NHS National Services Scotland

Personal Protective Equipment (PPE): Eye/Face Protection Literature Review

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ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

Contents

Key Information

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Document information	Description
Description:	This literature review examines the available professional literature on Personal Protective Equipment (PPE) – Eye/Face protection
Purpose:	To inform 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:	Updated as new evidence emerges with changes made to recommendations as required. Review will be formally updated every 3 years with next review in 2027.
Cross reference:	National Infection Prevention and Control Manual
Update level:	Practice – No significant changes to practice. Research – Several areas of research require higher quality primary research to allow the formation of evidence-based recommendations made regarding the use of eye/face for IPC in health and care settings. In particular, the efficacy of eye/face protection for different types of anticipated exposure.

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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	August 2020	Updated using 2-person systematic methodology with findings divided into two parts - SICP and TBP recommendations.
2.0	February 2025	Three-year update of Eye/face Protection Literature Review. This literature review was updated using a new methodology. Details on this process can be found within the **development process** on the NIPCM. The findings of this literature review are no longer separated into two parts (SCIP and TBP recommendations).

Approvals

Version	Date Approved	Name
1.0	August 2020	National Policies, Guidance and Outbreaks Steering Group
2.0	January 2025	National Policy, Guidance and Evidence Working Group

1 Objectives

The aim is to review the extant scientific literature regarding personal protective equipment (PPE) for eye and face protection in health and care settings to inform evidence-based recommendations for practice. The specific research questions are provided below.

1. What is eye and face protection?
2. What types of eye/face protection are recommended for health and care settings?
3. Are there any legislative requirements or standards (BS/EN/ISO) relating to the use of eye/face protection for infection prevention and control purposes?
4. When should eye/face protection be worn by health and care staff?
5. When should eye/face protection be worn by a service user/visitor?
6. Where and how should eye/face protection be donned (put on)?
7. Where and how should eye/face protection be doffed (taken off)?
8. When should eye/face protection be changed or removed?
9. How should eye/face protection be disposed of?
10. How should reusable eye/face protection be reprocessed/ decontaminated?
11. How should eye/face protection 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.** The complete search strategy is provided in **Appendix 1**.

Additional exclusion criteria to those outlined within the development process were applied. This includes exclusion of evidence and/or studies that:

- focus on modelling
- focus on occupational health impacts of eye/face protection
- make no attempt to link infection cases (for example lack of a clear epidemiological link or molecular typing)
- discuss eye/face protection used in contingency/crisis scenarios (for example, during PPE shortages)
- involve face masks without integrated eye/face protection

Definitions for grades of evidence are provided in **Appendix 2**. A PRISMA flowchart is presented in **Appendix 3**. Adapted from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[1]

3 Discussion

3.1 Implications for practice

3.1.1 What is eye and face protection?

In total, 10 pieces of evidence were included to answer this research question.[2-11] This is a new research question, added as part of the current update to this review. All evidence was graded SIGN50 Level 4 expert opinion and consisted of guidance documents from national and international organisations. Evidence graded SIGN50 Level 4 expert opinion is potentially subject to bias due to a lack of supporting evidence or systematic methodology underpinning the guidance. Three expert

opinion guidance documents were published in the UK,[2, 3, 5] two in the USA,[7, 9] and one was published in each of the following countries: Australia,[4] Canada,[8] and New Zealand.[11] One expert opinion document was published by the European Centres for Disease Prevention and Control (ECDC) and is therefore applicable to the European Union (EU)/European Economic Area (EEA).[10] Another was published by the World Health Organization (WHO) and therefore applies internationally.[6]

All identified expert opinion documents provided a definition of eye and face protection in the context of health and care settings. The evidence base varied slightly in the terminology used, however, ultimately the definitions provided are consistent. There is consistency amongst the evidence base that eye and face protection is provided by eye and face protective equipment, used to reduce the risk of exposure to the mucous membranes of the eyes,[2-11] nose,[6, 7] and mouth.[6, 7] The evidence differed in how the risk of exposure was described, including potentially infectious material,[9] pathogens,[3, 8] virus exposure,[10] or blood and/or body fluids.[2, 4, 6, 7, 9, 11] 'Virus exposure' is used by the ECDC as the guidance is targeted towards healthcare workers (HCWs) caring for patients with confirmed or suspected COVID-19 infection.[10] Health New Zealand guidance was also targeted towards health and disability care workers when caring for patients with acute respiratory infections, including COVID-19.[11] One piece of evidence by the Royal College of Nursing does not include the exposure type within its definition.[5]

Different types of eye/face protection are available, these are described within the research question "**What types of eye/face protection are recommended for health and care settings?**". Appropriateness of these specific types for certain tasks and anticipated exposures are discussed within the research question "**When should eye/face protection be worn by health and care staff?"**.

In summary, the literature defines eye/face protection as protective equipment that reduces the risk of exposure of the mucous membranes of the eyes, nose and mouth to blood and/or body fluids, which may be infectious.

3.1.2 What types of eye/face protection are recommended for health and care settings?

In total, 24 pieces of evidence were included to answer this research question. Six pieces of evidence were identified in previous version(s) of this literature review.[5, 9, 10, 12-14] and 18 were identified as part of this review update.[3, 4, 6-8, 11, 15-26] One guidance document was graded AGREE: 'Recommend with modifications' due to limitations of its systematic literature review methodology, and because the link between recommendations made and the supporting evidence is unclear.[22] The remaining evidence (n=23) was graded SIGN50 Level 4 expert opinion,[3-21, 23-26] including one British Standard.[12] Evidence graded SIGN50 Level 4 expert opinion is potentially subject to bias as there is often a lack of supporting evidence and an unclear methodology. No primary evidence was identified for this research question.

Eight expert opinion documents were published in the UK,[3, 5, 12, 13, 21, 23, 24, 26] five of which were published for UK health and care settings.[3, 5, 13, 24, 26] The remaining three documents are not specific, but are applicable, to health and care settings; these include one British Standard and two Health and Safety Executive (HSE) guidance documents.[12, 21, 23] Three documents were published by the WHO for health and care settings, one of which was graded AGREE: 'Recommend with modifications', and applies internationally.[6, 22, 25] One expert opinion document was published by the ECDC for health and care settings, and is therefore applicable to the European Union (EU)/European Economic Area (EEA).[10] The remaining evidence was published in the USA (n=8),[7, 9, 14, 15, 17-20] Australia (n=2),[4, 16] Canada (n=1),[8] and New Zealand (n=1).[11]

Types of eye/face protection

There is consistency in the evidence base that types of eye and face protection worn in health and care settings include goggles,[3-6, 8-11, 14-19, 22, 24, 25] face shields/visors,[3-11, 13-19, 22, 24] safety glasses[4, 8, 9, 11, 15, 16, 19] (sometimes referred to as safety spectacles)[13] with solid side shields,[4, 7, 11, 15] and surgical face masks with integrated face shields.[9, 13, 24] Guidance published by the Public Health Agency Canada also refers to 'masks' with built-in eye protection.[8]

Face masks without integrated face shields/visors are not discussed within this review, for more information on face masks, see the **Surgical face masks literature review** . The Centers for Disease Prevention and Control (CDC) states that healthcare workers may consider wearing powered air purifying respirators or full facepiece elastomeric respirators, which have built in eye protection, when respiratory protection is required.[20] However, this type of protection was deemed outside the scope of this review, further information can be found in the **RPE literature review**.

British Standard (BS) 7028:1999 and the HSE have described eye and face protection to include goggles, face shields, and safety glasses. However, these guidance documents are not specific to health and care settings.[12, 21, 23]

There was variation in the design features of goggles, face shields and safety glasses discussed within the evidence base. Goggles are described to consist of lenses and an elastic headband to hold them in place,[9, 12, 21] they may also incorporate direct or indirect ventilation,[9, 12, 21] and/or have anti-fog coatings.[4, 9] Where direct/indirect vents are positioned on the goggles is not provided by the evidence base. Only one piece of expert opinion guidance by BS 7028:1999 provided further classification of goggles as box type or cup type, differing in having single ocular or twin oculars, respectively.[12]

The terms ‘face shields’ and ‘visors’ were used interchangeably within the literature. Their design features are described as being chin length, extending below the chin, [15, 16] open at the bottom,[9] and/or covering the full face,[11-13, 16] including the sides of the face.[18, 19] BS 7028:1999 and HSE describe face shields as a single large lens with a frame or moulded visor attached to a brow guard with an adjustable headband.[12, 21]

As previously mentioned, safety glasses often incorporate solid side shields[4, 7, 11, 15] to offer lateral protection.[12, 21] The BSI and HSE state safety glasses can be of twin or singular ocular type, with single ocular also referred to as eye shields.[12, 21] The evidence identified for this research question did not specify the type of safety glasses used in health and care settings.

Prescription eyeglasses

There is consistency in the literature that prescription eyeglasses[3, 8, 11, 13, 22, 26] and contact lenses are not considered eye/face protection.[4, 9, 14, 16] Nine documents state that some types of goggles,[4, 9, 11, 12, 14, 16] face shields/visors[3, 11, 12, 16, 21, 26] and single ocular spectacles can be worn over prescription glasses.[12, 21] Prescription protective eyewear which incorporate prescription lenses are also available.[4, 9, 11, 16, 21] One expert opinion guidance document by the National Health and Medical Research Council (NHMRC) provides requirements for prescription eyewear to be considered appropriate eye/face protection, namely that eyewear must be close fitting between the frame and face, provide full coverage around the eyes, and have indirect side protection.[4] It is unlikely that generic prescription eyewear has these features, however, if this is the case additional protective eyewear is said to not be required.[4]

Conclusion

In summary, there is consistency in the evidence base that the types of eye/face protection worn in health and care settings include goggles, face shields/visors, safety glasses (sometimes referred to as safety spectacles) with solid side shields, and surgical face masks with integrated face shields. There appears to be variation in design features of goggles, face shields and safety glasses used in health and care settings. Lastly, prescription glasses and contact lenses are not considered within the literature to be eye/face protection.

3.1.3 Are there any legislative requirements or standards (BS/EN/ISO) relating to the use of eye/face protection for infection prevention and control purposes?

In total, 14 documents were included in relation to this research question. Six were legislation applicable to the UK, graded SIGN50 ‘mandatory’[27-32] and eight were British Standards graded SIGN50 Level 4 expert opinion.[12, 33-39] At the time of writing, these standards were the most recent versions available. It should be noted, however, that these are subject to amendment and that the standards discussed here may not represent all standards which apply to eye/face protection.

Two pieces of legislation[29, 30] and four standards,[12, 33, 34, 37] were identified in previous versions of this literature review. Four pieces of legislation[27, 28, 31, 32] and four British Standards[35, 36, 38, 39] were identified and included during this update.

Legislation

No specific legislative requirements were identified in the literature regarding the use of eye/face protection as personal protective equipment (PPE) for infection control purposes. The general wearing and provision of PPE in the health and care setting is covered by the Health and Safety at Work Act 1974 (HSWA),[29] The Management of Health and Safety at Work Regulations 1999 (MHSWR),[27] Control of Substances Hazardous to Health (amendment) Regulations 2004 (COSHH),[30] and the Personal Protective Equipment at Work (amendment) Regulations 2022 (PPER).[32]

In the UK, the HSWA is the generic health and safety legislation relating to occupational health at work. The MHSWR provides further duties employers and employees must fulfil to maintain health and safety at work. These pieces of legislation are not healthcare specific and do not explicitly discuss the use of PPE but are relevant to their provision within health and care settings.[27, 29]

More specific regulations are provided by COSHH 2004, which describes requirements to protect employees from substances hazardous to health within the workplace, including the use of PPE.[30] PPER 2022 provides regulations that outline employers' and employees' duties regarding PPE.[32]

British Standards

It is important to note that there is no specific standard for eye/face protection worn within the health and care setting. The standards available are general and apply to eye protection worn for protection against any occupational hazard, including droplets and liquid splashes.[12, 33-39] The relevant standards identified can be found in **Appendix 4**.

