

## REVIEW OF LITERATURE

<b>TEAM UNDERTAKING REVIEW:</b> Parts A and B – Health Protection Scotland. Part C – Welsh Healthcare Associated Infection Programme (WHAIP)	
<b>CONTACT PERSON:</b> Dawn Hill	
<b>TOPIC:</b> Use of alcohol hand rub/gel as a means of decontaminating hands.	
<b>PRINCIPAL RESEARCH QUESTION/OBJECTIVE:</b> To assess the evidence in relation to the effectiveness/appropriate application of alcohol hand rub/gel as a method for decontaminating hands.	
<b>METHODOLOGY</b>	
<b>i) Search strategy for identification of studies</b>	
<i>Period of publication</i>	Part A: 1966-2004
	Part B: 2004-2006
	Part C: 2007-2008

<p><b>Strategy key words for Part C</b></p> <p><i>From Health Protection Scotland literature review [2007]</i></p> <p><i>Supplemented with terms from SURE proposal to HTA</i></p>	<p>Hand hygiene, hand washing, handwashing, hand sanitizing, hand cleansing, hand decontamination,  Hand\$1 adj2 wash\$.ti,ab  Hand\$1 adj2 clean\$.ti,ab  Hand\$1 adj2 decontamin\$.ti,ab    Hand\$1 adj2 saniti\$.ti,ab  Hand\$1 adj2 antiseptis\$.ti,ab  Hand\$1 adj2 disinfect\$.ti,ab  Exp hand/  Exp sterilization/  Cross infection  Nosocomial  Healthcare associated infection  Health-care associated infection  Healthcare acquired infection  Hospital acquired infection  Compliance,Adherence,Attitudes  Perceptions,Professional compliance  Health behaviour , health behaviour  Attitude , attitude of health personnel  Health knowledge, attitudes, practice/  Comply\$4.ti,ab  Complies\$41.ti,ab  Adher\$.ti,ab, obey\$.ti,ab, conform\$.ti,ab, follow\$3.ti,ab , fulfil\$.ti,ab  observ\$.ti,ab abide\$.ti,ab  Barrier\$.ti,ab obstacle\$.ti,ab hurdle\$.ti,ab obstruct\$.ti,ab  facilitate\$.ti,ab enable\$.ti,ab assist\$.ti, ab help\$.ti,ab promot\$3.ti,ab  encourage\$1.ti,ab encouraging.ti,ab attitude\$1.ti,ab practice\$.ti,ab  practising.ti,ab practicing.ti,ab  Knowledge\$.ti,ab difficult\$.ti,ab impede\$.ti,ab hinder\$.ti,ab  hindrance\$.ti,ab    Care, care equipment, environment, contaminated contact , delivery of health care, exp Equipment and supplies, hospital/  Health facility environment, hospital, healthcare, occupational transmission, focal infection, cross infection/  Exp Hospitals/  Occupational diseases/  Infection/ focal infection/ infection control/  Bacteri\$, virus\$, equipment contamination.    Handwashing solution, hand washing solution, procedure, soaps, chlohexidine, air dryer, paper towel\$, hand towel\$, soap, liquid soap, soap solution, alcohol rub, alcohol solution, alcohol, alcohol\$ adj2 handrub\$4.ti,ab  Surgical scrub\$.ti,ab  Ring\$, jewellery, nail\$ nail polish, nails/  Cosmetics,</p>	
<p><b>Electronic databases for Part C</b></p> <p><i>(tick as appropriate)</i></p>	<p>MEDLINE ✓</p> <p>Science Direct</p> <p>CINAHL ✓</p> <p>Cochrane Library ✓</p> <p>British Nursing Index ✓</p>	<p>PsycINFO</p> <p>EMBASE ✓</p> <p>SIGLE</p> <p>HMIC ✓</p> <p>Health technology Assessment ✓</p>

<b><i>Specialist web sites / portals for Part C</i></b>	Bandolier, EPIC, JBI-connect, national Electronic Library – Infections, National Library of Guidelines, CDC, Welsh Assembly Government (WAG), Scottish Executive health Dept. (SEHD), health protection Agency (HPA), Health protection Scotland (HPS), Department of health (DH), National patient Safety Agency – Cleanyourhands, Healthcare Associated Infection research Network, Department of health & Social Services & Public Safety (DHSSPS-NI) Northern Ireland, health Information and Quality Authority (Republic of Ireland – health), National Resources Infection Control (NRIC), WHO, Hospital Infection Society, Infection Prevention Society, Society for Healthcare Epidemiology of America (SHEA), NPHS Knowledge Base
<b><i>Hand searching journals (2008 only)</i></b>	American Journal of Infection Control, British Journal of Infection Control, BMJ, Infection Control and Hospital Epidemiology, Journal of Hospital Infection
<b>ii) Selection criteria for inclusion of studies</b>	
<b><i>Sample</i></b>	All health and social care workers.
<b><i>Outcome measure(s)</i></b>	Effectiveness of intervention to reduce bacterial count on hands.
<b><i>Other inclusion criteria</i></b>	N/A
<b><i>Language Limitations</i></b>	English language only.

