Sterile Technique: Key Concepts and Practices



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STUDY GUIDE

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Sterile Technique: Key Concepts and Practices

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PURPOSE/GOAL

The purpose of this study guide and accompanying video is to provide information to perioperative staff members on key concepts and practices for establishing and maintaining a sterile field.

OBJECTIVES

After viewing the video and completing the study guide, the participant will be able to:

1. Define sterile technique.
2. Identify the parameters of a sterile field.
3. Describe practices that reduce the spread of infection when preparing or working in a sterile environment.
4. Discuss the importance of monitoring the sterile field.

INTRODUCTION

Surgical site infections (SSIs) are among the most frequent complications in patients who undergo surgical or other invasive procedures.[1] The Centers for Disease Control and Prevention (CDC) has estimated that in the United States, 290,000 SSIs occur annually, costing $3 to $8 billion dollars and causing 13,000 deaths.[2] The CDC further estimates that 26 to 54% of these infections are preventable.

Sterile technique means practicing specific procedures before and during invasive procedures to help prevent SSIs and other infections acquired in hospitals, ambulatory surgery centers, physicians' offices, and all other areas where patients undergo invasive procedures.[3] When practiced correctly, sterile technique helps reduce microbial contamination of the surgical site and decrease the number of microorganisms in ORs and other clinical environments.

Creating, maintaining, and monitoring a sterile field can improve patient outcomes. Using sterile technique when preparing, performing, or assisting with operative and other invasive procedures is essential to keeping an environment safe and preventing health care-associated infections in patients and health care workers. Perioperative nurses and all other medical and surgical personnel involved in operative and other invasive procedures should promote patient and worker safety by practicing correct sterile technique and by identifying, questioning, or stopping practices if they appear unsafe.

MICROBIOLOGY REVIEW

Sterile technique aims to prevent microbial contamination and infection, so we begin with a review of some basic aspects of microbiology and some of the most important microbial pathogens found in hospitals and other settings where operative and other invasive procedures are performed.

Microorganisms, or microbes, are too small to be visualized with the naked eye. They include bacteria, viruses, fungi, protozoa, and algae. Bacteria, fungi, protozoa, and algae are further classified by genus and species. Bacteria are additionally categorized by their morphology (shape), motility (ability to move), reaction to various staining tests, and ability to grow under aerobic versus anaerobic conditions and in different types of media. These categories help bacteriologists and clinicians distinguish among diverse bacterial species.

Many microbes are beneficial, and most bacteria are nonpathogenic (i.e., they do not cause disease).[4] Pathogenic microbes – particularly bacteria, viruses, and fungi – cause disease by invading and multiplying inside other organisms. These pathogens can cause serious and potentially fatal SSIs and other serious health care-associated infections. Some pathogens colonize the skin, upper respiratory tract, or intestinal tract of asymptomatic carriers. Infected health care workers can shed these microorganisms, putting patients at risk, especially those who are immunocompromised or undergoing surgical or other invasive procedures.

Pathogenic bacteria, viruses, and fungi also can develop numerous mechanisms of partial or complete resistance to antimicrobial drugs. These include spontaneous and induced genetic mutations as well as horizontal gene transfer, or the non-reproductive sharing of genes that confer resistance between organisms of the same or different species.[5] The vast majority of health care-associated infections are from drug-resistant organisms; and these infections increase morbidity, mortality, and health care costs. Researchers estimate that in the United States, antibiotic-resistant infections cause 8 million additional hospital days and cost at least $21 billion every year.[6]

Pathogens Associated with SSIs

Bacteria cause most SSIs, but bloodborne viruses are also of major concern.[5] The following list describes some of the most common and pathogenic microorganisms associated with SSIs and other health care-associated infections.

Bacteria

- ***Staphylococcus aureus*** is shed from human nasal and throat cavities. *S. aureus* causes SSIs as well as systemic infections (e.g., septic arthritis, myocarditis, and pneumonia).[5] Staphylococci can survive for long periods in dust, clothing, air, and bedding. Infections of methicillin- and vancomycin-resistant *S. aureus* (MRSA and VRSA) are associated with prolonged hospital stays and increased mortality rates.

  Colonized health care workers can transmit S. aureus to patients. In England, a prolonged outbreak of MRSA in cardiac surgery patients from 2011 to 2012 was linked to a single colonized health care worker who had cared for all patients in the outbreak.[7] Nasal swab cultures of health care workers showed that a nurse was colonized with a strain of levofloxacin-resistant MRSA that matched the outbreak MRSA strain based on three molecular typing techniques: spa-typing, pulsed-field gel electrophoresis (PFGE), and multi-locus variable-number tandem-repeat analysis. The nurse had no evidence of dermatitis or other chronic skin disease. The nurse underwent topical MRSA suppression therapy (nasal mupirocin

2% ointment three times daily, topical chlorhexidine 4% for five days, and a 10-day systemic course of 100 mg doxycycline twice daily and 300 mg rifampicin twice daily). Repeated follow-up cultures were negative, and the nurse returned to work. In addition, the cardiac surgery unit held staff education and training sessions to reinforce infection control practices such as hand washing and caring for patients in a single room.

- ***Enterococci*** are found in the gastrointestinal system and the female genital tract.[4] In addition to SSIs, these bacteria can cause septicemia, bacterial endocarditis, and urinary tract infections (UTIs). Enterococcal infections are most commonly associated with health care facilities. Patients with comorbid conditions are at higher risk of infection. As for S. *aureus*, vancomycin resistance is a concern.

  Among the first reported nosocomial outbreaks of vancomycin-resistant enterococci was a cluster of UTIs in a bone marrow transplant unit during the 1990s.[8] Five transplant patients were infected with a PFGE-matched strain of *Enterococcus faecium*, three of which were vancomycin-resistant. The patients had received an average of three weeks of vancomycin prophylaxis and all had been cared for in a single nursing unit by a single care team. Environmental cultures did not yield enterococci, but medical staff recognized the potential for person-to-person spread and instituted aggressive infection control measures, including hand washing, gowning, and gloving when entering patients' rooms; hand washing when exiting rooms; patient isolation; and isolation of the adjacent nursing unit. The transplant unit also changed its policies to limit prophylactic vancomycin to the first seven days after a bone marrow transplant.
- ***Pseudomonas aeruginosa*** thrives in wet environments.[4] These bacteria can occur as normal flora of the skin and intestinal tract, but also can cause fatal infections in immunocompromised persons. In 2009, *P. aeruginosa* caused joint space infections in seven patients who had undergone arthroscopic procedures at a single hospital in Texas.[9] The results of a case-control study did not identify risk factors related to patients or medical staff, but *P. aeruginosa* grew from 62 of 388 environmental samples, and an isolate from a gross decontamination sink matched the outbreak strain by PFGE. In addition, retained tissue was found in the lumen of the inflow/outflow cannulae and the arthroscopic shaver hand piece of reprocessed athroscopic equipment. The outbreaks ended after instrument processing protocols were changed.
- ***Group A streptococci*** can be cultured from the nasal passages, vagina, and anus of healthy persons. This bacterium can be carried through air and on dust in surgical environments and can infect surgical wounds, where it can spread through the lymphatic system, resulting in inflammation and cellulitis as well as potentially fatal necrotizing fasciitis.[5]
- ***Clostridium dificile*** is sometimes present in the gastrointestinal tract, and under specific conditions can overgrow in the colon and produce highly virulent toxins that cause severe colitis, diarrhea, dehydration, megacolon, colonic perforation, and death.[5] Overgrowth is often associated with prior antibiotic therapy, which reduces numbers of other bacteria in the intestinal tract. Therapy with proton pump inhibitors is also a documented risk factor for *C. dificile* infection.[10] The organism forms spores that can survive for up to five months and are resistant to heat, drying, and exposure to many disinfectants.[5] *C. dificile* has been cultured from health care workers' hands and fingernails; to prevent indirect and person-to-person transmission, contact precautions, antimicrobial hand washing, the use of personal protective equipment (PPE) are recommended along with thorough washing and disinfection of surfaces, equipment, and reusable devices in perioperative areas.
- ***Rapidly growing mycobacteria*** species (RGM) are ubiquitous in the environment, including in tap water. These bacteria increasingly have been associated with pulmonary infections in developing countries.[11] However, health care-associated outbreaks of RGM SSIs associated with contaminated water have occurred in developing countries, Europe, and the United States. Post-surgical skin and soft tissue may require removal of foreign objects (e.g., implants), drainage of abscesses, debridement, and four months of combination antimicrobial therapy (six months in the case of osteomyelitis).[12] Since 2000, RGM infections reported in in the United States have been in patients who underwent laser in situ keratomileusis (LASIK),[13] bone marrow transplants,[14] surgical implants,[15] and cosmetic surgery.[16]