The British Standards BS EN ISO 168:2002 and BS EN ISO 18526-3 provide several optional tests that may be conducted depending on the intended purpose or use of the eye protection for non-optical eye protection.[12, 37] Of these, several tests are likely to be relevant to eye/face protection worn in a health and care setting,

including area of coverage of face shields, protection against droplets, protection against large dust particles, and protection against gases and fine dust particles.[33, 37] Test methods outlined in these standards appear to be similar with slight variations, such as different test solution agents to test against droplet exposure.[33, 37] BS EN ISO 168:2002 provides a test for 'liquid splashes',[33] BS EN ISO 18526-3 does not provide any test against splashes, instead providing a test for protection against 'stream of liquids'.[37] It is unclear why two standards are available for similar test methods for eye/face protection. Despite being published more recently BS EN ISO 18526-3 is not said to replace BS EN ISO 168:2002, however BS EN ISO 168:2002 is currently under review.[33, 37] BS EN ISO 18526-3 also provides the following test methods which may be relevant to infection prevention and control (IPC), these include assessing area of protection from frontal and lateral directions and assessing the retention by the headbands of eye 'protectors'.[37] Test methods provided by these standards are generalised to apply to any occupational hazard, therefore these may not be fully applicable for IPC purposes. For example, where sample detection solutions and/or gases are used, these may not accurately mimic potentially infectious particles encountered in health and care settings.

Within the test for protection against droplets and liquid splashes provided by BS EN ISO 168:2002, it is outlined that the test for protection against 'droplets' applies to goggles only, and the test for protection against 'liquid splashes' applies to face shields only. BS 7028:1999, which provides guidance on selection of specific types of eye/face protection based on their performance, aligns with this.[12] However, as previously mentioned, this standard is not specific to health and care settings. Further discussion on suitability of types of eye/face protection is provided within the research question '**When should eye/face protection be worn by health and care staff?**'.

No evidence base was provided for these tests and other requirements detailed in these standards.[12, 33, 37] Additionally, preparation of the standards are stated to have been entrusted by technical subcommittees, however their membership is unknown. Given these limitations these have been graded as SIGN50 level 4 expert opinion.

Conclusion

In summary, there are no specific standards for eye/face protection worn in the health and care setting. Instead, standards apply generally to all occupational hazards faced, which may not be fully applicable for IPC purposes. Similarly, no specific legislative requirements were identified in the literature regarding the use of eye/face protection in health and care settings for IPC purposes. However, legislation is available covering the general wearing and provision of PPE in the health and care setting, which can be applied to eye/face protection.

3.1.4 When should eye/face protection be worn by health and care staff?

In total, 41 pieces of evidence were included to answer this research question. Twelve pieces of evidence were identified in previous versions of this literature review,[2, 5, 9, 12-14, 40-45] and 29 pieces of evidence were included during this update.[3, 4, 6-8, 11, 15, 16, 18-22, 24-26, 46-58] Of this evidence, two guidelines, one published in the UK and the other for international audiences, were graded AGREE: 'Recommend with modifications'.[2, 22] Three SIGN50 Level 3 experimental simulation studies were included,[42, 43, 46] and 36 documents were graded SIGN50 Level 4 expert opinion, including 34 guidance documents,[3-9, 11, 13-16, 18-21, 24-26, 40, 41, 44, 45, 47, 49-58] one technical report,[48] and one British Standard.[12] These documents were graded SIGN50 Level 4 expert opinion due to the lack of a systematic review of primary evidence to underpin the guidance or no provision of methods for identifying the evidence. Both guidelines graded AGREE: 'Recommend with modifications' carried out a systematic review of primary evidence, however aspects of the methodology such as the search strategies used, were not provided. Additionally, whilst both provided some discussion of the evidence, there was a lack of referencing amongst the evidence base underpinning some recommendations regarding eye/face protection, which made it difficult to establish a clear link between these and the supporting evidence.[2, 22]

The country or countries where the research was conducted, or to which the guidance applies, includes: the UK (n=14),[2, 3, 5, 12, 13, 21, 24, 26, 44, 52-54, 56, 57] the USA (n=13),[7, 9, 14, 15, 18-20, 40-43, 45, 55] international (n=4),[6, 22, 25, 58] Australia (n=3),[4, 16, 46] Europe/EU/EEA (n=4),[47-50] New Zealand (n=2),[11, 51] and Canada (n=1).[8]

Selection of the type of eye/face protection required appears to be a multifactorial process which may require a risk assessment.[5, 8, 12, 22] There is consistency amongst SIGN50 Level 4 expert opinion guidance documents that the appropriateness for the task,[5, 14, 16, 41, 51] the type of anticipated exposure,[5, 14, 16] and the fit of the eye/face protection[16, 51] should all be considered when selecting the type of eye/face protection to be worn by a HCW. Other considerations provided by single guidance documents, include the setting in which they are working,[16] individual preference,[16] local policy, and availability.[5] BS EN 7028:1999 states style selection should be based on the performance requirements, decided based on a risk assessment.[12] However, this standard does not provide clear guidance on the types of eye/face protection appropriate for tasks/anticipated exposure within health and care settings.

There is a lack of consistency amongst expert opinion guidance on the capabilities of goggles, face shields and safety glasses. Some guidance states that face shields can be worn in place of goggles[14, 16] or safety glasses.[16] Whereas, other guidance, including the British Standard 7028:1999, claim they do not offer the same levels of protection.[12, 21] Face shields are said to provide protection to the eyes and face, whereas goggles[4, 12, 14] and safety glasses[4, 12] are said to provide protection to the eyes only. One guidance document, applicable to Australian health and care settings, does not consider safety glasses as adequate eye protection unless they are of the wrap around type.[16] The Association for Surgical Technologies (AST) state face shields offer secondary protection only, with goggles offering primary protection.[9] No extant guidance provides information regarding which types of safety glasses are most appropriate for certain tasks or anticipated exposures.

Protection against splash and spray

There is consistency amongst two guidelines graded AGREE: ‘Recommend with modifications’ and 22 SIGN50 Level 4 expert opinion documents that eye/face protection should be worn if there is an anticipated risk of splashing or spraying of blood or body fluids.[2-8, 13-15, 19, 20, 22, 24, 25, 40, 41, 44, 45, 51, 52, 54, 56, 57] This is often recommended as part of standard precautions.[3-5, 8, 14, 22, 24, 44, 51] Three documents further recommend wearing eye/face protection during manual cleaning and decontamination of medical equipment,[4, 7, 15] specifically re-usable medical devices,[4] medical/surgical supplies and equipment,[15] and patient care items,[7] due to the

likelihood of splashing or spraying.[7] All evidence identified was specific to health and care settings, and therefore applies to those providing care, except for one piece of expert opinion guidance, published by the US Occupational Safety and Health Administration (OSHA) that applies to those 'working closely' with people with known or suspected influenza.[45] The health and care settings represented within this literature include dental, acute care, social care, domiciliary care, and caring for the deceased.[2-8, 13-15, 19, 20, 22, 24, 25, 40, 41, 44, 51, 52, 54, 56, 57] Additionally, some documents are pathogen specific and include patients with suspected or confirmed COVID-19,[19, 25, 54, 58] influenza,[24, 45] acute respiratory infections,[22] and non-high consequence infectious disease (HCID) mpox.[56]

One experimental study, graded SIGN50 Level 3, investigated the effectiveness of different types of eye/face protection against conjunctival contamination during a femoral osteotomy procedure using a cadaveric leg.[43] The study was carried out under controlled conditions using manikin head-forms and compared eye/face protection against no eye/face protection.[43] Body fluids were mimicked by adding saline and red dye solution to the ostomy site before and during the procedure.[43] The five types of eye/face protection used were modern prescription glasses, standard surgical telescopic loupes, hard plastic contoured glasses, disposable plastic glasses and a combination facemask with eye shield.[43] Manikin head-forms wearing the eyewear were tested at two different positions, central (looking straight ahead) and looking down at an angle of 30 degrees.[43] Within this study, all types of eyewear were associated with a statistically significant reduction in exposure to splash contamination on the simulated conjunctival target of the manikin ($p<0.05$), excluding prescription glasses ($p=0.73$), when compared with no eye/face protection.[43] Disposable plastic glasses (providing above, below and contoured side protection) were identified to be most effective, with a 96% reduction in contamination (95% CI 62%-98%), and significantly more effective than standard loupes ($p<0.05$) and the combination facemask with eye shield ($p=0.02$).[43] This study has limited generalisability due to its invitro nature and lack of information regarding manufacturers of the eye/face protection. The study did not compare commonly used eye/face protection within Scottish health and care settings, such as face shields. Additional limitations include the subjective visualisation method of the outcome measurement and unknown duration of time each piece of eyewear was tested.[43]

The included evidence often does not state the specific types of eye/face protection suitable when recommending eye/face protection be worn against splashing and spraying. Where types of eye/face protection are provided within the literature, these are given as non-exhaustive examples. There is consistency amongst few expert guidance documents that indirectly vented goggles, with a manufacturers anti-fog coating, provide the most reliable protection from splashing and spraying[4, 9, 14] at multiple angles.[4, 14] The HSE state protection is offered at multiple angles due to the complete rim of the goggles being in contact with the face.[21] Directly vented goggles are said to potentially allow for the entrance of splash and spray into the goggles.[9] Conversely, the British Standard 7028:1999 suggests goggles (and safety glasses) are ineffective against 'liquid splashing', defined as occurring with a splash of liquid, and only face shields are appropriate as they offer protection to the face.[12] The standard lacks referencing throughout, therefore the rationale for this definition is unknown, additionally this is not specific to health and care settings. Face shields are also suggested, by the British Standard, to be suitable for wearing when splash or spray is anticipated.[12, 16, 40] Face shields that extend from chin to crown,[4, 12] below the chin to the ears,[16] and wrap around the sides[14] are said to provide better protection against splashes or sprays. The AST and Australian Government aligns with this concept, stating face shields with openings at the bottom[9] and gaps around the sides[16] are unable to provide protection.[9] Only one piece of expert opinion guidance by the AST commented on the effectiveness of surgical face masks with integrated face shields, stating they are not able to provide 'optimal protection'.[9] Within this document, 'optimal protection' is described to be offered by indirectly vented goggles to protect from splashes, sprays, respiratory droplets and debris. Therefore, it is implied that surgical face masks with integrated face shields are deemed ineffective against these exposure types.[9]

Ultimately, in addition to a risk assessment for selection of types of eye/face protection,[5, 8, 12, 22] four expert opinion literature and one AGREE: 'Recommend: with modifications' guideline suggests that a risk assessment for splashing or spraying during a care procedure should also be carried out.[3, 4, 8, 22, 25] No specific information is provided within the included literature on how to carry out said risk assessment, however a range of potential procedures and patient care activities for assessment are cited. These include dental, surgical, invasive, and diagnostic procedures.

