

Indications and Techniques for Hand Hygiene

Literature Review

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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
2.0	December 2022	<p>Updated after review of current literature.</p> <p>Change of title from 'Hand washing, hand rubbing and indications for hand hygiene' to 'Indications and techniques for hand hygiene'.</p> <p>To include all variants of hand hygiene, the following objective was changed from 'What is the correct process and technique to ensure that all surfaces of the hands are covered during washing?' to 'What is the correct process and technique when using hand rub, hand wipe and alternative products to ensure effective hand hygiene?'</p> <p>Amalgamation of objectives below into 'When should hand hygiene be performed?':</p> <ul style="list-style-type: none">• When should hand hygiene be performed?• What is the evidence for each of the five key moments as indications for hand hygiene?• Are there any additional key moments where hand hygiene (hand washing or alcohol based hand rub (ABHR) use) should be performed? <p>Amalgamation of objectives below into 'Where should hand hygiene products be placed in the care environment?':</p> <ul style="list-style-type: none">• Where should alcohol based hand rub products be placed in the care environment?• Where should hand washing products be placed in the care environment? <p>Removal of objective that will be covered in the separate 'Hand Hygiene: Products' review:</p> <ul style="list-style-type: none">• Is the use of alcohol based hand rubs suitable for individuals who abstain from alcohol for religious reasons?
1.0	January 2020	Final for publication

Approvals

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2.0	December 2022	National Policy, Guidance and Evidence (NPGE) Working Group
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Contents

1. Objectives	7
2. Methodology	8
3. Discussion	8
3.1 Implications for practice	8
3.2 Implications for research	24
4. Recommendations	25
References	32
Appendices	32
Appendix 1: Grades of recommendation	40

1. Objectives

The aim of this review is to examine the extant scientific literature regarding indications and techniques for hand hygiene in health and care settings to inform evidence-based recommendations for practice.

The specific objectives of the review are to determine:

- When should hand hygiene be performed?
- What is the correct process and technique for hand washing to ensure effective hand hygiene?
- What is the correct process and technique when using hand rub, hand wipe and alternative products to ensure effective hand hygiene?
- What is the recommended water temperature for hand washing?
- How should hands be dried after hand washing?
- What is the available evidence regarding infection risk from fingernails to enable effective hand hygiene?
- What is the available evidence to support the 'bare below the elbows' policy?
- Is there available evidence to permit any wearing of jewellery in relation to hand hygiene, including jewellery worn for religious reasons?
- Where should hand hygiene products be placed in the care environment?
- What are the requirements for sink design, provision and types of taps for clinical hand wash basins?
- Where should clinical hand wash basins be placed in health and care settings?

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

When should hand hygiene be performed?

In total, 21 publications were identified that provide evidence relating to when hand hygiene should be performed which included nine before and after studies,¹⁻⁹ five guidelines,¹⁰⁻¹⁴ two expert opinions,^{15, 16} two retrospective cohort studies,^{17, 18} two interrupted time series studies,^{19, 20} one environmental study.²¹ In accordance with the SIGN 50 methodology, 14 of these were graded level 3 evidence (nine before and after studies,¹⁻⁹ two retrospective cohort studies,^{17, 18} two interrupted time series studies^{19, 20} and one environmental study²¹) and two guidance documents were graded level 4 evidence due to their lack of methodology.^{15, 16} Five other guidance documents (NICE, AORN, epic3, WHO, SHEA/IDSA) that are included in this section were assessed as 'Recommend' by the AGREE tool.¹⁰⁻¹⁴ In this update, four pieces of evidence have been added which included two retrospective cohorts,^{17, 18} one interrupted time series¹⁹ and one guidance document (AORN).¹¹

Most of the studies and guidance refer to the World Health Organization's (WHO) '5 moments for hand hygiene'.¹³ The WHO published guidance on the application of the '5 moments' in outpatient settings in 2012,¹⁶ in some settings 'moment 5' is removed as it is typically combined with 'moment 1' for example in care homes, in these settings the indications for hand hygiene may be referred to as the '4 Moments'. The concept of the five moments is based on an evidence-based hand transmission model and aims to provide reference points for when hand hygiene should be performed in order to interrupt the transmission of microorganisms throughout delivery of care. The five key moments are defined below including the relevant evidence per moment:

Moment 1: Perform hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) before touching a patient.^{10, 11, 13} There is consensus in the literature that hand hygiene should be performed using liquid soap and water or an alcohol based hand rub (ABHR) (if hands are not visibly soiled) before touching a patient.^{12, 14, 15}

Observational studies have demonstrated the risk of transmission to patients following contact with contaminated hands of healthcare workers (HCW).^{1-3, 20}

Moment 2: Perform hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) before carrying out a clean/aseptic procedure such as handling an invasive device.^{10, 11, 13, 14} There is a consensus of evidence that hand hygiene should be performed before carrying out a clean/aseptic procedure such as handling an

invasive device;^{12, 15} performing hand hygiene at this moment has been associated with fewer complications occurring in peripheral venous catheters.⁴

Moment 3: Hand hygiene should be carried out using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) after contact with body fluids, mucous membranes or wound dressings.^{10, 11, 13} There is a substantial volume of evidence indicating that hand hygiene should be performed using liquid soap or ABHR (if hands are not visibly

soiled) immediately after contact with body fluids, mucous membranes or wound dressings.^{12, 15} It is recommended in the National Infection Prevention and Control Manual (NIPCM) [gloves literature review](#) that when there is a risk of contact with blood, body fluids (including but not limited to secretions and/or excretions), non-intact skin, mucous membranes and lesions and/or vesicles, gloves should be worn to protect the HCW and/or the patient. However, gloves should not be worn as a substitute to hand hygiene and hand hygiene should be performed before donning and after removing sterile or non-sterile gloves.¹⁰⁻¹⁵ Performing hand hygiene at this indication is necessary to reduce the risk of infection to HCWs, as microorganisms can be isolated from infected wounds, but also to reduce the risk of transfer of microorganisms from a colonised to a clean site during different care activities on the same patient.¹⁵

