Perioperative Standards
and Recommended Practices
For Inpatient and Ambulatory Settings
Recommended Practices for Surgical Attire

The following Recommended Practices for Surgical Attire were developed by the AORN Recommended Practices Committee and have been approved by the AORN Board of Directors. They were presented as proposed recommendations for comments by members and others. They are effective November 1, 2010. These recommended practices are intended as achievable recommendations representing what is believed to be an optimal level of practice. Policies and procedures will reflect variations in practice settings and/or clinical situations that determine the degree to which the recommended practices can be implemented. AORN recognizes the various settings in which perioperative nurses practice. These recommended practices are intended as guidelines adaptable to various practice settings. These practice settings include traditional operating rooms (ORs), ambulatory surgery centers, physicians’ offices, cardiac catheterization laboratories, endoscopy suites, radiology departments, and all other areas where surgery and other invasive procedures may be performed.

Purpose
These recommended practices provide guidelines for surgical attire including jewelry, clothing, shoes, head coverings, masks, jackets, and other accessories worn in the semirestricted and restricted areas of the surgical or invasive procedure setting. The human body and inanimate surfaces inherent to the surgical environment are major sources of microbial contamination and transmission of microbes; therefore, surgical attire and appropriate personal protective equipment (PPE) are worn to promote worker safety and a high level of cleanliness and hygiene within the perioperative environment. These recommended practices are not intended to address sterile surgical attire worn at the surgical field or all PPE.

Recommendation I

Surgical attire should be made of low-linting material, contain shed skin squames, provide comfort, and promote a professional appearance.

In a prospective interventional study of surgical attire that was motivated by an increase in endophthalmitis after cataract surgery, researchers compared several types of polyester scrub attire and cotton scrub attire. They found that surgical attire made of 100% spunbond polypropylene decreased the bacterial load in the air by 50% compared to cotton surgical attire. Researchers also found that surgical attire helps contain bacterial shedding and promotes environmental control. In another study researchers found that the design of the surgical attire was not as important as the material of which it was made.

Ia. Surgical attire fabrics should be tightly woven, stain resistant, and durable. Surgical attire should provide comfort in terms of design, fit, breathability, and the weight of the fabric.

Cotton fabrics with pores greater than 80 microns may allow microorganisms attached to skin squames to pass through the interstices of the material’s weave. Tightly woven surgical attire [cotton and polyester [50/50] with 500 x 395 threads/10 cm] reduced the amount of bacteria shed into the air by two to five times, with the exception of methicillin-resistant Staphylococcus epidermidis (MRSE) from MRSE carriers.

Ib. Surgical attire made of 100% cotton fleece should not be worn.

Some fabrics made of cotton fleece material collect and shed lint. Lint may harbor microbial-laden dust, skin squames, and respiratory droplets. In addition, fleece is made up of a napped surface with low density, which renders it more flammable.

Cotton fiber is one of the most flammable fibers, and 100% cotton fleece without fire-retardant chemical treatment does not meet the federal flammability standard. Cotton blended with 10% to 20% polyester may reduce the flammability, but this is not always successful. Application of a fire-retardant chemical still may be required.

Recommendation II

Clean surgical attire, including shoes, head covering, masks, jackets, and identification badges should be worn in the semirestricted and restricted areas of the surgical or invasive procedure setting.

Clean attire minimizes the introduction of microorganisms and lint from health care personnel to clean items and the environment.

IIa. Facility-approved, clean, and freshly laundered or disposable surgical attire should be donned daily in a designated dressing area before entry or reentry into the semirestricted and restricted areas.

Changing from street apparel into facility-approved, clean, and freshly laundered or disposable surgical attire in a designated area decreases the possibility of cross-contamination and assists with traffic control.
II.a.1. When donning surgical attire, care should be taken to avoid contact of the clean attire with the floor or other possibly contaminated surfaces.

II.a.2. When wearing a two-piece scrub suit, the top of the scrub suit should be secured at the waist, tucked into the pants, or fit close to the body to prevent skin squames from being dispersed into the environment. Loose scrub tops may allow skin squames to disperse into the environment from the axilla and chest. The major source of bacteria dispersed into the air comes from health care providers’ skin. When skin squames come off the body surface, they carry any microorganism that is found on the surface of the individual’s skin. Every individual loses a complete layer of skin every four days (about 10^7 skin squames every day). With just the movement of walking, this may cause a loss of 10^10 squames per minute.