Additional wearing of eye/face protection

Droplet precautions

The WHO and Health New Zealand recommend wearing eye/face protection as part of 'droplet precautions' when there is risk of exposure to respiratory 'droplets'.[25, 51] The UK Health Security Agency (UKHSA) also recommend wearing eye/face protection as part of droplet precautions, but only where there is risk of splashing.[56] One guidance document by the HSE also recommends eye/face protection is worn as part of 'droplet precautions', however this document is specific to those caring for the deceased.[53] One piece of expert opinion guidance published by the CDC states that a recommendation could not be formed regarding routine use of eye protection in addition to a mask when in close contact with patients requiring 'droplet precautions', due to insufficient evidence or lack of consensus regarding efficacy.[14]

Within the guidance documents by the CDC and the HSE, 'droplet precautions' were said to be required for patients with a suspected or confirmed infection, and 'droplets' were defined as being larger than 5μm[4, 14, 53] with an ability to travel no more than one metre or three feet.[14, 53] The rationale for this definition is unclear, due to a lack of supporting high-quality evidence. The WHO, UKHSA and Health New Zealand did not provide a definition for 'droplet precautions'.[25, 51 56] The definitions of transmission modes are outside the scope of this literature review and are covered in depth in the NIPCM literature review, **'Transmission-based Based Precautions (TBPs) Definitions'**.

No clear indication is provided by the evidence regarding appropriate types of eye/face protection for 'droplets', and where types of eye/face protection are provided, these are given as non-exhaustive examples. One guidance document by the Australian Government states face shields with gaps around the sides may allow for droplets to reach the eyes.[16] This aligns with the British Standard 7028:1999 which states only goggles are effective against 'liquid droplets' as they allow complete enclosure of the orbital cavities. The Standard defined a 'liquid droplet' as in the form of an 'aerosol or mist', no further descriptions of aerosol or mist are provided.[12] The Standard lacks referencing throughout, therefore the rationale for the definitions are unknown. As previously mentioned, only one piece of expert opinion guidance by the AST commented on the effectiveness of surgical face masks with

integrated face shields. They state they are not able to provide 'optimal protection', described as protection against splashes, sprays, respiratory droplets and debris.[9] Therefore, it is implied that surgical face masks with integrated face shields are deemed ineffective against 'respiratory droplets'.[9]

Protection during aerosol generating procedures

One guideline document graded AGREE: 'Recommend with modifications' published by the WHO and two expert opinion guidance documents graded SIGN50 Level 4, published by the CDC and the UK Department of Health and Social Care (DHSC), state that eye/face protection should be worn during aerosol generating procedures (AGPs) on patients with a respiratory infection.[14, 22, 26] This aligns with other SIGN50 Level 4 expert opinion guidance specifically written for HCWs caring for patients with suspected/confirmed COVID-19[48, 50, 55, 58] and influenza.[24] One expert opinion guidance document recommends the wearing of eye/face protection during all AGPs, regardless of the infectious status of the patient undergoing the procedure, as AGPs generate droplets and splashes alongside aerosols.[13] Expert opinion guidance by the UK DHSC states eye/face protection should be worn during AGPs on patients not suspected or confirmed to have an infection spread by the 'aerosol' or 'droplet' route.[3] This may be interpreted as eye/face protection should be worn during all AGPs, however, this may not always apply as it is stated within the document this should be followed with additional infection specific guidance.[3]

Two experimental studies graded SIGN50 level 3 investigated the effectiveness of different types of eye protection against aerosol exposure, under controlled conditions using manikin head-forms.[42, 46] Both compared eye/face protection against no eye/face protection. The studies involved aerosolisation of particles (0.9% saline[46] and a culture media[42]) to simulate breathing/coughing from a 'patient' (the source). The studies varied in their experimental setup, one carried out within an operating room with 20 air changes per hour,[46] the other in a sealed chamber with no air exchange or filtration in controlled conditions.[42] The first study compared two types of face shields (open vented compared with enclosed) with two different manufacturers per each type, whereas the second only evaluated one type of face shield, the style/manufacturer of this was unknown. Both studies identified a statistically significant reduction in exposure to the particles released at specified

distances (46cm ($p<0.01$)[42] and up to 100cm ($p<0.0001$)[46]) from the source. The first study measured particle size as well as count and identified that this statistical reduction occurred with particles sized 0.3 to 5µm ($p<0.003$).[46] The second study continued measurement of particle count up to 30 minutes, at which time a significant reduction remained ($p<0.001$).[42] No statistically significant difference was identified between the open vented and enclosed face shield types, compared within the first study.[46] Due to the in-vitro nature of these studies they have limited generalisability, the use of aerosolised saline/culture media may not mimic blood/body fluids encountered in real life. Additionally, neither study considered other positions or angles in which someone could be exposed, and the impact this may have on effectiveness of the eye/face protection. The second study stated the volume of cough aerosols produced within their study are considerably larger than reported for a human coughing, again affecting the studies generalisability.[42] Overall, this limited evidence base is highly varied in terms of the experimental setup, environmental conditions, distance from the source, types of exposure, and style/manufacturer of eye/face protection tested. These varied factors, together with the 'in-vitro' nature, make it difficult to ascertain any conclusions from findings and to generalise from these. Further to this, a contamination event is an indirect measure of infection risk. A higher quantity and quality of studies are required to establish effectiveness of different types of eye/face protection against aerosol exposure, and their parameters.

The included literature does not provide clear indication of appropriate types of eye/face protection against aerosol exposure. As previously mentioned, the British Standard 7028:1999 states only goggles are effective against 'liquid droplets', defined as in the form of an 'aerosol or mist', as they enclose the orbital cavities.[12] The HSE suggest directly vented goggles may allow for entry of gases, and therefore recommend the wearing of indirectly vented goggles.[21]

Protection against specific pathogens

Ten expert opinion guidance documents (SIGN50 level 4),[4, 8, 18, 25, 26, 45, 47, 49, 50, 56] and one guideline graded AGREE: 'Recommend with modifications',[22] recommend the wearing of eye/face protection when caring for patients with certain or potential infections. The WHO guideline graded AGREE: 'Recommend with modifications',

recommends wearing eye/face protection when caring for patients with novel influenza (such as avian influenza), SARS and novel acute respiratory infection (ARI).[22] Other expert opinion guidance aligns with this, also suggesting wearing of eye/face protection when caring for patients with SARS and pandemic influenza.[4, 45] Additional infections mentioned by expert opinion guidance include suspected/confirmed SARS-CoV-2,[18, 19, 25, 50] viral haemorrhagic fever (VHF),[4] respiratory syncytial virus (RSV),[47] mpox[49] (when showing signs of a lower respiratory tract infection)[56], and any respiratory viral infection.[8, 26, 47] The Public Health Agency for Canada also state that eye/face protection is required by non-immune healthcare workers caring for patients with rubella or mumps.[8]

The ECDC state within one of their guidance documents published in 2021 that healthcare workers involved in environmental cleaning and waste management of COVID-19 infected patients should wear eye/face protection.[50] The UK DHSC also recommend this for HCWs caring for those with acute respiratory infections, including COVID-19, in social care settings.[26] Similarly, the CDC recommend cleaning of autopsy rooms (and anteroom, if applicable), after being occupied by a patient with COVID-19, should be carried out wearing eye/face protection.[19]

Extended use

Extended use of PPE, also referred to within the literature as sessional or continuous use, is described as the wearing of PPE for care of successive patients without removal between each patient.[8, 16, 20, 51] The small body (n=4) of SIGN50 Level 4 expert opinion guidance identified is aimed towards pandemic control,[20] specifically COVID-19,[16] and generally for health and care settings.[8, 51]

The evidence base is consistent in recommending that eye/face protection is suitable for extended use.[8, 16, 20, 51] One piece of expert opinion guidance states this is often appropriate within cohort settings when caring for patients infected with the same infectious agent.[8]

Source control

There was a lack of evidence identified regarding the use of eye/face protection for source control. Only one guidance document by the CDC, graded SIGN50 Level 4, stated face shields alone are not recommended to be used as source control.[18]

Conclusion

In summary, eye/face protection is recommended within the literature to be worn by health and care staff in many circumstances. Primarily, based on a risk assessment, when there is anticipated risk of splashing or spraying of blood or body fluids. Additionally, the literature describes wearing eye/face protection as part of ‘droplet precautions’ and during AGPs. The evidence base regarding AGPs is varied with some documents specific to patients with respiratory infections or infections transmitted via 'droplets/aerosols'. Eye/face protection is also recommended in literature to be worn around patients with certain or potential infections, such as respiratory infections, VHF, mpox, and rubella and mumps (when health care workers are non-immune).

Eye/face protection is described by literature as suitable for extended use, which is defined as the wearing for care of successive patients. There is insufficient evidence on the use of eye/face protection for source control, with only one expert opinion guidance document recommending face shields should not be used for source control.

Selection of the type of eye/face protection suitable for use appears to be multifactorial, often requiring a risk assessment. There is consistency in the literature that considerations must be made, for example the appropriateness for task and type of anticipated exposure, before selecting the type to be worn. Studies assessing the effectiveness of types of eye/face protection are limited in number and also lacking in generalisability. The extant guidance discusses the advantages and disadvantages of eye/face protection in the context of anticipated exposure. No conclusions can be drawn from this body of evidence on selection of types of eye/face protection suitable for certain tasks or anticipated exposure due to the evidence included being of low quality, with guidance documents often lacking supporting evidence.

3.1.5 When should eye/face protection be worn by a service user/visitor?

This research question was added during this literature review update. Three pieces of evidence were included, all were graded SIGN50 Level 4 expert opinion, due to

unclear processes for developing guidance.[7, 8, 12] No primary evidence was identified for this research question.

Only one SIGN50 Level 4 expert opinion document was included regarding the wearing of eye/face protection by patients.[7] Guidance written by the CDC, specifically for dental care settings, suggests that patients may wear eye protection to protect from spatter or debris during dental procedures.[7] However, no explicit recommendation was made regarding this statement and methods for obtaining the evidence cited is unknown.

Two SIGN50 Level 4 expert opinion documents provided recommendations for visitors wearing eye/face protection.[8, 12] The Public Health Agency of Canada suggest that visitors should have access to the same PPE as HCWs when providing direct patient care, which was inclusive of eye/face protection.[8] The document also states that PPE may not be necessary when visitors have been previously exposed to the patient before they were admitted, and PPE may be required for visitors that are visiting multiple patients.[8] Pathogen specific guidance for visitors wearing eye/face protection is provided, namely prolonged contact with patients under the age of 5 with suspected or confirmed *Haemophilus influenzae* type B infection, and when around patients with rubella or mumps, where the visitor is non-immune.[8] It was noted within this guidance that evidence regarding this statement was lacking.[8] As this guidance was written for health and care settings within Canada, this may not be applicable to NHSScotland.

The provision of eye protection for visitors is recommended within the BS 7028:1999, however this standard describes the use of eyewear for various hazards within all occupation settings and may not be applicable to IPC within health and care settings. The standard suggests the type of eye protection issued should be appropriate for the risk that may be encountered by the visitor.[12] No references were provided to ascertain the evidence-base for this statement within this document.

Conclusion

In summary, no conclusions can be drawn regarding the wearing of eye/face protection by a visitor or service user from this small body of evidence consisting of low-quality guidance documents. Whilst the British Standards Institution (BSI)

recommend the provision of eye protection for visitors within all occupational settings, this may not be applicable to health and care settings due to variation within practice and exposure scenarios.

