Personal Protective Equipment (PPE): Headwear Literature review

Evidence Tables

Version: 1.0

12 March 2026

Antimicrobial Resistance & Healthcare Associated Infection (ARHAI) Scotland
An NHS Scotland Assure Service

Version history

This literature review will be updated in real time if any significant changes are found in the professional literature or from national guidance/policy.

Version	Date	Summary of changes
1.0	12 March 2026	New Document

Contents

Introduction

All studies which are critically appraised as part of the literature review are assigned a grade of evidence based on the SIGN 50 methodology grading system (SIGN, 2004), which allows scientific studies to be assessed for quality using a number of reviewing forms (available from the SIGN website).

The main conclusions from the studies are summarized along with a brief description of the study quality in an Evidence Table. Studies, which have sufficient quality and specifically answer a defined research question are grouped together to enable formation of a “considered judgment” based on this information. This “considered judgment” is then used as the basis for formulation of recommendations.

This system allows formulation of recommendations supported by good quality observational studies in the case when RCTs are not available for practical or ethical reasons, as is generally found in infection control literature.

Levels of evidence

The following grades were given to the papers included in this evidence table:

SIGN 50 Evidence Levels

Grade	Description
1++	High quality meta analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Grade	Description
1-	Meta analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High quality systematic reviews of case-control or cohort studies. High quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well conducted case control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal
3	Non-analytic studies, for example case reports, case series
4	Expert opinion

AGREE II Evidence Levels

Grade	Description
AGREE 'Recommend'	This indicates that the guideline is of high overall quality and can be considered for use in practice without modifications.
AGREE 'Recommend with modifications'	This indicates that the guideline is of moderate overall quality. This could be due to insufficient or lacking information in the guideline for some items. If modifications are made, the guideline could still be considered for use in practice when no other guidelines on the same topic are available.
AGREE 'Do not Recommend'	This indicates that the guideline is of low overall quality and has serious shortcomings. Therefore, it should not be recommended for use in practice.

Research questions for evidence tables

Question 1: What type(s) of headwear are available for use in health and care settings?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hafinani EM, Cassier P, Aho S, et al. Guidelines for clothing in the operating theatre, 2021. Anaesthesia Critical Care & Pain Medicine. 2022; 41(3): 101084.	**Guidance, France**	**AGREE-II: Recommend with Modifications**	N/A	N/A	N/A

Assessment of evidence

Guidelines were developed jointly by the French Society of Hospital Hygiene (SF2H) and the French Society of Anaesthesia and Intensive Care Medicine (SFAR) to support decision-making on operating theatre attire. They focus specifically on surgical staff headwear and exclude surgical draping, gowns, patient garments, and PPE.

The guideline development involved a committee of experts with no reported conflicts of interest. Evidence was reviewed using PubMed and clinicaltrials.gov, appraised with the GRADE approach, and validated through expert consensus, although search strategies, evidence grading details, and several methodological elements were not reported.

Two key research questions were addressed:

1. Do reusable head coverings have advantages over single-use?
2. Does covering the ears (bouffant or surgical headgear) reduce infection risk more effectively than skullcaps?

Recommendations

- Experts suggest staff should wear head coverings (bouffant cap, skullcap, headgear) to minimise infection risk.
- The recommendations are largely based on expert opinion due to limited high-quality evidence.

Limitations

- Limited detail on search methods, evidence summaries, external review, update plans, and patient/target user perspectives.
- Evidence reporting is high-level and likely overlaps with previous expert opinion.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

The following recommendations are made:

- “There are many kinds of head coverings that can be worn in the perioperative environment, including bouffant caps and skull caps, which can either be reusable or disposable”
- “An interdisciplinary team at the health care organization should determine what kind of head coverings can be worn”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice {The Association for Perioperative Practice (AfPP), 2022, (AfPP). Standards and Recommendations for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre"

The following recommendation was found relevant to the research question

- "Disposable headwear is preferable; however, cloth hats are permissible if laundered and inspected for holes/imperfections in an approved facility and not at home. Bouffant and hood style covers are preferred as they cover hair, ears and hair at the nape of the neck"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Bailey, CR, Greatorex, B. Hyde, Y et al. Association of Anaesthetists of Great Britain & Ireland Guidelines - Infection prevention and control 2020 Accessed 31 October 2024	Expert Opinion, Ireland and UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

These guidelines produced by the Association of Anaesthetists are presented for the organisational management of infection prevention and control. The advice presented is based on published data, clinical studies and expert opinion.

- "Theatre caps should be worn in laminar flow theatres during prosthetic implant operations, and it is the Working Party's view that their general use should continue."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Canada. Infection Control Guidelines: Classic Creutzfeldt-Jakob Disease in Canada. 2002 Accessed 03 May 2024	Expert Opinion	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"This guideline provides a framework within which institutions and agencies may develop policies and procedures to address their needs through providing an overview of CJD and other human TSEs, including modes of transmission, is presented to provide a background and the recommendations in Canada"

The following recommendation is made in regard to surgical procedures of CJD patients.

- "HCWs should wear appropriate single-use personal protective equipment, such as gloves, liquid-repellent gowns, fluid-resistant aprons, head and foot coverings, face shields, and masks". This recommendation is graded as a category B.
- "Single use items should be used whenever possible" – Category B recommendation

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). AST Standards of Practice for Surgical Attire, Surgical Scrub, and Hygiene and Hand Washing. 2008. Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion.

Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made

Assessment of evidence

"Surgical attire that should be worn in the semi-restricted and restricted areas of the surgery department includes the head cover, masks, scrub suit, warm-up jacket, and shoes.

A. The surgical team members are responsible for preventing SSI by properly donning and wearing the appropriate head cover or hood. The surgical department should follow recommended OSHA and CDC standards for personal protective equipment (PPE).

    1. The surgical head cover or hood should be lint-free and cover all head and facial hear. Head covers prevent the shedding of hair, squamous cells, and/or dandruff onto the scrub suit.
    2. To prevent shedding onto the scrub suit, the first item of the surgical attire to be donned should be the head cover.
    3. Surgeons (skull) caps/head covers are not recommended for use. The determination is that the surgeons head cover does not completely cover the hair exposing the patient to the possibility of acquiring a SSI.
    4. Disposable bouffant and hood head covers offer complete coverage of the head and facial hair and should be worn by all OR personnel.
    5. It is recommended that surgery personnel with facial hair wear a disposable hood to completely cover the facial hair.
    6. The practice of allowing the use or not allowing the use of reusable cloth caps is governed by the healthcare facility policies and procedures. However, it is recommended that reusable cloth covers should not be worn.
    7. If worn, reusable cloth head covers should be laundered daily in the healthcare facility laundry services or third-party health-care accredited laundry facility that is contracted by the healthcare facility (see AST Recommended Standards of Practice for Laundering of Scrub Attire, 2008).
    8. If the reusable cloth head cover becomes contaminated with blood or body fluids it should be immediately removed and laundered.