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Moment 4: Perform hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) after touching a patient.^{10-13, 15} Contamination of HCW hands following direct contact with patients has been evidenced in a number of studies.^{1-3, 5-7, 19,}

²⁰ There is some evidence from an observational study showing the potential for microorganisms to be transferred from Vancomycin-resistant Enterococci (VRE)-positive sites on patients' skin to VRE-negative body and/or environmental sites.² As such, hand hygiene should be performed using liquid soap and water or an ABHR (if hands are not visibly soiled) between carrying out different care activities on the same patient.^{12, 13}

Moment 5: Hand hygiene should be carried out using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) following contact with the patient's immediate surroundings.^{3, 10-15} The fifth moment of the WHO hand hygiene guidelines is defined as “after touching patient surroundings” and indicates that hand hygiene must occur after exposure to any surface in the patient surroundings or care environment.¹³ In terms of the hospital environment, this encompasses “...all inanimate surfaces that are touched by or in direct physical contact with the patient such as the bed rails, bedside table, bed linen, infusion tubing or other medical equipment” and “...surfaces frequently touched by HCWs while caring for the patient...”.¹³ A number of studies have demonstrated that hands can become contaminated after contact with contaminated surfaces such as the patient's bed, bedside table or equipment within the patient's surroundings.^{1-3, 8, 9, 20} Additionally, the outer (plastic) surface of medical charts were identified as a risk for transmission of HAI.²¹ In general wards, 63.5% of the medical charts were found to be contaminated whereas the incidence of chart contamination was significantly higher (83.2%) in the ICUs.²¹

In addition to the moments described above, the WHO Guidelines on Hand Hygiene in Healthcare, the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force and the Association of periOperative Registered Nurses (AORN) guidelines for perioperative practice recommend that hand hygiene is performed using liquid soap and water or ABHR (if hands are not visibly soiled) before handling medication or preparing food and after visiting the toilet.^{11, 13-15}

It is mentioned in the various guidance above (WHO, AORN, NICE, CDC, SHEA/IDSA, Epic3) that soap and water should be used when hands are visible soiled or potentially contaminated with blood, other body fluids or excretions they must be washed with liquid soap and water.¹⁰⁻¹⁵ WHO, AORN, NICE and SHEA/IDSA guidelines also add that water and soap is preferable if exposure to potential spore-forming pathogens is strongly suspected or proven or when caring for patients with vomiting or diarrhoeal illness (regardless of wearing gloves).^{10, 11, 13, 14} Further information on when to use either hand washing products or hand rub products can be found within the [Hand Hygiene: Products review](#).

Recently, there has been a large focus on improving compliance across all of the hand hygiene moments as observational studies show that enhanced compliance with general hand hygiene is linked to a decrease in the incidence of HAIs which confirms that hand hygiene is important for prevention of HAIs.^{17, 18} However, it is important to note that this link is not a direct correlation, as other factors might influence the decrease of HAI incidence such as changes in other IPC measures.

What is the correct process and technique for hand washing to ensure effective hand hygiene?

Evidence that addressed the process and technique for hand washing included four guidance documents,¹⁰⁻¹³ two before and after studies,^{22, 23} one prospective cross-over study,²⁴ one experimental study²⁵ and one piece of expert opinion.¹⁵ In accordance with SIGN 50 methodology, four were graded level 3 evidence (two before and after studies,^{22, 23} one prospective cross-over study,²⁴ experimental study²⁵), and one was graded level 4 evidence (expert opinion¹⁵). The guidance documents (NICE, AORN, epic3, WHO) included in this section were assessed using the AGREE tool as 'Recommend'.¹⁰⁻¹³ In this update, three pieces of evidence have been added of which two are before and after studies^{22, 23} and one is a guidance document (AORN).¹¹

It is recommended that all cuts and abrasions should be covered with a waterproof dressing before performing hand hygiene, including hand washing.^{10, 12}

There is consensus in the literature regarding the recommended method for hand washing in the healthcare setting, which can be summarised as follows:¹⁰⁻¹³

- wet hands under running warm/tepid water
- apply the manufacturers recommended quantity of liquid soap
- rub hands together for at least 15 seconds, ensuring all surfaces of the hands are covered
- rinse hands well under running water
- dry hands thoroughly using a disposable paper towel
- turn off the tap using elbow or a paper towel to prevent contamination of clean hands

None of the evidence identified recommends how the tap should be turned on before handwashing is commenced. Moreover, there is not a consistent evidence base to inform how all surfaces of the hands should be covered during hand washing. The epic3 and NICE guidelines both mention that the hand wash solution must come into contact with all the hand surfaces and particular attention needs to be paid during rubbing to the tips of the fingers, the thumbs and the areas between the fingers.^{10, 12} However, there is no mention of a specific technique to do so. Ayliffe *et al* published the first description of a technique in 1978 and despite the fact that this study has several limitations and was not designed for application in clinical

practice, the WHO recommend this technique as best practice and it has been adopted internationally.^{13, 25} The six step technique is as follows:^{13, 25}

- rub hands palm to palm
- rub right palm over the back of the other hand with interlaced fingers and vice versa
- rub palm to palm with the fingers interlaced
- rub the backs of fingers to opposing palms with fingers interlocked
- use rotational rubbing of the left thumb clasped in the right palm and vice versa
- use rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa

One cross-over trial comparing bacterial reduction when using the technique described with modified techniques, found that a shortened repeated version of the six step technique was not significantly superior to the six step technique at reducing *Clostridioides difficile* from hands.²⁴

Tools are available to assess the efficacy of staff hand washing techniques and supporting quality improvement material. For example, powered activated carbon/charcoal (PAC) that acts as a tracer or black-light sensitive lotion can be used to visually display the deficit in their technique.^{22, 23}

What is the correct process and technique when using hand rub, hand wipe and alternative products to ensure effective hand hygiene?

