



Hand antiseptics: rubs versus scrubs, alcoholic solutions versus alcoholic gels

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Summary: This report describes three different investigations undertaken to demonstrate the advantage of fluid alcoholic hand disinfectants. In the first study, the skin compatibility of Sterillium, a liquid alcoholic rub-in hand disinfectant was compared with that of Hibiscrub, a water-based handwashing antiseptic. Using various parameters such as image analysis of removed squames (D-squames), skin roughness or transepidermal water loss, Hibiscrub was found to be significantly inferior to Sterillium. Hibiscrub caused skin irritation in 15 volunteers who could not complete the test.

In a second study, the microbicidal efficacy of Sterillium and Hibiscrub was tested in surgical hand disinfection. The microbial reduction by Sterillium was significantly greater than that of Hibiscrub, immediately after application as well as after the surgical procedure. In a third study, certain alcoholic gels were tested according to the EN 1500 'hygienic hand disinfection'. None of the gels tested passed the EN 1500 within 30 s. However, Sterillium met the EN 1500 requirement within 30 s. We conclude that Sterillium is superior to Hibiscrub in terms of skin tolerance and microbicidal efficacy in surgical hand disinfection. It is also superior to alcoholic gels.

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Introduction

Hand antiseptic products are marketed in three different forms of application. There are the washing products, solid or liquid medicate soaps which are diluted with water, the so called 'scrubs'. According to European terminology, these are intended for use as a hygienic handwash.¹ A second form of application is the liquid alcoholic hand disinfectants containing ethanol or/and propan-2-ol or/and propan-1-ol as active agents. These products contain additional skin care components. Because such products are rubbed on the hands without the use of water they are called 'rubs'. According to European terminology they are to be used for hygienic hand disinfection.² A third group of hand antiseptic products are the alcoholic gels, also for rubbing in

the hands without water. Alcoholic rub-in gels have been marketed for some years, and every year new products are introduced.

Alcoholic hand gels are very similar in composition to the fluid products. They contain 60–75% w/w of alcohol. The most commonly used alcohol is ethanol but mixtures from ethanol and propan-2-ol, ethanol and propan-1-ol, and propan-1-ol and propan-2-ol are also available. Apart from the alcohol used, the fluid products also differ in the gelling system used. This gelling or thickening system consists of two parts: polyacrylic acid and a neutralizer. Triethanolamine or similar polyamines are commonly used as neutralisers. Water is needed for swelling this system and consequently the higher the content of alcohol, the more difficult it is to enhance viscosity. For this reason the content of alcohol in these products is not more than 75%. The gelling system does not penetrate the skin and after continued application of gels on the hands, a sticky layer the amine salt of polyacrylic acid covers the

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hands. All these gels are intended for general cleaning of the hands in the domestic situation.

Various aspects of the different types of products can be compared, for example dermal tolerance under repeated use and antimicrobial activity. These two aspects were compared for two widely used products for hygienic handwash and hygienic hand disinfection. The former product was Hibiscrub and the latter Sterillium.

Materials and methods

Hibiscrub contains 4% by weight of chlorhexidine digluconate as active agent, surfactants, colours and perfume. Sterillium contains 45% w/w of propan-2-ol, 30% w/w of propan-1-ol and 0.2% w/w of ethylhexadecyldimethyl ammonium ethylsulfate skin care ingredients, colour and perfume.

Dermal tolerance

The skin tests were performed in the laboratories of the Beiersdorf Company in Hamburg, Germany. The microbicidal efficacy was tested in the University Hospital in Basle, Switzerland.

The first study was performed with a panel of 60 volunteers divided in two subgroups of 30 persons each. The first panel started with Hibiscrub, the second with Sterillium. Both products were used over seven weeks after one week of preconditioning. After an interval of four weeks the second run started with a single crossover of products.

Sterillium was used eight times per working day, on each occasion two aliquots of 3 ml were rubbed on the hands for 30 s. Likewise Hibiscrub was used eight times per working day, on each occasion two aliquots of 3 ml were used to wash the hands for one minute.