Assessment of evidence
9. Disposable bouffant and hood covers should be discarded in a designated receptacle after use. If the disposable head cover becomes contaminated with blood or body fluids, it should be removed and discarded as soon as possible, and a clean head cover donned.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Society of Anaesthesiologists (ASA). Statement on Surgical Attire. 2022 Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence
The American Society of Anesthesiologists (ASA) Committee on Occupational Health (COOH) evaluated scientific evidence and expert opinions regarding infectious outcomes linked to anesthesia care. Subsequently, the COOH produced expert consensus statements concerning surgical attire. These recommendations were intended to minimise the spread of infections in surgical and procedural environments. The following recommendations were deemed relevant for this question.

Assessment of evidence
• "When in a restricted or semi-restricted procedural area, cover the hair and scalp with head gear made of a disposable or launderable re-useable material." • "When choosing head gear material, consider containment of shed particles, comfort and fit". • "Establish and implement a process for laundering reusable head coverings regularly and whenever they become visibly soiled."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Association of Nurse Anaesthesiology {American Association of Nurse Anaesthesiology (AANA), 2015 AANA) Infection Prevention and Control Guidelines for Anaesthesia Care. 2015	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Accessed 28 October 2024					

Assessment of evidence

This guidance document developed by the American Association of Nurse Anaesthetists (AANA) supports patient safety through the use of evidence-based infection prevention and control practices. The purpose of these guidelines is to describe infection prevention and control best practices to increase awareness and reduce the risk of patients, Certified Registered Nurse Anaesthetists (CRNAs), and other healthcare providers transmitting and acquiring an HAI.

The recommendations below were found to be relevant to this research question.

- "Hair covering must be used upon entry to semi-restricted and restricted areas. Reusable cloth caps must be laundered daily and when visibly soiled"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Australian and New Zealand College of Anaesthetists (ANZCA) PG28(A) Guideline on infection control in anaesthesia 2015	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Accessed 28 October 2024					

Assessment of evidence

The Australian and New Zealand College of Anaesthetists (ANZCA)developed this guideline is to assist practitioners and facilities to implement strategies that will reduce risks of transmission of infection, based on evidence at the time. However, this was not systematic review of evidence and therefore, taken as expert opinion.

The following recommendations are stated:

- “Hair should be completely covered with a disposable theatre cap or a freshly laundered lint free hat”.

Question 2: Are there any standards or legislative requirements for the use of headwear in health and care settings?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. UK Statutory Instrument No. 8 Health and Safety The Personal Protective Equipment at Work (Amendment) Regulations. 2022. Came into force 6th April 2022 Accessed 29 October 2024	Legislation	**Mandatory**	N/A	N/A	N/A

Assessment of evidence

Below information taken from both the 1992 regulations and 2022 amendment.

“These Regulations may be cited as the Personal Protective Equipment at Work (Amendment) Regulations 2022 and come into force on 6th April 2022.”

Regulation 4:

“(1) Every employer shall ensure that suitable personal protective equipment is provided to his workers who may be exposed to a risk to their health or safety while at work except where and to the extent that such risk has been adequately controlled by other means which are equally or more effective.”

“(3) […] personal protective equipment shall not be suitable unless—

(a) it is appropriate for the risk or risks involved and the conditions at the place where exposure to the risk may occur;

(b) it takes account of ergonomic requirements and the state of health of the person or persons who may wear it;

(c) it is capable of fitting the wearer correctly, if necessary, after adjustments within the range for which it is designed;

(d) so far as is practicable, it is effective to prevent or adequately control the risk or risks involved without increasing overall risk;

(e) it complies with any enactment (whether in an Act or instrument) which implements in Great Britain any provision on design or manufacture with respect to health or safety in any relevant Community directive listed in Schedule 1 which is applicable to that item of personal protective equipment.,”

Maintenance and replacement of PPE:

Regulation 7:

“(1) Every employer shall ensure that any personal protective equipment provided to his workers is maintained (including replaced or cleaned as appropriate) in an efficient state, inefficient working order and in good repair.

(2) Every self-employed person shall ensure that any personal protective equipment provided to him is maintained (including replaced or cleaned as appropriate) in an efficient state, in efficient working order and in good repair.”

Assessment of evidence
Accommodation for PPE: Regulation 8: “Where an employer or self-employed person is required, by virtue of regulation 4, to ensure personal protective equipment is provided, he shall also ensure that appropriate accommodation is provided for that personal protective equipment when it is not being used.” “PPE must be properly looked after and stored when not in use, for example in a dry, clean cupboard. If it is reusable it must be cleaned and kept in good condition” “The Personal Protective Equipment Regulations 2002 which are associated with PPE Directive 89/686/EEC (now the Personal Protective Equipment (Enforcement) Regulations 2018 which are associated with Regulation (EU) 2016/425) state that PPE on the market must be supplied with relevant information on: (i) storage, use, maintenance, servicing, cleaning and disinfecting; (ii) the level of protection provided by the PPE; (iii) suitable PPE accessories and appropriate spare parts; (iv) limitations on use (v) the obsolescence period for the PPE or certain of its components.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. Health and Safety at Work etc. Act 1974. Changes 02 April 2024. Accessed 29 October 2024.	Legislation, UK	**Mandatory**	N/A	N/A	N/A
Assessment of evidence					
"An Act to make further provision for securing the health, safety and welfare of persons at work, for protecting others against risks to health or safety in connection with the activities of persons at work, for controlling the keeping and use and preventing the unlawful acquisition, possession and use of dangerous substances, and for controlling certain emissions into the atmosphere; to make further provision with respect to the employment medical advisory service" • "It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees"					

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Sixth Edition. 2013 Accessed 29 October 2024	Legislation	**Mandatory**	N/A	N/A	N/A
Assessment of evidence					
The Substances Hazardous to Health Regulations 2002 (as amended) (COSHH) cover all substances to which the regulations apply. The following recommendations regarding headwear are made: • Protection of employees regarding substances that are hazardous to health. These include “micro-organisms such as bacteria, viruses, fungi, and the agents that cause transmissible spongiform encephalopathies (TSEs)” • PPE should be suitable for the intended purpose, fit the wearer appropriately and comply with PPE regulations 2002. • Employer should take all reasonable steps to ensure that PPE is used properly					

Assessment of evidence

- The employer shall ensure that removed/disposed PPE is “subsequently decontaminated and cleaned or, if necessary, destroyed.”
- “Every employer shall ensure that the exposure of his employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled.”
- “The employer must provide employees with suitable PPE, e.g respiratory protective equipment (RPE), protective clothing, protective gloves, footwear, and equipment to protect the eyes. This is in addition to all other control measures if the combination of those measures fails to achieve adequate control of exposure.”
- “Exposure to harmful substances should be eliminated/prevented in the workplace, but where avoidance of this is not reasonably practicable, control measures should be employed which are appropriate to the activity and consistent with the risk assessment. where adequate control of exposure cannot be achieved by other means, the provision of suitable personal protective equipment”
- “Every employer shall ensure that personal protective equipment, including protective clothing, is:

  (a) properly stored in a well-defined place;

  (b) checked at suitable intervals; and

  (c) when discovered to be defective, repaired or replaced before further use.”
- Following use, PPE should be “removed on leaving the working area and kept apart from uncontaminated clothing and equipment.
- ”The employer shall ensure that removed/disposed PPE is “subsequently decontaminated and cleaned or, if necessary, destroyed.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government Regulation 2016/425 and the Personal Protective Equipment (Enforcement) Regulations 2018 Accessed 29 October 2024	Legislation	**Mandatory**	N/A	N/A	N/A

Assessment of evidence

To obtain a CE mark manufacturers of PPE should comply with these regulations (date dependent). These regulations do not affect end users of PPE who should ensure the CE marking is present in line with the Personal Protective Equipment at Work Regulations 1992.

