

Standard Infection Control and Transmission Based Precautions Literature Review

**Personal Protective Equipment
(PPE): Gloves**

Version 4.0

Publication date: 8 June 2022

Key Information

Document title:	Standard Infection Control and Transmission Based Precautions Literature Review: Personal Protective Equipment (PPE) Gloves
Date published/issued:	8 June 2022
Date effective from:	8 June 2022
Version/issue number:	4.0
Document type:	Literature review
Document status:	Final

Document information

Description: This literature review examines the available professional literature on PPE (Gloves) in health and care setting.

Purpose: To inform Standard Infection Control Precautions (SICP) and Transmission Based Precautions on PPE (Gloves) in the National Infection Prevention and Control Manual in order to facilitate the prevention and control of healthcare associated infections in NHS Scotland health and care settings.

Target Audience: All staff involved in the prevention and control of infection in Scotland.

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 2024

Cross reference: National Infection Prevention and Control Manual

Update level: **Practice** – No significant changes to practice.

Research – Further research is required regarding sterile versus non-sterile glove use for a number of procedures. There is also further research required to assess the infection risk from the transfer to pathogens from patients to the gloves of health and care staff, and to assess the efficacy of novel glove technologies is also required.

Contact

ARHAI Scotland Infection Control team:

Telephone: 0141 300 1175

Email: nss.ARHAinfectioncontrol@nhs.scot

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
4.0	June 2022	<p>This review was updated using two-person methodology.</p> <p>The research question, 'Should specific gloves be worn for specific procedures?' has been removed and incorporated into the following research questions; 'When should sterile gloves be worn and are they specified for specific procedures?' and 'When should non-sterile examination gloves be worn and are they specified for specific procedures?'. </p> <p>This review has incorporated the following SBARs, which have now been archived: 'Use of gloves for environmental cleaning', and 'Gloves for administering immunisations'.</p> <p>A number of recommendations have been removed and new recommendations have been added. The grading of existing recommendations have also been changed to reflect the quality of the evidence-based used to inform them.</p>
3.0	August 2016	<p>Addition of New Recommendation – 'When should sterile or non-sterile gloves be worn?'</p> <p>"Sterile gloves are not required for minor skin surgery, e.g. wound suturing and local skin excisions."</p> <p>(Grade B recommendation)</p>
2.0	April 2014	Defined as final
1.0	January 2012	Defined as final

Approvals

Version	Date Approved	Name
4.0	May 2022	National Policies, Guidance and Evidence Working Group

Contents

1. Objectives	6
2. Methodology	6
3. Discussion	7
3.1 Implications for practice	7
3.2 Implications for research	25
4. Recommendations	27
References	35
Appendices	46
Appendix 1: Specific standards pertaining to the quality and performance of gloves	46
Appendix 2: Grades of recommendation	52

1. Objectives

The aim is to review the extant scientific literature regarding gloves as PPE in health and care settings to inform evidence based recommendations for practice. The specific objectives of the review are to determine:

- Are there any legislative requirements for the use of gloves as PPE for infection control purposes?
- When/where should gloves be worn?
- When should sterile gloves be worn and are they specified for specific procedures?
- When should non-sterile examination gloves be worn and are they specified for specific procedures?
- What type of gloves should be worn based on material type e.g. latex, nitrile, neoprene?
- When should double gloving be adopted?
- When should gloves be changed or removed?
- How should gloves be donned?
- How should gloves be doffed?
- How should gloves be disposed of?
- How should gloves be stored?
- What are the healthcare-associated infection risks of reusing gloves?
- What are the healthcare-associated infection risks of using alcohol-based hand rub on gloves, rather than changing gloves?

2. Methodology

This targeted literature review was produced using a defined two-person systematic methodology as described in the [National Infection Prevention and Control Manual: Development Process](#).

3. Discussion

3.1 Implications for practice

Are there any legislative requirements for the use of gloves as PPE for infection control purposes?

There are no specific legislative requirements regarding the use of gloves as PPE for infection control purposes, that is, to prevent the spread of healthcare associated infection. Although the wearing of PPE in the health and care setting is covered by the [Health and Safety at Work etc. Act \(1974\)](#),¹ [Control of Substances Hazardous to Health 2002 Regulations \(as amended\)](#),² and the [Personal Protective Equipment at Work \(Amendment\) Regulations 2022](#).³

The Health and Safety at Work Act is the generic health and safety legislation for the UK and broadly covers the use of PPE and risk, but is not healthcare specific. The Control of Substances Hazardous to Health (COSHH) is more specific and provides details in relation to hazardous materials and the use of PPE; and can be used in conjunction with the Health and Safety at Work Act, which includes pathogens in the hospital environment and the use of appropriate PPE. For example, the use of gloves to protect against blood borne viruses during venepuncture. If an activity does not involve or is perceived not to involve contact with a hazardous material then the Personal Protective Equipment at Work amended 2022 Regulations provide general guidance on the use of PPE; in the hospital environment this could be the use of gloves to protect against glass fragments when cleaning up broken glass; however if the glass contained a laboratory sample then the activity would be covered by the COSHH.

In summary, UK legislation outlines responsibilities of the employer and employee. Employers are obligated to provide appropriate PPE for their employees when hazards within the workplace cannot be otherwise controlled.^{1, 2} Employers are also responsible for ensuring that PPE is suitable for the task undertaken, fits correctly and complies with PPE Regulations 2022.³ Furthermore, the PPE provided should offer the maximum protection possible with minimum discomfort. If multiple items of PPE are worn together, the employer must ensure that they are compatible with each other and that the level of protection they offer is not reduced.^{2, 3}

It was previously a requirement that PPE was CE marked.⁴ UK Conformity Assessed (UKCA) marking came into force on 1st January 2021. After 31st December 2022, PPE must be UKCA marked.⁵ CE marking demonstrates that a product complies with relevant European Union (EU)

product supply legislation so that it can be sold within the EU and other select countries. UKCA marking are expected to be the same as EU standards, demonstrating that products have met relevant UK legislation.⁵

Legislation outlines that employers must provide sufficient instruction on the correct use of PPE and provide appropriate accommodation for the storage of PPE when not in use.^{2, 3} Employees are then responsible for ensuring that they comply with these instructions and use PPE that is suitable for the task being undertaken.^{2, 3} Employers are responsible for ensuring that re-usable PPE is regularly checked and repaired or replaced before further use if damaged. Employees have a duty to wear the PPE provided by employers, ensure that PPE is worn correctly and according to manufacturer instructions, is well-maintained, kept in a clean condition and disposed of safely.^{2, 3, 6}

PPE at Work Regulations 2022 (as amended), associated with the PPE (Enforcement Regulations) 2018 and the Regulation (EU) 2016/425, outlines that PPE available on the market must be supplied with information on, “storage, use, maintenance, servicing, cleaning and disinfecting; the level of protection provided by the PPE; suitable PPE accessories and appropriate spare parts; limitations on use and the obsolescence period [expiry date] for the PPE or certain of its components”.

The Health and Safety Executive (HSE) has issued specific UK guidance to assist employers in adhering to their legal duties regarding the use of gloves to protect skin from exposure to hazardous substances at work.^{6, 7} Given the risk of allergy in response to the use of natural rubber latex gloves, the HSE stipulate that their use must be based on a risk assessment which has deemed their use necessary. In such instances, the HSE stipulates that disposable latex gloves must be low-protein and powder-free.

The HSE also stipulate that in terms of their material, the gloves chosen must offer adequate protection against the substances being handled, be suitable for the wearer in terms of comfort and fit and appropriate for the task being performed.^{6, 8}

Specific standards relating to gloves in health and care settings are outlined in [Appendix 1](#).

When/where should gloves be worn?

Although there was no primary evidence found to inform this research question, a substantial volume of expert opinion guidelines were identified regarding when and where gloves should be worn in the health and care setting. Thirty-four guidance documents were identified; twelve were published in the UK,⁸⁻¹⁹ 11 were published in the USA,²⁰⁻³⁰ 31 two were published in Australia,^{32, 33} and five were developed by the World Health Organization (WHO).³⁴⁻³⁹ The remainder were published in the Republic of Ireland (ROI), New Zealand and India, respectively.⁴⁰⁻⁴² Of note, three of the UK expert opinion guidance were developed in the context of COVID-19; however, these provide general recommendations regarding the use of gloves that can be applied to all pathogens.^{13, 17, 18}

There is consensus in the literature regarding why, when and where gloves should be worn in the health and care setting for standard infection control precautions (SICPs). It is consistently recommended that the decision to wear gloves for a specific task should be based on a risk assessment that aims to protect both the healthcare worker (HCW) and/or the patient. The assessment should consider whether there is a risk of contact with or exposure to: blood and/or body fluids;^{8, 10, 12-15, 18, 20, 21, 24, 26-30, 32-36, 38, 40, 42} secretions and/or excretions;^{9, 21, 24, 28, 29, 34-36, 39-41} non-intact skin;^{9, 10, 12, 14, 15, 18, 19, 21, 24, 27, 28, 30, 33-36, 39, 41} mucous membranes;^{10, 12, 14, 15, 19, 24, 27-30, 35, 36, 38, 39, 41} surfaces or items contaminated with body fluids,^{9, 10, 21, 23, 24, 27, 28, 30, 32, 35, 39-42} or hazardous drugs or chemicals, including detergents and other disinfectants and cleaning agents.^{14, 15, 29, 38, 41, 42}

Given the above risk assessment, gloves have therefore been recommended for environmental cleaning and cleaning of medical equipment in clinical and laboratory settings due to potential contact of surfaces or items contaminated with body fluids, in addition to risk of contact to hazardous chemicals.^{9, 10, 14, 15, 21, 23, 24, 26-30, 32, 35, 38, 40-42} For detailed information on environmental cleaning and cleaning of medical equipment, refer to [‘Management of patient care equipment’](#) and [‘Safe management of the care environment \(environmental cleaning\)’](#) published by ARHAI Scotland.

A number of guidance documents indicate gloves should be worn for invasive procedures,^{10, 18, 21, 33} including venepuncture or venous access procedures.^{15, 21, 38, 42} Although the Royal College of Nursing (RCN) support this recommendation regarding glove use, they recognise that some HCWs with experience in performing venepuncture may prefer not to use gloves, citing the reasons being decreased dexterity and increased risk of needlestick injury.¹⁵ It is important to note these guidelines do not indicate whether gloves worn for invasive procedures should be

sterile or non-sterile, or made of a specific material. Use of sterile versus non-sterile gloves for invasive procedures is discussed in more detail in the discussion section of this review under, 'When should sterile gloves be worn and are they specified for specific procedures?'

