Personal Protective Equipment (PPE): Headwear

Literature review

Version: 4.0

12 March 2026

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

Version history

Version	Date	Summary of changes

V4.0	12 March 2026	Three-year update of the literature review
		• Updated using a new methodology as outlined in the development process
		• Two new research questions were added
		  ○ "What type(s) of headwear are available for use in health and care settings?"
		  ○ "Where and how should headwear be donned (put on)?"
		• Question "Why should headwear be worn for infection control purposes?" was removed.
		The following questions were modified from the previous review.
		• Are there any legislative or standards requirements for the use of headwear as PPE for infection control purposes? (modification: added the phrase "or standards)"
		• When should headwear be worn for infection control purposes in health and care settings? (modification: previously "When/where should headwear be worn?")
		• What type(s) of headwear should be used in health and care settings? (modification: phrase ""in health and care settings" added)
		• What considerations should be given in the situation where headwear is worn for religious and/or cultural purposes? (modifications: previously, "What considerations should be made regarding religious and/or cultural head/face wear?")
		• When should headwear be doffed (taken off) or changed? (modification: terms "doffed/taken off" added)

Version	Date	Summary of changes
V3.0	August 2021	**Why should headwear be worn for infection control purposes?** New question added for review. **Are there any legislative requirements for the use of headwear as PPE for infection control purposes?** New recommendation 'PPE should be CE marked (for products purchased prior to 01st January 2021 and in use till 31st December 2021) or UKCA marked (from 01st January 2021onwards) and comply with the Regulation 2016/425 and the Personal Protective Equipment (Enforcement) Regulations 2018 (updated 2021) **Why should headwear be worn for infection control purposes?** New recommendation: Appropriate headwear should be donned: 'In procedures where there is a risk of splash injury from blood and body fluids (specifically in situations of blood borne viruses and high consequence infectious diseases) as PPE to protect the user's hair and forehead from droplet contamination.' 'In surgeries where there is high risk of Surgical site infections, as source control, to prevent shed of micro-organisms into the surgical field.' **When/where should headwear be worn?** New recommendations: Theatre setting

Version	Date	Summary of changes
		‘Headwear should be worn as part of surgical attire when entering restricted or semi restricted areas of the surgery.’ ‘Headwear should be worn as PPE in procedures where splashing or spraying of body fluids is anticipated, this includes arthroplasties and renal surgeries.’ ‘Headwear should be worn as source control, when performing clean/aseptic procedures where risk of infection is deemed to be high.’ Non-theatre settings ‘Headwear is not deemed as a necessary component outwith the theatre setting, unless, in haemodialysis settings or when entering contaminant- free environments.’ **What type(s) of headwear should be used?** New recommendations: ‘The choice of headwear should consider containment of shed particles, comfort and fit.’ ‘The choice of headwear should be made, based on local policy, by the interdisciplinary team at the healthcare facility and may include headgear made up of a disposable or launderable re-useable, lint free material which provides full hair and scalp coverage.’ **When should headwear be removed or changed?** This has been reworded to say ‘prior to leaving the dedicated clinical area (i.e the theatre setting); This has been reworded to say ‘at the end of a single clinical procedure or task; This has been reworded to say ‘at the end of a theatre session (for sessional use) This has been reworded to say ‘immediately or as soon as possible if visibly soiled or contaminated with blood or body fluids.

Version	Date	Summary of changes
		How should headwear be removed/disposed of? New recommendation: 'Head cover should be removed from behind the head-taking care to refrain from touching the head' This has been reworded to say 'Disposable headwear should be disposed of as healthcare (including clinical) waste in appropriate waste receptacle or bin.' This has been reworded to say 'Reusable headwear (used for PPE or source control) should be processed through a healthcare accredited laundry facility.' New recommendation: 'The employer shall ensure that removed/disposed PPE is "subsequently decontaminated and cleaned (if reusable) or, if necessary, destroyed." **What considerations should be made regarding religious and/or cultural head or face wear?** This has been reworded to say: 'Head and/or face coverings worn for religious or cultural reasons must not impede patient care, nor compromise source control or impact on clinical practice. If PPE is required to protect against blood or body fluid exposure, religious or cultural head or face wear must not compromise the protective barrier. If worn, religious or cultural head or face wear should be clean and changed in accordance with uniform policy. All other items of PPE must comply with PPE attire for the respective task being performed.'
V2.0	May 2016	**When/Where should headwear be worn.** This has been reworded to say 'The whole surgical team should wear appropriate headwear whilst in the theatre setting.'

Version	Date	Summary of changes
		How should headwear be removed/disposed of? New recommendation
V1.0	January 2012	Defined as final

Approvals

Version	Date Approved	Group/Individual
V4.0	February 2026	National Policy, Guidance and Evidence (NPGE) Working Group
V3.0	July 2021	National Policies Guidance and Outbreaks Steering Group
V2.0	April 2016	National Policies and Outbreaks Steering Group
V1.0	January 2012	Steering (Expert Advisory) Group for SICPs and TBPs

Key information

Document title:	Literature review: PPE (Headwear)
Date published/issued:	12 March 2026
Date effective from:	12 March 2026
Version/issue number:	4.0
Document type:	Literature review
Document status:	Final

Document information

Document information	Description
Description:	This literature review examines the available professional literature on PPE (Headwear) in the health and care setting.
Purpose:	To inform the Standard Infection Control Precaution (SICP) section on PPE (Headwear) in the National Infection Prevention and Control Manual in order to facilitate the prevention and control of healthcare associated infections in NHSScotland health and care settings.
Target Audience:	All NHS staff involved in the prevention and control of infection in NHSScotland.
Update/review schedule:	A formal review will be conducted in 5 years
Cross reference:	National Infection Prevention and Control Manual
Update level:	Practice – No changes to practice. Research – Several areas of research require higher primary quality research to allow the formation of evidence-based recommendations regarding the use of footwear for IPC in health and care settings.

