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Major Article

Wettability of hands during 15-second and 30-second handrub time intervals: A prospective, randomized crossover study

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application time
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training

Objective: At present, the shortest recommended application time of alcoholic handrubs is an application interval of 30 seconds. However, application times shorter than 30 seconds are regularly practiced. Therefore, the aim of this study was to investigate whether a 15-second application time achieves a comparable wettability of hands to a 30-second handrub application.

Setting: The wettability of 20 healthy volunteers' hands was compared after 15 seconds or 30 seconds of application time of an ultraviolet-light-active handrub, both before and after training in the application technique. Images of the ventral side and dorsal side of the hands were evaluated by computer software. Both groups' outcomes were analyzed with regard to the spread of the handrub on hands.

Results: There was no difference between the wetted areas of the hands after 15 seconds or 30 seconds of handrub application. A significant difference was observed between the wetted areas of hands in trained volunteers compared with untrained volunteers, irrespective of application time.

Conclusion: Based on our results, a 15-second application time is equal to 30-second application time in terms of wettability of hands. The improvement of wettability after training underlines the necessity to instruct new and untrained health care workers in hand antisepsis. Using fluorescent handrubs may be a feasible method to control and retrain hand hygiene techniques of long-time employees.

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Hand hygiene and hand antisepsis has become a global standard for prevention of health care-associated infections.¹ The World Health Organization considers hand hygiene an important measure to prevent health care-associated infections, and therefore established the worldwide campaign Clean Care Is Safer Care to improve patient safety by fostering awareness and practical support for hand hygiene.² So far, in Germany, more than 550 hospitals participate in this important health campaign.³

To date, effectiveness and skin tolerance of alcohol-based handrubs have been considerably optimized. However, compliance among health care workers is rarely acceptable, and execution of hand hygiene is usually shorter than the recommended time of

30 seconds-1 minute.⁴ Boyce et al^{2,5} found similar result in an analysis of 14 studies published between 1978 and 1997. The range of time spent on hand disinfection ranged was 7-24 seconds, and 8 studies identified application times of even <10 seconds. Overall, there is a large disparity between the manufacturer-recommended minimum hand antisepsis intervals and actual clinical practice.

Aside from the achievable antimicrobial reduction of an alcohol-based handrub, both, its capability to spread on hands and the wettability of the compound influence the most optimal result. Wettability can be optimized with increased application time, by the composition of the handrub, or by training of the application technique.

There are alcohol-based handrubs available that provide superior antimicrobial efficacy, as demonstrated in standardized phase 2/step 2 experiments following the European Norm EN 1500⁵ at application intervals of even 15 seconds compared with the reference 60% v/v propan-2-ol alcohol-based handrub with a 30-second application time.⁷ However, whether the spread of alcohol on the skin and the wettability of hands at different application times are comparable is still insufficiently understood.

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Conflicts of interest: None to report.

Therefore, the aim of our study was to investigate whether a comparable wettability of the hands is achieved during an application time interval of 15 seconds compared with 30 seconds. If alcohol-based handrubs are able to fulfill or surpass the requirements of the EN 1500 within 15 seconds and demonstrate antimicrobial efficacy in reducing test organisms on hands by a magnitude of ≥ 4 log,^{8,9} a contact time shorter than 30 seconds may be generally recommended.

MATERIALS AND METHODS

To determine the wettability on hands, 3 mL of the ultraviolet (UV)-light-active disinfectant Fluo-Rub (B. Braun Medical AG, Sempach, Switzerland) based on propan-2-ol (<50%) and propan-1-ol (<40%) was applied to hands according to the method described in EN 1500⁶ for either 15 seconds or 30 seconds. A photograph of the ventral and dorsal sides of each untreated and disinfected hand was captured and evaluated by the image analysis computer software analySIS pro (Olympus Deutschland GmbH, Hamburg, Germany). For analysis, a cut-off level was determined separating wetted from unwetted areas. All areas showing a higher chromaticity, which indicates the quality of a color as determined by its wavelength and purity, were considered wetted, areas with lower chromaticity were considered unwetted.

Study design

This study was reviewed and approved by the ethics committee of the University Medicine Greifswald (EC Registration No. BB109/10). All participants were informed on the procedures and gave written informed consent to participate. The study was designed as a prospective, randomized, crossover trial encompassing 20 volunteers (11 men and 9 women; mean age, 34 years [range, 21-50 years]), who were local university students and participated in the study voluntarily. Exclusion criteria included dermatitis of the hands, wearing artificial fingernails, and prior knowledge on the use of alcohol-based handrubs and hand antiseptics. The volunteers were instructed not to use nail polish or hand lotion for 5 days before and on trial days. Finger rings were not allowed during the entire test procedure.

