Preoperative Issues

Hand Hygiene

Hand hygiene is an essential element of an infection prevention program. Failure to perform appropriate hand hygiene is considered the leading cause of HAIs and contributes to the spread of multidrug resistant organisms (MDROs). Microorganisms transferred from the hands of health care workers to patients contribute to infection; improved hand hygiene is an important strategy to decrease HAI.1

The normal skin flora of the hands includes transient and resident microorganisms. The resident flora is comprised of microorganisms seated in the skin’s deeper layers, while the transient flora involves microorganisms that colonize, but generally do not propagate within, the skin’s superficial layers. As the term implies, transient microorganisms come and go; e.g., due to their superficial location, they can spread to and from the hands of health care workers by direct contact with patients or contaminated surfaces. Therefore, the superficial flora is associated with HAIs, but is also susceptible to removal by routine hand hygiene.

Microorganisms are transmitted via direct and indirect routes. Direct transmission occurs when person-to-person contact results in the spread of microorganisms from a person who is infectious or colonized to a susceptible recipient host. Indirect transmission occurs when a contaminated surface, substance, or instrument serves as an intermediary, conveying the microorganisms from a colonized or infectious person to a susceptible recipient host.2

Strategies to improve hand hygiene

Education is paramount to improving hand hygiene practice. Strategies to improve hand hygiene should address individual health care workers, groups of health care workers, and the institution as a whole.1

Expert authorities have recommended specific practices with regard to proper hand hygiene practices. The Association of periOperative Registered Nurses (AORN), the standard-bearer for best practices in the operating room, has stated that hand washing should be performed:

- Upon arrival at the health care facility
- Before and after every patient contact
- Before putting gloves on and after removing gloves
- Anytime there is a possibility that there has been contact with blood or other potentially infectious materials or surfaces
- Before and after eating
- Before and after using the restroom
- Before leaving the health care facility
- When hands are visibly soiled2
Preoperative Issues (continued)

The CDC has established that use of an alcohol-based handrub is the hand hygiene standard in health care settings, whereas hand washing is reserved for situations when hands are visibly contaminated and after caring for patients with *Clostridium difficile*. Health care workers should be able to demonstrate correct knowledge and use of hand rubs as well as the specific indications for hand washing.³

However, hand hygiene education alone, is insufficient to improve practice substantially. Furthermore, education in an organizational vacuum that does not set hand hygiene as a fundamental and primary objective, providing feedback on individual, group, and institutional performance, will not achieve satisfactory compliance. Hand hygiene promotion at the institutional level includes:

1. Written guidelines
2. Availability and accessibility of hand hygiene agents
3. Concern for and promotion of health care worker skin care with the provision of skin care agents
4. Establishing a culture of compliance with evidence-based guidelines
5. Administrative leadership that offers support, provides rewards, and imposes sanctions judiciously¹

This last point, the judicious use of sanctions, is gaining greater acceptance as health care leaders and consumers increasingly recognize that personal accountability for proper hand hygiene is an entirely reasonable expectation. Hence, failing to follow protocol, particularly when patient harm may result, merits consequences, including rebuke, fine, suspension, or even termination.⁴

**CDC tools and resources available at:**
- [http://www.cdc.gov/handhygiene/Basics.html](http://www.cdc.gov/handhygiene/Basics.html)
- [http://www.cdc.gov/handhygiene/training.html](http://www.cdc.gov/handhygiene/training.html)
- [http://www.cdc.gov/handhygiene/training/InteractiveEducation/pdf/Posters/Poster05_Fast_w.pdf](http://www.cdc.gov/handhygiene/training/InteractiveEducation/pdf/Posters/Poster05_Fast_w.pdf)

**World Health Organization: Clean Care Is Safer Care tools and resources available at:**
- [http://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf](http://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf)
- [http://www.who.int/gpsc/5may/tools/en/index.html](http://www.who.int/gpsc/5may/tools/en/index.html)
Nare Colonization

*Staphylococcus aureus* (s aureus) is carried in the nasal passages of 20% to 30% of healthy, human, and the preoperative nasal carriage of *S aureus* represents a risk factor for SSIs.\(^5\)