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Contents

1 Objective

The aim is to review the extant scientific literature regarding the use of headwear as Personal Protective Equipment (PPE) for standard infection control purposes in health and care settings to inform evidence-based recommendations for practice. The specific objectives of the review are to determine:

- What type(s) of headwear are available for use in health and care settings?
- Are there any standards or legislative requirements for the use of headwear in health and care settings?
- When should headwear be worn for infection control purposes in health and care settings?
- What type(s) of headwear should be used in health and care settings?
- What considerations should be given in the situation where headwear is worn for religious and/or cultural purposes?
- When should headwear be doffed (taken off) or changed?
- Where and how should headwear be donned (put on)?
- Where and how should headwear be doffed (taken off)?
- How should headwear be disposed?
- How should headwear be stored?

2 Methodology

This targeted literature review was produced using a defined systematic methodology as described in the National Infection Prevention and Control Manual: Development Process.

A new research question; What type(s) of headwear are available for use in health and care settings?, was added to this review update and a separate search was carried out for the new research question; any evidence identified relevant to existing research questions was considered for inclusion.

In addition to the exclusion criteria outlined in the NIPCM: Development Process, the following exclusion criteria were used in this review with excluded studies following appraisal included in Appendix 4.

- This review did not assess the use of headwear in non-clinical settings where there may be a health and safety requirement for wearing specialist headwear, for example in either estates or kitchen environments.
- Studies in which headwear was bundled with other PPE unless findings specific to headwear could be clearly extracted.
- Evidence focusing on the use of headwear worn by patients, rather than staff.
- Headwear with integrated respirators (RPE) and headwear specifically designed for High Consequence Infectious Disease (HCID) settings, and space suits.
- Studies primarily addressing visors or face or eye protection, as these are covered in the NIPCM eye and face protection review.
- Studies discussing laundering processes, or the cost-effectiveness and sustainability of reusable headwear were excluded from this review; these factors are considered within the Considered Judgement Form (CJF).

A search strategy is included in Appendix 1. Definitions for grades of evidence are provided in Appendix 2. A PRISMA flowchart is presented in Appendix 3. Adapted from: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.

3 Discussion

3.1 Implications for practice

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

This is a new question for the current review update. In total nine pieces of evidence were included.[1-9] One French guideline for surgical attire was graded AGREE 'recommend with modifications'[1] as it did not provide sufficient details on the search strategy, despite conducting a systematic literature search. Eight guidance documents were graded SIGN 50 level 4 expert opinion.[2-9] Two documents originated from the UK[2, 8], four from the USA[4-6, 9], one from France[1], one from Canada[3], and one from Australia/New Zealand.[7] No primary studies were identified relevant to this question.

The available types of headwear identified within the evidence base generally fall into these categories:

Bouffant caps

Four documents including one AGREE 'recommend with modifications' guideline[1], and three SIGN 50 level 4 expert opinion, discuss the use of bouffant caps.[2, 4, 9] Bouffant caps are described as providing complete coverage of the head and facial hair, covering hair, ears, and hair at the nape of the neck. They are characterised as offering full head coverage and are frequently recommended for comprehensive protection in operating theatre environments.

Skull caps or surgeon or theatre caps

Four documents including one AGREE 'recommend with modifications' guideline[1] and four SIGN 50 level 4 expert opinion, reference skull caps or theatre caps.[4, 7-9]. Skull caps are described as headwear that does not cover the ears, distinguishing them from bouffant caps. These caps are snug-fitting and typically cover only the top of the head and crown, often leaving the ears and nape exposed. The Association of Surgical Technologists (AST) guidance[4] specifically notes that surgeons caps do not completely cover the hair, exposing areas around the ears and nape of the neck.

Headgear

Two documents including one guideline graded AGREE 'recommend with modifications'[1] and one SIGN 50 level 4 expert opinion[4] use the general term 'headgear' to describe various types of head coverings, indicating this as an umbrella term for surgical head coverings.

Hoods

Two SIGN 50 level 4 expert opinion documents mention hood-style head coverings.[2, 4] Hoods are described as providing complete coverage of the head and facial hair, with the AST guidance specifically recommending disposable hoods for personnel with facial hair to ensure complete coverage and prevent shedding of squamous (skin) cells or hair into the sterile field.

Cloth caps or hats

Four SIGN 50 level 4 guidance documents specifically reference cloth caps or reusable cloth head coverings.[2, 4, 6, 7] These are described as reusable options that require regular laundering, with some guidance noting they should be freshly laundered and lint-free.[7]

Disposable vs Reusable options

In addition to the type of headwear, the evidence distinguishes between reusable and disposable options.