<b>iii) Quality assessment</b>	
<b><i>Study quality assessment</i></b>	
<b><i>Part A (1966 – 2004)</i></b>	Identified articles were reviewed according to Roe’s model. Guidance documents, however, were unable to be subjected to all such criteria.
<b><i>Part B (2004 – 2006) and Part C (2007-2008)</i></b>	Identified articles were reviewed according to either the ROE model for critical appraisal of scientific studies, Sign 50 methodology for systematic reviews and meta-analyses and the AGREE instrument for the evaluation of guidance documents as appropriate.
<b><i>Data collation and analysis</i></b>	Qualitative analysis of data performed on studies uncovered was undertaken using a case study approach. Guidance documents reviewed for any relevant commentary.

**RESULTS**

**Part A (1966 – 2004)**

Alcohol hand rubs/gels can be used as an alternative to handwashing, but only if hands are socially clean (i.e. not soiled with organic matter), otherwise the alcohol will be rendered inactive.

The main action of alcohol hand rubs/ gels is simply to inhibit flora without any effect on soil. Products containing alcohol are particularly useful when quick decontamination is needed and access to handwashing facilities is limited, but such products cannot be used when hands are soiled (Heenan, 1996, Kerr, 1998). In appropriate concentrations, alcohol (e.g. ethyl (ethanol), normal-propyl (n-propyl), isopropyl) provides the most rapid and greatest reduction in microbial counts on skin. (Lawbury et al., 1974, Groschel & Pruett, 1991).

According to the literature, concentrations of alcohol between 60% and 90% by weight appear to be most effective. (In the production process, it is necessary to dilute the alcohol with water to denature the protein.) Generally, a concentration of 60% to 70% is used as it causes less skin drying dermatitis than gels of higher concentrations and is less costly (Larson, 1995). Indeed, the drying effect of alcohol, possible skin problems as a result and possible resistance to disinfectants are highlighted by the literature (Gould, 1992).

It is important to use a sufficient quantity of hand gel/rub to thoroughly wet all surfaces of the hands. No clear indication is given in the literature as to the optimum amount to be applied. Users are instead directed to the manufacturer's instructions (on average 3ml for 30 seconds). In terms of duration, alcohol applications as brief as 15 seconds have been shown to be effective in preventing transmission by hand of gram negative bacteria (Ehrenkranz & Alfonso, 1991). Furthermore, it appears that assumptions are made through the literature that alcohol hand rubs/gels are applied using the same technique as for hand washing (see appendix)

1). Allowing the alcohol to dry is essential for its effectiveness.

As eluded to earlier, the major disadvantage of alcohol is its drying effect.

	<p>Reybrouck (1986) reported that personnel with dermatitis tend to shy away from hand decontamination, thereby carrying higher bacterial counts on damaged skin, resulting in a greater source of infection (Steere &amp; Mallison, 1975). To address this issue, emollients are now added to alcohol hand rubs/gels to minimise skin drying which may in fact enhance antimicrobial activity by slowing drying time, thus increasing contact time of alcohol with the skin. Concerns regarding the possible flammable properties of hand rubs/gels if used excessively or if splashed have been raised, however, no evidence to support these has been published.</p> <p>The potential risks associated with the flammable properties of hand rubs/gels if used excessively or if splashed appear to be low, according to the literature. NHS Quality Improvement Scotland's report of the provision of such alcohol-based products, published in 2005, highlighted the work of Greene (2003) who suggests that the incidence of fires associated with alcohol hand gels within health care settings is very low. The National Patient Safety Agency's alert (2004b) underlined the fact that two fires have been reported in the US while no such fires have been reported in the UK. However, they encouraged the appropriate placement of these products to minimise the risk to patients and staff alike. Any risk, although very low, is far outweighed by the benefits of improving hand hygiene.</p> <p>The availability of hand hygiene products and of handwashing facilities appears to have a major influence on good hand hygiene practice, according to research. Kesavan et al. (1998) suggest the appropriate and convenient placing of sinks is essential and the adequate provision of soap and soft paper towels encourages frequent and appropriate handwashing. In light of published evidence, the Chief Nursing Officer for NHS Scotland published a letter outlining the placing of alcohol hand rubs/gels at every bedside by April 2005, taking one step towards improving compliance.</p>
<p><b>Part B (2004 – 2006)</b></p>	<p>The original literature review covered a considerable amount of published research concerned with the action of alcohol in terms of hand hygiene. The annual review aims to identify, review and critique any scientific studies or guidance, which have been published in the intervening period since the original literature review, to determine if changes to guidance are required.</p> <p>Recent studies have provided further evidence of the reduction of nosocomial infection rates in healthcare settings after the introduction of alcohol based hand rub usage (Gordin <i>et al.</i>, 2005, Johnson <i>et al.</i>, 2005, King, 2004).</p>