Because more than 80% of HAI are endogenous, i.e., resulting from the patient’s native flora, nasal carriers of *S aureus* have a risk of infection with this organism. Recent research has shown that the number of SSIs due to *S aureus* acquired in the hospital can be reduced by rapid screening and decolonizing of nasal carriers upon admission.\(^6\)

To this end, intranasal mupirocin (Bactroban) has been evaluated in the prevention of SSIs. Although it reduces nasal carriage of *S aureus*, it is not yet clear whether there is a reduction of SSI rates resulting from its use.\(^6-7\)

The Society of Thoracic Surgeons (STS), however, believes strongly that the evidence supports its routine use in all patients undergoing cardiac surgical procedures in the absence of a documented negative test for staphylococcal colonization.\(^8\)

Preoperative Shower

Evidence on preoperative showering with topical antimicrobial agents to reduce the incidence of SSIs is variable. It is clear that such preoperative showers reduce microbial colony counts on the skin, with chlorhexidine gluconate (CHG) being more effective in this regard than povidone-iodine or medicated soap and water. However, it is not clear that CHG showers definitively reduce SSI rates.\(^2,5,7,9-10\)

Nevertheless, preoperative showers may have a place in the SSI prevention armamentarium and the recommendations vary based on the intended surgical site and the number of showers needed to achieve maximum effect.

The AORN recommends that patients undergoing open Class I (clean) surgical procedures below the chin have two preoperative showers with CHG.\(^2\)

Patients undergoing surgery of the head should be instructed to shampoo twice with 4% CHG before surgery. Conditioners and other hair care products should not be used after preoperative shampooing with CHG, because it may diminish its antiseptic effectiveness. Hair spray and alcohol-based hair products present a fire hazard in the operating room and should not be used.\(^2\)

In performing the preoperative shower, the patient should be instructed to rinse the skin thoroughly; dry off with a clean, dry towel; and then dress in clean, dry clothing.\(^2\) No body lotions, moisturizers, powder, or perfumes should be applied to the skin after the shower.
Surgical Safety and the Surgical Checklist

Despite the fact that SSI remains one of the most common causes of serious surgical complications, evidence-based measures known to prevent or mitigate them, such as antibiotic prophylaxis, are not consistently applied. However, there are low-tech strategies that should be employed to increase the use of such evidence-based measures—namely teamwork and checklists.\(^{11-13}\)

Teamwork in surgery

Due to the highly complex nature of surgery, teamwork is critical before, during, and after the procedure. Research has shown that effective teamwork in the surgical arena can improve patient outcomes and decrease the rate of adverse events. Even routine, elective surgery involves many critical steps that present opportunities for failure and potential for patient injury. Therefore, collaboration and clear communication between all members of the surgical team; use of well-established safe practices in anesthesia care; and dogged adherence to basic safety techniques, such as site marking and proper hand hygiene, are fundamental to ensuring that the surgery will proceed safely.\(^{13-14}\) In the operating room, the most critical resources are the collective knowledge and experience of the surgeons, anesthesia personnel, nurses, and technicians. Furthermore, to encourage robust collaboration and participation by each of these professionals, the team should use a multidisciplinary checklist.\(^{13}\)

The surgical checklist

A surgical checklist outlines the necessary steps to achieve a safe surgical outcome. It serves as both a reminder and a verification tool to prevent the omission of critical steps in the complicated processes of surgical preparation.\(^{13}\)

The World Health Organization (WHO) Surgical Safety Checklist is one such tool that is evidence based and widely used. It was developed by the Safe Surgery Saves Lives initiative based on WHO-recommended practices to ensure the safety of surgical patients. The checklist consists of items that require active communication among the surgical team members. It verifies that fundamental information is known to and shared by all members and that key safety precautions have been taken before inducing anesthesia, before making the incision, and before leaving the operating room when the procedure is finished.
When considering the individual questions of the WHO Checklist, surgeons, nurses and anesthesiologists will note that these items have historically gone unasked or, indeed, when asked, the information has gone unshared.