Previous version (2002) included in review.

- In place from April 2021. "Regulation (EU) 2016/425 (as incorporated into UK law) sets out the essential health and safety requirements that must be met before PPE products can be placed on the GB market."
- UKCA - Marking The Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019
    - To be UKCA marked, PPE manufacturers should comply with relevant regulations.

"PPE should be UKCA marked, not CE Marked, from 1st January 2021. If the conformity assessment was done by a UK conformity assessment body before 1 January 2021, the CE marking can still be used, but the product must be placed on the GB market before 31 December 2021.

Assessment of evidence
Where the PPE has been assessed by an EU notified body, manufacturers must continue to use the CE marking for products being placed on the GB market instead of the new UKCA marking. CE-marked products can only be placed on the GB market until 31 December 2021. Until 31 December 2022, the UKCA marking may be affixed to a label affixed to the PPE or a document accompanying the PPE, rather than being affixed to the PPE itself.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards Institute (BSI). BS EN13921:2007 Personal protective equipment. Ergonomic principles. Accessed 29 October 2024	Standard	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This standard provides guidance on the generic ergonomic characteristics related to personal protective equipment (PPE) – it does not however cover the requirements which relate to specific hazards of PPE design. Included in previous Headwear review – still the current version. It provides guidance on the generic ergonomic characteristics related to personal protective equipment (PPE).					

Assessment of evidence
BS EN 13921 specifies for the writers of PPE product standards, principles relating to: • anthropometric characteristics related to PPE • the biomechanical interaction between PPE and the human body • the thermal interaction between PPE and the human body • the interaction between PPE and the human senses: vision; hearing; smell and taste; and skin contact BS EN 13921 does not cover requirements related to the specific hazard for which PPE is designed.”

Question 3: Question 3: When should headwear be worn for infection control purposes in health and care settings?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hafinani EM, Cassier P, Aho S, et al. Guidelines for clothing in the operating theatre, 2021. Anaesthesia Critical Care & Pain Medicine. 2022; 41(3): 101084.	**Guidance. France**	**AGREE-II: Recommend with Modifications**	N/A	N/A	N/A
Assessment of evidence					
Guidelines were developed jointly by the French Society of Hospital Hygiene (SF2H) and the French Society of Anaesthesia and Intensive Care Medicine (SFAR) to support decision-making on operating theatre attire. They focus specifically on surgical staff headwear and exclude surgical draping, gowns, patient garments, and PPE.					

Assessment of evidence
The guideline development involved a committee of experts with no reported conflicts of interest. Evidence was reviewed using PubMed and clinicaltrials.gov, appraised with the GRADE approach, and validated through expert consensus, although search strategies, evidence grading details, and several methodological elements were not reported. Two key research questions were addressed: 1. Do reusable head coverings have advantages over single-use? 2. Does covering the ears (bouffant or surgical headgear) reduce infection risk more effectively than skullcaps? **Recommendations** • Experts suggest staff should wear head coverings (bouffant cap, skullcap, headgear) to minimise infection risk. • The recommendations are largely based on expert opinion due to limited high-quality evidence. **Limitations** • Missing details on search methods, evidence summaries, external review, update plans, and patient/target user perspectives. • Evidence reporting is high-level and likely overlaps with previous expert opinion.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice (AfPP). Standards and Recommendations	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.					

Assessment of evidence

"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre"

The following recommendations were found relevant to the research question. The recommendation below refers to theatre attire in general which includes head caps/hats

- "All staff entering restricted areas of the operating department wear designated theatre attire to minimise the risk of infection to themselves and the patient. Designated theatre attire minimises the risk of exposure of staff and patients to infection."
- "All head and facial hair should be completed covered by a headcover/cap to minimise the risk of microorganisms being shed into the surgical wound."
- "Headwear should always be worn in laminar flow theatres during prosthetic implant operations (Woodhead 2002)."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Humphreys H, Bak A, Ridgway E, et al. Rituals and behaviours in the operating theatre - joint guidelines of the Healthcare Infection Society and the European Society of Clinical Microbiology and Infectious Diseases. J Hosp Infect. 2023;140:165.e1-165.e28. doi:10.1016/j.jhin.2023.06.009 2023. Accessed 30 April 2024.	Guidance	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence
These guidelines were developed by the Health Infection Society in collaboration with the European Society of Clinical Microbiology and Infectious Diseases for an international audience. They are designed for any healthcare practitioner working in the operating theatre environment and can be adapted for local use. Intended users include clinical microbiologists, IPC doctors and nurses, theatre managers, surgeons, anaesthetists, surgical nurses, anaesthetic assistants, operating department practitioners, and estates staff. Systematic searches and analysis were performed to inform the recommendations, however, there are issues around applicability that were not addressed such as potential barriers and facilitators and tools to enhance implementation. Additionally, there is no clarity to show an explicit link between the evidence and forming the recommendations. Therefore, these limitations should be taken into account The following recommendation was made: • As no evidence exists, the guidance suggests a good practice point: " Ensure that all staff working in the operating room wear a head covering and a face mask in accordance with local policies”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Bailey, CR, Greatorex, B. Hyde, Y et al. Association of Anaesthetists of Great Britain & Ireland Guidelines - Infection prevention and control 2020 Accessed 31 October 2024	Expert Opinion, Ireland and UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

These guidelines produced by the Association of Anaesthetists are presented for the organisational management of infection prevention and control. The advice presented is based on published data, clinical studies and expert opinion.

- "Theatre caps should be worn in laminar flow theatres during prosthetic implant operations, and it is the Working Party's view that their general use should continue."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

The following recommendations are made:

- “Perioperative team members should cover their scalp and hair before entering the semi restricted and restricted areas of the surgical suite.”
- “Team members with facial hair should cover it before entering the restricted areas and before packaging items in the clean assembly section of the sterile processing area.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Institute for Health and Care Excellence (NICE) Surgical site infections: prevention and treatment. London: National Institute for Health and Care Excellence (NICE); 2020 Aug 19. (NICE Guideline, No. 125.) Accessed 15 March 2024	Guidance, UK	**AGREE** **Recommend with modifications**	N/A	N/A	N/A
Assessment of evidence					
"This guideline covers preventing and treating surgical site infections in adults, young people and children who are having a surgical procedure involving a cut through the skin. It focuses on methods used before, during and after surgery to minimise the risk of infection." Within the document the following statement regarding headwear is made: • "There is no evidence available that examines whether the wearing of scrub suits or head attire or overshoes by scrubbed or circulating theatre staff can prevent SSI"					