II.a.3. Health care personnel should change into street clothes whenever they leave the health care facility or when traveling between buildings located on separate campuses.

Surgical attire may become contaminated by direct or indirect contact with the external environment.

II.b. Jewelry including earrings, necklaces, watches, and bracelets that cannot be contained or confined within the surgical attire should not be worn. Jewelry that cannot be confined within the surgical attire should be removed before entry into the semirestricted and restricted areas. Necklaces on the skin may contaminate the front of the sterile gown if they are not confined within the surgical attire.

Wearing finger rings, nose rings, and ear piercings increases bacterial counts on skin surfaces both when the jewelry is in place and after removal. One study showed that earrings had bacterial counts more than 21 times higher beneath the earrings than on the surface of the earrings. Bacterial counts were nine times greater on the skin beneath finger and nose rings than on the rings themselves. The removal of watches and bracelets allows for more thorough hand washing.

II.b.1. Rings should be removed before hand washing or using hand rubs. Several studies have shown that wearing rings may result in colonization of health care providers’ hands with gram-negative and gram-positive pathogens. Finger rings have been found to increase skin surface bacterial counts. Although hand washing reduces these counts, there are more bacteria under rings than on the adjacent skin or the opposite hand. The pathogens identified in one study were coagulase-negative staphylococci, other skin flora, gram-negative cocci, Pseudomonas spp., and Staphylococcus aureus.

Removing rings before hand washing may decrease the potential for pathogens to remain on hands after hand washing. Removing rings before hand hygiene may enhance the effectiveness of the hand hygiene process.

II.c. Persons entering the semirestricted or restricted areas of the surgical suite for a brief time for a specific purpose (e.g., law enforcement officers, parents, biomedical engineers) should cover all head and facial hair and should don either freshly laundered surgical attire; single-use attire; or a single-use jumpsuit (e.g., coveralls, bunny suit) designed to completely cover outside apparel.

Clean and freshly laundered surgical attire, single-use attire, or single-use jumpsuits donned before entry into the semirestricted and restricted areas may minimize the potential for contamination of the environment and cross-contamination of the attire (e.g., animal hair, cross-contamination from other uncontrolled environments, spores in soil).

II.d. Shoes worn within the perioperative environment should be clean.

Soiled shoes have been found to contribute to environmental contamination within the perioperative environment. A study of shoes worn outdoors and shoes worn only in the surgical suite showed 98% of the outdoor shoes were contaminated with coagulase-negative staphylococci, coliform, and bacillus species compared to 56% of the shoes worn only in the surgical suite. Bacteria on the perioperative floor may contribute up to 15% of colony-forming units (CFUs), which are dispersed into the air by walking. Shoes that are worn only in the perioperative area may help to reduce contamination of the perioperative environment.

II.d.1. Shoes worn within the perioperative environment should have closed toes and backs, low heels, non-skid soles, and must meet Occupational Safety & Health Administration (OSHA) and the health care organization’s safety requirements.

Shoes that enclose the foot with backs, low heels, and non-skid soles may reduce the risk of injury from slips and falls and from dropped items. The OSHA regulations require the use of protective footwear in areas where there is a danger of foot injuries.
from falling or rolling objects or objects piercing the sole. The employer is responsible for determining if foot injury hazards exist and what, if any, protective footwear is required. The OSHA regulations mandate that employers perform a workplace hazard risk assessment and ensure that employees wear protective footwear to provide protection from identified potential hazards (eg, needlesticks, scalpel cuts, splashing from blood or other possibly infectious materials).

Shoes that have holes or perforations may not protect the feet from exposure to blood, body fluids, or other liquids that may contain potentially infectious agents. Shoes made of cloth, that are open-toed, or that have holes on the top or sides do not offer protection against spilled liquids or sharp items that may be dropped or kicked. In one study, 15 different types of shoes were tested with an apparatus that measured resistance to penetration by scalpels. The materials of the shoes included leather, suede, rubber, and canvas. Sixty percent of the shoes sustained scalpel penetration through the shoe into a simulated foot. Only six materials prevented complete penetration. These materials included sneaker suede, suede with inner mesh lining, leather with inner canvas lining, non-pliable leather, rubber with inner leather lining, and rubber.

II.e. Identification badges should be worn by all personnel authorized to enter the perioperative setting. Health care personnel as well as patients should be able to identify caregivers. Identification badges assist in identifying persons authorized to be in the perioperative setting and support security measures.

