GUIDELINE FOR **SURGICAL ATTIRE**

The Guideline for Surgical Attire was approved by the AORN Guidelines Advisory Board and became effective as of July 1, 2019. The recommendations in the guideline are intended to be achievable and represent 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 guideline can be implemented. AORN recognizes the many diverse settings in which perioperative nurses practice; therefore, this guideline is adaptable to all areas where operative or other invasive procedures may be performed.

Purpose

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

Surgical attire and personal protective equipment (PPE) are worn to provide a high level of cleanliness and hygiene within 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).

This document does not address patient clothing or linens used in health care facilities. The use of masks as PPE and the use of masks at the sterile field are outside the scope of this document; the reader should refer to the AORN Guideline for Sterile Technique[1] and the 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.

Evidence Review

A medical librarian with a perioperative background conducted a systematic search of the databases Ovid MEDLINE®, Ovid Embase®, EBSCO CINAHL®, and the Cochrane Database of Systematic Reviews. The search was limited to literature published in English from January 2014 through February 2018. At the time of the initial search, weekly alerts were created on the topics included in that search. Results from these alerts were provided to the lead author until August 2018. The lead author requested additional articles that either did not fit the original search criteria or were discovered during the evidence appraisal process. The lead author and the medical librarian also identified relevant guidelines from government agencies, professional organizations, and standards-setting bodies.

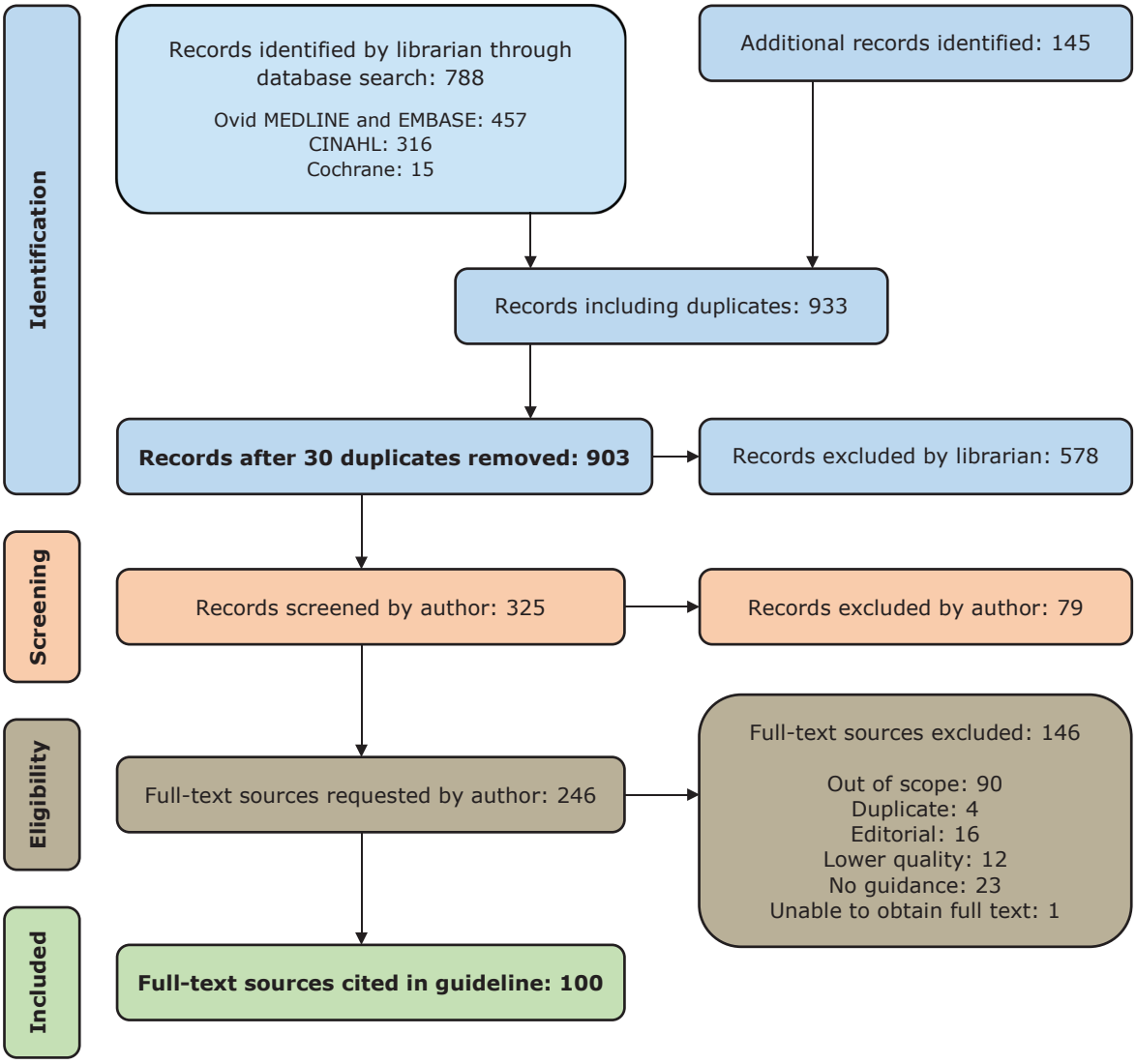
Search terms included *armpit, axilla, backpack, bacterial load, badge, beard, bedding and linens, bouffant, briefcase, bunny suit, cell phone, cellular phone, clean room, clothing, colonization, computers, computers (handheld/hand-held/portable), computers and computerization, coveralls, cross infection, dandruff, dermatitis (exfoliative/seborrheic), desquamate, desquamation, disease transmission, disposable hats, dust, ear, environment (controlled), epithelial cells, epithelium, equipment contamination, eyelashes, facial hair, fanny pack, fleece,* ***fomites****, fungi, groin, hair, head covering, hoods, infection control, infectious disease transmission, iPad, iPhone, jewelry, jumpsuit, lanyard, laundering, laundering scrubs, laundering service (hospital), mobile communication device, mobile phone, mold, nosocomial, pollen, protective clothing, purse, scalp, scrubs, seborrhea, seborrheic dermatitis, shed, shedding, skin, skullcaps, smartphone, squames, stethoscopes, surgical attire, surgical cap, surgical wound infection, tablet computer, textiles, tie, uniforms,* and *washing machine.*

