



## **Reducing the Risk of Surgical Site Infections: What is the evidence?**

Matthew Saltzman, MD

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## **Objectives**

- Describe the epidemiology and risks factors associated with surgical site infection (SSI)
- Introduce prevention strategies including skin antiseptics
- Review evidence- based data demonstrating the efficacy of 2% CHG/70% IPA in reducing SSI

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## Evidence Pyramid



Hierarchy of Evidence. Available at: <http://p4partners.org/tutorial04-ebph2-keyConcepts4.2.7.html>. Accessed April 30, 2010

## Surgical Site Infection



## Surgical Site Infection Overview

- A SSI develops in 2% to 5% of patients undergoing surgical procedures each year in the United States.<sup>1</sup>
- Institute of Healthcare Improvement has estimated that 40-60% of all SSIs are preventable.<sup>2</sup>



<sup>1</sup>. Anderson DJ et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals. *Infection Control and Hospital Epidemiology* 2009;24:555-561

<sup>2</sup>. Scott RD. The Direct Medical Costs of Healthcare-Associated Infections in US Hospitals and the Benefits of Prevention. Available at: [http://www.cdc.gov/nceodhqp/ssi/Scott\\_CostPaper.pdf](http://www.cdc.gov/nceodhqp/ssi/Scott_CostPaper.pdf). Accessed April 26, 2010.

## Epidemiology of SSI

- Approximately 500,000 SSIs annually<sup>1</sup>
- Each SSI adds approximately 7-10 postoperative hospital days<sup>1</sup>
- Mortality is 2-11 times greater with an SSI<sup>1</sup>
- \$11,874 - \$34,670: average attributable per patient cost of SSI, adjusted to 2007 dollars<sup>2</sup>
- Preventing a single SSI due to MRSA can potentially save hospitals as much as \$60,000<sup>3</sup>

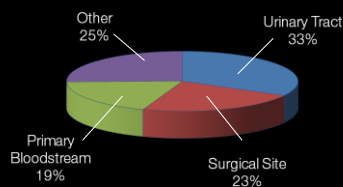
1. Anderson DJ et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals. *Infection Control and Hospital Epidemiology* 2008;29:551-561.  
 2. Scott RD. The Direct Medical Costs of Healthcare-Associated Infections in US Hospitals and the Benefits of Prevention. Available at <http://www.cdc.gov/nchs/data/inf-siss/costPaper.pdf>. Accessed April 29, 2010.  
 3. Anderson DJ et al. Clinical and Financial Outcomes Due to Methicillin Resistant Staphylococcus aureus Surgical Site Infection: A Multi-Center Matched Outcome Study. *PLoS One*, 4(12):1-6, December 2009.

## SSI Overview

- Costs of Preventable SSIs are no longer covered by Medicare.<sup>1</sup>
  - Vascular Catheter-Associated Infection
  - Coronary Artery Bypass Graft (CABG) Mediastinitis
  - Bariatric Surgery
  - Orthopedic Procedures

CMS Guidelines, October 1, 2008

## Nosocomial Infections



1. Weinstein RA. Nosocomial Infection Update. *Emerg Infect Dis*. 1998;4(3):418-420.  
 2. CDC. NNSIS Semiannual Report, December 2007.

## Agency for Healthcare Research and Quality

- **AHRQ**
  - lead Federal agency charged with improving the quality, safety, efficiency, and effectiveness of health care for all Americans
- **2009 National Healthcare Quality Report:**
  - Improvements in patient safety continue to lag behind expectations
  - Little progress has been made on eliminating health care-associated infections (HAIs)
  - Rates of postoperative sepsis increased by 8 percent over the previous year

2009 National Healthcare Quality Report and National Healthcare Disparities Report. Available at: <http://www.ahrq.gov/news/press/pr2010/0409nhrq.htm>. Accessed April 20, 2010.

## SSI: Risk Factors

- **Endogenous microorganisms**
  - Skin-dwelling microorganisms
    - Most common source
    - *S aureus* most common isolate
- **Exogenous microorganisms**
  - Surgical personnel
  - OR environment
  - All tools, instruments, and materials



Margaret A.J. et al. The hospital infection control practices advisory committee. Guidelines for prevention of surgical site infection. Infect Control Hosp Epidemiol. 1999;20(4):250-276.