Disposable headwear is discussed in six documents[2-5, 7, 9] and includes single-use bouffant caps, disposable hoods, and other single-use head coverings that are discarded after use. While reusable headwear is mentioned in six documents[2, 4-7, 9] and includes cloth caps and other launderable head coverings that require regular laundering in healthcare facility laundry services or accredited third-party facilities.

In summary, the types of headwear available for health and care settings as noted from the evidence include bouffant caps, skull caps, hood-style coverings, and options in either disposable or reusable forms.

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

Five pieces of evidence were included for this question[10-14], comprising four mandatory legislation documents[10-13] and one British Standard graded SIGN 50 level 4 expert opinion.[14] All documents were carried over from the previous version of this review, with two updated for the current review. No primary research was included owing to the nature of the research question.

While there is no legislation that explicitly mandates the use of headwear in health and care settings for infection control purposes, broader personal protective equipment (PPE) regulations and workplace health & safety laws and standards provide some guidance to ensure the safety and hygiene of workers in different settings.

Legislation on PPE and workplace safety

The wearing of PPE in the healthcare setting is covered by the Health and Safety at Work etc. Act (1974)[11], Control of Substances Hazardous to Health (COSHH) Regulations (2002 as amended)[12] and the Personal Protective Equipment at Work Regulations (1992 as amended).[10]

The Health and Safety at Work etc. Act 1974[11] places a legal duty on employers to ensure the health, safety, and welfare of their employees as far as reasonably practicable. While the legislation does not specifically mention headwear, it establishes a general obligation to implement safety measures where necessary, which may include the use of head coverings if worn for PPE purposes in health and care settings.

The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (Amended 2013)[12] focus on protecting employees from harmful substances, including microorganisms such as bacteria, viruses, and fungi. Under these regulations, employers are required to provide PPE, including headwear, if necessary, when other control measures do not fully eliminate exposure risks. Additionally, all reusable PPE must be properly maintained, stored, and

decontaminated after use to prevent contamination and ensure continued effectiveness.[12]

The Personal Protective Equipment at Work (Amendment) Regulations 2022[10] reinforce the obligation for employers to provide PPE to workers facing health or safety risks. Where headwear is deemed necessary for protection, it must be suitable for the risk, well-maintained, and properly fitted. This ensures that PPE remains effective in reducing workplace hazards and aligns with broader health and safety regulations.

The Regulation (EU) 2016-425 and the UK PPE (Enforcement) Regulations 2018[13] establish standards for the design, certification, and compliance of PPE, including headwear if classified as protective equipment. These regulations require that PPE must carry CE or UKCA markings to be legally placed on the UK market, ensuring that it meets safety and performance standards before use in workplaces, including healthcare settings.

Standards for PPE

The British Standard BS EN 13921:2007[14] provides ergonomic principles for PPE, ensuring that protective equipment, including headwear, is comfortable, well-fitted, and effective for users. However, this standard does not specify requirements for headwear in infection control, focusing instead on general PPE usability and design considerations.

In summary, while there is legislation in place outlining general requirements for PPE and workplace safety such as the Health and Safety at Work etc. Act, COSHH Regulations, and the PPE at Work Regulations, none of these explicitly mandate or address the use of headwear for infection control in health and care settings. Similarly, while BS EN 13921:2007 provides guidance on the ergonomic design and usability of PPE, it does not include headwear as PPE for IPC purposes. As such, current legislation and standards offer broad but non-specific support for the use of headwear.

3.1.3 When should headwear be worn for infection control purposes in health and care settings?

Thirteen pieces of evidence were included for this research question.[1, 2, 4-9, 15-19] Seven were identified in the current review update[1, 2, 8, 9, 15, 18, 19] and six were carried over from the previous version (3.0).[4-7, 16, 17] There was an absence of primary evidence. Only one study was identified but was excluded at critical appraisal stage due to methodological limitations.[20]

Three guidelines were graded AGREE 'recommend with modifications'.[1, 15, 19] One lacked clarity in explicitly linking the evidence to the recommendations[15], while two did not provide sufficient details on the search strategy, despite conducting a systematic literature search.[1, 19] Ten guidance documents were graded SIGN 50 level 4 expert opinion.[2, 4-9, 16-18] Two documents are from the UK[2, 8], one specific to Scotland and Ireland[17], one covering the European region[15], one from France[1], five from the USA[4-6, 9, 16], and one from Australia and New Zealand.[7]

The evidence is consistent in recognising the importance of headwear use in surgical and high-risk settings. However, the evidence reflects variation in the rationale behind headwear use; some documents focus on source control (protecting patients from contaminants shed by staff), while others support its use as part of PPE to protect the healthcare worker.

