

Does the Type of Surgical Headwear Worn in the OR Matter? A Review of Evidence and Opinions

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ABSTRACT

Proper surgical attire is essential in decreasing surgical site infections; however, the effectiveness of the different types of headwear is a controversial topic. We conducted a narrative review based on studies identified through a focused literature search to summarize and critically assess evidence and opinions on the most appropriate type of headwear for OR personnel. We included 48 articles: 17 original research studies and 31 non-peer-reviewed articles of various types. Research published before 2014 mostly supports the complete coverage of all hair, which aligns with the 2015 AORN guidelines. However, more recent literature rebuts these guidelines and emphasizes the importance of clean headwear. Although earlier studies (published before 2017) lacked scientific rigor, later studies (published after 2017) have other various limitations, including missing data on compliance, surgery-related techniques, and surgical attire other than headwear. The findings from this review highlight the importance of solid evidence-based guidelines and expert collaboration.

Key words: *surgical headwear, skull cap, bouffant cap, grey literature, surgical site infection.*

Providing patients with surgical care is an essential component of health care systems;¹ however, it carries several risks, including bleeding, thrombosis, cardiorespiratory complications, and surgical site infection (SSI).^{2,3} Achieving optimal surgical outcomes is dependent on team members meaningfully adopting evidence-based best practices that involve both procedural and human factors.

Health authorities around the world have created surgical outcome quality improvement tools and programs, such as the Surgical Safety Checklist,^{4,5} Enhanced Recovery After Surgery,⁶ and the National Surgical Quality Improvement Program.^{7,8} In addition, standard practice recommendations have been made for both patients and surgical team members to improve clinical outcomes. Some of the standard

presurgical preparations implemented to reduce the risk of SSIs include preoperative bathing of the surgical site with chlorhexidine gluconate, mechanical bowel preparation,⁹ surgical antibiotic prophylaxis and timing,¹⁰ and patient hair clipping rather than shaving.¹¹ Successful adoption of these standards into practice requires the surgical team members to acknowledge their importance and subsequently integrate these practices into their everyday workflow.

Similar standards exist to maintain the sterility of the surgical team, including adhering to surgical scrub techniques and wearing appropriate surgical attire. There is wide consensus on the recommendations for the use of sterile surgical gowns. However, there has been much debate over the use of different types of surgical headwear and their potential link to SSIs.¹²⁻¹⁸ In fact, this issue is so divisive

that it has made its way into more mainstream media with sensational titles such as “The skullcap feud,”¹⁹ “Surgeons are furious! The bouffant vs. the skull cap,”²⁰ and “Bouffant caps versus skull caps in the operating room: a no holds barred cage match.”²¹

PURPOSE

In this article, we will review, appraise, and summarize the quality of the available evidence for the use of bouffant versus skull caps in the OR in an attempt to inform future evidence-based decision making. We used the PICOS (population, intervention, comparison, outcome, study type) framework for our evidence-based analysis:²²

- problem or population studied = headwear type and its effect on SSIs,
- intervention = change in headwear worn during surgery,
- comparison = comparison of headwear types,
- outcome and results = any outcomes related to SSIs, and
- study design and methodology = all study types and nonoriginal research.

METHODS

We performed a review of the literature exploring the effect that OR team members' headwear had on SSIs. In our initial literature search, we specifically concentrated on the past 10 years and assessed research comparing bouffant cap versus skull cap headwear. Because many of the guidelines, commentaries, and opinion letters are based on academic literature older than 10 years, we performed additional snowball sampling to collect all articles cited as evidence for possible SSIs resulting from insufficient or missing head coverings for inclusion in our review. Given the anticipated paucity of evidence and issues of culture and identity that we expected to play a significant role in decision making regarding surgical headwear, we also included opinions, society positions, guidelines, and perspectives.