II.e.1. Identification badges should be secured on the surgical attire top, be visible, and be cleaned if they become soiled. Badge holders such as lanyards, chains, or beads pose a risk for contamination and may be very difficult to clean. One study of identification badges and lanyards showed that the median bacterial load isolated was 10-fold greater for lanyards (3.1 CFU/cm²) than for identification badges (0.3 CFU/cm²). The microorganisms recovered from lanyards and identification badges were methicillin-sensitive Staphylococcus aureus (MSSA), methicillin-resistant Staphylococcus aureus (MRSA), Enterococcus spp, and enterobacteriaceae. As with other personal attire, such as stethoscopes, identification badges become contaminated over time.

II.f. The use of cover apparel (eg, lab coat, cover gown) may be determined at each individual practice setting based on state regulatory requirements and the culture of the health care organization.

Wearing cover apparel over surgical attire outside of the perioperative suite may be required for some health care personnel in some health care organizations for a variety of reasons, which may include professional appearance. This may be based on the belief that cover apparel decreases the risk of infection. The use of cover apparel has been found to have little or no effect on reducing contamination of surgical attire.

II.f.1. Cover apparel should be laundered daily in a health care-approved or -accredited laundry facility. (See Recommendation V.)

Health care personnel may carry staphylococci and enterococci on their clothing, which may include surgical attire and cover apparel. Studies of cover apparel have shown that rather than protecting the clothing underneath the cover gown, cover apparel may contaminate the clothes worn under the cover apparel. Researchers have found that cover apparel is not always discarded daily after use or laundered on a frequent basis.

In one study of cover coats worn by 100 physicians, Staphylococcus aureus was isolated from 25 of the cover coats. The cuffs and pockets of the coats were the most contaminated.

In another study of 100 medical students, microorganisms were found on the cuffs and side pockets of the students' cover apparel. Contamination was found on their dominant hand sleeve cuffs and the backs of the cover apparel 10 cm down from the collar. These areas were contaminated with Staphylococcus sp on all cover apparel, Acinetobacter sp on seven students' cover apparel, and diphtheroids on 12 students' cover apparel.

In a study of health care practitioners' cover apparel, researchers found that cover apparel in inpatient and outpatient areas, intensive care units, administration areas, and the OR was contaminated with Staphylococcus aureus, which included susceptible and resistant isolates. Health care personnel with colonization were more likely to have home-laundered their cover apparel. Two-thirds of the health care practitioners perceived their cover apparel to be dirty because it had not been washed in more than a week.

II.g. Stethoscopes should be clean and not worn around the neck.

Inanimate objects, such as contaminated stethoscope tubing and diaphragms, may transmit pathogens such as MRSA by indirect contact (eg, by wearing the stethoscope around the
neck and contaminating the skin and surgical attire. Cleaning stethoscopes in combination with health care personnel washing their hands between caring for patients decreases the possibility of transmission of pathogens to patients and environmental surfaces.

Stethoscopes may be the most widely used medical device in a health care facility. Although stethoscopes are not considered part of the surgical attire, health care providers often wear them around their necks as though they were part of surgical attire. Stethoscopes come in direct contact with patients’ skin and could provide an opportunity for transmission of microbes from patient to patient, to health care personnel, or from health care personnel to patients. One study verified that stethoscopes could be a vector for transmission to patients. Another study conducted on stethoscope diaphragms noted that, when cultured before cleaning,

- 79.6% of the cultures grew gram-positive bacilli,
- 74.8% had Staphylococcus species non-aureus,
- 2.5% of baseline cultures showed MSSA, and
- group A streptococcus was found in 1% of cultures.

A study showed recontamination of stethoscopes can occur by the fifth time the stethoscope is used on different patients. The number of bacteria on a stethoscope increases with each use. Cleaning the stethoscope daily may not be adequate; cleaning stethoscopes may be required between each patient use. Several studies on contamination of stethoscope diaphragms and earpieces have been conducted and show that 66% to 100% of the diaphragms are contaminated. One study noted that to avoid increasing emergent strains, routine cleaning of stethoscopes may help reduce bacterial colony counts.

II.g.1. Fabric stethoscope tubing covers should not be used.

Adding fabric covers to stethoscope tubing may result in the covers acting as fomites. One study of stethoscope fabric covers isolated gram-positive aerobic bacteria, gram-negative aerobic bacteria, anaerobes, and yeast. The average length of time between stethoscope cover laundering was 3.7 months, with some fabric covers that were never laundered.

II.h. Fanny packs, backpacks, and briefcases should not be taken into the semirestricted or restricted areas of the perioperative suite.