Viruses

- ***Hepatitis viruses A, B, C, D, E, and G*** cause acute

and chronic liver inflammation with associated hepatomegaly, jaundice, and abdominal pain.[5] These viruses are bloodborne pathogens that have been associated with patient-to-patient and patient-to-health care worker transmission. In Nevada, an outbreak of patient-to-patient transmission of hepatitis C virus occurred after single-use medication vials were used for multiple patients during anesthesia.[17] In Virginia, a retrospective cohort study and DNA sequencing showed that an orthopedic surgeon unknowingly infected with hepatitis B virus had transmitted the virus to at least two patients.[18] The mechanism of transmission was not established, but investigators hypothesized that microperforation of the surgeon's gloves was responsible.

- ***Human immunodeficiency virus (HIV)*** is a retrovirus that attacks the cell membrane of host T-cells, which play a central role in cell-mediated immunity. Untreated HIV infection can cause severe immunodeficiency, with resulting morbidity and death from co-infections. As with other bloodborne pathogens, the HIV virus can be transmitted through accidental needle pricks and other injuries from sharp instruments.[5]

Rationale for Sterile Technique

The healthy, intact human epidermis and mucous membranes form a physical barrier against infection.[5] In the case of skin, this barrier is reinforced by the presence of lipids and antimicrobial peptides (AMP). AMPs, which are produced by keratinocytes and leukocytes, exhibit innate antimicrobial activity against invading pathogens and also recruit anti-inflammatory cells and trigger the release of cytokines, which provide additional defense.[19]

During surgical and other invasive procedures, the body's physical barriers against infections are breached, which increases the risk of infection. Historical research indicates that before Joseph Lister introduced antiseptic techniques into surgical practice in 1867, postoperative mortality rates were as high as 50%.[20] In modern times, sterile technique remains critically important, particularly because of the presence of drug-resistant pathogens in health care facilities and because many patients have weakened immune systems attributable to chronic diseases or other comorbidities. To protect patients, perioperative personnel must follow precise steps to prevent microbes shed from the body, head, hands, mouth, and nose from contaminating the surgical site.[3] Such steps also help protect health care workers from exposure to pathogens in blood, body fluids, and other potentially infectious materials.

Emerging Research on the Role of Nonpathogenic Microorganisms in Human Health

Although medical microbiologists and other clinical researchers have long known that nonpathogenic microbes play important roles in the normal functioning of human organ systems, new research is highlighting both the extent and importance of this role, particularly as it relates to the immune response. For example, normal microflora that colonize human skin, particularly *Staphylococcus epidermidis* bacteria, help outcompete opportunistic pathogens and prevent colonization by pathogenic microbes.[19] Similarly, a history of antibiotic use is a major risk factor for *Clostridium dificile* infections. Antibiotics destroy the normal flora of the human gut, facilitating overgrowth of *C. dificile*.[5,10]

PRACTICES TO REDUCE TRANSMISSIBLE INFECTIONS

All health care workers should follow specific practices to reduce the spread of transmissible infections. These practices include wearing appropriate attire, practicing hand hygiene, and wearing surgical masks and other PPE when indicated.[3,5] This section reviews each of these practices in detail.

Appropriate Attire

Appropriate attire is worn to support cleanliness and hygiene and promote the safety of patients and health care providers by helping limit microbial shedding and contamination. Proper scrub attire is clean, produces minimal lint (low-linting), and fits comfortably but is not oversized.[3,5] All persons who enter the semi-restricted and restricted areas of a surgical area should wear clean surgical attire, made of multiuse fabric or limited-use nonwoven material, that has been laundered in an appropriate facility.[21]

All perioperative personnel entering the OR or invasive procedure room for any reason should wear scrub attire and head coverings. Appropriate scrub attire includes a two-piece pantsuit, a one-piece coverall, or a scrub dress.[5] Loose scrub tops should be tucked into pants to keep them close to the body and prevent them from inadvertently coming into contact with sterile surfaces. Head coverings and hoods should fully cover the scalp and all hair on the head, including beards and facial hair. In 2003, an outbreak of the RGM Mycobacterium jacuzzii occurred in breast implant patients; the outbreak strain was isolated from the surgeon's eyebrows, hair, face, nose, ears, and groin.[22]

In addition to basic scrub attire, non-scrubbed personnel should wear a clean or single-use long-sleeved scrub jacket that is buttoned or snapped closed to completely cover the torso, arms, and wrists.[5] Scrubbed personnel do not wear this jacket because the sleeves cover the forearms and wrists, which must be surgically scrubbed.

In addition, shoe coverings must be worn when spills or splashes are likely, and must be changed if such events occur. Shoe coverings prevent personnel from inadvertently tracking biohazardous substances.

Hand Hygiene

Improper hygiene is a major risk factor for transmission of health care-associated infections. Health care professionals should follow several key steps to help reduce microbes on the hands and forearms and prevent transmission of pathogens.[5]

1. **Nails** should be kept short, and artificial nails should not be worn. Chipped nail polish should be removed before entering the perioperative area. Nail hygiene is especially important because most microorganisms on the hands are located beneath the fingernails. The area beneath the nails should be cleaned with a disposable nail cleaner.
2. **Rings** should be removed before entering the perioperative area.
3. **Watches and bracelets** should be removed before washing hands or beginning a surgical hand scrub.
4. **Hands and forearms** should be washed with soap and water. An alcohol-based antiseptic hand rub may be used when soil is not present on the hands.

Surgical Masks

When worn properly, surgical masks can help trap large respiratory droplets (>5 micrometer [µm]) that can contain bacteria and viruses.[5] In health care settings, surgical masks also establish a physical barrier to help protect the wearer from certain work-related infection hazards (i.e., the risk of inhaling droplets of blood, body fluids, and other potentially infectious materials that could contain infectious pathogens).