Very limited evidence has been identified regarding the process and technique of using hand wipes and alternative products. Therefore, this section is mainly focused on hand rubbing. In total, 28 papers informed the evidence base for the correct process and technique when using hand rub and one paper²⁶ (a randomised controlled trial (RCT)) was identified that covered the technique for the use of hand wipes. The evidence base includes nine before and after studies,²⁷⁻³⁵ seven experimental studies,³⁶⁻⁴² five guidance documents,¹⁰⁻¹⁴ five RCTs,^{26, 43-46} one case-control study,⁴⁷ one single cohort study,⁴⁸ and one expert opinion.¹⁵ In accordance with SIGN 50 methodology, five are considered level 1 evidence (five randomised controlled trials,^{26, 43-46} one is considered level 2 (case-control study⁴⁷), seventeen are considered level 3 evidence (nine before and after studies,²⁷⁻³⁵ seven experimental studies,³⁶⁻⁴² and one cohort

study⁴⁸), and one is considered level 4 evidence (expert opinion¹⁵). The five guidance documents (NICE, AORN, epic3, WHO, SHEA/IDSA) included in this section were assessed using the AGREE tool as 'recommend'.¹⁰⁻¹⁴ In this update, five pieces of evidence have been added which includes two RCTs,^{43, 44} one before and after study,²⁷ one experimental study³⁶ and one guideline (AORN) that was assessed as AGREE 'Recommend'.¹¹

As with hand washing, it is recommended that all cuts and abrasions should be covered with a waterproof dressing prior to performing hand hygiene.¹²

It is recommended that hand rubbing should be performed until hands are dry, typically for a minimum of 20-30 seconds.^{13, 15, 29-31} Several experimental studies have tested ABHR application at short times (≤ 15 seconds) and yielded mixed results in terms of antimicrobial activity and hand coverage.^{32, 33, 37, 38} One RCT showed no statistical difference in bioburden load on fingertips following 15 seconds or 30 seconds hand antiseptis application time.⁴³ However, compliance did increase by 15% when shortening the application time which can be an argument for using a shorter (15 seconds) application time. Application times of longer than 30 seconds have not been associated with greater microbial reduction.³⁸

In practice, the time taken for hands to dry is affected by the volume of ABHR product applied to the hands,³⁹ it has been suggested that the optimal volume of ABHR is that which is sufficient to keep the hands wet for 30 seconds and that this will vary by product type and individual hand size.^{31, 40} Larger volumes of ABHR typically have better microbicidal efficacy.^{29, 34} This is likely because larger volumes provide greater hand coverage.^{40, 47} The volume of ABHR required for adequate hand coverage is directly related to hand size;^{14, 41, 48} and microbial reduction by ABHR has been shown to be inversely related to hand size.⁴¹ A number of identified studies indicate that relatively large volumes (approximately 3 mL) are required to ensure full coverage and associated increased antimicrobial activity.^{29, 36, 47, 48} The volume of ABHR required for optimum efficacy is likely to vary for different formulations and so manufacturer's instructions regarding the volume that will provide adequate coverage of the hands should be followed.^{11, 13-15, 40} There is evidence that the volumes of ABHR likely to be used in practice may not be optimum because drying times of appropriate volumes may exceed 30 seconds.⁴² In the absence of manufacturer's instructions, WHO suggests that a palmful of product is enough to cover all surfaces of the hands.¹³

The technique for hand rubbing recommended by the WHO is the same as that recommended for hand washing and ensures a methodological approach is taken.¹³ The technique is:

- dispense ABHR into the cupped palm of one hand

- rub hands palm to palm
- rub right palm over the back of the other hand with interlaced fingers and vice versa
- rub palm to palm with the fingers interlaced
- rub the backs of fingers to opposing palms with fingers interlocked
- use rotational rubbing of the left thumb clasped in the right palm and vice versa
- use rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa

A RCT demonstrated that this six-step technique was more superior to use than the US Centers for Disease Control and Prevention (CDC) recommended technique,⁴⁵ which provides less procedural detail. A modified version of the WHO technique which added a further step covering fingertip decontamination before rubbing hands palm to palm found a significantly greater bacterial reduction compared to the original technique.³⁵ A few studies have considered shortening the WHO technique (3-step); however, their results did not favour either of the methods.^{27, 28, 45, 46} It is however shown that a shortened and thus simpler hand hygiene technique increases compliance and potentially improves hand hygiene practice within the clinical setting which might have positive effects on patients' clinical outcomes.^{27, 45} UK guidance (NICE and epic3) recommends that the process should ensure ABHR comes into contact with all surfaces of the hand and that particular attention should be paid to the fingertips, thumbs and areas between the fingers.^{10, 12}

There is some evidence that a 'responsible application' technique, meaning one in which there are no prescribed steps, is as effective as a prescribed technique or may even result in a better distribution of hand rub.^{37, 44, 46} However, there is consensus within guidelines (NICE, epic3 and CDC) that a technique ensuring that all surfaces of the hands are covered should be utilised.^{10, 12, 15}

No recommendations for the correct technique when using antimicrobial hand wipes or alternative products for hand hygiene were identified in published guidelines. Studies examining the efficacy of wipes did not report the application technique used except for one RCT where it was mentioned that manufacturer's instructions for use were followed.²⁶

What is the recommended water temperature for hand washing?