Included were research and non-research literature in English, complete publications, and publications with dates within the time restriction when available. Excluded were non-peer-reviewed publications and older evidence within the time restriction when more recent evidence was available. Editorials, news items, and other brief items were excluded. Low-quality evidence was excluded when higher-quality evidence was available, and literature outside the time restriction was excluded when literature within the time restriction was available **(Figure 1)**.

Articles identified in the search were provided to the project team for evaluation. The team consisted of the lead author and one evidence appraiser. The lead author and the evidence appraiser reviewed and critically appraised each article using the AORN Research or Non-Research Evidence Appraisal Tools as appropriate. A second appraiser was consulted if there was a disagreement between the lead author and the primary evidence appraiser. The literature was independently evaluated and appraised according to the strength and quality of the evidence. Each article was then assigned an appraisal score. The appraisal score is noted in brackets after each reference as applicable.

Each recommendation rating is based on a synthesis of the collective evidence, a benefit-harm assessment, and consideration of resource use. The strength of the recommendation was determined using the AORN Evidence Rating Model and the quality and consistency of the evidence supporting a

Figure 1. Flow Diagram of Literature Search Results



Adapted from: Moher D, Liberati A, Tetzlaff J, Atman DG; The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. *2009;6(6):e1000097.*

recommendation. The recommendation strength rating is noted in brackets after each recommendation.

Note: *The evidence summary table is available at http://www.aorn.org/evidencetables/.*

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1. Laundering

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

Wearing **clean** surgical attire may protect patients from exposure to microorganisms that could contribute to an SSI.

1.2 **After each daily use, launder scrub attire 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[4] in the absence of state requirements.**

[Recommendation]

Wearing attire 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 attire.

Moderate-quality evidence demonstrates that scrubs become contaminated with bacteria during the workday, including potentially pathogenic organisms that can be transmitted to other people or the environment.[5-15] Several studies have found that microorganisms can survive the home laundering process due to low water temperature and household detergents and can be transferred to other garments.[16-19] Biofilm may form in home washing machines, which can be transferred to other clothing and textiles washed in the same machine.[18,20]

After performing a systematic review, Goyal et al[15] concluded that provider attire is a potential source of pathogenic bacterial transmission in health care settings. There is limited data to link provider attire and health care–associated infections (HAIs). This review gave some guidance on strategies to reduce the spread of bacterial pathogens, including multidrug-resistant organisms that have the potential to cause HAIs. The authors recommended that facilities determine where scrubs will be laundered and, when required, provide laundering instructions for home laundering, such as to use hot water and bleach.

