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AORN eGuidelines+

Guidelines for Perioperative Practice: Surgical Attire

The Guideline for Surgical Attire was approved by the AORN Guidelines Advisory Board and became effective as of February 22, 2024. Information about the systematic review supporting this guideline, including the PROSPERO registration number, systematic review questions, description of the search strategy and evidence review, PRISMA 2020 flow diagram, evidence rating model, and evidence summary table is available at https://www.aorn.org/evidencetables/.

Purpose

This document provides guidance to perioperative team members for wearing **surgical attire** (ie, long sleeves, cover apparel, head coverings, shoes) in semi-restricted and restricted areas; laundering **scrub apparel**; cleaning identification badges, stethoscopes, and personal items such as backpacks, briefcases, cell phones, and electronic tablets; and determining attire for visitors to the perioperative area.

Surgical attire and personal protective equipment (PPE) are worn to provide a high level of cleanliness and hygiene in the perioperative environment and to promote patient and worker safety. Reducing the patient's exposure to microorganisms that are shed from the skin and hair of perioperative personnel may reduce the patient's risk for surgical site infection (SSI).

Personal items, such as electronic devices, cell phones, stethoscopes, and briefcases, brought into the semi-restricted and restricted areas can harbor potentially pathogenic bacteria, and frequent contact of these items with provider's hands can facilitate transfer of bacteria.

This document does not address patient clothing or linens used in health care facilities. The use of masks and other PPE are outside the scope of this document; the reader should refer to the AORN Guideline for Sterile Technique[1] and the AORN Guideline for Transmission-Based Precautions[2] for additional information. The wearing of rings, bracelets, watches, nail polish, artificial nails, or other nail enhancements is outside the scope of this document; the reader should refer to the AORN Guideline for Hand Hygiene[3] for additional information.

Recommendations

1.

Laundering

1.1

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Wear clean surgical attire when entering the semi-restricted and restricted areas. ***[Recommendation]***

Wearing clean surgical attire in the semi-restricted and restricted areas can reduce the risk of introducing pathogens to the environment and subsequent patient exposure to microorganisms that could contribute to an SSI.

Researchers who conducted two nonexperimental studies found that all personally owned uniforms, including those that were military issued, worn to work by 126 medical-surgical[4] and 53 emergency room[5] health care personnel were contaminated with bacteria at the start of the shift. Additionally, higher bacterial counts were present on uniforms that were previously worn. When compared to hospital-provided scrubs that were donned at the start of a shift, the number of bacteria found on the waist, sleeve cuff, abdomen, and back were significantly higher in personally owned uniforms. The researchers suggested that organizations consider expanding hospital uniform policies to include on-site uniform changes or, at a minimum, daily laundering.

The AORN Guideline for Design and Maintenance of the Surgical Suite provides additional information on designation of semi-restricted and restricted areas, including attire worn in these areas.[6]

1.2

After each daily use, scrub apparel should be laundered at

- a **health care–accredited laundry facility**,
- the health care organization according to state regulatory requirements, or
- the health care organization according to Centers for Disease Control and Prevention recommendations for laundering[7] in the absence of state requirements.

[Recommendation]

Wearing scrub apparel that is laundered at a health care–accredited laundry facility or at the health care organization in accordance with state regulatory requirements provides control of the laundering process and helps ensure that effective laundering standards have been met.

Home laundering is not monitored for quality, consistency, or safety. Home washing machines may not have the adjustable parameters or controls required to achieve the necessary thermal measures (eg, water temperature); mechanical measures (eg, agitation); or chemical measures (eg, capacity for additives to neutralize the alkalinity of the water, soap, or detergent) to reduce microbial levels in soiled scrub apparel.

During the workday, scrub apparel becomes contaminated with microorganisms, including potentially pathogenic organisms.[4,5,8-18] Microorganisms can survive the home laundering process as a result of low water temperature and household detergent formulation (eg, no bleaching agent) and can be transferred to other garments.[13,19-24] Biofilm may form in home washing machines, which can be transferred to other clothing and textiles washed in the same machine.[21,25]

1.3

Verify that scrub apparel laundered outside the facility and transported to the health care facility is free from visible damage and contamination before placing it in use.[26] ***[Recommendation]***

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Preventing clean scrub apparel from contamination during transport from the laundry facility to the health care facility can prevent physical damage (eg, stains, tears, holes) to the scrub apparel and minimizes the potential for contamination from the external environment.[26]

1.3.1

Transport laundered scrub apparel in enclosed carts or containers and in vehicles that are cleaned and disinfected regularly.[26] *[Recommendation]*

Carts, containers, and vehicles can be sources of contamination.

1.4

Store laundered scrub apparel in enclosed carts, cabinets, or dispensing machines that are cleaned and disinfected regularly.[26] *[Recommendation]*

Storing laundered scrub apparel in clean enclosed carts, cabinets, or dispensing machines helps prevent contamination. Storing clean attire in a facility locker with personal items from outside of the facility may contaminate the clean scrub apparel.