A research librarian conducted a focused literature review in September 2020 and included articles published from January 1, 2010, to the date the search was performed. They consulted three medical databases—Medline (Ovid), CINAHL (Cumulated Index to Nursing and Allied Health Literature), and PubMed—and performed a Boolean search using the key words *operating room** AND (*headgear* OR

headwear OR *hat**). The search resulted in 27 total articles: n = 4 (Medline), n = 6 (CINAHL), and n = 17 (PubMed). After eliminating duplicates, a total of 16 articles remained for assessment.

We performed a review of the literature exploring the effect that OR team members' headwear had on SSIs.

The final 16 articles explored or commented on the use of various types of headwear in the OR such that no additional selection criteria were applied. These articles included seven original peer-reviewed research studies, six letters, two commentaries, and one perspective.

We then evaluated the reference lists of these 16 articles for additional evidence and opinions for wearing specific headwear; 32 studies published from 1965 to 2019 were selected for inclusion in our review. The final total comprised 48 articles: 17 original research and 31 nonresearch. The 17 original research articles included

- retrospective analyses before and after an intervention (n = 5),
- prospective intervention studies (n = 5),
- case studies (n = 3),
- explorative studies (n = 2), and
- surveys (n = 2).

The 31 grey literature and nonprimary research articles included

- opinion letters, viewpoints, and perspectives (n = 12);
- reviews (n = 5);
- news articles (n = 4);
- editorials and commentaries (n = 3);
- statements (n = 3);
- guidelines (n = 2); and
- letters describing experiments (n = 2).

Data Abstraction and Analysis

For the data abstraction, the authors developed a PICOS-informed data collection sheet that included the following headings:

- year of publication and author(s),
- problem investigated or topic of the study (eg, contribution of hair or hair covering types to SSI) and population,
- study design and intervention or data types collected in the study (eg, contamination or SSI rates),
- comparison of headwear types or alternative protection intervention,
- study outcome and results as they relate to SSI and bacterial contamination rates, and
- study design and methodology with no restriction on study type.²³

Study limitations, biases, and author recommendations were also collected. Findings from the original research studies are collated in [Supplementary Table 1](#).²⁴⁻⁴⁰

To be as inclusive as possible, we also report on practice guidelines and recommendations, opinion papers, editorials, and newspaper articles. Structured data extraction from these non-peer-reviewed articles (eg, magazine articles) and other *grey literature* (eg, opinions in mainstream media) included the type of article, the topic (eg, headwear comparison, the relevant source to which the authors responded), the outcome, and the authors' own recommendation and opinion on headwear use. A list of these articles and a summary of findings is provided in [Supplementary Table 2](#).⁴¹⁻⁶³

Data Analysis and Critical Appraisal

Two evaluators (S.B., B.C.S.) descriptively analyzed the data and appraised each research article. They used the Joanna Briggs Institute checklist for systematic reviews and research synthesis⁶⁴ to assess the methodological quality and to scrutinize whether biases and limitations were adequately addressed. They considered the headwear recommendations in the studies, opinion letters, and commentaries.

FINDINGS

The tremendous increase in grey literature and peer-reviewed research articles published from 2017 to 2019 reflects the increased interest in types of surgical headwear. We collected articles on the bouffant-versus-skull-cap debate from the past 10 years to assess and

synthesize the evidence on risks and benefits of different types of headwear. Many of these more recent articles were based on studies published in preceding decades that investigated the effect of covering the hair and head in the OR.

