Comparative efficacy of alternative handwashing versus alcoholic rub with current protocol and current usage patterns among healthcare workers

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Abstract
Hand hygiene is a primary mechanism for reducing contact transmission of infectious agents. We evaluated the efficacy of hand hygiene agents under condition in which they are currently being used by healthcare workers. A total of forty Healthcare Workers (HCWs) and office workers in a teaching hospital washed their hands with procedures using soap and water, and alcohol-based gel, with and without standardized protocols. A total numbers of colony - forming units on the hands were 3.52 and 4.48 for the HCWs and non-patient staff hands, respectively ($p < 0.05$). The average reduction in the number of organisms before and after hand hygiene of any procedures showed always statistically significant differences by both standardized and non-standardized procedures, and they all demonstrated similar results when compared to each other, with only two exceptions. There was no difference in the proportion of HCWs or non-patient staff with Staphylococcus aureus and Gram-negative rods on their hands. This study demonstrated that the regular usage of alcohol gel is as good as handwashing with soap and water, and could increase compliance in the hand hygiene, especially in situations where there is a lack of sinks or HCWs are overworked.

Keywords: *Hand hygiene - Alcoholic rub - Nosocomial infection.*

INTRODUCTION

Nosocomial infections can be transmitted by microorganisms on the hands of healthcare workers (HCWs) to patients. It has been proved that hand hygiene is the leading measure for preventing infection transmission, but handwashing compliance is usually estimated as < 50%.[1]

If poor handwashing compliance is a serious problem in hospitals worldwide, it is even more critical in hospitals of developing countries, where even motivated personnel do not wash their hands as frequently as needed. Hospital facilities are designed without consulting infection control professionals, and sinks are usually insufficient, unsuitably located and frequently nonfunctional. Supplies of soap and paper towels are often

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inadequate, and multiple-use fabric towels are commonly used; these towels become damp dried, therefore they can harbor Gram-negative bacteria.[2]

Among shortcoming methodologies, some deserve to be mentioned: methods of evaluating hand-hygiene products require that test volunteers wash their hands for 30 seconds or 1 minute; however, average duration of handwashing by hospital personnel is < 15 seconds; methods for assessing waterless antiseptic agents for use as antiseptic hand rub require that 3 mL of alcohol be rubbed onto the hands for 30 seconds; time that allows to complete evaporation of the product and finally, volunteers used in these evaluations are usually surrogates for HCWs.[3] So that no are used obtain more realistic views of microbial colonization no risk of bacterial transfer and cross-transmission and which hand hygiene is best suited. A study was conducted among practicing HCWs by using standardized and current protocols under conditions in which handwashing and antiseptic hand rub.

MATERIAL AND METHODS

Hospital

The study was carried out within a tertiary care teaching Hospital of Universidade Federal of Uberlandia (HC/UFU) with 503 beds. This study was approved by the Ethics committee of the UFU for the clinical trial.

Study design

The study with randomized test sample that consisted of twenty HCWs and nursing assistants from internal medical ward (n=14) and surgery ward (n=6) who were HC/UFU staff. The control group consisted of twenty office workers, who do not have contact with patients. A hand culture was obtained by common consent before and after hand hygiene. None of these subjects were receiving antimicrobial or anti-inflammatory agents nor had skin disease (dermatitis, eczema or psoriasis).

Hand hygiene

Each volunteer performed four hand hygiene procedures one per week for four weeks in a row, handwashing with 3 mL of unmedicated soap for 30 seconds (a) and without control of time or volume (b), handrubbing with 3 mL of alcohol-based hand gel for 30 seconds (c) and without control of time or volume (d). The unmedicated soap in use was the same one used in the routine of the hospital (Vero PlusÒ, JohnsonDiversey, Brasil). The alcohol-based hand gel was LevergelÒ Ethyl 70% (JohnsonDiversey, Brasil). All participants had been previously instructed about the hand hygiene at extremity and between fingers, wrists and the whole surfaces of their hands.

Hand culture

Before hand hygiene, volunteers cleaned their hands for 10 seconds by using an unmedicated soap.[4] This short wash removed the excess of hand flora in order to standardize the sample.

The volunteer inserted the dominant hand into a sterile polyethylene bag containing 75 mL of tryptic soy broth (Difco, Maryland, USA) supplemented with Tween 80 and massaged it for 1 minute.

An inoculum of 0.1 mL, of sampling solution (undiluted, 1:10 and 1:100 dilutions) was plated onto the tryptic soy agar plate (Difco, Maryland, USA), incubated at 37º C for 24 hours, for count of colony forming units/mL (CFU/mL).

