Do you have skin in the game?
The high stakes of SSIs

Disclosure

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Objectives

- Examine the relationship between microbial cells and human cells
- Recognize the financial and personal impact of surgical site infections
- Explain the CDC’s conceptual formula for SSI Risk in relation to patient and process variables
- Describe the considerations for surgical skin prep selection
- Discuss the importance of creating a sterile surface to help manage the risk of surgical site infections
Surgical Site Infections

Impact of Surgical Site Infections

Surgical site infections (SSIs) are a huge burden on healthcare systems, providers and patients.


Why do we wear gloves during surgery?

We scrub our hands before surgery to decrease the amount of bacteria

But still we wear gloves to prevent residual bacteria and regrowth from our hands getting into the incision and causing an infection

Why wouldn't we take similar precautions with the patients skin?

What about the patients skin makes it a risk factor in the development of surgical site infections?
“We exist in the bacterial world, not bacteria in ours. Unfortunately, we believe that we can rid ourselves of bacteria when, in fact, we cannot.”

International Conference on Emerging Infectious Diseases; 2000; Atlanta, Georgia
Antibacterial Household Products: Cause for Concern
Stuart B. Levy

Risk of Surgical Site Infection (SSI) Conceptual Model

PROCESS VARIABILITY

\[
\text{RISK of SSI} = \text{Dose of bacteria} \times \text{Vigor of bacteria} \times \text{Patient risk factors}
\]

PATIENT VARIABILITY
Resistance of the Host (Patient)

- Age
- Co-morbidity, e.g., Diabetes
- Compromised Immune System
- Obesity
- Nutritional Status
- Nicotine Use
- Prolonged Preoperative Stay
- Steroid Use
- Duration of Surgery
- Remote Site Infection (Not treated prior to surgery)

Process Variability:
Dose of Bacteria (Contamination)

- Hand hygiene
- Appropriate antimicrobial prophylaxis
- Preoperative bathing
- Nasal decontamination
- Oral decontamination
- Hair removal
- Skin preparation
- Surgical hand antisepsis

Risk of Infection

According to the CDC's conceptual formula for SSI Risk, SSI are impacted by the number of microbes that contaminate an incision during surgery.

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 cm.

It can take as few as 10 microbes per sq cm to cause a surgical site infection.

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


Reducing the contamination level (dose of bacteria) will consequently reduce the risk of infection.

We cannot predict who will get an infection because...

- Each patient has a unique immune system
- Each patient has different risk factors
- Surgery is different for each patient
- Bacteria have different levels of virulence (strength)
- Bacteria may form biofilms

Therefore whatever we can control through prevention and standardization should be done to reduce the risk of infection and ensure the best outcome for each patient.

How can we reduce contamination from the patient’s own skin?

- Skin is decontaminated through the use of skin prep
- Skin prep removes microorganisms and reduces the number of organisms on the skin surface. But bacteria in the deeper layers of skin
- Bacteria may then penetrate the skin at the deepest part of the site
- Iodine-impregnated incise drapes work in the deeper layers of skin and form a barrier between the patient and the surgical wound
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**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 universally

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**What is a Surgical Skin Prep?**

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

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1. Joseph Lister and “Antiseptic Principles of the Practice of Surgery,” 1871, in which Lister advocates the use of carbolic acid (phenol).
Preoperative Skin Antisepsis

**Should, per guidelines:**
- Significantly reduce microorganisms on intact skin
- Contain non-irritating antimicrobial preparation
- Be broad-spectrum
- Be fast-acting
- Have persistent activity

**Additional Information:**
- Kills bacteria by attacking multiple cell processes
- Non-toxic at relatively high concentrations
- Relatively inexpensive
- Resistance usually does not form


Antiseptic Fundamentals

Basic Antiseptics

- Alcohol
- Iodine / Iodophor
- Chlorhexidine Gluconate
- Dual-active Antiseptic Products
**Alcohol**