3.1.6 Where and how should eye/face protection be donned (put on)?

In total, 27 pieces of evidence were included to answer this research question. Six pieces of evidence were identified in previous version(s) of this literature review,[9, 10, 13, 14, 30, 59] and 21 were identified during this update.[4, 8, 11, 16, 21, 22, 24, 26, 32, 57, 60-70] No primary evidence was included to answer this research question. Two pieces of mandatory legislation were included; PPER and COSHH, which apply directly to the UK.[30, 32] One guideline graded AGREE: 'Recommend: with modifications'[22] and 24 pieces of evidence graded SIGN50 Level 4 expert opinion were also included.[4, 8-11, 13, 14, 16, 21, 24, 26, 57, 59-70]

Twelve pieces of evidence were published within the UK, of which 10 were graded SIGN50 Level 4 expert opinion[13, 21, 24, 26, 57, 65-69] and two were mandatory legislation.[30, 32] The remaining evidence was published for or within the following country or countries: Australia (n=7),[4, 16, 60-64] the USA (n=3),[9, 14, 59] New Zealand (n=1),[11] Canada (n=1),[8] international (n=2),[22, 70] and Europe (n=1).[10]

The term 'don' is used throughout the literature to mean 'put on'.

Where should eye/face protection be donned?

One WHO guideline graded AGREE: 'Recommend: with modifications',[22] and nine guidance pieces of SIGN50 Level 4 expert opinion, by UKHSA and Australian Commissions, state donning of PPE should be carried out before entering a patients room[16, 57, 60-64, 67, 68] or isolation room/area.[22] These guidance documents are pathogen/setting specific and focus on treating patients with confirmed/suspected COVID-19,[16, 67, 68] residents (of care homes) with respiratory infections,[64] or patients under 'contact', 'droplet', and/or 'airborne' precautions.[57, 60-63] The WHO guideline is specific to IPC for acute respiratory infections in healthcare settings.[22] Definitions of these precautions are not provided within these documents. Within the WHO guideline, donning of PPE prior to mortuary care and postmortem examination is

considered, it is recommended this takes place in the ‘dress in’ room, outside of the autopsy room.[22]

One guidance document by the WHO, graded SIGN50 Level 4 expert opinion, recommends donning of PPE should take place within a ‘clean area’ at the entrance of an isolation unit.[70] No definition of a ‘clean area’ is provided and it is also unclear if the donning of PPE is recommended before or after entering the isolation unit.[70]

How should eye/face protection be donned?

Donning sequence

Prior to donning eye/face protection, three expert opinion guidance documents state PPE should be visually inspected to ensure there are no damages or defects.[9, 11, 70]

There is consistency amongst 17 SIGN50 Level 4 expert opinion and one AGREE: ‘Recommend with modifications’ guideline[22] that eye/face protection should be donned as part of an ensemble in the following order: apron/gown/coveralls (if worn), face mask (surgical face mask or respirator), eye/face protection, then gloves.[4, 8, 10, 16, 22, 24, 57, 59-65, 67-70] One guidance document by the WHO that recommends this sequence, provides a more extensive order for donning PPE when two pairs of gloves, rubber boots and head/neck covering is worn.[70] There is consistency amongst 11 expert opinion guidance documents that hand hygiene should be performed prior to donning PPE.[4, 8, 16, 60-65, 69, 70]

Of this evidence, several pieces were written for specific anticipated exposure types when caring for patients with confirmed/suspected COVID-19,[10, 16, 65, 68, 69] respiratory infections,[22, 24, 64] and under ‘contact’, ‘droplet’ and/or ‘airborne’ precautions,[57, 60-63]

Fit of eye/face protection

The COSHH legislates, “Every employer who provides any control measure, other thing or facility in accordance with these Regulations shall take all reasonable steps to ensure that it is properly used or applied as the case may be.”[30] The HSE interpret this statement to mean that PPE should be worn correctly and in accordance with the manufacturer’s instructions.[66] Three pieces of SIGN50 Level 4 expert opinion guidance support this recommendation.[8, 9, 13]

Several expert opinion guidance documents state that eye/face protection should be adjustable to ensure a proper fit[9, 14, 68] and fit snug/closely across the brow.[4, 9, 16] The ECDC states that goggles must fit the users' facial features and must be properly positioned to fit well.[10]

Only one guidance document by the UK DHSC provides guidance on wearing eye/face protection once donned.[26] They recommend eye/face protection should not be worn around the neck or on top of the head when not in use.[26]

Compatibility

The HSE guidance documents published to support compliance with COSHH[30] and PPER[32] legislation, state where two or more items of PPE are worn, the items must be compatible with each other.[21, 66] HSE provide the following example, where a half-mask respirator may not be compatible with a pair of goggles.[21]

Conclusion

Overall, there is consistency amongst the literature that the donning of eye/face protection should be carried out before entering a patient's room and as part of a PPE ensemble. Eye/face protection should be donned after a face mask/respirator, and within the following sequence: apron/gown/coveralls, face mask (surgical face mask or respirator), eye/face protection, then gloves. Additionally, the fit of the eye/face protection should be considered, ensuring it is positioned properly and fits snugly across the brow. Legislation mandates items of PPE worn must be compatible with each other.

3.1.7 Where and how should eye/face protection be doffed (taken off)?

In total, 28 pieces of evidence were included to answer this research question. Seven pieces were identified in previous versions of this literature review,[2, 9, 10, 13, 14, 30, 59] and 21 were identified during this update.[4, 7, 8, 16-18, 22, 24, 26, 57, 60-65, 70-74] No primary evidence was included within this research question. One piece of mandatory legislation was included; COSHH.[30] Two guidelines graded AGREE: 'Recommend with modifications'[2, 22] and 25 pieces of evidence graded SIGN50 Level 4 expert opinion were included.[4, 7-10, 13, 14, 16-18, 24, 26, 57, 59-65, 70-74]

Twelve pieces of evidence were published within the UK,[2, 13, 17, 24, 26, 30, 57, 65, 71-74] of which one piece was mandatory legislation[30] and another was an AGREE: 'Recommend with modifications guideline'.[2] The remaining evidence was published for or within the following country or countries: Australia (n=7),[4, 16, 60-64] the USA (n=5),[7, 9, 14, 18, 59] international (n=2),[22, 70] Canada (n=1)[8], and Europe/EU/EEA (n=1).[10]

The term 'doff' is used throughout the literature to mean 'take off' or 'remove'.

Where should eye/face protection be doffed?

There is inconsistency within the literature regarding whether eye/face protection should be doffed before or after leaving a service user area. COSHH legislates, "Personal protective equipment which may be contaminated by a substance hazardous to health shall be removed on leaving the working area and kept apart from uncontaminated clothing and equipment."[30] The WHO guideline graded AGREE: 'Recommend with modifications' and an expert opinion guidance document by the UK DHSC align with this.[22, 26] However, it should be noted the UK DHSC guidance is written specifically for HCWs caring for people with acute respiratory infections, including COVID-19, in social care settings. It is unclear as to whether removing 'on leaving the work area' should be interpreted as removing before or after leaving the work area.

Nine expert opinion guidance pieces state that eye/face protection should be doffed before leaving a patient area.[7, 13, 17, 24, 59, 62, 63, 71, 72] Several of these documents are setting/pathogen specific, including caring for patients with confirmed/suspected COVID-19[71, 72]or influenza,[24] and patients who require 'droplet',[57, 63] or combined 'droplet' and 'contact' precautions.[62] The remaining evidence applies generally to health and care settings, including dental care.[7, 13, 17, 59] Eight expert opinion guidance pieces recommend doffing of eye/face protection after leaving a patient area[4, 16, 57, 60, 61, 64, 73, 74] or, where possible, in an ante-/side room.[71, 73, 74] Of these, two expert opinion guidance documents by UKHSA are targeted towards care of suspected or confirmed COVID-19 patients,[57, 74] and three Australian expert opinion guidance documents are targeted towards HCWs caring for residents (of care homes) with respiratory infections,[64] and patients under 'airborne'[60] or combined 'airborne and contact' precautions.[61] Additionally, two expert opinion pieces,

including one specific to the care of suspected/confirmed COVID-19 patients, specify that eye/face protection should be doffed at least two meters away from the patient.[65, 71]

The WHO guideline, graded AGREE: 'Recommend with modifications', provides guidance for doffing PPE to those undertaking mortuary or post-mortem examination, which state this should take place in the designated 'dress out room'.[22] The CDC interim recommendations for HCWs during COVID-19 provide expert opinion guidance to ambulatory staff which states eye/face protection should be removed prior to entering the drivers compartment if they were involved in direct patient care to avoid contamination.[18]

How should eye/face protection be doffed?

Doffing sequence

Twenty of the 28 documents identified, including one AGREE: 'Recommend with modifications' guideline by the WHO,[22] provide recommendations on a PPE doffing sequence that minimises cross-contamination.[2, 4, 8, 10, 13, 16, 24, 57, 59-65, 70-72, 74] The evidence varies based on exposure type and setting, therefore some items of PPE (such as gloves, or aprons/gowns) are not seen to be required and therefore are not included within the doffing sequence provided by the guidance. There is general consistency in literature that eye/face protection should be removed after the doffing of gloves and doffing of a gown/apron/coverall,[2, 4, 8, 10, 13, 22, 24, 57, 59, 61, 62, 64, 65, 71, 72, 74] but before doffing a face mask[2, 4, 8, 10, 22, 24, 57, 59-65, 71, 72, 74] (often specified as a surgical face mask or respirator,[2, 8, 10, 22, 24, 57, 59-61, 64, 72, 74] depending on the anticipated type of exposure), if these items of PPE have been worn. One guidance document by the CDC, graded SIGN50 level 4 expert opinion, provides two PPE doffing sequence examples, one example aligns with this sequence, the second places doffing eye/face protection after gloves and before an apron/gown.[59] It is unclear why two sequence examples are provided. Of this evidence, several pieces were written for specific anticipated exposure types and cover when caring for patients with confirmed/suspected COVID-19,[10, 16, 65, 71, 72, 74] influenza,[24] respiratory infections,[22, 64] and patients under 'contact', 'droplet', and/or 'airborne' precautions.[57, 60-63]

Seven expert opinion guidance pieces state hand hygiene should be performed before and after removing eye/face protection (specifically after doffing a gown/apron/coveralls and before doffing a face mask).[8, 61-65, 71] The WHO guideline, graded AGREE: 'Recommend with modifications', recommends hand hygiene be performed before doffing eye/face protection and after all other items of PPE are doffed (specifically a face mask).[22] Fifteen documents partially align with this in regard to performing hand hygiene after doffing all PPE.[2, 4, 8, 24, 59-65, 70-72, 74] In a guidance document by the CDC, hand hygiene after doffing eye/face protection is recommended only if contamination of the hands occurs.[59]

One evidence piece provided by the WHO, graded SIGN50 Level 4 expert opinion, provides a more extensive sequence for doffing PPE when two pairs of gloves, rubber boots and head/neck covering is worn. This aligns with other literature in that eye/face protection should be doffed after an apron, and before a face mask, however it recommends hand hygiene be performed on gloved hands, the outer gloves removed, and hand hygiene performed once again on gloved hands before and after the removal of the head/neck covering, then gown and then eye/face protection. It is unclear of the anticipated exposure type or setting this is applicable to, however alludes to those with a high risk of infection, as two pairs of gloves are being worn.[70]

Doffing technique

Fourteen expert opinion pieces provide guidance on the technique for doffing eye/face protection to minimise risk of cross-contamination. There is consistency amongst the literature that the outside of the eye/face protection is considered to likely be contaminated, and therefore the eye/face protection should be removed by handling only the part that secures it to the wearers head (such as the elastic band, ties, earpieces, headband, or side arms).[4, 8-10, 13, 14, 16, 24, 59, 65, 70-72, 74] UKHSA, the WHO and the CDC expert opinion documents recommend the wearer uses two hands to handle the straps, pulling both behind and away.[59, 70-72, 74]

COSHH legislates, once PPE is removed "The employer shall ensure that the equipment referred to in paragraph (6) [PPE] is subsequently decontaminated and cleaned or, if necessary, destroyed".[30] Six guidance documents align with this,[9, 16, 24, 65, 72, 74] and five recommend removed eye/face protection should be placed in a

designated container for this.[4, 8, 9, 59, 64] This includes expert opinion guidance published by the AST specifically for surgical personnel. AST recommend that once goggles are removed, they should not be taken outside of the surgery department, and should be placed in a labelled container within the changing/locker rooms ready to be taken for cleaning and disinfection.[9]

Conclusion

In summary, there is inconsistency within the literature regarding whether eye/face protection should be doffed before or after leaving a patient area. Nine expert opinion guidance pieces state that eye/face protection should be doffed before leaving a patient area. Whereas eight recommend eye/face protection be doffed after leaving a patient area, or, where possible, in an ante-/side room. Eye/face protection should be doffed in an order that minimises cross-contamination. There is general consistency that eye/face protection should be removed after the doffing of gloves and doffing a gown/apron/coverall, but before doffing a face mask (surgical face mask or respirator). The literature suggests hand hygiene should be performed before and after removing eye/face protection. To remove eye/face protection, only the part securing the eye/face protection to the wearers head should be handled. Legislation mandates that worn PPE must be subsequently destroyed or cleaned and decontaminated.