The CDC and the AANA recommend that gloves should be worn when touching the patient or their environment when droplet precautions are necessary.^{24, 28, 30, 42} Guidelines developed by the WHO are in-line with CDC and AANA recommendations,³⁹ however, their guidance on infection prevention and control of pandemic and epidemic-prone acute respiratory pathogens in healthcare states that when contact precautions apply, latex gloves should be worn when entering the patient room, rather than donning gloves based upon risk assessment on anticipated contact with respiratory fluids.³⁵ A glove use information leaflet by the WHO also states that gloves are required during contact precautions, but there is failure to clarify whether a risk assessment on anticipated contact with the patient or their environment is necessary, although they do highlight that prolonged glove use for contact precautions in the absence of hand hygiene increases pathogen transmission risk.³⁶

There was a lack of clarity regarding the timing of donning gloves when applying TBPs. UKHSA state that gloves should be donned prior to entering a patient care area in their guidance for donning and doffing PPE for droplet precautions.¹⁷ The Australian Government state that where contact precautions are indicated, gloves should be donned before entering the patient care area.³³ However, it is unclear if this is advised because it is assumed that there will be contact with blood or bodily fluids. Similarly, the AANA state that gloves should be worn in the patient's room when airborne precautions are necessary, and if there is contact with the patient or their environment for droplet and contact precautions.^{42, 43} The RCN state that gloves should be worn as part of TBPs if required by local policies, but highlight that gloves are not necessary when there is no potential exposure to blood, bodily fluids or contaminated environments.¹⁵ The lack of evidence regarding the timing of when gloves should be worn when applying TBPs is likely because there is overall consensus as with the application of SICPs, that the decision to wear gloves for specific activities is based on a risk assessment that considers the risk of transmission between HCWs and patients.

In only two expert opinion guidance documents, gloves have also been indicated when HCWs are exposed to/performed aerosol-generating procedures (AGPs), where the WHO cited potentially increased risk of transmission of respiratory pathogens that are associated with these procedures.^{32, 35} However, it is unclear whether the increase risk of transmission is due to exposure to splashing or spraying associated with an AGP, rather than the infectious pathogen the patient is carrying, and the also WHO highlights that this recommendation is based on low-

quality evidence.³⁵ For further information on AGPs, refer to the [ARHAI Scotland AGP literature review](#).

Four expert opinion guidelines discussed the use of gloves for administering immunisations.^{21, 36-38, 44} There is consensus that wearing gloves is not typically necessary for administering immunisations unless:

- It is anticipated that there may be exposure to blood or body fluids;³⁷
- The healthcare worker has non-intact skin on their hands;^{21, 38} or
- The person receiving the immunisation has non-intact skin.³⁸

As already discussed, a number of expert opinion guidelines state that gloves should be worn for invasive procedures, however no definition of 'invasive procedures' is provided in the guidelines, so it is unclear whether this recommendation extends to the administration of immunisations.^{10, 18, 21, 33 15, 21, 38, 42}

The Advisory Committee on Immunization Practices (ACIP) published best practice guidelines for immunisation that were last updated in 2022. These expert opinion guidelines quote the Occupational Safety and Health Administration (OSHA), stating that gloves are not required when administering vaccinations unless the HCW has open lesions on their hands or there is risk that they may come into contact with the patient's blood or bodily fluids.³¹ Additionally, the WHO published a toolkit on best practices for injections and related procedures that outlines indications for glove use in injection practices.³⁷ This expert opinion guidance document states that gloves are not required for routine intradermal, injections if both the HCW's and the patient's skin is intact.³⁷ The guidance goes on to state that if there is risk of contact with blood or bodily fluids, or if the healthcare worker's or patient's skin is not intact, non-sterile gloves should be worn. More information regarding the use of non-sterile gloves can be found in the discussion section of this review under, 'When should non-sterile examination gloves be worn and are they specified for specific procedures?'

Lastly, a small proportion of the evidence base provided further information regarding when gloves are not necessary. The RCN and the WHO highlight that gloves should only be donned when a risk assessment deems them to be necessary to avoid overuse of gloves and a potential negative impact on compliance with hand hygiene.^{14, 15, 36, 38} The RCN also highlight that gloves are not a substitute for hand hygiene, which is in-line with Scottish expert opinion.¹⁴ Similarly, two guidance documents on infection prevention and control (IPC) measures for paediatrics indicated that gloves are not required for routine care of well children and the UK

Health Security Agency (UKHSA) highlighted that gloves are not necessary for administrative tasks, such as writing patient notes.^{18 21, 23}

When should sterile gloves be worn and are they specified for specific procedures?

Three primary studies, including a meta-analysis, randomised-controlled trial and prospective observational study, were identified in relation to this research question.⁴⁵⁻⁴⁷ The remainder of the evidence base was composed of IPC guidance, the majority of which was deemed to be expert opinion. Six of the guidance documents were published in the UK,^{10, 13, 15, 42, 48, 49} 12 were published in the USA,^{24, 27, 28, 43, 50-56} and four were published by the WHO.^{35, 36, 38, 39} The remainder of the guidance were published in ROI, Canada, Australia, New Zealand and India, respectively.^{33, 42, 57-60}

It is consistently recommended in the literature that the choice between wearing sterile or non-sterile gloves should be determined by the nature of the task being undertaken by the HCW. Sterile gloves have been indicated for: most surgical procedures;^{15, 24, 33, 36, 39, 43, 47, 53, 57} invasive procedures, including invasive radiological procedures;^{13, 15, 28, 33, 36, 39, 43, 49} as part of aseptic technique,^{33, 38, 51} and sterile procedures.^{13, 33, 35, 38, 40, 42, 49, 60} One document published in India recommended sterile gloves during contact with non-intact skin and mucous membranes.^{54, 60}

A number of expert opinion guidance documents indicate specific clinical activities for which sterile gloves should be worn. There is consensus in these documents that sterile gloves should be worn for vaginal deliveries;^{15, 33, 36, 39, 43} spinal, epidural and caudal procedures, e.g. central neuroaxial blocks;^{15, 24, 33, 36, 39, 43, 50} preparation of chemotherapeutic agents,^{15, 33, 36, 39, 43} and preparation of total parenteral nutrition.^{33, 36, 39, 43} Notably, these recommendations are based on expert opinion guidance with a lack of primary evidence to support their rationale.

There was consensus amongst five expert opinion guidance documents that sterile gloves should be used for arterial access.^{49, 55, 56, 60} However, there is a lack of consensus regarding the use of sterile versus non-sterile gloves for the insertion and management of urinary catheters and venous catheters, including central venous catheters (CVCs) and peripheral venous catheters (PVCs). A large body of guidance published globally indicate sterile gloves for catheter insertion and management, including urinary catheters.^{15, 24, 27, 28, 33, 36, 39, 43, 49, 60} However, UK, Australian and Indian IPC guidance state that clean, non-sterile gloves are adequate for all catheter management.^{10, 33, 59} Of note, although UK epic3 guidelines recommend non-sterile gloves for catheter management, they do not provide a recommendation regarding the use of sterile or non-sterile gloves for catheter insertion.⁶¹ Similarly, the National

Institute for Health and Care Excellence (NICE) highlight that clean, non-sterile gloves are sufficient for manipulating catheters, but do not state whether non-sterile gloves are also adequate for catheter insertion.⁹ The American Association of Nurse Anaesthesiology (AANA) advise that non-sterile gloves are adequate for catheter port access and de-access.⁴³

The Centres for Disease Control and Prevention (CDC) recognise this lack of consensus in the evidence-base and recommend that HCWs follow manufacturer instructions on catheter care and maintenance for this reason.²⁴ Given the lack of consensus in this area, it is not possible to provide recommendations on sterile versus non-sterile glove use for catheter insertion and/or management.

Literature reviews on CVC and PVCs are currently under development by ARHAI Scotland. These will include further information and recommendations regarding the PPE requirements for PVC and CVC catheter insertion and management.

There is also a lack of consensus in the expert opinion guidance regarding use of sterile or non-sterile gloves during wound care. Two pieces of guidance indicate sterile gloves for wound care.^{33,54} However, the Association for Professionals in Infection Control and Epidemiology (APIC) and Wound Ostomy Continence Nurses Society (WOCN) state that sterile gloves are only necessary during acute wound care for acute bedside debridement, a procedure involving the removal of dead, damaged or infected tissue.⁵⁴ Where acute bedside debridement is not required, APIC and WOCN state that non-sterile gloves are sufficient for wound care.⁵⁴ This recommendation was also supported by a UK nurse consultant in wound care, who indicated that non-sterile gloves are sufficient for wound care.⁴⁸

Finally, there is also some evidence from primary studies that the use of sterile gloves offers no additional benefits to the use of non-sterile gloves for minor skin surgery, e.g. wound suturing and local skin excisions.⁴⁵⁻⁴⁷ A prospective observational study found that use of non-sterile gloves was an independent factor for surgical site infection following skin excision with reconstruction procedures, however, this association did not remain for simple excision surgeries.⁴⁷ A randomised-controlled trial also found that use of sterile versus non-sterile gloves had no impact on wound infection following laceration repair.⁴⁶

When should non-sterile examination gloves be worn and are they specified for specific procedures?

One randomised controlled trial⁴⁶ and 17 pieces of expert opinion guidelines were identified in relation to this research question.⁴⁶ Five of the guidance documents were published in the UK,^{13, 15, 48, 49, 62} three were published in the USA,^{24, 43, 54} four were published by the WHO,^{35, 36, 38, 39} and the remainder were published in ROI, Australia, New Zealand, and India, respectively.^{33, 41, 42, 60}

There is consensus in the literature that non-sterile examination gloves can be worn when applying SIPCs, i.e. where there is potential contact with blood and bodily fluids that may occur during direct or indirect patient contact, and when performing non-sterile procedures.^{13, 15, 35, 36, 38, 40, 42, 43, 48, 49, 60}

The available literature provides a number of examples regarding specific procedures where contact to blood and/or bodily fluids may occur and when non-sterile examination gloves should therefore be worn; these include: emptying kidney dishes,^{15, 39, 42} pelvic and vaginal examinations,^{15, 33, 36, 39} venepuncture or venous access injections,^{42 15, 33, 36, 38} cleaning medical equipment,^{15, 39, 40} cleaning spills,^{15, 39} emptying urine catheter bags,³³ naso-gastric aspiration and dental examinations.³³ This list of procedures, however, is not exhaustive and is based on expert opinion.

As already discussed, there is a lack of consensus in the extant literature regarding the use of sterile or non-sterile gloves for catheter insertion and management, wound care and minor surgical procedures.

What type of gloves should be worn based on material type e.g. latex, nitrile, neoprene?