**Before Induction:**

1. Has the patient confirmed his/her identity, site, procedure, and consent?
2. Is the site marked?
3. Is the anesthesia machine and medication check complete?
4. Is the pulse oximeter on the patient and functioning?
5. Does the patient have a
   a. Known allergy?
   b. Difficult airway or aspiration risk?
   c. Risk of > 500 cc blood loss?
6. Does the patient have a risk of hypothermia?

**Before Incision:**

1. Checking with each member of the team: What is your name and role?
2. What is the patient’s name, the planned procedure, and the incision site?
3. Has the antibiotic prophylaxis been given within the past 60 minutes?
4. Is venous thromboembolism prophylaxis needed?
5. Surgeon:
   a. What are the critical or expected steps?
   b. How long will the case take?
   c. What is the anticipated blood loss?
   d. What implants or equipment are needed?
6. Anesthesiologist:
   a. Are there any patient-specific concerns?
7. Nurse:
   a. Has sterility been confirmed?
   b. Are there equipment issues or concerns?
   c. Is essential imaging displayed?

**Before Leaving the Operating Room:**

1. How should the name of the procedure be recorded?
2. Are the instrument, sponge, and needle counts complete?
3. How should the specimen(s) be labeled?
4. Are there any equipment problems to be addressed?
5. What are the key concerns for recovery and management of this patient?
Preoperative Issues (continued)

This tool fosters the disclosure and resolution of concerns by any individual team member prior to the surgery. If a step on the checklist cannot be verified, the process is halted until the issue can be rectified to minimize or eliminate avoidable harm to the patient.

Additional information can be found in the WHO Surgical Safety Checklist and Implementation manual:


Testing, Implementing, and Evaluating the Checklist

Just as there is no single solution to improve health care safety, there is no single checklist that will meet every health care organization’s needs. The WHO recommends that organizations modify the checklist to match their processes and culture, keeping in mind that successful implementation hinges on multidisciplinary collaboration. Commitment and participation from both clinical and administrative leadership are imperative for successful implementation of relevant, effective checklists.

In brief, the checklist implementation process consists of three phases\textsuperscript{13}:

\begin{itemize}
  \item Build the team
  \item Start small, then expand
  \item Track changes and improvements
\end{itemize}

Pilot testing the checklist prior to wider implementation has proven useful. Since the goal of the checklist is to introduce tools and strategies for team collaboration and communication, evaluating the effectiveness of the checklist and providing feedback is important. Tracking and reporting back to stakeholders on those improvements in patient safety that can be attributed to implementing the checklist will reinforce its use, ease its acceptance, and facilitate the adoption of checklists in other key, high-risk, complex processes.
Antibiotic Prophylaxis
Antibiotic prophylaxis is a short course of perioperative intravenous antibiotics aimed at reducing the microbial burden of intraoperative contamination. Appropriate use of antibiotics has been shown to reduce infectious morbidity and hospital costs and antibiotic prophylaxis prevents the development of SSIs in the first place. Bacteria involved in SSIs are either endogenous (from the patient’s normal flora) or exogenous (acquired from contamination during the surgery). Endogenous flora can cause disease when transmitted to normally sterile tissue during the operative procedure. Optimal prophylaxis ensures that adequate concentrations of an appropriate antimicrobial agent are present in the serum and tissue at the time of the incision, e.g., when the normally sterile tissue is first exposed to the exogenous flora.

Antibiotic prophylaxis is used for elective and urgent operations when the incision is closed primarily. The CDC has identified four principles of optimal antibiotic prophylaxis:

1. Use an agent that has been shown to reduce SSI rates;
2. Use the safest and least expensive drug warranted;
3. A bactericidal serum concentration of the drug must be established by the time of skin incision; and
4. Maintain therapeutic levels of the antimicrobial agent throughout the operation.

Antimicrobial Agent Selection
The choice of prophylactic antibiotic depends on the type of surgical procedure; the common pathogenic organisms relevant to the type of procedure and its location on the body; the safety and efficacy of the available antimicrobial agents; and current evidence supporting their use and cost. The potential benefit of surgical antimicrobial prophylaxis is determined by three considerations:

- Patient-related factors (ability of the host to respond to bacterial invasion)
- Procedural factors (characteristics of the surgical procedure that affect the likelihood of bacterial invasion at the operative site)
- Potential morbidity of infection

Surgical antimicrobial prophylaxis is recommended only when the potential benefits exceed the anticipated risks. The antimicrobial agent used for prophylaxis should be effective against the disease-relevant bacterial flora characteristic of the operative site. Cost, convenience, and safety of the agent should also be considered.