Wright et al[21] reported three cases of postoperative *Gordonia bronchialis* sternal infections after coronary artery bypass grafting surgery. *G bronchialis* was isolated from the scrub attire, axilla, hands, and purse of a nurse anesthetist and was implicated as the cause of the SSIs. Cultures taken from her roommate, who was also a nurse, showed the same microorganism. After notification of the culture results, the nurse anesthetist discarded her front-loading washing machine. During the next year, the nurse anesthetist's and her roommate's scrub attire, hands, nares, and scalps tested negative for *G bronchialis*. The authors concluded that the home washing machine was the likely bacterial reservoir. Home laundering may not reliably kill all pathogens, and the pathogens may survive in the form of biofilm within the washing machine. Biofilms have been implicated in malodor emitting from washing machines. The authors recommended that hospital laundering of scrub attire be implemented as a measure to reduce patients' risk of developing an SSI. Further research is needed to demonstrate a causal relationship between home laundering and human disease.

In a nonexperimental study of OR surgical attire conducted as the result of an increase in multidrug-resistant organisms and HAIs, Nordstrom et al[17] took swatches from unwashed, hospital-laundered, home-laundered, new cloth, and disposable scrub attire and tested them for the presence of microorganisms. The researchers found that the home-laundered scrub attire had a significantly higher total bacterial count than the facility-laundered attire, and they found no significant difference in bacterial counts between hospital-laundered, unused, or disposable scrub attire. The researchers concluded that although it is not known how contaminated scrub attire contributes to the spread of HAIs, hospital administrators and infection preventionists need to consider the potential for transmission of infection versus cost savings to the facility if home laundering is allowed. The researchers advised that health care workers be made aware of the risks of home laundering and be provided with instructions for best methods for home laundering in order to reduce the risk of infection.

Mitchell et al[10] conducted a literature review on the role of health care apparel and other textiles in the transmission of pathogens and determined that laundering scrubs at home may not be safe. Due to child safety laws to prevent scalding and burns, typical home washing machine temperatures do not exceed 110° F (43° C) and cannot reach the recommended water temperature of 160° F (71° C) required to remove significant quantities of microorganisms. However, the authors also discussed that industrial post-laundering practices may recontaminate attire.

Some evidence supports home laundering within specific parameters. Lakdawala et al[22] conducted a nonexperimental investigation of the effect of low-temperature washing cycles (140° F [60° C]) by assessing the amount of bioburden on health care workers' uniforms before and after laundering. The researchers concluded that a washing cycle of 140° F (60° C) for 10 minutes was sufficient to decontaminate hospital uniforms and decrease the bacterial load by at least a 7-log

reduction. The uniforms could become recontaminated after laundering, but the organisms could be easily removed by ironing.

Patel et al[23] conducted a study to determine the effectiveness of home laundering in removing *Staphylococcus aureus* from scrub attire. The researchers cut hospital-laundered scrub attire into squares, inoculated them with *S aureus,* and washed them at a typical household laundry temperature of 104° F (40° C) and a higher temperature of 140° F (60° C). The researchers concluded that the lower temperature did not remove *S aureus;* however, adding sequential tumble drying or ironing reduced the number of bacteria to an undetectable level. Washing at 140° F (60° C) produced a greater reduction in total viable organisms compared with washing at 104° F (40° C). The researchers concluded that scrub attire can be safely washed at 104° F (40° C) if tumble dried for 30 minutes or ironed.

Al-Benna[24] conducted a literature review to explore home laundering of scrub attire and found there was little scientific evidence that facility laundering was better than home laundering.

1.3 **Prevent contamination of laundered surgical attire during transport to the health care facility.**[25] *[Recommendation]*

Preventing clean surgical attire from contamination during transport from the laundry facility to the health care facility helps prevent physical damage to the surgical attire and minimizes the potential for contamination from the external environment.[25]

1.3.1 **Transport laundered surgical attire in enclosed carts or containers and in vehicles that are cleaned and disinfected regularly.**[25] *[Recommendation]*

Carts, containers, and vehicles can be a source of contamination.

1.4 **Store laundered surgical attire in enclosed carts, cabinets, or dispensing machines that are cleaned and disinfected regularly.**[25] *[Recommendation]*

Storing laundered surgical attire 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 attire.

1.5 **Scrub attire that has been penetrated by blood, body fluids, or other potentially infectious materials must be removed immediately or as soon as possible, and replaced with clean attire.**[26,27] *[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 **Scrub attire contaminated with visible blood or body fluids must remain at the health care facility for laundering.**[26] *[Regulatory Requirement]*

1.5.2 **Contaminated scrub 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 **Remove surgical attire before leaving the health care facility.** *[Recommendation]*

The benefits of removing surgical attire before leaving the facility outweigh the harms. Moderate-quality evidence supports changing out of surgical attire into street clothes when leaving the building to reduce the potential for health care workers to transport pathogenic microorganisms from the facility or health care organization into the home or community.