Two primary studies and 18 pieces of guidance were identified in relation to this research question.^{63, 64} Eleven of the guidance documents were published in the UK,^{6, 8-10, 13-15, 17, 19, 48, 49} one was published in ROI,⁴⁰ three were published in the USA,^{29, 30, 43, 53}, two were published in Australia,^{33, 65} one was published by the European Centre for Disease Prevention and Control (ECDC),⁶⁶ and two were published by the WHO.^{35, 38} There is broad agreement across the literature concerning the appropriateness and suitability of specific materials in relation to exposure to specific hazard, and therefore their suitability for use in the clinical setting. In total seven different glove materials were identified by this review:

- Latex or NRL (natural rubber latex).
- Vinyl or polyvinyl chloride platisols.
- Polythene.
- De-proteinised natural rubber latex (DPNRL) with the majority of latex proteins removed.
- Nitrile, i.e. nitrile butadiene rubber (NBR) or acrylonitrile-butadiene
- Polyvinyl chloride (PVC).
- Neoprene or chloroprene or polychloroprene.

Irrespective of their material, all gloves must meet appropriate European and British Standards, as outlined in [Appendix 1](#). If gloves are necessary, a risk assessment should be performed to assess the gloves are suitable for the wearer and the environment in which they are used. As previously discussed, the gloves chosen must offer adequate protection against the substances being handled, be suitable for the wearer in terms of comfort and fit, and be appropriate for the task in terms of the requirement for, for example, dexterity and sterility.^{6, 8, 9, 14, 15, 23, 30, 43}

There is consensus in the literature that latex (including DPNRL) gloves should be worn when it is anticipated that there will be contact with blood or body fluids because gloves manufactured from latex provide the best fit, dexterity and afford the greatest comfort as well as good barrier protection.^{33, 48 35, 38} However, this is not mandated by the HSE. If latex gloves are used in the health and care setting, they must be low-protein and powder free, as advised by the HSE and RCN.^{8, 14} Alternatives must also be available to those with sensitivity to natural rubber latex.^{6, 8-10, 23, 30, 44, 49} The WHO advise that all gloves should be powder free to prevent reaction with alcohol-based hand rub.^{38, 48}

Where latex cannot be worn it is recommended that either nitrile or neoprene gloves are a suitable alternative as they are comparable to latex gloves in terms of barrier performance to natural rubber latex.^{14, 30, 40} Additionally, neoprene gloves in particular have been proposed as a suitable alternative when dexterity is important, when the gloves are to be worn for an extended period of time, or if there is a risk of glove perforation.^{17, 40} However, one primary study found that latex gloves had lower odds of perforation compared to neoprene or nitrile gloves.⁶³ On the other hand, another primary study found that there was no significant difference in perforations in latex or nitrile gloves after adjusting for procedure type, staff role and mean time of glove usage.⁶⁴ The findings from this study are limited in terms of generalisability and NICE highlight that any glove used in the health and care setting offers adequate protection given that they

must all meet the same standards regarding the resistance to punctures or holes, irrespective of their material.⁹

Vinyl gloves have also been proposed as an alternative to latex gloves.^{17, 40} However, it has been highlighted in expert opinion guidance that vinyl gloves offer less barrier protection than latex and nitrile gloves thus recommend against their use, particularly when contact with blood or body fluids, or cytotoxic drugs and other harmful substances is anticipated.^{13, 14, 19, 26, 33, 40, 65} Primary evidence on inferior barrier protection of vinyl gloves compared to latex gloves was not identified in the available evidence base.

It is also recommended, in the literature, that polythene gloves are unsuitable for clinical care and should not be used for clinical purposes as they do not provide sufficient protecting against pathogens and do not meet British Standards.^{9, 14, 40}

There was a lack of evidence on gloves composed of other materials in the context of IPC in health and care settings. The Australian Government and CDC guidelines for infection control in dental settings recommended the use of utility gloves for manually cleaning reusable medical devices and for non-patient care activities, such as environmental cleaning and cleaning of care equipment.^{29, 33} The WHO support this recommendation in their guidance for IPC of epidemic- and pandemic-prone respiratory infections in health settings, stating that rubber gloves are recommended for heavy-duty tasks such as environmental cleaning.³⁵ Lastly, autopsy gloves, which are composed of 'cut-through synthetic mesh', were only mentioned in one piece of guidance, published by the WHO (2014).³⁵ In these guidelines, the WHO state that autopsy gloves, or two pairs of non-sterile gloves, should be worn during autopsies. However, the WHO did not clarify the rationale behind this recommendation.

Overall, no one glove material provides protection against all hazards which may be encountered in the care setting, where any doubt exists as to the barrier efficiency of a particular glove type, the manufacturer should be contacted for further information.

When should double gloving be adopted?

Twelve pieces of primary research were identified in relation to this research question.⁶⁷⁻⁷⁸

Fifteen documents were identified; four were published in the UK,^{9, 13, 15, 79} 13 were published in the USA,^{26, 29, 30, 35, 43, 53, 55, 73, 74, 80-84} one was published in Australia,³³ and one was published by the WHO.³⁵

The literature identified in relation to the practice of double gloving consistently recommends the practice of double gloving during surgical procedures as a means of increasing the barrier protection offered by a single pair of gloves.^{73, 74, 80} This is because perforations can often go unnoticed by the wearer.^{63, 67, 69, 70, 74, 75, 85} In the majority of primary studies that were assessed, surgeons' gloves are of greatest risk of perforation.^{67, 70, 71, 76, 77} Nevertheless, routine practice of double gloving has also been recommended for all of the surgical team,^{53 80, 81} as there is evidence to suggest that the gloves of surgical assistants and scrub nurses are also at risk of perforation.^{67, 68} The evidence suggests that there is an association between factors including duration of surgery,^{67, 70 63, 72, 76-78} the type of surgical procedure, whether the procedure is elective or emergency,⁷⁸ and the incidence of glove perforations. Perforations are more likely to occur in emergency surgery,⁷⁸ procedures which take a long time,^{63, 67, 70, 72, 77} open surgeries versus closed procedures,⁶⁷ and orthopaedic procedures when compared to soft tissue procedures.⁷² A small number of observational studies statistically assessed the site of glove perforations.^{68, 71, 72} However, there is lack of consensus in this area as the literature has identified both the non-dominant and dominant hand as being the site most frequently perforated.

The RCN, NICE and expert opinion from a surgeon based in the USA recommend that double gloving should be adopted in surgical settings when staff consider there to be a high risk of perforation, for example abdominal and orthopaedic surgeries, and negative consequences from any contamination as a result.^{9, 15, 84}

Exposure Prone Procedures (EPPs) are outlined in more detail in [Management of Occupational Exposures to Blood Borne Viruses](#).

A number of guidance documents have indicated double gloving for specific procedures. The AANA and the Society for Healthcare Epidemiology for America (SHEA) have both developed guidance on IPC in the context of anaesthesia care and recommend double gloving during airway manipulation.^{43, 55} The AANA also recommend that healthcare providers adopt double gloving when there is increased risk of complications from needle stick injuries, referencing risk of HIV or Hepatitis C contamination.⁴³ As previously mentioned, in their guidance on IPC measures for epidemic- and pandemic-prone acute respiratory guidance, the WHO recommend double gloving or the use of autopsy gloves when performing autopsies.³⁵ One piece of expert opinion guidance written in conjunction with the Society for Cardiovascular Angiography and Interventions states that double gloving should be considered in cardiac catheterisation laboratories if an operator has skin abrasions.⁵¹ However, this recommendation has limited generalisability to other clinical settings and was not included in other IPC guidance.

The use of an indicator glove when double gloving, a system where the inner glove is brightly coloured, has also been proposed for EPPs to facilitate the easy identification of perforations.⁷⁹

Two studies assessed the use of an indicator glove when double gloving.^{73, 74} One study found the use of an indicator glove when double gloving led to a higher frequency of glove changes, when compared to double gloving without an indicator glove ($p < 0.001$).⁷³ Although this demonstrates that the indicator glove system is effective in aiding staff to detect glove perforations and subsequently change their gloves, it is unclear whether both inner and outer gloves were changed; if only the outer gloves were changed, they may have become contaminated by the inner gloves when donning a new pair.

Only three pieces of expert opinion guidance provided information on the practice of double gloving in non-surgical settings.^{13, 15, 26} There is consensus in this literature that double gloving is not necessary during routine non-surgical clinical care.^{13, 15, 26}

Despite the high volume of the evidence relating to the practice of double gloving, there is a lack of evidence on how double gloves should be worn, specifically whether a different sized glove should be worn over or under another glove. Additionally, it is important to highlight that there is insufficient evidence that double gloving reduces the incidence of nosocomial infection, or that glove perforations increase the incidence of nosocomial infection.^{29, 33, 70, 79}

When should gloves be changed or removed?

This review identified a substantial volume of literature in relation to this research question. Eight pieces of primary evidence were identified,^{63, 67, 70, 72, 76-78, 85} in addition to 30 expert opinion guidance documents. Eleven pieces of guidance were published in the USA,^{23, 24, 27, 43, 53, 82, 83, 86-88} 31 nine were published in the UK,^{9-11, 14, 16-18, 49, 79} three were published by the WHO,³⁵⁻³⁸ and two were published by the ECDC.^{44, 89} The remainder were published in the ROI,⁴⁰ New Zealand,⁴² India,⁶⁰ and Australia.^{33, 90, 91}

Irrespective of setting, glove type, clinical specialty, or procedure, the literature is consistent regarding when gloves should be changed or removed. Specifically, there is consensus which can be summarised as follows:

- Gloves are a single-use item and should be changed after each use or upon completion of a task.^{10, 14, 16-18, 23, 33, 36, 38, 40, 43, 49, 60, 82}

- Gloves should be changed immediately if heavily contaminated by blood or bodily fluids.⁹, 42, 82, 88
- Gloves should be changed after patient contact and must be changed between patients. 9-13, 16-18, 23, 24, 27, 29, 31, 33-36, 38-40, 43, 44, 86, 89, 91
- Gloves may need to be changed after the completion of a single aspect of patient care/treatment on the same patient – for example, gloves may be required for insertion of an invasive device, once the device has been inserted it may be necessary to change gloves before providing additional care.⁹, 10, 12, 23, 27, 30, 33-36, 38-40, 43, 60, 88, 91
- Gloves must be changed if they are damaged and if a perforation is suspected;¹², 13, 29, 36, 39, 42, 51, 60, 82
- Gloves must be changed after contact with cleaning chemicals which may compromise the barrier integrity of the glove.⁵³, 82
- Gloves must be changed when there is an indication for hand hygiene.³⁶, 39, 82

In surgical settings where sterile gloves are indicated, there was overall consensus that gloves should be changed if contamination is suspected.⁴³, 53, 82, 87

Given the overlap in the evidence base, the risk of glove perforations has been discussed separately in the discussion section of this review under *'When should double gloving be adopted?'*. As discussed, there are many factors that may be associated with increased incidence of glove perforations. Given that perforations are associated with increased duration of surgeries, it has been recommended that gloves should be changed periodically to manage this risk, such as every 90 – 150 minutes.⁸² The Association of periOperative Registered Nurses (AORN) also recommend that gloves should be changed after touching optic eye pieces on the operative microscope, after touching a fluoroscopy machine and after touching a surgical helmet system hood or visor, however these recommendations are only applicable to surgical settings.⁵³, 82 However, citing a lack of evidence that glove perforations increase the incidence of wound infections, the Hospital Infection Society Working Party on Infection Control in Operating Theatres state that changing gloves following a needle puncture is not necessary.⁷⁹ It is important to note that the lack of evidence in this area is likely because it is accepted common practice that gloves are changed as soon as a perforation is noticed.