- Administer antibiotic prophylaxis in accordance with evidence-based standards and guidelines
- Administer the agent within one hour before making the incision to maximize its tissue concentration (two hours is the standard for vancomycin and fluoroquinolones)
Preoperative Issues (continued)

- Antibiotics should not be prescribed “on call to the OR,” since doing so often results in the antibiotic being administered too early.
- Select appropriate agents on the basis of the specific surgical procedure, the most common pathogens causing SSI for that procedure, and published recommendations.
  - For most procedures, particularly clean ones (Class I), the first generation cephalosporin, cefazolin, remains effective.
  - For procedures that might involve exposure to bowel anaerobes (clean-contaminated or Class II), the second-generation cephalosporins, cefoxitin and cefotetan, are recommended.
- Do not routinely use vancomycin for antimicrobial prophylaxis, as its indiscriminate use can lead to resistance as evidenced by the spread of methicillin-resistant S. aureus (MRSA), a vancomycin-resistant enterococcus (VRE). Vancomycin should generally be reserved for specific clinical circumstances, such as during a proven outbreak of MRSA when a high-risk procedure involving an implant is performed.

**Dosing**

Once the appropriate agent has been selected, proper dosing follows standard recommendations that are widely available. However, there are several special circumstances to consider:

1. Is repeat dosing required for prolonged procedures?
2. Must adjustments be made for procedures that involve large volume blood loss or fluid replacement?
3. Must dosing be adjusted for morbidly obese patients?

Ideally, therapeutic serum and tissues levels of the prophylactic antimicrobial agent should be maintained throughout the operation. Therefore, when the clinical situation involves any factors that would diminish such levels, repeat or increased dosing may be warranted.

Soft tissue levels of intravenously delivered prophylactic antimicrobial agents peak approximately 30 minutes after administration and then start to decline gradually. Therefore, if a procedure lasts long enough for tissue levels to decline below that which are pharmacologically effective, it is necessary to administer a repeat dose. For most of the relevant agents in use, that time is approximately four hours. If a procedure is still underway four hours after the original prophylactic dose was given, a second dose should be administered. This timing is based upon the antibiotic’s half-life in the body.

Similar reasoning can be applied to the second circumstance enumerated above: large volume blood loss or fluid replacement. Major blood loss replaced with large volumes of crystalloid can dilute the serum levels of antibiotic, decreasing the diffusion pressure into the tissues, thereby lowering tissue levels of antibiotic. Therefore, consideration should be given to re-dosing in situations where intraoperative blood loss exceeds 1500 mL.

In the third scenario, morbid obesity, there is evidence that higher initial dosing is appropriate to generate adequate tissue levels for effective prophylaxis. Therefore, dosing should be weight based.
Preoperative Issues (continued)

**Duration of Prophylaxis**

The duration of surgical antimicrobial prophylaxis should extend throughout the period in which bacterial invasion is facilitated and/or is likely to establish an infection. Indiscriminate use of antibiotics does not further decrease the incidence of wound infections and may result in increased costs and emergence of resistant infections.

Prophylaxis should be discontinued within 24 hours after surgery for most procedures, and within 48 hours for cardiac procedures.

**Strategies for Achieving Adherence with Guidelines**:

1. Educate all participants in the system that is developed to support the proper preparation of patients for procedures in which antibiotic prophylaxis is indicated.
   - Develop an educational program that enforces the importance and rationale of timely antimicrobial prophylaxis.

2. Establish a formal protocol for antimicrobial prophylaxis that standardizes antibiotic selection based on current evidence, formulary availability, institutional antimicrobial resistance patterns, and cost. Antibiotic therapy should be tailored to address the flora that is endemic to an individual institution through analysis of its institutional antibiogram. Local behaviors surrounding antibiotic use generate distinct patterns of antimicrobial resistance.