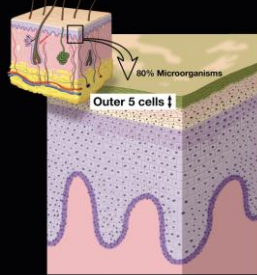
## SSI Risk Factors

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <b>Intrinsic Factors</b> <ul style="list-style-type: none"> <li>– Age</li> <li>– Glucose control</li> <li>– Obesity</li> <li>– Smoking cessation</li> <li>– Immunosuppressive medications</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Extrinsic Factors</b> <ul style="list-style-type: none"> <li>– Hair removal</li> <li>– Preoperative infection</li> <li>– Surgical scrub</li> <li>– <b>Skin preparation</b></li> <li>– Antimicrobial prophylaxis</li> <li>– Surgical technique</li> <li>– OR ventilation</li> <li>– Traffic control</li> <li>– Equipment sterilization</li> </ul> </li> </ul> |
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## Importance of Skin

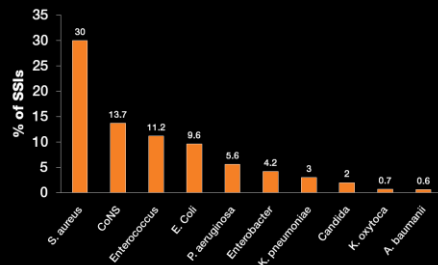
### Primary Function: Protective Barrier

- Microorganisms
  - 80% in first 5 cell layers of epidermis
- When skin is perforated
  - Integrity is compromised
  - ↑ infection risk



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## Percent of SSIs Associated With Selected Pathogens: January 2006–October 2007



Hidron, A, et al. Antimicrobial Resistant Pathogens Associated With Healthcare-Associated Infections: Annual Summary of Data Reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007. JOPHE Nov 2008, 23(11):390-391.

## SSI: Modifiable Risks

Glucose control

Preoperative CHG shower

Appropriate hair removal

Hand hygiene

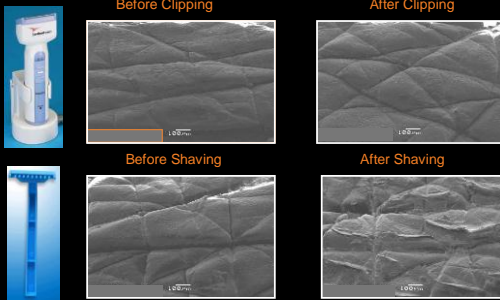
**Skin antisepsis**

Antimicrobial prophylaxis

Normothermia

1. Mangram AJ, et al. The hospital infection control practice advisory committee. Guidelines for prevention of surgical site infection. Infect Control Hosp Epidemiol. 1999;23(4):250-276.  
2. 5 Million Lives Institute for Healthcare Improvement. Available at: <http://itl.org/HIPPrograms/Campaign/Campaign.htm>. Accessed on April 19, 2010.

## HAIR REMOVAL: Clippers vs Razor




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## ANTIMICROBIALS

Antimicrobial	Mechanisms of Action
Alcohols	Denatures cell proteins Dissolves cell lipids
Iodine/Iodophors	Penetrates the cell wall Oxidizes cell contents Impairs protein synthesis, leading to cell death
Chlorhexidine	Destroys cell membrane Precipitates cell contents

1. Larson EL. *Am J Infect Control*. 1995;23(4):251-269.
2. Boyce JM, et al. *MMWR Recomm Rep*. 2002 Oct 25;51(RR-16):1-45.
3. Crosby CT. *Marine Res*. 2003;11:5.
4. Hidalgo E, Dominguez C. *Toxicol in Vitro*. 2001;15(4-5):271-276.