How should gloves be donned?

Two pieces of primary research and 35 pieces of expert opinion guidance were identified in relation to this research question.^{92, 93} Twelve expert opinion guidance documents were published in the UK,^{11, 12, 16, 62, 94 17, 18, 95 15, 94, 96} thirteen were published in the USA,^{21, 24, 27-30, 51, 53, 74, 82, 87, 97, 98} three were published in Australia,^{32, 33, 91} two were published by the ECDC,^{66, 89} five were published by the WHO,^{35, 36, 38, 39} one was published in New Zealand,⁴² and one was published in India.⁶⁰

A large proportion of the guidelines provide instruction on how to don sterile gloves in particular and are consistent in their recommendations regarding the procedure for donning them in order to maintain sterility.^{27, 28, 36, 39, 53, 60, 74, 82, 87, 92, 93} The procedure can be summarised as follows:

- Perform hand hygiene, or surgical hand preparation prior to surgical procedures, before applying gloves, ensuring hands are completely dry.^{11, 15, 17, 27-29, 33, 36, 38, 40, 51, 89, 94}
- Check the integrity of the sterile gloves package.³⁹
- The first, non-sterile, package should be opened by an assistant ensuring that the exterior of the second sterile wrapping is not touched.³⁹
- The second sterile package should be placed on a clean, dry surface; touching this package should be avoided to maintain sterility.^{39, 53}
- The glove should be picked up by the inside edge of the cuff using the thumb and index finger of one hand.³⁹
- The fingers of the first hand should be carefully inserted into the glove, which should be pulled to the wrist, taking care to avoid touching any surfaces to maintain sterility. The cuff should not be un-folded at this stage.³⁹
- Using the gloved hand, insert the fingers underneath the outside folded edge of the glove for the second hand.³⁹
- The fingers of the first hand should be carefully inserted and the glove pulled to the wrist, taking care to maintain sterility.³⁹
- Gloves should then be adjusted to ensure a comfortable and correct fit – taking care to maintain sterility. The glove cuffs may be unfolded at this stage by slipping the fingers of the other hand inside the fold.³⁹

- An assessment should be made as to whether sterility was maintained during the donning process.³⁹
- In addition to the above procedure for donning sterile gloves, two expert opinion pieces discussed closed and open-assisted staff-assisted gloving techniques for donning surgical gloves.^{53, 87} These techniques differ according to the positioning of surgical gowns whilst gloves are donned. In the closed technique, the hand that is inside the gown cuff of the ungloved staff member is fingertip level, where an already gowned and gloved assistant then opens each sterile glove one at a time at the cuff level to pull them over the hand of the staff member donning the gloves.^{53, 87} Conversely, the open-assisted gloving method may be used when the cuff of the gown is already at wrist level; using this technique, the glove is again pulled over the cuff of the gown by an assistant.^{53, 87} The closed assisted gloving technique is preferred and recommended when a new sterile gown has been donned and the AORN recommend the closed-gloving technique if an assistant is not available to help.^{53, 87} Use of the closed-assisted method is supported by Jones et al. (2010) who compared these methods in simulation exercises using UV powder as a proxy for bacterial contamination.⁹³ They found that the open-gloving method resulted in greater contamination when compared to the closed gloving method.⁹³

One primary study assessing whether double gloving improves barrier efficiency between surgeons and patients during orthopaedic and trauma surgery provided information on the method for donning double gloves in surgical settings.⁷⁴ The authors of this study recommended that the first pair of gloves should be positioned under the surgical gown and the second pair should be positioned over the cuff of the surgical gown and secured using tape.⁷⁴ However, using tape to secure gloves is not discussed in the remainder of the evidence-base and there is consensus amongst Scottish expert opinion that this practice is not recommended as it makes changing gloves and doffing PPE challenging.

The WHO were the only professional body to provide detailed procedures on donning non-sterile gloves.^{36, 39} Similar to donning sterile gloves, they recommend removing one glove from its original packaging at a time and minimising contamination of the gloves by touching only a restricted surface of the glove at the wrist.^{36, 39} The WHO also recommend to avoid touching the skin of the forearm of the hand already gloved to minimise contamination.^{36, 39}

Although the remainder of the evidence does not provide specific instructions on donning non-sterile gloves, there is agreement that hand hygiene should be performed before donning any gloves in the clinical setting,^{11, 18, 28, 29, 33, 36, 38, 40, 66, 94, 96} and that hands should be dry prior to donning gloves.^{15, 38, 40} There is also consensus that if other items of PPE are worn, gloves

should be donned last.^{12, 21, 24, 30, 32, 35, 42, 62, 91, 96, 98} Where applicable, gloves should be extended to cover the cuffs of gowns.^{33, 35, 42, 62, 82, 97-99} Two pieces of expert opinion guidance also stated that broken skin should be covered using waterproof dressings before donning gloves.^{15, 40} UKHSA recommend that hand and wrist jewellery should be removed, and guidelines for IPC in dental settings published by the CDC state that jewellery should be removed if they make donning gloves difficult or compromise the integrity of the glove.^{16, 29, 95} For further information on recommendations on wearing of jewellery in relation to hand hygiene, refer to literature review on [hand washing, hand rubbing and indications for hand hygiene](#) by ARHAI Scotland.

Any specific recommendations regarding the methods for hand hygiene, i.e. soap and water versus ABHR, and surgical hand antisepsis in the clinical setting prior to donning sterile gloves, are considered outside the scope of this literature review. Relevant recommendations regarding hand hygiene and donning gloves are made in the following reviews published by ARHAI Scotland: [Standard Infection Control Precautions Literature Review: Hand Hygiene: Hand washing, hand rubbing and indications for hand hygiene](#) and [Standard Infection Control Precautions Literature Review: Hand Hygiene: Surgical hand antisepsis in the clinical setting](#).

How should gloves be doffed?

Thirty-five guidance documents were identified in relation to this research question and no primary studies. Two of the guidelines were graded 'Agree: Recommend',^{9, 10} one was mandatory,¹⁰⁰ and the remainder were considered expert opinion. Seventeen documents were published in the UK,^{9-12, 15, 16, 18, 19, 62, 94-96, 100} 12 were published in the USA,^{20, 21, 24, 27, 28, 30, 43, 49, 55, 87, 97, 98} four were published in Australia,^{32, 33, 65, 91} one was published in New Zealand,⁴² one was published in India,⁶⁰ and one was published in ROI.⁴⁰ Finally, two were published by the ECDC,^{66, 89} and 6 were published by the WHO.^{34-36, 38, 39}

Based on the available evidence, the procedure for doffing gloves can be summarised as follows:

- Using the gloved hand, grip and lift the outside edge of the first glove cuff using the other hand – taking care not to touch the skin of the wrist or the hand.^{24, 33, 36, 39, 43, 65, 66, 91, 95-97, 100}
- Peel off the first glove off whilst turning it inside out. ^{30, 39, 43, 66, 95-98}
- Hold the removed glove in the gloved hand.^{30, 36, 39, 43, 95, 97, 98}

- Insert the first two fingers of the ungloved hand inside the cuff of the gloved hand.^{33, 36, 39, 95-97}
- Peel off the second glove off over the first glove and so that it covers the-glove that was doffed first.^{30, 33, 35, 36, 39, 43, 95, 96, 98}
- Dispose of the gloves in the appropriate waste stream.^{17, 33, 36, 39, 49, 66, 96-98, 100}
- Perform hand hygiene.^{9-12, 15, 17, 18, 20, 21, 24, 27, 28, 33-36, 38-40, 42, 49, 55, 60, 62, 65, 66, 89, 91, 94, 95, 98}

Four pieces of expert opinion guidance mentioned the order in which PPE should be removed. There was agreement that gloves should be removed first to minimise self-contamination.^{10, 16, 32, 62, 91, 95} Only one piece of guidance state how double gloves should be doffed; the AANA state that if double gloves are worn, the outer gloves should be doffed first before following the procedure for sterile glove removal.⁴³

The location of where gloves should be doffed was only discussed by four pieces of guidance. There is consensus that gloves should be doffed near the doorway of a care area, i.e. the area where the clinical task was performed, prior to exiting this area.^{33, 91, 97, 98} Although not explicitly mentioned, hand hygiene must be performed prior to exiting the area. The lack of information regarding where gloves should be doffed is likely because there is greater emphasis in extant evidence on doffing gloves and donning a new pair between patient care activities, or after caring for an individual patient.

As mentioned when discussing how gloves should be donned, any specific recommendations regarding the methods for hand hygiene are outside the scope of this literature review. Relevant recommendations regarding hand hygiene are discussed in the following reviews published by ARHAI Scotland: [Standard Infection Control Precautions Literature Review: Hand Hygiene: Hand washing, hand rubbing and indications for hand hygiene](#) and [Standard Infection Control Precautions Literature Review: Hand Hygiene: Surgical hand antisepsis in the clinical setting](#).

How should gloves be disposed of?

Twelve guidance documents were identified in relation to this research question. Seven were published in the UK,^{9, 10, 14, 17, 18, 49, 100} and the remainder were published in the USA, ROI, Australia, New Zealand and by the WHO, respectively.^{33, 38, 40, 42, 97}

There is consensus in the evidence that gloves should be disposed immediately after completion of a task using the appropriate waste stream in adherence with local policies and legislation.^{9, 10, 14, 17, 18, 33, 38, 40, 42, 49, 97, 100}

How should gloves be stored?

Five pieces of expert opinion guidance were identified in relation to this research question; one was published in the ROI,⁴⁰ and the remainder were published in the UK.^{11, 15, 18, 40} Gloves should be stored to allow ease of access for health and care staff.^{11, 15, 18} They should be stored in their original packaging and on a clean dry surface or wall-mounted.⁴⁰ Manufacturer instructions regarding storage should also be followed.¹⁵ As mentioned previously, the PPE at Work Regulations 2022 (as amended) states that employers must provide appropriate accommodation for PPE.³

What are the healthcare-associated infection risks of reusing gloves?

