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Efficacy of handrubbing with alcohol based solution versus standard handwashing with antiseptic soap: randomised clinical trial

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Abstract

Objective To compare the efficacy of handrubbing with an alcohol based solution versus conventional handwashing with antiseptic soap in reducing hand contamination during routine patient care.

Design Randomised controlled trial during daily nursing sessions of 2 to 3 hours.

Setting Three intensive care units in a French university hospital.

Participants 23 healthcare workers.

Interventions Handrubbing with alcohol based solution (n=12) or handwashing with antiseptic soap (n=11) when hand hygiene was indicated before and after patient care. Imprints taken of fingertips and palm of dominant hand before and after hand hygiene procedure. Bacterial counts quantified blindly.

Main outcome measures Bacterial reduction of hand contamination.

Results With handrubbing the median percentage reduction in bacterial contamination was significantly higher than with handwashing (83% v 58%, P=0.012), with a median difference in the percentage reduction of 26% (95% confidence interval 8% to 44%). The median duration of hand hygiene was 30 seconds in each group.

Conclusions During routine patient care handrubbing with an alcohol based solution is significantly more efficient in reducing hand contamination than handwashing with antiseptic soap.

Introduction

Handwashing is emphasised as the single most important measure to prevent cross transmission of

micro-organisms and thus to prevent nosocomial infections.¹ However, under routine hospital practice compliance with this measure is still unacceptably low, less than 50% in most studies published in the past 20 years.²⁻³ Recent studies have shown that this level of compliance will not reduce the risk of transmission of multiresistant bacteria in hospital.⁴ Attempts to improve compliance have included increasing the number of accessible sinks⁵ and educating healthcare workers,^{6,7} but none of these interventions led to a marked and sustained improvement in compliance.

Handrubbing with an alcohol based, waterless hand antiseptic seems to be the best method of increasing compliance with hand hygiene. It seems, however, that there is reluctance to accept handrubbing as a substitute for handwashing. In one study the main reason raised for not adhering to the recommendation to use handrubbing was the lack of confidence about its efficacy.⁸

We performed a randomised clinical trial to assess the efficacy of an alcohol based solution compared with standard handwashing with a medicated soap in reducing hand contamination during routine patient care.

Methods

Enrolment of participants

The study was a prospective randomised clinical trial with blinded evaluation of microbiological results. It was performed from June to July 2000 in three intensive care units (two surgical and one medical) of a 940 bed university. Eligible healthcare workers were all permanent and temporary nurses and nursing assistants of each unit.

Treatment groups

At the beginning of each session when each participant arrived at the unit (7 am) we used opaque sealed envelopes to assign randomly him or her to standard handwashing with a medicated soap (chlorhexidine gluconate 4%; Hibiscrub, Zeneca Pharma)⁹ or handrubbing with a waterless alcohol based solution (45% 2-propanol, 30% 1-propanol, 0.2% metconium ethyl sulphate, average 3-5 ml; Sterillium, Bode Chemie, Hamburg, Germany). All participants had been previously instructed in the use of the alcohol based solution when the hospital-wide handrubbing policy was launched a year ago by the infection control committee. A written protocol was available in each unit, and no additional information was provided to participants before the study started.

Monitoring and data collection

Patient care activities were monitored during daily sessions of two to three hours until a predetermined number of eligible activities had been performed. One session comprised five patient care activities that required hand hygiene before and after, which corresponded to 10 hand samplings (five samples obtained before and five after hand cleaning). Eligible activities were direct contact with the skin of a patient before invasive care, after interruption of care, and after contact with any part of a patient that was colonised with multiresistant bacteria. We also recorded the type of care performed, duration of care, whether the participant wore gloves, number of opportunities for hand hygiene according to the recent guidelines,¹⁰ number of actual hand hygiene procedures performed, and duration of hand hygiene procedure (that is, duration of the use of antiseptic agent).

Microbiological samples and processing

We took an imprint of fingertips and palm from the participant's dominant hand before and one minute after the procedure (see [bmj.com](#)). We recorded the total bacterial contamination of hands as the number of colony forming units (cfu) recovered from both the fingertips and palm after 48 hours of incubation. We identified *Staphylococcus aureus* or other pathogenic bacteria not usually found in skin flora by using standard microbiological procedures and determined their susceptibility to antibiotics. We specifically looked for methicillin resistant *S aureus* (MRSA), the most prevalent multiresistant organism at our institution. No anaerobic cultures were done. The microbiologist who examined the culture plates and reported the microbiological results was unaware of the hand hygiene method used.