3.1.8 When should eye/face protection be changed or removed?

Eight pieces of evidence were identified to answer this research question. Of these, one was identified in previous version(s) of this literature review,[13] and seven were identified during this update.[8, 11, 16, 20, 21, 26, 64] All evidence consisted of guidance documents and were graded SIGN50 Level 4 expert opinion due to a lack of scientific evidence to support their recommendations. No primary evidence was included within this research question.

The country, or countries, in which the guidance applies to includes: the UK (n=3),[13, 21, 26] Australia (n=2),[16, 64] the USA (n=1),[20] New Zealand (n=1),[11] and Canada (n=1).[8] All guidance is specific to health and care settings, except the HSE guidance which is published to support the implementation of the PPER legislation, and therefore

applies generally to PPE worn in any occupational setting. Two guidance documents are written for HCWs caring for patients with COVID-19,[11, 16],one for patients with respiratory infections,[64] and one for people with acute respiratory infections, including COVID-19, within social care settings.[26]

There is consistency within the literature that eye/face protection should be changed or removed when vision is impaired.[8, 13, 16, 21] This may be due to visible soiling and contamination[13, 64] or damage,[16, 26, 64] for example, scratched or worn lenses, or a visibly deformed headband.[21] Two expert opinion pieces, by Health New Zealand and the CDC, that provide recommendations on the changing or removal of eye/face protection worn for extended use, align with this.[11, 20] One piece of expert opinion by the Australian Government also provides recommendations on extended use and suggests removing eye/face protection when leaving a cohort area (a COVID-19 clinical area to a non-COVID-19 clinical area).[16]

There is consistency amongst four expert opinion guidance documents that damaged eye/face protection should be discarded.[16, 20, 21, 26] There is a lack of evidence regarding changing or removal of eye/face protection at the end of a clinical procedure or task.

Conclusion

In summary, there is consistency amongst expert opinion guidance that eye/face protection should be changed or removed when vision is impaired. This applies to extended use of eye/face protection, where one guidance document recommends that eye/face protection should be removed when leaving a cohort area. It is also recommended that any eye/face protection that is damaged should be discarded.

3.1.9 How should eye/face protection be disposed of?

Twelve pieces of evidence were included to inform this research question. Of these, two were identified in previous version(s) of this literature review,[13, 59] and 10 were identified during this update.[8, 11, 16, 20, 22, 24, 26, 64, 72, 74] One guideline by the WHO was graded AGREE: ‘Recommend with modifications’. The remaining evidence consisted of guidance that was graded SIGN50 Level 4 expert opinion due to a lack of

supporting evidence and an unclear methodology. No primary evidence was identified for this research question.

The country, or countries, in which the guidance applies to includes: the UK (n=5),[13, 24, 26, 72, 74] the USA (n=2),[20, 59] Australia (n=2),[16, 64] New Zealand (n=1),[11] Canada (n=1),[8]and international (n=1).[22] All evidence is directly applicable to health and care settings.

There is consistency amongst four SIGN50 Level 4 expert opinion guidance documents that eye/face protection labelled single use must be discarded after use.[13, 16, 20, 26] Within a document by the Australian government, an example of face shields with foam bands is provided which are considered single use due to their inability to be cleaned and disinfected.[16]

Three expert opinion guidance documents state eye/face protection should be disposed of in a waste container,[8, 59, 64] Public Health Agency Canada specify this should be a no-touch receptacle.[8] Additionally, four expert opinion guidance documents state that eye/face protection should be considered as clinical waste, and therefore disposed of as such.[13, 24, 72, 74] It should be noted two of these documents are COVID-19 guidance published by UKHSA,[72, 74] and another by the UK Department of Health and the Health Protection Agency is specific to pandemic influenza.[24] Two expert opinion documents state that disposal of eye/face protection should be in accordance with local policy/procedures.[11, 13] Health New Zealand provide COVID-19 guidance which states within the community setting, used PPE (including eye/face protection) should be disposed of in household general waste.[11] The NIPCM Safe Disposal of Waste Literature Review provides information regarding the appropriate waste stream for disposal of PPE, which includes eye/face protection. One AGREE: 'Recommend with modifications' guideline by the WHO, and one expert opinion guidance document by Public Health Agency Canada recommend hand hygiene should be performed following disposal of eye/face protection.[8, 22]

Conclusion

In summary, eye/face protection labelled single use should be discarded after use. There is consistency within the literature that eye/face protection should be

discarded in a waste container, with four pieces of expert opinion guidance considering this as clinical waste. It is recommended that hand hygiene be carried out after disposal.

3.1.10 How should reusable eye/face protection be reprocessed/decontaminated?

In total, 12 pieces of evidence were included to answer this research question. Of this evidence, two pieces were identified in previous version(s) of this literature review,[9, 12] and 10 were identified during this update.[3, 4, 8, 11, 16, 20-22, 26, 32] One piece of mandatory legislation was included; PPER.[32] One guideline by the WHO, graded AGREE: 'Recommend with modifications',[22] and 10 guidance documents graded SIGN50 Level 4 expert opinion, including one British Standard, were also included.[3, 4, 8, 9, 11, 12, 16, 20, 21, 26] No primary evidence was identified for this research question. The majority of the evidence (n=9) is directly applicable to health and care settings.[3, 4, 8, 9, 11, 16, 20, 22, 26] Three pieces of evidence, which includes one piece of legislation, guidance to support this legislation, and one British Standard, apply directly to Scotland but are not specific to health and care settings.[12, 21, 32]

The country, or countries, in which the guidance applies to includes: the UK (n=5),[3, 12, 21, 26, 32] the USA (n=2),[9, 20] Australia (n=2),[4, 16] Canada (n=1),[8] New Zealand (n=1),[11] and international (n=1).[22]

It is recommended within the literature that reusable eye/face protection should be cleaned and/or disinfected prior to re-use or storage.[4, 8, 9, 11, 12, 16, 20-22, 26] The WHO guideline, graded AGREE: 'Recommend with modifications', specifies eye/face protection should be cleaned thoroughly before disinfection.[22]

The PPER legislates, "Every employer shall ensure that any personal protective equipment provided to their workers is maintained (including replaced or cleaned as appropriate) in an efficient state, in efficient working order and in good repair".[32] The HSE interpretation of this legislation, written to aid compliance with the regulation, states there should be arrangements made for cleaning and disinfecting PPE used by more than one person.[21] Within this guidance, key points are provided regarding use of eye/face protection to aid employers with their maintenance, stating manufacturer's instructions on cleaning should be followed, especially when using

anti-mist, cleaning and antistatic fluids and cloths.[21] One AGREE: 'Recommend with modifications', and six expert opinion guidance documents align with this, recommending cleaning/disinfection of eye/face protection should be carried out in accordance with manufacturer's instructions.[3, 4, 9, 11, 16, 20, 22] One expert opinion guidance document, published by Health New Zealand, suggests cleaning can also be carried out in accordance with local IPC measures.[11] One expert opinion guidance document by Public Health Agency Canada states this should be carried out in accordance with organisational policy.[8] British Standard 7028:1999 states cleaning should be carried out according to user instructions, but also provides specific cleaning guidance. This states that eye/face 'protectors' should be cleaned with a non-abrasive mild detergent, warm water, and a soft lint-free cloth, followed by rinsing and drying.[12] Within the standard it is suggested that manufacturers cleaning solutions may be used, solvents or industrial cleaners should not be used, and general-purpose cleaning solutions should be used with 'suspicion'.[12] What is meant by 'suspicion' in this context is not defined. It should be noted this standard applies to eye/face protection worn in a wide range of occupational settings and is not specific to IPC.

The WHO guideline recommends hand hygiene be performed following cleaning of eye/face protection potentially contaminated with splash or spray.[22] As previously mentioned, this guideline was graded AGREE: 'Recommend with modifications' as, despite being based on a systematic literature review, some aspects of the methodology are not provided and the link between recommendations and supporting evidence is unclear.

Conclusion

In summary, it is recommended within the literature that reusable eye/face protection should be cleaned and/or disinfected prior to re-use or storage, and this should be carried out in accordance with manufacturer's instructions.

3.1.11 How should eye/face protection be stored?

Eight pieces of evidence were included to answer this research question, three pieces were identified in previous version(s) of this literature review,[9, 12, 30] and five pieces were identified during this update.[4, 21, 26, 32, 66] Of this evidence, two were

mandatory legislation, PPER and COSHH,[30, 32] and the remainder consisted of guidance documents graded SIGN50 Level 4 expert opinion, as there was a lack of supporting evidence/referencing and an unclear methodology.[4, 9, 12, 21, 26, 66]

The majority of the evidence included was published in, and therefore applies to, the UK (n=6).[12, 21, 26, 30, 32, 66] Only one piece of expert opinion published by the UK DHSC is directly applicable to UK health and care settings.[26] The remaining evidence applicable to the UK is not specific to health and care settings, however, is more generalised and therefore can apply. Other evidence included applies to health and care settings within Australia (n=1)[4] and the USA (n=1).[9]

The legislation PPER provides regulations that outlines employers' and employees' duties regarding PPE.[32] This legislates that, "Where an employer or self-employed person is required, by virtue of regulation 4, to ensure personal protective equipment is provided, they shall also ensure that appropriate accommodation is provided for that personal protective equipment when it is not being used".[32] The HSE provide expert opinion guidance which interprets this legislation to aid with compliance, this states PPE should be returned to the storage place provided under regulation 8 of PPER after use.[21] It is also stated that storage of PPE does not have to be in a fixed place and may be in suitable containers kept by the user, such as safety spectacles within a carrying case.[21] COSHH describes requirements to protect employees from substances hazardous to health within the workplace, including the use of PPE, and legislates, "Every employer shall ensure that personal protective equipment, including protective clothing is properly stored in a well-defined place".[30] To comply with this legislation, the HSE recommend that accommodation should ensure safe storage of PPE when not in use by protecting from contamination, loss, or damage, such as from sunlight, harmful substances, or damp.[66] The British Standard 7028:1999 directly aligns with this HSE guidance.[12] Three other expert opinion documents published by the UK DHSC, the AST, and the NHMRC are consistent with these recommendations.[4, 9, 26]

Conclusion

In summary, it is recommended within the literature that dedicated, accessible and appropriate storage accommodation for eye/face protection (when not in use) should

be provided by the employer. This storage accommodation should be considered safe and provide protection from any loss, damage, or contamination.