1.5

Surgical attire and personal clothing that has been penetrated by blood, body fluids, or other potentially infectious materials must be removed immediately or as soon as possible.[27,28] *[Regulatory Requirement]*

Changing contaminated, soiled, or wet attire may reduce the potential for contamination and protect personnel from exposure to potentially pathogenic microorganisms.

1.5.1

Attire contaminated with visible blood or body fluids must remain at the health care facility for laundering.[27] *[Regulatory Requirement]*

1.5.2

Contaminated attire must be bagged or containerized at the location where it was used and not be rinsed or sorted.[26] *[Regulatory Requirement]*

Rinsing or sorting contaminated reusable attire may expose the health care worker to blood, body fluids, or other potentially infectious materials.

1.6

No recommendation can be made for changing surgical attire when returning to the OR or procedural area after being in other areas in the building. *[No Recommendation]*

There is limited research evaluating patient outcomes when perioperative personnel don surgical attire and leave the procedural areas to complete other activities in the facility or outside the building for short periods (eg, sitting on the patio for lunch, walking to another building).

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Ilibman et al[29] conducted a study to determine if a correlation existed between scrub apparel contamination, activities performed, and areas visited outside the perioperative area. Clean hospital-provided scrubs were donned by 133 surgeons, who then performed their normal daily activities. Eleven medical students who remained in the OR acted as controls, and cultures were immediately taken from their scrub shirts' abdominal pocket. On the surgeons' re-entry to the OR, cultures were taken from the same area of scrubs, and the surgeons completed a questionnaire to indicate where they had been and the activities they had performed since donning the scrubs.

The bacterial counts found on the surgeons' scrubs were significantly higher than those on the control scrubs (39 versus 3 colony-forming units [CFU]). The rate of contamination with pathogenic bacteria was low, and no significant differences were found between the groups (13% vs 9%). *Staphylococcus aureus* was isolated, but methicillin-resistant *S aureus* and gram-negative bacteria were not detected. When asked where they had been since donning scrubs, for which more than one choice could be selected, 102 (77%) said they were in the OR, 55 (41%) were participating in medical activities (eg, in a ward or clinic), and 45 (34%) were involved in non-medical activities (eg, on a break, in a meeting, in an office). Using multivariate analysis, the researchers found that non-medical activities were associated with a lower risk of contamination with pathogenic bacteria, and medical activities, along with duration of wearing scrubs, were predictors of high bacterial loads. The researchers concluded that to determine the need for dedicated OR scrubs and frequent changing of scrubs, more controlled studies are necessary on the contamination of scrubs after specific procedures as well as the amount of time scrubs are worn during these activities.

1.6.1

An interdisciplinary team should determine the circumstances that require changing surgical attire when an individual has been in other areas of the building (eg, the decontamination area of the sterile processing department) or outside the building (eg, outdoor patio, garbage dumpster). ***[Recommendation]***

No published research was found on what circumstances might require changing surgical attire, and clinical judgment applied by an interdisciplinary team can provide this organization-specific guidance to perioperative teams.

1.6.2

The interdisciplinary team should include perioperative RNs, surgeons, anesthesia professionals, infection preventionists, and other stakeholders identified by the organization. ***[Recommendation]***

Input from team members who will be leaving procedural areas and who may need to change surgical attire can help with process development and may increase process adherence. Infection preventionists can provide guidance on potential risk for contamination and transmission.

1.7

Remove scrub apparel before leaving the health care facility at the end of the day. ***[Recommendation]***

Changing out of scrub apparel into street clothes when leaving the building reduces the potential for health care workers to transport pathogenic microorganisms from the facility or health care organization into the home or community.[15,18]

Microbiological sampling of health care workers' uniforms throughout the workday found several pathogenic organisms including multidrug-resistant species, particularly on areas of the uniform that had frequent contact with the patient and environment (ie, abdomen, pocket).[8,10,14,15,17,18,20]

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In a quasi-experimental study, 90 critical care health care workers (ie, 79 nurses, 11 patient care technicians) from a university hospital and a trauma center were provided with four sets of scrubs that were randomized to which shift they would be worn. During a course of 8 months, microbiological sampling of the scrub top front and pant thighs was performed randomly eight times during the last 4 hours of the participant's 12-hour shift. Thirty percent of the scrub samples (217/720) were contaminated with pathogenic bacteria, of which 116 (16%) were *S aureus*, 113 (16%) were gram-negative bacteria, 44 (6%) were an MDRO (eg, MRSA, vancomycin-resistant enterococci, multidrug-resistant gram-negative bacteria) and 21 (3%) were *Enterococcus*. Further differentiation of gram-negative bacteria found 46% (52/113) *Acinetobacter baumannii*, 18.6% (21/113) *Klebsiella pneumoniae*, 11.5% (13/113) *Pseudomonas aeruginosa*, 10.6% (12/113) *Enterobacter cloacae*, 6.2% (7/113) *Serratia marcescens*, 5.3% (6/113) *Klebsiella oxytoca*, 2.7% (3/113) *Escherichia coli*, and 1.8% (2/113) *Enterobacter aerogenes.* The researchers concluded that scrubs are a potential reservoir for pathogenic organisms.[14]

1.8

No recommendation can be made regarding personal clothing worn under surgical attire. *[No Recommendation]*

No evidence was found to evaluate the benefits and harms of wearing personal clothing under surgical attire.