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## The Ideal Skin Antimicrobial

- The “*ideal*” antimicrobial agent for skin should have the following properties:
  - Broad spectrum
  - Rapid bactericidal activity
  - Persistence or residual properties on the skin
  - Effective in the presence of organic matter
  - Non-irritating or have low allergic and/or toxic responses
  - None or minimal systemic absorption

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## Single Solution Comparison

Active Agents	Traditional Iodophors	Alcohol	CHG
Broad Spectrum	X	X	X
Rapid Activity		X	
Residual Activity			X
Activity in Blood/Organic material			X
Non-Irritating/Non-toxic	X (+/-)		X (+/-)
Toxic/Minimal Absorption			X

## Combined Agents: Comparison

Active Agents	Tincture of Iodine	Iodophors & Alcohol	CHG/Alcohol
Broad Spectrum	X	X	X
Rapid Activity	X	X	X
Residual Activity			X
Activity in Blood/Organic			X
Non-Irritating/Non-toxic			X (+/-)
Toxic/Minimal Absorption			X

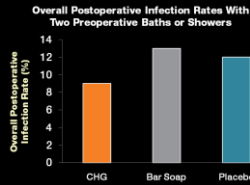
## Evidence for CHG in Surgery

- Berry. Comparison of PVP-I w/ CHG in Prophylaxis of Postoperative Wound Infection. *J. Hosp Infect* 1982;3(1):55-63 (5% CHG)
- Bibbo. CHG Provides Superior Skin Decontamination in Foot & Ankle Surgery. *Clin Orthop* 2005;438:204-8. (4% CHG)
- Darouiche. Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical Site Antisepsis. *The New England Journal of Medicine*. 2010; 362:18-26.
- Edmiston. Maximizing Skin Antisepsis in the Challenging Bariatric Patient. *Bariatric Times* 2009;6(12):20-22.
- Garibaldi RA. Prevention of Intraoperative Wound Contamination with Chlorhexidine Shower and Scrub. *J Hosp Infect*. 1988;11(suppl B):5-9.
- Hayek LJ, et al. A Placebo-controlled Trial of the Effect of two Preoperative Baths or Showers with Chlorhexidine Detergent on Postoperative Wound Infection Rates. *J Hosp Infect* 1987;10(2):165-172.
- Mangram. HICPAC Guidelines for Prevention of Surgical Site Infection. *Infect Control Hosp Epidemiol*. 1999;20(4):250-278
- Ostrander. Efficacy of Surgical Preparation Solutions in Foot and Ankle Surgery. *J Bone Joint Surg Am*. 2005;87:980-985.
- Paocharoen. Comparison of Surgical Wound Infection after Preoperative Skin Preparation w/ 4% CHG & Povidone Iodine. *J Med Assoc Thai*; 2009;92(7):898-902.
- Rauk. Educational Intervention, Revised Instrument Sterilization methods, and Comprehensive Preoperative Skin Preparation Protocol Reduce Cesarean Section Surgical Site Infections. *Am J Infect Control* 2010; 1-5.
- Saltzman. Efficacy of Surgical Preparation Solutions in Shoulder Surgery. *J Bone Joint Surg Am*. 2009;91:1949-1953.
- Swenson. Effects of Preoperative Skin Preparation on Postoperative Wound Infection Rates: A Prospective Study of 3 Skin Preparation Protocols. *Infection Control Hosp Epidemiology*; October 2009, Vol. 30, No. 10.

## Placebo-controlled Trial of the Effect of Two Preop Baths/Showers with CHG on Postop Wound Infection Rates

### Preoperative Showers

Patients who had 2 preoperative showers with CHG 24 hours before surgery had reduced rates of wound infection compared to patients who showered with soap.



Hayek LJ, et al. A placebo-controlled trial of the effect of two preoperative baths or showers with chlorhexidine detergent on postoperative wound infection rates. *J Hosp Infect.* 1987;10(2):166-172.

## Efficacy of Surgical Preparation Solutions in Foot and Ankle Surgery

Ostrander RV, Botte MJ, Brage ME. *J Bone Joint Surg Am.* 87:980-985, 2005.