In a systematic review, Goyal et al[15] concluded that provider attire is a potential source of pathogenic bacterial transmission in health care settings. There is limited data to link provider attire and HAIs. The authors recommended that providers wear clean scrub clothes when exiting and returning to the facility.

Sanon and Watkins[12] conducted a study to investigate the pathogens that nurses potentially take into a public setting outside the work environment. The 10 nurses who participated in the study were given sterilized scrub attire to wear prior to the beginning of their shift, and the scrubs were collected at the end of the shift. Microbial assessment of the scrubs showed that the average bacteria colony growth per square inch was 1,246 for the day shift and 5,795 for the night shift. After 48 hours, methicillin-resistant *Staphylococcus aureus* (MRSA) was present on four of the scrubs worn during the day shift and three of the scrubs worn during the night shift. Other bacteria present were *Bacillus* species, *Micrococcus luteus, Staphylococcus aureus, Staphylococcus epidermidis,* and *Micrococcus roseus.* In light of public health concerns about antibiotic resistance, the researchers recommended that facilities consider implementing policy regarding the wearing of scrub attire outside of the work environment.

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

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

1.7.1 **Establish and implement a process for managing personal clothing that may be worn under scrub attire, including**

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

[Conditional Recommendation]

1.7.2 **Personal clothing contaminated with blood, body fluids, or other potentially infectious materials must remain at the health care facility for laundering.**[26] *[Regulatory Requirement]*

2. Fabric

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

Moderate-quality evidence supports wearing tightly woven scrub attire. One quasi-experimental[28] and four nonexperimental[29-32] studies compared airborne bacterial contamination levels when perioperative team members wore various types of scrub attire. The results of four of the studies indicated that tightly woven scrub attire was superior to other types of scrub attire in decreasing bacterial contamination of the air.[28-31] Tammelin et al[28] defined conventional scrub attire as 50% cotton/50% polyester woven with 270 × 230 threads/10 cm and defined tightly woven scrub attire as 50% cotton/50% polyester woven with 560 × 395 threads/10 cm. However, there was no common definition of "tightly woven fabric" used in the collective evidence.

Wearing scrub attire that is low linting may help prevent lint particles from being 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.[33]

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

Although the evidence regarding the use of antimicrobial scrub attire 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 scrubs,[34-39] and four studies found no difference between standard scrubs and antimicrobial scrubs.[40-43]

Bearman et al[39] conducted a randomized controlled trial (RCT) to determine the effectiveness of antimicrobial fabric for reducing the bacterial burden on the hands and scrub attire of health care workers in an intensive care unit setting of an academic medical center. All study participants (N = 30) were randomly assigned to wear either traditional scrub attire or scrub attire made of antimicrobial fabric during a clinical shift for a 4-week period. Each health care worker underwent unannounced weekly garment and hand cultures. Cultures taken at the beginning and end of the shifts included garment cultures taken from the abdominal and leg pockets of the scrub attire. The researchers did not specify the length of the clinical shifts. The antimicrobial scrubs were associated with a 4 to 7 mean log reduction in MRSA but not in vancomycin-resistant *Enterococcus* or gram-negative rod bacteria.

Boutin and colleagues[40] conducted a randomized crossover trial to determine bacterial contamination of antimicrobial scrubs (chitosan/DMDM hydantoin) at the end of a typical 12-hour hospital shift. Standard untreated scrubs served as the control. A total of 110 health care workers participated in the study, and 720 samples were taken. Samples were taken at 4 and 12 hours. The researchers concluded that there was no difference in bacterial contamination between the antimicrobial scrubs and untreated scrubs and more research is needed before facilities invest in antimicrobial scrubs.

Anderson et al[43] conducted a three-arm RCT to test the efficacy of antimicrobial impregnated scrubs compared to standard scrubs. Two antimicrobial scrub types were compared with standard cotton/polyester scrubs. Forty nurses were enrolled in the study, and each completed three shifts in the scrub type that they were randomly assigned to wear. The researchers found that the antimicrobial fabric was not effective in reducing microbial contamination of the scrubs; however, the environment was an important source of contamination of the scrubs.