Perioperative personnel wear masks during surgical and other invasive procedures to help prevent the surgical site from becoming contaminated with microbes present in the mucus and saliva of perioperative personnel, and to help protect the skin of the face from splashes and sprays of blood, body fluids, and other

potentially infectious materials. Results from studies support this practice. For example, a prospective randomized controlled trial of 221 patients found that when surgeons wore clean surgical masks during cataract surgeries, there was a statistically significant decrease in the number of bacterial colonies that grew on blood agar plates located next to patients' heads, within the sterile field.[23]

To function correctly, the surgical mask must fully cover the mouth and nose, and its edges should conform to the face to prevent venting (i.e., flow of air around the sides of the mask where there is usually lower airflow resistance).[3] AORN specifies that masks should be worn when open sterile supplies are present or when preparing, performing, or assisting with operative or other invasive procedures, including insertion of central venous catheters, peripherally inserted central catheters, and guidewire exchange; procedures that require regional anesthesia; and high-risk spinal procedures (e.g., myeolograms, lumbar puncture, spinal anesthesia).

In addition, surgical masks may be placed on patients to limit the spread of respiratory diseases. However, it is important to note that even when worn properly, surgical masks cannot be relied on to protect workers against airborne infections.[5] Masks do not confer the same level of protection as a particulate respirator does. For this reason, health care workers must wear OSHA-specified respiratory protection when caring for persons with known or suspected active tuberculosis disease.

SELECTION OF SURGICAL GOWNS, GLOVES, AND DRAPES

Surgical gowns, gloves, and drape products are used to form a barrier that helps minimize movement of microbes, body fluids, and particles between sterile and unsterile areas. However, these products are only as effective and safe as the materials used to make them. Rips, punctures, and wear resulting from excessive friction on material can allow microbes, inorganic particulate matter, and body fluids to pass between sterile and nonsterile areas, exposing both patients and health care workers to the risk of infection from microbial contamination or bloodborne pathogens.[3]

To date, companies that manufacture surgical gowns, gloves, and drapes have not developed or implemented universal performance standards for these materials. Therefore, AORN recommends that surgical gowns, gloves, and drapes be evaluated and tested for safety, effectiveness, and cost before they are purchased or used. Several factors should be considered during product evaluation and selection.[3] Perioperative personnel should be aware of these factors and apply them when evaluating and selecting surgical gowns, gloves, and drapes.

1) Evaluators should keep in mind the health care facility's existing contracts on products, and whether the new product is compatible with products already in use.
2) When choosing gowns, gloves, and drapes, health care professionals should consider the specifics of operative and other invasive procedures, including:
   - The procedure duration. The penetration of sterile, disposable, non-woven drapes by bacteria has been shown to be time dependent. In one study, six brands of such drapes were tested during hip arthroplasty after 30 and 90 minutes. At 90 minutes, most drapes showed formation of less than 100 colony-forming units. However, penetrability varied by brand and no drape was found to be completely impenetrable.[24]
   - Anticipated blood and body fluid loss during the procedure, and the volume of irrigation fluid that will be used. This helps determine the extent to which the product must be able to prevent liquid penetration.
   - The possibility that excess leaning or pressure from hands or instruments will place additional force on the material. This helps determine the degree of tensile or tear strength required.
3) Evaluators should keep in mind the needs and preferences of the professionals who use the products. The team member's role should be considered, including his or her proximity to the sterile field and to potentially infectious liquids and other materials.
4) The quality of the materials and their construction must be carefully evaluated.
   - To protect both perioperative team members and patients, surgical gowns and drapes should be made of combustion-resistant material.
   - AORN recommendations specify that surgical gowns, gloves, and drapes be non-toxic, non-irritating to skin, functional, flexible, and able to resist wear, tear, and puncture.
   - Surgical gowns should have seams and points of attachment that minimize seepage of liquids and help prevent microbial passage.
   - Gowns and drapes should produce as little lint as possible (low-linting). Lint from surgical attire can exacerbate postoperative complications, because

bacteria can attach to lint particles and then settle in surgical sites and wounds. In one study, researchers used a personal cascade impactor sampling device to identify lint (e.g., wood fibers from disposable drapes and gowns) and nosocomial pathogens (e.g., S. aureus and other bacteria) from the air near the surgical field during vascular surgery.[25]

5) Environmental factors, such as the facility's policies on recycling or reprocessing, also merit consideration. If gowns and drapes will be reprocessed and reused, steam needs to be able to fully penetrate the material during sterilization, and the material must be able to withstand multiple washings and sterilization cycles.

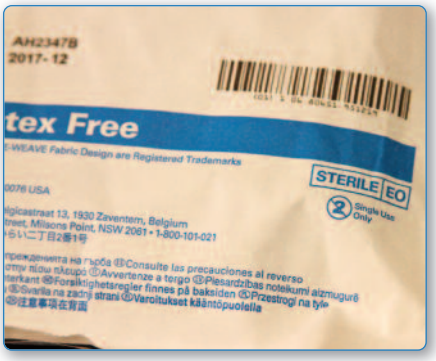
6) Gowns, gloves, and drapes must meet the requirements of federal, state, and local regulatory agencies, as well as standards-setting organizations. Mandatory regulations from the Occupational Safety and Health Administration (OSHA) require that surgical gowns, gloves, and other PPE prevent blood, body fluids, and other potentially infectious materials from coming in contact with employees' clothing, skin, eyes, mouth, or other mucous membranes when used under normal conditions.

   Because surgical gowns and drape products are considered surgical devices, they are regulated by the US Food and Drug Administration (FDA). Failure of these devices is subject to medical device reporting requirements, and as such, federal law requires that the failure be reported to the FDA.

7) Perioperative personnel should carefully review how manufacturers label and categorize products. Choosing appropriate protective apparel and drape products is facilitated by consistent labeling and classification systems by the manufacturers of these products. However, such standards are not yet a reality. The American National Standards Institute and the Association for the Advancement of Medical Instrumentation have published a universal classification system for companies that make protective apparel and drapes. This system is based on standardized testing that evaluates liquid barrier performance.

Barrier Performance

Barrier performance, or barrier quality, is a key factor when choosing surgical gowns, gloves, and drapes. These products must be able to minimize or prevent passage of microbes, fluids, and particulate matter between unsterile and sterile areas.[3]



Manufacturers label their surgical gowns and drapes based on the product's level of performance. This performance level is determined by the barrier properties of the part of the gown or drape where direct contact with blood, body fluids, and other potentially infectious materials is most likely to occur. AORN recommendations specify that health care professionals consider the barrier performance of the item as stated on the label, relative to the possibility of exposure to blood, body fluids, and other potentially infectious materials during an operative or other invasive procedure.[3]

Gown Size

Sterile surgical gowns must be of the correct proportions and sleeve length to fit correctly, while also permitting the wearer to move freely.[5] Surgical gloves should always cover the gown cuffs, a factor to consider when evaluating sleeve length. Gowns that are too small or short in the sleeves can restrict movement and expose the unsterile clothing or skin of scrubbed team members. This can put both patients and health care workers at risk of exposure to potentially infectious substances such as blood and body fluids.

Conversely, when gowns are too long in the sleeves, the cuff extends past the wearer's wrists and the gloves do not match up well with the lower sleeves. This creates extra fabric that can impede precise, controlled movements during procedures. To choose the correct size gown, personnel should ensure that it is large enough to wrap around the body and completely cover the back. The cuffs should fit the wrists correctly, enabling the surgical gloves to fully cover the cuffs.