Headwear for source control (protecting the patient)

Twelve guidance documents[1, 4-6, 8, 9, 15-19, 21] recommend the use of headwear primarily for source control, aimed at reducing the risk of surgical site infections (SSIs) or environmental contamination in operating theatres and high-risk clinical settings. These include three guidelines graded AGREE 'recommend with modifications'[1, 15, 19] and nine documents graded SIGN 50 level 4 expert opinion.[4-6, 8, 9, 16-18, 21]

The French Society of Anaesthesia and Intensive Care Medicine guidelines recommend that operating theatre staff wear headwear such as bouffant caps, skullcaps, to minimise the risk of patient infection.[1] This is supported by other AGREE-graded guidelines, including the NICE Surgical Site Infection guideline[19], which, while acknowledging a lack of direct evidence linking headwear to infection

prevention, supports its use to maintain theatre discipline and potentially minimise the risk of SSIs. This is reiterated in their quality standard for interoperative staff practices.[18] Additionally, the Healthcare Infection Society, ESCMID (Europe) guideline reinforces local policy alignment and recommends headwear use for surgical staff to prevent contamination.[15]

SIGN 50 level 4 expert opinion from the Association for Perioperative Practice (AfPP)[2] and the Association of Anaesthetists of Great Britain & Ireland[21], also support headwear for source control. The AfPP[2] recommends designated theatre attire, including head caps or hats, for all staff entering operating rooms to minimise the risk of exposure to infection for both staff and patients. The Royal Colleges of Surgeons of Edinburgh and Ireland,[17] and the Association of Anaesthetists of Great Britain and Ireland[8] recommend headwear in laminar flow theatres and during prosthetic procedures to reduce infection risk. The American College of Surgeons (ACS)[16], the (AST)[4], and the Association of periOperative Registered Nurses (AORN)[9] similarly advise full coverage of head and facial hair during invasive procedures or within theatre rooms, again linking this to a reduction in microbial shedding and environmental contamination including potential wound contamination. Similarly, the American Society of Anaesthesiologists (ASA)[5] advises the use of head coverings during surgical procedures to prevent the dispersion of infectious particles from the scalp and hair. The American Association of Nurse Anaesthesiology (AANA)[6] also recommends wearing headwear particularly as part of a sterile ensemble during procedures such as central venous catheter insertion to help minimise infection risk to the patient.

Headwear as PPE (protecting the wearer)

There is limited evidence supporting the use of headwear as PPE specifically for protecting healthcare workers from infectious risks. Only one SIGN 50 level 4 guidance document makes a reference that suggests the use of headwear for PPE purposes, is to protect the healthcare worker from contamination.[2]

The AfPP[2] notes that theatre attire, including headwear, contributes to minimising infection risks to both patients and staff, implying a dual role for headwear, although this is not explicitly linked to staff protection from a specific transmission mode.

However, while the Australian and New Zealand College of Anaesthetists (ANZCA) advises that hair should be completely covered with a disposable theatre cap or freshly laundered lint-free hat, they do not explicitly clarify whether this is intended as source control or PPE.[7]

In summary, the current evidence strongly supports the use of headwear in surgical and high-risk settings like laminar flow theatres, primarily as a source control measure to protect patients. In contrast, guidance on the use of headwear as PPE for protecting staff is limited.

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

Eleven pieces of evidence were included for this research question[1, 2, 4-7, 16, 22-25], with one identified in the current update[1] and 10 carried over from the previous (3.0) version.[2, 4-7, 16, 22-25]

One guideline was graded AGREE 'recommend with modifications' due to the lack of details on the search strategy, despite a systematic literature search being conducted.[1] Three primary studies (two retrospective cohort and one experimental), were graded SIGN50 level 3.[22-24] Seven guidance documents were graded SIGN 50 level 4 expert opinion.[2, 4-7, 16, 25] The included evidence comprises one document from the UK[2], one from France[1], one from Australia and New Zealand[7], and eight from the USA.[4-6, 16, 22-25]

There is no consistency across the evidence base with regards to the types of headwear that should be used in health and care settings, due to evidence regarding the effectiveness of specific headwear types being inconclusive.

Primary studies on headwear in healthcare settings

Three SIGN 50 level 3 studies evaluated the effectiveness of different types of headwear in minimising surgical site infections (SSIs) and environmental contamination in healthcare settings with mixed results.[22-24] There were no studies included that assessed the effectiveness of headwear as PPE in terms of protection for the wearer.

Haskins et al. in 2017,[22] using an observational retrospective cohort study, assessed the impact of headwear type (bouffant caps vs. skull caps) on SSIs following ventral hernia repair. The study analysed data from 6,210 procedures performed by 68 surgeons in America who were surveyed about their preferred surgical headwear from six options: disposable skull cap, cloth skull cap, disposable bouffant with ears exposed, disposable bouffant with ears covered, cloth bouffant, and surgical headgear with beard coverage. Among respondents, 31 surgeons (45.6%) wore disposable surgical skull caps, six surgeons (8.9%) wore cloth skull caps, 20 surgeons (29.4%) wore disposable bouffants with ears exposed, and 11 surgeons (16.1%) wore disposable bouffants with ears covered. No surgeons reported wearing cloth bouffants or surgical headwear.

No statistically significant association was found between surgeon headwear type and the risk of 30-day SSI or surgical site occurrences requiring procedural intervention (p-value not reported). There was also no statistically significant difference in the 30-day postoperative SSI incidence rates when all surgical cap types were compared to all surgical bouffant types, or when any combination of surgical caps and bouffants were compared to one another.

The retrospective design, combined with potential confounding factors that may increase SSI risk, limits causal inference. The authors acknowledge that the retrospective nature prevented them from determining correlations between bacteria isolated from wound infections and bacteria present on surgeons' skin or hair surfaces. Furthermore, the study focused solely on the association between surgeons' surgical cap attire and 30-day wound events, without accounting for the surgical cap attire of other operating room personnel or considering other established SSI risk factors that may confound the results.