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

2.2.1 **Follow the health care organization's process for the pre-purchase evaluation of products when considering the purchase of antimicrobial surgical attire.** *[Conditional Recommendation]*

3. Long Sleeves

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

Although the benefits of wearing long sleeves during performance of preoperative patient skin antisepsis are likely to exceed the harms, further research is needed to confirm the risk-benefit assessment and the effect on SSI outcomes.

Markel at al[44] conducted an experimental study to compare air contamination during intraoperative patient skin prep with and without arm coverage of the person performing the prep. A mock patient skin prep was performed in three hospitals with a total of 12 experiments, six with bare arms and six with arms covered. The researchers used particle counters to measure airborne particulate contamination. Active and passive microbial assessment was measured using air samplers and settle plate analysis. In one operating room (OR), there was a decrease in 5.0 µm-sized particles when the arms were covered. In the other two ORs, there was a decrease in total microbes when the arms were covered. Wearing 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 of the prep by loose-fitting sleeves is a potential harm of wearing long sleeves during preoperative patient skin antisepsis. This risk may be reduced by wearing a tight-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 wearing long sleeves in the semi-restricted and restricted areas other than during performance of preoperative patient skin antisepsis.** *[No Recommendation]*

No evidence was found to evaluate the benefits and harms of wearing long sleeves in the semi-restricted and restricted areas during any activities other than preoperative patient skin antisepsis.

In an organizational report, Chow et al[45] adopted a policy requiring all personnel to wear cover jackets in perioperative areas. They compared SSI data from before and after implementation and did not find any statistically significant differences in SSI outcomes. The authors noted that laundry costs increased approximately $1,000 per month.

In an independent cost analysis, Elmously et al[46] described implementation of disposable long-sleeve jackets at two facilities in the same hospital system. The added cost of implementing use of disposable jackets was $1,128,078 annually.

4. Cover Apparel

4.1 **If worn, cover apparel (eg, lab coats) should be clean.** *[Recommendation]*

Moderate-quality evidence shows that lab coats worn as cover apparel can be contaminated with large numbers of pathogenic microorganisms.[47-53] Researchers have found that cover apparel is not always discarded daily after use or laundered on a frequent basis.[47,48]

In a systematic review, Haun et al[52] 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 white coats. Pathogens recovered from these items included *Staphylococcus aureus,* gram-negative rods, and *Enterococcus.*

In another systematic review, Goyal et al[15] concluded that provider attire is a potential source of pathogenic bacterial transmission in health care settings. There is limited data to link provider attire and HAIs. The authors recommended increasing the frequency of laundering of white coats to at least weekly and when visibly soiled; providing multiple white coats to allow for laundering; and providing guidance for laundering at home when required, including the use of hot water, bleach, and heated drying.

In a nonexperimental study, Munoz-Price et al[48] investigated the laundering practices of 160 health care providers related to scrub attire and lab coats. Overall, lab coats were washed every 12.4 days and scrub attire every 1.7 days. Ninety percent of respondents laundered their lab coats only once per month, and four people washed their lab coats only once every 90 days to 12 months. Water temperature used by health care providers to launder their lab coats included cold (11%), warm (21%), and hot (52%); 11% did not know the temperature used; and 6% dry-cleaned their lab coats. Ninety percent of respondents acknowledged that their lab coats were potentially contaminated with hospital pathogens. The researchers recommended that lab coats be laundered regularly (ie, at least once or twice per week) and whenever dirty or soiled with body fluids. The researchers also recommended that the lab coats be laundered in hot water with bleach to reduce or eliminate potential pathogens.

In a nonexperimental study of contamination levels of health care practitioners' cover apparel, Treakle et al[47] found that cover apparel in inpatient and outpatient areas, intensive care units, administrative areas, and the OR was contaminated with *Staphylococcus aureus,* including MRSA. Two-thirds of the health care practitioners perceived their cover apparel to be dirty because it had not been washed in more than 1 week. Notably, health care personnel with contaminated cover apparel were more likely to have home laundered their cover apparel.

5. Head Coverings

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

Wearing a head covering may contain hair and bacteria that is shed by perioperative team members, which may prevent contamination of the sterile field and reduce the patient's risk for SSI.[54-57] Although there is a potential benefit to the patient, research has not demonstrated that covering the hair affects the multifactorial outcome of SSI rates.[55,58-60] Case studies have demonstrated, however, that human-to-human transmission of bacteria shed from the scalp and hair of perioperative team members can occur and has been directly attributed to SSI outbreaks.[61-64]

Hair and skin can harbor bacteria that may be dispersed into the perioperative environment. Moderate-quality evidence suggests that hair is a reservoir for bacteria.[7,54,61,65,66]

Mase et al[66] conducted a laboratory study to determine whether staphylococci that were present on the hair could be removed by shampooing. The results of the study showed that staphylococci become firmly attached to the human hair surface and the edge of hair cuticles. Extensive treatment with neutral detergents did not remove the organism, suggesting that conventional shampooing has little effect on removing staphylococci from hair. Moreover, these neutral detergents had little bactericidal activity on staphylococci. These results suggest that hair falling into the sterile field could be a source of multidrug-resistant staphylococci in SSIs.

