The purpose of this study was to examine operating room (OR) policies related to infection control and attire worn by Certified Registered Nurse Anesthetists (CRNA) and the attitudes of CRNAs toward these policies. A 20-question survey was distributed to a random sample of 3,000 members of the American Association of Nurse Anesthetists. The response rate was 26% (N = 790). Data collected were demographics, characteristics of OR attire protocols in surgical facilities, CRNA beliefs regarding infection control, and compliance with attire policies.

Same-day/ambulatory surgery centers were less likely to have formal protocols on OR attire than were inpatient hospital ORs. More than half (53.2%) of CRNAs reported being “always” compliant with attire protocols, but only 39.1% strongly agreed that their coworkers are compliant. CRNAs working in inpatient hospital ORs were more likely to report their coworkers as noncompliant with attire protocols, although there was no significant difference in reported personal compliance among groups. Experienced CRNAs tend to be more compliant with attire protocols. Implications for practice include evidence-based standardization of attire policies and encouragement of CRNAs’ participation in development of and compliance with policies to reduce surgical site infection rates.

Keywords: Infection control, laundering, operating room attire, surgical site infection.
Reusable cloth caps and cover garments are acceptable if they are also laundered daily or when visibly soiled. Shoe coverings should be used when there is a risk of splash contamination. Masks should be over the mouth and nose, secured tightly to prevent venting, and replaced between procedures. In addition to the AORN, the Centers for Disease Control and Prevention (CDC) made recommendations regarding OR attire. However, the CDC recommendations are less detailed and cite fewer studies than do the AORN guidelines. Unlike the AORN, the CDC does not put a strong emphasis on hospital-laundered OR attire. The CDC references Occupational Safety and Health Administration (OSHA) standards, noting that if the clothes are visibly soiled, OSHA mandates that the hospital provide OSHA-approved laundry facilities to clean the garment. The only evidence that the CDC cites in its recommendations is from a study about lab coats potentially increasing the spread of microbes. The CDC does acknowledge the problem of healthcare facilities having different policies regarding surgical attire and the different expert opinions behind them; some of its recommendations, such as changing clothes when they are visibly soiled, are based on common sense instead of proven evidence.

The American Association of Nurse Anesthetists (AANA) published The AANA Infection Prevention and Control Guidelines for Anesthesia Care. These guidelines address surgical masks, hair and shoe coverings, scrubs, and cover apparel. The guidelines parallel those of the AORN and emphasize following facility policy. They recommend the laundering of scrubs and reusable cloth caps daily or when visibly soiled. Home laundering in hot water, sodium hypochlorite, and detergent is permissible if no blood or microbial contamination is present. Laboratory (lab) coats are deemed potential sources of contamination and are not to be worn in the OR area.

Researchers have found that healthcare facilities that allow home laundering of scrubs and other OR attire demonstrate no significant increase in SSI rates. In contrast to this evidence, a case report of a single CRNA’s home-laundered attire led to Gordonia bronchialis in 3 postcoronary artery bypass patients. Researchers have noted that over time, regardless of laundering, scrubs are likely contaminated by the shedding of skin and skin flora. Healthcare professionals in nonsurgical settings typically launder their garments at home. The evidence suggests that for nonscrubbed OR staff, home laundering may be a clinically safe option, as long as certain strict conditions (ie, sufficiently high temperature, appropriate detergents, and heated drying and/or ironing) are met.

Peripheral to the infection control aspect, the likely financial advantages of home vs commercial laundering for healthcare organizations have also been identified.

One major problem with protocols regulating attire is low compliance due to lack of education, lack of enforcement, inconvenience, and/or conflict with individuals’ beliefs. According to the CDC, it is important for hospitals to develop a consistent standardized policy on surgical attire for the perioperative nurse. It is equally important to then enforce it by addressing the reasons for poor compliance.

This study was conducted to explore the ways in which OR attire protocols are being implemented at surgical facilities that employ CRNAs in the United States. It was guided by these 2 research questions: “What policies are in place to standardize the attire worn by CRNAs in the operating room for the purpose of infection control?” and “What are CRNAs’ beliefs and compliance with operating room attire policies?”

