, by applying an dressing some material capable of destroying the life of the floating particles. Upon this principle I have based a practice of which I will now attempt to give a short account.
The material which I have employed is carbolic or phenolic acid, a volatile organic compound, which appears to exert a peculiarly destructive influence upon low forms of life, and hence is the most powerful antiseptic with which we are at present acquainted.
The first class of cases to which I applied it was that of compound fractures, in which the effects of decomposition in the injured part
g

Joseph Lister and “Antiseptic Principles of the Practice of Surgery”
1867, in which Lister advocates the use of carbolic acid (phenol)

1. AORN. Guideline for Preoperative Patient Skin Antisepsis. *Guidelines for Perioperative Practices*. Denver, Colorado: AORN, Inc. 2017.

What is a Surgical Skin Prep?

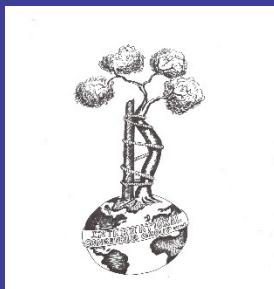
- An antiseptic solution applied to the skin to remove transient microorganisms (including bacteria) at the surgical site
- Effective skin antiseptics rapidly and persistently remove transient microorganisms and reduce resident microorganisms to subpathogenic levels with minimal skin and tissue irritation



Prevention of SSI

Preoperative

■ Hand washing



CDC

- Antiseptic agent
- 2 Minutes
- No recommendation



- Scrubbing with antimicrobial soap and H₂O
- Alcohol based handrub
(Evidence== moderate)

Contamination

- We believe that a majority of contaminations of the surgical site occur during draping



- Screening?
- Universal decolonization
- PVP-I based product

The screenshot shows the homepage of the journal "Antimicrobial Agents and Chemotherapy". At the top left is the logo of the American Society for Microbiology, which consists of a stylized 'A' and 'S' intertwined. To its right, the journal title "Antimicrobial Agents and Chemotherapy" is written in red. To the right of the title is a search bar with a magnifying glass icon and the word "search", followed by a blue link "Advanced Search". Below the header, there is a horizontal navigation bar with links: "Home", "Articles", "For Authors", "About the Journal", and "Subscribe". A red horizontal bar separates this from the main content area. In the main content area, there is a sub-navigation link "Mechanisms of Resistance". Below it is a large, bold, black title: "Clinical Relevance of Topical Antibiotic Use in Coselecting for Multidrug-Resistant *Staphylococcus aureus*: Insights from *In Vitro* and *Ex Vivo* Models". At the bottom of the content area, the names of the authors are listed in blue: "Yi Nong, George Taiaroa, Shivani Pasricha, Romain Guérillot, Ian R. Monk, Sarah L. Baines, Glen P. Carter, Benjamin P. Howden, Deborah A. Williamson".

Prevention

Ten Step Approach

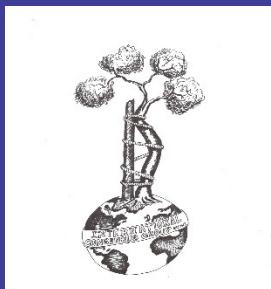
- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

- Which one
- When
- How (long)

Prevention of SSI

Perioperative

■ Antimicrobial (type)



- First generation cephalosporins
- Vancomycin for select group

CDC

- First generation cephalosporins
- Silent on vancomycin

- Cephalosporins

(Evidence== Low to moderate)



Antibiotics

Which One?

■ Cephalosporins (Cefazolin or cefuroxime)

- Good tissue penetration
- Excellent *in vivo* against
 - Staph & Strep
 - Some gram negative coverage
- Minimum toxicity
- Long half-life



Antibiotics

How much?

- Cephalosporins (Cefazolin or cefuroxime)

- Weight based
- >80 Kg--- give 2 gr IV



Antibiotics How much?

- Repeat
 - Long case >2 hours
 - Large blood loss volume (>70% circulating volume)



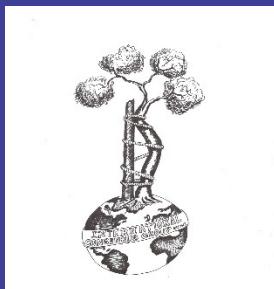
Classen DC, et al: *N Engl J Med* 326:281, 1992

- Which one
- When
- How (long)

Prevention of SSI

Perioperative

■ Antimicrobial (type)



- Within one hour
- Vanc- two hours

CDC

- Within one hour



Within two hours
(Evidence== Moderate)

- Which one
- When
- How (long)

Antibiotics

How ?

- Intravenous
- Majority of “effective” prophylactic agents have poor bio-availability

■ Core Section

Antibiotic Prophylaxis



- 1E. In Clean-contaminated procedures, **do not administer additional prophylactic antimicrobial agent** doses after surgical incision is closed in the operating room, even in the presence of a drain. (Category 1A)(Key Question)

Antibiotic Prophylaxis

- The panel recommends
AGAINST the prolongation of antimicrobial prophylaxis after completion of operation
(evidence: Moderate)

Shorter Duration of Abx

Clin Orthop Relat Res (2019) 00:1-14
DOI 10.1097/CORR.0000000000000619

Clinical Orthopaedics
and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

2018 Musculoskeletal Infection Society Proceedings

Is There a Difference in Infection Risk Between Single and Multiple Doses of Prophylactic Antibiotics? A Meta-analysis

Sean P. Ryan MD, Beau J. Kildow MD, Timothy L. Tan MD, Javad Parvizi MD, FRCS,
on behalf of the American Association of Hip and Knee Surgeons Research Committee,
Michael P. Bolognesi MD, Thorsten M. Seyler MD, PhD

429

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A commentary by James A. Keeney, MD, is
linked to the online version of this article at
jbs.surg.org.

Perioperative Antibiotic Prophylaxis in Total Joint Arthroplasty

A Single Dose Is as Effective as Multiple Doses

Timothy L. Tan, MD, Noam Shohat, MD, Alexander J. Rondon, MD, MBA, Carol Foltz, PhD, Karan Goswami, MD,
Sean P. Ryan, MD, Thorsten M. Seyler, MD, PhD, and Javad Parvizi, MD, FRCS

Investigation performed at The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania

One vs Three

- Multicenter study
- Duke Team (2150 patients)
- Please consider joining the study



■ Core Section

Antibiotics to wound

- 2B.1. Do not apply antimicrobial agents (i.e ointments, solutions, powders) to the surgical incision for the prevention of surgical site infection (Category 1B)(Key Question)

Antibiotic Resistance is Now A Global Threat According To Several WHO Reports



E. faecium - Multidrug resistant (MDR)
S. aureus - Methicillin resistant (MRSA)
K. pneumoniae - 3rd gen cephalosporins, carbapenems
A. baumannii - MDR
P. aeruginosa - MDR
Enterobacter species - MDR
S. pneumoniae - Penicillin
Salmonella - Fluoroquinolones
Shigella - Fluoroquinolones
N. gonorrhoea - 3rd gen cephalosporins
E. coli - 3rd gen cephalosporins, fluoroquinolones



ACIBADEM
MEHMET ALİ AYDINLAR
UNIVERSITY



Second International Consensus on Periprosthetic Joint Infection

G-78: What are the indications for dual perioperative antibiotic prophylaxis in patients undergoing orthopedic procedures? What are the optimal combination antibiotics?