Equal inoculum of sampling solution undiluted was plated onto a Sabouraund dextrose agar (Difco, Maryland, USA), incubated room temperature, MacConkey agar plate (Difco, Maryland, USA), Mannitol salt agar plate (Difco, Maryland, USA), Bile esculin agar (Dignolab, Barcelona, Spain), Mannitol salt agar supplemented with 6 µg/mL of oxacillin (Sigma, St. Louis, USA) and MacConkey agar supplemented with 2 µg/mL of ceftazidime (Glaxo, Rio Janeiro, Brazil), incubated at 37º C

for 48 hours and specification of bacteria and yeasts was performed by standard microbiologic techniques.[5]

Data analysis

After verification of normality, t- Tests were applied to compare counts of bacteria by using GraphPad Prism 4 version 2003 (San Diego, CA) and chi-square tests were used for comparing the proportions of different types of organisms by using Epi Info version 2000 (CDC, Atlanta, GA). Corresponding 95% confidence intervals. All P-values are two-tailed, and the alpha level of significance was less than 0.05.[4]

RESULTS

The mean total log_{10} counts of organisms, before hand hygiene were 4.48 and 3.52 for the office workers and HCWs hands, respectively (P< 0.0001) in Table 1.

Comparisons between the mean number of CFU after handwashing with soap and water with and without standardization (time and volume) or alcohol based, did not show any statistically significant differences, with the exception of when procedures (soap versus alcohol gel) with standardization for HCWs and without standardization for control (P<0,05).

Table 2 includes the overall results for each group (HCWs and non-patient staff) of volunteers, considering the four procedures. Comparison of the mean number of CFU before and after handwashing or handrubbing showed statistically significant difference except for alcohol-based gel rubbing standardized (HCWs) and non standardized (controls).

The microorganisms isolated in the hands before handwashing with soap and water and handrubbing with alcohol gel were showed in Table 3. Enterococcus spp. and Candida spp. were not found on the hands of any volunteer.

Samples of S. aureus were not resistant to the neither meticillin/oxacillin nor samples of GNB were resistant to the third generation cefalosporin.

DISCUSSION

A significant proportion of infections result from cross-contamination of microorganisms by hands of healthcare workers (HCWs), that is the main route of spread, [6] and handwashing is widely accepted as the most important preventive measure.[7]

There is vast literature about handwashing with water and soap as well as alcohol- based handrubs; these researches, however, used volunteers who are usually surrogates for HCWs, and their hand flora may not reflect the flora found on the hands of personnel working in healthcare setting.[3] In our investigation, the analysis were accomplished with HCWs and standardized and non-standardized hand hygiene procedures.

Therefore, there is no data regarding the efficacy of these products under conditions in which they are actually used, with or without standardized hand hygiene, by HCWs[3], and mainly in countries developing, like Brazil, where the structure and the inputs can influence the compliance of the hands hygiene.

The microbial count observed in HCWs' hands was lower and statistically significant, even after hand hygiene, when compared to individuals without patient association. This may indicate an influence of the hand hygiene products and frequency or hand hygiene techniques used exclusively by HCWs.

Although, the plain soap simply removes transient bacteria from skin but does not kill them and alcohol-based hand rubs increase the likelihood of killing potentially pathogenic bacteria.[8] Our study confirms that the use of soap and water for daily handwashing and alcohol gel for hand hygiene waterless result in a bacterial reduction sometimes with the same efficiency.

Table 1 - Comparison of the mean of CFU (log_{10} ± SD) among the professionals' groups (with and without direct contact with patient), before and after the hand hygiene.

Procedures		HCWs	Controls	*P*
Before		3.52 ± 0.66	4.48 ± 0.76	<0.0001*
After	a	3.16 ± 0.62	4.12 ± 0.81	<0.0001*
	b	3.27 ± 0.44	3.95 ± 0.75	0.0006*
	c	3.38 ± 0.53	4.01 ± 0.70	0.0013*
	d	3.12 ± 0.89	4.34 ± 0.57	<0.0001*

Notes: - CFU= colony forming units; SD = standard deviation;
- handwashing with 3 mL of unmedicated soap for 30 seconds (a) and without control of time or volume (b); handrubbing with 3 mL of alcohol-based hand gel for 30 seconds (c); without control of time or volume (d);
- * statistically significant difference (*P*< 0.05, tests *t* Student).

Table 2 - Number of CFU (log_{10} ± SD) of the professionals' groups (with and without direct contact with patients), before and after hand hygiene.

Professionals' groups	Before	After		RF (log_{10})	P (95%)
HCWs (n=20)	3.52 ± 0.66	a	3.16 ± 0.62	0.36	0.006*
		b	3.27 ± 0.44	0.25	0.02*
		c	3.38 ± 0.53	0.14	0.16
		d	3.12 ± 0.89	0.40	0.04*
Controls (n=20)	4.48 ± 0.76	a	4.12 ± 0.81	0.36	0.003*
		b	3.95 ± 0.75	0.53	0.005*
		c	4.01 ± 0.70	0.47	0.01*
		d	4.34 ± 0.57	0.14	0.21

Notes: - CFU = colony forming units; SD = standard deviation; RF = Reduction factor;
- handwashing with 3 mL of unmedicated soap for 30 seconds (a) and without control of time or volume (b); handrubbing with 3 mL of alcohol-based hand gel for 30 seconds (c); without control of time or volume (d);
- * statistically significant difference (*P*< 0.05, tests *t* Student).