A limited volume of evidence was identified by this review which examines water temperature for hand washing. In total, five pieces of evidence were identified which included three guidelines,^{11, 13, 14} one before and after study⁴⁹ and one expert opinion.¹⁵ In accordance with SIGN 50 methodology, one is considered level 3 evidence (before and after study⁴⁹) and one is considered level 4 evidence (expert opinion¹⁵). The three guidance documents (AORN, WHO, SHEA/IDSA) included in this section were assessed using the AGREE tool as 'Recommend'.^{11, 13, 14} In this update, one guidance document (AORN) was added.¹¹

One study found no significant effect on bacterial reduction associated with water temperatures ranging from 15 to 38 °C when using plain or antimicrobial soap.⁴⁹ The AORN recommend in their guidelines to control the water temperature for hand hygiene between 21.1° C and 26.7° C (70° F and 80° F) for the reason that water temperatures higher than 26.7° C (80° F) are conducive to the growth of *Legionella* bacteria.¹¹ However, it is recognised that additional research is needed to determine the effect on bacterial colonisation.

While little evidence was identified on the reduction of contamination, there is consensus in WHO, SHEA/IDSA and CDC guidelines that hands should be washed using warm or tepid water because repeated exposure to hot water may lead to the development of dermatitis and staff may be intolerant to cold water which may contribute to suboptimal hand washing.¹³⁻¹⁵

There is limited evidence to determine whether extremes of temperature (hot or cold) affect compliance of healthcare workers or the rigour of their hand washing technique, but expert consensus determined that compliance may be improved by washing with warm/tepid water rather than hot or cold.

How should hands be dried after hand washing?

In total, 11 publications informed the evidence base on how hands should be dried after hand washing which included four guidelines,¹⁰⁻¹³ four before and after studies,⁵⁰⁻⁵³ two experimental studies^{54, 55} and one expert opinion.¹⁵ In accordance with SIGN 50 methodology, six are considered level 3 evidence (four before and after studies⁵⁰⁻⁵³ and two experimental studies^{54,55}) and one is considered level 4 evidence (expert opinion¹⁵). The four guidance documents (NICE, AORN, epic3, WHO) included in this section were assessed using the AGREE tool as 'Recommend'.¹⁰⁻¹³ In this update, one guidance document (AORN) and one before and after study were added.^{11, 50}

Thorough drying of hands is important as wet hands have been shown to harbour more bacteria than dried hands.⁵¹ A few studies have compared various hand drying methods including warm air-dryers, high speed (or jet) air-dryers, and paper towels.⁵⁰⁻⁵⁵ High speed and warm air-dryers may be unsuitable for hand drying as they have been found to produce significantly more droplets which were dispersed over a larger area compared with use of paper towels.^{54, 55} As a result, high-speed air-dryers have been associated with significantly higher microbial contamination of environmental surfaces compared to paper towels and recovery of bacteria from surfaces of high speed air-dryers has been found to be significantly higher than from the surface of paper towel dispensers.⁵²

Three before and after studies examined the effectiveness of various hand drying methods for removing bacteria from washed hands and found mixed results. One study found that hand drying with paper towels resulted in a greater reduction of mean colony forming units (CFUs) than drying with a warm air-dryer or high speed air-dryer;⁵³ and another two studies found the opposite, that is high-speed air-dryers were more effective in reducing bacterial counts than drying with paper towels.^{50, 51} One of these studies used newly installed air dryers and these results might not directly translate to existing air dryers in health and care settings.⁵⁰

The use of paper towels is recommended in most national and international guidelines.^{10-13, 15} Recommendations include the use of good quality, disposable paper towels for hand drying.^{10-12, 15} It is also recommended that hands should be dried using a method that avoids recontamination and that the same towel(s) should not be used multiple times or by multiple individuals.^{11, 13, 15} There is consensus that cloth towels (both hanging and roll type), represent a contamination risk and are therefore unsuitable for use in health and care settings.^{13, 15}

What is the available evidence regarding infection risk from fingernails to enable effective hand hygiene?

In total, 11 publications were identified that discussed infection risk from fingernails in relation to hand hygiene. The evidence base includes five guidance documents,^{10-13, 56} one RCT,⁵⁷ one retrospective cohort study,⁵⁸ one cross-sectional study,⁵⁹ one before-and-after study,⁶⁰ one outbreak investigation⁶¹ and one expert opinion.¹⁵ In accordance with SIGN 50 methodology, one is considered level 1 evidence (RCT),⁵⁷ four are considered level 3 evidence (one retrospective cohort study,⁵⁸ one cross-sectional study,⁵⁹ one before-and-after study⁶⁰ and one outbreak investigation⁶¹) and one is considered level 4 evidence (expert opinion).¹⁵ Four guidance documents (NICE, AORN, epic3, WHO) included in this section were assessed using

the AGREE tool as 'Recommend'¹⁰⁻¹³ and one guidance document (DL(2018)4, Scottish Government) is considered mandatory.⁵⁶ In this update, one RCT (SIGN level 1+)⁵⁷ and one guidance document were added.¹¹

There is agreement across the literature that staff should keep nails short when working in health and care settings with the specific recommendation that finger nails should not exceed one-quarter inch (approximately 0.5 cm) in length beyond the end of the fingertip.^{10, 12, 13, 15, 58} However, it is not clear how this length was determined and one cross sectional study found a correlation between fingernails longer than 2 mm and the presence of *Staphylococcus aureus*.⁵⁹ The Scottish Government's Directorate Letter DL(2018)04 on dress code across NHSScotland, states that staff should keep their nails short and clean when providing patient care.⁵⁶

DL(2018)04 also states that NHSScotland HCWs should not wear false/artificial nails when providing patient care.⁵⁶ This requirement is consistent with the evidence identified from the extant professional literature by this review. Studies demonstrate that wearing false/artificial nails of any kind should not be permitted in the healthcare setting and this has been adopted by evidence-based guidelines.^{11-13, 15} While CDC (expert opinion) and WHO guidelines state that artificial nails or extenders should not be worn when having direct contact with patients at higher risk of infection,^{13, 15} others (for example NICE, AORN and Epic3 guidelines) suggest they should not be worn during any patient contact.¹⁰⁻¹² The evidence suggests that the wearing of artificial nails is inappropriate in the clinical setting due to the detrimental effects they have on hand hygiene in comparison to individuals with natural nails and the increase in hand contamination associated with wearing artificial nails.^{11, 58, 60} There is also evidence to link artificial nails with outbreaks of infection.^{11, 58, 61} An investigation of an outbreak of *Klebsiella pneumoniae* infections in a neonatal intensive care unit identified an association of infection with care from a HCW wearing artificial nails contaminated with ESBL-producing *K. pneumoniae*.⁶¹