There was no primary evidence identified in relation to the HAI risk of glove reuse. Seven pieces of expert opinion guidance documents were identified; three of the expert opinion documents were published in the USA,^{24, 29, 30} one was published in Australia,³³ one was published in the UK,¹⁸ and the remaining two documents were published by the WHO.^{38, 39}

There is consensus that gloves should not be reused in the evidence identified.^{30, 23, 28, 36, 37, 24} Specifically, the WHO consulted experts who recommended that the re-use of gloves must be strongly discouraged due to a lack of standardised and validated methods for glove reprocessing.³⁹ The CDC and UKHSA support this statement, stating that glove reuse contributes to cross contamination and subsequent cross-infection.^{18, 30} The Australian Government recommended that utility gloves worn for environmental cleaning or cleaning of medical equipment may be decontaminated for reuse following manufacturer instructions, as long as the integrity of the glove has not been compromised. However, this recommendation is not applicable to gloves composed of other materials, as they are considered single use items.³³

What are the healthcare-associated infection risks of using alcohol-based hand rub on gloves, rather than changing gloves?

There was no primary evidence identified that assessed ABHR glove disinfection in real-life clinical settings. Six guidance documents were identified, including three published in the UK,^{10, 17, 18} one published in the USA,⁵⁵ one published in Australia,³³ one published by the WHO,³⁹ and one published by the ECDC.⁶⁵

There is overall consensus in the evidence base that the use of alcohol-based hand rub on gloves, rather than changing gloves, should be discouraged.^{17, 33, 39} The WHO provides clear recommendations that *gloves “should not be washed, decontaminated, or reprocessed for any reuse purpose”*; the concern being that decontamination practices may damage the material integrity of gloves and impair their protective function.⁶⁵

Additionally, SHEA have also highlighted that there is a lack of research in this area.⁵⁵ Although they state that changing gloves with hand hygiene between doffing and donning gloves is preferred, they also state that there is insufficient data to make a recommendation regarding the use of ABHR on gloves, or to assess whether ABHR may negatively impact glove integrity.⁵⁵ SHEA also state that the use of ABHR on gloves may be beneficial when changing gloves is not feasible.⁵⁵ However, given that there is consensus in the remainder of the guidelines against the use of ABHR on gloves, there is a lack of evidence to support such a recommendation.

3.2 Implications for research

There is an extensive body of literature which examines glove use. Much of this literature is in the form of expert opinion and consequently, when assessed, yields a low level of evidence and graded recommendation. Although there is a lack of rigorous primary research, overall, there is consensus of expert opinion.

The evidence described below has not been used to inform recommendations, but instead highlight areas for future research.

A large body of evidence assessed the transfer of organisms from patients to the gloves of HCWs.¹⁰¹⁻¹¹⁶ Although these studies highlight a potential source of HAI in health and care settings, given their limitations, including their observational study design and lack of controls, these studies fail to confirm that transfer of pathogens occurs between staff and/or patients. To improve the rigour of this area of research, these studies would benefit from employing methods

such as whole genome sequencing to assess the direction of transmission and consequently, the risk of cross contamination from gloves.

A number of novel technologies have been proposed where gloves have been impregnated with antimicrobial agents to mitigate risk of cross transmission of pathogens.¹¹⁷⁻¹²⁴ Although this is a promising area of research, these studies did not inform formal recommendations as there was lack of consistency in how the gloves were treated and the methods used to assess their efficacy. Moreover, they were largely experimental in nature, thus their findings were not applicable to real-life settings. Future research should adopt prospective study designs, comparing traditional gloves to impregnated gloves to assess whether their use results in a decrease in the incidence of HAIs in clinical settings.

Of note, this literature review failed to identify rigorous evidence regarding a variety of glove types that may be used in health and care settings, for example, gauntlet gloves, or surgical gloves that composed of novel materials that offer increased protection for orthopaedic procedures. Future research should look to assess the variety of glove types available in health and care settings, as well as the efficacy gloves composed of novel materials compared to traditional gloves compared of traditional materials.

Two studies proposed alternative designs for glove storage and dispensing in order to reduce hand and glove contamination when donning gloves.^{125, 126} Again, these studies were largely experimental in design and lacked generalisability. Further research in real-life clinical settings would determine whether these systems are feasible to use in health and care settings and result in reduced contamination.

Finally, there may be a need to clarify or expand legislation relating to the use of appropriate PPE. At present much of the legislation relates to the handling and management of dangerous substances and/or chemicals with no specific regulation for pathogens in a non-laboratory clinical environment.

4. Recommendations

This review makes the following recommendations based on an assessment of the extant scientific literature on gloves as PPE in the health and care setting.

Are there any legislative requirements for the use of gloves as PPE for infection control purposes?

The Health and Safety at Work etc. Act (1974) Control of Substances Hazardous to Health 2002 Regulations (as amended) and Personal Protective Equipment at Work Regulations 2022 (as amended) legislate that employers (i.e. NHSScotland) must provide PPE which affords adequate protection against the risks associated with the task being undertaken. Employees (i.e. health and care workers) have a responsibility to comply by ensuring that suitable PPE is worn correctly for the task being carried out.

(Mandatory)

The employee is responsible for selecting appropriate gloves for the tasks being undertaken, taking into account the substances being handled, type and duration of contact, size and comfort of the gloves, and the task and requirement for glove robustness and sensitivity.

(Mandatory)

The employee is responsible for donning and doffing gloves correctly to avoid cross-contamination, and for disposing of gloves safely.

(Mandatory)

PPE must fit the wearer and if being worn with other items of PPE, the employer must ensure that these are compatible with each other and do not reduce the level of protection provided if worn together.

(Mandatory)

Glove material and durability should be appropriate to the task, and gloves should fit correctly.

(Mandatory)

The use of latex gloves must be based on a risk assessment which has deemed their use necessary, and that in such instances, disposable latex gloves must be low-protein and powder-free.

(Mandatory)

Latex-free glove alternatives must be available for staff and patients with sensitivity to latex.

(Mandatory)

PPE must be UKCA marked. PPE that is CE marked may still be used until 1st January 2023.

(Mandatory)

Specific standards relating to the quality and performance of gloves are outlined in Appendix 1.

(Mandatory)

When/where should gloves be worn?

The use of gloves should be based on an assessment of the risk of contact with blood, body fluids (including but not limited to secretions and/or excretions), non-intact skin, mucous membranes, lesions and/or vesicles, hazardous drugs and chemicals, e.g. cleaning agents: Where such a risk exists, gloves should be worn to protect the healthcare worker and/or the patient.

(Grade C recommendation)

Gloves should not be worn as a substitute to hand hygiene.

(Grade C recommendation)

Unless recommended by vaccine manufacturers, it is not usually necessary to wear gloves for administering immunisations unless:

- It is anticipated that there may be exposure to blood or body fluids;
- The healthcare worker has non-intact skin on their hands; or
- The person receiving the immunisation has non-intact skin.

(Grade C recommendation)

Gloves should be worn during environmental cleaning and cleaning of used medical equipment.

(Grade C recommendation)

Refer to the literature reviews on [‘Management of patient care equipment’](#) and [‘Safe management of the care environment’](#) for specific PPE recommendations for cleaning of patient care equipment and the environment.

When should sterile gloves be worn and are they specified for specific procedures?

Sterile gloves should be worn:

- for surgical procedures;
- for invasive procedures, e.g. central neuroaxial blocks;
- as part of an aseptic technique; and
- for the insertion of invasive devices.

Holding statement: There was a lack of consensus regarding the use of sterile versus non sterile gloves during CVC and PVC insertion and/or management. Work is currently underway by ARHAI Scotland to examine the available evidence on this topic. This literature review will therefore be updated to incorporate necessary recommendations when they are available.

When should non-sterile examination gloves be worn?

Non-sterile gloves should be worn for:

- non-sterile procedures, e.g. patient examination; and
- communal care equipment and environmental cleaning.

(Grade C recommendation)

When indicated, non-sterile gloves should be used for administering immunisations.

(Grade C recommendation)

What type of gloves should be worn based on material type e.g. latex, nitrile, neoprene?

Latex (including DPNRL) gloves should be worn when it is anticipated that there will be contact with blood or body fluids as they provide the best fit, dexterity and provide the greatest comfort as well as good barrier protection.

(Grade C recommendation)

Where latex cannot be worn either nitrile or neoprene gloves are a suitable alternative.

(Grade C recommendation)

Vinyl gloves should not be worn when it is anticipated there will be contact with blood or body fluids, cytotoxic drugs, or other harmful substances.

(Grade C recommendation)

Polythene gloves are unsuitable for clinical care and should not be used for clinical purposes.

(Grade C recommendation)

When should double gloving be adopted?

It is recommended that double gloving, with one pair representing an indicator glove, should be considered for Exposure Prone Procedures (EPPs) in the operating theatre setting, for example orthopaedic or gynaecological surgical procedures, and if appropriate, be adopted by all members of the scrub team.

(Grade C recommendation)

When should gloves be changed or removed?

Gloves are a single-use item and should be changed immediately after each use or upon completion of a task.

(Grade C recommendation)

Gloves should be changed after patient contact and therefore must be changed between patients.

(Grade C recommendation)

Gloves may need to be changed after the completion of a single aspect of patient care/treatment – even on the same patient – for example, gloves may be required to insert an invasive device, once the device has been inserted it may be necessary to change gloves before providing additional care.

(Grade C recommendation)

Gloves should be changed if a perforation or puncture is suspected or identified.

(Grade C recommendation)

How should gloves be donned?

The process for donning **sterile** gloves is summarised as follows:

Perform hand hygiene before applying sterile gloves, ensuring hands are completely dry.

The procedure for donning sterile gloves should be as follows:

- Check the integrity of the sterile gloves package.
- The first, non-sterile, package should be opened by an assistant ensuring that the exterior of the inner packaging of the sterile gloves is not touched.
- The second sterile package should be placed on a clean, dry surface; touching this package should be avoided to maintain sterility.
- The glove should be picked up by the inside edge of the cuff using the thumb and index finger of one hand.

- The fingers of the first hand should be carefully inserted into the glove, which should be pulled to the wrist, taking care to maintain sterility by avoiding touching any surfaces. The cuff should not be un-folded at this stage.
- Using the gloved hand, insert the fingers underneath the outside folded edge of the glove for the second hand.
- The fingers of the first hand should be carefully inserted and the glove pulled to the wrist, again taking care to maintain sterility by avoiding touching any surfaces.
- Gloves should then be adjusted to ensure a comfortable and correct fit – taking care to maintain sterility. The glove cuffs may be unfolded at this stage, using the fingers of the other hand inside the fold
- An assessment should be made as to whether the glove was contaminated during the donning process.

(Grade C recommendation)

Hand hygiene should also be performed prior to donning non-sterile gloves. Non-sterile gloves should be donned one at a time, taking care to minimise contamination by touching a restricted surface of the gloves at the wrist, and avoiding touching the skin of the hand already gloved.