Items brought into the OR, such as fanny packs, backpacks, briefcases, and other personal items that are constructed of porous materials, may be difficult to clean or disinfect adequately and may harbor pathogens, dust, and bacteria. Pathogens have been shown to survive on fabrics and plastics. Dust is made up of skin particles, hair, fabric fibers, pollen, mold, fungi, insect parts, glove powder, and paper fibers, among other things. Bacteria may be transported from one location to another by carriers such as dust or liquids, and may contaminate fanny packs, backpacks, and briefcases.

The type of environmental surface and its ability to support microbial growth will influence microbial carriage. Gram-positive cocci (eg, coagulase-negative staphylococci) may persist in dry settings. Settings that are moist and soiled may support gram-negative bacilli (eg, floors). Fungi favors moist, fibrous material and are also found in dust.

**Recommendation III**

All individuals who enter the semirestricted and restricted areas should wear freshly laundered surgical attire that is laundered at a health care-accredited laundry facility or disposable surgical attire provided by the facility and intended for use within the perioperative setting.

Surgical attire helps contain bacterial shedding and promotes environmental cleanliness. An individual sheds millions of skin squames daily. Five percent to 10% of skin squames carry bacteria. In a study on dispersal of MRSE, carriers of MRSE were seen as possible sources of air contamination in ORs.

III.a. Surgical attire should be changed daily or at the end of the shift.

It has been reported that surgical attire may have bacterial colony counts that are higher when scrub clothing is removed, stored in a locker, and used again. Microbes have been shown to survive for long periods of time on fabrics such as surgical attire.

III.a.1. Reusable or single-use contaminated attire should be placed in appropriately designated containers after use. Worn reusable surgical attire should be left at the health care facility for laundering.

III.a.2. Surgical attire that has been penetrated by blood or other potentially infectious materials should be removed immediately or as soon as possible and replaced with freshly laundered, clean surgical attire. When extensive contamination of the body occurs, a shower or bath should be taken before donning fresh attire.

Changing contaminated, soiled, or wet attire reduces the potential for contamination and protects personnel from prolonged exposure to potentially harmful bacteria.

III.a.3. Wet or contaminated surgical attire should not be rinsed or sorted in the location of use.
Human hair can be a site of pathogenic bacteria such as MRSA. Routine shampooing of hair with neutral detergents does not remove MRSA or have a bactericidal effect.60

IV.a. A clean, low-lint surgical head cover or hood that confines all hair and covers scalp skin should be worn. The head cover or hood should be designed to minimize microbial dispersal.

Hair acts as a filter when it is uncovered and collects bacteria in proportion to its length, waviness, and oiliness. Studies have shown that Staphylococcus aureus and Staphylococcus epidermidis have a tendency to colonize hair, skin, and the nasopharynx.62 Head coverings designed to contain hair and scalp skin will minimize microbial dispersal.63 Skull caps may fail to contain the sides of hair above and in front of the ears and hair at the nape of the neck.

IV.a.1. Used single-use head coverings should be removed and discarded in a designated receptacle daily or when contaminated.

Placing contaminated head coverings in a designated receptacle assists in maintaining a clean and orderly area and decreases the possibility of cross-contamination.

IV.a.2. Reusable head coverings should be laundered in a health care-accredited laundry facility after each daily use.66 (See Recommendation V.)

Recommendation V

Surgical attire should be laundered in a health care-accredited laundry facility.

Surgical attire; street clothing; PPE; and other hospital textiles (eg, bed linens, towels, privacy curtains, washcloths) may become contaminated by bacteria and fungi during wear or use. In one study, researchers found that microbes can survive on hospital textiles for extended periods of time. These textiles included

- 100% cotton clothing;
- 60% cotton and 40% polyester blend (eg, scrub suits, lab coats);
- 100% polyester clothing; and
- polyethylene plastic aprons.

Researchers inoculated these textiles with staphylococci under laboratory conditions. The textiles were allowed to remain in ambient air without any laundering for various periods of time. Results showed that the staphylococci survived one to 56 days on polyester and up to 90 days on polyethylene plastic. The longer the microbial inoculum of staphylococci on polyester and polyethylene, the longer the staphylococci survived. Even if only a few hundred staphylococci survived, they were viable for days on most textiles. The shortest time for enterococci survival on textiles was 11 days.69

Researchers in another study tested fungal survival under laboratory conditions on

- 100% cotton clothing;
60% cotton and 40% polyester blend (eg, scrub suits, lab coats, clothes);  
100% polyester clothing; and  
polyethylene plastic aprons.