The evidence regarding the wearing of nail products (that is polish/varnish and gel nails) is limited, as there are not many recent publications on the different types of nail polish. There is no direct evidence that the wearing of nail products increases hand contamination. In fact, one cross-sectional study found that nail polish had no impact on the bacterial loads of hands⁵⁹ whereas one RCT showed that wearing fresh nail polish (unchipped on day 1) reduced the bacterial loads compared to natural nails.⁵⁷ However, it was shown that chipped nail polish increases microorganism growth significantly and as the chipping increases, the bacterial load increases as well. Chipping of the nail polish occurs quickly, within 24 hours, and 90% of the nails were chipped on day two.⁵⁷ Therefore, the evidence suggests that chipped nail products may act as a reservoir for microorganisms and since chipping of nail polish occurs very quickly,

the wearing of nail polish may contribute to infection risk for patients. More research is required that investigates the growth of microorganisms when wearing durable nail products such as gel polish. The NICE and epic3 guidelines recommend that fingernails of HCWs should be free of nail polish when delivering patient care.^{10, 12}

What is the available evidence to support the ‘bare below the elbows’ policy?

Limited evidence has been identified that addressed the ‘bare below the elbows’ policy which refers to the absence of clothing and jewellery on the arm below the elbows. The wearing of jewellery is covered in the next research question (‘Is there available evidence to permit any wearing of jewellery in relation to hand hygiene, including jewellery worn for religious reasons?’) and thus this section covers the absence of clothing on the arm below the elbows. The evidence base includes three guidance documents^{10, 12, 56} and one before and after study.⁶² In accordance with SIGN 50 methodology, the one before and after study is considered level 3 evidence.⁶² Two guidance documents (NICE, epic3) included in this section were assessed using the AGREE tool as ‘Recommend’^{10, 12} and one (DL(2018)4, Scottish Government) was considered mandatory.⁵⁶ No new relevant studies have been added in this update.

Current national policy DL(2018)4 states that clinical staff should be ‘bare below the elbows’ when providing patient care which is also stated in NICE and epic3 guidelines.^{10, 12, 56} The rationale behind this is to allow for effective hand decontamination and to avoid contact of workwear with the patients or environmental surfaces.¹⁰ The DL(2018)4, Scottish Government recommends that staff who wish to cover their forearms for religious reasons may wear disposable over-sleeves, these must be removed and disposed of before performing hand hygiene and replaced with a new set after.⁵⁶ Staff who wish to cover their upper forearms for religious reasons may wear three-quarter length sleeves that are not loose but be able to be securely rolled/pulled back during handwashing.⁵⁶

The evidence base which currently underpins the policy is not comprehensive, and the majority of studies did not pass the appraisal stage of this review due to their limitations. A before and after study was identified which found that medical staff who were bare below the elbow and those that were not did not have significantly different bacterial loads on their hands following hand washing.⁶²

Is there available evidence to permit any wearing of jewellery in relation to hand hygiene, including jewellery worn for religious reasons?

In total, 12 publications were identified that provided evidence on wearing jewellery in relation to hand hygiene. The evidence base includes five guidance documents,^{10-13, 56} two before and after studies,^{63, 64} one case-control study,⁶⁵ one experimental study,⁶⁶ one cross sectional study⁵⁹ and two expert opinions.^{15, 67} In accordance with SIGN 50 methodology, one is considered level 2 evidence (case-control study⁶⁵), four are considered level 3 evidence (two before and after studies,^{63, 64} one experimental study,⁶⁶ one cross sectional study⁵⁹) and two are considered level 4 evidence (expert opinion^{15, 67}). Four of the guidance documents (NICE, AORN, epic3, WHO) included in this section were assessed using the AGREE tool as 'Recommend'¹⁰⁻¹³ and one (DL(2018)4, Scottish Government) is mandatory.⁵⁶ In this update, one guidance document (AORN)¹¹ and one case-control study⁶⁵ have been added.

A number of studies report that HCWs who wore jewellery, predominantly but not exclusively rings, exhibited greater bacterial counts on their hands, even following hand hygiene.^{59, 64, 65} An experimental study suggests that the jewellery itself can harbour microorganisms and thus pose an infection risk.⁶⁶ It should be noted that this experimental study showed that plain rings harboured lower numbers of bacteria in comparison to ornate rings, nonetheless a case-control study showed that there was no difference in hand contamination between a ring with or without a stone.^{65, 66} However, it has been discussed that the practicality of wearing a ring (especially with a stone) has the potential to damage gloves.¹¹

Evidence specifically regarding the wearing of watches or bracelets was limited.^{12, 13, 59, 63} Despite the fact that multiple pieces of guidance recommend that watches (including activity trackers) and wrist jewellery should be removed to ensure hands can be decontaminated throughout the duration of clinical work, the evidence behind this is not consistent.^{10, 12, 13, 56} One before and after study examining contamination of hands and wrist watches, concluded that wearing a watch does not contribute to higher levels of bacteria on hands unless they are physically manipulated or touched.⁶³ However, a cross-sectional study recovered more than three times as many bacteria from HCWs wearing watches than those without watches.⁵⁹

The DL(2018)4 states that NHSScotland HCWs should not wear any wrist or hand jewellery (other than a plain band ring) when providing patient care,⁵⁶ and this would also include pierced/embedded jewellery. Recommendations from a number of UK (NICE and epic3) and international (WHO) guidelines also state that jewellery should not be worn when providing clinical care¹³ or should at least be removed prior to hand hygiene.^{10, 12} However, CDC guidance

(expert opinion) published in 2002 states that the wearing of rings is an unresolved issue and therefore no recommendations were made.¹⁵ Although no evidence is identified on ring dosimeters (radiation rings), if these are worn in practice they should be treated like plain band rings.

