ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

NHS National Services Scotland

Standard Infection Control and Transmission Based Precautions Literature Review

Personal Protective Equipment (PPE): Aprons and Gowns

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Key Information

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Description:	This literature review examines the available professional literature on PPE (Aprons/Gowns) in health and social care settings.
Purpose:	To inform the Standard Infection Control Precautions (SICP) and Transmission Based Precautions sections on Personal Protective Equipment (PPE) Aprons and Gowns in the National Infection Prevention and Control Manual in order to facilitate the prevention and control of healthcare associated infections in NHS Scotland hospital settings.
Target Audience:	All health and care staff involved in the prevention and control of infection in Scotland.
Circulation list:	Infection Control Managers, Infection Prevention and Control Teams, Public Health Teams.
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** – Changes to advised practice include recommendations to not wash hands with soap and water whilst wearing an apron/gown and not using reusable gowns for procedures which require sterility e.g. aseptic procedures or within the operating theatre. **Research** – Calls for research into the benefits of changing gowns part way through surgical procedures, design elements which facilitate appropriate doffing, the infection control risk associated with the glove-gown interface and gowns/aprons coated with anti-viral or anti-bacterial substances.

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Version History

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

Version	Date	Summary of changes
1.0	January 2021	This literature replaces the Standard Infection Prevention Control literature review on PPE: Aprons and Gowns, Version 3.0, April 2015. This literature review includes Transmission Based Precautions for PPE: Aprons and Gowns and has been updated using two-person systematic review methodology.
1.1	January 2022	**How should aprons/gowns be donned?** Update to recommendation under this reference based on Scottish expert opinion. 'When worn as part of contact precautions, an apron (or gown if excessive splash or spray is anticipated) should be donned for direct care delivery and contact with the patient's care environment.'

Approvals

Version	Date Approved	Name
1.0	January 2021	Steering (Expert Advisory) Group for SICPs and TBPs
1.1	January 2022	

Linked Documentation

Document title	Document Filepath
National Infection Prevention and Control Manual	National Infection Prevention and Control Manual /

Contents:

1. Objectives

The aim of this review is to examine the extant professional literature regarding the use of aprons/gowns as Personal Protective Equipment (PPE) for standard and transmission based infection prevention and control purposes in health and social care settings.

The specific objectives of the review in regards to SICPs are to determine:

- Are there any legislative requirements for the use of aprons/gowns as PPE for infection control purposes?
- When/where should aprons/gowns be worn for SICPs?
- What type(s) of aprons/gowns should be used for SICPs?
- When are reusable aprons/gowns appropriate?
- When should aprons/gowns be removed/changed?
- How should aprons/gowns be donned?
- How should aprons/gowns be doffed?
- How should aprons/gowns be disposed of?
- How should aprons/gowns be stored?

The specific objectives of the review in regards to TBPs are to determine:

- When/where should aprons/gowns be worn for TBPs?
- What type(s) of aprons/gowns should be used for TBPs?

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 (SICPs)

Are there any legislative requirements for the use of aprons/gowns as PPE for infection control purposes?

There are no specific legislative requirements regarding the use of aprons/gowns as PPE for standard infection control purposes, although the use of PPE in health and social care settings is covered by the Health and Safety at Work etc. Act (1974)[1], Control of Substances Hazardous to Health (2002 as amended) regulations[2], and the Personal Protective Equipment at Work Regulations 1992 (as amended).[3] It is a legal requirement that employers provide personal protective equipment for their employees where hazards of the workplace cannot be controlled by other means.[1-3]

The Health and Safety at Work etc. 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.[1] 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 almost be viewed as a detailed schedule of the Health and Safety at Work etc. Act, which would include pathogens in health and social care settings, and the use of appropriate PPE – for example the use of gloves to protect against blood borne viruses during venepuncture.[2] If an activity does not involve or is perceived not to involve contact with a hazardous material then the Personal Protective Equipment at Work Regulations 1992 provide general guidance on the use of PPE;[3] in health and social care settings 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 COSHH.[2]

All of the UK legislation and regulations outline the responsibilities of the employer and employee. Both COSHH and the PPE at work regulations outline that exposure to harmful substances should be eliminated/prevented in the workplace, but where avoidance of this is not reasonably practicable, control measures should be employed which are appropriate to the activity and consistent with the risk assessment.[2, 3]

Legislation outlines that PPE must be suitable for the task being undertaken, fit appropriately and, if being worn with other pieces of PPE, the employer shall make sure that the pieces are compatible with each other and in wearing them together, do not reduce the level of protection.[2, 3] PPE should be CE marked and, regarding its design and manufacture, should comply with the Personal Protective Equipment Regulations 2002.[2, 3]

Employers must provide adequate instruction and information on how to correctly use PPE provided and employees in turn have a responsibility to comply, by ensuring that suitable PPE is worn correctly for the task being carried out.[2, 3]

Employers must ensure that PPE is maintained in good working order and in a clean condition. Employers must also ensure that PPE is properly stored in a designated area, checked at suitable intervals and, when discovered to be defective, repaired or replaced before further use.[2, 3]

The Personal Protective Equipment Regulations 2002 and Regulation (EU) 2016/425 which are associated with PPE Directive 89/686/EEC (now the Personal Protective Equipment (Enforcement) Regulations 2018) state that PPE on the market must be supplied with relevant 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 expiry date for the PPE and its component parts.[3]

Personal protective equipment should comply with applicable British and European standards which are outlined in Appendix 1.

When/where should aprons/gowns be worn for SICPs?

There is consensus of expert opinion in the literature that aprons/gowns should be worn in health and social care settings when it is anticipated that there may be exposure to blood, body fluids, secretions or excretions through close contact with patients or any activity/procedure.[4-18] This is noted in some sources to include handling of contaminated laundry[10] and/or patient care equipment and instruments/devices that are visibly soiled or may have been in contact with blood or body fluids.[13, 18]

There is consensus of UK expert opinion that aprons are worn for situations in which close contact with a patient, materials or equipment may lead to body fluid contamination of uniforms

[4-11, 19] but that full body, fluid repellent gowns are required where extensive splashing of blood or bodily fluids is anticipated.[4-6, 8, 19]

Guidance from the Healthcare Infection Control Practices Advisory Committee (HICPAC), as part of their standard precaution recommendations, outline that gowns are worn during aerosol generating procedures (AGPs).[13] Aprons are not mentioned and this is reflected in all non-UK apron/gown guidance. It is therefore unclear from the current American evidence base as to whether aprons or gowns are required for AGPs on patients who are not suspected of carrying an infectious agent.