The microorganisms used as the inoculum were Candida albicans, Candida tropicalis, Candida krusei, Candida parapsilosis, Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Aspergillus terreus, Fusarium sp, Mucor sp, and Paecilomyces sp. These pathogens were isolated in the researchers’ health care facility. The data collected showed that candida, aspergillus, mucor, and fusarium, which are known to be health care-associated infectious agents, survived on fabrics and plastics for at least one day and often for weeks. The survival of these microorganisms on these textiles and plastics shows that they may serve as reservoirs or vectors for fungi. Another study showed that Staphylococcus aureus and Pseudomonas aeruginosa bind to polyester and acrylic fibers.

Health care-accredited laundry facilities are preferred because they follow industry standards. The Healthcare Laundry Accreditation Council (HLAC) offers voluntary accreditation for those laundry facilities that process reusable health care textiles and which incorporate OSHA and the Centers for Disease Control and Prevention (CDC) guidelines and professional association recommended practices. The HLAC standards for accreditation include, but are not limited to,

- Textile quality control procedures are defined and implemented.
- The inventory system is adequate to ensure supply.
- Soiled and contaminated textile areas are separated by a physical barrier.
- The ventilation is controlled with negative pressure in the soiled area, positive pressure from the clean textile area through the soiled textile area, 6 to 10 air exchanges per hour, and air vented to the outside.
- Clean textiles are stored in an area free of vermin, dust, and lint at room temperatures of 68°F to 78°F (20°C to 25.5°C).
- Storage shelves are 1 inch to 2 inches from the wall, the bottom shelf is 6 inches to 8 inches from the floor, and the top shelf is 12 inches to 18 inches below the ceiling.
- Hand washing facilities are located in all areas with soiled textiles; hand washing or antiseptic dispensers are in the clean textile area; and employees perform hand washing after glove removal and restroom use, before eating, and when hands are contaminated with blood or other potentially infectious materials.
- Working surfaces are clean and are disinfected if they become contaminated with blood or other potentially infectious materials.
- The OSHA Exposure Control Plan is in place and PPE is supplied and available.
- Personnel training is provided and documented.
- Quality control monitoring and processes are in place.

Material Safety Data Sheets are available for each chemical used.
- Water quality is tested on a regular basis for hardness, alkalinity, iron content, and pH.
- Soiled health care textiles are handled, collected, and transported according to local, state, and federal regulations.
- Each wash load is monitored and applicable data for each wash are recorded, including cycle, presoak, wash, rinse, and final rinse times; water levels and usage; temperatures; and chemical usage.
- Water extraction and drying are performed using methods that preserve the integrity of the textiles and minimize bacterial growth.
- Cleaned textiles are packaged and stored in fluid-resistant bundles or fluid-resistant carts or hampers and are handled as little as possible.
- Carts used for transport or storage are kept clean and are well maintained.
- Clean textiles are stored and transported separately from soiled textiles.
- Vehicles used to transport textiles provide separation of clean and soiled textiles, and the vehicle interiors are cleaned on a regular basis.

Routine monitoring of laundry processes, including cleaning of work areas, equipment, and good hand hygiene practices, is important to minimize cross-contamination of clean textiles. An accredited health care facility laundering process includes monitoring correct measurement of chemicals, sufficient water, correct temperature, mechanical action, and the duration of the washing cycle. Cleaning and disinfecting the work area includes, but is not limited to, the washers, extractors, dryers, and conveyor belts. The presence of skin bacteria on processed textiles and environmental surfaces in one study directed attention to hand hygiene of the laundry facility workers, air contamination, inadequate separation of soiled and clean work areas, and the cleaning and disinfecting of all of the equipment and work surfaces. Water can be a source of bacterial transmission, which makes thorough drying of textiles vital. Staphylococci, Salmonella, and Mycobacterium are fairly resistant to heat and may survive drying.

Home laundering is not monitored for quality, consistency, or safety. Exposure of health care personnel and their family members to blood and other potentially infectious materials may result from improper handling and decontamination of surgical attire. Home washers may have a lower temperature (ie, < 160°F [71.1°C]) or washing parameters and temperatures may not be adjustable. Home washers may have limited capacity for chemical additives and may not have directions for using alkalies and acids.