- The oldest antiseptic (131-201 AD)
- Rapid broad-spectrum antimicrobial activity
- Denatures cell wall proteins
- No persistence
- Concentration determines effectiveness: 80-95% (TFM)
- Iodopropyl alcohol (isopropanol) – most commonly used in surgical skin preparations
- Ethyl alcohol (ethanol) – most commonly used in hand sanitizers

*核算 1,2,3


*Irresistibility increases with higher concentration*
Chlorhexidine Gluconate

- Introduced in 1950s
- Good broad spectrum antimicrobial coverage
- Disrupts cell membranes and precipitates cytoplasm
- Ability to penetrate stratum corneum leaving a persistent residue and residual effect
- Repeated use = further reduction of bacteria
- Typical concentrations - 0.5% - 4%


Dual-active Antiseptic Products

Common dual-active antiseptics:
- Iodine Povacrylex and Isopropyl Alcohol
- Povidone Iodine and Isopropyl Alcohol
- Chlorhexidine Gluconate and Isopropyl Alcohol

“The whole is greater than the sum of its parts”
Aristotle

Considerations for Selection of Preps

- The most commonly used patient skin preps must meet regulatory criteria for immediate microbial kill and persistent antimicrobial activity
- It is important to look at other factors that may affect performance when choosing a prep for surgical patients
- There is NO one prep that will meet all prepping needs
Surgical Skin Prep Selection

Preoperative Skin Antisepsis

| SHEA (IDSA) | “Wash and clean skin around incision site. Use a dual agent skin preparation containing alcohol, unless contraindication exists” |
| CDC Directive for the Prevention of Surgical Site Infection | “Perform intraoperative skin preparation with an alcohol-based antiseptic agent unless contraindicated. (Category IA—strong recommendation; high-quality evidence)” |
| AORN | Recommendation III “The collective evidence indicates that there is no one antiseptic that is more effective than another for preventing SSI.” |
| NQF: Safe Practice #22 | Preoperatively use solutions that contain isopropyl alcohol as skin antiseptic preparation until other alternatives have been proven as safe and effective, and allow appropriate drying time per product guidelines.

None of these state that one antiseptic agent is preferred over another.

Things to Consider when Choosing a Surgical Prep

- Does the patient have any allergies or sensitivities?
- Is the patient under two months of age?
- Is the skin intact?
- Where is the surgical procedure site?
- What are the active ingredients in the prep?
- Does the procedure involve prepping a large surface area?

Baseline Considerations
- Patient Factors: Allergies / sensitivities, Age of patient, Skin condition, Location / Type of procedure
- Active Ingredients: Aqueous solution, Dual active solution
- Size of Area Being Prepped: Use an appropriately sized applicator
Things to Consider when Choosing a Surgical Prep

Baseline Considerations

Patient Factors
- Allergies / sensitivities
- Age of patient
- Skin condition
- Location / Type of procedure

Active Ingredients
- Aqueous solution
- Dual-active solution

Size of Area Being Prepped
- Use an appropriately sized applicator

Other Important Factors

Ability to maintain antimicrobial effectiveness

Patient Factors

- Allergies / sensitivities
- Age of patient
- Skin condition
- Location / Type of procedure

Active Ingredients

- Aqueous solution
- Dual-active solution

Size of Area Being Prepped

- Use an appropriately sized applicator

The need for protection doesn’t end when the surgery ends

Hospitals are some of the most contaminated environments
- We go to the hospital for care, but in fact are exposed to microorganisms which can cause infection, including multi-drug resistant organisms
- Risk of cross contamination is high
- If you stay in a room that was previously occupied by a patient with a multi-drug resistant organism, your risk of acquiring that same organism / infection goes up

Protecting the surgical wound post surgery is more important than ever

Outpatient: Patients are going home sooner
- Patients going home quickly
- Less clinical monitoring and oversight once they leave
- Uncontrolled home environment
- Competence / compliance of person caring for wound post-operative

After you prep the skin and start surgery, its important the prep stays on the skin and continues to provide protection

- Not all preps are created equal
- Some preps are water soluble, which means they can easily be washed or rubbed off in surgery
- If prep is removed, then it is no longer working and providing antimicrobial protection for the patient

Its important clinicians understand that preps vary in their ability to remain on the skin throughout surgery and provide antimicrobial efficacy
Not all skin preps perform to the same level under surgical conditions

Prep Needs to Stay on the Skin to Remain Effective

During surgery, most preps can be removed by a number of factors, including:

- saline irrigation
- dabbing with sponges or gauze
- bodily fluids

If surgical prep is removed during surgery, patients lose the critical protection of the active ingredient.