Jewellery worn for religious reasons such as Kara bangles worn by initiated Sikhs do not require to be removed for hand decontamination, however, they should be pushed up the arm and secured in place to enable effective hand decontamination.⁶⁷ In regards to a plain band ring or ring dosimeter, this should also be manipulated when undertaking hand hygiene to enable effective hand decontamination.

Where should hand hygiene products be placed in the care environment?

In total, 13 pieces of evidence were identified that discussed the placement of hand hygiene products in the care environment which included five guidance documents,^{11-14, 68} two observational studies,^{69, 70} two before and after studies,^{71, 72} one cross-sectional study,⁷³ one retrospective cohort study⁷⁴ and two expert opinions.^{75, 76} In accordance with SIGN 50 methodology, six are considered level 3 evidence (two observational studies,^{69, 70} two before and after studies,^{71, 72} one cross-sectional study,⁷³ one retrospective cohort study⁷⁴) and two are considered level 4 evidence (expert opinions^{75, 76}). Four of the guidance documents (AORN, epic3, WHO, SHEA/IDSA) included in this section were assessed using the AGREE tool as 'Recommend'¹¹⁻¹⁴ and one is mandatory.⁶⁸ In this update, one guidance document assigned 'Recommend' by the AGREE tool (AORN)¹¹), one retrospective cohort study⁷⁴ and one expert opinion have been added.⁷⁵

The placement of hand hygiene products is crucial to encourage and assist staff to comply with correct hand hygiene practices.¹³ In terms of liquid soap and disposable paper towels, current NHSScotland guidance states that these must be wall mounted and placed at sinks allowing for easy operation.^{13, 76} One observational study examining two different layouts of hand hygiene products at hand wash basins observed the rates of hesitation and error when applying hand hygiene products, including soap, ABHR and moisturiser.⁶⁹ No significant difference was found between the two different layouts used. The authors suggest that standardising the layouts of products at sinks in health and care settings may reduce errors in hand hygiene.⁶⁹

In terms of hand rub products, it is recommended by national (Scottish Government, Health Facilities Scotland, epic3) and international (WHO, SHEA/IDSA) guidelines that they should be made available to staff as close to each individual patient as possible.^{12-14, 76} There is evidence

to demonstrate that higher rates of hand hygiene compliance are associated with ABHR dispensers which are easily visible upon entry to the clinical area;^{71, 73} that are near to the point of patient care;^{74, 75} and are placed close to an entrance or exit.⁷³ The WHO adds that ABHR products should be placed within five metres of toilets, where PPE is put on/removed and where healthcare waste is handled.⁷⁵ Products may be placed on a wall mounted dispenser, or attached to the end of each bed/bassinet.^{68, 74} Where this is not practical (for instance where there is a potential risk to the patient from ingestion), a personal ABHR dispenser may be used that is carried by staff on the belt or in the pocket^{11, 68, 72} It is important to note that there are some limitations of personal dispensers such as the small amount of hand rub that the containers hold, the cost, environmental considerations of disposable dispensers and the potential contamination of the external surface of the bottle.¹³

It is also recommended that hand rub should be made available for use by visitors, particularly where hand washing facilities are limited. Visitor use of ABHRs is also improved by placing dispensers in locations with increased visibility.⁷⁰ Health Facilities Scotland guidance states that local risk assessments should be undertaken to guide the placement of ABHR dispensers and the number of these required within clinical areas.⁷⁶ In addition, risks of ABHR related to fire, ingestion or unintended use should also be considered.^{11, 68} The AORN guidelines recommend that ABHR product dispensers should be at least 1.2m apart and not be placed above or within 2.5cm of an ignition source (for example electrical outlet, switch).¹¹

What are the requirements for sink design, provision and types of taps for clinical hand wash basins?

Limited evidence is identified regarding sink and tap design and provision for clinical hand wash basins. Most evidence is in the form of guidance (of which three were classified as expert opinion due to the absence of a systematic methodology) and there is a lack of studies in the literature regarding the provision and the most effective sink design to reduce contamination and splash risk. The evidence base included one guidance document,¹¹ three expert opinions⁷⁶⁻⁷⁸ and one experimental study.⁷⁹ In accordance with SIGN 50 methodology, one is considered level 3 evidence (experimental study⁷⁹) and three are considered level 4 evidence (expert opinions⁷⁶⁻⁷⁸). The guidance document (AORN) included in this section was assessed using the AGREE tool as 'Recommend'.¹¹ In this update, one experimental study⁷⁹ and one guidance document (AORN) have been added.¹¹

Sink design, provision and types of taps are important factors to consider when making an assessment of hand washing facilities. Health Facilities Scotland (HFS) guidance states that sinks located in the clinical area need to be fit for purpose (for example designed to prevent splashing, enable effective cleaning, not be able to have a plug or overflow and include a splash-back).⁷⁶ An experimental study that investigated three sink types observed significantly less droplets on the floor during handwashing when using a sink specifically designed to prevent splashing (hydrophilic glaze, moulded ceramic fin and thinned and rounded uppermost rims at the edges and back of the basin).⁷⁹

The adequate provision and visibility of sinks in clinical areas is important as this should encourage staff to comply with hand hygiene protocols. In critical care areas, each bed space should have a clinical wash-hand basin; however, the provision of more than is necessary presents a risk of infection from water due to the infrequent use and the resulting water stagnation.⁷⁶ It is therefore recommended that advice on the number and location of hand wash stations should be sought from the infection prevention and control team.⁷⁶ Furthermore, it is recommended that sinks used for hand washing should be used solely for this purpose and not be used for disposal of waste.^{11, 76, 77}