The surprising results were shown in the comparison between handwashing and alcohol hand rubs. As indicated, hand antisepsis is significantly more efficient than standard handwashing with unmedicated soap and water.[9,10]

During routine patient care, handwashing compliance is unacceptably low in most of studies published.[1] *Factors that may influence on the compliance are the following: being physicians or a nursing assistant rather than a nurse; being a nursing assistant rather than a nurse; being male; working in an intensive care unit; working during the week; wearing gown and gloves; using an automated sink; performing activities under high risk of cross-transmission; and having many opportunities for hand hygiene per hour of patient care*[1, 3] *and the accessibility of products by HCWs may be important factors.*[11]

Table 3 – Microorganisms isolated in hands before hand hygiene on the hands of the professionals' groups (with and without direct contact with patients).

Microorganisms	HCWs N=20 (%)	Controls N=20 (%)	*P*	OR (IC, 95%)
Coagulase-negative Staphylococci	16 (80)	13 (65)	0.47	2.15 (0.4 – 11.5)
S. aureus	7 (35)	5 (25)	0.73	1.62 (0.3 - 7.9)
Gram -positive rods	3 (15)	0	0.23	-
Gram -negative rods	2 (10)	4 (20)	0.65	0.44 (0.05 - 3.5)
Enterobacter aglomerans	1 (5)	1 (5)	1.0	1.0 (0.0 – 40.1)
Klebsiella pneumoniae	0	1 (5)	1.0	0.0 (0.0 – 18.0)
Escherichia coli	1 (5)	1 (5)	1.0	1.0 (0.0 – 40.1)
Pseudomonas aeruginosa	0	1 (5)	1.0	0.0 (0.0 – 18.0)

Notes: - OR = odds ratio;
- Test Chi-square

In hospitals with limited resources mainly unsuitable number of accessible sinks and sinks without running water, soap or towels are common. On the other hand frequency of handwashing may damage the skin and result in increased colonization of microbes[8], and reduced compliance.[3]

Use of alcohol waterless hand disinfection has been the preferred method for hand hygiene compared with traditional handwashing with unmedicated soap, because alcohol-based gel requires less time, offers rapid bactericidal action and irritates hands less often.[12]

The hands of HCWs may become persistently colonized with pathogenic flora as S. aureus, Gram-negative rods, or yeast.[3] Hospital acquired infections with antibiotic resisteance bacteria such as methicilin-reistant Staphylococcus aureus (MRSA) are not uncommon and can be difficult and expensive to treat.[13] This study indicates that the composition of the bacteria found in the hands of HCWs and non-patient staff were not different. The carriage rates of these organisms epidemically important (S. aureus and GNB) on hands were 45%.

Even with the difficulty to estimate a relative importance from the improvement in compliance in hand hygiene compared with the uses of the antibacterial hand-cleansing agent in reducing nosocomial infections, we would acknowledge that both products appraised are of equal importance.

This study demonstrated that handwashing with soap and water or handrubbing with an alcohol-based gel, are significantly efficient. Moreover, the handrubbing with alcohol gel has advantages as, skin acceptability and may influence adherence of HCWs to recommended hand hygiene practices.

Comparação da eficácia da lavagem das mãos versus fricção alcoólica em protocolos atuais e os hábitos de consumo entre os profissionais de saúde

Resumo

A higiene das mãos é um exercício primário para reduzir a transmissão por contato de agentes infecciosos. Nós avaliamos a eficácia dos utensílios usualmente utilizados pelos profissionais de

saúde para a higiene das mãos. Um total de quarenta profissionais de saúde (HCWs) e de trabalhadores da administração de um hospital de ensino lavavam as mãos com água e sabão, utilizando procedimentos-padrões, mas utilizavam o álcool em gel, com e sem protocolos padronizados. Um número total de unidades formadoras de colônia nas mãos foram de 3,52 e 4,48 para os HCWs e o pessoal da administração, respectivamente (p <0,05). A média de redução do número de organismos antes e depois de quaisquer procedimentos sempre mostrou diferenças estatisticamente significativas tanto para os procedimentos padronizados quanto para os não-padronizados, e todos eles demonstraram resultados semelhantes quando comparados uns aos outros, com apenas duas exceções. Não houve nenhuma diferença na proporção de Staphylococcus aureus e bactérias Gram-negativas entre os HCWs e o pessoal da administração quando colhido o material das mãos de ambos os grupos. Este estudo demonstrou que o uso regular de álcool em gel é tão bom como lavar as mãos com água e sabão, o que poderá aumentar o hábito da higiene das mãos, especialmente em situações em que existe uma falta de pias ou quando os HCWs estiverem sobrecarregados.

Palavras-chave: Higiene das mãos - Fricção alcoólica - Infecção hospitalar.

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Acknowledgements

The authors would like to all of the volunteers involved in this study and to CAPES for financial support.

Recebido em / *Received*: 13/10/2008
Aceito em / *Accepted*: 17/12/2008