HICPAC also outline that routine donning of gowns on entrance into high-risk units (e.g. ICU, NICU, HSCT) is not indicated.[13] Similarly, they provide expert opinion that gowns are not required for health care workers or visitors upon routine entry into the room of a patient requiring a protected environment e.g. allogeneic hematopoietic stem cell transplantation patients.[13]

Sterile gowns are worn in surgery to prevent dissemination of surgeons' skin and hair particles which could contaminate the patient's surgical wound leading to infection.[20]

Fluid repellent gowns appear to be required for surgeries regardless of the surgeon's perceived levels of body contamination with body fluids and therefore should perhaps not be based on their own risk assessment of exposure. In an observational study where 4 surgeons performed 500 dermatological excisional procedures, visual blood contamination was present on 'surgical gowns' in 42% of cases. The physicians in this study were not aware of blood splashes at the time of contamination.[21]

The Association of Anaesthetists of Great Britain and Ireland outline a requirement for gowns in all invasive surgical procedures but a number of specific invasive surgical procedures are also cited, by this organisation and others, as requiring the use of sterile surgical gowns.[8] These procedures include insertion of central venous catheters, [8, 12, 22] insertion of peripherally inserted central catheters,[12] insertion of pulmonary artery catheters[22] and spinal, epidural and caudal procedures.[8] All of these sources are, however, considered to be expert opinion.

Some experts highlight that evidence for the infection control benefits of wearing a surgical gown for some routine interventional procedures is inconclusive and that gowning should be considered a precautionary measure during procedures with known higher infection rates.[23]

One randomised controlled trial (RCT) with a focus on epidural catheter insertion found no significant differences between intervention and control groups (operator wearing a gown compared to operator not wearing a gown) regarding contamination rates of; catheter tips, the catheter's skin-adjacent segments or the working areas.[24] A sub analysis of samples obtained from the working areas revealed that in the un-gowned group, a higher incidence of colonisation with coagulase-negative *Staphylococcus* (which is considered normal skin flora) was observed.[24] This was in contrast to the much more balanced distribution of *Bacillus* species (the most common environmental microorganism in hospitals) and coagulase-negative *Staphylococcus* bacteria in the gowned group (P = 0.014) suggesting that healthcare workers (HCWs) exposed arms may have been a source of contamination.[24] Limitations of this study include the uncertainty surrounding the exact source of bacteria as genotype sequencing was not performed, colonisation being an indirect measure of infection and bias created through the operator being aware of the study and observation. Hand washing was also assumed and not observed for a proportion of operators. Overall this RCT suggests that gowns may not have an effect on infection rates associated with epidural catheter insertion but further research is needed.[24]

A 2003 systematic review and meta-analysis aimed to investigate the effects of attendants and visitors to newborn nurseries wearing an overgown.[25] Authors looked at newborn mortality rates, lengths of stay and rates of nosocomial infection and colonisation.[25] Eight trials reporting outcomes for 3,811 infants were included and no trials concerning visitor gown wearing were found.[25] Trial quality varied, with only two assessed as being of good quality.[25] There was no statistically significant effect of gowning policy on death rate (RR 0.84, 95% CI 0.70 to 1.02) or incidence of systemic nosocomial infection (RR 1.24, 95% CI 0.90 to 1.71).[25] Similarly, the analysis also showed no significant effect of gowning policy on the incidence of colonisation or length of hospital stay.[25] This study aligns with American guidance from HICPAC which states that routine use of gowns upon entering neonatal intensive care units is not indicated.[13]

What type(s) of aprons/gowns should be used for SICPs?

According to expert opinion, aprons or gowns should be selected to provide adequate protection based on anticipated exposure to blood and bodily fluids.[26]

There is a general consensus in the literature that aprons and gowns worn for protection against body fluid splash and spray should be fluid repellent/plastic [4-9, 14, 19, 27] and that if a gown or apron is solely being used to prevent contamination of HCW skin and/or uniforms it need not be sterile.[8, 12, 14, 15, 22]

Disposable, single use plastic aprons can be used for general close contact where contamination of clothing may occur.[4, 6, 8, 10, 19]

Full-body, fluid repellent gowns are indicated for use in situations where there is risk of extensive splashing of blood, body fluids, secretions or excretions, for example when assisting with childbirth or theatre procedures.[4, 6, 8]

A sterile gown is required for aseptic procedures.[8]

For sleeveless, non-sterile, plastic, disposable aprons, the HSE and MHRA advise that they be made from low density polyethylene (LDPE), not contain natural rubber latex, have ties which secure the apron around the body at the back or sides and have a minimum thickness, impact strength and tear resistance based on British Standards (see Appendix 1).[28] They state that aprons should adhere to Essential Health and Safety Requirements Annex II of PPE Regulation (EU) 2016/425.[28] The HSE and MHRA also provide minimum size dimensions for aprons (width 685 mm +/- 15mm, length 1170mm +/- 15mm, tie length ≥415 mm, neck hole width ≥240mm - ≤265mm and neck hole depth ≥160mm).[28]

The UK HSE and MHRA outline that single use, sterile surgical gowns should be of mid-calf length, have bonded seams and meet necessary standards including those pertaining to sterility, flammability, liquid penetration and tensile strength (see Appendix 1).[28] These organisations also indicate that labelling should include an indication of sterility, the method of sterilisation, the type of gown, the level of fluid resistance, an expiry date and warnings on its use in certain areas (e.g. flammability) where appropriate.[28] Non-sterile gowns must also meet these requirements, excluding those of sterility.[28]

In regards to surgical gowns, the Association of periOperative Registered Nurses (AORN) recommend that members of the surgical team should have a gown large enough to cover their

backs but not so large as to unintentionally come into contact with unsterile items.[26] They state that “the sleeves of the gown should cover the arms down to the wrist comfortably so the cuffs of the gown will not pull out of the gloves”.[26]

A 2002 report from the Hospital Infection Society Working Party on Infection Control in Operating Theatres advises that overall, theatre gown material should be waterproof and disposable.[20] American authors expand on this point to highlight that theatre gowns need to be resistant to liquid penetration,[29] microbial penetration,[29] and release minimal particles such as lint.[29, 30] Cotton and polyester cotton-blended surgical gowns are not recommended with authors stating that disposable, polypropylene, spun bond laminate materials offer the best protection.[20] AORN 2003 highlight that surgical gowns should be comfortable, facilitate maintenance of the wearer’s desired body temperature, be free of toxic ingredients or allergens, be flexible enough to conform loosely to the wearer’s body and be resistant to tears, punctures or abrasions.[29] However, these statements can only be considered expert opinion. In the context of NHS Scotland PPE provision, most of these features would be met through required adherence to British and European standards (see Appendix 1).