3.2 Implications for research

At present, there are no specific standards or legislation for eye/face protection worn in health and care settings. Whilst the current legislation is generalised to provide employers and employees with requirements for wearing PPE in the workplace and handling and management of dangerous substances and/or chemicals, expansion on their appropriate use for IPC within health and care settings would be beneficial. This also applies to British Standards which apply to many occupational settings. There appears to be no standards for eye/face protection against infectious particles.

As highlighted by this review, a higher quantity and quality of primary evidence evaluating the effectiveness of the various types of eye/face protection against different types of exposures is needed. Specifically, studies which compare different types of eye protection for the treatment of patients infected with respiratory pathogens. In line with this concept, more research is needed generally on the propensity for different infections, specifically respiratory pathogens, to be transmitted via the ocular route and the protective effect of eye protection. One systematic review and meta-analysis which aimed to investigate the use of eye/face protection to prevent transmission of viruses was considered.[75] However, the majority of studies included within the meta-analysis implemented eye/face protection as part of a bundle of other infection control measures. As a result, it is not possible to determine the individual effectiveness (or lack thereof) of the eye/face protection, therefore the meta-analysis was excluded (see **Appendix 5** for full list of excluded studies). Well-designed and appropriately controlled studies which focus on eye/face protection, and as part of an ensemble or bundle of IPC measures, would aid understanding of the settings in which they may be an effective measure of IPC.

Eye protection is currently recommended, amongst expert opinion guidance, for anticipated splash or spray; however, further evidence is needed on its requirement for protection against surgical dust and smoke, and potential for transmission of infectious particles via this dust and smoke.

This review identified a body of evidence consisting of observational and simulation studies which investigated splashing of substances onto eye/face protection during different procedures.[76-89] These studies were deemed outside the scope of this review as their primary objective was to evaluate the occurrence of splash and spray during the procedure. Additionally, the studies had no control group (with no eye/face protection) to evaluate the efficacy of eye/face protection worn to protect from spraying and splashing.

A lack of distinction between what types of eye/face protection are considered eye protection and/or face protection was noticed within the evidence base. Also, there appears to be a lack of clear guidance regarding the certain type of eye/face protection appropriate for tasks/anticipated exposures.

Two guidelines published by the Association of periOperative Registered Nurses, and one guideline published by the National Institute for Health and Care Excellence were considered and appraised using the 'Appraisal of Guidelines for Research & Evaluation' (AGREE) II Instrument and were graded AGREE: 'not recommend'.[90-92]The guidelines were graded AGREE: 'not recommend' due to a lack of an explicit link between the evidence base and the recommendations provided. In addition to this, the guidelines lacked clarity regarding how the recommendations were formulated out-with the evidence (in terms of expert opinion and other considerations to inform these). They were therefore excluded from this review. However, these guidelines are broadly in line with the cited literature where relevant within the main body of the research questions.

The COVID-19 pandemic has highlighted the need for more evidence on extended use of eye protection regarding its appropriateness, instances where this can be applied, and impact on when eye/face protection should then be changed or removed. Guidance documents that proposed recommendations on eye/face protection used in the context of PPE shortages were excluded from this literature review as typically, the recommendations proposed did not follow manufacturer instructions or legislation relating to PPE or RPE use.

Evidence regarding harms from wearing eye/face protection was identified within the literature, such as fogging of the eye/face protective equipment and occupational health impacts. These are out with the scope of this review, however, are important

factors to consider within IPC recommendations, as they often affect compliance and may impact on delivery of clinical procedures as well as staff and patient safety.

In conclusion, there are several areas of research that require higher quality primary research to allow the formation of evidence-based recommendations made regarding the use of eye/face for IPC in health and care settings. Particularly the efficacy of eye/face protection for different types of anticipated exposure.

References

1. Moher D, Liberati A, Tetzlaff J, Altman D. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS medicine. 2009;7(6).

2. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. Journal of Hospital Infection. 2014;86:1-70.

3. Department of Health and Social Care. **Infection prevention and control: resource for adult social care**. 2022 [accessed 26 March 2024]..

4. National Health and Medical Research Council (NHMRC). **Australian Guidelines for the Prevention and Control of Infection in Healthcare**. 2019 [accessed 26 March 2024]..

5. Royal College of Nursing. **Essential Practice for Infection Prevention and Control Guidance for nursing staff 2017** [accessed 29 August 2023].

6. World Health Organization. Aide Memoire: **Standard Precautions in Health Care**. 2007 [accessed 02 August 2023].

7. Centers for Disease Control and Prevention. **Guidelines for Infection Control in Dental Health-Care Settings**. 2003 [accessed 02 August 2023].

8. Public Health Agency of Canada. **Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings**. 2017 [accessed 03 July 2023].

9. Association of Surgical Technologists. **AST Guidelines for Best Practices in Use of Eye Protection During Surgical Procedures**. 2017 [accessed 29 June 2023].

10. European Centre for Disease Prevention and Control. **Guidance for wearing and removing personal protective equipment in healthcare settings for the care of patients with suspected or confirmed COVID-19**. 2020 [accessed 14 August 2023].

11. Health New Zealand. **COVID-19: Infection prevention and control recommendations for health and disability care workers**. 2023 [accessed 26 March 2024].

12. British Standards Institution. BS 7028:1999 Eye protection for industrial and other uses. Guidance on selection, use and maintenance. 1999.

13. Coia J, Ritchie L, Adisesh A, Booth CM, Bradley C, Bunyan D, et al. Guidance on the use of respiratory and facial protection equipment. Journal of hospital Infection. 2013;85(3):170-82.

14. Siegel JD, Rhinehart E, Jackson M, Chiarello L. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. American journal of infection control. 2007;35(10):S65-S164.

15. Association for Professionals in Infection Control and Epidemiology. **APIC Implementation Guide: Infection Preventionist's Guide to the OR**. 2015 [accessed 27 July 2023].

16. Australian Government. **Guidance on the use of personal protective equipment (PPE) for health care workers in the context of COVID-19**. 2022 [accessed 03 July 2023].

17. Centers for Disease Control and Prevention. **Transmission-Based Precautions**. 2016 [accessed 04 August 2023].

18. Centers for Disease Control Prevention. I**nterim infection prevention and control recommendations for healthcare personnel during the coronavirus disease 2019 (COVID-19) pandemic**. 2020 [updated 08 May 2023; accessed 26 March 2024].

19. Centers for Disease Control and Prevention. **Collection and submission of postmortem specimens from deceased persons with confirmed or suspected COVID-19**. 2022 [accessed 03 July 2023].

20. Centers for Disease Control and Prevention. **Strategies for Conserving the Supply of Eye Protection**. 2023 [accessed 10 August 2023].

21. Health and Safety Executive. **Personal protective equipment at work. The Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations**. 2022.

22. World Health Organization. **Infection prevention and control of epidemic- and pandemic prone acute respiratory infections in health care**. 2014 [accessed 14 August 2023].

23. Health and Safety Executive. **Using personal protective equipment (PPE) to control risks at work**. 2020 [accessed 14 August 2023].

24. Department of Health, Health Protection Agency. **Pandemic (H1N1) 2009 Influenza – A summary of guidance for infection**. 2009 [accessed 04 August 2023].

25. World Health Organization. **Infection prevention and control guidance for long-term care facilities in the context of COVID-19 – Interim Guidance**. 2021 [accessed 01 August 2023].

26. Department of Health and Social Care and UK Health Security Agency. **Infection prevention and control (IPC) in adult social care: acute respiratory infection (ARI)**. 2024 accessed 26 March 2024].

27. The Management of Health and Safety at Work Regulations 1999, No. 3242 (1999).

28. Regulation 2016/425 and the Personal Protective Equipment (Enforcement) Regulations 2018: Great Britain. Statutory guidance, (2016).

29. Health and Safety at Work etc. Act 1974, (1974).

30. The Control of Substances Hazardous to Health Regulations 2002 (as amended), No. 2677 (1992).

31. The Personal Protective Equipment (Enforcement) Regulations 2018. Satutory Instrument 2018, No. 390 (2018).

32. The Personal Protective Equipment at Work (Amendment) Regulations 2022, No. 8 (2022).

33. British Standards Institution. BS EN ISO 168:2002. Personal eye-protection — Non-optical test methods. 2002.

34. British Standards Institution. BS EN 13921:2007. Personal protective equipment. Ergonomic principles. 2007.

35. British Standards Institution. BS EN ISO 18526-1:2020. Eye and face protection. Test methods - Geometrical optical properties. 2020.

36. British Standards Institution. BS EN ISO 18526-2:2020. Eye and face protection. Test methods - Physical optical properties. 2020.

37. British Standards Institution. BS EN ISO 18526-3:2020. Eye and face protection — Test methods — Part 3: Physical and mechanical properties. 2020.

38. British Standards Institution. BS EN ISO 16321-1:2022. Eye and face protection for occupational use - Part 1. General requirements. 2022.

39. International Organization for Standardization. ISO/TS 20141:2022. Personal safety. Personal protective equipment. Guidelines on compatibility testing of PPE. 2022 [accessed 23 March 2023].

40. Association of periOperative Registered Nurses. Recommended practices for prevention of transmissible infections in the perioperative practice setting. AORN Journal. 2007;85(2):383-96.

41. Centers for Disease Control and Prevention. **Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings – Recommendations of the Healthcare Infection Control Practices Advisory Committee**. 2022 [accessed 22 August 2023]..

42. Lindsley WG, Noti JD, Blachere FM, Szalajda JV, Beezhold DH. Efficacy of face shields against cough aerosol droplets from a cough simulator. Journal of occupational environmental hygiene. 2014;11(8):509-18.

43. Mansour III AA, Even JL, Phillips S, Halpern JL. Eye protection in orthopaedic surgery: an in vitro study of various forms of eye protection and their effectiveness. Journal of Bone and Joint Surgery. 2009;91(5):1050-4.

44. National Institute for Health and Care Excellence. **Healthcare-associated infections: prevention and control in primary and community care**. 2017 [accessed 20 December 2022].

45. U.S. Department of Labor Occupational Safety and Health Administration. **Guidance on Preparing Workplaces for an Influenza Pandemic**. 2007 [accessed 29 August 2023].

46. Chao I, Lee S, Brenker J, Wong D, Low C, Desselle M, et al. The effect of clinical face shields on aerosolized particle exposure. Journal of 3D Printing in Medicine. 2023;7(1).

47. European Centre for Disease Prevention and Control. **Considerations for infection prevention and control practices in relation to respiratory viral infections in healthcare settings**. 2023 [accessed 03 July 2023].

48. European Centre for Disease Prevention and Control. **Considerations related to the safe handling of bodies of deceased persons with suspected or confirmed COVID-19**. 2020 [accessed 14 August 2023].

49. European Centre for Disease Prevention and Control. **Monkeypox infection prevention and control guidance for primary and acute care settings**. 2022 [accessed 03 July 2023].

50. European Centre for Disease Prevention and Control. I**nfection prevention and control and preparedness for COVID-19 in health care settings – Sixth update**. 2020 [accessed 29 June 2023].

51. Health New Zealand. **Infection prevention and control**. 2023 [updated 03 June 2023; accessed 07 July 2023].

52. Health and Safety Executive. **Handling the deceased with suspected or confirmed COVID-19**. [accessed 16 August 2023]..

53. Health and Safety Executive. **Managing infection risks when handling the deceased**. 2018 [accessed 18 October 2023].