3. Standardize the delivery and administration process.
   - Design a system that ensures antibiotics are available at the time of the surgery.
   - Assign and standardize specific responsibility and accountability for antibiotic administration.
   - Use visible reminders or surgical checklists to ensure prescribing, administering, and re-dosing of prophylactic antibiotics.

4. Provide feedback
   - Follow up with institutional and individual provider reports of compliance with prophylaxis protocols and subsequent SSI rates.
Preoperative Issues (continued)

Hair Removal
If possible, hair at the surgical site should be left in place and removed only if it will actually interfere with performing the surgical procedure. Furthermore, if hair must be removed, it should be done by using depilatory cream or a hair clipper, as shaving creates microscopic cuts in the skin that serve as niduses for bacterial infection. Research studies have found that preoperative shaving of the surgical site increases the risk of SSI, and results in higher SSI rates than using a depilatory cream or clipping. Hair removal should be performed on the day of surgery as close to the time of the start of the procedure as possible, but in a location outside of the operating room.

Hair clipping should be performed using a single-use electric or battery-operated clipper or a clipper with a reusable head that can be disinfected between patients. Although use of depilatory cream carries a lower risk of SSI than shaving or clipping, it may cause hypersensitivity reactions.

Overcoming the entrenched practice of shaving before surgery requires fortitude and perseverance. Measures that will help achieve compliance with recommendations include:

- Remove razors from the entire operating room suite
- Train staff in the use of hair clippers
- Have an adequate supply of clippers available
- Ensure that the staff has a convenient, private location to perform hair removal in a location outside of the operating room
- Place visible reminders about preferred hair removal techniques throughout the operating room
- Educate patients not to shave preoperatively and to challenge their care providers if they are advised to shave

Surgical Hand Scrub
As explained above, hand hygiene is a critical component of an infection prevention program. Nowhere is this principle more fundamental than in the operating room. Health care personnel must receive formal education and training, and then undergo competency validation on surgical hand hygiene products and procedures. They should perform a surgical hand scrub before donning sterile gloves for surgery or other invasive procedures.

Members of the surgical team who have direct contact with the surgical field and/or sterile instruments must perform a surgical scrub.
Choice of antiseptic

An antimicrobial surgical scrub agent, intended for surgical hand antisepsis, or an alcohol-based antiseptic surgical hand rub, with documented persistent and cumulative activity that has met U.S. Food and Drug Administration (FDA) regulatory requirements for surgical hand antisepsis, is acceptable. The active components of antiseptics that are available in the U.S. include alcohol, CHG, iodine/iodophors, para-chloro-meta-xylene (PCMX), or triclosan. Alcohol-based agents show an immediate reduction of 95% of the resident flora and a 99% reduction with repeated applications. However, products containing alcohol are generally used less frequently than other antiseptics due to their inflammability.

CHG rapidly reduces both skin flora and transient bacteria. Additionally, CHG has residual activity on the skin that helps to prevent rapid regrowth of skin organisms and enhances the duration of skin antisepsis.

Most data indicate that povidone-iodine and CHG have equal efficacy in decreasing the bacterial contamination of the skin, but CHG has a longer effect, is less toxic in open wounds, and causes less skin irritation with prolonged use.

Technique

Scrubbing technique, duration of the scrub, condition of the hands, and techniques used for drying and gloving all may influence the effectiveness of the surgical scrub. Current recommendations for surgical scrub with antimicrobial soap are as follows:

1. Remove all hand or arm jewelry.
2. Keep nails short and do not wear artificial nails.
3. Clean under each fingernail prior to performing the first scrub of the day and for any visible foreign material.
4. Scrub the hands and forearms up to the elbows for the length of time recommended by the manufacturer of the antimicrobial soap in use (typically 2-5 minutes).
5. After performing the surgical scrub, keep the hands up and away from the body with the elbows flexed.
6. Dry hands with a sterile towel, ensuring that the towel touches only the parts being dried. Start drying the fingers of one hand and then the other. Next, dry each hand using a different part of the towel that has been kept away and clean. Finally, work up each arm toward the elbow, again keeping contaminated parts of the towel away from each successive area being dried.
7. Don a sterile gown and gloves using a technique that preserves the hands' antisepsis.
8. When using an alcohol-based surgical handrub that has sustained activity, strictly follow the manufacturer’s instructions:
   a. Adhere to recommended application times.
   b. Apply the product to dry hands only.
   c. Do not combine other surgical hand scrub products with alcohol-based surgical handrub.
   d. After application of the alcohol-based handrub, allow hands and forearms to dry thoroughly before donning a sterile gown and gloves.