The following parameters were measured before and after application:

Skin roughness by automatic profilometric measurements on silicone impressions of the volar surface of the forearms^{5,6}

Desquamation by image analysis of scales removed by adhesive discs (D-squames)⁷

Skin hydration by electric capacity measurement using the corneometer technique⁸

Transepidermal water loss by means of an evaporimeter⁹

Clinical assessment by observation of the hands and forearms of the volunteers by a dermatologist

The number of volunteers which dropped out of the study because of skin damage as decided by a dermatologist.

Microbial efficacy (surgical hand disinfection)

In a randomized cross-over clinical trial the antimicrobial efficacy of Sterillium for the surgical hand-rub was tested against Hibiscrub in the Kantonsspital Basel over a period of 11 weeks. This hospital has 1400 beds, 15 operating theatres, 24 376 surgical interventions per annum (including 1040 neurosurgical interventions and 48 kidney transplantations) done by 75 surgeons.

Two weeks were needed for recruitment, four weeks to conduct the Sterillium arm of the study, one week's interval and then four weeks for the Hibiscrub part of the.

The bag-broth technique according to Reagan *et al.*¹⁰ was used for sampling. Processing started within 1 h of sampling. Organisms were recovered by the glove juice method. Plastic bags with the sampling fluid were placed on the subjects hands. The bag on each hand was secured and massaged for 1 min in a uniform manner by a laboratory technician. The number of surviving bacteria was determined by spread-plating serial dilutions (soybean-casein digest agar; incubation for at least 48 h). The active ingredients of the antiseptic products were neutralized in the glove juice with a combination of Tween 80, Saponin, histidine and cysteine.

Microbicidal efficacy: gels versus Sterillium (hygienic hand disinfection)

Three alcoholic gels claim hygienic hand disinfection in compliance with EN 1500. These are Stokosept Gel, assanis Pro and gel hydroalcoolique. Four other gels are used in hospitals: Prevacare, Purell, Endure 300 and Manugel. All seven gels were tested either in our microbiological laboratory or in Greifswald by Kramer and Rudolph as prescribed by EN 1500.²

The antimicrobial efficacy of each product was compared with that of 60% (v/v) 2-propanol on artificially contaminated hands (*E. coli* K 12, NCTC 10538) using a cross-over design with 15 volunteers. The hands were first washed for 1 min with soft soap, dried with paper towels, immersed in the contamination fluid up to the mid-metacarpals for 5 s with fingers spread and then allowed to dry for 3 min. Control microbial counts were obtained by

rubbing the fingertips for 1 min in a Petri dish containing a liquid broth using a separate dish for each hand. Either 3 ml of the hand gel or two aliquots of 3 ml of the reference alcohol were applied to the hands. The rub-in period was 30 s for the hand gels and 60 s for the reference alcohol, as prescribed by EN 1500. The smaller volume of gel and shorter application time were chosen because most alcohol-based liquid hand disinfectants used in the hospital meet the EN 1500 requirement with 3 ml and within 30 s. The post-exposure microbial counts were determined immediately after the rub-in period using Petri dishes containing liquid broth with neutralizers. Appropriate aliquots are spread on solid agar after neutralization. Plates were incubated aerobically at 36°C for 18 to 24 h.

The number of colony forming units per plate and dilution step were recorded. All viable counts per millilitre of sampling fluid were transformed to decimal logarithms. For both reference and test procedure the logarithm of the counts from right and left hands of each subject were averaged separately for prevalues and postvalues. The arithmetic means of all individual log reduction factors (RF) were calculated for both the reference and the test procedure. The Wilcoxon matched-pairs signed rank test (one-sided) was used for testing the mean log RF of a test product against that of the reference product. The level of significance was set at $P=0.01$.