RESEARCHED BY:



Rolando Suarez



Alex Soriano



Michael Kheir

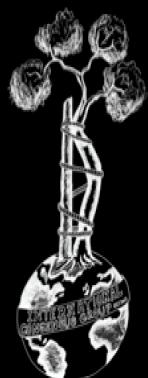
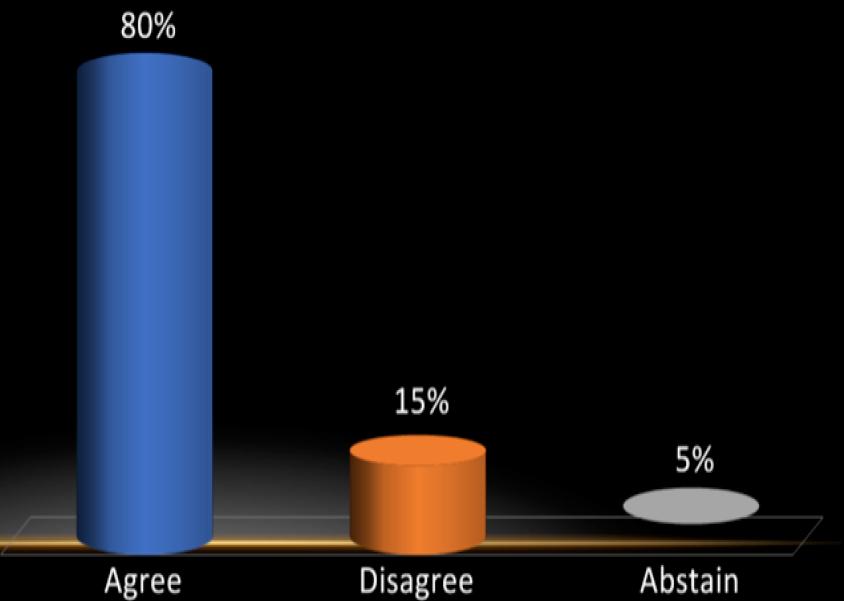


Second International Consensus on Periprosthetic Joint Infection

Recommendation: In the absence of high-level data, we recommend that dual antibiotic prophylaxis should be reserved only for patients being at high risk of infection, such as those undergoing revision surgery and patients at high risk of MRSA infection.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Prevention of PJI

Dual Antibiotic

Vancomycin (needs 1 hour)

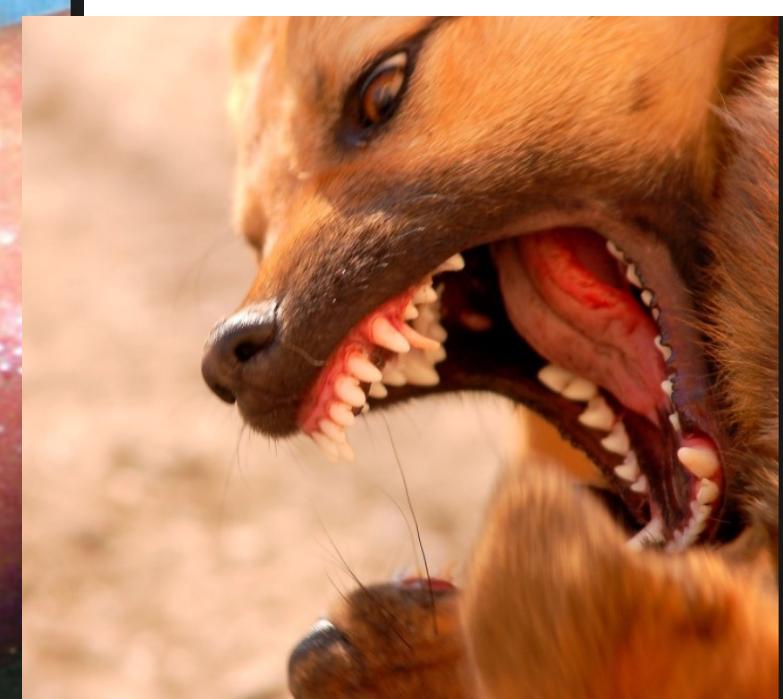
- MRSA carriers
- MRSA Infection
- Institutionalized patients
- Healthcare workers



Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management



Soft Tissue Necrosis



Prevention

Ten Step Approach

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- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Surgery is no Picnic



Second International Consensus on Periprosthetic Joint Infection

G-92: Does operative time affect
the risk of SSI/PJI?

RESEARCHED BY:



Danielle Ponzio



Qiaojie Wang

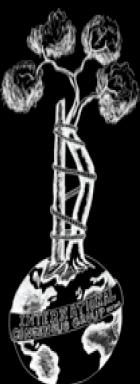
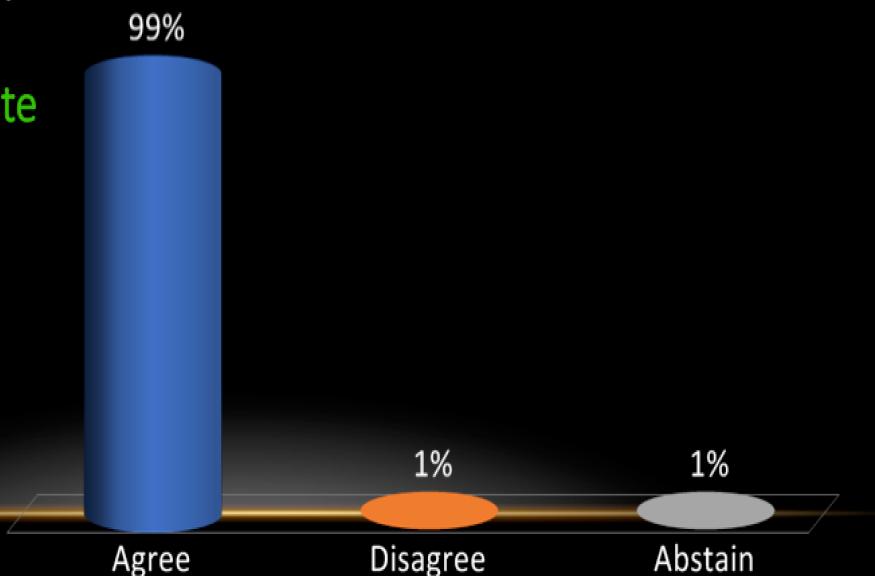


Second International Consensus on Periprosthetic Joint Infection

Recommendation: Yes. There is an association between prolonged operative time and surgical site infection. Prolonged operative time may be a result of a considerable and inescapable level of complexity of the surgery. Coordinated efforts to reduce the operative time without technically compromising the procedure can provide additional benefits for infection prevention.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Prevention

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- Wound Management



Second International Consensus on Periprosthetic Joint Infection

G-35: Does the number of individuals in the operating room affect the rate of SSI/PJI? If so, what strategies should be implemented to reduce traffic in the operating room?

RESEARCHED BY:



Eleftherios Tsiridis



Daniel Del Gaizo

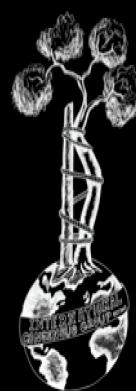
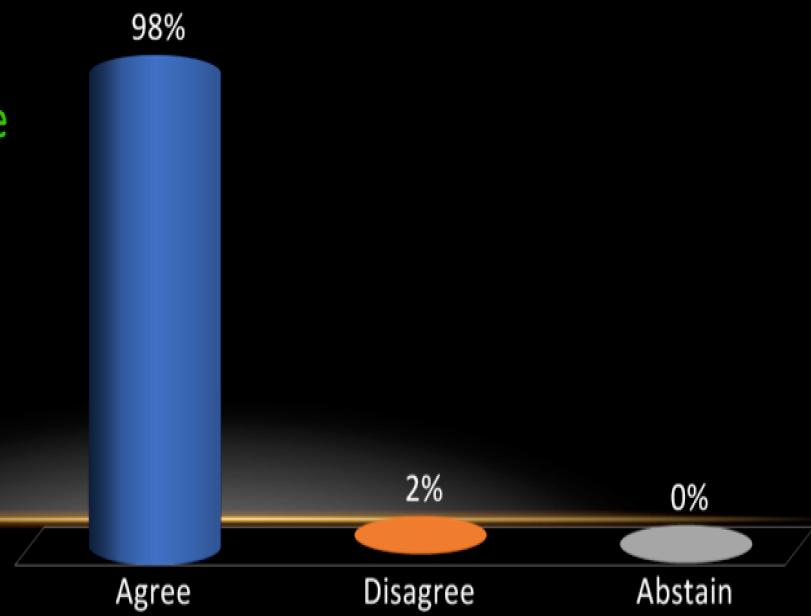