Home laundering may not meet the specified measures necessary to achieve a reduction in microbial levels in soiled surgical attire. These measures involve mechanical, thermal, and chemical components, including
- diluting and agitating the water to remove microorganisms and bioburden;
- selecting suitable chemicals, if low-temperature cycles (<160°F [<71.1°C]) are used;
- using proper chemical concentrations if low-temperature cycles are used;
- using water temperatures >160°F (>71.1°C) for more than 25 minutes for hot-water cycles;
- using chlorine bleach, which gives added microbial benefit; and
- adding chemicals known as "soil" to the water to neutralize alkalinity in the water, soap, or detergent.

These measures cause a shift in pH from 12 to 5, inactivating some microorganisms. Low temperatures (i.e., <160°F [<71.1°C]) may be used so long as the drying temperatures and ironing temperatures provide the additional microbial benefits to ensure surgical attire is clean.51

A study on bacterial contamination of home-laundred uniforms began by culturing uniforms worn at the beginning of the shift. Thirty-nine percent of the uniforms identified as "clean" had one or more microorganisms (e.g., vancomycin-resistant enterococci, MRSA, Clostridium difficile) identified. Uniforms were tested again at the end of the shift and 54% had one or more microorganisms; some that were positive at the beginning of the shift were negative at the end of the shift. In one demonstration, bacillus spores were transferred from health care providers' aprons and cotton uniforms to a mock patient.68

A study of home-laundred uniforms involved taking surveillance cultures from five patients. Results showed that three of the patients were colonized with the same strain of microorganism as that cultured from the health care providers' uniforms. With uniforms contaminated with microorganisms at the beginning of a shift, the researchers suggested that inappropriate laundering practices may be the cause.69

**Home laundering has been shown to be less effective for cleaning surgical attire than laundering by health care facilities or commercial laundries.**72

A quantitative study was performed in 20 different geographical areas.73 Eight laundering methods were studied:
- reusable clean scrubs laundered at the facility in which they were used;
- reusable worn scrubs laundered at the facility in which they were used;
- reusable clean scrubs that were home laundered;
- reusable worn scrubs that were home laundered;
- reusable clean scrubs laundered by an outside laundry facility;
- reusable worn scrubs laundered by an outside laundry facility;
- packaged, clean, single-use, non-woven scrubs; and
- packaged, worn, single-use, non-woven scrubs.

Results of the study showed that the bioburden on home-laundred surgical attire was significantly greater than on surgical attire that was facility-laundred; laundered by a third-party; or single-use, disposable. Home-laundred clean scrub at the beginning of the day had the same amount of organisms as did worn scrubs at the end of the work day.70

A quantitative study was performed on cotton strips of fabric that were inoculated with 10 mL of a viral suspension to discover if enteric viruses (i.e., adenovirus, rotavirus, hepatitis A virus) survived a home-laundring process. The inoculated fabric strips were washed, rinsed, and dried on a 28-minute permanent press cycle in home washers. It was found that enteric viruses remained on the fabric strips after they were washed.71

V.a. Laundered surgical attire should be protected during transport to the practice setting to prevent contamination.3,5,
- Proper transfer and storage of surgical attire protects surgical attire from contamination by:
  - preventing any physical damage to laundry,
  - minimizing microbial contamination from environmental surfaces, and
  - preventing any deposits from airborne sources such as dust to settle on laundry.5,53

V.a.1. Surgical attire should be transported in a clean vehicle and enclosed carts or containers.5,53
- Laundry vehicles can be a source of contamination. Cleaning and disinfection on a regular basis are required.

V.b. Clean surgical attire should be stored in a clean, enclosed cart or cabinet.5,53
- Storing clean surgical attire in a locker with personal items from outside of the hospital may contaminate the clean surgical attire. Enteric viruses have been detected in lockers where contaminated attire can act as reservoirs for viral transmission.12,22

V.b.1. Surgical attire may be stored in a dispensing machine. Dispensing machines should be routinely emptied and cleaned according to the manufacturer's directions.
- Attire-dispensing machines may be used to increase individual accountability, promote cost containment, facilitate an adequate supply, and provide clean storage for surgical attire.3,24

**Recommendation VI**

All individuals entering the restricted areas should wear a surgical mask when open sterile supplies and equipment are present.