(Grade C recommendation)

If worn with other items of PPE, gloves should be donned last.

(Grade C recommendation)

If worn with a gown, gloves should be extended to cover the cuff of the gown.

(Grade C recommendation)

The practice of donning gloves should follow the 'bare below the elbows' policy, including removal of jewellery due to risks associated with the integrity of the glove.

(Grade C recommendation)

Please refer to the ARHAI literature review titled ['Hand washing, hand rubbing and indications for hand hygiene'](#) for further information on the 'bare below the elbows' policy and wearing of jewellery in relation to hand hygiene.

How should gloves be doffed?

The procedure for removing all gloves (sterile or non-sterile) should be as follows:

- Using the gloved hand, grip and lift the outside edge of the first glove cuff using the other hand – taking care not to touch the skin of the wrist or the hand.
- Peel off the first glove off whilst turning it inside out.
- Hold the removed glove in the gloved hand.
- Insert the first two fingers of the ungloved hand inside the cuff of the gloved hand.
- Peel off the second glove off whilst turning it inside out and so that it covers the glove that was doffed first.
- Dispose of the gloves in the appropriate waste stream.
- Perform hand hygiene.

(Grade C recommendation)

If worn with other items of PPE, gloves should be removed first to minimise self-contamination.

(Grade C recommendation)

How should gloves be disposed of?

Gloves should be disposed of immediately after completion of a task using the appropriate waste stream in adherence with local policies and legislation

(Grade C recommendation)

How should gloves be stored?

Gloves should be stored in a location to allow ease of access for health and care staff.

(Grade C recommendation)

Gloves should be stored in a clean/dry area until required for use.

(Grade C recommendation)

What are the healthcare-associated infection risks of reusing gloves?

There is a lack of primary evidence on the healthcare-associated infection risks of reusing gloves. This practice is therefore not recommended.

(Grade C recommendation)

What are the healthcare-associated infection risks of using alcohol-based hand rub on gloves, rather than changing gloves?

There is a lack of evidence on the healthcare-associated infection risks of using alcohol-based hand rub on gloves rather than changing gloves. This practice is therefore not recommended.

(Grade C recommendation)

References

1. [UK Government. Health and Safety at Work etc. Act 1974](#), (1974).
2. UK Government. The Control of Substances Hazardous to Health (Amendment) Regulations 2002. 2002.
3. UK Government. The Personal Protective Equipment at Work (Amendment) Regulations 2022. 2022.
4. UK Government. Personal Protective Equipment (Enforcement) Regulations 2018. 2018.
5. British Standards Agency (BSI). [BSI PPE UKCA marking update for Personal Protective Equipment \(PPE\)](#). 2021; (Accessed 18th February 2022).
6. Health and Safety Executive (HSE). [Selecting Latex Gloves. 2021](#); (Accessed 8th February 2022).
7. Health and Safety Executive (HSE). [Managing Risks from Skin Exposure at Work. 2015](#); (Accessed 8th February 2022).
8. Health and Safety Executive (HSE). *Health and Safety in Care Homes*. 2nd Edition ed. London: The Crown, 2014.
9. National Institute for Health and Care Excellence (NICE). [Healthcare-associated infections: prevention and control in primary and community care. 2017](#); (Accessed 7th February 2022).
10. Loveday HP, Wilson JA, Pratt RJ, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect* 2014; 86 Suppl 1: S1-70. 2013/12/18. DOI: 10.1016/s0195-6701(13)60012-2.
11. Department of Health (DoH). [Health Building Note 00-09: Infection Control in the Built Environment. 2013](#); (Accessed 8th February 2022).
12. NHS England and NHS Improvement. [Standard infection control precautions: national hand hygiene and personal protective equipment policy 2019](#); (Accessed 7th February 2022).
13. UK Health Security Agency (UKHSA). [COVID-19: infection prevention and control \(IPC\). Guidance on infection prevention and control for seasonal respiratory infections including SARS-CoV-2. 2022](#); (Accessed 8th February 2022).

14. Royal College of Nursing (RCN). [Essential Practice for Infection Prevention and Control. 2017](#); (Accessed 8th February 2022).
15. Royal College of Nursing (RCN). [Tools of the Trade. Guidance for health care staff on glove use and the prevention of work-related dermatitis. 2021](#); (Accessed 8th February 2022).
16. UK Health Security Agency (UKHSA). [Guide to donning and doffing PPE: Droplet Precautions for Health and Social Care Settings. 2020](#); (Accessed 8th February 2022).
17. UK Health Security Agency (UKHSA). [Personal protective equipment: resource for care workers working in care homes during sustained COVID-19 transmission in England. 2021](#); (Accessed 9th February 2022).
18. UK Health Security Agency (UKHSA). [Infection prevention and control for seasonal respiratory infections in health and care settings \(including SARS-CoV-2\) for winter 2021 to 2022 - Appendix for UK ambulance services. 2021](#); (Accessed 10th February 2022).
19. UK Health Security Agency (UKHSA). [Personal protective equipment \(PPE\): resource for care workers delivering domiciliary care during sustained COVID-19 transmission in England. 2022](#); (Accessed 8th February 2022).
20. Anonymous. Infection control in physicians' offices. *Academy of Pediatrics. Pediatrics* 2000; 105: 1361-1369.
21. Rathore MH and Jackson MA. Infection prevention and control in pediatric ambulatory settings. *Pediatrics* 2017; 140 (5) (no pagination).
22. American Association of Nurse Anaesthesiology (AANA). [Infection Prevention and Control Guidelines for Anesthesia Care. 2015](#); (Accessed 7th February 2022).
23. American Academy of Ophthalmology (AAOO). [Infection Prevention in Eye Care Services and Operating Areas and Operating Rooms - 2012. 2012](#); (Accessed 7th Feb 2022).
24. Centres for Disease Control and Prevention (CDC). [Basic Infection Control and Prevention Plan for Outpatient Oncology Settings. 2011](#); (Accessed 7th Feb 2022).
25. Siegel JD, Rhinehart E, Jackson M, et al. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Health Care Settings. *American journal of infection control* 2007; 35: S65-S164. DOI: 10.1016/j.ajic.2007.10.007.

26. Centres for Disease Control and Prevention Healthcare Infection Control Practices Advisory Committee (HICPAC). [Guidelines for Environmental Infection Control in Health-Care Facilities. 2019](#); (Accessed 8th February 2022).
27. Boyce JM and Pittet D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR Recomm Rep* 2002; 25: 1-45.
28. Smith PW, Bennett G, Bradley S, et al. SHEA/APIC guideline: infection prevention and control in the long-term care facility, July 2008. *Infection control and hospital epidemiology* 2008; 29: 785-814. DOI: 10.1086/592416.
29. Kohn GW, Collins AS, Cleveland JL, et al. Guidelines for Infection Control In Dental Health-Care Settings. *Morbidity and Mortality Weekly Report* 2003; 52: 1-61.
30. Centres for Disease Control and Prevention (CDC). 2007 [Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. 2019](#); (Accessed 7th Feb 2022).
31. Kroger A, Bahta L and Hunter P. [General Best Practice Guidelines for Immunization. Best Practices Guidance of the Advisory Committee on Immunization Practices \(ACIP\).](#) (Accessed 15th March 2022).
32. Ferguson JK, Stuart RL, Cheng AC, et al. ASID (HICSIG) position statement: infection control guidelines for patients with influenza-like illnesses, including pandemic (H1N1) influenza 2009, in Australian health care facilities. *The Medical journal of Australia* 2009; 191: 454-458.
33. Australian Government. Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019). 2019; Available at: nhmrc.gov.au/about-us/publications/australian-guidelines-prevention-and-control-infection-healthcare-2019 (Accessed 8th February 2022).
34. World Health Organization (WHO). [Standard Precautions in Health Care: Aide-memoire. 2007](#); (Accessed 8th February 2022).
35. World Health Organization (WHO). [Infection prevention and control of epidemic-and pandemic prone acute respiratory infections in health care. 2014](#); (Accessed 8th February 2022).
36. World Health Organization (WHO). [Glove Use Information Leaflet. 2009](#); Available at: (Accessed 8th February 2022).

37. Hutin Y, Hauri A, Chiarello L, et al. Best infection control practices for intradermal, subcutaneous, and intramuscular needle injections. *Bull World Health Organ* 2003; 81: 491-500.
38. World Health Organization (WHO). [WHO best practices for injections and related procedures toolkit. 2010](#); (Accessed 8th February 2022).
39. World Health Organization (WHO). [WHO Guidelines on Hand Hygiene in Health Care: A Summary. 2009](#); (Accessed 8th February 2022).
40. Public Health Agency. [The Northern Ireland Regional Infection Prevention and Control Manual. \[Year Unknown\]](#); (Accessed 7th February 2022).
41. Anonymous. Infection control practices in healthcare settings. *Journal of the Indian Medical Association* 2009; 107: 533-537.
42. Brown L, Munro J and Rogers S. Use of personal protective equipment in nursing practice. *Nursing standard (Royal College of Nursing)* 2019; 34: 59-66.
43. American Association of Nurse Anaesthesiology (AANA). [Infection Prevention and Control Guidelines for Anaesthesia Care](#). (Accessed 7th Feb 2022) 2015.
44. European Centre for Disease Prevention and Control (ECDC). [Infection prevention and control and preparedness for COVID-19 in healthcare settings - sixth update. 2021](#); (Accessed 7th February 2022).
45. Brewer JD, Gonzalez AB, Baum CL, et al. Comparison of sterile vs nonsterile gloves in cutaneous surgery and common outpatient dental procedures a systematic review and meta-analysis. *JAMA Dermatology* 2016; 152: 1008-1014.
46. Perelman VS, Francis GJ, Rutledge T, et al. Sterile Versus Nonsterile Gloves for Repair of Uncomplicated Lacerations in the Emergency Department: A Randomized Controlled Trial. *Annals of Emergency Medicine* 2004; 43: 362-370.
47. Rogues AM, Lasheras A, Amici JM, et al. Infection control practices and infectious complications in dermatological surgery. *Journal of Hospital Infection* 2007; 65: 258-263.
48. Hampton S. The appropriate use of gloves to reduce allergies and infection. *British journal of nursing (Mark Allen Publishing)* 2002; 11: 1120-1124.
49. Association of Anaesthetists. [Guidelines: Infection Prevention and Control 2020. 2020](#); (Accessed 10th February 2022).