Second International Consensus on Periprosthetic Joint Infection

Recommendation: Yes. The number of individuals in the operating room (OR) and door openings (DO) during total joint arthroplasty (TJA) are correlated to the number of airborne particles in the OR. Elevated airborne particles in the OR can predispose to subsequent periprosthetic joint infection (PJI). Therefore, operating room traffic should be kept to a minimum. Multiple strategies, outlined below, should be implemented to reduce traffic in the OR during orthopaedic procedures.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



OR Environment

- People Shed up to 10,000 bacteria/min.
- “Dispersers”
 - 13% of Men
 - 5% of Post-menopausal Woman
 - 1% of Pre-menopausal Women

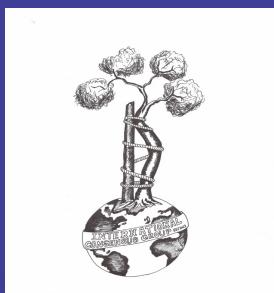


•Traffic--- terrible

Prevention of SSI

Perioperative

■ Operating room environment



- No need for LAF
- Positive pressure

CDC

- Not visited

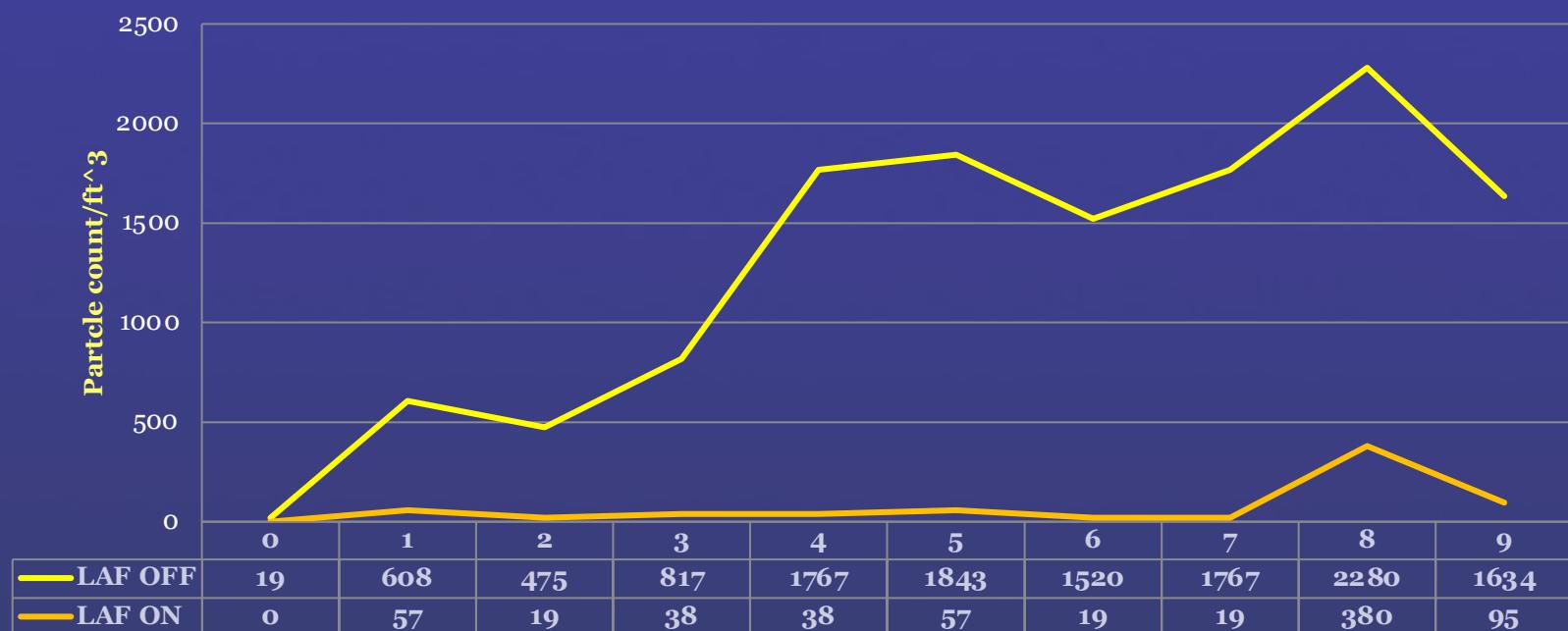


- Do NOT use LAF
(Evidence== Low to moderate)

Laminar Airflow

- 9 people entered the same room with 15 minutes interval
- Particle count ($0.5\text{-}1 \mu\text{m}$) was detected in two different settings: With and Without LAF

Change in particle count by number of people



Second International Consensus on Periprosthetic Joint Infection

G-52: Is there a relationship between levels of airborne microorganisms in the operating room and the risk of prosthesis-related infection (PRI)?

RESEARCHED BY:



Rabih O. Darouiche

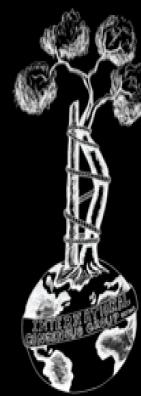
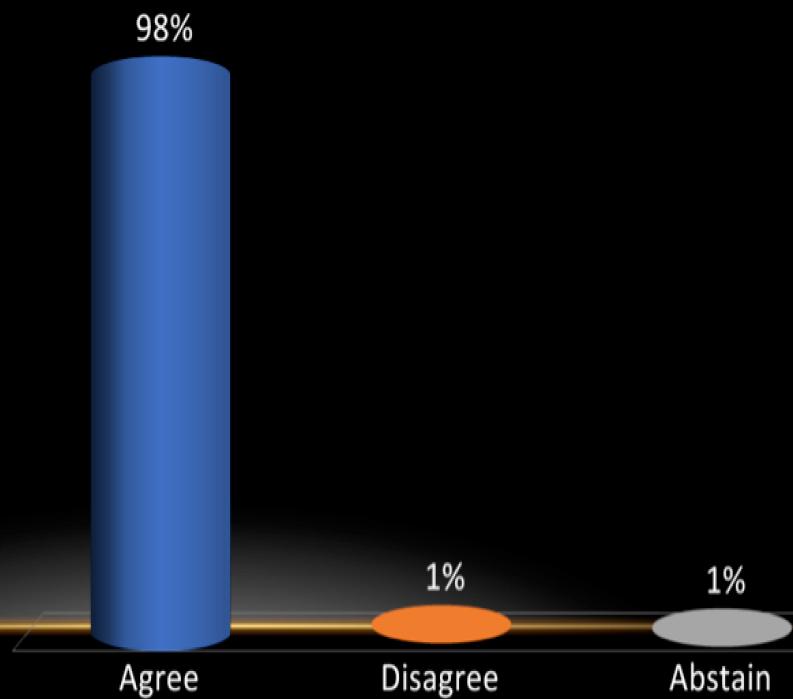


Second International Consensus on Periprosthetic Joint Infection

Recommendation: Yes. High quality evidence indicate that there is a proportional relationship between intraoperative levels of airborne microorganisms (colony-forming units or CFU) and the incidence of PJI.