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]*

Several studies have demonstrated that beards can be a source of bacterial organisms.[67-69]

In a nonexperimental study, McLure et al[68] examined dispersal of bacteria by men with and without beards and by women. The results of the study showed that there was significantly more bacterial shedding by bearded men than by clean-shaven men or by women even when a mask was worn. The researchers suggested that beards may act as a reservoir for bacteria and dead organic material.

Wakeam et al[69] compared facial bacterial colonization rates among 408 male health care workers with and without facial hair. The results of this study demonstrated that male hospital workers with facial hair did not harbor more potentially concerning bacteria than clean shaven workers. Clean shaven workers were significantly more likely to be colonized with *Staphylococcus aureus,* including MRSA. Both groups shed bacteria at high rates. The researchers suggested standard infection prevention practices be followed to prevent contamination during the performance of sterile procedures.

Parry et al[67] conducted a study to determine whether nonsterile surgical hoods reduce the risk of bacterial shedding by bearded men. Ten bearded and 10 clean-shaven surgeons completed three sets of standardized facial motions, each lasting 90 seconds while unmasked, masked, and masked and hooded. The addition of surgical hoods did not decrease the total number of bacteria as measured in colony-forming units (CFU). The unmasked men shed a significantly higher number of CFU than the masked men. The researchers concluded that the bearded surgeons did not appear to have an increased likelihood of bacterial shedding compared to the non-bearded surgeons while wearing surgical masks, and the addition of surgical hoods did not decrease the amount of shedding

5.3 **No recommendation can be made for the type of head covers worn in the semi-restricted and restricted areas.** *[No Recommendation]*

The evidence does not demonstrate any association between the type of surgical head covering material or extent of hair coverage and the outcome of SSI rates.

Markel et al[70] compared disposable bouffant style caps and skull caps to newly home-laundered cloth hats to determine permeability, particle transmission, and pore size. All three types of hats were evaluated twice at two different institutions for a total of four 1-hour-long mock surgeries for each hat. All hat types underwent permeability and porosity testing. The researchers found that disposable bouffant hats were more permeable to bacteria compared to the disposable skull caps and cloth caps. The researchers acknowledged that cloth hats are not always laundered daily, and a dirty, unwashed cloth hat could possibly lead to airborne contamination and transmission of bacteria.

Kothari et al[59] conducted a nonexperimental study to compare SSI rates of patients whose attending surgeon's preferred cap style was either bouffant or skullcap. The data for this study came from a previously published, prospective RCT on the impact of hair clipping on SSI. A total of 1,543 patients were included in the trial, and the prevalence of diabetes and tobacco use were similar among both groups. Thirty-nine percent of the surgeons preferred wearing bouffant caps and 61% preferred wearing skullcaps. Surgical site infections occurred in 8% of patients whose surgeons preferred a bouffant cap and 5% of the patients whose surgeons preferred a skullcap. When adjusting for the type of surgery, there was no significant difference in SSI rates for skullcaps compared to bouffant caps. A limitation of this study design is that it was a retrospective review of a previous clinical trial and the head coverings of other team members were not documented. The researchers concluded that type of cap worn did not significantly affect SSI rates after accounting for surgical procedure type.

Haskins et al[58] conducted a nonexperimental study to investigate the incidence of postoperative wound infections following ventral hernia repair and the type of surgical hat worn, using data from the Americas Hernia Society Quality Collaborative database. Surgeons were sent a survey asking them what type of surgical hair covering they wear in the OR. The association of the type of hat worn, operative factors, and patient variables was compared with 30-day wound infections using multivariate logistic regression. A total of 68 surgeons responded, resulting in 6,210 cases analyzed. The researchers concluded that the type of surgical hat worn was not associated with an increased risk of 30-day SSIs or surgical site occurrences requiring procedural intervention. A limitation of this study design is that the survey may have introduced response bias. Furthermore, the survey did not capture the types of surgical hats worn by other team members in the OR and may have overgeneralized the type of surgical hat worn.

