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Major Article

Effect of hand lotion on the effectiveness of hygienic hand antisepsis: Implications for practicing hand hygiene

Helga Paula MD [a,*], Nils-Olaf Hübner MD [b], Ojan Assadian MD, DTMH [a,c], Katja Bransmöller MD [b], Romy Baguhl MD [b], Harald Löffler MD [d], Axel Kramer MD, PhD [b]

[a] Department of Hospital Epidemiology & Infection Control, Medical University of Vienna, Vienna, Austria
[b] Institute for Hygiene and Environmental Medicine, Ernst-Moritz-Arndt University, Greifswald, Germany
[c] Institute for Skin Integrity and Infection Prevention, School of Human & Health Sciences, University of Huddersfield, United Kingdom
[d] SLK-Kliniken GmbH, Am Gesundbrunnen 20-26, Heilbronn, Germany

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Background: Skin protection products should be used after washing hands with soap, during breaks, after work, and during leisure time. Aside from their beneficial effects, skin care products may also interact with alcohol-based hand disinfectants by reducing their efficacy. The aim of this study was to investigate the effect of a hand lotion on the effectiveness of hygienic hand antisepsis using an alcohol-based handrub.

Methods: The effect of a protective hand lotion against an isopropyl alcohol-based handrub was investigated in 20 healthy volunteers according to the European standard test procedure EN 1500 in the following combinations: handwashing and application of hand lotion, only application of hand lotion, and no washing and no hand lotion (control), each for 5 minutes or 1 hour before hand antisepsis. The difference in microbiologic before-and-after values were expressed as log reduction factor.

Results: The effectiveness of hand antisepsis was not significantly affected in any of the groups using the tested hand lotion.

Conclusions: Hand antisepsis may be delayed for 5 minutes after hand lotion application. Shorter time intervals might be possible but were not tested.

Healthy and intact skin is a prerequisite for effective hand antisepsis.[1] The prevalence of eczematous hand lesions among health care workers ranges between 20% and 40%.[2,3] Up to now, these lesions have been an underestimated problem of multifactorial etiology. In 2004, skin diseases in Germany remained at the top of the list of occupational illnesses: 56% of health care workers with an annual incidence of 7.3 occupational diseases per 100,000 health care workers, making them the most affected group.[4,5] Therefore, the use of hand barrier cream and similar skincare products to prevent development of irritant contact dermatitis is advised.[5] Hand lotions are designed to delay or prevent cutaneous penetration of substances with noxious effects. Such protective skincare products should be used after washing hands with soap or after other dermal exposure to water-related activities (such as dishwashing), during breaks, after work, and during leisure time. The proactive effect of several skin hand lotions has been proven experimentally in skin irritation tests[6,7] as well as in clinical settings.[8] The beneficial effect of skin care products has been proven for eczematous, dry, red, and chapped hands, with approximately 38% of the effectiveness of glucocorticoids without their local and systemic side effects.[9,10] The regular use of hand lotion was associated with a 50% reduction in the risk of developing irritant contact dermatitis.[4]

However, aside from their beneficial effects, skincare products might also interact with alcohol-based handrubs and reduce their efficacy.[11] Indeed, most alcohol-based handrubs and skincare products are not tested for potential interactions. The matter of a lack of harmonising handrubs and skincare products has been pointed out in international recommendations; however, no specific recommendations are provided due to missing or insufficient data.[12]

* Adress correspondence to: Helga Paula, MD, Department of Hospital Epidemiology & Infection Control, Medical University of Vienna, Vienna General Hospital, Waehringer Guertel 18-20, Vienna 1090, Austria.
E-mail address: helga.paula@meduniwien.ac.at (H. Paula).

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HL and AK designed the study, NOH, OA, HL, and AK analyzed the data, NOH performed the laboratory work, HP, OA, NOH, KB, HL, and AK wrote the manuscript. All authors read and approved to the final version of the manuscript.

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The aim of this study was to investigate the inhibitory effect of a hand lotion on the effectiveness of hygienic hand disinfection using an alcohol-based hand disinfectant with an isopropyl alcohol (70% v/v) basis, the reference standard for testing hygienic hand antisepsis according to the test standard EN 1500.[13]

METHODS

Hand lotion

The hand barrier cream CWS-HandProtect (No. 433712; HTS Deutschland, Dreieich, Germany) was used for this study. This lipid-regulating water-in-oil emulsion is a silicone-free, not-perfumed hand lotion containing octyloctanoate, polyglyceryl-2-dipolyhydroxystearate, dioctylcyclohexan, glycerol, *Buxus chinensis* (jojoba oil), *Cera alba* (beeswax), panthenol, magnesium sulfate, hydrolyzed wheat protein, allantoin, methylparaben, propylparaben, phenoxyethanol, dehydroacetic acid, sorbic acid, benzoic acid, and lactic acid.

Alcohol-based handrub

For hand antisepsis, the commercially available handrub Polyalcohol-Hand-Antiseptic (No. 07019; Antiseptica, Pulheim, Germany) was used, a ready-to-use bactericidal, fungicidal, and limited virucidal handrub containing 70 mL isopropyl alcohol, 0.1 mL 1.3-butandiol, lanolin-poly (oxyethylene), and perfumed oil.