Rios-Diaz et al.[23] in 2018, conducted a retrospective cohort study analysing the effect of an American hospital policy change that banned skull caps in favour of bouffant or helmet-style headwear. The study examined data from 1,901 (760 pre-policy and 1,141 post-policy) surgical cases from the ACS National Surgical Quality Improvement Program (NSQIP) and found no significant difference in overall SSI rates before (5.3%) and after (5.5%, $p = 0.809$) the headwear policy change. Further breakdown of SSI types (superficial, deep, and organ or space infections) also

revealed no statistically significant differences (superficial SSI p = 0.834, deep SSI p = 0.248, organ or space SSI p = 0.766). Multivariate analysis confirmed that the odds ratio for SSIs in the post-implementation period was 1.12 (95% CI: 0.73–1.71, p = 0.59). Because of the study's retrospective nature, there is an inherent risk of unmeasured confounders such as surgeon experience, ventilation, and sterilisation techniques. Additionally, factors like surgeon skill, operative time, and intraoperative techniques were not captured in the NSQIP data. The NSQIP sampling excluded procedures exceeding 3 per 8-day cycle, potentially biasing case distribution.

Markel et al.[24] in 2017, conducted an experimental study assessing microbial shedding, particle contamination, and fabric permeability of three types of headwear: disposable bouffant caps, disposable skull caps, and reusable cloth skull caps. Results from this American study indicated that bouffant caps were associated with significantly more airborne particles in the 0.5-1.0 µm range than cloth skull caps (p = 0.012 and p = 0.001, respectively). Higher passive microbial contamination at the sterile field was observed with bouffant caps compared to both skull cap types (p < 0.05). Fabric permeability tests showed that bouffant caps were significantly more porous than cloth skull caps (p < 0.05), potentially contributing to greater contamination risk. The study was conducted in a controlled simulated environment rather than actual surgical conditions, which may limit its real-world applicability.

Coverage Style

Five SIGN level 4 expert opinion guidance documents[2, 4-7] specifically advise the use of headwear that covers the scalp, hair, and ears, with the AST[5] explicitly advising against skull caps due to their inability to provide full coverage. However, the French society of anaesthesia and intensive care medicine in their guidelines graded AGREE 'recommend with modifications' did not find conclusive evidence supporting the requirement for ear coverage and therefore did not advise a specific type of headwear (for example a bouffant instead of a skull cap).[1] Similarly, a 2018 joint statement from the ACS, AST, the AORN, the ASA, the Association for Professionals in Infection Control and Epidemiology (APIC), the Council on Surgical and Perioperative Safety and The Joint Commission states that there is insufficient evidence linking headwear type or style to SSIs suggesting that this aspect may not be critical for infection control.[25] In contrast, one SIGN 50 level 4 expert opinion

document, from the ACS permits skull caps as long as they provide adequate hair coverage.[16]

Reusable Headwear

The French Society of Anaesthesia and Intensive Care Medicine, in its guidelines graded AGREE 'recommend with modifications', does not express a preference for headwear type.[1] Instead, it advises that surgical staff may use either disposable single-use or reusable head coverings highlighting the added benefit of environmental sustainability, in operating theatres to minimise patient infection risk.

Two SIGN 50 level 4 guidance documents[2, 5] acknowledge the use of reusable headwear, typically with conditions around laundering. The AfPP[2] permits reusable cloth caps if they are properly laundered and inspected. The ASA recommends covering the hair and scalp with head gear made of a disposable or launderable re-useable material, acknowledging both options while emphasising proper maintenance for reusable items. [5]

Disposable Headwear

One AGREE 'recommend with modifications' and three SIGN 50 level 4 guidance documents permit the use of disposable headwear. However, guidelines from French Society of Anaesthesia and Intensive Care Medicine do not express a preference.[1] The AfPP[2] and the ASA[5] both recommend disposable headwear with a preference for bouffant or hood-style caps that cover the hair, ears, and nape of the neck. The Australian and New Zealand College of Anaesthetists[7] notes that hair should be "completely covered with a disposable theatre cap or freshly laundered lint-free hat," with a clear preference for disposable options.

In summary, the limited number of primary studies were unable to demonstrate a significant impact on SSI rates associated with the use of specific headwear type. Experimental data suggest that disposable bouffant caps may be more permeable and allow greater microbial shedding compared to skull caps specifically the cloth type, though this has not been directly linked to an increased risk of SSIs. None of the identified studies or guidance documents address the effectiveness of headwear as PPE for protecting the wearer from splash or spray exposure, with focus exclusively on patient outcomes.

Guidelines and expert opinion recommendations remain inconsistent, with some organisations favouring bouffant or hood-style caps for full coverage, while others permit skull caps as long as they adequately cover the hair. There is also no consensus on whether reusable or disposable headwear is preferable, with documents often balancing infection control concerns against environmental sustainability. Most extant guidance is based on expert opinion, highlighting the lack of strong empirical evidence supporting any specific headwear type.

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

Three pieces of evidence were included to answer this research question, all guidance documents graded SIGN 50 level 4 expert opinion.[9, 26] Two were identified in the current review[9, 16, 26] and one carried over from the previous (V3.0) version.[16] One document originates from the UK[26], while the other two are from the USA.[9] No primary studies were identified relevant to this question.