Patient Skin Antisepsis/Skin Prep
The CDC provides the following evidence-based recommendations for surgical skin preparation:

Procedure

1. Thoroughly wash and clean at and around the incision site to remove gross contamination before performing antiseptic skin preparation.
2. Apply perioperative antiseptic skin preparation in concentric, enlarging circles, moving from the incision towards the periphery. The prepared area must be large enough to incorporate any likely extension of the incision or creation of additional incisions or drain sites, if necessary.

Choosing an agent
The optimal antiseptic skin preparation agent should:

1. Significantly reduce microorganisms on intact skin
2. Be broad spectrum
3. Be fast-acting
4. Have persistent effect
5. Be non-irritating

The CDC has not issued a recommendation as to which antiseptic should be used preoperatively to prevent SSIs. The most commonly used antiseptic skin preparation agents include CHG, alcohol-based solutions, and iodophors, such as povidone-iodine. While both CHG and iodophors have broad spectrum antimicrobial activity, CHG’s effect lasts longer with greater residual effect after a single application. Overall, it achieves greater reductions in skin microflora and is not inactivated by contact with blood or serum.

Current clinical evidence confirms CHG’s superiority over povidone-iodine for preoperative antisepsis. A recent study of 897 patients found CHG and alcohol surpassed cleansing with povidone-iodine for preventing SSI within 30 days after surgery, and demonstrated a greater than 40% reduction in SSI.
Preoperative Issues (continued)

**Surgical Attire and Drapes**

While evidence about the relationship between surgical attire and the shedding of live microorganisms from operating room personnel exists, only a few controlled studies have evaluated the relationship between the use of surgical attire and the incidence of SSIs. Nevertheless, personal protective equipment, including scrub suits, masks, surgical caps, hoods, and shoe covers, should all be used in accordance with federal and state regulations, as well as professional society guidelines.

**Masks**

Wearing a mask clearly protects the health care worker’s face from exposure, but some studies have raised questions about their efficacy and cost-effectiveness with regard to reducing SSIs. Nevertheless, the protection afforded the surgical staff warrants their use. The Occupational Safety and Health Administration (OSHA) requires that masks and protective eye wear be worn whenever splashes can be anticipated.

Furthermore, the AORN states that all individuals entering restricted areas of the operating room suite should wear a mask when open sterile items and equipment are present.

Surgical caps reduce contamination of the field by organisms shed from the hair and scalp. Personnel should cover their head and facial hair when in the semi-restricted and restricted areas of the surgical suite.

Shoe covers are used to maintain sanitation and, when badly soiled, should be removed before leaving the operating room.

Shoe covers have not been shown to reduce SSI risk and footwear dedicated for use in the operating room can be worn in lieu of shoe covers. Again, the underlying principle is sanitation and even dedicated OR shoes, when soiled, should be cleaned or discarded.

**Sterile gloves**

Sterile gloves must be worn when performing all sterile procedures, including those on tissues that should be sterile, such as open wound dressing changes. Non-sterile, medical grade gloves can be used for non-sterile activities.

In the operating room, sterile gloves are worn (a) to minimize the transmission of microorganisms from the surgical team’s hands to the patient, and (b) to prevent exposure of the team members’ hands to the patient’s body fluids and tissues. Sterile gloves should be inspected immediately upon donning and before contact with sterile supplies and tissue. They should be changed:

- After each patient contact;
- When a visible defect is noted;
- When suspected or actual contamination occurs;
Preoperative Issues (continued)

- When a suspected or actual perforation occurs;
- Immediately following direct contact with uncured methyl methacrylate (bone cement);
- If the wearer receives an electrical shock from an electrosurgical unit;
- When gloves begin to swell or expand; and
- According to institutional policy.²