A surgical mask protects both the surgical team and the patient from transfer of microorganisms.14 The surgical mask protects health care providers from droplets greater than 5 micrometers in size. Examples of diseases that produce droplets include group A streptococcus, adenovirus, and Neisseria meningitides.25 A single surgical mask is worn to protect the health care provider from contact with infectious material from the patient (e.g., respiratory secretions, sprays of blood or body fluids) and to protect the patient from exposure to
infectious agents carried in the provider's mouth or nose. Surgical masks protect surgical team members' noses and mouths from inadvertent splashes or splatters of blood and other body fluids. A study involving 8,500 surgical procedures showed that 26% of exposures to blood were to the heads and necks of scrubbed personnel, and that 17% of blood exposures were to circulating personnel outside the sterile field.

VI.a. The mask should cover the mouth and nose and be secured in a manner to prevent venting. A mask that is securely tied at the back of the head and behind the neck decreases the risk of health care personnel transmitting nasopharyngeal and respiratory microorganisms to patients or the sterile field. Infectious particles can reach the wearer's nose and mouth by passing through leaks at the mask-face seal.

VI.b. A fresh, clean surgical mask should be worn for every procedure. The mask should be replaced and discarded whenever it becomes wet or soiled.

The filtering capacity of a mask is compromised when it becomes wet. In a study to determine microbial barrier effecting surgical masks with 95% bacterial filtration at one-, two-, three-, and four-hour intervals showed that after four hours, the masks had decreased efficacy. Avoiding unnecessary speaking and keeping in mind the patient's possible immunological status are important. This research study showed that all counts of CFUs were lower than $4 \times 10^6$, which could cause an SSI in patients with poor immunity, those with surgical wound complications (e.g., ischemia, hematoma), or those undergoing surgery with an implant.

VI.b.1. Masks should not be worn hanging down from the neck.

The filter portion of a surgical mask harbors bacteria collected from the nasopharyngeal airway. The contaminated mask may cross-contaminate the surgical attire top.

VI.c. Surgical masks should be discarded after each procedure. Masks should be removed carefully by handling only the mask ties. Hand hygiene should be performed after removal of masks.

Removing masks by the ties prevents possible contamination of the hands. The filter portion of the mask harbors bacteria collected from the nasopharyngeal airway.

VI.d. Only one surgical mask should be worn at a time.

Masks are intended to contain and filter droplets of microorganisms expelled from the mouth and nasopharynx during talking, sneezing, and coughing. Use of a double mask creates an impediment to breathing and does not increase filtration; therefore, this is not recommended.

Recommendation VII

Health care personnel should receive initial and ongoing education and demonstrate competency on appropriate surgical attire.

Competency assessment verifies that health care personnel have an understanding of the articles and purpose of surgical attire. This knowledge is essential for reducing the risk of health care-associated infections.

VII.a. Health care personnel should receive education and guidance on appropriate articles of surgical attire worn in the perioperative environment at orientation and after changes are made. Health care personnel should be informed of and be compliant with the health care organization's surgical attire policy, including laundering policies.

Ongoing education of perioperative personnel facilitates the development of knowledge, skills, and attitudes that affect patient and worker safety.

VII.a.1. Health care personnel should understand the risk of becoming colonized or infected with microorganisms from patients or the environment when surgical attire is cleaned improperly.

Recommendation VIII

Policies and procedures for surgical attire should be developed, reviewed periodically, and be readily available within the practice setting.

Policies and procedures serve as operational guidelines and establish authority, responsibility, and accountability within the organization. Policies and procedures also assist in the development of patient safety, quality assessment, and improvement activities.

VIII.a. Surgical attire policies and procedures should include, but not be limited to, requirements related to

- facility-approved and standardized surgical attire,
- areas where surgical attire is worn,
- infection prevention and control,
- use of PPE,
- laundering,
- transport and storage of clean attire, and
- compliance monitoring.

An understanding of surgical attire policies and procedures assists health care personnel in protecting the patient, themselves, and their family members.

VIII.b. Policies and procedures should be introduced and reviewed in the initial orientation, when new surgical attire is introduced, and during ongoing education of health care personnel.

Review of policies and procedures assists health care personnel in being knowledgeable
about and compliant with the health care organization’s policies and procedures.

**Recommendation IX**

The health care organization’s quality management program should evaluate compliance with surgical attire policies and identify and respond to opportunities for improvement.

Quality management programs that enhance personal performance and monitor surgical attire practices are established to promote patient and health care personnel safety. Health care laundry processing requires specialized equipment, adequate space, qualified personnel with ongoing training, and continuous monitoring for quality assurance.

**IX.a.** Structure, process, and performance measures should be identified.

Structure, process, and performance measures can be used to improve surgical attire quality and monitor compliance with facility policies and procedures, national standards, and regulatory requirements.