USE OF STERILE TECHNIQUE WHEN GOWNING AND GLOVING

Performing the Surgical Hand Scrub and Moving to the Sterile Area

Health care personnel should perform a surgical hand scrub before setting up sterile supplies or donning sterile gowns and gloves for surgical or other invasive procedures.[3]

It is acceptable to use either an antimicrobial surgical scrub agent intended for surgical hand antisepsis, or an alcohol-based antiseptic surgical hand rub with documented persistent and cumulative antimicrobial activity that meets FDA regulations for surgical hand antisepsis.[5]

After completing the scrub, personnel should move to the OR or invasive procedure area, keeping the hands above the elbows. Inside the OR, they should use a sterile towel to dry the hands and arms, if necessary. They should stay away from the instrument table during this process to avoid accidentally contaminating its surface with water or cleaning agents. They should also ensure that the hands and arms are completely dry so that they do not drip onto the gown or another sterilized item. Surgically scrubbed hands should not touch nonsterile surfaces at any time.

Donning the Gown and Gloves

Scrubbed personnel should don gown and gloves in a sterile area, away from the main instrument table.[3] This practice helps prevent instruments and sterile surfaces from coming into accidental contact with droplets of water, antiseptic solution, or exposed skin or clothing. In one study, researchers cultured pathogenic and environmental bacteria from drops of water from 15 surgeons' arms after the surgeons performed a standard five-minute surgical hand scrub.[26] For the same reason, sterile gloves should not be opened directly atop a sterile gown.[3]

Scrubbed team members should first don the sterile gown, and then the gloves.

The outside of a surgical gown that extends from the chest down to the level of the surgical field is considered part of the sterile field.[3] This was the region associated with the lowest rate of contamination in a controlled study that evaluated surgical gowns used during 29 spinal procedures.[27] Researchers tested 50 surgical gowns used during the procedures by taking samples at six-inch intervals from the neck to the bottom of each gown. A second group of 50 sterile gowns was swabbed to provide a sterile control. The results showed that bacterial growth primarily occurred in the areas of the gowns above the chest (near the wearer's head and face) and below the operative field (outside the sterile field).

The rest of a surgical gown–including the neckline, shoulders, and axillary area–should be considered contaminated.[3] These areas of the gown rub against skin and clothing, which can decrease their barrier function. In addition, the back of the gown is considered unsterile because it is not constantly monitored.

When picking up a sterile gown to help another scrubbed team member put it on, the gowned and gloved staff member should maintain sterility by touching only the outside of the gown.[3] Likewise, the scrubbed team member who is donning the gown will keep his or her hands completely inside the gown sleeves.

The sterile glove wrapper and the gloves should not be touched until the gown is on, with the hands inside the sleeves. After gloves are donned but before anything in the sterile field is touched, the gloves should be inspected be sure they are intact. Furthermore, visual inspections of gloves should be repeated throughout their use.

Closed-assisted versus Open-assisted Gloving

There are two main methods of gloving: closed assisted, and open assisted.

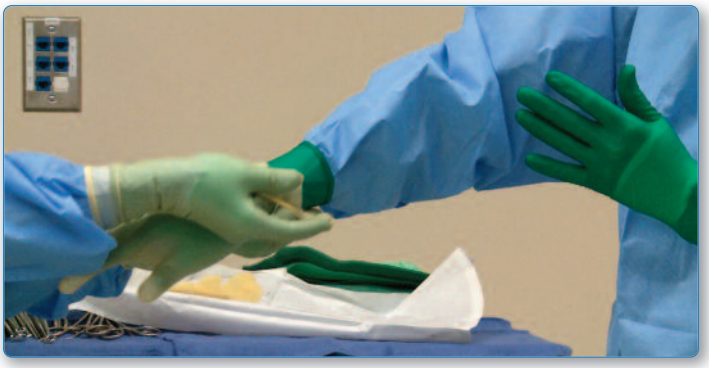
The closed assisted gloving method should be used whenever possible during initial gloving.[3] In a blinded, randomized study, researchers used fluorescent powder to assess contamination of the inside glove cuff during open and closed-assisted gloving. The results indicated that open-assisted gloving was associated with significantly higher rates of contamination of the glove cuffs than with the closed-assisted method.[28]

When performing closed-assisted gloving, the scrubbed team member who is donning the gloves keeps the cuff of the gown at or beyond the tips of the fingers.[3] Another scrubbed team member holds the glove to be donned in a sterile manner. The wearer then slides his or her hand inside the glove. The gown cuff only touches the inside of the glove, not the exterior.

In contrast, during open-assisted gloving, the gown sleeve is pulled up to wrist level, exposing the fingers and hand. This method should be used only when it is not possible or practical to perform closed-assisted gloving.

Double Gloving

Unnoticed glove perforations can result in accidental exposures of workers to infectious substances, including serious bloodborne pathogens, and can put patients at



increased risk for SSIs from exposure to exogenous microbes from scrubbed skin.[21]

To decrease these risks, scrubbed team members should wear two surgical gloves on each hand whenever there is a risk of exposure to blood, body fluids, or other potentially infectious materials during operative or other invasive procedures.[3] Wearing two pairs of gloves helps protect the inner glove and decreases the chance of skin becoming exposed.

Study data support the practice of double gloving. In one study, researchers contaminated PPE with bacteriophages (a type of virus) and then assessed the extent to which study participants transferred the virus to their face, hands, and scrubs when removing the PPE. The results showed that significantly less virus was transferred to the hands when participants practiced double gloving.[29]

Another prospective study calculated glove perforation rates among perioperative nurses randomly assigned to wear either one or two pairs of gloves while assisting during invasive procedures.[30] Using water leakage and air inflation tests, researchers then assessed the gloves for punctures. Similar perforation rates were found for gloves in the single-pair group (10 of 112 gloves, or 9%) and the double-pair group (12 of 106 gloves, or 11%), and gloves worn by both first assistants and scrub nurses also had perforations. However, none of the inner gloves were perforated in the double-pair group. It is also notable that perforation occurred as early as 20 minutes into the procedure (average, approximately 70 minutes). The researchers concluded that double gloving should be introduced as routine practice.

Perforation Indicator Systems

AORN recommendations specify that perforation indicator systems be used whenever double gloves are worn.[3] In perforation indicator systems, the inner pair of gloves is colored so that it will show through more clearly if there is a perforation in the outer layer. When a glove is perforated, moisture enters between the layers, and this makes the colored inner glove easier to see.

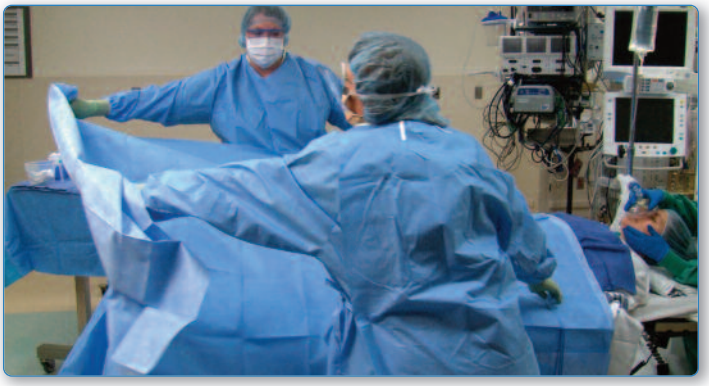
When to Change Gloves

During surgical or other invasive procedures, gloves should be changed:

- Whenever contamination or perforation is suspected, even if team members are not sure it occurred.
- After each patient procedure to prevent transmission of infection between patients.
- After touching visors and surgical helmet system hoods.
- After adjusting optic eyepieces on microscopes.
- Immediately after contact with methyl methacrylate, a chemical that can rapidly permeate latex gloves.
- If the gloves become loose on the hands as a result of absorption of fluids or fat.