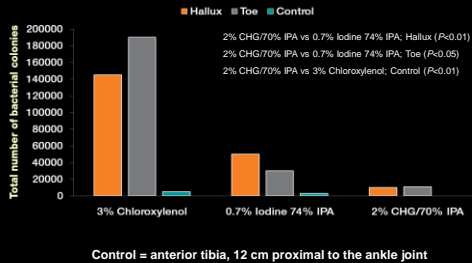
## Study Overview

- Prospective, randomized trial
- 125 evaluable patients
  - 40 subjects/group
  - 5 pre-prep baseline
- Products
  - ChloraPrep® (2% CHG/70% IPA)
  - DuraPrep® (0.7% Iodine/74% IPA)
  - Techni-Care® (3% Chloroxylenol) (PCMX)
- Cultures: hallux, web spaces between toes, and control site

Ostrander RV, et al. *Bone Joint Surg Am.* 2005;87(5):980-985.

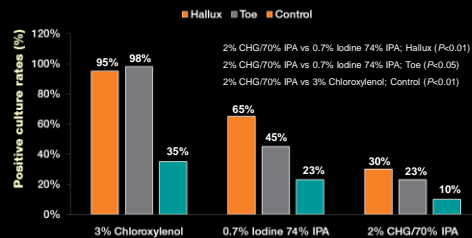


## Bacterial Colony Counts/Site/Prep



Ostlander RV, et al. J Bone Joint Surg Am. 2005;87-A:980-985.

## Percent of Positive Cultures



Ostlander RV, et al. J Bone Joint Surg Am. 2005;87-A:980-985.

## Study Summary

- The use of effective preoperative preparation solution is an important step in limiting surgical wound contamination and preventing infection, particularly in foot and ankle surgery.
- Of the three solutions tested in the study, the combination of chlorhexidine and alcohol was most effective for eliminating bacteria from the forefoot prior to surgery.

Ostlander RV, et al. J Bone Joint Surg Am. 2005;87-A:980-985.

## Efficacy of Surgical Preparation Solutions in Shoulder Surgery

Saltzman MD, Nuber GW, Gryzlo SM,  
Marecek GS, Koh JL.  
*J Bone Joint Surg Am.* 2009;91:1949-1953




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## The sequela of infection following shoulder surgery can be devastating.....



Mirzayan, JBJS-A 2000

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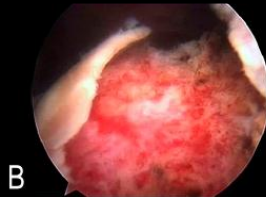
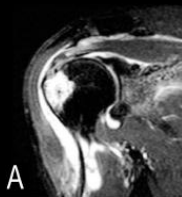
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## Infection following rotator cuff repair

Average of 3.5 debridements necessary to successfully control infection



Settecerrri, J Shoulder Elbow Surgery 1999

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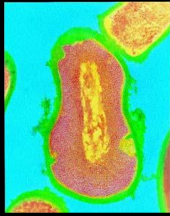
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## Propionibacterium acnes



- Non-spore forming, anaerobe
- Normal skin flora
- Lipid-rich areas such as hair follicles
- Skin contaminant?

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## Propionibacterium acnes



- 20 of 39 cases of deep infection following rotator cuff repair (Athwal, J Shoulder Elbow Surgery 2007)
- 6 of 7 infections following mini-open rotator cuff repair (Herrera, J Shoulder Elbow Surgery 2002)
- 45 of 75 patients undergoing revision shoulder arthroplasty (Topolski, J Shoulder Elbow Surgery 2006)

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## Study Overview

- Prevalence of infection
  - Rotator cuff repair
    - 0.27%-1.9%<sup>1,2</sup>
  - Periprosthetic following arthroplasty
    - 0%-3.9%<sup>3,4</sup>
- Use of an effective skin-preparation solution may be an important step in preventing infection following shoulder surgery

1. Sakman MD, Nader GW, Gyrto SM, et al. Efficacy of surgical preparation solutions in shoulder surgery. *J Bone Joint Surg Am*. 2003;91:1949-1953.  
 2. Herrera MP, et al. Infection after mini-open rotator cuff repair. *J Shoulder Elbow Surg*. 2002;11:605-8.  
 3. Klein NW, et al. Management of early deep infection after rotator cuff repair surgery. *J Shoulder Elbow Surg*. 2005;14:1-6.  
 4. Spaulding JH, et al. Infection after shoulder arthroplasty. *Clin Orthop Relat Res*. 2003;382:206-15.  
 5. Wells NA, Rockwood CA Jr. Complications of shoulder arthroplasty. *Clin Orthop Relat Res*. 1996;327:47-69.