In the UK, the Health and Safety Executive outline an exemption under the Personal Protective Equipment at Work Regulations as amended, which allows Sikhs who were turbans to forgo additional head protection in any workplace, except in high-risk or emergency situations where head protection is deemed essential for the protection of the individual through risk assessment. The exemption extends to visitors and non-workers, with employers holding limited liability should an incident occur.[26] However, this guidance broadly covers workplaces rather than being specific to health and care settings and does not address patient safety considerations, focusing solely on the protection of the individual wearer.

The SIGN 50 level 4 guidance from the AORN[9] provides guidance that allows religious head coverings, such as hijabs, veils, and turbans, to be worn in semi-restricted and restricted areas of operating suites, provided they meet the required standards as identified by local policy. These include being clean, made from tightly woven, low-linting fabric, free of adornments, and fitted properly with loose ends tucked into the scrub top.

Another SIGN 50 level 4 guidance document from the ACS[16], states that religious beliefs regarding headwear should be respected as long as patient safety is not compromised. However, the guidance does not specify how this balance should be achieved in practice.

In summary, while legal exemptions allow Sikhs who wear turbans to forgo protective headgear in most workplaces, IPC and patient safety remain key considerations when accommodating religious headwear. Expert opinion such as that from AORN and ACS, supports the inclusion of religious head coverings in restricted areas, provided they adhere to strict hygiene standards and do not compromise patient safety.

3.1.6 When should headwear be doffed (taken off) or changed?

Four guidance documents, all graded SIGN 50 level 4 expert opinion, were included for this question.[4, 5, 9, 16] One was identified in the current review[9] and three carried over from the previous (2021) version.[4, 5, 16] The identified evidence originates from the USA. [4, 5, 9, 16] No primary studies were identified relevant to this question.

The majority of the guidance identified relates to surgical or operative settings, with very limited focus on non-operative settings.

Three SIGN 50 level 4 documents recommend that head coverings or hats should be removed and replaced if contaminated or soiled. [4, 5, 16] Only the AORN guidance specifically mentions removal when contaminated with potentially infectious materials (e.g., blood or body fluids), advising this should be done as soon as possible without delaying urgent patient care.[9]

The ACS adds that headwear worn during dirty or contaminated cases must be changed before subsequent cases, even if not visibly soiled.[16]

In summary, the available evidence, though limited to expert opinion and focused primarily on surgical settings, consistently recommends that both disposable and reusable headwear be changed daily and removed and replaced if it becomes contaminated.

3.1.7 Where and how should headwear be donned (put on)?

Three documents were included for this question, all graded SIGN 50 level 4 expert opinion.[2, 4, 9] One is from the UK [2], and two are from the USA.[4, 9] No primary studies were identified relevant to this question.

Where to don

Three SIGN 50 level 4 documents provide advice on when to don headwear without specifying the exact location. The AORN[9] states that headwear should be donned before entering semi-restricted and restricted areas of the surgical suite.

Similarly, the AfPP[2] and the AST[4] do not specify an exact location for donning headwear but imply that it should occur before stepping into environments where sterile attire is required.

How to don

Two SIGN 50 level 4 expert opinion pieces offer guidance on how to don headwear, though none provides a specific step-by-step process.[2, 4] They advise headwear be donned before putting on the scrub suit to prevent contamination of scrub clothing with hair or dandruff.

In summary, extant guidance is consistent in advising that headwear should be donned before donning sterile clothing or entering critical areas of the surgical suite.

3.1.8 Where and how should headwear be doffed (taken off)?

Five guidance documents were included for this question, all graded SIGN 50 level 4 expert opinion.[2, 4, 6, 9, 27] Two were identified in the current update [2, 9], while three were carried over from the previous version.[4, 6, 27] One document is from the UK[2], three from the USA[4, 6, 9], and one from the World Health Organization (WHO) intended for a global audience.[27] No primary studies relevant to this question were identified.

Where to Doff Headwear

One document graded SIGN 50 level 4 provides guidance on the location of doffing headwear.[2] The AfPP[2] recommends that head coverings be removed before traveling between buildings and before leaving the healthcare facility.

Although the AORN[9] does not provide guidance on specific location of doffing they advise that headwear should not be worn outside of the surgical or perioperative environment which implies removal prior to exiting these areas.

How to Doff Headwear

Three SIGN 50 level 4 expert opinion documents provide guidance on how to remove surgical headwear, all emphasising the need to minimise contamination during the doffing process, although the specific removal process differs.[4, 6, 27] The AANA[7] advises removing surgical caps using gloves, avoiding contact with the inner surface of the cap while the WHO[27] advises rolling the head covering from the back to the front, ensuring that the outer contaminated surface is not touched but does not specify wearing gloves or mention contacting the inner surface.

In summary, there is general consistency in extant guidance that headwear should be removed in a manner that minimises contamination, prior to exiting the surgical environment.

3.1.9 How should headwear be disposed?

Four documents were included for this research question, all graded SIGN 50 level 4 expert opinion.[2, 4, 6, 9] One document is from the UK [2] and three from the USA.[4, 6, 9]Two were identified in the current update[2, 9], while two were carried over from the 2021 version.[4, 6] No relevant primary studies were identified.

Disposable headwear

Four SIGN50 level 4 guidance documents[2, 4, 6, 9] offer guidance on disposal of disposable headwear, consistently emphasising that it should be discarded immediately after use in designated waste receptacles. The AST recommends that disposable bouffant and hood covers be disposed of in appropriate waste bins to

prevent contamination of the environment.[4] Similarly, the AANA[6] and AfPP[3] advise that all used headwear including surgical caps be disposed of in an appropriate waste container.