1.8.1

An interdisciplinary team (See Recommendation 1.6.2) may be convened to establish and implement a process for managing personal clothing that may be worn under surgical attire, including

- the types of fabrics (eg, nonlinting) that may be worn under surgical attire,
- the amount of fabric that may extend beyond the surgical attire (eg, a crew neck collar under a V-neck scrub top),
- laundering frequency (eg, daily), and
- laundering method (eg, facility laundering, home laundering).

[Conditional Recommendation]

2.

Fabric

2.1

Select fabrics for scrub apparel that are tightly woven and low linting. *[Recommendation]*

Moderate-quality evidence supports wearing tightly woven scrub apparel. One quasi-experimental[30] and six nonexperimental[31-36] studies compared airborne bacterial contamination levels when perioperative team members wore various types of scrub apparel. The results of four of the studies indicated that tightly woven scrub apparel was superior to other types of scrub apparel in decreasing bacterial contamination of the air.[30-33]

Wearing scrub apparel that is low linting can reduce the number of lint particles disseminated into the environment where bacteria may attach to the lint and settle in surgical sites and wounds and increase the potential for postoperative patient complications.[37]

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2.2

No recommendation can be made for surgical attire that is intended to contain shedding (eg, cuffed sleeves, tucked shirt, cuffed pants).[30-36,38] *[No Recommendation]*

In addition to a tightly woven property, studies have found scrub apparel design can contribute to the reduction of airborne bacterial counts in the OR or procedure room.[30-36] However, scrub apparel configurations varied between studies. Three studies[30,31,35] compared standard scrub tops and pants to special scrub suits with cuffs at the arms, neckline, and ankles, with the scrub top tucked into the pants. Andersen and Solheim[32] compared standard scrub tops and pants to a one-piece coverall with short sleeves and tight-fitting cuffs at the arms and ankles. In another three studies,[33,34,36] participants wore scrub apparel with short sleeves made of different materials, but with cuffs at the sleeves, neckline, waist, and ankles. Study limitations included inconsistencies in air delivery systems (eg, unidirectional, turbulent) and laundering frequency of scrub apparel (eg, single use, one time, 50 times, 100 times). More controlled study of this topic is warranted.

2.3

No recommendation can be made for wearing surgical attire made of antimicrobial fabric. *[No Recommendation]*

Although the evidence regarding the use of antimicrobial fabric is of high quality, there is a wide range of variability in study results and several studies were performed in the laboratory setting. Six studies support its use as a means to decrease bacterial contamination of fabrics,[39-44] and four studies found no difference between standard fabrics and antimicrobial fabrics.[45-48]

Additional research is needed to determine the potential harms to the wearer of wearing surgical attire made from antimicrobial fabric.

2.4

Convene an interdisciplinary team and follow the health care organization's process for the pre-purchase evaluation of products when considering the purchase of surgical attire. *[Recommendation]*

The interdisciplinary team can determine the evaluation criteria for scrub apparel used as surgical attire (eg, comfort, temperature regulation, fabrics and design that facilitate ease of movement while performing clinical tasks). See the AORN Guideline for Medical Device and Product Evaluation[49] for more guidance.
3.

Long-Sleeved Scrub Apparel

3.1

Arms may be covered during performance of preoperative patient skin antisepsis. *[Conditional Recommendation]*

There is limited research on covering arms as a method to minimize dispersal of skin contaminants into the environment. Although the benefits of wearing long sleeves during performance of preoperative patient skin

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antisepsis are likely to exceed the harms, additional research is needed to confirm the risk-benefit assessment and the effect on SSI outcomes.

In an experimental study, Markel et al[50] compared air contamination during intraoperative patient skin prep with and without arm coverage of the person performing the prep. Active and passive microbial assessment was measured using air samplers and settle plate analysis after mock patient skin preps (ie, six with bare arms, six with arms covered). The researchers found that long sleeves specifically appeared to decrease the amount of *Micrococcus* in the environment. The researchers recommended wearing attire with long sleeves when performing the intraoperative patient skin prep.

Contamination by loose-fitting sleeves is a potential harm of wearing long sleeves during preoperative patient skin antisepsis. This risk can be reduced by wearing a tighter-fitting sleeve, avoiding reaching over the prep area, or wearing a sterile sleeve, which may reduce the potential for introducing pathogens to the prep area. Research is needed to evaluate this potential harm and risk-reduction interventions.
3.2

No recommendation can be made for the wearing of long sleeves in the semi-restricted and restricted areas during times other than performance of preoperative patient skin antisepsis. ***[No Recommendation]***

No experimental evidence was found to evaluate rates of environmental contamination with and without the wearing of long sleeves in the semi-restricted and restricted areas during any activities other than preoperative patient skin antisepsis.

