Standard Infection Control Precautions Literature Review:
Hand Hygiene:
Products

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Version	**Date**	**Summary of changes**	**Changes marked**
1.0	January 2012	Defined as final	
2.0	April 2014	Updated after review of current literature	
3.0	August 2015	Updated after review of current literature	
4.0	July 2020	Update of the Hand Hygiene: products literature review v3.0 using the two-person NIPCM methodology. Research questions modified. Addition of the following recommendations: **When should antimicrobial soap be used for hand hygiene in health and care settings?** Hands should be washed with antimicrobial soap and water before performing an invasive procedure; **When should alcohol based hand rub (ABHR) be used for hand hygiene in health and care settings?** ABHR solutions containing 62-90% alcohol by volume are the preferred product for hand hygiene in health and care settings unless hands are visibly contaminated/soiled, or when there is likely to be exposure to spore forming organisms (C. difficile or B. anthracis) or infectious diarrhoeal diseases (norovirus); **What is the correct technique when using antimicrobial hand wipes for hand hygiene?** Manufacturer's instructions should be followed for	

		correct technique when using hand wipes for hand hygiene; Recommendations regarding surgical scrubbing removed for inclusion in the HH – Surgical hand antisepsis in the clinical setting literature review.	

Approvals – this document requires the following approvals (in cases where signatures are required add an additional 'Signatures' column to this table)::				
Version	**Date Approved**	**Name**	**Job Title**	**Division**
1.0	January 2012	Steering (Expert Advisory) Group for SICPs and TBPs		
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3.0	August 2015	Steering (Expert Advisory) Group for SICPs and TBPs		
4.0	July 2020	National Policy Guidance and Outbreaks Steering and Consensus groups		

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Description:	This literature review examines the available professional literature on Hand Hygiene Products in health and other care settings.
Purpose:	To inform the Standard Infection Control Precaution (SICP) section on Hand Hygiene Products in the National Infection Prevention and Control Manual.
Target audience:	All NHS staff involved in the prevention and control of infection in NHSScotland.
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.
Cross reference:	National Infection Prevention and Control Manual http://www.nipcm.hps.scot.nhs.uk/
Update Level:	Change to practice – no significant change to practice Research – no significant change

Contents:

1. Objectives

The aim of this review is to examine the extant scientific literature regarding the use of hand hygiene products for standard infection control purposes in health and care settings. The specific objectives of the review are to determine:

- What is a non-antimicrobial soap?
- How effective is non-antimicrobial soap at removing/killing microorganisms?
- When should non-antimicrobial soap be used for hand hygiene in health and care settings?
- What is an antimicrobial soap?
- How effective is antimicrobial soap at removing/killing microorganisms?
- When should antimicrobial soap be used for hand hygiene in health and care settings?
- What is alcohol based hand rub (ABHR)?
- How effective is alcohol based hand rub (ABHR) at removing/killing microorganisms?
- When should alcohol based hand rub (ABHR) be used for hand hygiene in health and care settings?
- What is non-alcohol based hand rub?
- How effective is non-alcohol based hand rub at removing/killing microorganisms?
- When should non-alcohol based hand rub be used for hand hygiene in health and care settings?
- What are antimicrobial hand wipes?
- How effective are antimicrobial hand wipes at removing/killing microorganisms?
- When should antimicrobial hand wipes be used for hand hygiene in health and care settings?
- What is the correct technique when using antimicrobial hand wipes for hand hygiene?

NB. Products for performing surgical hand antisepsis are discussed in the SICPs literature review - 'Hand Hygiene: surgical hand antisepsis in the clinical setting'.

2. Methodology

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

3. Discussion

3.1 Implications for practice

What is a non-antimicrobial soap?

Non-antimicrobial soap (commonly referred to as plain soap) is available in bar, leaflet, tissue, powder and liquid formats.[1-3] The detergent properties of non-antimicrobial soap enable the physical removal of transient microorganisms along with dirt and organic matter from the hands.[1-6] However, unlike ABHR and antimicrobial soaps, the available evidence suggests that non-antimicrobial soaps themselves are not capable of killing or inhibiting the growth of microorganisms.

How effective is non-antimicrobial soap at removing/killing microorganisms?