Materials and Methods

Following institutional review board approval, data for this study were collected using the Operating Room Attire Assessment Tool, a 20-question survey developed by the researchers and divided into 4 sections focused on demographics, beliefs, institutional policy, and personal practice regarding compliance with attire protocols. Five experts evaluated this tool for content validity.

The AANA Research Services distributed the data collection tool. The AANA manages email surveys on a secure server for researchers who plan to collect data from AANA members. The AANA Electronic Survey Application was completed and approved by the AANA. An email was sent to 3,000 CRNA members of the AANA who were randomly selected by a computer-generated random draw method. Random selection is based on computer-generated numbers with a uniform distribution, and there is an equal probability of getting any one random number as another. The email included a link to the secure online data collection tool and the cover letter. The participants were informed there were no direct benefits or risks associated with study participation or penalties for opting out. The participant could withdraw from the research at any time before submission of the data; however, once submitted, the data could not be withdrawn. The data collection tool was available for 2 weeks and took approximately 10 minutes to complete. Seven days before the survey deadline the AANA sent an electronically mailed reminder to the selected study participants.

CRNAs’ beliefs regarding infection control and attire in the OR setting were assessed using 5-point Likert scales with possible responses of “strongly disagree,” “disagree,” “neutral,” “agree,” or “strongly agree” for each question. Questions addressed beliefs regarding impacts of commercial laundering and home laundering on SSI risk as well as whether their clothing or the clothing of nonsterile OR staff presents infection risk.

Specific questions were asked to identify policies and
practices that exist regarding OR attire requirements for CRNAs. Questions included the type of protocol at the primary place of employment, methods of protocol education, laundering methods, mandatory and prohibited attire, and mandatory attire changes between surgical procedures. The respondents were asked to select all that apply to each question except type of protocol and laundering methods, which asked for a single response. The CRNAs were also asked about their compliance with OR attire protocols. Responses were via 5-point Likert Scales and the respondent could choose answers ranging from “strongly disagree” to “strongly agree” or “always” to “never,” depending on the question. The data were examined and met the assumptions for descriptive statistics, \( \chi^2 \) analysis, and analysis of variance. These analyses were performed using SPSS version 20 (IBM Corp). \( P \) values < .05 were considered statistically significant.

Results

- **Demographic Information.** A total of 790 of the 3,000 subjects responded, for a 26% response rate. The demographic data collected are detailed in Table 1. The largest group of respondents worked in inpatient hospital ORs (62%). There were no significant differences between the types of education provided at different facilities.

- **Operating Room Attire Policies.** Frequency data for type of protocol and laundering protocol at each type of facility are detailed in Figure 1. Most facilities (71.6%) have a formal protocol in place. The majority of CRNAs have scrubs laundered commercially and personal items (reusable hats, jackets, and lab coats) laundered at home (Figure 2). Items of attire that are mandated or prohibited at each type of facility are detailed in Figure 3, where the results for office, pain clinic, and military facilities are included with “other” responses because of extremely low representation in the sample.

When the authors examined the OR attire protocols in place at different types of facilities, there were statistically significant differences between the types of protocol (formal/informal/none). Same-day surgery facilities and ambulatory surgery centers are significantly more likely to have no protocol in place (\( P = .012 \)). There were significant differences between the specific laundering protocols at different types of facilities. Inpatient
hospital ORs are significantly more likely to have scrubs laundered commercially with personal items laundered at home. Same-day surgery/ambulatory surgery centers are significantly more likely to have both scrubs and personal items laundered at home (P = .001).

• Nurse Anesthetist Beliefs and Practices Regarding Attire. The overall frequency of responses to questions about the beliefs of CRNAs regarding OR attire and infection control, as well as the practices of CRNAs regarding compliance with OR attire policies, is shown in Figure 4. Most CRNAs (65.1%) surveyed indicated that they are “always” compliant with mandatory attire at their primary place of employment, and 53.2% indicated that they are “always” compliant with both mandatory and prohibited attire. Fewer CRNAs (31.9%) indicated that they “strongly agree” that their coworkers are compliant with attire protocols. CRNAs working at inpatient hospital ORs were statistically significantly less likely to report that their coworkers are compliant with protocols than those working in outpatient hospital ORs (P = .044).