When are reusable aprons/gowns appropriate?

Extremely limited evidence was identified on this topic. The WHO suggest that reusable gowns (with appropriate inter-use processing) are only appropriate for periods where resources may be limited and disposable PPE items are not available.[16] They highlight the importance of disinfecting these gown types properly after each use.[16]

The UK HSE suggest that reusable gowns may be appropriate in the context of COVID-19 via their inclusion of required features in a 2020 standards document.[28] They state that reusable gowns should meet the same standards as single use gowns (excluding those of sterility where applicable) and that reusable gowns should have accompanying information on the reprocessing methodology with a manufacturing or expiry date and a defined number of reprocessing cycles.[28] American expert opinion expands on this point by highlighting that repeated processing will ultimately diminish the protective barrier ability of reusable materials; but throughout the manufacturer’s recommended life cycle, they should not fail to meet the original barrier quality level.[29]

Based on ARHAI Scotland expert opinion, as reusable gowns will be laundered using validated processes between uses but not sterilised, they should not be used for procedures where a sterile field is required e.g. aseptic surgical procedures or within the operating theatre.[31] Reusable gowns may be used in other settings where sterility is not a requirement, providing they are appropriately laundered between uses in line with manufacturer's instructions.

When should aprons/gowns be removed/changed?

Based on expert opinion, plastic aprons/fluid-repellent gowns should be worn as single-use items for one procedure or episode of patient care.[5, 6, 17, 19, 22] Australian guidance outlines that gowns/aprons should be removed and hand hygiene performed upon exit from the room.[32]

Inappropriateness of reuse of gowns without intermediary processing is reflected in American and UK expert opinion which suggests that gowns should not be reused, even for repeated contacts with the same patient.[9, 13, 18] The CDC state that HCWs should not wear the same gown for care of more than one patient.[33]

Expert opinion outlines that soiled gowns should be removed, with care, as soon as possible.[12, 14-16] In line with this recommendation *Gemmel et al* outline that *"contaminated clothing should be changed and safely discarded into an appropriate receptacle at the earliest opportunity"*.[8] These statements may create uncertainty as they perhaps suggest that contamination of an apron or gown should result in its immediate removal as opposed to being solely based on the end of an episode of patient care and leaving the patient room. Based on current guidance and expert opinion, aprons/gowns should be changed if they become grossly contaminated.

The WHO's TBP advice regarding wearing a single gown for care of multiple cohorted patients (before reprocessing) is unclear. Statements can be found which reflect its appropriateness specifically if no patient contact occurs; *"gowns may also be worn during the care of more than one patient in a single cohort area only, provided that the gown does not come into direct contact with any patient"* but are in contrast to statements, found in the same source, where it is never advised; *"PPE – including gloves and gowns – must be changed between patients, even when providing care in a cohort or isolation room or area"*.[16]

Multiple observational studies were identified where authors aimed to establish the risks associated with resistant organism contamination of gowns, following care of patients.[34-41] Most

identified the proportion of gowns contaminated following care and the specific care activities that were more often associated with contamination. These studies had a multitude of limitations which included a lack of sequencing in order to establish direct links between gown and patient isolates although in two studies, a small sub sample of isolates were examined which showed 89-91% of gown and patient/environment isolates being related.[38, 41] Another common major limitation was failure to take HCW baseline samples in order to rule out themselves being the source of gown contamination rather than the patient or environment, although this was carried out in three studies.[36-38] Most studies had a patient population which excluded those who were not colonised or infected with a resistant micro-organism, however, broadening the inclusion criteria to involve all patients of a health or care setting would have been helpful in order to establish general contamination rates rather than only for those patients to whom contact precautions apply. In two studies which did focus on a wider patient population rather than only colonised patients, contamination of gowns with the relevant pathogens occurred for patients having been categorised as non-colonised - this could reflect environmental contamination of gowns or inaccurate testing methods.[39, 41]

In a systematic review of bacterial gown contamination, studies were found to be limited by examination of multistep prolonged interactions where the exact origin of transferred microorganisms remained unknown.[42] The authors did not identify any studies reporting on the transfer of pathogens from gowns and uniforms to patients. The overall estimated frequency of transfer of pathogens from patients and their environments to gowns was 10% (6-14%) based on 13 studies.[42] The authors drew the general conclusion that pathogen transfer to gloves, hands and gowns is very frequent in health and care settings. In general, risk factors for contamination were contact with moist body surfaces, longer duration of care and care of patients with an invasive device.[42] This review supports the recommendation that gowns be changed after each patient interaction and/or interaction with the patient's environment.

In summary, these observational studies could not demonstrate the effectiveness of gowns in providing contamination protection for clothing worn underneath or even definitively demonstrate a direct proven transference of resistant bacteria from patient or environment to gown. It is clear however, that following care of colonised patients or interaction with their environment, a proportion of gowns will be contaminated and therefore a recommendation of changing gowns following each episode of care associated with a patient or their environment, is supported.

An observational study showed that bacterial contamination of gowns following surgery is common.[43] Following 69 orthopaedic surgeries, bacterial contamination was identified on 12% of 133 surgical gowns which represented bacterial gown contamination occurring in approximately one fifth of procedures.[43] In another study, authors looked to examine the number of bloodstains found on gowns, following oral surgery where high speed rotary instruments were used, as well as the presence of diluted and invisible bloodstains.[44] Gowns were contaminated in 16 of 25 surgeries whereas leucomalachite testing revealed that 21 of 25 were in fact contaminated with blood.[44] These studies support the recommendation that gowns should be changed after every surgical procedure and even if not visibly contaminated.