Handwashing soap

For handwashing, a nonantimicrobial liquid potash soap (No. 11751201; Caesar & Loretz GmbH, Hilden, Germany) steam-sterilized at 121°C was used.

Volunteers

This study was reviewed and approved by the ethics committee of the University Medicine Greifswald (registration No. BB18/12). All participants were informed on the procedures and gave written informed consent before their participation. Recruitment was based on the availability and willingness of healthy volunteers to participate in the study. Exclusion criteria were based on presence of any visible skin lesions of the hands up to the wrists. In addition, the study subjects were not allowed to wear jewelry or to use any hand lotions, skincare products, or hand disinfectants 1 week before the trial. During the trial period, test persons' hands were not permitted to be treated with lotion or disinfectants other than the products tested in the study. Fingernails had to be short and clean.

Twenty healthy volunteers were included into this study. Except for 3 individuals (1 aged 31-40 years and 2 aged 50-60 years), the volunteers (10 men and 10 women) were recruited from the age group 20-30 years (mean age 29.5 ± 9.78 years).

Test setting and simulated hand contamination

Study volunteers were distributed into 6 groups. All 20 volunteers performed all 6 experiments using a crossover design, which is depicted in Table 1. Group A used only alcohol-based handrub (control), whereas members of group B used hand lotion 5 minutes before hand antisepsis, members of group C used hand lotion 1 hour before hand antisepsis, Group D performed handwashing before hand antisepsis without using hand lotion, members of group E performed handwashing and applied hand lotion 5 minutes before hand antisepsis, and members of group F washed hands followed by hand lotion 1 hour before hand antisepsis.

Table 1
Influence of washing hands with soap or applying protective hand lotion on the efficacy of hand antisepsis

Group (n = 20 per group)	Soap washing	Hand lotion		Handrub	Prevalue (log)	Postvalue (log)	Reduction (log)
		5 min	1 h				
A	No	No	No	Yes	6.44 ± 0.37	3.47 ± 0.44	2.97 ± 0.46
B	No	Yes	No	Yes	6.51 ± 0.27	3.01 ± 0.66	3.50 ± 0.64
C	No	No	Yes	Yes	6.56 ± 0.32	3.21 ± 0.55	3.35 ± 0.59
D	Yes	No	No	Yes	6.51 ± 0.59	3.31 ± 0.65	3.20 ± 0.75
E	Yes	Yes	No	Yes	6.46 ± 0.28	3.12 ± 0.54	3.34 ± 0.59
F	Yes	No	Yes	Yes	6.58 ± 0.22	3.28 ± 0.64	3.30 ± 0.73

After ascertaining the microbiologic prevalues from hands, each test person used 3 mL alcohol-based handrub for 30 seconds according to the European standard test procedure EN 1500.[13] The disinfection method was completed by subsequently rinsing both hands for 5 seconds under running tap water and then shaking off excess water. Thereafter, the microbiologic postvalues were determined.

The partial washing of hands before antisepsis (group D) and subsequent treatment with lotion (groups E and F) was performed for the duration of 1 minute with 3 mL potash soap and subsequent rinsing under running tap water and followed by drying with paper towels. After 1 minute, the test group with lotion treatment received 0.5 mL hand lotion into the dry palm, which was distributed over the palm of the hand analogous to the rubbing technique for hand antisepsis per EN 1500 guidelines. After 5 minutes (group E) or 1 hour (group F), antisepsis was performed. The test persons were required to wear cotton gloves during the application time of 1 hour.

For artificial contamination, both hands were immersed for 5 seconds to the midmetacarpals in a sampling broth containing the cultured test organism *Escherichia coli* K 12 (NCTC 10538) at a concentration of 1×10^8 CFU/mL, and, holding the wet hands in a horizontal position for 3 minutes, allowed to air-dry. The finger tips and thumbs were squeezed for 1 minute at a time in 10 mL trypton-soy-broth per EN 1500, to determine the before and after values. The contamination fluid was never older than 3 hours after spreading to the first volunteer. Furthermore, it was ensured that during the trial, the hands of all test persons were treated with the same batch of contamination fluid. An amount of 0.1 mL was divided from the dilutions 10^{-3} and 10^{-4} onto trypton-soy-agar and incubated aerobically for 48 hours at 36°C ± 1°C. Hand antisepsis was performed in the standard rubbing technique for the duration of 30 seconds according to EN 1500 guidelines.

The neutralizing agent containing 30 g trypton-soy-broth (519791), 30 g polysorbate 80 (27022), 30 g saponine (1310498), 1 g histidine (13326), and 1 g cysteine (1.02838.0025), was validated according to EN 12054. It was used to determine the postvalues in the collection and the dilution fluid as well as in agar, but not to determine the prevalues.

Design and statistical analysis

When determining the prevalues after artificial contamination and contingent upon the test groups formed, the release of pathogens was determined by hands that were not washed and treated with lotion (groups B and C), hands that were washed and treated with lotion (groups E and F), hands that were neither washed nor treated with lotion (group A control).

The difference of microbiologic pre- and postvalues were expressed as log reduction factor. Means were compared in each group. To detect statistical difference, means were analyzed with the Wilcoxon-Wilcox test (Friedman analysis). A significance level of $P < .01$ was set according to EN 1500.