The Chief Nursing Officer (CNO) circulated a letter (SEHD, 2005) in February 2005, which detailed the Executive's proposal for establishing widespread use of alcohol based handrubs in NHS Scotland. This document recommended that alcohol based handrubs should be made available to staff as near to each individual patient as possible. This could be via a wall mounted dispenser, or one attached to the end of each bed or personal dispenser carried by staff on the belt or in the pocket, in certain clinical situations i.e. with very young patients.

Furthermore, a Health Technology Assessment (HTA) published by NHS Quality Improvement Scotland, (NHS QIS, 2005) stated that the potential benefit of the provision of alcohol based handrubs for use by all NHS Scotland staff in clinical areas, is likely to outweigh the costs and also recommended the provision of alcohol hand rub for the use of visitors particularly where hand washing facilities are limited. One study recently published showed results demonstrating that although alcohol hand gels were the most efficacious in bacterial removal, that they were less efficient with high levels of viral contamination (Sickbert-Bennett *et al.*, 2005). Furthermore, this study also showed that the use of alcohol hand rubs showed the best efficiency after a single episode of hand hygiene but this decreased over subsequent ten hand hygiene episodes, which were assessed as part of this study. However, this study did not make any recommendations based on the results and similar results have not been reported elsewhere, but it may be worth monitoring for future studies.

One of the disadvantages of alcohol gel is reported reluctance of use by staff, particularly due to perceived drying of the skin. As previously stated, emollients are now added to the alcohol hand rubs / gels to minimise skin drying. A study has been recently published (Houben *et al.*, 2006), which analyses in depth, actual skin condition associated with the intensive use of alcohol as well as a sensorial evaluation by the users. None of the alcohol gels used in the study caused skin irritation; however sensorial evaluation by users showed a preference for alternatives to isopropanol. This study also found that the favoured concentration of alcohol for avoiding skin irritation was 70%, with the addition of emollients, which is in line with the current model policy on use of alcohol hand gels for hand hygiene.

WHO Guidelines on Hand Hygiene in Healthcare (advance draft) has recently been made available for final consultation (WHO, 2006). These guidelines state that hands should be washed with soap and water if exposure to spore-forming organisms is strongly suspected or proven.

This guidance is based on a study (Weber *et al.*, 2003), which looked at the efficacy of various hand hygiene agents used to remove *Bacillus atrophaeus* (a surrogate for *Bacillus anthracis*) from contaminated hands. This study showed that alcohol hand rub solution was not effective in removing these spores and recommended the use of hand washing with soap and water. Furthermore, the CDC Guideline for Hand Hygiene in Health-Care Settings published in 2002 (Boyce & Pittet, 2002), also recommend that hands should be washed with non anti-microbial or anti-microbial soap and water if exposure to *Bacillus anthracis* is suspected or proven. The recommendation goes on to state that it is the physical action of washing and rinsing hands under such circumstances, which is recommended because alcohols, chlorhexidine, iodophors and other antiseptic agents have poor activity against spores.

There have been some case studies which have been recently published and critiqued during the process of this literature review which demonstrate a general reduction of nosocomial infection rates following the introduction of alcohol hand rubs, however without concomitant reduction in cases of *Clostridium difficile*-associated diarrhoea (CDAD) (Gordin *et al.*, 2005, King, 2004).

The current guidance is that soap and water should be used for hand decontamination in preference to alcohol hand gels, if the hands are visibly soiled; i.e. if contaminated with soilage or organic matter. However, bacterial spores are not visible to the naked eye and therefore it may not be clear when contamination of the hands with *Clostridium* spores has occurred e.g. in the case of an outbreak.