Reusable headwear

The AORN[9] in their guidance graded SIGN 50 level 4, provides a conditional recommendation that organisations should establish a clear process for managing reusable headwear that includes laundering frequency and laundering methods. Alongside the AST[4], they advise that if worn, reusable head coverings must stay at the health care facility for laundering or an accredited third-party facility. Home laundering is discouraged due to the risk of improper cleaning and potential cross-contamination as it cannot be properly monitored and therefore fails to meet the rigorous standards of accredited laundry facilities, as referenced in their Standards of Practice for Laundering of Scrub Attire.[28]

In summary, extant guidance is consistent in advising that disposable headwear should be discarded in designated waste bins immediately after use. One guidance source advises that if contaminated with potentially infections materials, reusable headwear should be laundered in healthcare facilities or by an accredited third-party facility, not at home, to prevent cross-contamination.

3.1.10 How should headwear be stored?

Only two documents were included: one mandatory legislation [29] and one guidance document graded SIGN 50 level 4 expert opinion.[30] Both documents were produced by the UK HSE.[29, 30] No primary studies were identified.

The HSE provides general PPE storage recommendations under the Personal Protective Equipment at Work Regulations.[30] This guidance emphasises that PPE, including headwear, must be properly maintained and stored in a clean, dry area, such as a cupboard, when not in use. If the headwear is reusable, it must be decontaminated appropriately and kept in good condition before storage. The HSE further highlights that reusable PPE that becomes contaminated during use should be decontaminated before being stored.[30]

The COSHH[29] outlines additional requirements for PPE storage, stressing that adequate space must be provided for the storage of PPE. Depending on the facility and the type of PPE, this could include labelled lockers, shelves, or designated containers. The primary goal is to protect PPE from contamination, loss, or damage caused by harmful substances, moisture, or excessive sunlight. COSHH regulations highlight that improper storage can compromise the effectiveness of PPE, potentially reducing its protective capabilities.

In summary, both COSHH and HSE guidance are consistent in requiring that suitable storage is necessary to prevent physical damage from chemicals, high humidity, heat, damp, and accidental impacts. However, the guidance is largely general to all PPE and all workplaces.

3.2 Implications for research

There is a lack of primary scientific evidence regarding the use of headwear in health and care settings. Future studies should further explore the effectiveness of headwear as PPE for the wearer, and its use as source control for reduction of SSI. This is reflected in extant guidance documents, most of which are graded SIGN 4 expert opinion due to the absence of primary evidence.

Moreover, current legislation on PPE primarily focuses on the handling and management of hazardous substances rather than infection prevention in clinical settings. Much of the existing legislation is not tailored to health and care environments, requiring cautious interpretation when applying PPE regulations to headwear use.

Three studies[20, 31, 32] assessing the effectiveness of surgical exhaust helmets (as part of surgical space suits) and body exhaust gowns, for use within dedicated surgical settings focussing on arthroplasty, were also identified as part of this review but excluded following critical appraisal. Overall, the results demonstrated that use of surgical helmets was associated with very limited or no increased benefit, in comparison to wearing a standard surgical gown and cap or no headwear. Two of the studies relied on simulation methods, limiting their applicability to real world

clinical settings.[31, 32] While the study by So et al, had multiple confounders with significant differences in the mean age between the groups.[20] It is anticipated that further literature will be published relating to the use of surgical helmets in certain surgical settings. Future literature review updates may need to consider the potential benefits and risks associated with the use of these.

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Appendix 1: Search Strategy

Searches were conducted to cover the period from 1 January 2020 to 28 May 2024

Medline

1. Head Protective Devices/
2. (head adj3 wear).ti,ab,kf
3. (head?ear or head gear or headcap or head cap or surgical cap or hood or bouffant).mp.
4. (hat or hats).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]
5. 1 or 2 or 3 or 4
6. exp Infections/
7. Disease Transmission, Infectious/
8. source control.mp.
9. Cross Infection/
10. (cross infection or healthcare associated or health care associated or hospital acquired or hospital onset).ti,ab,kf.
11. exp Hospitals/
12. exp Universal Precautions/
13. (donn* or doff* or remov*).mp.
14. (Dispos* or waste).mp.
15. (Store* or storing or storage).mp.
16. religio*.mp.
17. exp Infection Control/
18. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17

19. 5 and 18

20. limit 19 to (english language and yr="2020 -Current")

Embase

1. exp head protection/

2. (head?ear or head gear or headcap or head cap or surgical cap or hood or bouffant).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]

3. (hat or hats).mp.

4. (head adj3 wear).ti,ab,kf.

5. 1 or 2 or 3 or 4

6. exp infection/

7. disease transmission/

8. source control.mp.

9. cross infection/

10. (cross infection or healthcare associated or health care associated or hospital acquired or hospital onset).ti,ab,kf.

11. exp universal precaution/

12. exp hospital/

13. exp universal precaution/

14. (donn* or doff* or remov*).mp.

15. (dispos* or waste).mp.

16. (store* or storing or storage).mp.

17. religio*.mp.

18. exp infection control/

19. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18

20. 5 and 19

21. 20 not conference*.so,su,pt.