Retrospective reviews of SSI rates[51-54] and postoperative complications (ie, readmission, reoperation, sepsis, wound dehiscence, mortality)[53,54] found no difference in rates or complications after implementation of long-sleeve jacket wear in the semi-restricted and restricted areas. Some researchers included a cost analysis in their study and found an incremental cost increase with the implementation of long-sleeve jacket wear, with no improvements in patient outcomes.[51,52,54]

Limitations of the studies include variability in the length of retrospective review, time frame of SSI surveillance, procedure types, wound classifications,[51-54] and monitoring of jacket wear compliance[51,52,54]; inclusion of surgical attire other than long-sleeve jackets[51-54]; and inclusion of other SSI prevention measures.[51,52,54] Additionally, in the three studies with a cost analysis,[51,52,54] only disposable jackets were evaluated; whereas a comparison with reusable jackets and associated laundering cost may have shown laundering to be more cost-effective.
4.

Lab Coats

4.1

If worn, lab coats should be clean. ***[Recommendation]***

Moderate-quality evidence indicates that lab coats worn as cover apparel can be contaminated with large numbers of pathogenic microorganisms.[55-61] Pathogens can be transferred from cover apparel by direct contact with patients or surrounding surfaces. Additionally, indirect contact can occur when the hands of health care personnel touch portions of the cover apparel, such as the pockets, and subsequently contact patients or surfaces.[57,62] Researchers have found that cover apparel is not always discarded daily after use or laundered on a frequent basis.[55,56]

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In a systematic review, Haun et al[60] examined bacterial contamination of health care personnel attire and other devices. The researchers found 72 studies that assessed contamination of a variety of items including lab coats. Pathogens recovered from these items included *Staphylococcus aureus*, gram-negative rods, and *Enterococcus*.

In a nonexperimental study of contamination levels of health care practitioners' cover apparel, Treakle et al[55] found that cover apparel in inpatient and outpatient areas, intensive care units (ICUs), administrative areas, and the OR was contaminated with *Staphylococcus aureus*, including MRSA.

Van Aartsen et al[62] investigated the potential transference of pathogens from lab coats to other surfaces by inoculating the sleeve cuffs and pockets of 20 internal medicine physicians' lab coats with viral DNA surrogate markers, observing the physicians during patient rounds, and sampling for DNA markers if either direct or indirect contact with the lab coat occurred. Thirty-four interactions (48.6%) resulted in one or more direct or indirect contacts with the lab coat and patient or surfaces, of which transfer of one or both DNA markers occurred in 14 (41.2%) of the patient interactions. The researchers concluded that contaminated lab coats could contribute to pathogen transmission.
5.

Head Coverings

5.1

Cover the scalp and hair when entering the semi-restricted and restricted areas. *[Recommendation]*

The wearing of a head covering is intended to contain hair, skin, and microorganisms that can be shed by perioperative team members, which can prevent contamination of the sterile field.[10,63-67] Reducing the risk of contamination of the sterile field is an important consideration for reducing the patient's risk for SSI. However, published research has not demonstrated that covering the hair affects the multifactorial outcome of SSI rates.[67-70]

5.2

Cover a beard when entering the restricted areas and while preparing and packaging items in the clean assembly section of the sterile processing area. *[Recommendation]*

Beards of various lengths can harbor microorganisms, including drug-resistant bacterial species, which are shed into the environment at high rates.[71-74]

In a recent retrospective analysis of 20,960 primary surgical procedures performed over a 14-year period at a university hospital in Germany, researchers found no significant association between SSI rates and the presence of facial hair or beard type.[75] However, in this study, the facility policy required all team members at the surgical field, including the surgeon, to wear surgical hoods that wrap around the neck. A limitation of this study design is that it was retrospective, making it difficult to determine the actual amount of facial hair present at the time of the surgical procedure. The researchers noted that these findings underscore the importance of covering hair on the scalp and covering facial hair. The researchers also stated that depending on the length of facial hair, a beard cover worn under the mask or an additional face mask might be necessary to cover facial hair.

5.3

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An interdisciplinary team that includes members of the perioperative team and infection preventionists should determine the type of head covers that will be worn at the health care organization. ***[Recommendation]***

The evidence does not demonstrate any association between the type of surgical head covering material or extent of hair coverage and SSI rates.[59,67,69,70,76]

Surgical headwear, such as magnifying loupes and headlights, can affect the type of head cover selected because these devices are often removed and maneuvered during wearing of surgical head covers, making an effective fit and comfort a priority.[70] Correct-sized head covers can also contribute to hair containment and prevention of shedding.[38]

Collaborative efforts that include stakeholders and surgeons are key to implementing quality improvement initiatives.[67]

5.3.1

Religious head coverings (eg, head scarves [hijabs], veils, turbans, bonnets) that are clean, are constructed of tightly woven and low-linting material, are without adornments, and fit securely with loose ends tucked in the scrub top may be worn to cover the hair and scalp in the semi-restricted and restricted areas. ***[Conditional Recommendation]***

Some religious traditions include the practice of wearing specific head coverings. Some of these head coverings are configured in a way that covers the hair and scalp, and others also cover portions of the wearer's neck and chest.