54. Health and Safety Executive. **Safe Working Practices**. 2022 [accessed 03 July 2023]; 2023.

55. Lynch JB, Davitkov P, Anderson DJ, Bhimraj A, Cheng VC, Guzman-Cottrill J, et al. Infectious Diseases Society of America Guidelines on Infection Prevention for Health Care Personnel Caring for Patients with Suspected or Known COVID-19. Clinical Infectious Diseases. 2020.

56. UK Health Security Agency, Public Health Scotland, Public Health Wales, Public Health Agency Northern Ireland. **Principles for control of non-HCID mpox in the UK: 4 nations consensus statement**. 2023 [accessed 03 July 2023]..

57. UK Health Security Agency. **Guide to donning and doffing PPE: Droplet Precautions for health and social care settings**. 2023 [accessed 04 August 2023].

58. World Health Organization. **Infection prevention and control in the context of coronavirus disease (COVID-19): a living guideline**. 2023 [updated 13 January 2023; accessed 04 October 2023].

59. Centers for Disease Control and Prevention. **Sequence for putting on Personal Protective Equipment (PPE) and How to safely remove Personal Protective Equipment (PPE)**. 2014 [accessed 14 August 2023].

60. Australian Commission on Safety and Quality in Health Care. **For all staff Airborne precautions in addition to standard precautions**. 2022 [accessed 03 August 2023].

61. Australian Commission on Safety and Quality in Healthcare. **For all staff Combined airborne & contact precautions in addition to standard precautions**. 2023 [accessed 04 August 2023].

62. Australian Commission on Safety and Quality in Healthcare. **For all staff Combined contact & droplet precautions in addition to standard precautions**. 2023 [accessed 04 August 2023].

63. Australian Commission on Safety and Quality in Healthcare. **For all staff Droplet precautions in addition to standard precautions**. 2022 [accessed 04 August 2023].

64. Australian Commission on Safety and Quality in Healthcare. **Precautions for aged care homes caring for residents with or suspected of having respiratory viruses**. 2023 [accessed 04 August 2023].

65. Department of Health and Social Care. **PPE guide for non-aerosol generating procedures**. 2022 [updated 15 December 2022; accessed 03 July 2023].

66. Health and Safety Executive. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance. 2013.

67. UK Health Security Agency. **Putting on (donning) personal protective equipment including coveralls for aerosol generating procedures (AGPs). Airborne Precautions**. 2020 [accessed 04 August 2023].

68. UK Health Security Agency. **Putting on (donning) personal protective equipment (PPE) for aerosol generating procedures (AGPs). Airborne Precautions – Gown version**. 2020 [accessed 13 September 2023].

69. UK Health Security Agency. **Putting on personal protective equipment (PPE) Standard Infection Control Precautions**. 2020 [accessed 13 September 2023].

70. World Health Organization. **How to put on and how to remove personal protective equipment (PPE)**. 2015 [accessed 02 August 2023].

71. UK Health Security Agency. **Taking off personal protective equipment (PPE) Standard Infection Control Precautions**. 2020 [accessed 13 September 2023].

72. UK Health Security Agency. **Removing (doffing) personal protective equipment (PPE) including coveralls for aerosol generating procedures (AGPs). Airborne Precautions**. 2020 [accessed 13 September 2023].

73. NHS England. **National infection prevention and control manual for England**. 2022 [accessed 14 August 2023].

74. UK Health Security Agency. **Removal of (doffing) personal protective equipment (PPE). Airborne Precautions for AGPs – Gown version**. 2022 [accessed 13 September 2023].

75. Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet. 2020;395(10242):1973-87.

76. Aguilar-Duran S, Panthagani A, Naysmith L, Holme S. Incidence and risk factors of blood splatter in dermatological surgery: how protective are full facial masks? British Journal of Dermatology. 2017;176(1):275-7.

77. Birnie AJ, Thomas KS, Varma S. Should eye protection be worn during dermatological surgery: prospective observational study. British Journal of Dermatology. 2007;156(6):1258-62.

78. Brandner JM, Boor P, Borcherding L, Edler C, Gerber S, Heinemann A, et al. Contamination of personal protective equipment during COVID-19 autopsies. Virchows Archiv : an international journal of pathology. 2022;480(3):519-28.

79. Comisi JC, Ravenel TD, Kelly A, Teich ST, Renne W. Aerosol and spatter mitigation in dentistry: Analysis of the effectiveness of 13 setups. Journal of Esthetic and Restorative Dentistry. 2021;33(3):466-79.

80. Davies C, Khan Ma, Ghauri A, Ranaboldo C. Blood and body fluid splashes during surgery–the need for eye protection and masks. The Annals of The Royal College of Surgeons of England. 2007;89(8):770-2.

81. De Silva R, Mall A, Panieri E, Stupart D, Kahn D. Risk of blood splashes to the eye during surgery. South African Journal of Surgery. 2009;47(1).

82. Endo S, Kanemitsu K, Ishii H, Narita M, Nemoto T, Yaginuma G, et al. Risk of facial splashes in four major surgical specialties in a multicentre study. Journal of Hospital infection. 2007;67(1):56-61.

83. Ishihama K, Iida S, Koizumi H, Wada T, Adachi T, Isomura-Tanaka E, et al. High incidence of blood exposure due to imperceptible contaminated splatters during oral surgery. Journal of oral maxillofacial surgery. 2008;66(4):704-10.

84. Kelly G, Gana P, Nielsen T, Macgregor F. The incidence of potential conjunctival contamination in tonsillectomy. Journal of the Royal College of Surgeons of Edinburgh. 2000;45(5):288-90.

85. Keogh I, Hone S, Colreavey M, Walsh M. Blood splash and tonsillectomy: an underestimated hazard to the otolaryngologist. The Journal of Laryngology Otology. 2001;115(6):455-6.

86. McNamara I, Tehrani H, Sassoon E. Ocular contamination during lesional surgery—a hazard for the plastic surgeon. Journal of plastic, reconstructive aesthetic surgery. 2006;59(3):263-5.

87. Stacey AW, Czyz CN, Kondapalli SSA, Hill RH, Everman KR, Cahill KV, et al. Risk of ocular blood splatter during oculofacial plastic surgery. Ophthalmic Plastic Reconstructive Surgery. 2015;31(3):182-6.

88. Tehrani H, Juma A, Lambe G, James M. The risk of eye splash in burn surgery. Burns. 2009;35(4):587-9.

89. Wines MP, Lamb A, Argyropoulos AN, Caviezel A, Gannicliffe C, Tolley D. Blood splash injury: an underestimated risk in endourology. Journal of endourology. 2008;22(6):1183-8.

90. Association of periOperative Registered Nurses. **Transmission-Based Precautions**. 2018 [accessed 10 October 2023].

91. Association of periOperative Registered Nurses. Guideline for care and cleaning of surgical instruments. AORN Journal. 2020;112(3):9-11.

92. National Clinical Guideline Centre. **Infection: prevention and control of healthcare-associated infections in primary and community care [CG139]**. 2003 [updated 2017; accessed 03 April 2024].

Appendices

Appendix 1: Search Strategy

EMBASE search 2020 to current

1. exp eye protective device/
2. (eye shield* or eye protect* or goggle* or face shield* or visor*).mp.
3. (safety adj (spectacles or glasses*)).mp.
4. 1 or 2 or 3
5. exp infection/
6. exp disease transmission/
7. exp infection control/
8. exp universal precaution/
9. (donn* or doff*).mp.
10. (dispose* or reprocesse* or decontaminat*).mp.
11. 5 or 6 or 7 or 8 or 9 or 10
12. 4 and 11
13. limit 12 to (human and english language and yr="2020 -Current")

MEDLINE search 2020 to current

1. exp Eye Protective Devices/
2. (eye shield* or eye protect* or goggle* or face shield* or visor*).mp.
3. (safety adj (spectacles or glasses*)).mp.
4. 1 or 2 or 3
5. exp Infections/

6. exp Disease Transmission, Infectious/

7. exp Infection Control/

8. exp Universal Precautions/

9. (donn* or doff*).mp.

10. (dispose* or reprocesse* or decontaminat*).mp.

11. 5 or 6 or 7 or 8 or 9 or 10

12. 4 and 11

13. limit 12 to (english language and humans and yr="2020 -Current")

CINAHL search 2020 to current

S20 S8 AND S18 to English Language

S19 S8 AND S18

S18 S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17

S17 decontaminat*

S16 reprocesse*

S15 dispose*

S14 doff*

S13 donn*

S12 MH "Universal Precautions"

S11 MH "Infection Control+"

S10 MH "Disease Transmission+"

S9 MH "Infection+"

S8 S1 OR S2 OR S3 OR S4 OR S5 OR S6

S7 safety N1(spectacles OR glasses*)

S6	visor*
S5	face shield*
S4	goggle*
S3	eye protect*
S2	eye shield*
S1	MH "Eye Protective Devices"

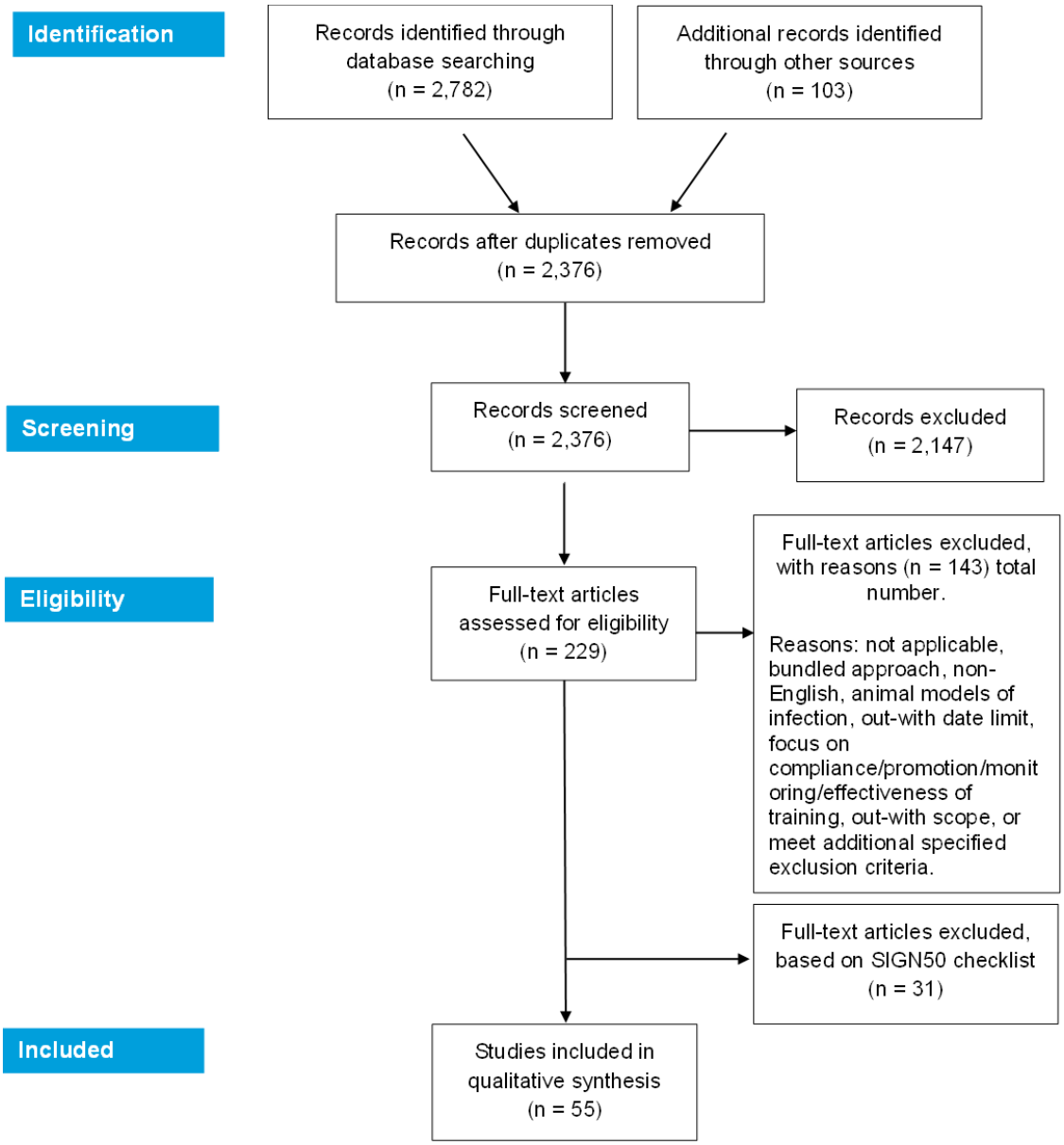
Appendix 2: SIGN50 Evidence Levels

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

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.