5.3.1 **An interdisciplinary team, including members of the surgical team and infection preventionists, may determine the type of head covers that will be worn at the health care organization.** *[Conditional Recommendation]*

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

Moderate-quality evidence suggests that ears are a potential reservoir for pathogens, although research has not demonstrated any association between covering the ears and SSI rates.

Katsuse et al[71] conducted a nonexperimental study of the earlobes and fingers of 200 nurses working at a university hospital to determine whether cross transmission could occur between bacteria-colonized pierced earring holes and fingers. *Staphylococcus aureus* was recovered from the earlobes of 24 nurses (19%) with pierced ears (n = 128) and seven nurses (10%) without pierced ears (n = 72). Of the nurses who were positive for *S aureus* (n = 31), 15 also had *S aureus* on their fingers, which included 12 from the pierced-ear group and three from the unpierced-ear group. With the exception of one nurse, the susceptibility patterns and genotypes of *S aureus* were identical for the earring hole and fingers. The researchers concluded that pierced earlobes can be a source of HAIs due to cross contamination from earring holes to fingers.

Covering ears may also prevent earrings worn by scrubbed team members from falling into the sterile field, which increases the patient's risk for SSI and 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 at the end of the shift or 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.**[26] *[Regulatory Requirement]*

5.5.2 **Establish and implement a process for managing reusable head coverings, including**

- **the type of fabrics (eg, nonlinting) that may be worn,**
- **laundering frequency (eg, daily), and**
- **laundering method (eg, facility laundering, home laundering).**

[Conditional Recommendation]

6. Shoes

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

In a systematic review, Rashid et al[72] found that shoes have the ability to transfer infectious organisms to the floor and contribute to floor contamination.

In a nonexperimental study, Amirfeyz et al[73] examined shoes worn outdoors and shoes worn only in the surgical suite (N = 120). 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]*

The OSHA regulations for foot protection[74] require the use of protective footwear that meets ASTM F2414 standards[75] 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 employees wear footwear that provides protection from identified potential hazards (eg, needlesticks, scalpel cuts, splashing from blood or other potentially infectious materials).[74] The National Institute for Occupational Safety and Health recommends wearing slip-resistant shoes for prevention of slips, trips, and falls.[76]

In a laboratory study, Barr and Siegel[77] 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.**[74] *[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.**[74] *[Regulatory Requirement]*

7. Identification Badges

7.1 **Clean identification badges with a low-level disinfectant when the badge becomes soiled with blood, body fluids, or other potentially infectious materials.** *[Recommendation]*

Moderate-quality evidence supports that identification badges may be contaminated with pathogens.

In a prospective cross-sectional study, Caldwell at al[78] cultured employee common access cards and identification badges in a burn unit. The overall contamination rate was 75%. There was an 86% bacterial contamination rate on the access cards and a 65% bacterial contamination rate on the identification badges. When the badges and cards were cleaned weekly, the contamination rate dropped to 50%, which indicated that even weekly cleaning appeared to have an effect on the contamination rate.

7.1.1 **Determine the frequency for routine badge disinfection (eg, daily, weekly).** *[Conditional Recommendation]*

7.2 **Clean lanyards with a low-level disinfectant when the lanyard becomes soiled with blood, body fluids, or other potentially infectious materials.** *[Recommendation]*

Moderate-quality evidence supports that lanyards may be contaminated with pathogens.

In a cross-sectional study, Kotsanas et al[79] 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.

8. Stethoscopes

8.1 **Clean stethoscopes before each patient use according to the manufacturer's instructions for use.** *[Recommendation]*

Moderate-quality evidence supports that hand hygiene and stethoscope cleaning by health care personnel decreases the risk of transmitting pathogens to patients and environmental surfaces.[52,80-90] Stethoscopes come in 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.

In a systematic review, Haun et al[52] examined bacterial contamination of health care personnel attire and other personal devices. The review found 72 studies that assessed contamination of a variety of items including stethoscopes. Pathogens recovered from these items included *Staphylococcus aureus,* MRSA, gram-negative rods, and *Enterococcus* species.

In a comparative study, Denholm et al[91] examined the microbial contamination levels of the stethoscopes of 155 physicians and medical students and compared personal stethoscopes with facility-owned stethoscopes. The researchers isolated significantly more organisms from personal stethoscopes than from facility-owned stethoscopes; however, there was no significant relationship between the frequency of stethoscope cleaning and the degree of contamination. The researchers concluded that even regular cleaning of stethoscopes may be insufficient to prevent colonization with pathogenic organisms and that stethoscopes used for patients at high risk for HAIs should be restricted to single-patient use.