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Recommendations Issued by Learned Societies

The recommendations for head coverings included the use of a clean surgical head cover or hood to cover the ears, sideburns, and scalp skin of the entire top and back of the head rather than a smaller skull cap, which only covers the top of the head and leaves the ears, nape, and sideburns uncovered.⁶⁵ The American College of Surgeons (ACS) did not endorse this recommendation, citing insufficient evidence "that leaving ears, a limited amount of hair at the nape of the neck, or modest sideburns uncovered contributes to wound infections."⁴⁸ Additionally, after a 2018 joint meeting of American professional perisurgical organizations (ie, ACS, AORN, American Society of Anesthesiologists, Association for Professionals in Infection Control and Epidemiology, Association of Surgical Technologists, Council on Surgical and Perioperative Safety), ACS issued a statement reporting that current scientific evidence does not show any association between SSI rates and the type of hat or the extent of hair coverage, and that "covering the ears is not practical for surgeons and anesthesiologists and in many cases counterproductive to their ability to perform optimally in the OR."⁵⁷ The ACS endorses the use of the paper or cloth skull cap as long as they are clean, changed every day, and not worn outside the OR.⁴⁸ The Operating Room Nurses Association of Canada recommends that "[a]ll facial and head hair shall be completely confined by a clean hat, hood, balaclava, and/or beard cover,"^{66(p2-25)} but does not explicitly favor one type of head covering over another.⁶⁶ In addition to policies and position statements of different professional bodies in North America, the academic literature includes several articles about surgical

headwear. These include primary research findings and reviews of the literature as well as opinion letters and commentaries on the types of headwear deemed most appropriate for the OR.

The Case for the Bouffant Cap

The recent dispute about types of headwear in the OR was sparked by the 2015 AORN surgical attire guideline, which suggested that ears and all hair should be covered by the headwear of surgeons and surgical staff members in the OR.⁶⁵ The AORN guideline and recommendations were based on research identifying the hair^{24-27,29,30,32} and scalp²⁷ as potential sources of pathogenic microorganisms that cause SSI outbreaks. These studies involved recording bacterial colony counts during mock surgeries^{26,28,30} as well as case reports investigating bacterial outbreaks in hospitals that were traced back to bacterial contaminants from surgical staff members.^{25,27} Staphylococcal bacteria adhere tightly to human hair shafts²⁹ such that both AORN and the Operating Room Nurses Association of Canada have recommended the nonexposure of hair for both surgical personnel and patients. In addition, authors of one study found that ears harbored a greater number of bacteria than exposed eyebrows and the forehead and called for coverage of ears in the OR.³¹ Because skull caps leave the ears, hair at the nape of the neck, and sideburns exposed, AORN recommended the wearing of alternative head coverings whereby all hair is covered. When worn correctly, bouffant caps cover the ears and all hair and are purported to limit surgical site contamination by microbiota from the uncovered scalp hair and ears of surgical staff members.³⁰

Many of these early studies did not include a thorough analysis of confounding variables and potential limitations in their study designs, although interference with the type of laminar airflow in the OR was mentioned. As an example, Friberg et al³⁰ suggested that the direction of airflow—specifically, turbulent OR ventilation versus vertical laminar airflow—affects microbial dispersion in the OR, with turbulent ventilation doubling air contamination and thus potentially increasing the risk of SSI. Similarly, Humphreys et al²⁸ concluded that reduced bacterial counts were related to ventilation rather than headgear and recommended that only scrubbed (as opposed

to casual or nonscrubbed) staff members wear disposable headgear, citing cost effectiveness. This is in direct contrast with the findings of Mastro et al²⁷ based on the outbreak investigation of SSIs that highlight the importance of considering the potential contamination that may originate from personnel other than surgeons. Surgical site infection tracing efforts have identified that personnel can be the source of infection even when they are not present in the OR during a surgical procedure but were involved with preoperative and postoperative preparation and cleaning of the OR.²⁷

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The Case for the Skull Cap

Many surgeons have argued that skull caps are more comfortable; research shows that surgeon comfort is an important factor in patient outcomes for prolonged surgeries that can last many hours.⁴² In 2017 and 2018, in response to the AORN guideline recommendation, several studies were conducted to either assess SSI rates before and after implementing changes based on the revised guideline^{36,37,39,40} or compare the bouffant cap to the skull cap by measuring microbial dispersion in mock surgeries.³⁵ The bulk of this research showed no difference in OR contamination after surgical staff members adopted the 2015 AORN surgical attire guideline. For example, one study of 15,000 class I neurosurgical procedures showed that the use of bouffant caps did not significantly ($P = 1.0$) decrease SSIs over a prospective follow-up period of 13 months.³⁶ A multivariable logistic regression analysis of ACS National Surgical Quality Improvement Program data for 6,000 patients in the nine months before and after implementing the AORN guideline recommendation did not find an association between type of OR headwear and SSI rates.³⁷ However, the studies comparing the number of SSIs before and after the adoption of the 2015 AORN surgical attire guideline also have a variety of limitations and confounding variables.