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## Study Overview

- **Objective:** Examine the native bacteria around the shoulder and to determine the efficacy of three different surgical skin preparation solutions on the eradication of bacteria from the shoulder.
- **Design:** Prospective, Randomized, Single-Institution Study
- **Patient Characteristics**
  - Age: 17-79 yo.
  - Gender: 84 Male, 66 Female
- **Randomized to:**
  - PVP-I (0.75% iodine scrub & 1.0% iodine paint)
  - Duraprep™ (0.7% Iodophor & 74% isopropyl alcohol)
  - Chloraprep® (2% chlorhexidine gluconate & 70% IPA)

Saltzman et al. J Bone Joint Surg Am. 2009;91:1949-1953.

## Native Bacterial Flora

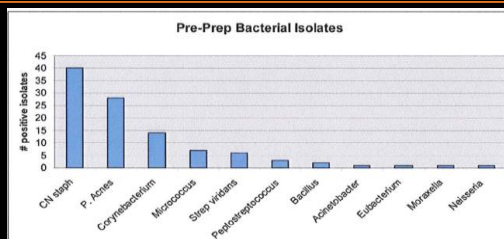


Fig. 1  
Bar graph showing the number of positive isolates for each organism prior to surgical skin preparation. CN staph = coagulase-negative Staphylococcus, P. Acnes = *Propionibacterium acnes*, and *Strep viridans* = *Streptococcus viridans*.

Saltzman et al. J Bone Joint Surg Am. 2009;91:1949-1953.

## Overall Rates of Positive Cultures

Microorganism	Povidone-Iodine	DuraPrep	Chloraprep	Comparison of PVP-I & DuraPrep (p value)	Comparison of PVP-I & Chloraprep (p value)	Comparison of DuraPrep & Chloraprep (p value)
Overall	31%	19%	7%	0.05	<0.0001	0.01
Coag. (-) Staphylococcus	19%	4%	2%	<0.001	<0.001	0.41
<i>Propionibacterium acnes</i>	15%	12%	7%	0.53	0.07	0.23

Saltzman et al. J Bone Joint Surg Am. 2009;91:1949-1953.

## Study Summary

- Successfully identified the native bacteria present around the shoulder prior to surgery
- ChloraPrep is more effective than DuraPrep and PVP-I at eliminating bacteria from the shoulder region
- ChloraPrep & DuraPrep are able to eliminate coagulase-negative Staph from the shoulder region more effectively than PVP-I
- "In conclusion, we recommend that an agent that contains chlorhexidine and alcohol be used for skin preparation prior to shoulder surgery."

Saltzman et al., J Bone Joint Surg Am. 2009;91:1949-1953.

## Effects of Preoperative Skin Preparation on Postoperative Wound Infection Rates: A Prospective Study of 3 Skin Preparation Protocols

Swenson BR, Hedrick TL, Metzger M, Bonatti H, Pruett TL, Sawyer RG. *Infect Control Hosp Epidemiol* 2009; 30:000-000.

## Study Overview

- **Objective:** To compare the effects of different skin preparation solutions on surgical site infection rates
- **Design:** Quasi-experimental - three skin preps were compared by sequential implementation design at a single site. Primary outcome: overall rate of SSI by 6 months
- **3209 operations**
  - All adult general surgery
  - Sequential 6-month implementation
- **Products:**
  - Period 1 (Jan-June 2006): PVP-I scrub and paint combination (Betadine) with isopropyl alcohol application between steps
  - Period 2 (July – Dec 2006): ChloraPrep
  - Period 3 (Jan-June 2007): DuraPrep

Swenson BR, et al. *Infect Control Hosp Epidemiol* 2009; 30:000-000.

## SSIs and Wound Classification by Preparation Received

Variable	No. of SSIs	No. of surgical procedures	Povidone-iodine n = 1 514 procedures	Chlorhexidine n = 827 procedures	Iodine povidone n = 794 procedures	P <sup>a</sup>
<b>SSIs</b>						
All <sup>b</sup>	178	...	72 (4.8)	68 (8.2)	38 (4.8)	.001
Superficial	120	...	49 (3.2)	45 (5.4)	26 (3.3)	.019
Deep	11	...	6 (0.4)	4 (0.5)	1 (0.1)	.49
Organ/space	49	...	18 (1.2)	19 (2.3)	12 (1.5)	.12

NOTE: Data are no. (%) or proportion (%) of surgical procedures, unless otherwise indicated. Data were not available on all surgical procedures.