Things to Consider when Choosing a Surgical Prep

Baseline Considerations

Patient Factors
- Allergies / sensitivities
- Age of patient
- Skin condition
- Location / Type of procedure

Active Ingredients
- Aqueous solution
- Dual-active solution

Size of Area Being Prepped
- Use an appropriately sized applicator

Other Important Factors

Ability to maintain antimicrobial effectiveness

Hours of antimicrobial persistence

Surgical wounds can take up to 96 hours to seal following surgery

- Many clinicians believe 48 hours is enough protection
- However, 48 hours for a wound to seal is an average, but many factors impact the time to seal
- Patient co-morbidities, age, weight, smoking, environment, etc. can affect sealing time
- The time required can be as short as 24 hours all the way up to 96 hours
- The type of closure, e.g., fully closing, partially closing, packing a wound, etc. can also affect sealing time... beyond 96 hours for some

Length of antimicrobial persistence is important when choosing a surgical prep

### Things to Consider when Choosing a Surgical Prep

#### Baseline Considerations

**Patient Factors**
- Allergies / sensitivities
- Age of patient
- Skin condition
- Location / Type of procedure

**Active Ingredients**
- Aqueous solution
- Dual-active solution

**Size of Area Being Prepped**
- Use an appropriately sized applicator

#### Other Important Factors

- Ability to maintain antimicrobial effectiveness
- Hours of antimicrobial persistence
- Are you using an incise drape?

### Why does incise drape adhesion matter?

When a drape lifts, it allows for bacteria to be transferred into the wound.

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In a study, drape lift was associated with a 6-fold increase in SSI.¹

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### The prep you use can dramatically effect the ability of an incise drape to adhere well to the skin

- Many different active ingredients are used in the various surgical skin preps currently available
- Formulations of the skin prep can affect how well the incise sticks to the skin
- Some prep actually improve adhesion while others interfere with adhesion and lead to increased drape lift

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Your choice of skin prep matters when using incise drapes
### Things to Consider when Choosing a Surgical Prep

#### Baseline Considerations

**Patient Factors**
- Allergies / sensitivities
- Age of patient
- Skin condition
- Location / Type of procedure

**Active Ingredients**
- Aqueous solution
- Dual-active solution

**Size of Area Being Prepped**
- Use an appropriately sized applicator

#### Other Important Factors

<table>
<thead>
<tr>
<th>Ability to maintain antimicrobial effectiveness</th>
<th>Hours of antimicrobial persistence</th>
<th>Are you using an incised drape?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to see on all skin tones</td>
<td></td>
<td>Dripping, running, and pooling</td>
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#### Proper application and protection makes a difference

- **Scrub**
- **Paint**
- Use repeated back and forth strokes

*AORN Guidelines State…*

*Sheets, padding, positioning equipment, and adhesive tape should be protected from dripping or pooling of skin antiseptics beneath and around the patient…removal of materials that are saturated with the skin antiseptic before the patient is draped*
What are you doing for fire safety?

- Many preps contain alcohol. While this helps improve efficacy of the prep, it is also highly flammable and poses a fire risk to the patient.
- For this reason, it is required to wait a minimum of 3 minutes for the prep to dry before beginning the procedure.
- However, there is always risk that the solution pools on or around the patient, not fully evaporating and increasing risk for fire.