50. Benhamou B, Mercier FJ and Dounas M. Hospital policy for prevention of infection after neuraxial blocks in obstetrics. *International Journal of Obstetric Anesthesia* 2002; 11: 265-269.
51. Chambers CE, Eisenhauer MD, McNicol LB, et al. Infection control guidelines for the cardiac catheterization laboratory: Society guidelines revisited. *Catheterization and Cardiovascular Interventions* 2006; 67: 78-86.
52. Lo E, Nicolle LE, Coffin SE, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals: 2014 update. *Infection Control and Hospital Epidemiology* 2014; 35: 464-479.
53. Spruce L. Back to Basics: Sterile Technique. *AORN journal* 2017; 105: 478-487.
54. Association for Professionals in Infection Control and Epidemiology Inc. (APIC) and the Wound Ostomy Continence Nurses Society (WOCN). [Position Statement: Clean vs Sterile: Management of Chronic Wounds. 2001](#); (Accessed 7th Feb 2022).
55. Munoz-Price LS, Bowdle A, Johnston BL, et al. Infection prevention in the operating room anesthesia work area. *Infection Control & Hospital Epidemiology* 2019; 40: 1-17. 2018/12/11. DOI: 10.1017/ice.2018.303.
56. Centres for Disease Control and Prevention (CDC). [Guidelines for the Prevention of Intravascular Catheter-Related Infections. 2017](#); (Accessed 8th February 2022).
57. Chan D, Downing D, Keough CE, et al. Joint practice guideline for sterile technique during vascular and interventional radiology procedures: From the Society of Interventional Radiology, Association of Perioperative Registered Nurses, and Association for Radiologic and Imaging Nursing, for the Society of Interventional Radiology (Wael Saad, MD, Chair), Standards of Practice Committee. *Journal of Vascular and Interventional Radiology* 2012; 23: 1603-1612.
58. Mehta D, Chambers N, Adams B, et al. Comparison of the prevalence of surgical site infection with use of sterile versus nonsterile gloves for resection and reconstruction during mohs surgery. *Dermatologic Surgery* 2014; 40: 234-239.
59. Javeri Y, Jagathkar G, Dixit S, et al. [Indian society of critical care medicine position statement for central venous catheterization and management 2020](#). *Indian Journal of Critical Care Medicine* 2020; 24: 6-30.
60. Mehta Y, Gupta A, Todi S, et al. Guidelines for prevention of hospital acquired infections. *Indian Journal of Critical Care Medicine* 2014; 18: 149-163.

61. Loveday HP, Lynam S, Singleton J, et al. Clinical glove use: Healthcare workers' actions and perceptions. *Journal of Hospital Infection* 2014; 86: 110-116.
62. UK Health Security Agency (UKHSA). [Putting on \(Donning\) Personal Protective Equipment \(PPE\) for Aerosol Generating Procedures \(AGPs\). Airborne Precautions. 2020](#); (Accessed 8th February 2022).
63. Korniewicz DM, Garzon L and Plitcha S. Health Care Workers: Risk Factors for Nonlatex and Latex Gloves during Surgery. *American Industrial Hygiene Association Journal* 2003; 64: 851-855.
64. Murray CA, Burke FJ and McHugh S. An assessment of the incidence of punctures in latex and non-latex dental examination gloves in routine clinical practice. *British Dental Journal* 2001; 190: 377-380.
65. Australian Government. [Guidance on the use of personal protective equipment \(PPE\) for health care workers in the context of COVID-19. 2021](#); (Accessed 7th Feb 2022).
66. European Centre for Disease Prevention and Control (ECDC). [Guidance for wearing and removing personal protective equipment in healthcare settings for the care of patients with suspected or confirmed COVID-19. 2020](#); (Accessed 7th Feb 2022).
67. De Oliveira AC and Gama CS. Evaluation of surgical glove integrity during surgery in a Brazilian teaching hospital. *American Journal of Infection Control* 2014; 42: 1093-1096.
68. Demircay E, Unay K, Bilgili MG, et al. Glove perforation in hip and knee arthroplasty. *Journal of Orthopaedic Science* 2010; 15: 790-794.
69. Driever R, Beie M, Schmitz E, et al. Surgical glove perforation in cardiac surgery. *Thoracic and Cardiovascular Surgeon* 2001; 49: 328-330.
70. Eklund AM, Ojarvi J, Laitinen K, et al. Glove punctures and postoperative skin flora of hands in cardiac surgery. *Annals of Thoracic Surgery* 2002; 74: 149-153.
71. Ghadami A, Zarei M, Rad JZ, et al. Associated factors of surgical glove damages in orthopedic surgeries. *Asian Journal of Pharmaceutics* 2018; 12: S609-S614.
72. Thanni LO and Yinusa W. Incidence of glove failure during orthopedic operations and the protective effect of double gloves. *Journal of the National Medical Association* 2003; 95: 1184-1188.
73. Korniewicz D and El-Masri M. Exploring the Benefits of Double Gloving During Surgery. *AORN Journal* 2012; 95: 328-336.

74. Sadat-Ali M, Al-Habdan I, AlBluwi M, et al. Can double gloves improve surgeon-patient barrier efficiency? *International surgery* 2006; 91: 181-184.
75. Hubner NO, Goerdts AM, Mannerow A, et al. The durability of examination gloves used on intensive care units. *BMC Infectious Diseases* 2013; 13 (1) (no pagination).
76. Pai S, Shantharam Shetty M, Ajith Kumar M, et al. Glove perforation during orthopaedic surgery - A study. *Nitte University Journal of Health Science* 2011; 1: 7-9.
77. Sayin S, Yilmaz E and Baydur H. Rate of Glove Perforation in Open Abdominal Surgery and the Associated Risk Factors. *Surgical Infections* 2019; 20: 286-291.
78. Malhotra M, Sharma JB, Wadhwa L, et al. Prospective study of glove perforation in obstetrical and gynecological operations: Are we safe enough? *Journal of Obstetrics and Gynaecology Research* 2004; 30: 319-322.
79. Woodhead K, Taylor EW, Bannister G, et al. Behaviours and rituals in the operating theatre. A report from the Hospital Infection Society Working Party on Infection Control in Operating Theatres. *J Hosp Infect* 2002; 51: 241-255. 2002/08/17. DOI: 10.1053/jhin.2002.1220.
80. Ban KA, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. *Journal of the American College of Surgeons* 2017; 224: 59-74.
81. Anderson DJ, Podgorny K, Berríos-Torres SI, et al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. *Infection control and hospital epidemiology* 2014; 35: 605-627. DOI: 10.1086/676022.
82. Association of periOperative Registered Nurses (AORN). [Sterile Technique: Quick View. 2018](#); (Accessed 8th February 2022).
83. American College of Surgeons. [Revised Statement on Sharps Safety. 2016](#); (Accessed 8th February 2022).
84. Sugarbaker PH. Increased safety of surgical glove application: the under/over method. *Annals of the Royal College of Surgeons of England* 2018; 100: 339-340.
85. Tlili MA, Belgacem A, Sridi H, et al. Evaluation of surgical glove integrity and factors associated with glove defect. *American Journal of Infection Control* 2018; 46: 30-33.
86. Calfee DP, Salgado CD, Milstone AM, et al. Strategies to prevent methicillin-resistant staphylococcus aureus transmission and infection in acute care hospitals: 2014 update. *Infection Control and Hospital Epidemiology* 2014; 35: 772-796.

87. Kennedy L. Implementing AORN recommended practices for sterile technique. *AORN Journal* 2013; 98: 14-26.
88. Dubberke ER, Carling P, Carrico R, et al. Strategies to prevent clostridium difficile infections in acute care hospitals: 2014 update. *Infection Control and Hospital Epidemiology* 2014; 35: 628-645.
89. European Centre for Disease Prevention and Control (ECDC). [COVID-19 infection prevention and control measures for primary care, including general practitioner practices, dental clinics and pharmacy settings: first update. 2020](#); (Accessed 7th February 2022).
90. Stuart RL, Cheng AC, Marshall CL, et al. ASID (HICSIG) position statement: Infection control guidelines for patients with influenza-like illnesses, including pandemic (H1N1) influenza 2009, in Australian health care facilities. *Medical Journal of Australia* 2009; 191: 454-458.
91. Stuart RL, Marshall C, Harrington G, et al. ASID/ACIPC position statement - Infection control for patients with Clostridium difficile infection in healthcare facilities. *Infection, Disease and Health* 2019; 24: 32-43.
92. Byrd WA, Kavolus JJ, Penrose CT, et al. Donning Gloves Before Surgical Gown Eliminates Sleeve Contamination. *Journal of Arthroplasty* 2019; 34: 1184-1188.
93. Jones C, Brooker B and Genon M. Comparison of open and closed staff-assisted glove donning on the nature of surgical glove cuff contamination. *ANZ journal of surgery* 2010; 80: 174-177.
94. Abramowicz JS, Basseal JM, Brezinka C, et al. ISUOG Safety Committee Position Statement on use of personal protective equipment and hazard mitigation in relation to SARS-CoV-2 for practitioners undertaking obstetric and gynecological ultrasound. *Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology* 2020; 55: 886-891.
95. UK Health Security Agency (UKHSA). [Putting on Personal Protective Equipment \(PPE\): Standard Infection Control Precautions. 2020](#); (Accessed 8th February 2022).
96. Association of Ambulance Chief Executives. [Ambulance Sector Level 2 PPE - Donning & Doffing. 2021](#); (Accessed 10th February 2022).
97. Rushing J. Wearing personal protective gear. *Nursing* 2006; 36: 56-57.

98. Centres for Disease Control and Prevention (CDC). [Sequence for Putting On Personal Protective Equipment \(PPE\)](#). [Date Unknown]; (Accessed 7th Feb 2022).
99. European Centre for Disease Prevention and Control (ECDC). [Guidance for wearing and removing personal protective equipment in healthcare settings for the care of patients with suspected or confirmed COVID-19. 2020](#); (Accessed 7th February 2022).
100. Health and Safety Executive (HSE). [Correct removal of gloves: Single use gloves \(splash resistant\). 2005](#); (Accessed 9th February 2022).
101. Guerrero DM, Nerandzic MM, Jury LA, et al. Acquisition of spores on gloved hands after contact with the skin of patients with *Clostridium difficile* infection and with environmental surfaces in their rooms. *American Journal of Infection Control* 2012; 40: 556-558.
102. Hayden MK, Blom DW, Lyle EA, et al. Risk of hand or glove contamination after contact with patients colonized with vancomycin-resistant *Enterococcus* or the colonized patients' environment. *Infection Control and Hospital Epidemiology* 2008; 29: 149-154.
103. Ilmarinen T, Auvinen E, Hiltunen-Back E, et al. Transmission of human papillomavirus DNA from patient to surgical masks, gloves and oral mucosa of medical personnel during treatment of laryngeal papillomas and genital warts. *European Archives of Oto-Rhino-Laryngology* 2012; 269: 2367-2371.
104. Jackson SS, Thom KA, Magder LS, et al. Patient contact is the main risk factor for vancomycin-resistant *Enterococcus* contamination of healthcare workers' gloves and gowns in the intensive care unit. *Infection Control and Hospital Epidemiology* 2018; 39: 1063-1067.
105. Landelle C, Verachten M, Legrand P, et al. Contamination of healthcare workers' hands with *clostridium difficile* spores after caring for patients with *C. difficile* infection. *Infection Control and Hospital Epidemiology* 2014; 35: 10-15.
106. Landelle C, De Gea-Hominal A, Touveneau S, et al. Bacterial contamination of the hands of intensive care unit staff during respiratory tract care: Preliminary results. *Antimicrobial Resistance and Infection Control Conference: 3rd International Conference on Prevention and Infection Control, ICPIC* 2015; 4.
107. Morgan DJ, Rogawski E, Thom KA, et al. Transfer of multidrug-resistant bacteria to healthcare workers' gloves and gowns after patient contact increases with environmental contamination. *Critical Care Medicine* 2012; 40: 1045-1051. Review.