Several experience subgroups of CRNAs demonstrated significantly different responses in the beliefs section of the data collection tool. There was a statistically significant difference between groups responding to the prompt, “It is best for the OR attire worn at my primary place of employment to be standardized in a protocol.”
Those CRNAs with 0 to 5 years of experience were significantly less in agreement with the statement than CRNAs with 6 to 10 years' experience ($P = .038$), 16 to 20 years ($P = .015$), 21 to 25 years ($P = .001$) and 25 or more years ($P = .033$). There was a statistically significant difference between experience groups response to “I am compliant with wearing OR attire that is required by protocol at my primary place of employment.”

CRNA beliefs about laundering methods as means of infection control did not significantly differ among groups at facilities with different laundering protocols.

**Discussion**

- **Protocol Variation.** This study shows that attire protocols in surgical facilities nationwide are varied, a situation reflected by current guidelines including the CDC's, which acknowledge that there are no nationally standardized guidelines regarding appropriate OR attire or laundering practices. In an examination of the attire that is mandatory and/or prohibited at various facility types, some items are less consistently regulated than others (particularly cloth caps, long-sleeved undershirts, and personal jackets). This may be due to nonuniform recommendations from experts, literature, and professional organizations,
particularly the AANA and AORN. Future research into SSI rates by facilities with or without protocols in place for these items may assist in determining best practices based on actual patient impact, if any, vs lab research on materials that is extrapolated into theoretical risk.

- **Nurse Anesthetist Beliefs.** This study also demonstrates that CRNAs tend toward certain opinions regarding attire and infection control. Overall, more than two-thirds of participating CRNAs (68%) believe it is best practice to have a standardized policy in place for OR attire, although most CRNAs (63.9%) disagree or strongly disagree that clothing they wear poses an infection risk to patients. Further study could determine whether CRNAs believe that current protocols are already highly effective in reducing infection, or if the belief that attire should be standardized is independent from the idea that it provides infection control. Research has shown that scrubs worn by nurses while conducting patient care do become contaminated. However, only 3 documented cases of SSIs linked to the home-laundered attire of a single CRNA who cared for those patients. Conflicting recommendations based on anecdotal experience or dogma rather than based on evidence may decrease CRNA buy-in for a change to an attire policy.

- **Compliance With Protocols.** Although 53% of the respondents in this study reported that they are always compliant with attire policies in place for both mandatory and prohibited items, 10.1% reported being rarely or never compliant. It would be worth further examining the specific motivations behind noncompliance. Some possible reasons for this are personal beliefs or the desire for individuality when base clothing is facility-provided.

- **Laundering.** One aspect of attire regulation in which policy seems to closely follow the evidence is laundering. Although expert organizations recommend washing temperatures of 71.2°C (160°F), lower temperatures down to 60.0°C (140°F) are considered acceptable so long as laundry chemicals (eg, chlorine bleach) and high temperature drying techniques are used. This is not consistently feasible in the home laundry because of variation in machine function, temperature in dryers, and home water temperature. Many homeowners lower their water heater’s temperature to avoid scald injuries, and have limited capacity for chemical additives. Most (79.8%) of the surgical facilities represented in this study commercially launder OR scrubs. Commercial laundering of personal attire items for the staff was done by 18.9% of the facilities. Approximately 48% of CRNAs surveyed agreed or strongly agreed that commercial laundering reduces SSI rates. This may be due to the perceived reliability of commercial laundering facilities in providing more “intense” cleaning (ie, high heat, strong detergents) than attire is likely to receive in most homes.

**Conclusion**

With the reduction of iatrogenic infections (including SSIs) as a top goal in patient safety reports and the Institute of Medicine reporting that current medical knowledge and practice may help reduce nosocomial infection rates, it is imperative the healthcare industry use evidence to create best practices to reduce SSIs. At the same time, the healthcare industry must try to avoid potentially costly and unnecessary requirements—a delicate balancing game. Close examination of current literature on best practices for attire in the OR is needed to generate standardized protocols applicable to surgical settings that promote safe, cost-effective, professional practice for the CRNA. Professional organizations, healthcare management, and most importantly CRNA leadership need to work collaboratively to overcome barriers to policy development, implementation, education, and adherence.

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**DISCLOSURES**

The authors have declared no financial relationships with any commercial entity related to the content of this article. The authors did not discuss off-label use within the article.