In terms of taps, HFS guidance states that both hot and cold running water should be available for employees where they are expected to wash their hands.⁷⁶ In healthcare settings mixer taps should be used as high water temperatures are used to control microorganisms such as *Legionella* spp.⁷⁶ The operation of the taps should allow them to be easily turned on and off without recontamination of the operator's hands (for example operated either by the elbow, knee or foot).⁷⁶ Although, the use of non-touch sensor taps can also aid this, there are known issues associated with the cleaning and flushing of these. In high risk units the use of sensor operated, automated taps is not recommended as the complexity of the internal mechanisms can result in a greater risk of contamination by microorganisms and biofilms.⁷⁸

The placement of the tap is crucial to prevent splashes and contaminated aerosols. It is therefore recommended that taps are placed in such a way that they do not point directly into the drain hole.^{11, 76} In addition, the use of a shallow sink will also cause splashing and therefore should be avoided.^{11, 76} Shallow sinks may not provide enough space under the tap to allow sufficient hand washing and avoidance of contact with the basin/tap. Therefore, the need for adequate spacing with respect to installation of adjuncts such as point of use filters should also be considered. Swan-neck tap outlets must not be used due to them not emptying fully, creating potential for stagnant water. Strainers and anti-splash devices for sink outlets should not be used as they can become easily contaminated.⁷⁶

Where should clinical hand wash basins be placed in health and care settings?

Limited evidence has been identified regarding the location of clinical hand wash basins in health and care settings. In total, six studies informed the evidence base which included two guidance documents,^{11, 14} one observational study,⁸⁰ one cross-sectional study⁸¹, one before and after study⁸² and one expert opinion.⁷⁶ In accordance with SIGN 50 methodology, three are considered level 3 evidence (one observational study,⁸⁰ one cross-sectional study⁸¹ and one before and after study⁸²) and one is considered level 4 evidence (expert opinion⁷⁶). The two guidance documents (AORN, SHEA/IDSA) included in this section were assessed using the AGREE tool as 'Recommend'.^{11, 14} In this update, one guidance document (AORN) was added.¹¹

Clinical hand wash basins should be in a visible and easily accessible location.^{11, 14, 76, 80-82} An observational study found that hand hygiene compliance increased following the installation of additional sinks, the design of which focused on increased visibility.⁸² However, there is a risk that too many sinks multiply the risks in relation to contamination, cleaning, supply and flushing. As previously mentioned, the provision of more than is necessary presents a risk of infection from water due to infrequent use and the resulting water stagnation.⁷⁶ In a cross-sectional study, adequate sink visibility was found to be correlated with increased hand washing frequency by healthcare staff.⁸⁰ Another cross-sectional study found that direct visualisation and distance to the sink from the patient care area was strongly associated with hand washing compliance.⁸¹ It is important to note that sufficient space between clinical hand wash sinks and patients is necessary to minimise risk of contamination by splash or spray. However, a minimal distance between clinical hand wash basins and the patient and/or preparation area to prevent spread of contamination by splash or spray has not been established due to a lack of evidence in the literature.¹¹ In areas where clinical procedures or examinations are undertaken (for example. outpatient departments) the sink should be located close to the procedure.^{14, 76} However, clinical procedures that require sterile fields should not be in the vicinity of sinks or clinical hand wash basins.

3.2 Implications for research

This systematic literature review has identified gaps in various subjects regarding indications and techniques for hand hygiene. More research and/or separate pieces of work are required to ascertain:

- sink and tap design features that limit transmission of organisms from their source and reservoir to external surroundings
- the effect on hand contamination when wearing different types of (durable) nail polish on natural nails
- the various aspects of microbial transmission, colonisation and infection and in particular the role of casual contact and environmental contact in the transmission of microorganisms

Much of the literature that examines indications and techniques for hand hygiene in health and care settings is in the form of expert opinion and consequently, when assessed, yields a low quality level of evidence. The identified literature on techniques for hand washing and rubbing, and methods for hand drying presented some conflicting results and further research is required in these areas, ideally with larger numbers of participants and in clinical settings.

The studies identified in this review were heterogeneous in design, typically had a small number of participants and were often confounded by factors such as hand size, volume of product used, differences in drying times and training of participants. These factors are often not adequately controlled in the published literature, for example one study reported a significant difference in compliance with technique between ABHR and non-antimicrobial soap and water which could have explained the difference in efficacy observed. It is challenging to synthesise strong recommendations from these heterogeneous studies, the evidence base would benefit from larger studies with better controls for variables such as volume, hand size, drying time, formulation and compliance with technique.

4. Recommendations

This review makes the following recommendations based on an assessment of the extant scientific literature on indications and techniques for hand hygiene in the health and care setting.

When should hand hygiene be performed?

The World Health Organization's '5 moments for hand hygiene' should be used to highlight the key indications for hand hygiene.

Moment 1: Hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) should be performed before touching a patient.

Moment 2: Perform hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) before carrying out a clean/aseptic procedure such as handling an invasive device.

Moment 3: Hand hygiene should be carried out using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) after contact with body fluids, mucous membranes or wound dressings.

Moment 4: Perform hand hygiene using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) after touching a patient.

Moment 5: Hand hygiene should be carried out using liquid soap and water or an alcohol based hand rub (if hands are not visibly soiled) following contact with the patient's immediate surroundings.

(Category B)

Some additional examples of hand hygiene moments include, but is not limited to:

- before handling medication
- before preparing food
- after visiting the toilet
- before putting on (donning) and after removing (doffing) of personal protective equipment (for example sterile or non-sterile gloves)

- between carrying out different care activities on the same patient

(Category B)

If hands are visibly soiled or potentially contaminated with blood, other body fluids or excretions they should be washed with liquid soap and water. Washing with liquid soap and water is also the preferable method after potential exposure to spore-forming pathogens or when caring for patients with vomiting/diarrhoeal illness.