Two study groups were observed: the first group of all 20 volunteers was informed in the technique of hand antiseptics but was not actively trained (untrained group). The second group was informed and additionally trained in hand antiseptics techniques (trained group). On days 1 and 2, the volunteers performed a 15-second and 30-second handrub, respectively, with 3 mL regular hand antiseptic fluid. On the third and fourth days, instruction with practical training took place before the 15-second and 30-second hand antiseptics application (Table 1).

All untrained volunteers washed their hands before the trial using water and plain liquid soap to remove dirt and sweat, followed by thoroughly drying hands with a clean paper towel. The dorsal side and the palm of the unwetted hands were photographically documented before each wettability experiment. At the start of the experiment, a pictorial chart of the standardized handrub procedure according to EN 1500⁶ was handed to each volunteer. The

Table 1

Group assignment of the study volunteers

Group	Day 1	Day 2	Day 3	Day 4
1	15	30	15	30
	Untrained		Trained	
2	30	15	30	15

Values are presented as seconds.

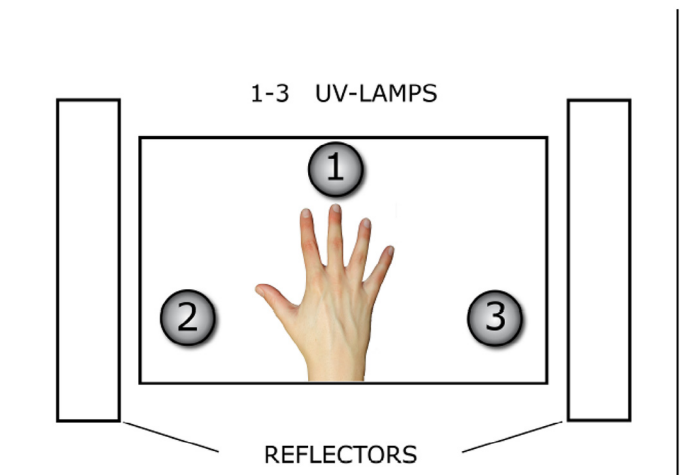


Fig 1. Schematic drawing of the experiment setup, as photographed and evaluated by analySIS pro (Olympus Deutschland GmbH, Hamburg, Germany) software. UV, ultraviolet.

volunteers were allowed unlimited time to memorize the steps for the standardized handrub movements. Thereafter, each volunteer received 3 mL Fluo-Rub and applied it for either 15 seconds or 30 seconds, depending on group allocation. The time was recorded using a stopwatch. After air drying the hands for an additional 30 seconds in each group, a paper cuff was placed around the wrists and the after image was photographed.

On days 3 and 4, images of the unwetted, cleaned, and dried hands of the volunteers were captured, analogously to days 1 and 2, before the extended instruction started. During the instruction, pictures depicting commonly overlooked spots of wettability were demonstrated to highlight and inform possible areas not sufficiently wetted. Then, the single steps of standard hand antiseptics were meticulously practiced together with the instructor. If the volunteers were able to perform the steps in a swift sequence without mistakes, Glo Germ-Gel (Glo Germ Company, Moab, UT), which is fluorescent and easy to rinse, was used instead of the previously used Fluo-Rub. The result was subsequently monitored under UV light. If unwetted areas were detected, volunteers reapplied 3 mL Glo Germ-Gel to amend the mistakes of the first handrub. As soon as all areas showed correct wetting under UV light, the volunteers thoroughly washed the gel off their hands. Another UV light control was performed and as soon as the hands were free of Glo Germ-Gel residues, the volunteers performed a 15-second or 30-second handrub with 3 mL Fluo-Rub, depending on interval allocation. Parallel to days 1 and 2, a photograph was taken after 30 seconds of air drying and while wearing a paper cuff.

Visual documentation

To detect the fluorescence, a UV-light lamp 4W/366 nm (Merck AG, Darmstadt, Germany) on a tripod was used (Fig 1). All images were captured using a digital camera (model E-10; Olympus America, Inc, Center Valley, PA). The exposure time was 2 seconds with a lens aperture set at 5.0. Black velour paper was used as contrasting background in photographs to clearly depict the hands. The paper's rough surface did not reflect the striking light directly but reflected it diffusely, so distracting mirror reflections were avoided. The color black offered the best contrast for white hands, and improved the image quality during evaluation on the digital screen.

Before the start of the experiments, a black paper template of the left and right hand of each volunteer was created to allow

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