Hand washing whilst wearing aprons or gowns appears to create a risk of bacterial contamination and by extension a risk of nosocomial transmission. In an observational study 109 sinks which had drains positive for Gram negative bacilli were included in an investigation of handwashing and gown contamination.[45] Baseline negative control cultures of gowns, HCW hands and environmental surfaces surrounding the sink were taken.[45] HCWs washed their hands for 15 seconds. Culture plates were used to sample hands, abdominal areas of gowns (including places with visible water splashing) and counter tops <6 inches from bowl post handwashing.[45] The protocol was repeated with sink drain covers in place. Ten of 109 (9%) cover gowns were contaminated. The sink drain cover significantly reduced the proportion of gowns that were contaminated but did not eliminate contamination (2% vs 9% p=<0.03).[45] Limitations of this study include the concepts that sinks were from only one hospital, pre-test cleaning of sinks may have resulted in an underestimation of contamination as Gram negative bacilli in bowl could be present and accumulate between cleanings and the fact that no sequencing was done to directly link bacterial strains. This study suggests that during handwashing, clothing/gowns can become contaminated with bacteria present in the sink drains, in this case, Gram negative bacilli.[45] If performing a sterile procedure, it would be expected that the HCW would don a sterile gown following hand hygiene but if hand hygiene is performed during care without doffing and donning fresh PPE there may be an opportunity for contamination of the gown – and a subsequent risk of indirect colonisation/infection of a patient. This study, however, does not provide evidence for transference of pathogens from gown to patient resulting in infection. This study suggests that hand hygiene should not be performed whilst wearing gowns or aprons.[45]

Some in-vitro experimental studies looked at the survivability of specific pathogens on differing fabrics and plastics.[46] One study assessed *P. aeruginosa, S. marcescens, Proteus mirabilis, E.*

coli, K. pneumonia, Acinetobacter species and *Enterobacter species*.[46] Survival times of 48 hours to more than 1440 hours were recorded for polyethylene material, commonly used for plastic aprons.[46] In another study, *Staphylococci* and *Enterococcus* strains survived for over 90 days on polyethylene[47] whilst in a study which looked at the survivability of SARS-CoV, survival for 2 days was noted on plastic (polypropylene coated with polyethylene film) disposable gown material .[48] Limitations include the *in vitro* nature of the experiments meaning that environmental factors which may impact survivability were not addressed. It is also unclear if the concentrations of bacteria and virus used to inoculate the materials represent common amounts of bodily contamination following care. The findings of these studies provide evidence of the long survival time of some bacterial and viral isolates on materials commonly used in healthcare environments supporting the need for gowns and aprons made of these materials to be single-use.

How should aprons/gowns be donned?

Hand hygiene should be performed before donning PPE.[4, 18, 33, 49]

Based on UK expert opinion an apron should be donned using the following steps:

- Remove apron from the roll or dispenser,
- Open it outwards ensuring the inner surface (when stored) faces the patient to prevent any contamination on its outer surface (based on storage) coming into contact with the patient,
- Place the neck loop over your head,
- Position the apron to cover as much of the front of your body as possible,
- Fix the apron in place by tying the waist straps behind your back. 4

In regards to the PPE ensemble, the apron or gown should be donned first,[13, 33] followed by the mask, eye protection and gloves.[49]

When worn as part of contact precautions, expert opinion published on behalf of the American Association of Nurse Anaesthetists (AANA) and the Society for Healthcare Epidemiology of America (SHEA), and guidelines from Healthcare Infection Control Practices Advisory

Committee (HICPAC) advise that gowns should be donned upon entry to the patient room.[13, 22, 50] ARHAI Scotland recommends that aprons should be donned to perform direct patient care or when in direct contact with the patient's care environment. If excessive splash or spray is anticipated, a gown should be donned.

A specific step-by-step methodology for donning a gown is not outlined in the literature but certain aspects of the process are emphasised:

Reusable gowns should be visually inspected to assess their integrity before use.[29]

Gowns should be secured at the back of the neck and waist.[15, 22]

They should fully cover torso from neck to knees, arms to end of wrists, and wrap around the back.[15]

When using a gown with back closure a second operator should assist in fastening the back.[49]

Gloves should be extended to cover the wrists over the gown's cuffs.[49] This is essential when donning a sterile gown and gloves for aseptic procedures (The gown cuff of the ungloved team member should remain at or beyond his or her fingertips. The ungloved team member inserts his or her hand into the glove so that the gown cuff touches only the inside of the glove).[26]

It was theorised by *Byrd et al* that gown sleeve contamination during donning of a surgical sterile gown could be lessened through an (under) 'gloves-first' technique.[51] In their randomised cross over trial, 37 surgeons donned gowns and gloves having applied a UV lotion to their hands.[51] Surgeons used their preferred donning technique; either 1) staff assisted closed technique *(surgeon inserts bare hands into gown but not beyond sleeve end, assistant helps with glove being pulled over sleeve end whilst surgeon pushes hand through. Second set of gloves then donned)* or 2) staff assisted open technique *(surgeon inserts bare hands all the way through end of gown sleeve and assistant helps with glove being pulled over hands and portion of sleeve)* and the new 'gloves-first' technique *(surgeon dons gloves, then gown, then assistant helps with glove being pulled over gloved hand and portion of sleeve)* in a randomised order.[51] The gloves-first technique demonstrated zero contamination of gown sleeves (excluding cuffs) in all samples. This was significantly less than both closed and open staff assisted techniques ($P < 0.0001$), however, due to the small sample size and specific PPE used, further research would be needed to support a formal recommendation.[51] Another limitation of this study includes the requirement that the 'gloves-first' technique involves double gloving, which, based on UK

guidance, would be a recommendation based on the performance of exposure prone procedures.[52]

How should aprons/gowns be doffed?