Double-gloving has been shown to reduce the wearer’s risk of exposure to blood and fluids. The AORN, the CDC, the American College of Surgeons, and the American Academy of Orthopedic Surgeons all recommend that health care providers double glove during invasive procedures. Upon completion of the invasive procedure, both pairs of gloves should be discarded and hand hygiene should be performed.²,⁵

Gowns and drapes
Sterile surgical gowns and drapes create a barrier between the surgical field and potential sources of bacteria. They should be chosen based on the type of the operation, its estimated duration, and the amount of blood loss expected. Additional considerations include their impermeability, comfort, and cost. They should have the ability to maintain an isothermic environment for patients and health care workers. Surgical gowns and drapes should be low-linting, since lint particles spread into the environment where bacteria attach to them and pose a potential for increased postoperative complications.²

Surgical gowns should be selected according to their barrier characteristics and the expected exposure to blood and body fluids, in accordance with OSHA guidelines for the use of personal protective equipment (PPE).² OSHA regulations require that if blood or other potentially infectious materials penetrate a garment, the garment shall be removed immediately or as soon as feasible.⁵

Adhesive incise drapes have been evaluated in several studies, and have not been shown to be superior in controlling wound infections when compared with standard skin preparation and draping. However, it has been shown that the infection rate increases if the adhesive drape becomes separated from the skin during the operative procedure.³⁰
Preoperative Issues (continued)

Environment
The operating room environment plays an important role in reducing the threat of SSI. A number of activities that occur in this environment are controlled by the surgical team. Attention to these factors may affect the patient’s risk of developing a surgical site infection.

Standards for airflow and ventilation in the operating room are intended to protect patients from SSIs and health care workers from acquiring infection from patients. Air in the operating room environment contains microbe-filled dust, lint, skin particles, and respiratory droplets, with the majority of the airborne bacteria coming from the skin of the patients and the staff.

Airflow and ventilation
To prevent SSIs, clean air under positive pressure is supplied to the operating room. Maintaining operating rooms at positive pressure prevents airflow from less clean areas into cleaner areas. Heating, ventilation, and air conditioning systems remove air contaminants and control air flow patterns, which are designed to minimize contamination of the sterile field. Disruptions in the airflow patterns within the operating room can redirect contaminants into the sterile field, increasing the risk of SSI.

The air quality in the operating room should be sequentially filtered through two filters. The first filter should be rated as 30% efficient, and the second should be 90% efficient. The operating room should be maintained with a minimum of 15 air exchanges per hour with a recommended range of 20 to 25 air exchanges per hour. Laminar air flow and the use of ultra-violet (UV) radiation have been suggested as additional measures to reduce SSI risk; however, intraoperative UV radiation has not been shown to reduce overall SSI risk.

Ambient air
SSI rates following certain procedures increase when a patient is permitted to become hypothermic. Therefore, it is important to monitor the ambient temperature in the room and maintain it at a level that does not induce hypothermia. Generally, the temperature in the operating room should be kept between 68º F and 73º F (20º C and 23º C). The room temperature should be increased when directed forced-air heating alone is insufficient to maintain normothermia, such as when large areas of body surface are exposed during surgery. Procedures that include significant exposure to evaporative heat loss include open abdominal procedures, due to the large surface area of exposed visceral and parietal peritoneum, and large area tangential excisions and split thickness skin grafting for burn wound care. (Refer to section on Hypothermia under “Intraoperative Issues” for more information on preventing hypothermia.)

The relative humidity in the operating room should be maintained between 30% and 60%. Low humidity increases the risk of electrostatic charges, which pose a fire hazard, increase the potential for dust, and increase the rate of evaporation leading to heat loss and hypothermia. High humidity, on the other hand, increases the risk of microbial growth and can be uncomfortable for the fully gowned surgical team.
Preoperative Issues (continued)

**Traffic patterns**
The microbial level in operating room air is directly proportional to the number of people moving about in the room. Therefore, efforts should be made to minimize personnel traffic during operations. Operating room doors should be closed, except as needed for movement of patients, personnel, supplies, and equipment.