Therefore, although there are no recent studies which have specifically assessed the effect of alcohol on the organism, *Clostridium difficile*, it is felt that the weight of evidence that the use of alcohol gels is less effective against spores is sufficient and that the recommendation in the model policy on hand hygiene should be altered to reflect this.

<p><i>Part C(2007 -2008)</i></p>	<p>This review aims to identify, review and critique any scientific studies or guidance, which have been published in the intervening period since the last literature review, to determine if changes to guidance are required.</p> <p>A systematic review carried out by NHS Quality Improvement Scotland (<i>Stout et al., 2007</i>) looked at the clinical effectiveness of alcohol-based products in increasing hand hygiene compliance and reducing infection rates. Alcohol-based hand hygiene products are usually introduced as part of a multi-faceted intervention programme to improve hand hygiene compliance and infection rates, rather than in isolation. The evidence showed that multi-component interventions that include alcohol-based products are as effective as those that do not, both in achieving sustained hand hygiene compliance and in reducing the incidence of healthcare-associated infections (HAIs). However, they encountered problems in assessing these studies. It was not possible to assess the effect of alcohol-based products independently of other components, studies varied in their methodology and, as commented upon before in these reviews, there were methodological weaknesses in the studies which were examined. The reviewers were unable to compare or make definite conclusions about the effects of specific interventions, or to measure the magnitude of effects. However, they conclude that the costs of providing alcohol-based hand hygiene products and an effective promotional campaign are likely to be relatively small when compared to the costs of HAIs for healthcare providers and patients.</p> <p><i>Lausten et al. (2008)</i>, examined the effect of correctly using alcohol-based hand rub in a clinical setting. This was an observational study with microbiological sampling of hands. They found that 56% of HCWs correctly used the alcohol-based rub before the procedures and 58% after the procedures. The correct use reduced the CFU's on the hands by 90%, but the incorrect use only reduced it by 60%. Testing after the procedures showed that correct use reduced counts by 82% and incorrect use by 54%. The researchers defined correct use as an adequate volume (2 pump strokes, approx 2-3ml), rubbing for 30s until hands dry and covering all surfaces of the hands. This re-iterates the importance of the correct use of these products.</p> <p>In another study published in 2008, <i>Rupp et al.</i> describe a prospective controlled cross-over trial of alcohol-based hand gel in critical care units. They examined rates of adherence to hand hygiene practices when alcohol-based hand gel was provided and monitored the impact of use on the incidence of healthcare-associated infections (HAIs). The overall rate of adherence to hand hygiene recommendations was significantly affected by receipt of education and the availability of alcohol based hand gel. Adherence rates improved dramatically after the introduction of alcohol-gel, increasing from 38% to 68% in one unit, and from 38% to</p>
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69% in the second unit, and improvement was noted in all groups of HCWs. Hand hygiene rates were better at higher workloads when hand gel was available. The improvement in compliance with hand hygiene measures was not associated with detectable changes in the incidence of HAIs. Further studies would be needed to better address the relationship between hand hygiene and HAI's.

*Loffler et al. (2007)*, published a study in the British Journal of Dermatologists examining how irritant to skin alcohol-based hand rubs are. On the basis of patch testing they found that alcohol-based hand rubs cause less skin irritation than hand washing, and that even on previously irritated skin they did not enhance irritation. In addition, an alcohol-based hand rub may even decrease rather than increase skin irritation after a hand wash due to a mechanical partial elimination of the detergent.

The epic2 guidelines (*Pratt et al., 2007*) review relevant literature in this area. They highlight that alcohol is not effective against some microorganisms like *Clostridium difficile*, may not be effective in some outbreak situations and will not remove dirt and organic material. The standards pertaining to the use of alcohol-based hand rubs as follows:

- \* Hands should be decontaminated between caring for different patients or between different care activities for the same patient. For convenience and efficacy an alcohol-based handrub is preferable unless hands are visibly soiled. Local infection control guidelines may advise an alternative product in some outbreak situations.

- \* Hands should be washed with soap and water after several consecutive applications of alcohol handrub.

- \* When decontaminating hands using an alcohol-based hand-rub, hands should be free of dirt and organic material. The hand-rub solution must come into contact with all surfaces of the hand. The hands must be rubbed together vigorously, paying particular attention to the tips of the fingers, the thumbs and areas between the fingers, until the solution has evaporated and the hands are dry.

## CONCLUSIONS

### *Part A (1966 – 2004)*

Evidence indicates that the main action of antiseptic hand rubs/gels, is simply to inhibit flora, but has no effect on soil

Generally, alcohol hand gels/rubs of a concentration of 60% to 70% are used as they cause less skin drying dermatitis than those gels of higher concentrations.