- In most cases, only the headwear of the surgeons was recorded, and the headwear worn by other personnel present in the OR was not recorded or ensured.³⁴
- The surgeons' procedure volume and operating techniques may have differed before and after the guideline change.³⁹
- Differences in OR attire before and after the adoption of the 2015 AORN surgical attire guideline were not restricted to headwear (eg, bouffant versus skull cap) and included changes in other types of OR attire.^{37,40}

In addition, studies may not show significant differences in SSI rates between contrasting types of headwear.^{37,38}

Based on two independent assessments of the scientific quality of the 17 peer-reviewed studies using the Joanna Briggs Institute critical appraisal tool, we found that the earlier studies (ie, published between 1965 and 2013²⁴⁻³²) lacked the rigorous scientific methodology regarding statistical analysis and assessment of bias and limitations that characterized the later studies (ie, published between 2017 and 2019³³⁻⁴⁰). Although the earlier publications did not specifically investigate different types of headwear but rather the general effect of exposure of hair and ears in the OR on SSIs rates, some of these findings^{24,25} likely guided the 2015 AORN recommendations for the use of bouffant caps.

Disposable Versus Cloth Headwear

Another area of debate is the role of disposable versus cloth headwear. We found only four studies when searching for literature using *cloth* and *disposable* as search terms.^{28,30,35,38} On full review of these articles, only Markel et al³⁵ compared disposable bouffant and skull cap hats and newly laundered cloth skull caps. Hat fabric was also tested for permeability, particle transmission, and pore sizes. The study concluded that disposable bouffant hats should not be considered superior to disposable or cloth skull caps because they had the greatest permeability, penetration, and microbial shed. When cloth skull caps were compared to disposable skull caps, they found no differences in terms of microbial or particulate shed. The study recognized that differences in materials and brands of headwear can influence the porosity and microbial shed. Importantly, testing was performed on clean cloth skull caps, and often many cloth hats are not laundered daily. Therefore, no conclusions can be made on dirtier, unwashed headwear that could possibly

lead to different penetration, transmission, and airborne contaminants.³⁵ According to the ACS 2016 *Statement on Operating Room Attire*, "Like OR scrubs, cloth skull caps should be cleaned and changed daily. Paper skull caps should be disposed of daily and following every dirty or contaminated case."⁴⁸

Opinions From the Grey Literature

To evaluate surgical professionals' tendency toward or preference for either bouffant or skull caps, we examined opinions collected from letters, commentaries, reviews, and other grey literature. A major concern that emerged from the grey literature was that the strict 2015 AORN surgical attire guideline was not grounded in sufficient evidence to support the complete hair, scalp, skin, sideburns, and nape of the neck coverage requirement to minimize SSIs in the OR. The 2015 AORN surgical attire guideline was based on prioritizing patient safety and providing the cleanest surgical environment possible, erring on the side of caution. Aligning with the surgeons' call for skull caps, the ACS offered a statement allowing skull caps to be worn if certain conditions are met, such as covering "close to the totality of hair" and cleaning and changing the caps daily.⁴⁸ These conditions were echoed in a *Healthcare Purchasing News* opinion letter;⁵³ however, no specific guidelines were offered for monitoring adherence to these rules.

The 2015 AORN surgical attire guideline was based on prioritizing patient safety and providing the cleanest surgical environment possible, erring on the side of caution.