Generally, non-antimicrobial soap is considered to be less effective than both antimicrobial soap and ABHR at reducing hand contamination.[6-13] There is some conflicting evidence that non-antimicrobial soap may be superior to ABHR at reducing viral contamination (influenza A, rhinovirus and norovirus) on hands but it is unclear if the contaminating viral RNA in these studies was viable due to the testing methods used.[14-16] Non-antimicrobial soap has also been shown to be superior to ABHR for the removal of *Clostridioides difficile* spores from hands.[17, 18] In addition, when hands are soiled, non-antimicrobial soap has been shown to be more effective at reducing hand contamination than ABHR.[19]

When should non-antimicrobial soap be used for hand hygiene in health and care settings?

The extant guidance consistently recommends that hand washing with non-antimicrobial soap is the preferred method of hand hygiene when hands are visibly contaminated/soiled (with dirt, blood, body fluids) or when there is likely to be exposure to spore forming organisms (e.g. *C. difficile*, *Bacillus anthracis*) or gastrointestinal (GI) infections (e.g. norovirus).[6, 20-25]

What is an antimicrobial soap?

Antimicrobial soap is a generic term for soap products with a range of antimicrobial active ingredients, such as chlorhexidine, triclosan, hexachlorophene, chloroxyenol, povidone iodine and quaternary ammonium compounds.[6]

How effective is antimicrobial soap at removing/killing microorganisms?

Antimicrobial soaps have largely been found to reduce transient and resident microorganisms found on hands to a greater degree than non-antimicrobial soaps.[7-9] A single study found no immediate difference in reduction of bacterial hand contamination between triclosan-containing and non-antimicrobial soap, however, antimicrobial soaps may have a persistent effect that makes them more effective than non-antimicrobial soap over time.[26]

The evidence for the effectiveness of antimicrobial soap compared to ABHR is mixed. A single study found antimicrobial soap to be less effective at reducing bacterial hand contamination than ABHR.[13] However, the majority of studies show that antimicrobial soap is as effective,[27] or more effective at reducing hand contamination than ABHR.[7, 8, 28] None of the included studies specifically assessed the effectiveness of antimicrobial soaps against viral contamination and the World Health Organization (WHO) consider antimicrobial soap to be less effective than ABHR, generally.[6]

Studies on the routine use of chlorhexidine-containing soaps for hand hygiene have found no difference in rates of HAI compared to ABHR or non-antimicrobial soap.[29, 30]

Experimental studies have compared a variety of different antimicrobial soaps (active ingredients; concentrations) in a variety of different ways (technique; contact times; volume; in vivo; in vitro) against a range of microorganisms (viral; bacterial; fungal), which does not facilitate comparison.[7-9, 13] No clear conclusions can be drawn on the most appropriate type of antimicrobial soap for a given circumstance on the basis of this evidence.

When should antimicrobial soap be used for hand hygiene in health and care settings?

CDC guidance states that either non-antimicrobial soap or antimicrobial soap is appropriate for washing visibly contaminated/soiled hands or when there is exposure to spore forming organisms or infectious diarrhoea.[24, 25] However, the majority of extant guidance and expert reviews, all of which were more recently published, do not recommend the routine use of antimicrobial soaps for hand hygiene. [1, 3, 20, 29, 31] The use of antimicrobial liquid soap is however, recommended when carrying out WHO hand hygiene moment 2 i.e. before a clean/aseptic procedure,[6, 23] for surgical hand antisepsis,[20] and its use has been suggested in areas where high risk patients are cared for[1] and during outbreaks.[20]

What is alcohol based hand rub (ABHR)?

Alcohol based hand rubs are commercially available as liquid solutions, gels and foams; the active ingredient in ABHR may be ethanol, isopropanol or n-propanol in concentrations typically ranging from around 60 to 95% (v/v).[5, 6, 23]

How effective is alcohol based hand rub (ABHR) at removing/killing microorganisms?

It is unclear from the evidence identified whether the ABHR format (i.e. gel, foam or liquid) has any influence on effectiveness.[6, 32-35] It is also unclear which formulation of ABHR (alcohol type, alcohol concentration, additional ingredients) has the optimum microbicidal properties for all situations. WHO Guidelines on Hand Hygiene in Healthcare state that alcohol solutions containing 60-80% alcohol are most effective, with higher concentrations being less effective due to the fact that proteins are not easily denatured in the absence of water.[6] However, Society for Healthcare Epidemiology of America (SHEA) guidelines state that a minimum of 62% v/v alcohol should be used and formulations with up to 90% have been shown to be effective.[23] There is evidence to indicate that there is a dose-dependent effect, with higher alcohol concentrations having better microbicidal properties,[3, 36] however, differences in formulations make direct comparison challenging.[36]