It is consistently recommended that aprons/gowns are removed following glove removal but before doffing eye protection and masks.[5, 27, 49] Some TBP sources recommend a hand hygiene phase following removal of gloves but before gown doffing,[16] with the European Centre for Disease Prevention and Control (ECDC) going further and advising hand hygiene and a new pair of gloves before gown doffing/continuing the doffing procedure.[49]

Gowns and aprons should be removed in such a way as to avoid contact with the contaminated outer surface and therefore self-contamination.[5, 13, 15, 16, 22, 27, 33, 49]

To remove an apron:

- Break the ties at the neck/back,
- Pull the apron away from the neck and shoulders, taking care to only touch the inside surface, i.e. ensuring the apron is dirty side to dirty side,
- The apron should then be folded or rolled into a ball and placed in the appropriate waste stream.[4]

To remove a gown:

- Untie the ties at the back.
- Using a peeling motion the gown should be pulled down from each shoulder so that the gown is turned inside out.[13, 15, 22, 33, 49]
- Taking care to avoid contact with the body, the gown should be rolled into a ball and placed in either the appropriate laundry or waste stream.[13, 15, 22, 33]

It is consistently recommended that hand hygiene should be performed following the removal of aprons/gowns.[4, 5, 13, 16, 18, 32, 33, 49]

Remove an apron or gown before leaving the patient room/environment [13, 16, 32, 50]

In *Verbeek et al's* 2020 systematic review 24 studies were included based on all types of PPE, associated donning and doffing procedures and their efficacy in protecting against infectious diseases.[53] Two studies examined Centres for Disease Control and Prevention (CDC) doffing protocols for gowns.[53] These studies were both classed by authors as providing very low certainty evidence and were excluded through individual appraisal as part of this ARHAI Scotland review.

There is some inconsistency in recommended doffing procedures. The ECDC recommend that gloves should be removed, hand hygiene performed followed by application of fresh gloves before doffing one's gown, however, no evidence is provided for this recommendation and this is COVID-19 specific guidance which may not reflect SICPs recommendations.[49] The ECDC also recommend that an assistant help the doffer with unfastening a back closing gown and that for this, the assistant should wear gloves and a mask, however, again, this is COVID-19 specific guidance and may not reflect SICP recommendations.[49] The WHO recommend that a one-step of gown and glove doffing together can be appropriate but this is not outlined elsewhere and is TBP specific guidance.[16]

How should aprons/gowns be disposed of?

It has been recommended that used disposable aprons/gowns should be disposed of into the appropriate waste stream in accordance with local policy (i.e. healthcare (including clinical) waste),[4-6, 15, 19] while non-disposable protective clothing should be placed in a designated container or bag sent for laundering.[5, 16, 49]

It is also recommended that hand hygiene be performed following disposal of PPE.[16]

How should aprons/gowns be stored?

Based on UK legislation, employers need to ensure that appropriate accommodation is provided to store PPE. Storage should "prevent damage from chemicals, sunlight, high humidity, heat and accidental knocks; prevent contamination from dirt and harmful substances; reduce the possibility of losing the PPE and enable the sufficient drying of PPE to ensure its effectiveness is maintained".[2, 3] The Personal Protective Equipment (Enforcement) Regulations 2018 state that PPE on the market must be supplied with relevant information on storage.[2, 3]

3.2 Implications for Practice (TBPs)

When/where should aprons/gowns be worn for TBPs?

Inconsistency can be found in the recommendation for aprons and gowns to always be worn solely based on a body fluid exposure risk assessment and regardless of infective pathogen. Guidance was identified where aprons and gowns were recommended based on the care of patients known or suspected to be infected with specific pathogens regardless of anticipated fluid exposure.

Royal College of Nursing (RCN) 2017 guidance echoes SICP expert opinion regarding aprons being worn whenever there is a risk of contamination of uniforms or clothing with blood and body fluids but also broadly states that aprons should be worn *"when a patient has a known or suspected infection"* and states that gowns may be required, based on local policy, in certain settings (e.g. maternity and A&E) or *"when there are high risk respiratory infections or infections caused by some multi-resistant bacteria"*.[19] These statements, however, are somewhat vague and should only be considered expert opinion.

National Institute for Health and Care Excellence (NICE) 2012 guidance presents findings of two observational studies investigating contamination of uniforms when disposable plastic aprons were worn and two ICU based, observational, before and after studies which compared isolation procedures with gowns and gloves against those with gloves alone in the prevention of acquisition of vancomycin resistant enterococci (VRE).[6] All studies were appraised as being very low quality with the conclusion being there was uncertain evidence as to *"whether there is any difference in mean bacterial colony count on uniforms when wearing an apron compared with not wearing an apron",* there was evidence of *"a statistically significant and clinically important reduction in MRSA contamination of care assistant uniforms when aprons were used for washing, and meal assistance in a long-term care facility compared with when no aprons were used",* there was *"a statistically significant reduction of uncertain clinical importance in MRSA contamination of nurses uniforms when aprons were used for dressing changes and biological sampling compared with when no aprons were used"* and that there was a *"statistically significant reduction of uncertain clinical importance in VRE acquisition when gowns and gloves were worn in isolation procedures compared to when gloves alone were worn".*[6] These conclusions indicate that wearing aprons/gowns for the care of colonised patients may have a protective and beneficial effect but that the choice of apron or gown is unclear and further research is required.

In line with findings of the NICE 2012 review, a 2009 observational study provided very weak evidence to support the wearing of single-use plastic aprons during care activities.[54] A significant decrease in MRSA contamination was associated only with one specific care activity; meal assistance (p=0.001), however, insignificant reductions in contamination were observed during other activities such as washing, changing, dressing, and biological sampling.[54]

Also in line with findings of the NICE 2012 review, a 2002 before-after study suggested that gowns in addition to gloves when worn as part of contact precautions for VRE colonised or infected patients, may have a protective effect, in regards to patient acquisition of VRE on the same ward, in this case an ICU.[55] VRE acquisition rates were 9.0 cases per 1000 ICU-days in the gown periods and 19.6 cases per 1000 ICU-days in the no-gown period (p=<0.01).[55] It was noted by authors that better compliance with infection control practices was associated with gown use which may have been the true contributing factor associated with reduced VRE acquisition rates.[55]

In slight contrast to the NICE 2012 evidence review, a 2015 Cochrane review surmised that there was no appropriate evidence to appraise in relation to the efficacy of gloves, gowns or masks in the control of transmission of MRSA within health and care settings.[56]

When employing contact precautions, a gown is consistently advised for contact with the patient or any potentially contaminated environmental surfaces or equipment in close proximity to the patient.[13, 15, 17, 22, 33, 50, 57] Some sources expand on this point and state that gowns should be worn when treating patients who require droplet [17, 22] or airborne precautions as well. [22] The CDC are more specific in their droplet and airborne precaution recommendations, stating that if substantial spraying of respiratory fluids is anticipated, a gown should be worn.[33]