Statistical analysis

Our analyses were based on the intention to treat principle; one participant dropped out of the study after four samplings instead of five because his hands

were visibly soiled with body fluids. The participants were the unit of analysis. Bacterial counts were expressed as number of cfu per hand. Firstly, we calculated the percentage reduction in hand contamination for each cleaning procedure. Secondly, we obtained the average percentage reduction for each participant by calculating the mean over the five procedures per participant and used Mann-Whitney tests to compare the percentage reduction between the two groups.

Results

A total of 23 healthcare workers were included in the study and analysed; 12 were randomised to handrubbing and 11 to handwashing. Randomised participants performed 114 patient care activities (59 in the handrubbing group and 55 in the handwashing group). The distribution of activities was comparable between the two groups. The baseline characteristics of the two randomised groups and the activities performed were also largely comparable (see [bmj.com](#)). Gloves were worn during most activities with a similar frequency between groups.

In both groups bacterial counts were lower after hand hygiene (table). For each participant the median reduction of bacterial contamination achieved by handrubbing was significantly higher than the reduction achieved by handwashing (83% (interquartile range 78-92%) *v* 58% (-58-74%), respectively, $P=0.012$). The difference in the percentage reduction between the two groups was 26% (95% confidence interval 8% to 44%).

During monitoring sessions, the median cumulative number of observed handrubbing was 1 (0-3) before the first sample and 10 (6-14) before the fifth sample. The percentage reduction in contamination at the first evaluated handrubbing was 88% (74-97%) and at the fifth was 95% (76-99%). Thus, handrubbing remained effective after several applications of alcohol based solution.

The median time spent on hand hygiene was relatively low in the handwashing group, where the antiseptic soap was applied for only 30 seconds (23-37 sec); 36 handwashing procedures (65%) lasted less than 30 seconds. The median duration of handrubbing was also 30 seconds (29-33 sec), which is the required time for bactericidal activity.

Discussion

We have shown that handrubbing with an alcohol based solution is more effective than handwashing with an antiseptic soap in reducing bacterial contamination of hands during routine patient care. This was partly due to the inadequate time spent washing hands conventionally.

Bacterial counts (colony forming units) before and after two methods of hand cleaning

	Before		After		Median % reduction (IQR)
	Mean (SD); 95% CI	Median (IQR)	Mean (SD); 95% CI	Median (IQR)	
Handrubbing	271 (372); 174 to 368	101 (29-380)	35 (59); 20 to 50	7 (2-31)	86 (70-96)
Handwashing	232 (331); 143 to 321	117 (15-239)	69 (106); 41 to 97	9 (1-135)	73 (25-93)

IQR=interquartile range.

Several experimental studies in which hands were artificially contaminated with various micro-organisms have shown that handrubbing with alcohol based products is more effective than handwashing with unmedicated or antiseptic soap.¹¹⁻¹⁵ Most of these studies incorporated supervised hand hygiene techniques to ensure conformity to usual recommendations or at least insisted on the quality of the technique. Our study was designed not to interfere with the actual practice of participants in terms of compliance with and quality of hand hygiene, our main objective being to evaluate the efficacy in routine care.

In a recent study, handrubbing was equivalent to antiseptic handwashing in reducing hand contamination.¹⁶ However, the product tested contained less alcohol than the one we used (61% versus 75%) and contained another antiseptic compound. The sampling method used was the glove juice technique, which is difficult to perform during routine care activities.

Duration of cleaning and effect

The difference in the effect may have been partly due to the duration of handwashing. The recommended optimal duration of handwashing is at least 30 seconds and up to 1 minute, a time that was adhered to in less than 35% of opportunities. Handrubbing and handwashing were actually performed by participants for a similar length of time. This duration (30 seconds) seems sufficient for handrubbing with alcohol based solutions but may not be long enough for handwashing with a medicated soap. Most observational studies have shown that handwashing is seldom performed for more than 30 seconds, and our study confirms these findings.¹⁷⁻¹⁹ Therefore, the rapid efficacy of alcohol based solutions compared with handwashing, even with an antiseptic agent, is a major argument supporting their use in clinical practice.²⁰ Handrubbing also achieved a higher reduction in bacterial contamination, suggesting higher efficacy.

We also found that handrubbing remained effective after a series of applications. This finding contradicts the results of Paulson et al, who reported that the efficacy of handrubbing after artificial inoculation of hands decreased with the number of procedures performed.²¹

Limitations

We assessed bacterial contamination by taking agar fingerprints of the dominant hand and did not use the glove juice technique, which may be more effective in recovering the whole bacterial burden on hands.¹⁰ Our technique may have underestimated the degree of hand contamination, though we are not aware of a direct comparison of the two techniques in terms of assessment of bacterial burden on hands. However, bacterial counts before hand hygiene were consistent with baseline hand contamination found in two other clinical studies that used fingerprinting.²²⁻¹⁶ The design of our study, which was planned not to interfere with regular activities, did not allow using the glove juice technique. However, we believe the comparison of the two procedures tested, using the same technique for culture, remains valid.