ABHR has been demonstrated to have antibacterial, antifungal and antiviral properties.[5, 37-41] Generally, ABHR has been found to have better microbicidal properties than non-antimicrobial soap.[6, 7, 10-13, 23] However, hand washing with soap and water is more effective than ABHR against spore forming organisms such as *C. difficile*.[17, 18, 28] Spores are resistant to the effects of alcohol; the detergent properties of soap (which ABHRs do not possess) allow the spores to be physically removed from hands. There is also some evidence that plain soap and water more effectively removes viral RNA from hands than ABHR, however this is also likely due to its detergent properties and it is not possible to say whether the contaminating viral material was viable in these studies.[14-16]

At concentrations ranging from 50-90%, ethanol is thought to have sufficient virucidal activity to be effective against most clinically relevant viruses.[39] It has also been identified that ethanol may have greater activity against some viruses than isopropanol, particularly at high (>95%) concentrations.[3, 6] However, at lower concentrations (<75%) the effectiveness of both ethanol and isopropanol against non-enveloped viruses such as enterovirus may be limited.[38] The routine use of ABHR has been associated with an increased risk of norovirus outbreaks in long-term care facilities;[42] however, at high concentrations (>80%) both ethanol and n-propanol based ABHRs have been shown to be effective against a norovirus surrogate.[43]

The evidence is mixed on whether the microbicidal properties of ABHR are better than those of antimicrobial soap: some evidence indicates that ABHR is better;[12, 13, 23, 44, 45] some evidence indicates that antimicrobial soap is better;[8] and some evidence indicates that there is no difference.[9, 27, 46] The WHO hand hygiene guidelines consider ABHR to be more effective than both non-antimicrobial and antimicrobial soap.[6]

Some ABHR formulations have additional antimicrobial agents such as hydrogen peroxide, chlorhexidine gluconate, triclosan and organic acids added to the formula; there is mixed evidence on for the effectiveness of these formulations compared to 'plain' ABHR with some studies showing additive formulations to be more effective, [36, 47] and some equally effective.[48] It

is unclear from the identified evidence what the risks/benefits for the routine use of ABHR with additional antimicrobial agents are.

ABHR is not considered to be effective when hands are visibly contaminated/soiled, as it does not have detergent properties[6, 20-22, 49] and has been found to be ineffective in the presence of organic matter/soil.[41] The results of one study indicate that ABHR may have activity against *Serratia marcescens* in the presence of blood contamination on hands, however, the methodology used does not allow comparison with current hand hygiene practice and there is insufficient evidence to support the use of ABHR in these circumstances.[50]

When should alcohol based hand rub (ABHR) be used for hand hygiene in health and care settings?

The extant guidance consistently recommends that ABHR should be the preferred method for hand hygiene[6, 20, 21, 23, 24] unless hands are visibly contaminated/soiled,[1, 2, 6, 20-23, 49] or when there is likely to be exposure to spore forming organisms (e.g. *C. difficile*, *B. anthracis*) or infectious diarrhoeal diseases (e.g. norovirus).[6, 20-23]

What is non-alcohol based hand rub?

Non-alcohol based hand rub (ABHR) products have been developed as alternatives to ABHRs, they may contain a range of antimicrobial agents however, this review identified insufficient evidence to describe what these agents may be.

How effective is non-alcohol based hand rub at removing/killing microorganisms?

This review identified extremely limited evidence suitable for inclusion on the effectiveness of non-alcohol based had rubs; one study investigated a product based on polyhexamethylene guanidine and found it significantly reduced fingertip colonisation.[51] No comparison was made between the test product and ABHR,[51] therefore it is not possible to draw any conclusions or make evidence-based recommendations for this research question.

When should non-alcohol based hand rub be used for hand hygiene in health and care settings?

The National Infection Prevention and Control consensus group agree that non-ABHRs should not currently be recommended for use in NHSScotland and advise these should not be used in other care settings.

What are antimicrobial hand wipes?

This review identified limited evidence to describe the composition of commercially available antimicrobial hand wipes. Generally, they may consist of a disposable, soft material impregnated with antimicrobial agents for example benzalkonium chloride,[8] parachlorometaxylenol,[8, 17] and/or alcohol.[8, 17, 52, 53]

How effective are antimicrobial hand wipes at removing/killing microorganisms?