Assessment of evidence
• "Although there is limited evidence concerning the use of specific non-sterile theatre wear (scrub suits, masks, hats and overshoes), the GDG consensus was that wearing non-sterile theatre wear is important in maintaining theatre discipline and may therefore contribute to minimising the risk of SSI" • "Staff should wear specific non-sterile theatre wear (scrub suits, masks hats and overshoes) in all areas where operations are undertaken"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Institute for Health and Care Excellence (NICE) Surgical Site Infection, Quality Standard (QS49) Quality Statement: Interoperative staff practices 2013. Accessed 15 March 2024	Expert Opinion Guidance, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence
"NICE quality standards describe high-priority areas for quality improvement in a defined care or service area. Each standard consists of a prioritised set of specific, concise and measurable statements. This quality standard covers preventing and treating surgical site infections. It covers adults, young people and children having a surgical procedure that involves a cut to the skin in all healthcare settings. It describes high-quality care in priority areas for improvement." Within the document the following statement regarding the use of headwear in theatre is suggested as best practice • "Staff should wear specific non-sterile theatre wear (scrub suits, masks hats and overshoes) in all areas where operations are undertaken"

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Australian and New Zealand College of Anaesthetists (ANZCA) PG28(A) Guideline on infection control in anaesthesia 2015 Accessed 28 October 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure

Assessment of evidence

The Australian and New Zealand College of Anaesthetists (ANZCA)developed this guideline is to assist practitioners and facilities to implement strategies that will reduce risks of transmission of infection, based on evidence at the time. However, this was not systematic review of evidence and therefore, taken as expert opinion.

The following recommendations are stated:

- “Hair should be completely covered with a disposable theatre cap or a freshly laundered lint free hat”.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). AST Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. 2008.	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Accessed 28 October 2024					

Assessment of evidence

These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion.

Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made

“Surgical attire that should be worn in the semi-restricted and restricted areas of the surgery department includes the head cover, masks, scrub suit, warm-up jacket, and shoes.

B. The surgical team members are responsible for preventing SSI by properly donning and wearing the appropriate head cover or hood. The surgical department should follow recommended OSHA and CDC standards for personal protective equipment (PPE).

10. To prevent shedding onto the scrub suit, the first item of the surgical attire to be donned should be the head cover.

11. Surgeons (skull) caps/head covers are not recommended for use. The determination is that the surgeons head cover does not completely cover the hair exposing the patient to the possibility of acquiring a SSI.

This guidance adds to the evidence base for wearing of head cover as part of surgical attire within semi-restricted and restricted areas of surgery. It should be worn prior to donning the scrubs.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Society of Anaesthesiologists (ASA) Statement on Surgical Attire. Accessed 30 October 2024	Expert Opinion, USA.	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The American Society of Anesthesiologists (ASA) Committee on Occupational Health (COOH) evaluated scientific evidence and expert opinions regarding infectious outcomes linked to anesthesia care. Subsequently, the COOH produced expert consensus statements concerning surgical attire. These recommendations were intended to minimise the spread of infections in surgical and procedural environments.

The following recommendation were deemed relevant for this question,

- "When in a restricted or semi-restricted procedural area, cover the hair and scalp with head gear made of a disposable or launderable re-useable material".

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American College of Surgeons (ACS). Statement on Operating Room Attire. 2016 Accessed 30 0ctober 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

Within this document the ACS states that its guidelines for appropriate attire are based on "professionalism, common sense, decorum, and the available evidence". Therefore, the recommendations made below are graded as expert opinion.

- "During invasive procedures, the mouth, nose, and hair (skull and face) should be covered to avoid potential wound contamination. Large sideburns and ponytails should be covered or contained. There is no evidence that leaving ears, a limited amount of hair on the nape of the neck or a modest sideburn uncovered contributes to wound infections."
- "Earrings and jewellery worn on the head or neck where they might fall into or contaminate the sterile field should all be removed or appropriately covered during procedures."

This statement adds to the evidence base for use of headwear (no type specified) as part of invasive procedures, specifically involving a sterile field, to prevent wound contamination.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
McHugh SM, Corrigan MA, Hill ADK, et al The Royal Colleges of Surgeons of Edinburgh and Ireland. Surgical attire, practices and their perception in the prevention of surgical site infection. 2014. Accessed 31 October 2024	Expert Opinion, Scotland and Ireland	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The recommendation is drawn from the author's review of the available literature based on surgical attire in the field of general surgery. Certain integral aspects of conducting a systematic review were not followed (e.g. inclusion/exclusion criteria, multiple reviewers etc.), and as such, the recommendation can only be graded as expert opinion.

- "Appropriate surgical headgear must be worn by surgical teams, especially in settings were infection risk is considered to be high e.g. grafting or prosthetic procedures"

The recommendation adds to the evidence base for use of headwear within the surgical setting.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Association of Nurse Anaesthesiology (AANA) Infection Prevention and Control Guidelines for Anaesthesia Care. 2015	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This guidance document developed by the American Association of Nurse Anaesthetists (AANA) supports patient safety through the use of evidence-based infection prevention and control practices. The purpose of these guidelines is to describe infection prevention and control best practices to increase awareness and reduce the risk of patients, Certified Registered Nurse Anaesthetists (CRNAs), and other healthcare providers transmitting and acquiring an HAI.

The recommendations below were found to be relevant to this research question.

- Hair covering (no specific type mentioned) should be worn:
    a. Upon entry to semi-restricted and restricted areas.
    b. on performing Regional neuraxial technique
- The document also makes a recommendation re-Central Venous Catheter Insertion.

Assessment of evidence
a. In order to reduce the incidence of infections such as central line-associated bloodstream infections, the following is recommended for the proper insertion of a central line: Perform hand hygiene and don sterile gloves, sterile gown, surgical cap, and surgical mask, and cover the patient's entire body with a large sterile drape prior to insertion • This practice recommendation adds to the evidence base for use of surgical caps in settings associated with surgery (specifically neuraxial anaesthesia and central venous catheter insertion).

Question 4: What type(s) of headwear should be used in health and care settings?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hafinani EM, Cassier P, Aho S, et al. Guidelines for clothing in the operating theatre, 2021. Anaesthesia Critical Care & Pain Medicine. 2022; 41(3): 101084.	**Guidance, France**	**AGREE-II: Recommend with Modifications**	N/A	N/A	N/A
Assessment of evidence					
Guidelines were developed jointly by the French Society of Hospital Hygiene (SF2H) and the French Society of Anaesthesia and Intensive Care Medicine (SFAR) to support decision-making on operating theatre attire. They focus specifically on surgical staff headwear and exclude surgical draping, gowns, patient garments, and PPE. Evidence was reviewed using PubMed and clinicaltrials.gov and appraised via GRADE, though search methods and reporting were limited. Recommendations are mainly based on expert opinion due to insufficient high-quality evidence.					

Assessment of evidence
Relevant recommendations • Staff should wear head coverings (bouffant, skullcap, or headgear) to minimise infection risk. • Single-use or reusable headwear is acceptable, but reusable is preferred for sustainability. • No strong evidence supports differences in infection prevention between headwear types, including whether ears should be covered. **Limitations** The review lacked detailed search strategies, evidence grading, and patient/user perspectives, relying heavily on expert opinion with limited systematic evidence.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Haskins IN, Prabhu AS, Krpata DM, et al. Is there an association between surgeon hat type and 30-day wound events following ventral hernia	Observational (retrospective survey). USA	**Level 3**	Surgical caps	bouffant vs. skull cap	Primary outcome: -Incidence of surgical site infection (SSI) associated with surgeon hat type, and;

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
repair?. Hernia. 2017;21(4):495-503. doi:10.1007/s10029-017-1626-7. Accessed 5 November 2024					Secondary outcome: - incidence of surgical site occurrence requiring procedural intervention (SSOPI) and its association with surgeon hat type.