Grade	Description
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[1]



Appendix 4: Standards pertaining to eye and face protection

This appendix provides a non-exhaustive list of standards pertaining to eye/face protection. The standards listed represent the most recent versions available at the time of publication. Please note, however, standards are subject to amendments and the most recent versions should always be sourced and used in practice.

Standard	Title	Description	Publication Date
BS 7028:1999	Eye protection for industrial and other uses – Guidance on selection, use and maintenance	This standard outlines the classification, selection, and care and maintenance of occupational eye-protectors, as well as occupational eye-protector programmes.	November 1999
BS EN ISO 168:2002	Personal eye-protection. Non-optical test methods.	This standard outlines test methods for non-optical eye-protectors. Tests are provided for: • minimum robustness of oculars with filtering effect and cover plates • stability at elevated temperature • resistance to ultraviolet radiation, ignition, corrosion, and high-speed particles • protection against molten metals	January 2002

Standard	Title	Description	Publication Date
		area of coverage of face shields • penetration by hot solids • against droplets and liquid splashes • against large dust particles • against gases and fine dust particles • resistance to surface damage by fine particles • resistance to fogging of oculars.	
BS EN 13921:2007	Personal protective equipment. Ergonomic principles.	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 that PPE may be designed.	September 2007
BS EN ISO 16321-1:2022	Eye and face protection for occupational use - Part 1. General requirements	This document specifies general requirements for eye and face protectors. Requirements apply to protectors intended for use against one or more common occupational hazards such as impacts from flying particles and fragments, optical radiation, dusts, splashing liquids, molten	May 2022

Standard	Title	Description	Publication Date
		metals, heat, flame, hot solids, harmful gases, vapours and aerosols. Additional requirements for eye and face protectors used during welding and related techniques and for mesh protectors are given in ISO 16321-2 and ISO 16321-3, respectively.	
BS EN ISO 18526-1:2020	Eye and face protection. Test methods - Geometrical optical properties.	Reference test methods are specified for determining the spherical, cylindrical, and prismatic refractive power properties of unmounted and mounted plano lenses (non-corrective lenses) for eye and face protectors.	March 2020
BS EN ISO 18526-2:2020	Eye and face protection. Test methods - Physical optical properties.	Reference test methods are specified for determining the physical optical properties of personal eye and face protectors.	February 2020
BS EN ISO 18526-3: 2020	Eye and face protection — Test methods — Part 3: Physical and mechanical properties.	Reference test methods are specified for determining the physical and mechanical properties of eye and face protectors.	January 2020
PD ISO/TS 20141:2022	Personal safety – Personal protective	This document describes compatibility for ensembles of personal protective equipment	August 2022

Standard	Title	Description	Publication Date
	equipment – Guidelines on compatibility testing of PPE.	(PPE) to be used by personnel where operating situations and processes require more than one piece of PPE. The document includes examples of interactions between PPE and suggestions of test procedures.	

Appendix 5: Excluded studies

The following primary studies were excluded during critical appraisal based on their limitations:

- Al Mohajer M, Panthagani KM, Lasco T, Lembcke B, Hemmige V. Association between universal face shield in a quaternary care center and reduction of SARS-COV2 infections among healthcare personnel and hospitalized patients. International journal of infectious diseases. 2021;105:252-5.
- Anon JB, Denne C, Rees D. Patient-Worn Enhanced Protection Face Shield for Flexible Endoscopy. Otolaryngology-Head & Neck Surgery. 2020;163(2):280-3.
- Bhaskar ME, Santhanam A. SARS-CoV-2 Infection Among Community Health Workers in India Before and After Use of Face Shields. Journal of the American Medical Association. 2020;324(13):1348-9.
- Brainard J, Hall S, van der Es M, Sekoni A, Price A, Padoveze MC, et al. A mixed methods study on effectiveness and appropriateness of face shield use as COVID-19 PPE in middle income countries. American Journal of Infection Control. 2022;50(8):878-84.
- Brandner JM, Boor P, Borcherding L, Edler C, Gerber S, Heinemann A, et al. Contamination of personal protective equipment during COVID-19 autopsies. Virchows Archiv: an international journal of pathology. 2022;480(3):519-28.
- Breda Mascarenhas LA, Machado BAS, Rodrigues LdAP, Saraiva Hodel KV, Bandeira Santos AA, Freitas Neves PR, et al. Potential application of novel technology developed for instant decontamination of personal protective equipment before the doffing step. PloS one. 2021;16(6).
- Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet. 2020;395(10242):1973-87.

- Comisi JC, Ravenel TD, Kelly A, Teich ST, Renne W. Aerosol and spatter mitigation in dentistry: Analysis of the effectiveness of 13 setups. Journal of Esthetic and Restorative Dentistry. 2021;33(3):466-79.
- Dinsmore J, Brands S, Perry S, Lopez M, Yutong D, Palasz D, et al. Efficacy of Various Facial Protective Equipment for Infection Control in a Healthcare Setting. Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health. 2021;22(5):1045-50.
- Hall S, Johnson P, Bailey C, Gould Z, White R, Crook B. Evaluation of Face Shields, Goggles, and Safety Glasses as a Virus Transmission Control Measure to Protect the Wearer Against Cough Droplets. Annals of Work Exposures & Health. 2023;67(1):36-49.
- Hawkins ES, Fertel BS, Muir MR, Meldon SW, Delgado FJ, Smalley CM. Adding eye protection to universal masking reduces COVID-19 among frontline emergency clinicians to the level of community spread. The American journal of emergency medicine. 2021;46:792-3.
- Ionescu AC, Brambilla E, Manzoli L, Orsini G, Gentili V, Rizzo R. Efficacy of personal protective equipment against coronavirus transmission via dental handpieces. Journal of the American Dental Association (JADA). 2021;152(8):631-40.
- John DTJ, Hassan DK, Weich DH. Donning and doffing of personal protective equipment (PPE) for angiography during the COVID-19 crisis. European Heart Journal. 2020;41(19):1786-7.
- Khong GC, Bhat J, Sharma RS, Leong SC. Analysis of Droplet Splatter Patterns During Coblation Tonsil Surgery in the Covid-19 Pandemic. Annals of Otology, Rhinology & Laryngology. 2022;131(2):219-24.
- Ko-Keeney EH, Saran MS, McLaughlin K, Lipman S. Improving protection from bioaerosol exposure during postoperative patient interaction in the COVID-19 era, a quality improvement study. American journal of otolaryngology. 2020;41(6):102634.
- Lescanne E, van der Mee-Marquet N, Juvanon JM, Abbas A, Morel N, Klein JM, et al. Best practice recommendations: ENT consultations during

the COVID-19 pandemic. European annals of otorhinolaryngology, head and neck diseases. 2020;137(4):303-8.

- Noguera SV, Espinoza EPS, Côrtes MF, Oshiro ICV, Spadão FdS, Brandão LMB, et al. Disinfection of 3D-printed protective face shield during COVID-19 pandemic. American Journal of Infection Control. 2021;49(4):512-5.
- Peng L, Chen Y, Yang S, Wang G, Gu Y, Shen B, et al. Viral contamination on the surfaces of the personal protective equipment among health care professionals working in COVID-19 wards: A single-center prospective, observational study. American Journal of Infection Control. 2023;51(3):276-81.
- Pittayanon R, Faknak N, Ananchuensook P, Prasoppokakorn T, Plai-Dum S, Thummongkhol T, et al. Amount of contamination on the face shield of endoscopists during upper endoscopy between patients in two positions: A randomized study. Journal of gastroenterology and hepatology. 2021;36(7):1913-9.
- Pratt A, Eckermann N, Venugopalan SR, Uribe LM, Barlow L, Nonnenmann M. Evaluation of aerosols in a simulated orthodontic debanding procedure. Scientific reports. 2023;13(1):4826.
- Ronen A, Rotter H, Elisha S, Sevilia S, Parizer B, Hafif N, et al. Investigation of the protection efficacy of face shields against aerosol cough droplets. Journal of occupational and environmental hygiene. 2021;18(2):72-83.
- Saini V, Sikri K, Batra SD, Kalra P, Gautam K. Development of a highly effective low-cost vaporized hydrogen peroxide-based method for disinfection of personal protective equipment for their selective reuse during pandemics. Gut Pathogens. 2020;12(1):29.
- Salimnia H, Meyer MP, Mitchell R, Fairfax MR, Gundel A, Guru N, et al. A laboratory model demonstrating the protective effects of surgical masks, face shields, and a combination of both in a speaking simulation. American Journal of Infection Control. 2021;49(4):409-15.

- Shah A, Zhuang E, German J, Tai S, Schanz M, Glendening G, et al. Surface Contamination of Reusable Respirators and Face Shields During Care of Critically Ill COVID-19 Patients. Workplace Health & Safety. 2023;71(3):137-43.
- Sterr CM, Nickel I-L, Stranzinger C, Nonnenmacher-Winter CI, Gunther F. Medical face masks offer self-protection against aerosols: An evaluation using a practical in vitro approach on a dummy head. PloS one. 2021;16(3):e0248099.
- Varela AR, Gurruchaga AP, Restrepo SR, Martin JD, Landazabal YDC, Tamayo-Cabeza G, et al. Effectiveness and adherence to closed face shields in the prevention of COVID-19 transmission: a non-inferiority randomized controlled trial in a middle-income setting (COVPROSHIELD). Trials. 2022;23(1):698.
- Wendling J-M, Fabacher T, Pebay P-P, Cosperec I, Rochoy M. Experimental Efficacy of the Face Shield and the Mask against Emitted and Potentially Received Particles. International journal of environmental research and public health. 2021;18(4).
- Woodfield MJ, ones RM, Sleeth DK. Influence of face shields on exposures to respirable aerosol. Philadelphia, Pennsylvania: Taylor & Francis Ltd; 2022. Report No.: 1545-9624.
- Ye MJ, Sharma D, Campiti VJ, Rubel KE, Burgin SJ, Illing EA, et al. Aerosol and droplet generation from mandible and midface fixation: Surgical risk in the pandemic era. American Journal of Otolaryngology - Head and Neck Medicine and Surgery. 2021;42(1):102829.
- Zhang X-B, Wei Y-L, Zhao G, He M, Sun J, Zeng W. Coronavirus disease 2019: Repeated immersion of chlorine-containing disinfectants has adverse effects on goggles. Frontiers in public health. 2023;11.
- Zhou L, Yao M, Zhang X, Hu B, Li X, Chen H, et al. Breath-, air- and surface-borne SARS-CoV-2 in hospitals. Journal of Aerosol Science. 2021;152:105693.