Level of Evidence: Strong

- A. Agree
- B. Disagree
- C. Abstain



CDC Guidelines for SSI Prevention

■ Arthroplasty Section (10 Key Questions)

- Blood transfusion
- Systemic Immunosuppressive therapy
- Intra-articular injections
- Anticoagulation
- Surgical space suits
- Postoperative AMP during
- Biofilm



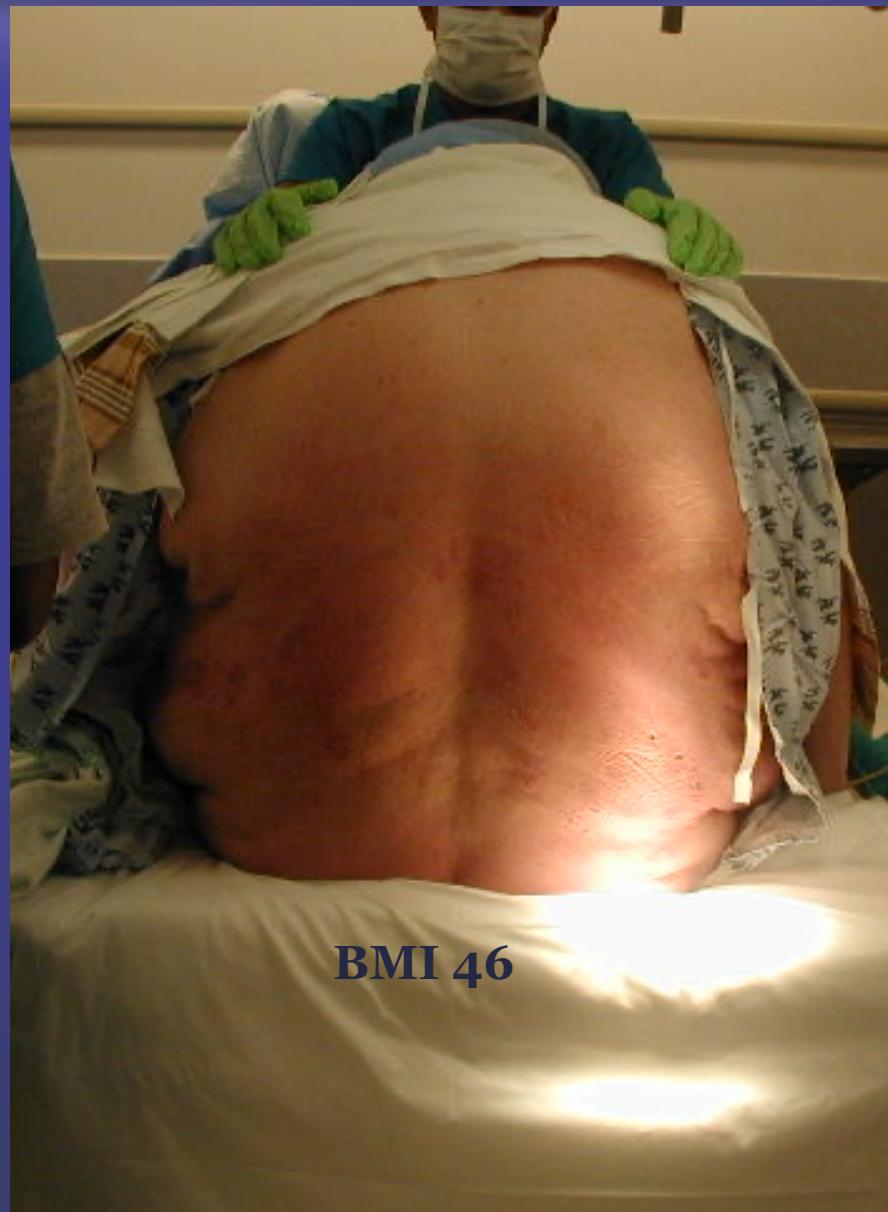
No recommendation

Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Hypotensive Anesthesia



Second International Consensus on Periprosthetic Joint Infection

G-73: Does the use of tranexamic acid reduce the incidence of SSI/PJI following orthopedic procedures?

RESEARCHED BY:



Mandus Akonom



Robert Molloy



Javad Parvizi

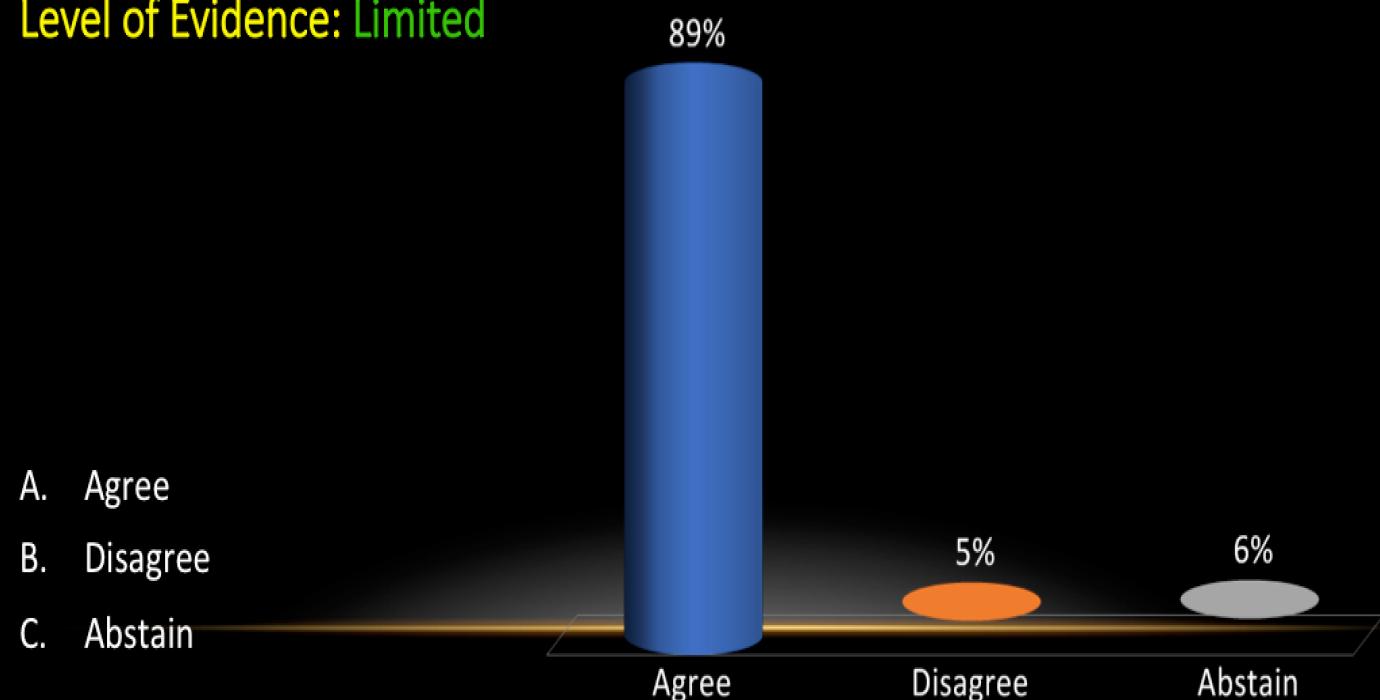


Yale Ellington

Second International Consensus on Periprosthetic Joint Infection

Recommendation: The administration of tranexamic acid (TXA) potentially reduces the incidence of surgical site infection (SSI) and/or periprosthetic joint infection (PJI) following total joint arthroplasty (TJA) by limiting post-operative anemia and the need for allogeneic blood transfusion.