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Things to Consider when Choosing a Surgical Prep

**Baseline Considerations**

- Patient Factors:
  - Allergies / sensitivities
  - Age of patient
  - Skin condition
  - Location / Type of Procedure

- Active Ingredients:
  - Aqueous solution
  - Dual-active solution

- Size of Area Being Prepped:
  - Use an appropriately sized applicator

**Other Important Factors**

- Ability to maintain antimicrobial effectiveness
- Hours of antimicrobial persistence
- Are you using an incise drape?
- Dripping, running, and pooling
- Select the prep that is best for the patient and their procedure

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Creating a Sterile Surface
We scrub our hands before surgery to remove bacteria but still wear gloves to prevent residual bacteria and regrowth from our hands getting into the incision and causing an infection. How can we apply the same standard of care to the patient’s skin?

Creating a Sterile Surface on the Patient’s Skin

Applying the same standard of care to the patient’s skin as we do our hands requires creating a sterile surface.

A sterile surface cannot be created on the skin until the sterile field has been established.

We start by applying an effective surgical prep to reduce as much bacteria on the skin as possible.

Surgical drapes are then placed to create the sterile field on the patient and surrounding tables and Mayo stand.

The sterile field is now established, but have we created a sterile surface on the patient’s skin?

Preps Alone Can’t Eliminate Bacteria on a Patient’s Skin

Use a skin prep to reduce as much bacteria on the skin as possible.

However, antiseptics work primarily on the skin surface, not in the deeper layers of the skin. The skin is never sterile.

According to a study, CHG in skin preps does not penetrate into the deeper layers of the skin. Below a depth of 300 μm, CHG concentration may not be effective for killing bacteria.

Incise Drapes Help Prevent Contamination of the Incision

An incise drape is a plastic film coated with adhesive that is placed on the skin over the incision area. It immobilizes residual bacteria on the skin and helps prevent items in surgery from touching the skin and transferring bacteria into the incision.

Some incise drapes contain a breathable film and iodine in the adhesive layer of the incise drape. The breathable film helps prevent moisture build-up, and the iodine in the adhesive helps kill residual bacteria under the drape.

New Evidence in the Fight Against Infection

In a recent ex vivo study on human skin, the iodine in an iodine-impregnated surgical incise drape was shown to be present at concentrations effective against methicillin-resistant Staphylococcus aureus (MRSA) at a depth of 1000 microns, in the deeper layers of the skin where hair follicles are present.

Using and incise drape was shown to be significantly more effective at reducing microbial contamination vs. using no drape

Chen et al. in a prospective, randomized clinical study of patients undergoing hip preservation surgery: the use of an antimicrobial incise drape versus not using an incise drape showed:

- Antimicrobial incise drape was significantly more effective at reducing microbial wound contamination at the incision site compared to not using an incise drape.
- At surgery end, 12.5% of incisions with antimicrobial incise drape and 27% of incisions without an incise drape were positive for bacteria.
- When controlling for preoperative colonization and other factors, patients without incise drapes were significantly more likely to have bacteria at the incision than patients with antimicrobial incise drape at the time of closure.

Chen AF, Rezapoor MR, Tan TLT, Maltenfort MGM, Parvizi JP. Incise draping (Ioban) is protective against surgical site contamination during hip surgery: a prospective, randomized trial. Paper presented at: 26th Annual Open Scientific Meeting of the Musculoskeletal Infection Society; August 2016; Charlotte, NC.
New clinical study shows that an iodine impregnated drape can help reduce the risk of infection as well as reduce overall cost

Bejko et al.
Comparison of efficacy and cost of iodine impregnated drape vs. standard drape in cardiac surgery

In a new prospective randomized study of 5,100 patients undergoing cardiac surgery, 3M Ioban was associated with:

• A significant reduction (71%) in the overall incidence of SSIs when compared with the use of a non-antimicrobial incise drape

• Cost effective direct patient related care, delivering overall cost savings of $828,000 (or about $1,025 per patient)

Bejko et al. Comparison of efficacy and cost of iodine impregnated drape vs. standard drape in cardiac surgery

Conclusion

- Control process variability factors that can reduce the bacterial load
- Use effective antiseptic skin preps to kill as much bacteria as possible on the skin
- Whenever possible create a sterile surface using an Iodine-impregnated surgical incise drape

Questions?

Thank You!