The number of personnel entering the operating room should be limited as much as feasible and traffic into and out of the operating room should be minimized through pre-planning. Consideration, therefore, must be given to the location and quantity of supplies stored inside and outside the operating room; the location of flash sterilizers; and the equipment and supplies that are opened and assembled before the start of the case.

**Disinfection and Sterilization**
Disinfection and sterilization of medical devices and surgical instruments are essential to reduce transmission of infectious pathogens to patients. Health care policies must identify, primarily on the basis of the items' intended use, whether cleaning, disinfection, or sterilization is indicated.

Then, appropriate processing and reprocessing guidelines must be followed. Medical devices and surgical instruments needing reprocessing can be divided into three categories:

- a. Critical items
- b. Semicritical items
- c. Non-critical items

**Critical items** – Items which enter normally sterile tissue or the vascular system are categorized as critical and should be sterile when used.

**Semicritical items** – Items that come in contact with mucous membranes or skin that is not intact are considered semicritical and should receive high-level disinfection, at a minimum, prior to use. High-level disinfection kills all microorganisms with the exception of bacterial spores. (Disinfection levels are defined below).

**Non-critical Items** – Items that come in contact with intact skin should receive intermediate-level disinfection, low-level disinfection, or cleaning.
Cleaning, Disinfection, and Sterilization

Cleaning
Cleaning is the removal of visible soil from objects and surfaces, which is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is essential before high-level disinfection and sterilization. Effective sterilization cannot take place without effective cleaning. The process of sterilization is impeded by the relative number (i.e., bioburden), type, and resistance of microorganisms on the items to be sterilized. The manufacturer’s written instructions for handling and reprocessing should be used to determine how to replicate the validated cleaning and the recommended cleaning procedures can lead to decreased susceptibility to disinfectants.

Disinfection
Disinfection describes a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects. In health care settings, items are often disinfected by liquid chemicals or wet pasteurization.

There are three levels of disinfection:

a. **High-level disinfection**: A process that kills all microorganisms, with the exception of high numbers of bacterial spores and prions

b. **Intermediate-level disinfection**: A process that kills microorganisms, most viruses, and tuberculosis bacteria, with the exception of high numbers of bacterial spores or prions

c. **Low-level disinfection**: A process by which most bacteria, some viruses, and some fungi are killed

Sterilization
Sterilization describes the use of a physical or chemical procedure to eliminate all microbial life, including highly resistant bacterial endospores.

The AORN offers the following recommendations for sterilization:

1. **Saturated steam under pressure** should be used to sterilize heat- and moisture-stable items, unless otherwise indicated by the device manufacturer.

2. **Flash sterilization** should be used only in select clinical situations and in a controlled manner. Flash sterilization should be used only when there is insufficient time to permit processing by the preferred wrapped or container method, and should not be used as a substitute for maintaining sufficient instrument inventory. Flash sterilization should be performed only if all the following conditions are met:
   - The device manufacturer’s instructions are followed;
   - Items are disassembled and thoroughly cleaned with detergent and water;
   - Lumina are brushed, then flushed under water with a cleaning solution, and rinsed thoroughly;
Preoperative Issues (continued)

- Items are placed in a closed sterilization container or tray, validated for flash sterilization in a manner that allows steam to contact all instrument surfaces; and
- Measures are taken to prevent contamination during transport from the sterilizer to the sterile field.

3. **Ethylene oxide sterilization** is a low-temperature process that is appropriate for heat- and moisture-sensitive surgical items, when indicated by the device manufacturer.

4. **Low-temperature hydrogen peroxide gas plasma sterilization** should be used for moisture-sensitive and heat-sensitive items, when indicated by the device manufacturer.

5. **Sterilization systems using peracetic acid** as a low-temperature liquid sterilant appropriate for heat-sensitive surgical items that can be immersed, when indicated by the device manufacturer.

6. **Sterilization systems using ozone** should be used for moisture- and heat-sensitive items, when indicated by the device manufacturer.

7. **Dry-heat sterilization** should be used to sterilize waterless items that can withstand high temperatures, when indicated by the device manufacturer.
Preoperative Issues (continued)

References


Preoperative Issues (continued)