Additionally, gloves should be changed every 90 to 150 minutes.[2] Studies have consistently demonstrated that numbers of glove perforations increased with the length of time they were worn.[31-34]

STERILE DRAPES



This study guide provides a basic overview of sterile draping. The topic is covered in more detail in a separate video and study guide.

The proper use of sterile surgical drapes is fundamental to establishing a sterile field. Sterile drapes function to form a barrier that helps prevent microbes from moving from unsterile to sterile areas during surgical or other invasive procedures. According to the CDC, maximal sterile drape precautions (including the use of a full-body drape) should be used whenever a central venous catheter or peripherally inserted central catheter is placed and during guidewire exchanges.[35-36]

A randomized, controlled trial found that the use of a full sterile drape plus a sterile gown, gloves, and a cap during central venous catheter insertion was associated with lower rates of catheter colonization and catheter-related bloodstream infections compared with the use of sterile gloves and a small drape only.[37]

Sterile drapes are placed on the patient, furniture, and equipment in the OR or the invasive procedure area. Drapes must be handled so as to prevent contamination, and should be moved as little as possible after they are positioned. Repositioning patients and drapes can threaten the integrity of the sterile field. Limited repositioning of the patient's head or extremities is usually acceptable when necessary, so long as it is done away from the sterile field, and with clear communication among team members.[5]

PREPARING A STERILE FIELD

The sterile field consists of the area surrounding the site of the incision or perforation into tissue, or the site of introduction of an instrument into a body orifice that has been prepared for a surgical or other invasive procedure.[3] The sterile field also includes all work areas, furniture, and equipment covered with sterile drapes and drape accessories, and all personnel who are wearing sterile attire.

Perioperative personnel are key to creating, maintaining, and monitoring the sterile field. Before preparing a sterile field, they should perform a surgical hand scrub and don a sterile gown and gloves. This helps minimize contamination by microbes present on the skin and clothing.

Placement and Timing of Sterile Field Preparation

The sterile field should be prepared where it will be used.[3] Moving the sterile field after it is created increases the risk of contamination, because air currents created by movement can lead to microbial and particle contamination. For the same reason, movement of personnel around the sterile field should be kept to a minimum.

In addition, the sterile field should be prepared as near as possible to the start time of the surgical or other invasive procedure. This helps minimize the amount of dust and other

airborne particles that settle on the field, which is important because these particles can increase contamination by bacteria and other microbes. AORN recommendations note that the potential for contamination is event-related, and that there is no specified time for preparing a sterile field relative to the time of the procedure.[3]

To prevent a variety of hazards and the risk of microbial transmission between patients, only one patient at a time should be in the OR or other procedure room. To further decrease the risk of cross-contamination of the sterile field, sterile supplies should be opened for only one patient at a time in the OR or other procedure room.

Segregation of Instruments

Sterile fields and instruments should be kept separate during procedures that involve both the abdomen and perineal area.[3] The perineum has a higher number of microorganisms than the abdomen does, and placing instruments, gloves and other items in the abdomen after they have contacted the perineal area can cause serious infections.

In addition, the peritoneum is mechanically distended during laparoscopic abdominal procedures, which can make it easier for bacteria to pass through to the bloodstream, kidneys, and lungs. This is another reason it is important to prevent cross-contamination during dual procedures.

Cross-contamination also can cause UTIs, which CDC's National Healthcare Safety Network has identified as the most common health care-acquired infection. To help prevent iatrogenic UTIs during gynecological laparoscopies, appropriate sterile technique must be used when passing transurethral instruments and catheters.

Isolation Technique for Bowel Surgery

During bowel surgery, surgical personnel should practice isolation technique, also known as bowel technique or contamination technique.[3] This practice helps prevent microorganisms in the bowel from penetrating the abdominal cavity, the surgical site, or the tissues of the abdominal wall.

During isolation technique, the following practices should be followed[3]:

- Surgical instruments or equipment that have touched the inside of the bowel are not used after the bowel has been closed.
- Contaminated items are removed from the sterile field or placed in a separate area, so that the sterile team does not touch them again.
- Clean instruments are used to close the wound.

The area of the gastrointestinal tract proximal to the distal ileum usually has low populations of bacteria. However, these regions may have higher bacterial concentrations when patients are taking antacids or proton-pump inhibitors for gastrointestinal disorders such as gastroesophageal reflux disease (GERD).[10] For patients with these disorders, isolation technique may be practiced during surgical or other invasive procedures of regions of the gastrointestinal tract proximal to the bowel.[3]

Isolation technique should be implemented from the time that the gastrointestinal tract is transected until the anastomosis is closed. AORN recommends that health care organizations create and practice standardized procedures for isolation technique to help reduce errors and improve efficiency and continuity among perioperative team members.

Either a single or dual setup can be used for isolation technique.

Single setup means preparing one setup for the procedure, including anastomosis and closure. The following steps should be followed during single setup[3]:

- Before transection of the bowel, place clean sterile towels or a wound protector around the surgical site.
- Segregate all contaminated instruments and other items that have contacted the bowel lumen to a designated area (e.g., Mayo stand, basin).
- Refrain from touching the sterile back table while the bowel is open.
- When the anastomosis is complete, remove the contaminated instruments, towel drapes, wound protector, and any other potentially contaminated items (such as the electrosurgical pencil, suction, or light handles) from the sterile field, or place them in a separate area that will not be touched by perioperative team members.
- Irrigate the wound and apply moist counted sponges or towels to protect the tissue.
- Initiate team communication announcing the change to clean closure.
- One scrubbed team member should remain at the sterile field while all other team members change into clean gowns and gloves.
- The scrubbed team member who remained at the field should remove the moist counted sponges or towels and then change into a clean gown and gloves.
- Initiate accounting procedures.

- Apply clean light handles.
- Apply clean drapes to cover the existing drapes, which may be soiled with bowel contents.
- Secure a clean electrosurgical pencil and suction to the field.
- Proceed with wound closure using only clean instrumentation and other items.

Dual setup means preparing separate setups, one for the procedure and one for the closure. The following steps should be followed when practicing dual setup[3]:

- Before transection of the bowel, place clean sterile towels or a wound protector around the surgical site.
- When the anastomosis is complete, remove the contaminated instruments, towel drapes, wound protector, and any other potentially contaminated items (e.g., electrosurgical pencil, suction, light handles) from the sterile field, or return all contaminated instruments and other items to the procedure setup that will not be touched by perioperative team members.
- Irrigate the wound, and apply moist counted sponges or towels to protect the tissue.
- Initiate team communication announcing the change to clean closure.
- One scrubbed team member should remain at the sterile field while all other team members change into clean gowns and gloves.
- The scrubbed team member who remained at the field should remove the moist counted sponges or towels and then change into a clean gown and gloves.
- Initiate accounting procedures.
- Apply clean light handles.
- Apply clean drapes to cover the existing drapes, which may be soiled with bowel contents.
- Secure a clean electrosurgical pencil and suction to the field.
- Proceed with wound closure, using only instrumentation and other items from the closure setup.