A sufficient quantity of hand gel/rub should be used to thoroughly wet all surfaces of the hands (refer to manufacturers' instructions – on average 3ml).

Alcohol applications of 15 seconds have been shown to be effective in preventing transmission by hand. Refer to manufacturers' instructions – on average 30 seconds.

Alcohol hand rub/gel should be applied using thorough technique as is applied when washing hands with soap and water (see appendix 1 for technique of Ayliffe et al. (1978); Lawrence (1985)).

The major disadvantage of alcohol is its drying effect.

Emollients are now added to minimise skin drying.

Emollients may enhance antimicrobial activity by slowing drying time, thus increasing contact time of alcohol with the skin.

Sufficient time should be given to allow the alcohol hand rub/gel to dry.

The risk regarding the flammability of alcohol hand gels if used excessively or splashed is considered low, according to the literature and is far outweighed by the benefits of improving hand hygiene.

<p><b>Part B (2004 – 2006)</b></p>	<p>Current research continues to provide evidence that the use of alcohol gels in healthcare settings has coincided with a decrease in nosocomial infection rates.</p> <p>Rates of <i>Clostridium difficile</i> infection have been unaffected by the increased usage of alcohol hand rubs / gels. Scientific evidence shows that alcohol has little or no effect against spores</p> <p>Current guidance in the hand hygiene model policy states that hands should not be decontaminated with alcohol if contaminated with soilage / organic matter. However, bacterial spores are not visible to the naked eye and therefore it may not be clear when contamination of the hands with <i>Clostridium</i> spores has occurred e.g. in the case of an outbreak</p> <p>A statement should be added that soap and water should be used to decontaminate hands if exposure to spore forming organisms is strongly suspected or proven i.e. in the case of an outbreak of <i>Clostridium difficile</i></p>
<p><b>Part C (2007-2008)</b></p>	<p>The costs of providing alcohol-based hand hygiene products and an effective promotional campaign are likely to be relatively small when compared to the costs of HAIs for healthcare providers and patients.</p> <p>The correct method of applying alcohol-based hand rubs needs to be emphasized to staff in much the same way as the correct hand washing technique is.</p> <p>Compliance with hand hygiene can be improved by the provision of alcohol-based hand rubs, especially at higher workloads.</p> <p>Alcohol-based hand rubs are less irritant to skin than washing with detergents.</p> <p>Alcohol-based hand rubs are not effective against <i>Clostridium difficile</i> or in certain outbreaks, and will not remove dirt or organic material. In these situations hands need to be decontaminated with soap and warm water.</p> <p>Hands should be washed with soap and water after several consecutive applications of alcohol handrub.</p>

<b>RECOMMENDATIONS</b>	
<b>Part A (1966 – 2004)</b>	<p>Alcohol hand rubs/gels can be used when quick decontamination is needed and access to handwashing facilities is limited, but such products cannot be used when hands are soiled as this will inactivate the alcohol.</p> <p>All surfaces of the hand should be covered when using antimicrobial soap hand gel/rub (see appendix 1).</p> <p>Refer to manufacturers' instructions for amount required and duration (on average 3ml for 30 seconds).</p> <p>Alcohol hand rub/gel should be allowed to dry thoroughly.</p> <p>Hand decontamination products must be made available to staff to maximise compliance with good hand hygiene practice.</p>
<b>Part B (2004 – 2006)</b>	<p>Hands should be washed with soap and water if exposure to spore forming organisms is strongly suspected or proven i.e. in the case of an outbreak of <i>Clostridium difficile</i>.</p>
<b>Part C (2007-2008)</b>	<p>As a result of the literature review for Part C, nothing additional needs to be added to Infection Prevention Model Policy/Procedure 2 (version1).</p>
<b>PRACTICAL APPLICATION</b>	<p>As the hand hygiene measures described have been recommended for some time, no significant change to practice should be required; however, the standards set down must be achieved.</p>
<b>RESOURCE IMPLICATIONS</b>	<p>As per current policies. All resources required for dealing with hand hygiene should already be in place.</p>

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## Appendix 1



1. Rubbing palms.



2. Rubbing the back of the left hand with the palm of the right hand.



3. Rubbing the palm of the right hand with the back of the left hand.



4. Rubbing the fingers of the right hand with the palm of the left hand.



5. Rubbing the thumb of the right hand with the palm of the left hand.



6. Rubbing the fingers of the left hand with the palm of the right hand.

Figure 6.1. Hand-washing technique (Adapted from CDC (Centers for Disease Control and Prevention) 2009).