<sup>a</sup> For pairwise comparison with chlorhexidine.

<sup>b</sup> Of the 182 SSIs in the study, 4 involved surgical procedures that did not use any of the defined preparation solutions, so the total here is 178.

Swenson et al. Infect Control Hosp Epidemiol 2009; 30:000-000.

## Study Summary

- Lowest infection rate was seen in period 3, with iodine povidone preparation method
- In subgroup analysis, no difference in outcomes was seen between patients prepared with PVP-I (\*\*alcohol) and those prepared with Iodine povidone
- Patients in both groups had significantly lower SSI rates, compared with rates for patients prepared with 2% CHG & 70% alcohol
- Authors concluded iodophor-based compounds may be superior to chlorhexidine for this purpose in general surgery patients.

Swenson et al. Infect Control Hosp Epidemiol 2009; 30:000-000.

## Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis

Darouiche RO, Matthew MD, Wall J, Itani KMF, et al. *N Engl J Med* 2010;362:18-26.

## Study Overview

- **Objective:** Compare the efficacy of chlorhexidine-alcohol with povidone-iodine for preventing surgical site antisepsis
- **Primary End Point**
  - Incidence of any SSI 30 days following surgery
- **Secondary End Point**
  - Occurrence of individual types of surgical site infections

Darouiche RO et al. *The New England Journal of Medicine*. 2010; 362:18-28.

## Study Overview

### Design:

- Prospective, Multi Centered, Randomized Study
- Adult patients undergoing clean contaminated surgery
- Patients in the two groups were similar with respect to: demographics, other medical conditions, individual risk for infection, and the length and type of surgery
- 1:1 randomization
  - ChlorPrep (chlorhexidine and alcohol) N= 409 or
  - Scrub Care Skin Prep Tray (scrub and paint, PVP-I) N= 440

Darouiche RO et al. *NEJM*. 2010; 362:18-28.

## Proportion of Patients with SSI, According to Type of Infection

**Table 2.** Proportion of Patients with Surgical-Site Infection, According to Type of Infection (Intention-to-Treat Population).

Type of Infection	Chlorhexidine-Alcohol (N=409) no. (%)	Povidone-Iodine (N=440) no. (%)	Relative Risk (95% CI) <sup>a</sup>	P Value <sup>†</sup>
Any surgical-site infection	39 (9.5)	71 (16.1)	0.59 (0.41–0.85)	0.004
Superficial incisional infection	17 (4.2)	38 (8.6)	0.48 (0.28–0.84)	0.008
Deep incisional infection	4 (1.0)	13 (3.0)	0.33 (0.11–1.01)	0.05
Organ-space infection	18 (4.4)	20 (4.5)	0.97 (0.52–1.80)	>0.99
Sepsis from surgical-site infection	11 (2.7)	19 (4.3)	0.62 (0.30–1.29)	0.26

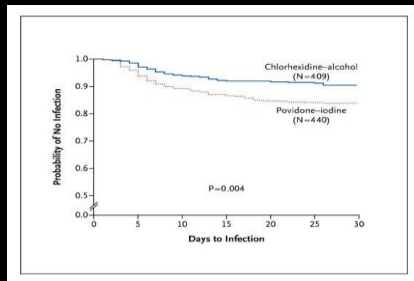
<sup>a</sup> Relative risks are for chlorhexidine-alcohol as compared with povidone-iodine. The 95% confidence intervals were calculated with the use of asymptotic standard error estimates.

<sup>†</sup> P values are based on Fisher's exact test.

Darouiche RO et al. *N Engl J Med*. 2010;362:18-28.

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## Kaplan-Meier Curves for Freedom from Surgical Site Infection (Intention-to-Treat Population)



Darouiche RO et al. *N Engl J Med*. 2010;362:18-26.

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## Adverse Events

Table 4. Clinical Adverse Events (Intention-to-Treat Population).