INTRODUCING ITEMS TO THE STERILE FIELD

To prevent contamination, items that are introduced into the sterile field must be opened, dispensed, and transferred using practices that:

- Protect their sterility.
- Protect the sterility of the sterile field.
- Prevent unsterile objects or unscrubbed team members from reaching or leaning over the field.

Inspection Before Opening

Before introducing any object to a sterile field, the item should be inspected to verify that it has been correctly processed and packaged and that the packaging is intact.[3] These practices help reduce the chance of inadvertent microbial contamination. The following are general steps that should be followed before introducing any item to a sterile field:

- Check for an expiration date before opening the item. If this date has passed, do not use the item.
- Check the wrappers of instrument trays for moisture and to be sure they have not torn.
- Check the chemical sterilization indicator in the package to make sure the color has changed as expected, which signifies appropriate sterilization.

Opening and Delivery Technique for Wrapped Items

Assisting team members should hand sterile items directly to a scrubbed team member or place them securely on the sterile field, so they do not slide off or push other items off the field.[3] Items should not be tossed. Tossing an item could compromise the sterile drape or cause other items to shift.

To avoid tearing or puncturing the surgical drape, heavy or sharp items should either be handed directly to a scrubbed team member or opened on a separate, clean, dry surface.

Whenever opening wrapped sterile supplies, the perioperative team member should[3]:

- First open the wrapper flap that is farthest away from his or her body.
- Then open each side flap.
- Last, open the near (or closest) flap.

This helps prevent movement of an unsterile arm over the sterile contents of the package, which could contaminate it. The edges of the wrapper are considered contaminated. They should be secured and not allowed to touch sterile areas or items.

Opening Peel Packages and Rigid Sterilization Containers

Peel pouches should be opened onto the sterile field so that the contents of the pouch do not touch the unsterile edges, and so that the team member who is opening the peel pouch does not touch the inside of the package.[3] This practice prevents contamination of the package contents.

Rigid sterilization containers should be inspected and then opened onto a flat, clean, dry surface.[3] This facilitates removal of the contents without contamination of the items or the sterile field. The external locks, latch filters, tamper-evident devices, and valves of the rigid sterilization container should be checked to make sure the seal is intact. In addition, it is important to verify that the external chemical indicator has changed to indicate that the container has been through the sterilization process.

AORN recommends following the manufacturer's instructions for opening rigid containers to help ensure that the contents remain sterile. The perioperative team member should[3]:

- Lift the lid up, away from the container and toward him or herself.
- Check the lid for integrity of the filter or valve.
- Treat the package as contaminated if the filter is moist, broken, ripped, torn, or punctured.
- Not allow contaminated packages to touch the sterile field.

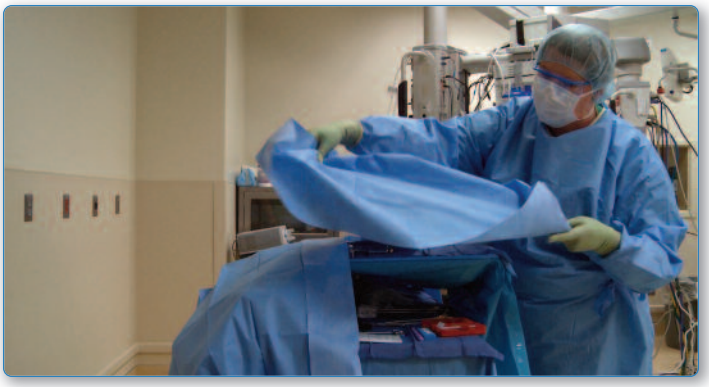
If the package passes inspection, a scrubbed team member lifts the inner basket or baskets up and out of the rigid container without touching unsterile areas. Before instruments are placed on the sterile surgical field, the inside of the rigid container should be inspected for signs of damage or contamination, and the team member should verify that the internal color change indicator has changed as expected, signifying that it has been through the sterilization process.[3]

MONITORING THE STERILE FIELD

Leaving a sterile field unattended, even for a brief time, increases the risk of undetected contamination.[3] Therefore, sterile fields must be monitored continuously from the time they are created until the surgical or other invasive procedure is completed. AORN recommendations specify that perioperative personnel **not** tape closed the doors to the OR or other procedure room as an alternative to monitoring the sterile field.

Covering a Sterile Field

If a surgical or other invasive procedure is unexpectedly delayed, or if there is increased activity around a sterile field, the field may be covered with a sterile drape to prevent airborne contamination.[3] In one study, researchers divided 45 opened, sterile trays into three groups: trays left uncovered in a locked OR, trays left uncovered in an OR with single-person traffic occurring every 10 minutes from an unsterile hallway, and trays that were immediately covered with a sterile surgical towel. The trays were cultured at time 0 and at 30, 60, 120, and 240 minutes after they were opened. The results showed that the covered trays were not contaminated, but that there



was no difference between the uncovered trays left in a locked OR and those in a room with single-person traffic.[38]

AORN recommends that health care organizations work with infection preventionists to develop procedures for covering sterile fields.[3] Those protocols should specify when a sterile field can be covered, and for how long. Perioperative personnel should cover and uncover a sterile field in such a way that no part of the drape that falls or is moved below the sterile field is then moved above the field. This practice helps prevent the creation of air currents that could carry microbes from unsterile areas into the surgical field.

Personnel should use two sterile "cuffed" drapes to cover a sterile field.[3] The first drape should be placed horizontally over the table with the cuff at, or just past, the halfway point. Then, from the opposite side of the table, the second cuffed drape should be placed so that it completely covers the cuff of the first drape. To remove the two drapes, hands should be placed inside the cuff of the first drape, and the drape should be lifted up toward the worker and away from the table. This process should be repeated for the second drape while standing at the opposite side of the table.

Recognizing and Correcting Breaks in Sterile Technique

Perioperative personnel play a crucial role in monitoring for, identifying, communicating about, and correcting breaks in sterile technique.[3] These actions help protect both patients and surgical team members by reducing or eliminating the risk of microbial contamination and possible infection if a break occurs.

Immediate steps should be taken to correct a break in sterile technique unless doing so would increase risk to the patient. In such a situation, corrective action should be taken as soon as it is safe to do so. Waiting to take corrective action makes it more difficult to fully mitigate the break and achieve complete containment.

Perioperative personnel must recognize that sterilization and high-level disinfection are only effective when items in a sterile set are free of organic material, because organic material can obstruct sterilizing agents from coming into contact with surfaces of instruments and other equipment. If blood, hair, tissue, bone fragments, grease, or other materials are found on an item in a sterile set, the entire set should be treated as contaminated.[3] If such materials enter a patient's body, they can directly cause infection or form a nidus for infection.

Corrective action should be taken by[3]:

- Removing the surgery set, and any items that the contaminated item could have touched.
- Changing gloves of any team member who may have touched the item.
- Taking additional actions as appropriate, depending on the circumstances of the procedure and what else the item came in contact with.

If a perioperative team member discovers that an instrument in a sterilized set is clamped closed or not correctly disassembled, the entire set must be regarded as contaminated.[3] This is because the clamped surfaces of the instrument may not have been adequately exposed to the sterilizing agent, and therefore cannot be assumed to be free of contamination. The set and any other instruments that it may have come in contact with should be removed from the area, and personnel who touched the contaminated item should change gloves. Additional corrective steps should be taken as indicated by facility policy.