The rapid efficacy of alcohol based solutions and their availability at the bedside make these solutions an ideal substitute for conventional handwashing and

What is already known on this topic

To improve compliance with hand hygiene during patient care, handrubbing with an alcohol based solution has been proposed as a substitute for handwashing because of its rapid action and accessibility

Experimental studies show that handrubbing is at least as effective as medicated soap in reducing artificial contamination of hands

Many healthcare workers still have reservations regarding its efficacy and are reluctant to use this technique

What this study adds

When used in routine practice, handrubbing with an alcohol based solution after contact with patients achieved a greater reduction in bacterial contamination of hands than conventional handwashing with medicated soap

should help in achieving increased compliance with hand hygiene during patient care. Improving hand hygiene compliance can lead to reduced rates of nosocomial infection and acquisition of multiresistant bacteria.²³ Other investigations are still needed to assess the best methods for promoting handrubbing and education on indications for hand hygiene at the bedside.

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Acquisition of W135 meningococcal carriage in Hajj pilgrims and transmission to household contacts: prospective study

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The annual Islamic pilgrimage to Mecca and Medina (Hajj) attracts more than two million pilgrims from all over the world. Overcrowding provides ideal conditions for transmission of meningococci. During the Hajj 2000 an international outbreak of meningococcal disease occurred.¹ This outbreak generated particular interest as it was caused by serogroup W135, which hitherto had not played a major role in epidemics.^{2,3} Furthermore, many close contacts of asymptomatic returning pilgrims were affected.² Although vaccination can protect pilgrims against invasive disease due to W135, it does not prevent acquisition of pharyngeal carriage, which is the primary source for transmission.⁴ Returning pilgrims may spread the bacteria to their unvaccinated household contacts or even to the community at large. We investigated the extent of transmission of *Neisseria meningitidis* in Hajj pilgrims and their contacts, in order to provide evidence for developing a rational public health policy.

Methods and results

We conducted a prospective study of meningococcal carriage in Singaporean pilgrims before the Hajj 2001 and in pilgrims and their household contacts two weeks after return from the Hajj. We performed serogrouping and pulsed field gel electrophoresis on meningococcal isolates to determine the predominant serogroup and relatedness of the strains. We questioned participants about the occurrence of any symptoms of upper respiratory tract infection, use of antibiotics within the past month, and number of people in the household.

We took tonsillopharyngeal swabs from 204 Malay pilgrims at the time of vaccination with quadrivalent meningococcal vaccine (median 39 (range 18-72) days before their departure for the Hajj pilgrimage). Median age was 48 (24-74) years, and 92 (45%) were men. Only one of these pilgrims carried *N meningitidis*, which was identified as serogroup X.

We took repeat swabs from 171 (84%) of the pilgrims at a median of 17 (1-45) days after their return from the Hajj and found 29 (17%) to be meningococcal carriers ($P < 0.001$ compared with carriage rate before the Hajj) (table). Ninety five (56%) of returning pilgrims reported cough in the preceding month, and 70 (41%) reported use of antibiotics. Carriage was significantly higher in pilgrims who had not taken antibiotics (22/101, 22%) than in those who had taken antibiotics (7/70, 10%) ($P = 0.045$), but no relation existed between carriage and age, sex, or recent symptoms of upper respiratory tract infection.

Pulsed field gel electrophoresis showed 26/29 (90%) meningococcal isolates in Hajj returnees to be a single clone, identified as serogroup W135 in most cases and related to the strains that caused Hajj associated invasive meningococcal disease in Singapore.

The returning pilgrims reported a median of 4 (1-10) people living in their household. The total number of contacts (non-Hajj pilgrims within the same household) was 317. We took swabs from 233 (74%) of these household contacts at a median of 26 (3-45) days after the pilgrim's return to the household. The median age of household contacts was 20 (1-67) years, and 165 (52%) were children under the age of 18 years. The prevalence of meningococcal carriage in household contacts was 8.2%, of whom 42% were carrying the W135 clone (3.4% of all household contacts). All but one of the contacts carrying the W135 clone were contacts of returning pilgrims with the W135 clone. Of the

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Meningococcal carriage in Hajj pilgrims and their household contacts. Values are numbers (percentages) unless stated otherwise

	Pilgrims before Hajj (n=204)	After Hajj	
		Pilgrims (n=171)*	Household contacts (n=233)
All isolates	1 (0.5)*†	29 (17)*	19 (8.2)
W135 clone	0	26 (15)	8 (3.4)

* $P < 0.001$ between pre-Hajj and post-Hajj pilgrims (McNemar test).

†Prevalence of pre-Hajj meningococcal carriage in the 171 pilgrims who returned for the post-Hajj swab was 0.6%.