22. limit 21 to (english language and yr="2020 -Current")

CINAHL

S20 S16 AND S17 Limiters - Publication Date: 20200101-20241231

S19 S16 AND S17 Narrow by Language: - english

S18 S16 AND S17

S17 S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15

S16 S1 OR S2 OR S3

S15 TI (cross infection or healthcare associated or health care associated or hospital acquired or hospital onset) OR MW (cross infection or healthcare associated or health care associated or hospital acquired or hospital onset) OR AB (cross infection or healthcare associated or health care associated or hospital acquired or hospital onset)

S14 religio*

S13 store* OR storage OR storing

S12 dispos* OR waste

S11 donn* OR doff* OR remov*

S10 source control

S9 MH "Hospitals+"

S8 MH "Infection+"

S7 MH "Infection Control+"

S6 MH "Disease Transmission+"

S5 MH "Religion and Religions+"

S4 (MH "Cross Infection+")

S3	head#ear OR head gear OR hat* OR headcap OR head cap OR surgical cap OR hood
S2	(TI head N3 wear) OR (AB head N3 wear) OR (SU head N3 wear)

Appendix 2: Evidence Levels

SIGN 50 Evidence Levels

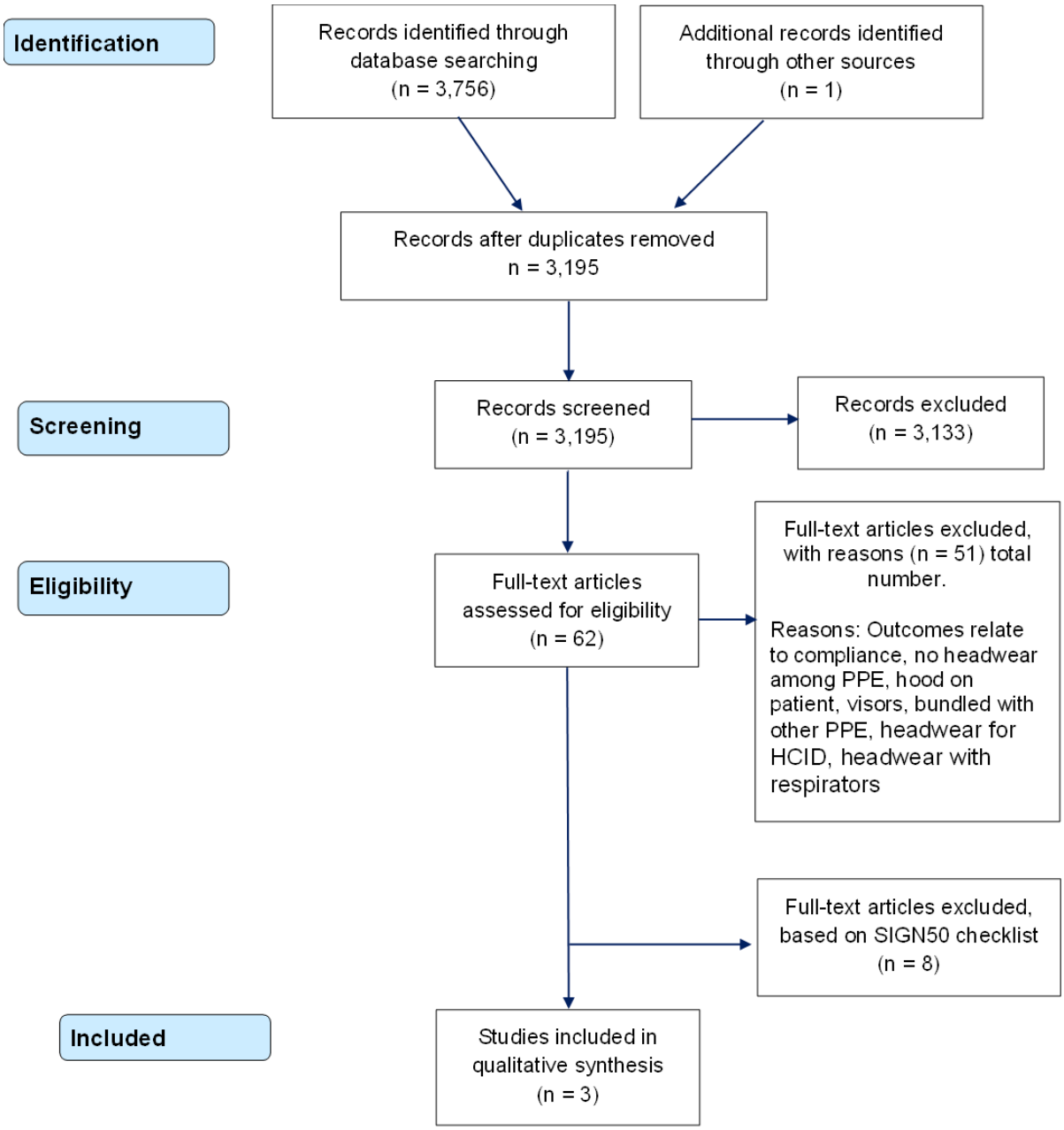
Grade	Description
1++	High quality meta analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1-	Meta analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High quality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

Grade	Description
	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.

Appendix 3: PRISMA flow diagram



Appendix 4: Studies excluded following critical appraisal

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