Policy restrictions or policies that do not address the use of religious head coverings in perioperative settings can be a barrier for members of some religious groups who currently work or aspire to work in procedural areas. In a survey, Malik et al[77] explored the experiences of 84 female Muslim health care professionals who wore a headscarf in the surgical setting and their view on "bare below the elbows" policies. Most of the participants (94%) agreed that wearing a headscarf was important to them because of their religious beliefs, yet more than half (51.5%) experienced problems trying to wear a headscarf in the perioperative setting; some women reported feeling embarrassed (23.4%), anxious (37.1%), or bullied (36.5%). The researchers concluded that policies can be at odds with an individual's personal beliefs, which may contribute to a decrease in workplace diversity and fewer opportunities for certain groups.

5.3.2

Religious head coverings that cover only a portion of the hair and scalp (eg, kippahs, yarmulkes) may be worn under another head covering. ***[Conditional Recommendation]***

5.3.3

Establish and implement a process for managing reusable head coverings (eg, cloth personal head coverings, religious head coverings), including

- the types of fabrics (eg, nonlinting) that may be worn,
- laundering frequency (eg, daily), and
- laundering method (eg, facility laundering, home laundering) when reusable head coverings are worn in the facility.

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[Conditional Recommendation]

See Section 1. Laundering and Section 2. Fabric for more information.
5.4

No recommendation can be made for covering the ears in the semi-restricted and restricted areas. *[No Recommendation]*

One nonexperimental study that included 200 nurses in a university hospital in Japan suggested that ears are a potential reservoir for pathogens that can be transferred to the hands,[78] although research has not demonstrated any association between covering the ears and SSI rates.

Covering ears may prevent earrings worn by scrubbed team members from falling into the sterile field and increasing the patient's risk for SSI or a retained item. However, covering the ears may have potential harms, such as impairing hearing and potentially impeding team communication, interfering with use of a stethoscope, and hindering the fit of protective eyewear or loupes.

5.5

Remove head coverings when they are contaminated. *[Recommendation]*

5.5.1

Reusable head coverings contaminated with blood, body fluids, or other potentially infectious materials must remain at the health care facility for laundering.[27] *[Regulatory Requirement]*
6.

Shoes

6.1

Wear clean shoes when entering the semi-restricted or restricted areas. *[Recommendation]*

Moderate-quality evidence indicates that shoes can transfer infectious organisms to the floor and contribute to floor contamination.[79-81]

In a nonexperimental study, Amirfeyz et al[81] examined shoes worn outdoors (n = 40) and shoes worn only in the surgical suite at the beginning of the day (n = 40) and at the end of the day (n = 40). The results of the study demonstrated that 98% of the outdoor shoes were contaminated with coagulase-negative staphylococci, coliform, and *Bacillus* species compared with 56% of the shoes worn only in the surgical suite. Bacteria on the perioperative floor may contribute up to 15% of CFU dispersed into the air by walking. The researchers concluded that shoes worn only in the perioperative area may help to reduce contamination of the perioperative environment.

6.2

Wear protective footwear that meets the health care organization's safety requirements. *[Recommendation]*

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The Occupational Safety and Health Administration (OSHA) regulations for foot protection[82] require the use of protective footwear that meets ASTM F2414 standards[83] 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 whether 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 personnel wear footwear that provides protection from identified potential hazards (eg, needlesticks, scalpel cuts, splashing from blood or other potentially infectious materials).[82] The National Institute for Occupational Safety and Health recommends wearing slip-resistant shoes for prevention of slips, trips, and falls.[84]

In a laboratory study, Barr and Siegel[85] examined 15 different types of shoes and tested them 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. Wearing shoes made of these materials could potentially prevent harm to the perioperative team member.
6.3

Fluid-resistant shoe covers or boots must be worn in instances when gross contamination can reasonably be anticipated.[82] ***[Regulatory Requirement]***

6.4

Shoe covers worn as PPE must be removed immediately after use. After removal, discard the shoe covers and perform hand hygiene.[82] ***[Regulatory Requirement]***
7.

Stethoscopes

7.1

Clean and disinfect stethoscopes before each patient use according to the manufacturer's instructions for use (IFU). ***[Recommendation]***

Moderate-quality evidence supports that hand hygiene and stethoscope cleaning and disinfection decreases the risk of transmitting pathogens to patients and environmental surfaces.[60,86-95] Stethoscopes come into direct contact with patients' skin and could be a mechanism for transmission of pathogens from patient to patient, from patient to health care worker, or from health care worker to patient. According to the Spaulding classification system, stethoscopes are **noncritical patient care items** and should be cleaned and disinfected with an Environmental Protection Agency–registered **low-level disinfectant** when the item is visibly soiled and on a regular basis (ie, between patient uses).[96] However, if the item comes in contact with nonintact skin (ie, an open wound) an intermediate level disinfectant is recommended.[92,96]

In a systematic review, Alves de Queiroz Júnior et al[90] examined the bacterial contamination and resistance profile of noncritical patient care devices used by health care personnel. The review authors found 22 studies that assessed contamination of a variety of items including stethoscopes. In eight of the studies, between 89% and 100% of the samples were contaminated with bacteria. The most recurrent pathogens recovered from these items were *Staphylococcus aureus*, *Acinetobacter* species, *Pseudomonas* species, and *Klebsiella pneumoniae*.