MOVING IN AND AROUND THE STERILE FIELD

Proximity to the Sterile Field and Number of Personnel

Members of the perioperative team should move in and around a sterile field in a way that minimizes movement and air currents that could cause contamination.[3] A study of health care-worker behavior during 22 joint arthroplasty surgeries found that levels of airborne particulates and colony-forming units at surgical sites increased with the duration of the procedures and the number people in the OR.[39]

Scrubbed team members should remain close to the sterile field to minimize traffic-associated airborne contamination.[3] Instead of leaving the room when radiographs are taken, they should wear protective devices that reduce radiation exposure.

In addition, the number of people involved in a surgical or

other invasive procedure should be kept to a minimum. Furthermore, to prevent contamination of the sterile field or scrubbed persons, unscrubbed team members should stay at least 12 inches away from the sterile field and scrubbed persons at all times.[3] They should face the sterile field as they move near it and should avoid moving in between sterile fields or scrubbed persons.

Position of Hands and Arms

Scrubbed team members should keep their hands and arms above waist level and away from the axillary region. Moving the hands and arms to unsterile areas below the edge of the table and then returning them to the sterile field could cause contamination and is not an accepted practice. Hands and arms should be observed constantly to ensure that they remain sterile.[3]

Changing Levels and Positions

Scrubbed members of the surgical team also should attempt to stay at the same level, whether seated or standing, throughout the surgical or invasive procedure. They should not sit down during a procedure unless this level will be maintained throughout the procedure. Changing levels increases motion and air currents, and can bring unsterile areas of the gown into contact with sterile regions. One study, which used starch powder sprinkled on the part of the drape below the sterile field to simulate contaminants, found a 6-inch increase in the area of contamination every time a surgeon in a surgical gown stepped on and off a footstool.[40] When scrubbed team members need to change position during surgery, they should turn back to back or face to face while remaining apart from one other, the sterile field, and the unsterile areas of the room.[3]

Conversations

The act of speaking produces exhaled respiratory droplets that can carry infectious pathogens. For example, a study used human albumin particles sprayed on the face and nostrils under masks to simulate airborne pathogens.[41] The researchers found that the longer participants wearing surgical masks conversed, the more contamination occurred in a simulated surgical wound consisting of a water bath located beneath the persons speaking. Contamination was highest when more persons were present in the room, and was lowest when persons wore a complete hood that overlapped with the mask.

AORN recommends that surgical team members speak only when necessary when they are near a sterile field, to decrease contamination and possible respiratory transmission.[3] Perioperative personnel can help enforce this practice by reminding health care professionals not to engage in extraneous conversation when they are working near or at a sterile field.

EDUCATION, TRAINING, AND QUALITY ASSURANCE

Education and quality assurance activities for perioperative personnel are central aspects of implementing proper sterile technique. Both initial and ongoing education and competency testing programs on sterile technique play an important role in patient and worker safety. AORN recommends that education and competency evaluation programs focus on several topical areas, including[3]:

- General sterile technique
- Isolation technique
- Methods for correctly introducing surgical items, medications, and solutions to the sterile field
- Practices to maintain and correct breaks in the sterile field
- Minimizing the number of persons present in an OR or other procedure room
- Proper documentation of operative and other invasive procedures, including breaks in sterile technique

In addition, AORN recommends that perioperative personnel receive education and training that emphasizes the need for communication and teamwork in the perioperative environment. This recommendation highlights the need for perioperative nurses and other personnel to develop and practice strong collaborative, leadership, and planning skills.

Health care organizations should provide perioperative professionals with thorough, evidence-based education and competency evaluations for perioperative professionals on sterile technique. Such programs are part of national accreditation requirements, and AORN recommends these programs cover specialized knowledge and skills related to sterile technique as well as clinical and aesthetic knowledge, teamwork, and situational awareness.

In addition, AORN recommends that health care professionals perform quality assurance by creating written policies and procedures related to sterile technique, reviewing them regularly, testing their implementation, revising them when needed, and ensuring that these policies and procedures are easily accessible to perioperative personnel at the health care facility.

Policies and procedures help delegate responsibility and foster accountability, both among team members and throughout the health care facility. Protocols related to sterile technique are

designed to protect both patients and workers from health care-associated infections, and also can save time and resources. Studies reinforce the efficacy of these protocols. For example, one referral hospital decreased its rate of post-mastectomy SSIs by 59% after it implemented an infection control program that included continuous wound surveillance, performance feedback data to surgeons, closed anti-reflux evacuation systems, and standard wound and drainage-tube care practices.[42]

In addition, policies and procedures for providing appropriate care, treatment, and health care services are mandatory, regulatory, and accreditation requirements for hospitals and ambulatory care settings. AORN recommends that perioperative nurses participate in regular, ongoing quality assurance, monitoring, and performance activities designed to improve the practice of sterile technique.

To implement effective quality assurance programs, health care personnel must identify appropriate ways to measure performance when sterile technique is being practiced. Examples of such performance measures include double gloving, collecting data on performance and quality indicators, analyzing data, evaluating the effectiveness of current practices, and taking corrective action when necessary.

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POST-TEST

STERILE TECHNIQUE: KEY CONCEPTS AND PRACTICES

Multiple choice. Please choose the word or phrase that **best** completes the following statements.

1. Choose the INCORRECT statement. Proper sterile technique:
   a. eliminates all microorganisms in the OR
   b. is a key responsibility of perioperative personnel
   c. helps prevent health care-associated infections in patients and medical professionals
   d. includes wearing gowns, gloves, and surgical masks whose barrier performance is appropriate for the specific procedure being performed

2. Complete the following statement: The bacterium _____, which colonizes the nose and throat of asymptomatic carriers, can cause surgical site infections (SSIs) as well as severe systemic infections including myocarditis, and pneumonia.
   a. *Pseudomonas aeruginosa*
   b. *Staphylococcus epidermidis*
   c. *Staphylococcus aureus*
   d. *Clostridium dificile*

3. When entering the OR or procedure area, non-scrubbed members of the perioperative team should wear:
   a. a head covering and clean, low-linting two-piece pantsuit, one-piece coverall, or scrub dress
   b. a clean or single-use long-sleeved scrub jacket that is buttoned or snapped closed and fully covers the torso, arms, and wrists
   c. shoe coverings, if spills or splashes are likely to occur
   d. all of the above

4. Perioperative hand hygiene includes all of the following EXCEPT:
   a. removing bracelets and watches before washing hands or beginning a surgical hand scrub
   b. removing chipped nail polish before entering the perioperative area
   c. removing visible soil on the hands and arms with an alcohol-based antiseptic hand rub that meets US Food and Drug Administration (FDA) standards for antimicrobial activity
   d. using a disposable nail cleaner to clean under the nails
   e. removing rings before entering the perioperative area

5. The proper method of wearing a surgical mask is:
   a. tied closely to the face, to prevent venting of respiratory contaminants around the sides
   b. tied loosely around the face, to facilitate ease of breathing
   c. with the ties crossed around the back of the head
   d. none of the above

6. A surgical mask should be worn at all the following times EXCEPT:
   a. during lumbar puncture
   b. during insertion of a central venous catheter (CVC)
   c. when placing a peripheral venous catheter
   d. in the presence of opened packs of sterile supplies

7. A surgical mask provides adequate protection when entering the room of a patient who requires airborne precautions.
   a. true
   b. false