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. The results of this study showed that stethoscopes could be significant contributors to MRSA infections and that they should be routinely cleaned and disinfected before and after each patient use.

9. Personal Items

9.1 **Establish a process to prevent contamination of the semi-restricted and restricted areas from personal items (eg, briefcases, backpacks). The process may include cleaning or containing the item or placing the item in a designated location.** *[Conditional Recommendation]*

Items brought into the semi-restricted and restricted areas, such as briefcases, backpacks, and other personal items, may be difficult to clean and may harbor pathogens, dust, and bacteria. Cleaning these items may help to decrease the transmission of potentially pathogenic microorganisms from external surfaces to perioperative surfaces and from perioperative surfaces to external surfaces.

9.2 **Clean cell phones, tablets, and other personal communication or hand-held electronic equipment according to the device manufacturer's instructions for use before these items are brought into the OR, and perform hand hygiene.** *[Recommendation]*

Moderate-quality evidence[52,92-100] demonstrates that cell phones, tablets, and other personal hand-held devices are highly contaminated with microorganisms, some potentially pathogenic. 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.

Datta et al[92] conducted a nonexperimental study to investigate the rate of bacterial contamination of the mobile phones of health care workers employed in a tertiary health care teaching hospital. Of the 200 health care workers' mobile phones sampled, 144 (72%) were contaminated with bacteria, and 18% of those bacteria were MRSA. The researchers concluded that simple measures such as regular cleaning of cell phones and other hand-held electronic devices and improving hand hygiene may decrease patients' risk of acquiring HAIs from pathogens carried on personal mobile devices.

9.3 **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 result in a retained foreign body.

10. Visitor Attire

10.1 **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 scrub attire or single-use jumpsuits 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.

Fomite: An inanimate object that, when contaminated with a viable pathogen (eg, bacterium, virus), can transfer the pathogen to a host.

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.

Restricted area: Includes the OR and is accessible only from a semi-restricted area.

Scrub attire: Nonsterile apparel designed for the perioperative practice setting that includes two-piece pantsuits and scrub dresses.

Semi-restricted 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 of instruments, and corridors leading to the restricted areas of the surgical suite.

Surgical attire: Nonsterile apparel designated for the perioperative practice setting that includes scrub attire (eg, two-piece pantsuits, scrub dresses), scrub jackets, and head coverings.

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External Review: Expert review comments were received from individual members of the American Association of Nurse Anesthetists (AANA), American College of Surgeons (ACS), Association for Professionals in Infection Control and Epidemiology (APIC), American Society of Anesthesiologists (ASA), International Association of Healthcare Central Service Materiel Management (IAHCSMM), Practice Greenhealth, and the Society for Healthcare Epidemiology of America (SHEA). Their responses were used to further refine and enhance this guideline; however, their responses do not imply endorsement. The draft was also open for a 52-day public comment period.

Financial Disclosure and Conflicts of Interest

This guideline was developed, edited, and approved by the AORN Guidelines Advisory Board without external funding being sought or obtained. The Guidelines Advisory Board was financially supported entirely by AORN and was developed without any involvement of industry.

Potential conflicts of interest for all Guidelines Advisory Board members were reviewed before the annual meeting and each monthly conference call. Nineteen members of the Guideline Development Group reported no potential conflict of interest.[1-5,7-10,12-18,20-22] Three members[6,11,19] disclosed potential conflicts of interest. After review and discussion of these disclosures, the Advisory Board concluded that none of the potential conflicts related to any content in this guideline.

Publication History

Originally published March 1975, *AORN Journal,* as AORN "Standards for proper OR wearing apparel."

Format revision March 1978, July 1982.

Revised March 1984, March 1990. Published as proposed recommended practices, August 1994.

Revised November 1998; published December 1998. Reformatted July 2000.

Revised November 2004; published in *Standards, Recommended Practices, and Guidelines,* 2005 edition. Reprinted February 2005, *AORN Journal.*

Revised October 2010 for online publication in *Perioperative Standards and Recommended Practices.*

Reformatted September 2012 for publication in *Perioperative Standards and Recommended Practices,* 2013 edition.

Revised September 2014 for online publication in *Perioperative Standards and Recommended Practices.*

Minor editing revisions made in November 2014 for publication in *Guidelines for Perioperative Practice,* 2015 edition.

Revised 2019 for online publication in *Guidelines for Perioperative Practice*.

Scheduled for review in 2024.