The evidence for the effectiveness of antimicrobial hand wipes is limited and mixed.[8, 17, 52, 53] Hand wipes have been found to be ineffective at reducing bacteriophage MS2 on artificially contaminated hands[8] and are less effective at reducing microbial hand contamination than either antimicrobial[52] or non-antimicrobial soaps.[8, 17] In comparison to ABHR, hand wipes have been found to be more effective at removing *C. difficile* spores.[17] However, there are mixed results when comparing effectiveness of hand wipes to ABHR for non-spore forming bacteria with hand wipes found to be both less effective[8, 53] and more effective than ABHRs with similar formulas.[52]

When should antimicrobial hand wipes be used for hand hygiene in health and care settings?

The SHEA hand hygiene guidelines state that alcohol impregnated wipes may be beneficial to first responders who cannot easily access wall-mounted dispensers or sinks.[23] It has been suggested that alcohol impregnated wipes could be used as a substitute for plain soap and water, but not for ABHR or antimicrobial soap.[5, 24] Due to the lack of robust evidence the National Infection Prevention and Control consensus group agreed that hand wipes should not be recommended for use in NHSScotland or other care settings in Scotland except in special circumstances e.g. if no running water is available, and that this must be followed by hand hygiene using ABHR.

What is the correct technique when using antimicrobial hand wipes for hand hygiene?

No recommendations for the correct technique when using antimicrobial hand wipes for hand hygiene were identified in published guidelines. The identified experimental studies either followed manufacturer's instructions[52] or did not describe the application technique used.[8, 17] Therefore, in situations where the use of hand wipes is necessary and acceptable manufacturer's instructions for use should be followed.

3.2 Implications for research

There are uncertainties around the efficacy of antimicrobial hand wipes and non-alcohol based hand rubs and further research in these areas is required. Although there is sufficient consistency in the evidence base to allow synthesis and development of recommendations, there exists considerable conflicting evidence on the effectiveness of the different hand hygiene products against different classes of microorganisms, specifically when comparing the effectiveness of different product classes. This is due to the heterogeneity of the included studies in terms of the product formulations, test organisms, hand decontamination protocols and the influence of different study designs. The validity of many of the included studies is hampered by small sample sizes, in addition the techniques used for hand hygiene and the training of participants for many studies were poorly described or not described at all increasing the risk of bias in their conclusions.

4. Recommendations

This review makes the following recommendations based on an assessment of the extant scientific literature on hand hygiene products for standard infection control purposes in health and care settings:

When should non-antimicrobial (plain) soap be used for hand hygiene in health and care settings?

Hands should be washed with non-antimicrobial soap and water when visibly contaminated/soiled or when there is likely to be exposure to spore forming organisms (e.g. *C.difficile, B.anthracis*) or gastrointestinal (GI) infections (e.g. norovirus). [ABHR is the preferred product for hand hygiene otherwise.]

(Category B)

When should antimicrobial soap be used for hand hygiene in health and care settings?

Hands should be washed with antimicrobial soap and water before performing an invasive procedure.

Antimicrobial soaps with immediate and sustained antimicrobial effect are suitable for surgical hand antisepsis.

(Category B)

When should alcohol based hand rub (ABHR) be used for hand hygiene in health and care settings?

ABHR solutions containing 62-90% alcohol by volume are the preferred product for hand hygiene in health and care settings unless hands are visibly contaminated/soiled, or when there is likely to be exposure to spore forming organisms (*C. difficile* or *B. anthracis*) or infectious diarrhoeal diseases (norovirus).

(Category B)

When should non-alcohol based hand rub be used for hand hygiene in health and care settings?

The use of non-alcohol based hand rub products for hand hygiene is not recommended in health and other care settings.

(Category C)

When should antimicrobial hand wipes be used for hand hygiene in health and care settings?

Hand wipes should not be used for hand hygiene by staff in health and care settings **unless** there is no running water available. In this instance, staff may use hand wipes followed by ABHR and wash their hands at the first available opportunity.

(Category C)

What is the correct technique when using antimicrobial hand wipes for hand hygiene?

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

(Category C)

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Appendix 1: Grades of recommendation

Grade	Descriptor	SIGN levels of evidence
Mandatory	A mandatory recommendation (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 NPGO groups when there is no robust professional or scientific literature available to inform guidance.	SIGN level 4, or opinion of NPGO group
No recommendation	Insufficient evidence to recommend one way or another	N/A