8. Sterile gowns and drapes are regulated as surgical devices. Federal law requires that if a gown or drape fails, the event must be reported to which US agency?
   a. Centers for Disease Control and Prevention (CDC)
   b. Agency for Health Care Research and Quality (AHRQ)
   c. National Institutes of Health (NIH)
   d. Food and Drug Administration (FDA)

9. When evaluating appropriate materials for gowns, gloves, and drapes, perioperative personnel should consider
   a. the length of the procedure and anticipated volumes of blood loss, fluid loss, and irrigation fluid used
   b. the barrier performance of the products
   c. whether electrosurgical cautery will be performed
   d. A and B

10. When performing a surgical hand scrub, it is acceptable to use an alcohol-based antiseptic solution if it exhibits persistent, cumulative antimicrobial activity that meets FDA standards.
   a. true
   b. false

11. A surgical hand scrub should be performed
   a. before donning sterile gowns and gloves for surgical and other invasive procedures
   b. whenever you need to enter the OR
   c. in the OR or invasive procedure area
   d. before opening a sterile instrument pack

12. Which areas of a surgical gown are considered sterile?
   a. the front, from the chest to six inches below the surgical field
   b. the front, from the chest to the level of the surgical field
   c. the neck and shoulders
   d. the axillary area

13. When donning a surgical gown, it is permissible to
   a. stand next to the instrument table
   b. grasp the outside back of the gown with your scrubbed hands
   c. accept help from an unscrubbed perioperative team member, so long as the helper touches only the inside of the gown
   d. don the surgical gloves first, and then the gown

14. When performing closed assisted gloving, you should pull the gown cuffs up over your wrists toward your elbows and then don the gloves.
   a. true
   b. false

15. Randomized studies show that _____ gloving is associated with increased microbial contamination of glove cuffs. For this reason, _____ gloving should be performed whenever possible when donning the initial pair of gloves.
   a. open assisted, closed assisted
   b. closed assisted, open assisted

16. Even small perforations in surgical gloves increase risk of exposure to bloodborne pathogens and potentially infectious materials. When wearing surgical gloves, it is appropriate to do all of the following EXCEPT:
   a. double glove during surgical and other invasive procedures
   b. change gloves when contamination or perforation is suspected, even if you are not sure it happened
   c. change gloves every 45 minutes during surgical and other invasive procedures
   d. use a performance indicator system in which the inner pair of gloves is colored to make perforations easier to see

17. Surgical gloves should be changed
   a. immediately after your gloves come in contact with methyl methacrylate, because it can rapidly break down latex
   b. between patients, but only if the patient is suspected to have an infection or if the gloves are visibly contaminated
   c. if they become loose on the hands from exposure to fluids or fat
   d. A and C

18. A sterile field includes which of the following?
    a. the site surrounding an incision or tissue perforation
    b. the site where an instrument has been introduced into a body orifice that has been prepared for a surgical or other invasive procedure
    c. working areas, furniture, and equipment covered with sterile drapes and drape accessories
    d. personnel in sterile attire
    e. all of the above

19. When preparing a sterile field, the first thing that team members should do is
    a. perform a surgical hand scrub
    b. don sterile gloves
    c. don a sterile gown
    d. don clean (nonsterile) gloves

20. To decrease risk of contamination, AORN recommends that a sterile field be
    a. prepared in the room adjacent to where it will be used
    b. prepared as close as possible to the start time of the procedure
    c. prepared no more than 60 minutes before the start time of the procedure
    d. covered and left for up to two hours if a procedure is unexpectedly delayed

21. While assisting during a surgery, a team member observes that an instrument in a set is clamped shut. The rest of the instruments in the set are unclamped, as expected. The chemical sterilization indicators have changed, as expected. The team member has already passed other instruments in the pack to the surgeon. To take corrective action, the team member should:
    a. unclamp the instrument
    b. use a sterile sponge or towel to pick up the clamped instrument and set it aside, then continue using the rest of the pack
    c. set the instrument and the rest of the pack aside, and discuss the event with the team when the procedure is over
    d. remove the entire set and any other instruments the set may have come in contact with; change gloves; and notify the team right away, so that additional corrective steps can be taken, if needed

22. Which of the following procedures for isolation technique, also known as bowel technique or contamination technique, is NOT recommended?
    a. when practicing single setup, segregate all instruments, towels, and other items (e.g., Mayo stand, basin) that have contacted the bowel lumen to a designated area,
    b. begin isolation technique when the gastrointestinal tract is transected, and end it when anastomosis is complete
    c. after announcing the change to clean closure, ensure that the entire scrubbed team leaves the sterile field and changes into sterile gown and gloves at the same time
    d. a health care facility should develop and follow standardized procedures for bowel isolation technique to reduce errors and improve efficiency among perioperative team members

23. When opening a sterile package, the LAST flap to be opened should be
    a. the flap to your left
    b. the flap closest to you
    c. the flap to your right
    d. the flap farthest from you

24. Which of the following activities is NOT correct when inspecting a rigid sterilization container?
    a. check external locks, latch filters, tamper-evident devices, and valves to ensure that the seal is intact
    b. place the container on the sterile field and lift the lid up and away from you
    c. inspect the lid's filter to be sure it is not moist, broken, ripped, or torn
    d. after a scrubbed team member has lifted the inner basket out of the rigid container, check the inside surface of the container for signs of damage, contamination, or debris

25. When two scrubbed team members need to change position during an operative or other invasive procedure, they should do so by passing each other
    a. back to back
    b. front to front (face to face)
    c. back to front
    d. A or B

26. Which is NOT a recommended practice for maintaining a sterile field?
    a. when scrubbed, keep hands and arms above waist level and away from the axillary region at all times
    b. when near the sterile field, speak only when necessary
    c. if the surgery or procedure is delayed, tape the door to the procedure room closed to prevent contamination from air currents
    d. minimize movements when near the sterile field, and do not move in between two sterile fields

27. When is it acceptable for a scrubbed team member move away from a sterile field?
    a. to retrieve items from a sterilizer
    b. when radiographs (x-rays) are being taken
    c. when changing into sterile gown and gloves after announcing the change to clean closure
    d. all of the above

28. Scrubbed team members should sit during an operative or other invasive procedure only if the entire procedure will be performed at that level.
    a. true
    b. false

29. To prevent contamination of the sterile field, unscrubbed team members should face the field when approaching it, should not walk between two sterile fields or scrubbed persons, and should stay at least _____ away from a sterile field and from scrubbed persons at all times.
    a. 6 inches
    b. 12 inches
    c. 18 inches
    d. 24 inches

30. To promote facility-wide best practices in sterile technique, AORN recommends that registered nurses
    a. practice collaboration, leadership, and teamwork in the perioperative environment
    b. take part in ongoing quality assurance, monitoring, and performance activities designed to improve the performance of sterile technique
    c. help establish a culture in which concerns about breaches in sterile technique are communicated immediately and appropriately
    d. all of the above

POST-TEST ANSWERS
STERILE TECHNIQUE: KEY CONCEPTS AND PRACTICES

1. *a*
2. *c*
3. *d*
4. *c*
5. *a*
6. *c*
7. *b*
8. *d*
9. *d*
10. *a*
11. *a*
12. *b*
13. *c*
14. *b*
15. *a*
16. *c*
17. *d*
18. *e*
19. *a*
20. *b*
21. *d*
22. *c*
23. *b*
24. *b*
25. *d*
26. *c*
27. *c*
28. *a*
29. *b*
30. *d*