Assessment of evidence

Study objective and design:

- The study aimed to evaluate if the type of headwear—bouffant vs. skull cap—affects the rate of SSIs and surgical site occurrences requiring procedural intervention (SSOPIs) in ventral hernia repair surgeries. Using data from the Americas Hernia Society Quality Collaborative (AHSQC).
- The study analysed data from 6,210 ventral hernia repairs conducted by 68 surgeons, across different hospitals who wore various headwear types.

Results:

- After examining data from 6,210 hernia surgeries, no significant difference in SSI or SSOPI rates was found between different types of headwear, including disposable bouffants, cloth skull caps, and disposable skull caps.

Assessment of evidence

- Several factors were associated with a higher risk of SSIs, such as patient obesity, chronic obstructive pulmonary disease, the complexity of the hernia, and longer operative time. However, headwear type itself did not independently influence SSI or SSOPI rates.
- Multivariate analysis confirmed that other clinical factors were more impactful on SSI and SSOPI outcomes than the type of headwear worn by surgeons. FOR SSI and SSOPI: There was no statistically significant difference in the incidence of postoperative SSI or SSOPI when all surgical cap types were compared to all surgical bouffant types or when any combination of surgical caps and surgical bouffant were compared to one another.

Limitations

- As an observational study, it can only identify associations, not causations. Despite multivariate adjustments, the study cannot fully account for all confounding factors.
- Data was collected via surveys, with a response rate of 79.1%. Surgeons self-reported their preferred headwear, which may not accurately reflect actual use in all cases or may introduce response bias if some surgeons are inclined toward certain types due to personal beliefs or past training.
- Although different headwear types were considered, not all possible combinations were included, such as cloth bouffants or other specialised headgear, limiting generalisability to broader surgical attire choices.
- Focusing on ventral hernia repairs limits the findings' applicability to other types of surgeries where infection risks and conditions may differ

Overall, the study adds data to the debate on surgical headwear highlighting the lack of significant association between type of surgical headwear worn by the surgeon during ventral hernia procedures and the incidence of both 30-day post-op SSI and SSOPI. However, it is limited in its design and by the lack of a causal link between headwear type and SSI outcomes

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice (AfPP). Standards and Recommendations for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre"

The following recommendations were found relevant to the research question. The recommendation below refers to theatre attire in general which includes head caps/hats

- "Disposable headwear is preferable; however, cloth hats are permissible if laundered and inspected for holes/ imperfections in an approved facility and not at home. Bouffant and hood style covers are preferred as they cover side hair, ears and hair at the nap of the neck."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Rios-Diaz AJ, Chevrollier G, Witmer H, et al. The art and science of surgery: Do the data support the banning of surgical skull caps?. Surgery. 2018;164(5):921-925. doi:10.1016/j.surg.2018.05.01. Accessed 6 November 2024	Before and after study (retrospective). USA	**Level 3**	Policy Change: In late December 2015, the institution adopted a policy banning skull caps, instead requiring bouffant or helmet-style headwear for OR staff.	Headwear Type Before vs. After the Policy: Patients were grouped into two cohorts: those who underwent surgery before the policy implementation (using skull caps) and those after the implementation (using bouffant or helmet headwear).	The primary outcome was any type of SSI (within 30 days of follow-up, which included superficial, deep, and organ/ space infections as per the National Nosocomial Infections Surveillance system of the CDC. Patients who underwent two or more procedures and had an SSI were counted as one.

Assessment of evidence

The study design is a before and after retrospective study, using data from the American College of Surgeons National Surgical Quality Improvement Program (QIP) to analyse 30-day post-surgical outcomes. A sensitivity analysis was also conducted to control for confounding factors, particularly to account for additional measures taken by the colorectal surgery division.

Assessment of evidence

Results

- SSI Rates: The overall SSI rate was 5.4%, with no significant difference in SSI rates before (5.3%) and after (5.5%) [P=0.809] the headwear policy change.
- Types of SSIs: The distribution of SSIs by type (superficial, deep, organ/space) also showed no notable differences between the two groups (superficial p= 0.834, deep p= 0.248, organ/space p=0.766).
- Multivariate Analysis: After adjusting for potential confounders like age, obesity, smoking status, and wound classification, there was no significant association between headwear type and SSI rates. The odds of SSI were not different in the post implementation period (odds ratio 1.12 [95% confidence interval 0.73–1.71]; p=0.59)
- Sensitivity Analysis**:** Excluding cases involving colorectal surgeons (who implemented additional SSI-reduction measures), the findings remained consistent, suggesting that the headwear policy alone did not impact SSI rates. No differences were observed in overall SSI rates between before and after the headwear policy was adopted (6% versus 5.6%; p = 0.74), and there was no association of this policy with changes in SSI occurrence (odds ratio 1.00 [0.63–1.58]; p = 0.90).

Limitations

- Retrospective, observational study hence no way to check compliance to protocol and limited by potential biases in data selection and confounding variables.
- Single institution limits generalisability
- Only clean and clean-contaminated surgeries included (selection bias)
- The proportion of cases included in the before and after cohort differed (760 vs. 1141), the impact of which is unknown. The difference in patient numbers between the two cohorts could affect the results. This difference arose due to procedural constraints in the NSQIP dataset.
- While the study adjusted for many confounders, variables such as surgical technique and surgeon experience were not included and could influence SSI rates.

Assessment of evidence
Overall, this study suggests that surgical headwear type (skull caps vs. bouffant caps) does not significantly impact SSI rates and therefore a reconsideration of strict policies mandating bouffant caps

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). Association of Surgical Technologists (AST) Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. 2008. Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion. Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made • "The surgical head cover or hood should be lint-free and cover all head and facial hear. Head covers prevent the shedding of hair, squamous cells, and/or dandruff onto the scrub suit." • "Surgeons (skull) caps/head covers are not recommended for use. The determination is that the surgeons head cover does not completely cover the hair exposing the patient to the possibility of acquiring a SSI." • "Disposable bouffant and hood head covers offer complete coverage of the head and facial hair and should be worn by all OR personnel." • "It is recommended that surgery personnel with facial hair wear a disposable hood to completely cover the facial hair." • "The practice of allowing the use or not allowing the use of reusable cloth caps is governed by the healthcare facility policies and procedures. However, it is recommended that reusable cloth covers should not be worn" This guidance adds to the evidence base for wearing hats/head covers which gives full head coverage such as disposable bouffants and hood head covers for head and facial hair coverage as part of surgical attire within surgical settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Society of Anaesthesiologists (ASA) Statement on Surgical Attire. 2019 Accessed 30 October 2024.	Expert Opinion, USA.	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The American Society of Anaesthesiologists (ASA) Committee on Occupational Health (COOH) evaluated scientific evidence and expert opinions regarding infectious outcomes linked to anaesthesia care. Subsequently, the COOH produced expert consensus statements concerning surgical attire. These recommendations were intended to minimise the spread of infections in surgical and procedural environments.