108. Morgan DJ, Liang SY, Smith CL, et al. Frequent multidrug-resistant acinetobacter baumannii contamination of gloves, gowns, and hands of healthcare workers. *Infection Control and Hospital Epidemiology* 2010; 31: 716-721.
109. Pineles L, Morgan DJ, Lydecker A, et al. Transmission of methicillin-resistant Staphylococcus aureus to health care worker gowns and gloves during care of residents in Veterans Affairs nursing homes. *American Journal of Infection Control* 2017; 45: 947-953.
110. Roghmann MC, Johnson K, Sorkin JD, et al. Transmission of methicillin-resistant staphylococcus aureus (Mrsa) to healthcare worker gowns and gloves during care of nursing home residents. *Infection Control and Hospital Epidemiology* 2015; 36: 1050-1057.
111. Tenorio AR, Badri SM, Sahgal NB, et al. Effectiveness of gloves in the prevention of hand carriage of vancomycin-resistant enterococcus species by health care workers after patient care. *Clinical Infectious Diseases* 2001; 32: 826-829.
112. Zachary KC, Bayne PS, Morrison VJ, et al. Contamination of gowns, gloves, and stethoscopes with vancomycin-resistant enterococci. *Infection Control and Hospital Epidemiology* 2001; 22: 560-564.
113. Blanco N, Johnson JK, Sorkin JD, et al. Transmission of resistant Gram-negative bacteria to healthcare personnel gowns and gloves during care of residents in community-based nursing facilities. *Infection Control and Hospital Epidemiology* 2018; 39: 1425-1430.
114. Pineles L, Morgan DJ, Lydecker A, et al. Transmission of methicillin-resistant Staphylococcus aureus to health care worker gowns and gloves during care of residents in Veterans Affairs nursing homes. *American Journal of Infection Control* 2017; 45: 947-953. DOI: 10.1016/j.ajic.2017.03.004.
115. Kpadeh-Rogers Z, Robinson GL, Alserahi H, et al. Effect of Glove Decontamination on Bacterial Contamination of Healthcare Personnel Hands. *Clinical Infectious Diseases* 2019; 69: S224-S227.
116. Moran V and Heuertz R. Cross Contamination: Are Hospital Gloves Reservoirs for Nosocomial Infections? *Hospital topics* 2017; 95: 57-62.
117. Ali S and Wilson APR. Effect of poly-hexamethylene biguanide hydrochloride (PHMB) treated non-sterile medical gloves upon the transmission of Streptococcus pyogenes,

carbapenem-resistant E. coli, MRSA and Klebsiella pneumoniae from contact surfaces. *BMC Infectious Diseases* 2017; 17: 574.

118. Assadian O, Kramer A, Ouriel K, et al. Suppression of surgeons' bacterial hand flora during surgical procedures with a new antimicrobial surgical Glove. *Surgical Infections* 2014; 15: 43-49.
119. Barza M. Efficacy and tolerability of ClO₂-generating gloves. *Clinical Infectious Diseases* 2004; 38: 857-863.
120. Bricout F, Moraillon A, Sonntag P, et al. Virus-inhibiting surgical glove to reduce the risk of infection by enveloped viruses. *Journal of Medical Virology* 2003; 69: 538-545.
121. Borkow G and Gabbay J. Putting copper into action: copper-impregnated products with potent biocidal activities. *FASEB Journal* 2004; 18: 1728-1730.
122. Caillot JL and Voiglio EJ. First clinical study of a new virus-inhibiting surgical glove. *Swiss Medical Weekly* 2008; 138: 18-22.
123. Daeschlein G, Kramer A, Arnold A, et al. Evaluation of an innovative antimicrobial surgical glove technology to reduce the risk of microbial passage following intraoperative perforation. *American Journal of Infection Control* 2011; 39: 98-103.
124. Kahar Bador M, Rai V, Yusof MY, et al. Evaluation of the efficacy of antibacterial medical gloves in the ICU setting. *Journal of Hospital Infection* 2015; 90: 248-252.
125. Amos JR, Moy AS and Gomez A. Design of a new non-sterile glove-dispensing unit to reduce touch-based contamination. *Australasian Medical Journal* 2014; 7: 171-174.
126. Assadian O, Leaper DJ, Kramer A, et al. Can the design of glove dispensing boxes influence glove contamination? *Journal of Hospital Infection* 2016; 94: 259-262.

Appendices

Appendix 1: Specific standards pertaining to the quality and performance of gloves

Standard	Title	Description	Publication Date
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
ISO 11193-1:2020	Single-use medical examination gloves – Part 1: Specification for gloves made from rubber latex or rubber solution	This standard specifies requirements for packaged sterile or bulked-nonsterile rubber gloves intended for use during medical examinations or therapeutic procedures, in order to protect both the patient and user from cross-contamination; however, this standard does not cover safe use of examination gloves.	August 2020
ISO 11193-2:2006	Single-use medical examination gloves — Part 2: Specification	This standard specifies requirements for packaged sterile, or bulked non-sterile poly(vinyl chloride) gloves for use in medical examinations, and diagnostic or therapeutic procedures, in order to protect the patient and user from cross-contamination. This	November 2006

Standard	Title	Description	Publication Date
	for gloves made from poly(vinyl chloride)	standard also covers poly(vinyl chloride) gloves intended for use when handling contaminated medical materials.	
Statutory Instrument 2018 No. 390 and The Product Safety and Statutory Instrument 2019 No. 696	Consumer Protection Health and Safety – The Personal Protective Equipment (Enforcement) Regulations 2018 and The Product Safety and The Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019	Statutory instrument No. 390 sets out the standards for PPE in the UK. Schedule 35 of Statutory Instrument No. 696 sets out the amendments made to Statutory Instrument No. 390 due to the UK's withdrawal from the EU and requires that all PPE is UKCA marked. As it was previously a requirement that PPE was CE marked, CE marking is still valid until 31st December 2022 if items are assessed by EU27 notified body. UKCA and CE marking demonstrates that an item has been manufactured to a particular standard and passed the appropriate tests for the PPE type and intended use/purpose.	Instrument No. 390: April 2018; Instrument No. 696: March 2019
BS EN 455-1:2020	Medical gloves for single use. Part 1: Requirements and testing for freedom from holes	This standard outlines requirements and test methods for single-use medical gloves to determine freedom from holes.	May 2020

Standard	Title	Description	Publication Date
BS EN 455-2:2015	Medical gloves for single use. Part 2: Requirements and testing for physical properties	This standard outlines requirements and test methods to ensure that the physical properties of single-use medical gloves in order to ensure that gloves provide and maintain an adequate level of protection in order to protect both the patient and use from cross-contamination.	April 2015
BS EN 455-3:2015	Medical gloves for single use. Part 3: Requirements and testing for biological evaluation	This standard outlines the requirements and test methods for the evaluation of biological safety for single-use medical gloves. However, this standard does not specifically address adverse reactions that may result from the use of single-use medical gloves.	April 2015
BS EN 455-4:2009	Medical gloves for single use. Part 4: Requirements and testing for shelf life determination	This standard outlines the requirements for shelf-life for single-use medical gloves and the requirements for labelling and disclosure of information relevant to the test methods used.	August 2009
BS EN ISO 374-1:2016+A1:2018	Protective gloves against dangerous chemicals and micro-organisms -	This standard outlines the requirements for the use of protective gloves to protect the user against dangerous chemicals, and defines the terms to be used.	August 2018

Standard	Title	Description	Publication Date
	Terminology and performance requirements for chemical risks		
BS EN ISO 374-2:2019	Protective gloves against dangerous chemicals and micro-organisms - Determination of resistance to penetration	This standard specifies a test method for the penetration resistance of gloves that are used to protect against dangerous chemicals and/or micro-organisms.	October 2019
BS EN ISO 374-4:2019	Protective gloves against dangerous chemicals and micro-organisms - Determination of resistance to degradation by chemicals	This standard outlines the test method for the determination of the resistance of glove materials to degradation by dangerous chemicals with continuous contact.	October 2019

Standard	Title	Description	Publication Date
BS EN ISO 364-5:2016	Protective gloves against dangerous chemicals and micro-organisms — Part 5: Terminology and performance requirements for micro-organisms risks	This standard outlines the requirements and test methods for protective gloves used to protect the user against micro-organisms.	October 2016
BS EN 16523-1:2015+A1:2018	Determination of material resistance to permeation by chemicals - Permeation by potentially hazardous liquid chemicals under conditions of continuous contact	This standard outlines the requirements for the determination of the resistance of gloves, footwear and protective clothing to permeation by potential hazardous chemicals when in continuous contact. This standard is used with the specification given in the products standards, i.e. EN ISO 374-1:2016 for gloves, where the following information is defined: and pre-conditioning, precise sampling (place, size number) and associated levels of performance.	October 2018.

Legend:

BS = British Standards produced by the [British Standard Institution](#)

EN = European Standards (European Norm) produced by the [European Committee for Standardisation](#)

ISO = International Standards produced by the [International Standards Organization](#)

EN standards are gradually being replaced by ISO standards – when these are adopted in the UK they are prefixed with BS (e.g. BS EN; BS EN; BS EN ISO). This is usually to accommodate UK legislative or technical differences or to allow for the inclusion of a UK annex or foreword

Appendix 2: Grades of recommendation

Grade	Descriptor	Levels of evidence
Mandatory	'Recommendations' that are directives from government policy, regulations or legislation	N/A
Category A	Based on high to moderate quality evidence	SIGN level 1++, 1+, 2++, 2+, AGREE strongly recommend
Category B	Based on low to moderate quality of evidence which suggest net clinical benefits over harm	SIGN level 2+, 3, 4, AGREE recommend
Category C	Expert opinion, these may be formed by the NIPC groups when there is no robust professional or scientific literature available to inform guidance.	SIGN level 4, or opinion of NIPC group
No recommendation	Insufficient evidence to recommend one way or another	N/A