Despite new research into the bouffant-versus-skull-cap debate, outcomes and opinions are still conflicting. A brief summary of the opinions and recommendations of the literature included in this review is provided in [Table 1](#). Some authors argue for more research^{42,47,56,58} and greater cooperation and coordination to develop and deliver evidence-based care;¹⁴ others see a need to include stakeholder opinions, calling for open dialogue and collaborative efforts that would see continuous review and reevaluation of policies.^{60,63} Several authors are of the opinion to leave the choice of headwear type to the surgeons.^{13,52,58,59} One survey of 317 American surgeons

Table 1. Recommendations Regarding Surgical Headwear as Suggested by the Authors of the Reviewed Articles

Recommendation	Original Research Articles (N = 17)	Other Literature (N = 27) ^a
Skull cap preferred	1	0
Bouffant cap preferred	0	1
All hair and ears should be completely covered	4	6
Headwear required, type unspecified	0	2
Either type of headwear is permissible; should be surgeon's choice	3	5
More research is necessary	2	5
Insufficient evidence	2	6
Other ^b	5	2

^a Four news articles that made no recommendations were excluded.
^b Other recommendations: following strict OR attire policy, checking personnel for contaminants, and performing general hygiene.

under the age of 45 years found that policies mandating the use of bouffant caps were perceived as intrusive, restrictive, and reducing surgeon morale, in addition to not being evidence-based.¹⁵

Presumably, under the pressure of the conflicting literature and intensified by a viewpoint article that pointedly and intensely disagreed with the 2015 AORN surgical attire guideline,¹⁶ and based on emerging evidence from 2015 to 2018, AORN revised the guideline in 2019 whereby they stated that “no recommendation could be made for the type of head covers worn,”^{62(p435)} and that an interdisciplinary team, including surgical staff members and infection prevention professionals, can determine the type of head cover worn at the facility.⁶²

DISCUSSION

Health care leaders should choose efforts and initiatives aimed at quality improvement carefully because these carry the potential to consume resources while conferring little to no benefit—potentially fueling controversy. The same is also true when a benefit is falsely attributed to implementing a change that challenges the status quo without full knowledge of the potential harms to patients and risks to the overall surgical quality improvement. An accurate,

robust, and objective assessment of risks and benefits of new guidelines is of particular importance when considering the context of the net benefit to patients and health care systems. This review showed that the institution of stricter guidelines regarding headwear worn in the OR has not been associated with a reduction in SSI rates.

The research conducted to date is not entirely conclusive because of a variety of limitations and, as such, provides no definitive answer to end the debate. Limitations in selected studies include lack of knowledge regarding the headwear worn by personnel other than the surgeon in the OR, changes in other OR attire concomitant to changes in headwear, effect of laminar airflow on infectious agent dispersion in the OR, limited numbers of mock surgery studies, and bias regarding the gender of the surgeons participating in the studies. Optimal studies to quantify SSI rates and associated surgical headwear are challenging and pose an ethical dilemma because they increase risk and can potentially harm participating patients.

There is no clear advantage for one particular type of headwear, and we are still left with weighing a “better safe than sorry” approach for bouffant caps versus comfort and personal preference for skull caps, particularly for lengthy procedures. We should consider questions such as the following.

- How much discomfort and distraction do bouffant caps cause?
- Do bouffant caps interfere with surgical performance and communication among the surgical team?
- How much of surgeons' professional identity comes from “looking like a surgeon,” and how does wearing a bouffant cap affect this identity?
- If caps have to be adjusted during surgical procedures, is this a source of contamination?
- What value should be attributed to team morale and to having the freedom to choose one's own clothing?
- Must every item of the surgical team's clothing be approved and provided by the institution, including shoes and eyewear?
- What value might be achieved by a consistent “team uniform” to support a culture of safety?
- Where is the line drawn between personal freedom, institutional policy, and accountability for surgical outcomes?