The following recommendation were deemed relevant for this question,

- “When in a restricted or semi-restricted procedural area, cover the hair and scalp with head gear made of a disposable or launderable re-useable material”.
- “When choosing head gear material, consider containment of shed particles, comfort and fit”.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Australian and New Zealand College of Anaesthetists (ANZCA) PG28(A) Guideline on infection control in anaesthesia 2015 Accessed 28 October 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The Australian and New Zealand College of Anaesthetists (ANZCA)developed this guideline is to assist practitioners and facilities to implement strategies that will reduce risks of transmission of infection, based on evidence at the time. However, this was not systematic review of evidence and therefore, taken as expert opinion.

The following recommendations are stated:

- “Hair should be completely covered with a disposable theatre cap or a freshly laundered lint free hat”.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American College of Surgeons (ACS). Statement on Operating Room Attire. 2016 Accessed 30 0ctober 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

Within this document the ACS states that its guidelines for appropriate attire are based on “professionalism, common sense, decorum, and the available evidence”. Therefore, the recommendations made below are graded as expert opinion.

- “The skullcap can be worn when close to the totality of hair is covered by it and only a limited amount of hair on the nape of the neck or a modest sideburn remains uncovered”

This statement adds to the evidence base for wearing skulls caps which provide full hair coverage with the exception of some hair on nape of neck and sideburns left uncovered.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Association of Nurse Anaesthesiology (AANA) Infection Prevention and Control Guidelines for Anaesthesia Care. 2015	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This guidance document developed by the American Association of Nurse Anaesthetists (AANA) supports patient safety through the use of evidence-based infection prevention and control practices. The purpose of these guidelines is to describe infection prevention and control best practices to increase awareness and reduce the risk of patients, Certified Registered Nurse Anaesthetists (CRNAs), and other healthcare providers transmitting and acquiring an HAI.

The recommendations below were found to be relevant to this research question.

- "Cover hair, facial hair, side burns, and the back of the neck using a clean covering."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Markel TA, Gormley T, Greeley D, et al. Hats Off: A Study of Different Operating Room Headgear Assessed by	Experimental Study	**Level 3**	Assessed the effectiveness of three types of headgear: disposable bouffant caps, disposable skull caps, and cloth skull caps.	Study compared the effectiveness of each headgear type based on factors like permeability, particle shedding, and analysis	Primary outcomes (environmental quality indicators): Amount of microbial contamination and Particle shedding at the sterile field

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Environmental Quality Indicators. J Am Coll Surg. 2017;225(5):573-581. doi:10.1016/j.jamcollsurg.2017.08.014 Accessed 7 November 2024			Each headgear type was tested during separate mock procedures for particle and microbial contamination levels	focused on whether cloth and disposable skull caps were superior or equivalent to bouffant caps.	actively and passively. Secondary outcomes (fabric assessment): Hat permeability, penetration, porosity, thickness was also evaluated and fibre imaging performed

Assessment of evidence

Study design

This was an experimental, non-randomized, and unblinded study conducted in a controlled operating room environment. Mock surgeries were performed to create realistic airborne conditions. Airborne particle and microbial shedding were measured using validated methods, such as air samplers and settle plates, as well as equipment to test fabric permeability and porosity.

Results

- Particle Contamination: Bouffant caps allowed more airborne particles in the 0.5-1.0 mm range than cloth skull caps. Disposable skull caps and cloth skull caps did not show significant differences in particle counts. Disposable bouffant hats had significantly higher airborne particle contamination compared to cloth hats at particle sizes of 0.5 µm ($p = 0.012$) and 1.0 µm ($p = 0.001$).

Assessment of evidence

- Microbial Contamination: Passive microbial sampling showed higher microbial contamination with bouffant caps than with disposable or cloth skull caps. Active air sampling did not show significant microbial shedding differences among headgear types.
- Permeability and Porosity: Bouffant caps were highly permeable and porous, often allowing more particle penetration than skull caps. Cloth skull caps had the lowest permeability but were also prone to particle shedding.
    - Penetration: Penetration of particulate matter was higher for bouffant hats (101.9%±1.1%) compared to others. (Disposable skull crown (94.6±1.8%, $p < 0.05$) and disposable skull sides (92.0±0.6%, $p < 0.05$).
    - Penetration was also high for cloth skull hats (100.1±0.84%)
    - Thickness: Cloth hats were significantly thicker than bouffant hats or the crowns and sides of disposable skull caps ($p < 0.05$)
    - Porosity: Average pore sizes and the maximum pore sizes in bouffant hats were significantly higher (89.4 ±30.68 µm and 251.8 ±67.9 µm) than those seen in cloth skull caps (26.1 ±4.1 µm and 89.5 ±5.7 µm) ($p < 0.05$).

Limitations

- The study was conducted in a controlled environment, not actual surgeries, which may limit direct applicability to real surgeries.
- The study was not blinded, and personnel performing procedures also collected data, potentially introducing bias.
- Only specific brands and types of headgear were tested, so results may not generalise across all headgear types on the market.
- Cloth caps were laundered prior to testing, but real-world use may involve varied washing practices, affecting sterility.

Assessment of evidence
In this experimental study which assessed 3 different types of headgear within a simulated operative environment, disposable bouffant hats were found to be more porous at average and maximum pore sizes compared to both skull caps (disposable and cloth) ($p < 0.05$), as well as have greater particle shed at particle sizes 0.5- and 1.0 µm in comparison to Cloth skull caps. On passive sampling, bouffant hats were found to have higher microbial shed as compared to disposable skull caps or cloth skull caps ($p < 0.05$), at the sterile field, however no significant differences were observed during active sampling. With regards to permeability, bouffant hats and disposable skull cap crowns were significantly more permeable than cloth skull caps and disposable skull cap sides which may contribute to higher bacterial shed however more experiments needed to make this association. The study suggests that bouffant caps, are not necessarily superior to skull caps in reducing microbial and particle contamination. Disposable skull caps showed similar or better results, and laundered cloth skull caps may offer additional benefits in terms of sterility.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
ACS, AORN, ASA, APIC, AST and TJC A Statement from the Meeting of ACS, AORN, ASA, APIC, AST, and TJC Concerning Recommendations	Expert Opinion, USA	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
for Operating Room Attire. 2018 Accessed 7 November 2024					

Assessment of evidence

The American College of Surgeons (ACS), the American Society of Anesthesiologists (ASA), the Association of peri-Operative Registered Nurses (AORN), the Association for Professionals in Infection Control and Epidemiology (APIC), the Association of Surgical Technologists (AST), the Council on Surgical and Perioperative Safety (CSPS); and The Joint Commission (TJC) met on February 27, 2018, to review and discuss the literature related to recommendations for operating room (OR) attire, specifically ear and hair covering and made the following suggestions.

- “The requirement for ear coverage is not supported by sufficient evidence”.
- “At present, available scientific evidence does not demonstrate any association between the type of hat or extent of hair coverage and SSI rates”.

This recommendation contradicts the evidence base for full ear coverage as part of surgical attire citing not sufficient evidence. Evidence regarding headwear type is also inconclusive. As there is no evidence presented for the formulation of the consensus statement it can only be graded as expert opinion.