Level of Evidence: Limited



- A. Agree
- B. Disagree
- C. Abstain



Tranexamic Acid Reduces the Rate of Periprosthetic Joint Infection After Aseptic Revision Arthroplasty

Mitchell R. Klement, MD, Fortunato G. Padua, MD, William T. Li, BS, Max Detweiler, BS, and Javad Parvizi, MD, FRCS

J Bone Joint Surg Am. 2020;102:1344-50

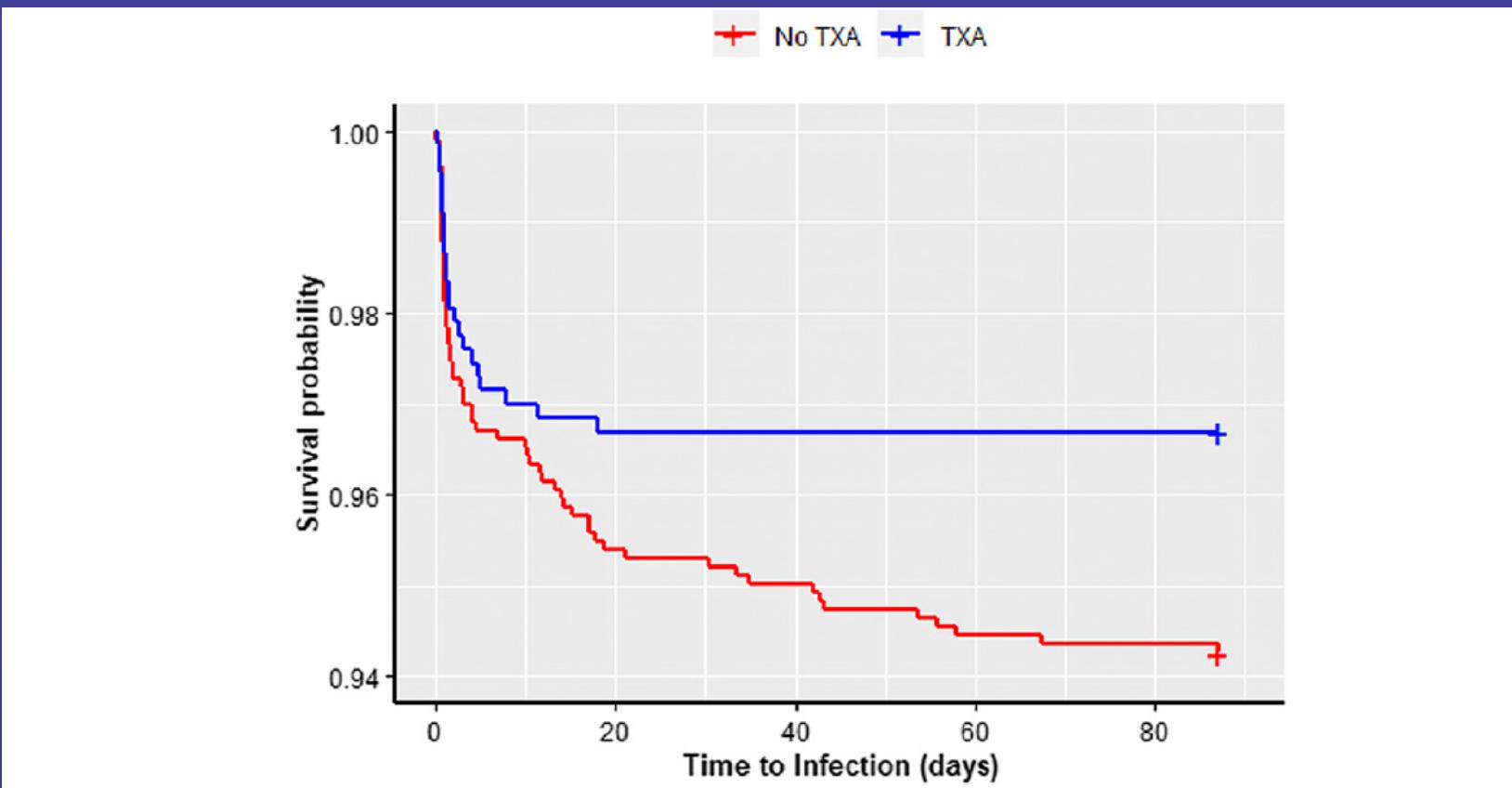


Fig. 2

Time-to-event analysis demonstrating that the likelihood of infection-free survival in the 90-day postoperative period is increased by receipt of TXA.

Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Clean Instruments

- Visit SPU
- Instruments need to be cleaned

Do Not Touch Implants



Prevention

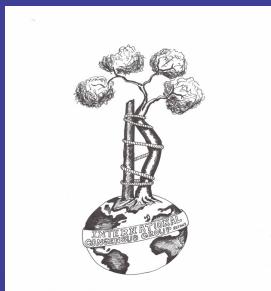
Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Prevention of SSI

Perioperative

■ Wound irrigation



- Irrigation is essential
- Dilute povidone-iodine

CDC

- Aqueous povidone iodine



- Saline— no evidence
- Aqueous povidone iodine
(Evidence== Moderate)

Iodophor

- 9A. Consider intraoperative irrigation of deep or subcutaneous tissues with aqueous iodophor solution for the prevention of surgical site infection (Category II)(Key Question)

Personal Experience

- Served on CDC task force representing AAOS to develop the SSI prevention guidelines

- CDC recommends the use of aqueous PVP-I solution

Compounding



Issues with Creating Home Brew

1) Concentrated form of PVP-I is not sterile

- ❖ Current PVP-I products are not terminally sterilized
- ❖ Several reports of infection secondary to contaminated PVP-I and other aseptically filled antiseptics

Contaminated Povidone-Iodine Solution -- Texas

From December 29, 1988, to January 21, 1989, *Pseudomonas cepacia* was isolated from peritoneal fluid of four patients and blood of two patients at a children's hospital in Texas. In three of four patients who were receiving inpatient peritoneal dialysis for renal failure, clinical findings were consistent with peritonitis. Two intensive-care unit (ICU) patients, who were not on dialysis, whose blood cultures grew the organism had no clinical findings attributable to *P. cepacia* bacteremia.

Hospital personnel recovered *P. cepacia* in pure culture from three previously opened 1-gallon containers of Clinidine, a povidone-iodine solution (Clinipad Corporation, Guilford, Connecticut, Lot #823529, expiration date: September 1991). Solution from this lot was being used by the peritoneal dialysis staff to disinfect tops of multidose vials of dialysis fluid additives, peritoneal fluid administration set connectors, and ports of peritoneal dialysis systems. Clinidine was also being used by ICU staff for antisepsis of skin before venipuncture and to disinfect the tops of blood-culture bottles. In further investigations by CDC and Food and Drug Administration (FDA), *P. cepacia* was isolated from two unopened bottles obtained from a subdistributor and one opened bottle of the same lot number being used in another health-care facility; both facilities are located in Texas.

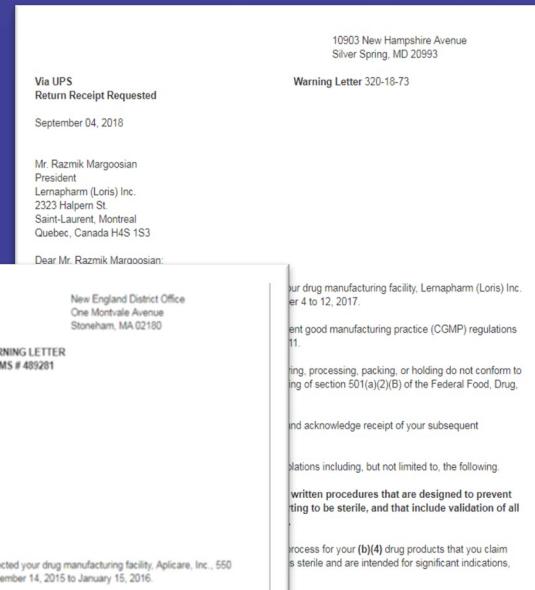
On February 6, 1989, FDA initiated an investigation of the manufacturing plant in Connecticut. On February 9, the company initiated a voluntary recall of the implicated lot. CDC and FDA are continuing investigations to determine the source of the outbreak. Reported by: JD Siegel, MD, PN Duer, Children's Medical Center, CE Haley, MD, Dallas County Health Dept, Dallas, Texas. KA Thomassen, MPA, DM Perrotta, PhD, Epidemiology Div, Texas Dept of Health. Southwest Regional Office, Dallas; Hartford Resident Post, Hartford, Connecticut; Epidemiological Investigations Br, Div of Emergency and Epidemiological Operations, Food and Drug Administration. Hospital Infections Program, Center for Infectious Diseases, CDC.