Clinical Adverse Event	Chlorhexidine-Alcohol (N=409)	Povidone-Iodine (N=440)	Absolute Difference <sup>a</sup> percentage points (95% CI)	P Value <sup>†</sup>
	no. (%)	no. (%)		
Adverse events in ≥5% of patients in either group	228 (55.7)	256 (58.2)	-2.4 (-9.1 to 4.2)	0.49
Drug-related adverse events‡	3 (0.7)	3 (0.7)	0.1 (-1.1 to 1.2)	>0.99
Serious adverse events in ≥1% of patients in either group	72 (17.6)	70 (15.9)	1.7 (-3.3 to 6.7)	0.52
Serious drug-related adverse events	0	0	—	—
Death	4 (1.0)	3 (0.7)	0.3 (-0.9 to 1.5)	0.72

<sup>a</sup> The absolute difference is shown as the rate in the chlorhexidine-alcohol group minus the rate in the povidone-iodine group.

<sup>†</sup> P values were calculated with the use of Fisher's exact test.

<sup>‡</sup> Drug-related adverse events included pruritus, erythema, or both around the surgical wound and are reported even though the rate was not 5% or higher in either group.

Darouiche RO et al. *N Engl J Med*. 2010;362:18-26.

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## Study Summary

- The application of chlorhexidine-alcohol reduced the risk of infection by 41%
  - CHG/IPA 9.5% vs PI 16.1% -  $P = 0.004$
- "Since two thirds of surgical-site infections are confined to the incision, optimizing skin antisepsis before surgery could result in a significant clinical benefit"
- In order to prevent one case of SSI, the estimated number of patients needing CHG/IPA vs. PI is approximately 17.
- Preop cleansing of the patient's skin with chlorhexidine-alcohol is superior to cleansing with povidone-iodine for preventing SSI after clean-contaminated surgery.

Darouiche et al. *New Engl J Med* : 2010; 362:18-26.



## Swenson vs. Darouiche

Non-randomized	Randomized
Non-blinded	Blinded
Single Center	Multicenter
New bundled care package at start	-
Outpatient center opened during phase 3 (DuraPrep)	-
Shorter cases?	
Healthier patients?	

Level IV

Level I

## Cost of Antiseptic Products in the US

- Mean cost of PI prep tray per patient: ~\$3
- Mean cost of one CHG/IPA applicator: \$7
- Mean no. of CHG/IPA applicators/patient: 2
- Mean cost of CHG/IPA applicators per patient: \$14
- Extra cost of CHG/IPA vs. PI/1,000 patients: \$11,000

Darouiche RD. Will skin-prep practice change following new study results? OR Manager. Vol 26, No 4, April 2010.

## Potential Cost-Savings Per 1,000 Clean-Contaminated Surgeries

	Cost of Superficial SSI (\$1,000/case)	Cost of Deep SSI (\$20,000/case)	Cost of 75:25 mix SSI (\$4,400/case)
ChlorPrep group ( 95 SSIs / 1000 surgeries )	\$95,500	\$1,900,000	\$546,250
Povidone- Iodine group ( 161 SSIs / 1000 surgeries )	\$161,000	\$3,220,000	\$925,750
Difference between ChlorPrep & Povidone-Iodine	\$66,000	\$1,320,000	\$379,500
Potential Cost Savings using ChlorPrep (ChlorPrep vs. Povidone-Iodine)	\$55,000	\$1,309,000	\$368,500

### Cost of Antiseptic Products in the US:

\*Mean cost of ChlorPrep per patient: \$14 (\$7 per applicator x 2)  
 \*Mean cost of Povidone Iodine prep tray per patient: ~\$3  
 \*Extra cost of ChlorPrep vs. Povidone Iodine = \$11,000 (\$14 - \$3 = \$11 x1,000 surgeries)

Darouiche RD. Will skin-prep practice change following new study results? OR Manager. Vol 26, No 4, April 2010.

## Conclusion

"The weight of evidence suggests that chlorhexidine-alcohol should replace povidone-iodine as the standard for preoperative surgical scrubs."

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Wenzel RP. Minimizing Surgical-Site Infections. *N Engl J Med* 362:1.

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