In Australian infection control guidance for patients with Clostridioides difficile infection (CDI) it is advised that contact precautions should be in place for symptomatic CDI patients, including the donning of gowns/aprons and gloves on entry to patient rooms.[32]

Australian infection control guidance for influenza states that in high risk aerosol settings and for AGPs, an impervious long-sleeved gown is required.[27] Whilst in pandemic and epidemic WHO guidance, it is advised that HCWs wear gowns during AGPs that have been consistently associated with an increased risk of transmission of acute respiratory infection (ARI) pathogens.[16] Public Health England (PHE) COVID-19 guidance advises that AGPs on patients infected with suspected or confirmed droplet transmitted infectious agents require use of a full

body, fluid repellent gown.[58] There appears to be some expert opinion consensus that long sleeved fluid resistant gowns should be worn for AGPs on patients suspected of having respiratory infectious agents. It is unclear as to why this is a specific recommendation as respiratory infections are primarily spread via the respiratory route and a requirement to wear a full body fluid repellent gown for AGPs would fall in line with SICPs recommendations which advise their use based on a risk assessment for extensive splash or spray.

This WHO 2014 guidance, for the control of epidemic and pandemic prone ARIs, also suggests that there are pathogens for which gowns are required and pathogens for which a risk assessment in line with SICPs for gown use is sufficient.[16] A risk assessment in line with SICPs, based on anticipated body fluid exposure is outlined as required for bacterial ARI, including plague, TB and influenza virus (with sustained human-to-human transmission).[16] Gowns are required outright for 'other' ARI viruses (e.g. parainfluenza, RSV, adenovirus), new influenza viruses with no sustained human-to-human transmission (e.g. avian influenza), SARS and novel ARIs.[16]

Australian influenza guidance states that staff involved in surface cleaning of potentially contaminated areas should wear disposable impervious gowns along with other PPE.[27]

The ECDC advise in some guidance that long-sleeved water resistant gowns be worn when caring for suspected or confirmed COVID-19 cases[49] but this is now in slight contrast to other updated ECDC guidance which supports an approach based on anticipated exposure to body fluids.[59] Newer guidance states that when caring for a suspected or confirmed COVID-19 case, gloves and a gown or apron should be considered when there is a risk for contact with body fluids; this includes during patient transport and *"in settings in which contamination is presumed to be high, such as where aerosol-generating procedures are performed"*.[59] The ECDC states that aprons can be used in place of gowns, especially when risk of contact with body fluids is low.[59] For staff engaged in environmental cleaning and waste management, a gown is advised without reference to risk assessment.[59]

The Department of Health and Social Care advise that in all health and care settings those within two metres of a suspected or confirmed COVID-19 patient should wear an apron with a caveat of thoroughly washing forearms if there is a risk of exposure to droplets.[60] It is also stated that for delivery of care to any individual who is 1) part of a vulnerable group and meets the shielding criteria or 2) has someone in their household who meets the shielding criteria, a

single use disposable plastic apron must be worn for the protection of the patient.[60] These sources are however, expert opinion and specific to COVID-19.

Some in-vitro experimental studies looked at the survivability of specific pathogens on differing fabrics and plastics. In one study, *P. aeruginosa, S. marcescens, Proteus mirabilis, E. coli, K. pneumonia, Acinetobacter species and Enterobacter species* demonstrated survival times of 2 to 840 hours on cotton fabrics which are commonly used in scrubs and tunics worn by HCWs.[46] In another study, *Staphylococci* strains survived for at least one day on all test materials and *Enterococcus* strains survived for at least 11 days.[47] Another study looked at the survivability of SARS on differing fabrics and plastics.[48] SARS-CoV survived on plastic (polypropylene coated with polyethylene film) disposable gown material for 2 days.[48] When a cotton gown was tested, SARS-CoV survived for 5 minutes to 24 hours depending on amount of artificially seeded virus.[48] Limitations include the *in vitro* nature of the experiments meaning environmental factors which may impact survivability were not addressed. It is also unclear if the concentrations of bacteria and virus used to inoculate the fabrics represent common amounts of bodily contamination following care. The findings of these studies provide evidence of the long survival time of some bacterial and viral isolates on materials commonly used in healthcare environments, including cotton clothing, supporting the need for single-use protective clothing to be worn when HCWs come into contact with colonised/infected patients. The evidence for efficacy of aprons and gowns for protection against contamination is a separate matter.

What type(s) of aprons/gowns should be used for TBPs?

Tanabe et al conducted an in vitro experimental study whereby adhesion of artificially-seeded MRSA to different gown/coverall fabrics was assessed both when material was undamaged and when subjected to machine derived pressing and friction.[61] Undamaged, gowns made from material N (polyester with a water-repellent finish) and material V (chemical protective garment made from flash spun high-density polyethylene) were found to be comparable in their resistance to MRSA adhesion and better than material C (material V with an additional polymer coating).[61] Limitations of this study include the artificial nature of the pressing and rubbing, the specific fabrics used as well as the focus on MRSA only. MRSA adhesion is also an indirect measure of nosocomial transmission risk. This study highlights that damage caused by regular care activities could potentially increase bacterial adherence in class 3 protective clothing and surgical gowns.

In *Verbeek's* 2020 systematic review, various types of PPE were assessed in regards to their efficacy in providing protection against highly infectious diseases.[53] Six studies were included that compared different types of gown and protective clothing,[53] however, four of these were excluded from this ARHAI Scotland review when assessed individually due to their low quality. In line with this, authors concluded that low to very low grade evidence suggests that greater coverage of the body may lead to better protection but that protective clothing which provides greater coverage may be more difficult to doff.[53]

3.3 Implications for Research

There is limited scientific evidence on the use of aprons and gowns in health and social care, particularly in the context of social care settings. However, there is, for the most part, consensus of expert opinion. The studies described in this section have not been used to inform final recommendations but are described below as they may indicate prudent avenues for further research.