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In a nonexperimental cross-sectional study, Campos-Murguía et al[89] examined the number of potentially pathogenic organisms present on stethoscopes by analyzing 112 stethoscopes from 12 hospital departments. Forty-eight stethoscopes (43%) had microorganisms that were potentially pathogenic. Of the 50 potentially pathogenic bacteria found, 43 (86%) were *S aureus*, and 18 of those were methicillin resistant (42%). The results of this study showed that stethoscopes could be significant contributors to MRSA infections and that they should be cleaned and disinfected before and after each patient use.

Napolitani et al[91] conducted a systematic review to evaluate the effectiveness of different disinfection methods in the reduction of bacteria on stethoscope surfaces. In the 17 studies reviewed, chemical disinfectants, antibacterial copper surfaces, and devices emitting ultraviolet light (UV-C) all reduced bacterial counts. However, an impregnated silver ion cover yielded significantly higher bacterial counts. The researchers concluded that disinfection failure was more likely caused by irregular use of products as opposed to product effectiveness.

7.2

Promote cleaning and disinfection of stethoscopes by

- developing convenient standardized processes (ie, time, method) that are integrated into clinical workflows,[91,95,97]
- providing resources (eg, disinfectant product, hand rub dispensers) in convenient locations,[91,97,98]
- educating perioperative personnel about
    - risks of cross contamination with device use and
    - how to clean and disinfect devices according to the manufacturer's IFU,[86,90,92,93,95,98] and
- posting visual reminders with instructions.[95]

[Recommendation]

Health care workers' self-reports of cleaning and disinfection frequencies may be overreported,[86,93,94] as direct observation studies found only 15% to 18% of health care workers cleaned and disinfected their stethoscopes after patient encounters.[92,97]

When surveyed, health care personnel indicated reasons for not cleaning and disinfecting stethoscopes to be lack of resources for cleaning and disinfection,[98] lack of knowledge of what to use for cleaning and disinfection, not being aware of the manufacturer's IFU, too much time involved,[86,90,97,98] not believing stethoscopes are a source of health care–associated infections (HAIs),[90,93,95] or simply forgetting.[98]

7.2.1

Education that includes real-time feedback for stethoscope cleaning and disinfection practices may be implemented, such as

- cleaning verification testing (eg, adenosine triphosphate [ATP]) and
- culturing before and after disinfection.[89,98]

[Conditional Recommendation]

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Providing education with integrated real-time feedback has been demonstrated to increase health care worker buy-in and adherence to effective stethoscope cleaning and disinfection practices.[89,98]
8.

Identification Badges, Access Cards, and Personal Items

8.1

Clean and disinfect identification badges and access cards (eg, digital keys) when the item becomes soiled with blood, body fluids, or other potentially infectious materials. ***[Recommendation]***

Moderate-quality evidence supports that identification badges and access cards may be contaminated with pathogens.[99,100]

In a prospective cross-sectional study, Caldwell et al[99] cultured health care workers' common access cards and identification badges in a burn unit. The overall contamination rate was 75%. There was an 86% bacterial contamination rate for the access cards and a 65% bacterial contamination rate for the identification badges. When the badges and cards were cleaned weekly, the contamination rate dropped to 50%, which indicated that even weekly cleaning may have an effect on the contamination rate.

8.1.1

Establish and implement a routine disinfection schedule for identification badges and access cards (eg, daily, weekly). ***[Conditional Recommendation]***

8.2

An interdisciplinary team that includes perioperative RNs, surgeons, anesthesia professionals, infection preventionists, and others identified by the organization should determine if lanyards can be used in the perioperative setting. ***[Recommendation]***

Moderate-quality evidence indicates that lanyards can be contaminated with pathogens[100-102] and that the materials lanyards are constructed from are not easy to clean and disinfect.[101,103] The potential harms of wearing lanyards in the perioperative setting are likely to outweigh the benefits. Lanyards can make carrying multiple badges more convenient for the wearer, especially when used for badge-controlled access. However, lanyards can come into contact (both direct and indirect) with patients and environmental surfaces in the perioperative setting. Researchers discourage the use of lanyards in health care settings.[100-102]

In a cross-sectional study, Kotsanas et al[100] examined the pathogenic contamination of identification badges and lanyards and found that the median bacterial load was tenfold more for lanyards (3.1 CFU/cm^2) than for identification badges (0.3 CFU/cm^2). The microorganisms recovered from lanyards and identification badges were methicillin-sensitive *Staphylococcus aureus*, MRSA, *Enterococcus* species, and *Enterobacteriaceae.* The researchers concluded that identification badges should be clipped on and disinfected regularly and that lanyards should be changed frequently or should not be worn.