Editorial Note

Editorial note: In this outbreak, three patients developed peritonitis, and three had pseudoinfections associated with probable intrinsic contamination of a povidone- iodine solution. This is the third instance of suspected intrinsic contamination of an iodophor solution ever reported to CDC. In 1980, a cluster of *P. cepacia* pseudobacteremias in seven northeastern U.S. hospitals was associated with a

FDA Warning

- FDA requested label changes and single-use packaging for some over-the-counter topical antiseptic products to remove “sterile” from labels to decrease risk of infection
- FDA released a communication recommending that health care professionals not dilute antiseptic products after opening



<https://www.fda.gov/inspections-compliance-enforcement-and-criminal-investigations/warning-letters/lernapharm-loris-inc-552525-09042018>

<https://www.ipqpubs.com/wp-content/uploads/2017/01/2016- -Apicare-Inc.pdf>

FDA Drug Safety Communication: FDA requests label changes and single-use packaging for some over-the-counter topical antiseptic products to decrease risk of infection. 2013.

Issues with Creating Home Brew

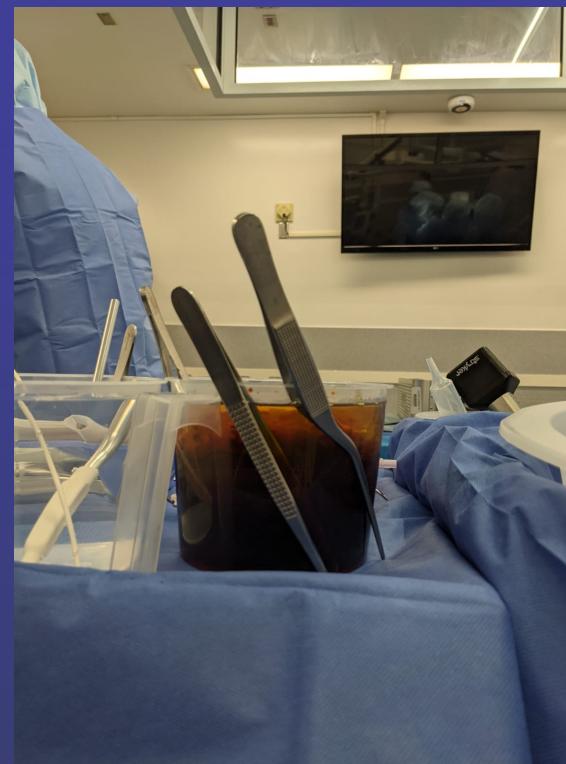
2) Concentrated form of PVP-I not meant to be used internally

- Not for irrigation of body cavity
- Not FDA approved



Issues with Creating Home Brew

3) Does not mix properly (no surfactant)



Issues with Creating Home Brew

4) Open source, messy and not
standardized



4) Does not meet Joint Commission National Patient Safety Goals

The Joint Commission National Patient Safety Goals

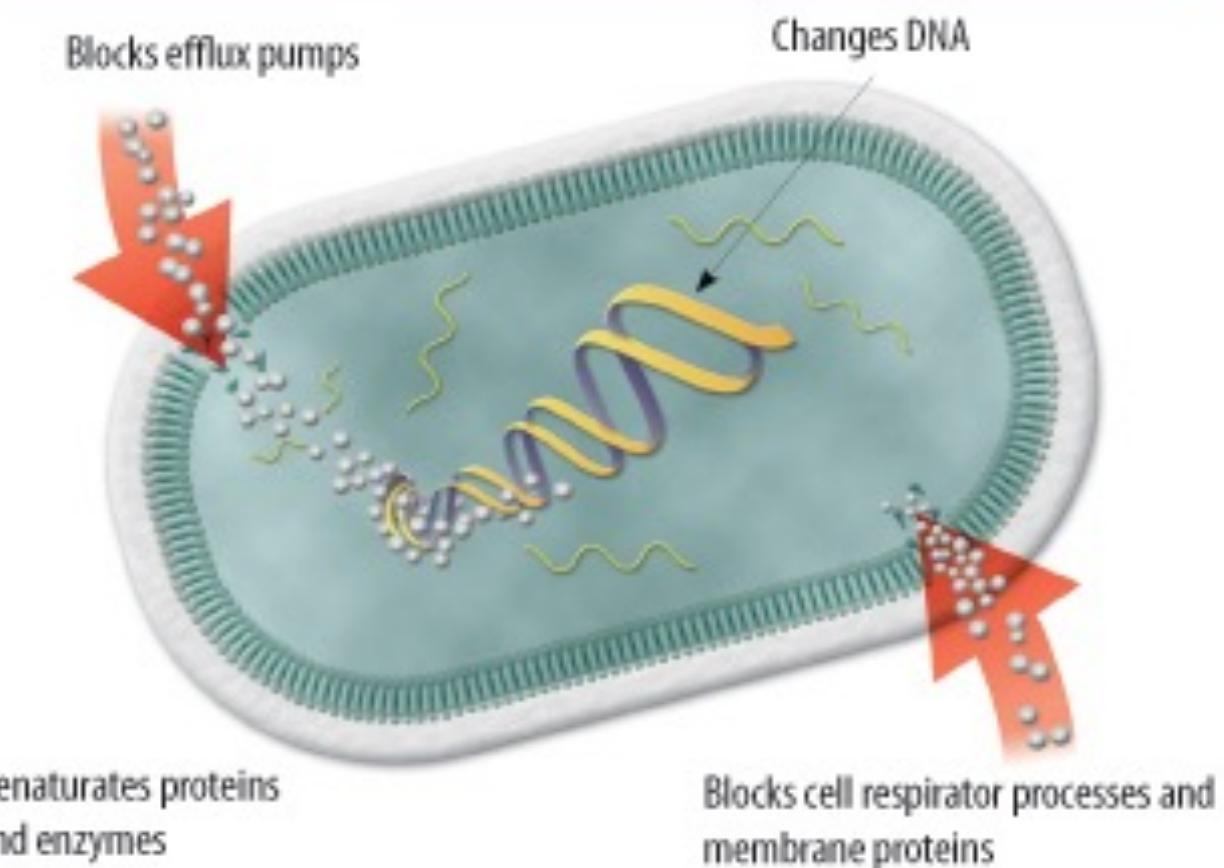
Goal 3: Improve the safety of using medications.

NPSG.03.04.01: Label all medications, medication containers, and other solutions on and off the sterile field in perioperative and other procedural settings.

Note: Medication containers include syringes, medicine cups, and basins

Mode of Action

Figure 1 The antimicrobial action of iodine



Reproduced with permission of Smith & Nephew

No Resistance to PVP-I

- Mupirocin, fusidic acid, gentamicin
- Chlorhexidine, quaternary ammonium salts, silver and triclosan

Lachapelle JM et al Future Med 2013
Demling RH et. Al J Burns Wounds 2007
Ellington MJ et al J Antimicrob Agents 2015
Hetem DJ et al J Hosp Infect 2013
Leaper DJ et al Int Wound J 2008
Yasuda T et al Postgrad Med 1993
Kunisada T, et al Dermatology 1997

Clinical Evidence: Iodophor

The Journal of Arthroplasty 35 (2020) 1374–1378



Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



Complications - Infection

Is There a Role for Preclosure Dilute Betadine Irrigation in the Prevention of Postoperative Infection Following Total Joint Arthroplasty?



Pablo A. Slullitel, MD * , Johanna S. Dobransky, MHK, CCRP, Kamal Bali, MD, Stéphane Poitras, PT, PhD, Raman S. Bhullar, MD, The Ottawa Arthroplasty Group Paul R. Kim, MD, FRCSC

Division of Orthopaedic Surgery, The Ottawa Hospital, General Campus, Ottawa, Ontario, Canada

Conclusion: There was a decreased infection rate in the betadine group overall when groups were propensity-matched. Because the reduction in the acute infection rate was clinically significant, we feel

Methods: We retrospectively reviewed primary TJAs between 2010 and 2018. Dilute betadine lavage was introduced to our practice in November 2014. We included 3513 total hip arthroplasties, 3932 total knee arthroplasties, and 1033 hip resurfacings (HRs). In group 1 ($n = 5588$), surgical wounds were irrigated with saline; group 2 used dilute betadine solution ($n = 2890$). Subanalyses using propensity matching based on known risk factors of infection—age, body mass index, American Society of Anesthesiologists grade, diabetes, and procedure—were completed.