Type of apron/gown

A limited number of controlled trials have been conducted using surgical gown and drape materials coated with antibacterial substances. These trials show promise but are currently limited by small sample sizes and indirect measures of SSI risk and/or nosocomial infection.[62, 63]

It has been demonstrated that the glove gown interface could be a potential source of surgical site contamination therefore indicating that further research may be needed into mitigating this risk.[64] One UK expert opinion source stated that sterile adhesive tape could be placed circumferentially around the proximal end of gloves, covering the non-waterproof cuff and adhering to the waterproof sleeve of the gown.[65] Authors state that this is to avoid the risk of contamination from non-waterproof cuffs which anecdotally become contaminated with sweat.[65]

Specific designs of gowns have been explored in a limited way with a suggestion that gowns with tighter wrists and more wrist/hand coverage may result in less wrist and hand contamination during doffing, however, further research in this area is needed.[66]

The HSE and MHRA state that long sleeved, single use, non-sterile, plastic aprons should have over the head designs which are perforated to facilitate removal through the head loop and

avoid the apron having to be pulled over the head when doffing.[28] They do not stipulate the same feature for sleeveless plastic aprons which could be considered to be an oversight.[28]

Removing and/or changing aprons/gowns

One study explored the effects of time on bacterial contamination of surgical gowns following total hip arthroplasty procedures.[43] Their findings demonstrated borderline significance and suggested that further investigation is needed into whether changing of gowns mid-way through long surgeries may influence SSI rates.

There is insufficient evidence to support the wearing of cover gowns over surgical attire to prevent infection when theatre staff leave the theatre area temporarily.[20]

There is a multitude of studies on transference of bacteria from colonised patients to PPE but a lack of studies or evidence for gown contamination being transferred to patients from HCW PPE.

4. Recommendations

4.1 SICPs Recommendations

This review makes the following recommendations based on an assessment of the extant professional literature on the use of aprons/gowns as PPE for standard infection control purposes:

Are there any legislative requirements for the use of aprons/gowns as PPE for infection control purposes?

The Health and Safety at Work etc Act (1974), Control of Substances Hazardous to Health (2002 as amended) regulations and Personal Protective Equipment at Work Regulations 1992 (as amended) legislate that employers (i.e. NHS Scotland) must provide PPE which affords adequate protection against the risks associated with the task being undertaken. Employees (i.e. health and social care workers) have a responsibility to comply by ensuring that suitable PPE is worn correctly for the task being carried out.

(Mandatory)

PPE must fit appropriately and, if being worn with other pieces of PPE, the employer shall make sure that the pieces are compatible with each other and in wearing them together, do not reduce the level of protection.

(Mandatory)

Employers must ensure that PPE is maintained in good working order and in a clean condition.

(Mandatory)

PPE should be CE marked and comply with the Personal Protective Equipment Regulations 2002.

(Mandatory)

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

(Mandatory)

When/where should aprons/gowns be worn for SICPs?

Aprons/gowns should be worn when it is anticipated that there may be exposure to blood, body fluids, secretions or excretions through close contact with a patient or any activity/procedure with a choice of apron or gown based on a risk assessment and anticipated levels of body fluid exposure.

(Category C recommendation)

Aprons/gowns should be worn during aerosol-generating procedures in patients who are not suspected of carrying an infectious agent for which alternative PPE may be recommended. The choice of apron or gown is based on a risk assessment and anticipated level of body fluid exposure.

(Category B recommendation)

Full body gowns are not indicated for routine use in neonatal intensive care units.

(Category B recommendation)

Sterile surgical gowns should be worn by all scrubbed members of the operating theatre surgical team.

(Category C recommendation)

Sterile gowns should be worn for insertion of central venous catheters, insertion of peripherally inserted central catheters, insertion of pulmonary artery catheters and spinal, epidural and caudal procedures.

(Category C recommendation)

What type(s) of aprons/gowns should be used for SICPs?

Plastic aprons and/or fluid repellent gowns should be used in health and care settings for protection against body fluid splash and spray.

(Category C recommendation)

Disposable, single use plastic aprons can be used for direct patient care where minimal contamination of clothing may occur.

(Category C recommendation)

Full-body fluid repellent gowns must be used when there is a risk of extensive splashing of blood, body fluids, secretions or excretions.

(Category C recommendation)

A sterile gown is required for aseptic procedures.

(Category C recommendation)

Non-sterile, plastic, disposable aprons should be made from low density polyethylene (LDPE), not contain natural rubber latex, have ties which secure the apron around the body at the back or sides and have a minimum thickness, impact strength and tear resistance based on British standards (see appendix 1).

(Mandatory)

Surgical gowns should be of mid-calf length, have bonded seams and meet necessary British standards including those pertaining to flammability, liquid penetration, tensile strength (and sterility if labelled as sterile and used for aseptic procedures).

(Mandatory)

Surgical gowns should release minimal particles such as lint.

(Category C recommendation)

When are reusable aprons/gowns appropriate?

Fluid repellent reusable gowns are acceptable for use when protection against splash or spray of body fluids is needed but sterility is not required. Reusable gowns should not be worn in the operating theatre environment or for aseptic surgical procedures.

(Category C recommendation)

Reusable gowns should be appropriately processed between uses based on manufacturer's instructions.

(Mandatory)

When should aprons/gowns be removed/changed?

Aprons/gowns should be worn as single-use items and should be removed/changed after every task/procedure, episode of patient care or surgery.

(Category C recommendation)

Aprons/gowns should not be reused even for different tasks carried out consecutively on the same patient.

(Category C recommendation)

Aprons/gowns should be removed before leaving the patient's environment, for example, a patient's room or bed space area.

(Category C recommendation)

Aprons/gowns should be removed/changed if they become grossly contaminated.

(Category C recommendation)

If hand hygiene with soap and water is required, this should not be performed whilst wearing an apron/gown in line with a risk of apron/gown contamination; hand hygiene using ABHR is acceptable.

(Category B recommendation)

How should aprons/gowns be donned?

Hand hygiene should be performed before donning an apron or gown.

(Category C recommendation)

Aprons/gowns should be donned first followed by the mask, eye protection and gloves.

(Category C recommendation)

Reusable gowns should be inspected for integrity before donning.