(Category B)

What is the correct process and technique for hand washing to ensure effective hand hygiene?

Cuts and abrasions should be covered with a waterproof dressing before commencing hand washing.

Hands should be washed as follows:

- wet hands under running warm/tepid water
- apply the manufacturers recommended quantity of liquid soap – normally via a measured dispenser
- rub hands together for at least 15 seconds, ensuring all surfaces of the hands are covered with lather
- rinse hands well under running water
- dry hands thoroughly using a disposable paper towel
- turn off the tap(s) using elbow or a paper towel to prevent contamination of clean hands

The following technique should be used to ensure that all surfaces of the hands are covered during hand washing:

- rub hands palm to palm
- rub right palm over the back of the other hand with interlaced fingers and vice versa
- rub palm to palm with the fingers interlaced
- rub the backs of fingers to opposing palms with fingers interlocked

- use rotational rubbing of the left thumb clasped in the right palm and vice versa
- use rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa

(Category B)

What is the correct process and technique when using hand rub, hand wipe and alternative products to ensure effective hand hygiene?

Application of a sufficient volume of ABHR to cover all surfaces of the hands is important to ensure effective hand hygiene.

(Category B)

Manufacturer's instructions should be followed for the volume of ABHR required to provide adequate coverage of the hands. In the absence of manufacturer instructions, volumes of approximately 3 mL are recommended to ensure full coverage.

(Category B)

Hands should be rubbed together to ensure that the ABHR solution covers all surfaces of the hands.

(Category B)

Hand rubbing should be performed until the hands are dry, typically for a minimum of 20-30 seconds.

(Category B)

Manufacturer's instructions should be followed for correct technique when using hand wipes for hand hygiene.

(Category C)

What is the recommended water temperature for hand washing?

Hands should be washed with warm/tepid water to mitigate the risk of dermatitis associated with repeated exposures to hot water and to maximise hand washing compliance. Compliance may be compromised where water is too hot or too cold.

(Category B)

How should hands be dried after hand washing?

Hands should be dried thoroughly following hand washing using a soft, absorbent, disposable paper towel from a dispenser which is located close to the sink but beyond the risk of splash contamination.

- Cloth towels – either roll or hanging type – pose a contamination risk and therefore should not be used in health and care settings.
- Air-dryers, including high speed air-dryers, should not be used in the clinical setting or other health and care settings because they may disperse microorganisms into the environment.

(Category B recommendation)

What is the available evidence regarding infection risk from fingernails to enable effective hand hygiene?

When providing patient care, nails should be kept short and clean, and staff should not wear false/artificial nails.

(Mandatory)

Fingernails should not exceed one-quarter inch (approx. 0.5 cm) beyond the end of the fingertip to prevent the accumulation of debris under nails and to facilitate effective hand hygiene.

(Category B recommendation)

Nail products should not be worn as chipped nails may harbour bacteria and thus present an infection risk.

(Category B recommendation)

What is the available evidence to support the 'bare below the elbows' policy?

It is recommended that staff providing care in NHSScotland settings should be 'bare below the elbows'.

(Mandatory)

Is there available evidence to permit any wearing of jewellery in relation to hand hygiene, including jewellery worn for religious reasons?

Hand or wrist jewellery, including wrist watches, activity trackers, embedded jewellery, bracelets and rings (excluding a plain finger ring), should not be worn when providing patient care because they can inhibit effective hand decontamination and may increase bacterial load on the hands.

(Mandatory)

Bracelets or bangles which are worn for religious reasons should be able to be pushed higher onto the arm and secured in place for all patient care activities. This is to enable effective hand hygiene.

(Category C recommendation)

Where should hand hygiene products be placed in the care environment?

Liquid soaps and paper towels must be wall mounted and placed near sinks allowing for easy operation.

(Category B recommendation)

ABHR should be made available to staff as near to each individual patient as possible. Where this is not practical (for instance where there is a potential risk to the patient from ingestion), a personal ABHR dispenser may be used that is carried by staff on the belt or in the pocket

(Category B recommendation)

A risk assessment should be carried out considering aspects such as location, visibility, dispenser size and whether the use of personal dispensers is required/appropriate. This assessment should also consider the risk in relation to fire, ingestion, or unintended use.

(Category B recommendation)

What are the requirements for sink design, provision and types of taps for clinical hand wash basins?

Sinks located in the clinical area need to be fit for purpose (for example designed to prevent splashing, enable effective cleaning, designed not to have a plug or overflow, include a splash-back). Sinks should be large enough to contain most splashes and enable the correct hand washing technique to be performed without excessive splashing of the user and the surrounding area.

(Category C recommendation)

Advice on the number and location of hand wash stations should be sought from the infection prevention and control team as this varies dependant on the clinical area.

(Category C recommendation)

Adherence to [SHFN part A](#) for sink and tap design and provision is required when undertaking any refurbishment, new builds or remedial works within the healthcare environment.

(Category C recommendation)

Clinical hand wash basins should be dedicated for the purposes of hand washing only and not be used for disposal of clinical/domestic waste; alternative sinks and sluices should be used for disposal purposes.

(Category B recommendation)

Where should clinical hand wash basins be placed in health and care settings?

Clinical hand wash basins should be in a visible and easily accessible location and close to the patient care environment.

(Category B recommendation)

Sufficient space between clinical hand wash basins and patients is necessary to minimise risk of contamination by splash or spray; however, the minimal distance has not been established and more research is needed.

(Category C recommendation)

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Appendices

Appendix 1: 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

Appendix 2: PRISMA Flow Diagram

PRISMA Flow Diagram of the evidence identified during the three-year update between 1st of June 2019 and 31st of June 2022. For more details on the search strategy, see [National Infection Prevention and Control Manual: Development Process](#).