**IX.a.1.** Quality indicators for surgical attire may include, but are not limited to,

- head coverings completely cover the hair and scalp;
- warm-up jackets with wrist-length sleeves are worn and are snapped;
- identification badges are worn, visible, and clean;
- shoes are clean and protect health care personnel’s feet;
- visibly soiled or wet surgical attire is removed and cleaned at an accredited health care laundry facility;
- masks, when worn, are tied securely and are discarded after each procedure; and
- cover apparel, if worn, is laundered daily at the organization or an accredited laundry facility.

**IX.b.** Quality assurance monitoring of laundry processes should be ongoing.

A study of the risk of *Clostridium difficile* cross-contamination in the laundry process illustrates that cross-contamination occurs with the use of nonsporicidal disinfectants, but that the use of sporicidal disinfectant cloths showed significantly reduced CFUs. The researcher concluded that cleaning *Clostridium difficile*-contaminated surfaces with nonsporicidal disinfectants creates a vector for cross-contamination to other textiles via the laundering process. Cleaning contaminated surfaces with sporicidal disinfectant may not completely eliminate this vector, but does significantly reduce associated risk.

A rare outbreak of zygomycosis in a hospital was investigated by the CDC using standard outbreak protocols. Zygomycosis is an invasive fungal infection caused by mucormycetes, which includes a Rhizopus species (ie, a group of molds that is commonly found in the environment). Infections with this microorganism are rare and usually occur in people who have underlying medical conditions. A cluster of six cases occurred from August 2008 to July 2009. Of the six cases, five patients died (ie, premature children up to age 13). All five children had risk factors for zygomycosis, which included acidosis (ie, four children) and bone marrow transplant (ie, one child). Hospital linens were the only items common to these cases. Environmental cultures taken at the hospital revealed Rhizopus species on 26 out of 65 swabs (40%) of clean linens and areas in contact with clean linens, and on 1 out of 25 samples (4%) of items not in contact with linens. Clean linen closets were cultured, including those in the OR, where two items were found to be Rhizopus-positive. Researchers determined the hospital linens to be the most likely vehicle of transmission to patients’ skin. Contamination of linens may have occurred during laundering, on route to the hospital, or during delivery to the hospital. The hospital changed commercial laundry facilities, replaced all of its linens, disinfected all linen storage closets, and used a different delivery area for its linens in an effort to prevent reoccurrence of this type of outbreak.

**Glossary**

Restricted area: Includes the OR and procedure room, the clean core, and scrub sink areas. People in this area are required to wear full surgical attire and cover all head and facial hair, including sideburns, beards, and necklines.

Semirestricted area: Includes the peripheral support areas of the surgical suite and has storage areas for sterile and clean supplies, work areas for storage and processing instruments, and corridors leading to the restricted areas of the surgical suite.

Surgical attire: Nonsterile apparel designated for the OR practice setting that includes two-piece pantsuits, cover jackets, head coverings, shoes, masks, protective eyewear, and other protective barriers.

**References**


34. Hospital Accreditation Standards. Oakbrook Terrace, IL: The Joint Commission; 2008:47-68.


79. Carbone HL, Hellickson LA, Thomasser AL, Vu LK. Clostridium difficile cross contamination in the textile
laundering process: the importance of selecting an appropriate hard surface disinfectant. Paper presented at: International Conference on Healthcare-Associated Infections; March 19, 2010; Atlanta, GA.


Acknowledgments

LEAD AUTHORS
Joan Blanchard, MSS, BSN, RN, CNOR, CIC
Perioperative Nursing Specialist
AORN Center for Nursing Practice
Denver, Colorado

Melanie Braswell, DNP, MS, RN, CNS, CNOR
Full-Time Faculty School of Nursing
Purdue University
Lafayette, Indiana

CONTRIBUTING AUTHORS
George Allen, PhD, MS, RN, CNOR
Director of Infection Control
Downstate Medical Center
Brooklyn, New York

Nancy Bjerke, MPH, RN, CIC
Consultant
Association for Professionals in Infection Control and
Epidemiology, Inc (APIC)
San Antonio, Texas

Sorin Brull, MD
American Society of Anesthesiology
Professor of Anesthesiology
Mayo Clinic College of Medicine
Rochester, Minnesota

Publication History
Originally published March 1975, AORN Journal, as AORN “Standards for proper OR wearing apparel.”
Reformatted July 2000.
Revised October 2010 for online publication in Perioperative Standards and Recommended Practices.