Question 5: What considerations should be given in the situation where headwear is worn for religious and/or cultural purposes?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive (HSE) Personal protective equipment at work The Personal Protective Equipment at Work Regulations 1992 (as amended) Guidance on Regulations. 2022. Accessed 03 May 2024.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This guidance produced by HSE “provides practical advice on how to comply with the requirements of the Personal Protective Equipment at Work Regulations 1992 as amended by the Personal Protective Equipment at Work (Amendment) Regulations 2022 (hereafter referred to as “the Regulations”)”

Within the document the following suggestions are deemed relevant for the research question, however, it should be noted that this refers broadly to head protection and all work place settings rather than solely health and care settings.

- “Sections 11 and 12 of the Employment Act 1989, as amended by section 6 of the Deregulation Act 2015,9 provide an exemption from the need to wear head protection in any workplace (including construction sites) for turban-wearing Sikhs, with certain limited exceptions for high-risk tasks”
- “The exemption applies to any turban-wearing Sikh in the workplace whether they are a worker or not (for example, visitors). It applies solely to turban-wearing members of the Sikh faith; the exemption applies only to head protection, and Sikhs are required to wear all other necessary PPE under these Regulations.”
- “Where a turban-wearing Sikh chooses not to wear head protection, the exemption includes a limitation on the liability of the duty holder should an incident occur”
- “The exceptions referred to relate to certain high-risk tasks performed by individuals in occupations which involve providing an urgent response to an emergency. In these tasks, a risk assessment will have identified that head protection is essential for the protection of the individual”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

The following recommendations are made.

- "AORN provides a conditional recommendation allowing religious head coverings, such as head scarves (hijabs), veils, and turbans, to be worn in the semi restricted and restricted areas if they
  - are clean
  - are made from tightly woven, low-linting fabric.
  - do not contain adornments
  - fit properly (loose ends may be tucked into the scrub top)."

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American College of Surgeons (ACS). Statement on Operating Room Attire. 2016 Accessed 30 0ctober 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
Within this document the ACS states that its guidelines for appropriate attire are based on “professionalism, common sense, decorum, and the available evidence”. Therefore, the recommendations made below are graded as expert opinion. • “Religious beliefs regarding headwear should be respected without compromising patient safety”. This recommendation suggests that headwear relating to religious requirements must be respected as long as it does not compromise safety of the patient. No information given regarding the formulation of the statement hence it can only be graded as professional opinion.					

Question 6: When should headwear be doffed (taken off) or changed?

Evidence from 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	Level 4	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

“AORN provides a conditional recommendation for organizations developing a process for managing reusable head coverings that includes the types of fabrics allowed (e.g., non linting), how often they need to be laundered (e.g, daily), and laundering methods (e.g., facility laundering, home laundering).”

- “If head coverings become contaminated, they should be removed.”

Assessment of evidence
• "When reusable head coverings become contaminated with potentially infectious materials (e.g., blood, other body fluids) they must stay at the health care facility for laundering"

Evidence from previous updates:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American College of Surgeons (ACS). Statement on Operating Room Attire. 2016 Accessed 30 0ctober 2024	Expert Opinion Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
Within this document the ACS states that its guidelines for appropriate attire are based on "professionalism, common sense, decorum, and the available evidence". Therefore, the recommendations made below are graded as expert opinion. • "Soiled scrubs and/or hats should be changed as soon as feasible and certainly prior to speaking with family members after a surgical procedure". • "Scrubs and hats worn during dirty or contaminated cases should be changed prior to subsequent cases even if not visibly soiled"					

Assessment of evidence
• "Cloth skull caps should be cleaned and changed daily. Paper skull caps should be disposed of daily and following every dirty or contaminated case". This adds to the evidence base for removing soiled headwear as soon as possible after the procedure and before speaking to family members. It also adds to the evidence of changing hats worn during dirty or contaminated cases even if not visibly soiled and prior to the subsequent case

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Society of Anaesthesiologists (ASA) Statement on Surgical Attire.2019 Accessed 30 October 2024.	Expert Opinion, USA.	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
The American Society of Anesthesiologists (ASA) Committee on Occupational Health (COOH) evaluated scientific evidence and expert opinions regarding infectious outcomes linked to anesthesia care. Subsequently, the COOH produced expert consensus statements concerning surgical attire. These recommendations were intended to minimise the spread of infections in surgical and procedural environments. The following recommendation were deemed relevant for this question,					

Assessment of evidence
• "Establish and implement a process for laundering reusable head coverings regularly and whenever they become visibly soiled". This guideline is meant for surgical attire within the operating room and adds to the evidence base for changing head cover when visibly soiled.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). AST Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. 2008. Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical					

Assessment of evidence

scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion.

Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made

- “If worn, reusable cloth head covers should be laundered daily in the healthcare facility laundry services or third party health-care accredited laundry facility that is contracted by the healthcare facility.”
- “If the reusable cloth head cover becomes contaminated with blood or body fluids it should be immediately removed and laundered.”
- “If the disposable head cover becomes contaminated with blood or body fluids, it should be removed and discarded as soon as possible, and a clean head cover donned.”

Question 7: Where and how should headwear be donned (put on)?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice (AfPP). Standards and Recommendations for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre" The following recommendation was found relevant to the research question • "All head and facial hair should be completely covered by a headcover/cap to minimise the risk of microorganisms being shed into the surgical wound" • "Headwear should be donned prior to donning the scrub suit to prevent hair or dandruff being shed onto the scrub clothing"					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
(AST). AST Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. 2008. Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion.

Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made

- “Prior to donning the scrub suit the head cover should be donned to prevent shedding of microbes onto the scrub suit.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

The following recommendations are made:

- “Perioperative team members should cover their scalp and hair before entering the semi restricted and restricted areas of the surgical suite.”
- “Team members with facial hair should cover it before entering the restricted areas and before packaging items in the clean assembly section of the sterile processing area.”

Question 8: Question 8: Where and how should headwear be doffed (taken off)?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice (AfPP). Standards and Recommendations for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre"

The following recommendation was found relevant to the research question

- "Head coverings should be removed when travelling between buildings, before leaving the facility or if they become soiled". However, this recommendation is reproduced from the AORN 2019 guidelines

Assessment of evidence
• "Headwear should be changed daily, unless it becomes soiled, when it should be changed immediately. Headwear should not be worn outside of the theatre environment." • Disposable headwear is preferable; however, cloth hats are permissible if laundered and inspected for holes/imperfections in an approved facility and not at home. Bouffant and hood style covers are preferred as they cover hair, ears and hair at the nape of the neck"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.					

Assessment of evidence
"AORN provides a conditional recommendation for organizations developing a process for managing reusable head coverings that includes the types of fabrics allowed (e.g., non linting), how often they need to be laundered (e.g, daily), and laundering methods (e.g., facility laundering, home laundering)." • "If head coverings become contaminated, they should be removed." • "When reusable head coverings become contaminated with potentially infectious materials (e.g., blood, other body fluids) they must stay at the health care facility for laundering"

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Association of Nurse Anaesthesiology (AANA) Infection Prevention and Control Guidelines for Anaesthesia Care. 2015	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This guidance document developed by the American Association of Nurse Anaesthetists (AANA) supports patient safety through the use of evidence-based infection prevention and control practices. The purpose of these guidelines is to describe infection prevention and control best practices to increase awareness and reduce the risk of patients, Certified Registered Nurse Anaesthetists (CRNAs), and other healthcare providers transmitting and acquiring an HAI. The recommendations below were found to be relevant to this research question. • "If donning double gloves, dispose of outer glove following sterile glove removal protocol prior to removing surgical cap" • "Remove cap using gloves, refraining from contacting inner part of cap" • "Dispose of cap in proper waste receptacle" This practice recommendation adds further detail to the evidence base for the correct removal and disposal of surgical caps which should be removed after removing outer gloves if donning double gloves without touching/contacting inner part of cap and disposed in waste receptacle.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). AST Standards of Practice for Surgical Attire, Surgical Scrub,	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hand Hygiene and Hand Washing. 2008. Accessed 28 October 2024					

Assessment of evidence

These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion.

Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made

- “If the disposable head cover becomes contaminated with blood or body fluids, it should be removed and discarded as soon as possible, and a clean head cover donned.”
- “Disposable bouffant and hood covers should be discarded in a designated receptacle after use”

This recommendation adds to the evidence base for the safe disposal of disposable head covers in designated waste receptacles after their usage.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The World Health Organization. Steps to take off personal protective equipment (PPE) including gown. 2015 Accessed 12 March 2024	Expert Opinion Guidance, Global	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This is a resource detailing the sequential steps in taking off personal protective equipment. The resource makes the following recommendation regarding cleaning footwear. • "Remove head and neck covering taking care to avoid contaminating your face by starting from the bottom of the hood in the back and rolling from back to front and from inside to outside, and dispose of it safely"					

Question 9: Question 9: How should headwear be disposed?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association of periOperative Registered Nurses (AORN) Guidelines in Practice: Surgical Attire. 2024. Accessed 30 October 2024	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This is a journal article that provides a summary of the updated AORN guidelines as such does not provide the full methodology of how these guidelines were developed. The methodology as well as the detailed guidelines are inaccessible and as such the recommendations provided here are graded as expert opinion.

“AORN provides a conditional recommendation for organizations developing a process for managing reusable head coverings that includes the types of fabrics allowed (e.g., non linting), how often they need to be laundered (e.g, daily), and laundering methods (e.g., facility laundering, home laundering).”

- “If head coverings become contaminated, they should be removed.”

Assessment of evidence
• "When reusable head coverings become contaminated with potentially infectious materials (e.g., blood, other body fluids) they must stay at the health care facility for laundering"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Association for Perioperative Practice (AfPP). Standards and Recommendations for Safe Perioperative Practice. 2022 Fifth Ed. PP:202-203.	Expert Opinion, UK	**Level 4**	N/A	N/A	N/A

Assessment of evidence
"AfPP's benchmark publication has been updated for 2022, providing comprehensive guidance on evidence-base best practice and minimising risk in and around the operating theatre" The following recommendations were found relevant to the research question. The recommendation below refers to theatre attire in general which includes head caps/hats • "After use, headwear should be discarded into an appropriate container for disposal or laundering."

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
American Association of Nurse Anaesthesiology (AANA) Infection Prevention and Control Guidelines for Anaesthesia Care. 2015	Expert Opinion Guidance, USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This guidance document developed by the American Association of Nurse Anaesthetists (AANA) supports patient safety through the use of evidence-based infection prevention and control practices. The purpose of these guidelines is to describe infection prevention and control best practices to increase awareness and reduce the risk of patients, Certified Registered Nurse Anaesthetists (CRNAs), and other healthcare providers transmitting and acquiring an HAI.

The recommendations below were found to be relevant to this research question.

- “If donning double gloves, dispose of outer glove following sterile glove removal protocol prior to removing surgical cap”
- “Remove cap using gloves, refraining from contacting inner part of cap”
- “Dispose of cap in proper waste receptacle”

Assessment of evidence
This practice recommendation adds further detail to the evidence base for the correct removal and disposal of surgical caps which should be removed after removing outer gloves if donning double gloves without touching/contacting inner part of cap and disposed in waste receptacle.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists (AST). AST Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. 2008. Accessed 28 October 2024	Expert Opinion Guidance. USA	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These standards of practice were developed by the AST Education and Professional Standards Committee and approved by the AST Board of Directors. They aim to support healthcare facilities in reinforcing best practices for surgical attire and the surgical scrub within the perioperative setting. The purpose of these recommended standards is to offer a framework for healthcare

Assessment of evidence
workers (HCWs) in perioperative environments to guide the development and implementation of policies and procedures for proper surgical attire and scrub practices. However, no methodology is provided on how these were developed and as such graded as expert opinion. Within the document, the following standard of Practice I was found to be relevant to this research question. The following recommendations are made • "If the disposable head cover becomes contaminated with blood or body fluids, it should be removed and discarded as soon as possible, and a clean head cover donned." • "Disposable bouffant and hood covers should be discarded in a designated receptacle after use" This recommendation adds to the evidence base for the safe disposal of disposable head covers in designated waste receptacles after their usage.

Question 10: How should headwear be stored?

Evidence added to 2023 update:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive, HSE. Using personal protective equipment (PPE) to control risks at work. – Maintenance. 2022 Accessed 15 March 2024	Expert Opinion Guidance, UK	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
"This guidance provides practical advice on how you can comply with the requirements of the Personal Protective Equipment at Work Regulations 1992 as amended by the Personal Protective Equipment at Work (Amendment) Regulations 2022. This HSE guidance is not specific to footwear but broadly covers all types of PPE, therefore this should be taken into account when using this guidance. The following recommendation was found to be relevant to headwear • "PPE must be properly looked after and stored when not in use, for example in a dry, clean cupboard. If it is reusable it must be cleaned and kept in good condition"					

Assessment of evidence
• "Where PPE becomes contaminated during use, it should be cleaned and decontaminated, before storage; otherwise the accommodation may itself become contaminated and will also require suitable cleaning and decontamination. PPE which is ready for use should be clearly segregated from that which is awaiting repair or maintenance and clearly labelled as such so the correct PPE is chosen." • "Every employer shall ensure that any personal protective equipment provided to his employees is maintained (including replaced or cleaned as appropriate) in an efficient state, in efficient working order and in good repair." "Storage is required to: ○ (a) prevent damage from chemicals, sunlight, high humidity, heat and accidental knocks; ○ (b) prevent contamination from dirt and harmful substances; ○ (c) reduce the possibility of losing the PPE; ○ (d) enable the sufficient drying of PPE to ensure its effectiveness is maintained, for example retaining its insulating capabilities if used in damp, hot or cold environments."

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. The Control of Substances Hazardous to Health Regulations. Sixth Edition. 2013 Accessed 15 March 2024	Legislation	**Mandatory**	N/A	N/A	N/A

Assessment of evidence

The Substances Hazardous to Health Regulations 2002 (as amended) (COSHH) cover all substances to which the regulations apply.

The following recommendations regarding footwear are made:

- "Employers should ensure that PPE is maintained in an efficient state, in efficient working order, in good repair and in a clean condition"
- "Employers should ensure that accommodation is provided for PPE so that it can be safely stored or kept when it is not in use. The adequacy of the accommodation will vary according to the quantity, type and its use, e.g pegs, (labelled) lockers, shelves or containers etc. The storage should be adequate to protect the PPE from contamination, loss or damage by, for example, harmful substances, damp or sunlight."