Journal List > Springer Open Choice > PMC8363528



Spine Deform. 2021; 9(5): 1315–1321.

PMCID: PMC8363528

Published online 2021 May 10. doi: [10.1007/s43390-021-00333-3](https://doi.org/10.1007/s43390-021-00333-3)

PMID: [33970432](#)

Povidone-iodine irrigation combined with Vancomycin powder lowers infection rates in pediatric deformity surgery

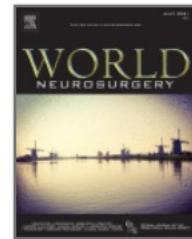
Rolando Figueroa Roberto,^{✉1,2} Flynn Andrew Rowan,³ Deepak Nallur,¹ Blythe Durbin-Johnson,¹ Yashar Javidan,^{1,2} and Eric Otto Klineberg^{1,2}

► Author information ► Article notes ► Copyright and License information ► [Disclaimer](#)

- no intervention 10%, Vanc alone 1.4%, Vanc + PVPI 0.7%. In the neuromuscular group infection rate reduced from 14% to 7%



World Neurosurgery
Volume 151, July 2021, Pages e700-e706



Original Article

Prevention of Surgical Site Infection in Lumbar Instrumented Fusion Using a Sterile Povidone-Iodine Solution

César M. Carballo Cuello, Ricardo J. Fernández-de Thomas, Orlando De Jesus, Aixa De Jesús Espinosa,
Emil A. Pastrana ☰✉

- 6.7% in Normal saline group vs 0.7% in PVP-I ($p<0.008$)
- Adjusted odds ratio = 0.113

The Journal of Arthroplasty 35 (2020) 241–246



ELSEVIER

Contents lists available at [ScienceDirect](#)

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



Complications - Infection

Dilute Povidone-Iodine Solution Prevents Intraoperative Contamination of Sterile Water Basins During Total Joint Arthroplasty

Check for updates

Mark R. Nazal, MPH ^{*}, James L. Galloway, ABJ, Karanpreet K. Dhaliwal, MS, Steven K. Nishiyama, DO, PhD, John S. Shields, MD

Department of Orthopaedic Surgery, Center for Total Joint Replacement, Wake Forest Baptist Health, Winston-Salem, NC

Clinical Evidence: Iodophor

THE JOURNAL OF
ARTHOPLASTY



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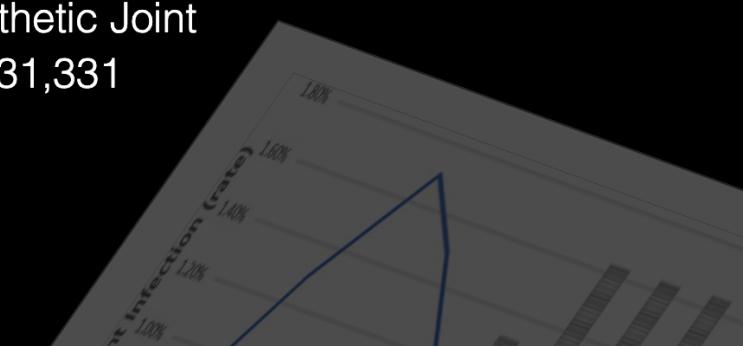


FULL LENGTH ARTICLE | ARTICLES IN PRESS

Dilute Povidone-Iodine Irrigation Reduces the Rate of Periprosthetic Joint Infection Following Hip and Knee Arthroplasty: An Analysis of 31,331 Cases

Noam Shohat, MD • Graham S. Goh, MD • Samantha L. Harrer • Scot Brown, MD

Published: November 02, 2021 • DOI: <https://doi.org/10.1016/j.arth.2021.10.026>



Results

340 patients (1.09%) developed PJI. Dilute povidone-iodine irrigation was associated with 2.34 times lower rate of PJI (0.6% vs 1.3%). Using multiple regression, dilute

Conclusion

The routine use of dilute povidone-iodine could prevent one PJI for every 137 TJA patients, regardless of their preoperative risk. These findings support the use of povidone-iodine irrigation as a safe and cost-effective measure to reduce PJI.

Alternative Solutions

**Chlorhexidine
gluconate and
saline**

**Antibiotics with
saline**

**Pre-mixed
solutions with
preservative
level
antiseptics**

**Pre-mixed
solutions with
surfactants**

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update

Michael S. Calderwood MD, MPH^{1,a}, Deverick J. Anderson MD, MPH^{2,a} , Dale W. Bratzler DO, MPH³,
E. Patchen Dellinger MD⁴ , Sylvia Garcia-Houchins RN, MBA, CIC⁵, Lisa L. Maragakis MD, MPH⁶ ,
Ann-Christine Nyquist MD, MSPH⁷, Kiran M. Perkins MD, MPH⁸, Michael Anne Preas RN, MS, CIC⁹ ,
Lisa Saiman MD, MPH¹⁰ , Joshua K. Schaffzin MD, PhD¹¹ , Marin Schweizer PhD¹² , Deborah S. Yokoe MD, MPH¹³
and Keith S. Kaye MD, MPH^{14,b}

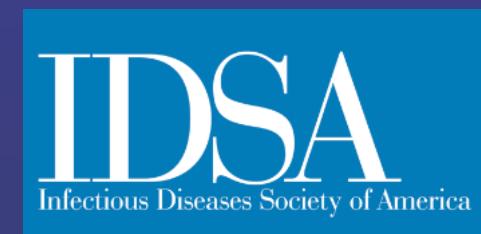
¹Dartmouth Hitchcock Medical Center, Lebanon, New Hampshire, United States, ²Duke Center for Antimicrobial Stewardship and Infection Prevention, Duke University School of Medicine, Durham, North Carolina, United States, ³University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, United States,

⁴University of Washington Medical Center, Seattle, Washington, United States, ⁵The Joint Commission, Oakbrook Terrace, Illinois, United States, ⁶Johns Hopkins School of Medicine, Baltimore, Maryland, United States, ⁷Children's Hospital Colorado, University of Colorado School of Medicine, Aurora, Colorado, United States, ⁸Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, United States, ⁹University of Maryland Medical System, Baltimore, Maryland, United States, ¹⁰Columbia University Irving Medical Center and NewYork-Presbyterian Hospital, New York, New York, United States, ¹¹Children's Hospital of Eastern Ontario, University of Ottawa, Ottawa, Ontario, Canada, ¹²Center for Access and Delivery Research and Evaluation, Iowa City VA Health Care System, University of Iowa, Iowa City, Iowa, ¹³University of California-San Francisco, San Francisco, California, United States and ¹⁴Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey, United States

9. Perform intraoperative antiseptic wound lavage.¹⁷¹ (Quality of evidence: MODERATE)

- f. Given the dearth of povidone-iodine solutions formally labeled “sterile,” we advise surgeons to educate themselves as to their options and to carefully weigh the risks and benefits of using povidone-iodine solutions available at their facility.