(Category C recommendation)

When donning an apron:

- Remove apron from the roll or dispenser.
- Open it outwards ensuring the inner surface (when stored) faces the patient to prevent any contamination on its outer surface (based on storage) coming into contact with the patient
- Place the neck loop over your head
- Position the apron to cover as much of the front of your body as possible
- Fix the apron in place by tying the waist straps behind your back

(Category C recommendation)

When donning a gown:

- Gowns should be secured at the back of the neck and waist.
- They should fully cover torso from neck to knees, arms to end of wrists, and wrap around the back.

- When using a gown with back closure a second operator should assist in buttoning up the back.
- Gloves should be extended to cover the wrists over the gown's cuffs.

(Category C recommendation)

When donning a surgical gown for an aseptic procedure

- It is essential that gloves are extended to cover the wrists and the gown's cuffs.
- The gown cuff of the ungloved team member should remain at or beyond his or her fingertips. The ungloved team member inserts his or her hand into the glove so that the gown cuff touches only the inside of the glove

(Category C recommendation)

When worn as part of contact precautions, an apron (or gown if excessive splash or spray is anticipated) should be donned for direct care delivery and contact with the patient's care environment.

(Category C recommendation)

How should aprons/gowns be doffed?

In regards to a PPE ensemble, gloves should be removed first, followed by aprons/gowns, eye protection and mask, whilst avoiding self-contamination.

(Category C recommendation)

Aprons/gowns should be removed using the ties at the back and contact with the sleeves or front should be avoided.

(Category C recommendation)

To remove an apron:

- Break the ties at the neck/back.
- Pull the apron away from the neck and shoulders, taking care to only touch the inside surface, i.e. ensuring the apron is dirty side to dirty side.
- The apron should then be folded or rolled into a ball and placed in the appropriate waste stream.

(Category C recommendation)

To remove a gown:

- Untie the ties at the back.
- Using a peeling motion the gown should be pulled down from each shoulder so that the gown is turned inside out.
- Taking care to avoid contact with the body, the gown should be rolled into a ball and placed in either the appropriate laundry or waste stream.

(Category C recommendation)

Hand hygiene should be performed after removal of aprons/gowns.

(Category B recommendation)

An apron/gown should be removed before leaving the patient room/environment.

(Category B recommendation)

How should aprons/gowns be disposed of?

Aprons and single use gowns should be disposed of into the appropriate waste stream (contaminated/hazardous) in accordance with local policies for waste management.

(Category C recommendation)

Non-disposable protective clothing should be placed in a designated container or laundry bag and sent for laundering.

(Category C recommendation)

Hand hygiene should be performed following disposal of PPE.

(Category C recommendation)

How should aprons/gowns be stored?

Aprons/gowns should be stored away from direct sunlight, heat sources and liquids, including chemicals, in an area that is clean and protects them from contamination.

(Mandatory)

4.2 TBP Recommendations

This review makes the following recommendations based on an assessment of the extant professional literature on the use of aprons/gowns as PPE for transmission based infection control purposes

When/where should aprons/gowns be worn for TBPs?

An apron/gown should be worn when caring for patients known or suspected to be colonised/infected with antibiotic resistant bacteria including contact with the patient's environment.

(Category B recommendation)

What type(s) of aprons/gowns should be used for TBPs?

Plastic aprons and/or fluid repellent gowns should be used in health and social care settings for protection against body fluid splash and spray.

(Category C recommendation)

A full body fluid repellent gown should be worn when conducting AGPs on patients known or suspected to be infected with a respiratory infectious agent.

(Category C recommendation)

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Appendix 1: Specific standards relating to the quality and performance of aprons and gowns

Standard	Title	Description	Publication date
BS EN 13795:2019	Surgical clothing and drapes. Requirements and test methods.	This standard sets out the general requirements and tests for disposable and reusable surgical drapes and gowns including water-resistance tests, microbiological resistance tests, burst tests and tensile tests.	April 2019
BS EN ISO 22610:2006	Surgical drapes, gowns and clean air suits, used as medical devices, for patients, clinical staff and equipment. Test method to determine the resistance to wet bacterial penetration.	This standard sets out the test method to determine the resistance of surgical drapes, gowns and clean air suits to wet bacterial penetration.	January 2007.
BS EN ISO 22612:2005	Clothing for protection against infectious agents. Test method for resistance to dry microbial penetration.	This standard describes a test method, with the associated equipment, that may be used to determine a material's resistance to dry penetration of bacteria on particles in the size range most typical for human skin scales.	March 2005.

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.
Statutory Instrument 2002 No. 1144	Health and Safety – Personal Protective Equipment Regulations 2002	This instrument sets out the standards for PPE in the UK. Schedule 4 sets out the standards for conformity across the UK (and the EU) and requires that **all** PPE is **CE marked**. 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.	May 2002.
BS EN 556-1:2001	Sterilization of medical devices. Requirements for medical devices to be designated "STERILE". Requirements for terminally sterilized medical devices.	This standard outlines the requirements for a product to be deemed sterile at use and applies to sterile surgical gowns.	December 2001
BS EN 7765-1: 2004	Plastics film and sheeting. Determination of impact resistance by the free-falling dart method. Staircase methods.	This standard applies to plastic aprons and their minimum appropriate impact strengths.	September 1996

Standard	Title	Description	Publication date
BS EN 6383-2:2004	Plastics. Film and sheeting. Determination of tear resistance. Elmendorf method.	This standard applies to plastic aprons and specifies a method of determining the force required to propagate a tear from a slit under specified conditions of loading.	November 1991

Legend:

BS = British Standards produced by the British Standard Institution (www.bsigroup.co.uk)

EN = European Standards (European Norm) produced by the European Committee for Standardisation (www.cen.eu)

ISO = International Standards produced by the International Standards Organization (www.iso.org)

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 Grading of recommendations

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

Appendix 3: Search Strategy

EMBASE and MEDLINE search from 2000 - Current

1. Gown*.mp
2. Apron*.mp
3. 1 or 2
4. Exp Hospitals/
5. Exp Infections/
6. Exp Infection Control/
7. Exp Disease Transmission, Infectious/
8. 4 or 5 or 6 or 7
9. 3 and 8

CINAHL search from 2000 - Current

1. Gown*
2. Apron*
3. 1 or 2
4. (MH "Hospitals+")
5. (MH "Infection+")
6. (MH "Infection Control+")
7. (MH "Disease Transmission+")
8. 4 or 5 or 6 or 7
9. 3 and 8