Murphy et al[102] conducted a cross-sectional study with epidemiological analysis to determine if *S aureus* found on lanyards worn by health care personnel originated from the environment or the wearer. The lanyards and nares of 102 health care personnel were cultured, and molecular fingerprinting (pulse-field gel electrophoresis and antibiogram) showed that 26% of health care personnel carrying *S aureus* in their nares had similar *S*

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aureus strains on their lanyards. The researchers concluded that nasal bacterial flora is highly likely to be transferred to lanyards, providing a source for transmission to patients. In the survey completed by participants, 91% reported their lanyards had never been laundered and the mean age of lanyards was 22 months. The researchers recommended that if regular lanyard laundering is not promoted, clipping of identification badges high on the chest, away from patients, and regular disinfection of badges should occur.

In an epidemiological investigation of a *Candida auris* outbreak involving seven patients in two ICUs, a cloth lanyard holding a shared controlled drug access key used by health care personnel in both ICUs was identified as the source.[101] The finding prompted removal and banning of the shared controlled drug access key lanyard and all lanyards worn by ICU health care personnel. Random cultures of 100 of the banned lanyards identified one positive for *C auris* and 13 positive for other yeast organisms. With removal of all lanyards, no additional *C auris* infections were identified and the outbreak was terminated. The investigators also found the lanyards were made of polyester or nylon and that *C auris* could survive on this material up to 14 days. Additionally, they noted that lanyards most often have rough surfaces, unlike the smooth plastic surface of identification badges, which can contribute to a buildup of soil and pathogens. The researchers recommended reviewing policies on lanyard use, particularly during outbreaks.

8.2.1

If lanyards are used, establish and implement a process and schedule for routine disinfection (eg, daily, weekly). ***[Recommendation]***

Millar and Moore[103] investigated the efficacy and feasibility of using a steam disinfector with a dryer to destroy pathogenic organisms on lanyards by inoculating 38 new polyester lanyards with 30 pathogenic bacteria and one yeast organism and processing the lanyards according to the manufacturer's IFU. On completion of the cycle, no inoculated organisms were recovered, and all moisture was removed from the lanyards. The researchers concluded that the steam-dryer device could allow immediate use of dry pathogenic-free lanyards, unlike wet disinfection that requires a drying wait period. If not completely dry, lanyards can cause irritation to the wearer's neck. The researchers acknowledged that additional studies are needed to determine the best method and frequency for disinfecting lanyards.

8.3

Establish and implement a process to prevent contamination of the semi-restricted and restricted areas from personal items (eg, briefcases, backpacks, surgical loupes and cases). ***[Recommendation]***

Personal items brought into the semi-restricted and restricted areas may be difficult to clean and may harbor pathogens, dust, and bacteria.

8.3.1

The process may include cleaning and disinfecting or containing the item or placing the item in a designated location. ***[Conditional Recommendation]***

Cleaning these items can decrease the risk for transmission of potentially pathogenic microorganisms from external surfaces to perioperative surfaces and from perioperative surfaces to external surfaces.

In a nonexperimental study, Graham et al[104] investigated the contamination rate of personal surgical loupes and storage cases of surgeons employed in a large, regional orthopedic practice. Of the 21 surgeons' loupes sampled, 19 (90%) were contaminated with bacteria, and fungi was present on 10 (48%). In the five storage cases sampled, bacterial contamination was identified in two (40%) and fungi was found in all five cases (100%). As loupes are used directly over the sterile field with no barrier, the researchers concluded regular

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cleaning of loupes and airing out of storage cases may decrease the risk of surgical field contamination and the risk to patients of acquiring an SSI.

8.4

Clean and disinfect cell phones, tablets, and other personal communication or hand-held electronic equipment according to the device manufacturer's IFU before these items are brought into the OR, and perform frequent hand hygiene when handling these devices throughout the workday. ***[Recommendation]***

Cell phones, tablets, and other personal handheld devices can be highly contaminated with microorganisms, some potentially pathogenic.[60,105-117] Researchers recommended regular cleaning of these devices and implementing hand hygiene before and after use. Reducing the numbers of microorganisms present on the devices may protect patients from the risk of HAIs resulting from the transfer of microorganisms from the devices or hands of health care workers to patients.

In a systematic review, De Groote et al[110] examined bacterial contamination of health care personnel's cell phones. The review found 50 studies, 38 observational and 12 interventional, with a total of 5,425 microbiological samples. Pathogenic bacteria recovered included *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae*, and *Pseudomonas* and *Acinetobacter* species. The 12 interventional studies investigated the effect of cleaning and disinfection on bacterial contamination levels and found significant reductions, with six of the studies achieving a reduction of 80% or more.