PVP-I Irrigation Solution



Prevention

Ten Step Approach

- Host optimization
- Reduce bioburden
- Perioperative antibiotics
- Respect soft tissues
- Expeditious surgery
- Minimize foot traffic
- Minimize blood loss
- Instruments/Implants
- Remove bioburden prior to closure
- Wound Management

Risk Factors for PJI

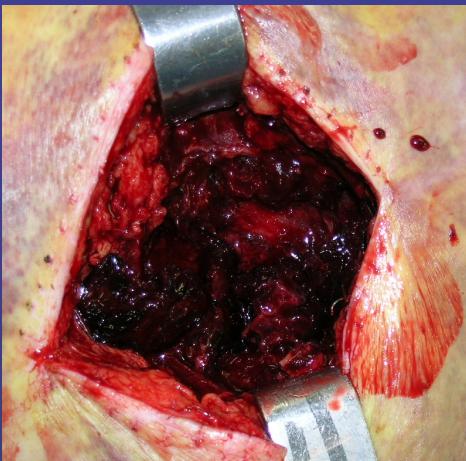
- Rheumatoid arthritis
- Steroid therapy
- Diabetes mellitus
- Prior septic arthritis
- Prior arthroplasty
- Malignancy
- Lymphocyte $<1.5 \times 10^9$
- More than 4 hospital days prior to TJR
- Homologous blood
- Duration of hospitalization
- Decubitus ulcers
- NINS>1
- Superficial wound infection
- Wound drainage
- Wound hematoma
- Wound dehiscence

Berbari EF, et al; Clin Infect Dis, 27:1247, 1998

Pulido L et al CORR 2009

Wound Complications

- Drainage
- Hematoma
- Cellulitis



Treat Aggressively

HK-75: What should be done for patients with persistent wound drainage after total joint arthroplasty? What are the indications for surgical intervention?

RESEARCHED BY:

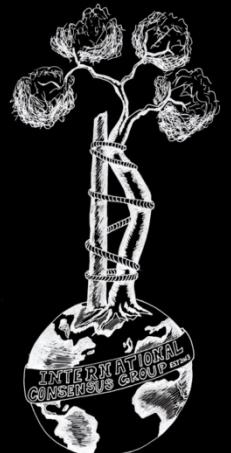


Ali Oliashirazi MD,
United States of America

James Purtill MD,
United States of America

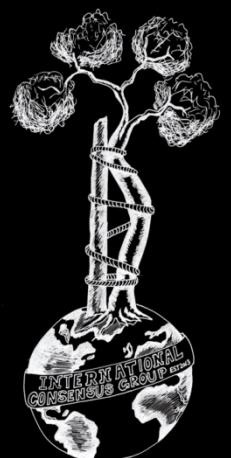
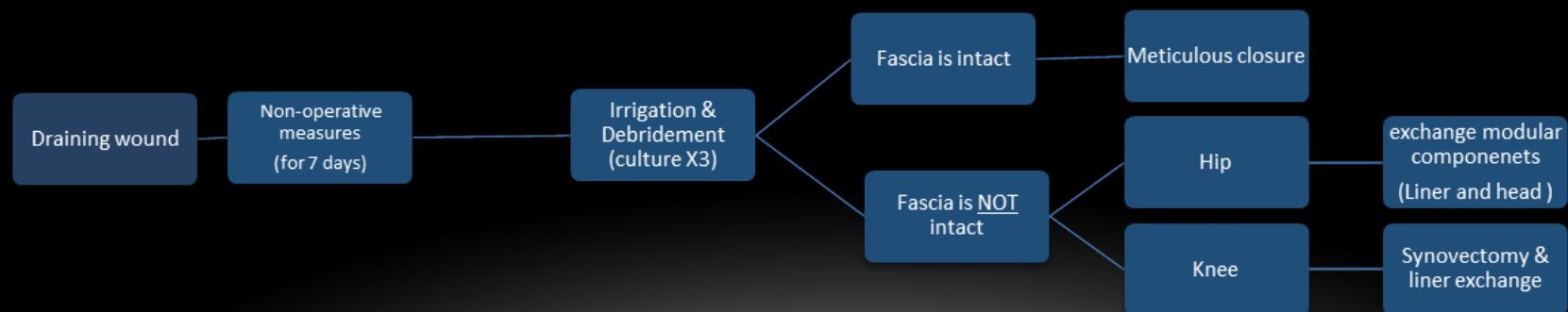


Brianna Fram MD,
United States of America



Literature:

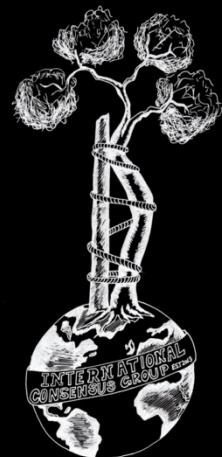
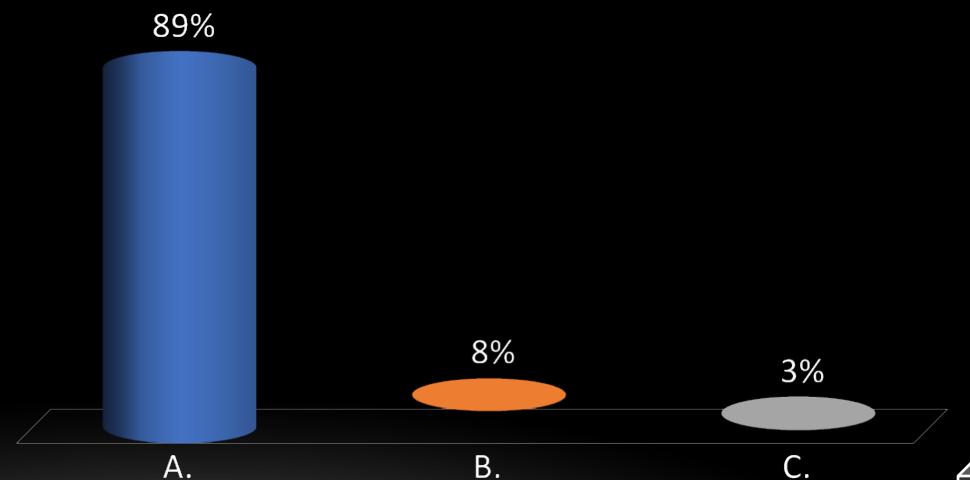
- **Meta-analysis 0, Prospective/Randomized 0, Retrospective 12**
- One of the first steps in patients with PWD is to cease the anticoagulation medications, followed by negative pressure wound therapy
- Surgical intervention for drainage should be considered after 5 to 7 days of PWD (Patel et al., Jaber et al.).



Recommendation: Management of draining wounds after total hip or knee arthroplasty consists of two main steps; non-operative and operative. The non-operative measures include: modification of VTE prophylaxis, nutritional supplementation, dressing measures (such as negative pressure wound therapy), and restriction of range of motion. If draining continues for more than 7 days after implementing the nonoperative measures, operative interventions may be indicated – including irrigation and debridement, synovectomy and single-stage exchange. In certain situations, superficial wound washout may be indicated.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



■ Core Section

Antibiotic Wound Dressing

- 2D. RCT evidence suggests uncertain tradeoffs between benefits and harms regarding antimicrobial dressings applied to surgical incisions following primary closure in the operating room for the prevention of SSI.

(No recommendation/unresolved issue)

Dressing Change

Day 7



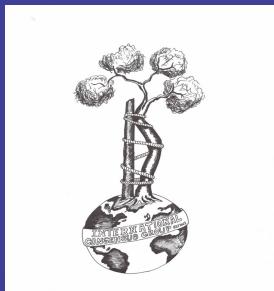
Negative Pressure Dressing



Prevention of SSI

Postoperative

■ Anticoagulation



- Avoid potent anticoagulation

CDC

- Not visited



- Not visited

Hematoma

- Serious event
- Soft-tissue ischemia/necrosis
- Prevents antibiotic access

Nelson CL, et al: Clin Orthop 147:167, 1980

Hematoma

- Associated with administration of anticoagulation
- Increases risk of PJI

Parvizi J, et al: J Arthroplasty 2008

Anticogulation

- Aspirin for majority
- As effective as any agent
- Less complication

Conclusion

- Surgical site infections and periprosthetic joint infections are multifactorial
- It is critical to take necessary steps throughout the patient's journey to minimize risk
- Ensure your surgical team is aligned

No Dwell Time Needed





THANK YOU.