Key Takeaways

- ◆ The purpose of surgical attire is to help prevent surgical site infections (SSIs). The effectiveness of different types of headwear is a controversial topic. In 2015, AORN published an updated guideline recommending that the hair and ears of all surgical team members be completely covered in the OR.
- ◆ Some groups, including the American College of Surgeons, debated the strength of the evidence on which this guideline was based, leading to heated discussion and more research, opinion pieces, and other grey literature. This article reviews, appraises, and summarizes the quality of the available evidence for the use of bouffant versus skull caps in the OR in an attempt to inform future evidence-based decision making.
- ◆ Much of the literature on which the 2015 guideline update was based identified hair as a potential source of pathogenic microorganisms and a cause of SSI outbreaks. However, these articles did not specifically investigate different headwear types, but rather the general effect that hair and ear exposure had on SSI rates. Many of these articles also lacked rigorous scientific methodology.
- ◆ In response to the recommendation, several new studies were performed to assess SSI rates before and after the change. The bulk of this research found no difference in OR contamination after surgical staff members adopted the AORN recommendation. However, the research is not entirely conclusive because of a variety of limitations (eg, type of headwear not recorded, inconsistent procedure volumes and operating techniques) and provides no definitive answer to end the debate.

Although these pertinent questions remain largely unanswered, there has been some recent progress made regarding the debate on the cultural, religious, and personal values surrounding choice of headwear. In May 2021, AORN updated its 2019 surgical attire guideline to address religious head coverings.⁶⁷ 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. Therefore, according to the current guideline,

Religious head coverings (eg, head scarves [hijabs], veils, turbans, bonnets) that are clean, 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 area.^{67(p1096)}

Additionally, facilities should

[e]stablish and implement a process for managing reusable head coverings (eg, cloth personal head coverings, religious head coverings), including the type of fabrics ... laundering frequency ... and laundering method (eg, facility laundering, home laundering)....^{67(p1096)}

We found a lack of a clear and definite recommendation for headwear preference, which suggests that the choice should be left to the surgeon or surgical team members. In addition, our results show that there is a need for additional research and evidence-based guidelines that are re-evaluated in a collaborative manner. AORN is setting the tone for this type of collaboration by working with the American Association of Nurse Anesthesiology, ACS, American Society of Anesthesiologists, Association for Professionals in Infection Control and Epidemiology, Healthcare Sterile Processing Association (formerly the International Association of Healthcare Central Service Materiel Management), Society for Healthcare Epidemiology of America, and Surgical Infection Society.

LIMITATIONS

Our review is subject to limitations. We did not include a systematic search of all literature. Our study was performed with a narrow search strategy resulting in a small number of citations. We mitigated this concern to some degree using snowballing techniques to search citations and identify additional important literature. Our approach is likely to capture the most important and influential articles but is unlikely to provide a comprehensive review of the literature. Consequently, articles

reporting on evidence for either the bouffant or the skull cap might have been missed. Similarly, our collection of grey literature is not exhaustive and may represent only a snapshot of opinions, letters, and other commentaries on the subject. However, our goal was not to meet the stringent guidelines of a systematic review, but to explore the evidence, opinions, and recommendations in the current literature to guide decision making on surgical headwear.

CONCLUSION

Our review considers both the science and the current opinions on the evidence (or lack thereof) for choice of surgical headwear as a cause of SSIs. Evidence in recent years suggests that there may be no difference in SSI rates associated with the type of headwear worn by surgeons in the OR and that neither type of headwear holds a clear advantage over the other. Guidelines on this topic should be evidence-based and steered by the collaborative efforts of interdisciplinary teams that include stakeholders, surgical staff members, and infection prevention specialists. The 2015 AORN guideline recommendations on surgical headwear—and their subsequent repeal in 2019—are proof of the continued challenge to find conclusive scientific evidence to support one practice over another.

SUPPORTING INFORMATION

Additional information may be found online in the supporting information tab for this article.

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