Shakir et al[109] sampled the phones of 53 orthopedic surgeons and found 44 (83%) had pathogenic bacteria on initial testing, four (8%) had pathogenic bacteria after cleaning, and 40 (75%) of the phones had pathogenic bacteria 1 week after cleaning.

Murgier et al[108] reported that of 52 perioperative personnel,[18] (34%) cleaned their phones several times a week, whereas Shakir et al[109] found that only 19 of 53 orthopedic surgeons (36%) cleaned their phones every couple of weeks. In both studies, most participants (87% and 84%, respectively) indicated that they did not regularly perform hand hygiene after cell phone use. In a similar survey, Leong et al[115] found that of 205 respondents, only 11.5% of perioperative personnel cleaned their phones daily and 9.4% never cleaned their phones.

8.5

Promote cleaning and disinfection of badges, access cards, and personal electronic devices by

- determining a cleaning process (eg, the frequency and methods),[107,108,112,114,117,118]
- educating perioperative personnel on
    - risks of cross contamination with device use and
    - how to clean devices according to the manufacturer's IFU,[108,111,112,119]
- posting visual reminders and cleaning instructions,[107,115,118] and
- providing resources (eg, cleaning products, hand rub dispensers) in convenient locations and near entrances to the operative suite.[107,115,118,119]

[Recommendation]

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When surveyed, health care personnel indicated reasons for not cleaning communication devices included lack of resources to clean the devices, not being aware of manufacturer's IFU, concern that cleaning would damage the device, lack of time, not believing these items are a source of HAIs, and forgetfulness.[109,115]

Moderate-quality evidence and two case studies found that visual confirmation of bacterial growth, cleaning reminders, cleaning stations, and education on how to clean and the importance of cleaning led to increased compliance with cleaning[109,119] and a reduction in the number of bacteria on phones, including HAI-causing pathogens.[107,118,119]

8.5.1

Education that includes real-time feedback for effective cleaning and disinfection practices may be implemented, such as

- cleaning verification testing (eg, ATP) and
- culturing before and after cleaning and disinfection.[107,109,118]

[Conditional Recommendation]

Providing education with integrated real-time feedback has been demonstrated to increase health care worker buy-in and adherence to effective cleaning practices for cell phones.[107,109,118]
8.6

An interdisciplinary team may evaluate emerging technologies for cleaning of badges, access cards, lanyards, and personal electronic devices. *[Conditional Recommendation]*

Four quasi-experimental studies evaluated the efficacy of ultraviolet wavelength technology, specifically UV-C, to disinfect health care workers' cell phones.[114,120-122] In each of these studies, when the UV-C device was consistently used, a significant reduction in cell phone bacterial growth was achieved. Additional clinical studies are needed to determine UV-C applicability in the perioperative environment, its effect on cell phones, and the most effective delivery system and nanometer frequency.[120-122]

Millar and Moore[103] successfully disinfected lanyards in a steam disinfector with a dryer. The researchers concluded that the steam-dryer device allowed immediate use of dry pathogenic-free lanyards, unlike wet disinfection that requires a drying wait period. If not completely dry, the lanyard can cause irritation to the wearer's neck. The researchers acknowledged that additional studies are needed to determine the best method and frequency for disinfecting lanyards.

8.7

No recommendation can be made for whether a necklace may be worn in the semi-restricted and restricted areas. *[No Recommendation]*

No evidence was found to evaluate the benefits and harms of wearing a necklace in the semi-restricted and restricted areas. Wearing a necklace while scrubbed poses a risk that the necklace could fall into the sterile field and become a retained foreign body.
9.

Visitor Attire

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Visitors entering the semi-restricted or restricted areas of the surgical suite (eg, law enforcement officers, parents, biomedical engineers) should don either clean surgical attire or a single-use jumpsuit (eg, coveralls, bunny suit) designed to completely cover personal apparel. *[Recommendation]*

The benefits of wearing clean attire in the semi-restricted and restricted areas of the surgical suite for non-emergent situations may outweigh the harms. Donning clean surgical attire or a single-use jumpsuit before entry into the semi-restricted and restricted areas may help to maintain a clean environment and decrease the possibility of transferring microorganisms from external areas and personal attire to perioperative surfaces and patients.

Glossary

Clean: The absence of visible dust, soil, debris, or blood.

Health care–accredited laundry facility: An organization that processes health care linens and has successfully passed an inspection of its facility, policies and procedures, training programs, and relationships with customers.

Low-level disinfectant: An agent that destroys all vegetative bacteria, some fungi, and some viruses but not all bacterial spores.

Noncritical patient care items: Medical equipment that encounters intact skin but not mucous membranes. Examples include bedpans, blood pressure cuffs, and stethoscopes.

Scrub apparel: Nonsterile garments that can include two-piece pantsuits, scrub dresses, and long-sleeved jackets.

Surgical attire: Scrub apparel and head coverings worn in the semi-restricted and restricted areas of the perioperative and procedural practice setting.

Tightly woven: material that is so dense that it is difficult for microorganism-carrying skin scales to exit or reach air. Synonym: Low permeable

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