Results

Dermal tolerance

The results are given in Table I. Sterillium has the better values for skin roughness, D-squames, skin hydration, transepidermal water loss and clinical

Table I Comparison of the dermal tolerance of Sterillium and Hibiscrub with various parameter in a clinical trial with 60 volunteers

Type of assessment	Hibiscrub	Sterillium
Skin roughness	--	++
D-squames	---	--
Electrical capacity	---	+
Transepidermal water loss	-	+
Clinical assessment	-	+
Drop outs (n)	15	1

-- = very poor, - = poor, + = good, ++ = very good.

evaluation. A dramatic finding is the very high number of subjects dropping out of the Hibiscrub group. Altogether 15 persons gave up using Hibiscrub for reasons related to the use of the product, but there was only one person who discontinued Sterillium. In this study Sterillium has shown as significant advantage to Hibiscrub in terms of skin compatibility.³

Microbicidal efficacy (surgical hand disinfection)

Before treatment with Sterillium the microbial concentration in the sampling fluid was 5.34 ± 0.13 expressed as \log_{10} with SD; before treatment with Hibiscrub the figure was 5.51 ± 0.31 . These initial colony counts are not significantly different. After treatment with Sterillium, a reduction by 2.4 ± 0.13 was observed to a \log_{10} count of 2.94 on the hands. After treatment with Hibiscrub a reduction by 1.3 ± 0.12 was observed to a \log_{10} count of 4.21 colony forming units on the hands (Figure 1). This difference between the products is highly significant ($P < 0.001$). After surgical operations an increase of \log_{10} counts of 0.6 ± 0.13 and 0.4 ± 0.09 , respectively, was observed, which is not a significant difference between the two products.⁴

Microbicidal efficacy: gels versus Sterillium (hygienic hand disinfection)

The results are given in Table II. All major liquid hand disinfectants (e.g., Sterillium) pass the requirement of the norm within 30 s. With Sterillium (30 s) a mean RF of 4.26 ± 0.45 was found compared with the reference alcohol (4.10 ± 0.59 ; data not presented). An application time of 30 s is

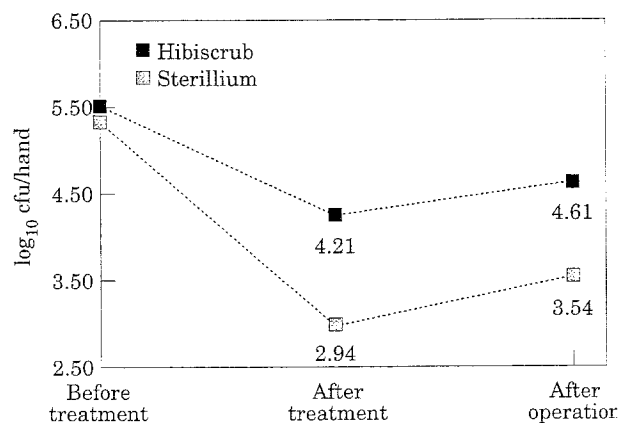


Figure 1 Mean count reduction in the preoperative treatment of hands with Sterillium or Hibiscrub in a randomized clinical cross-over trial.

Table II Mean reduction expressed as RF (\log_{10} reduction factor) with SD of *E. coli* from artificially contaminated hands with the reference alcohol (2-propanol, 60%) or an alcoholic gel; test performed as specified by EN 1500

Name	Mean RF (reference)	Mean RF (gel)	P value
Stokosept Gel	3.78 ± 0.58	2.68 ± 0.41	<0.01
Assanis pro	4.46 ± 1.06	3.68 ± 0.90	<0.01
Gel hydroalcoolique	5.07 ± 0.79	4.09 ± 0.57	<0.01
Prevacare	4.12 ± 0.65	3.07 ± 0.37	<0.01
Purell	4.12 ± 0.65	3.07 ± 0.29	<0.01
Endure 300	4.12 ± 0.65	2.13 ± 0.50	<0.01
Manugel	4.96 ± 0.82	4.07 ± 0.74	<0.01

considered to be the appropriate time for a hygienic hand disinfection by most European professional societies on infection control. None of the tested gels met the requirements of the EN 1500 within 30 s.

Conclusion

In conclusion, of the three types of different hand antiseptic products, alcoholic liquids are superior to scrubs in terms of skin compatibility and of efficacy whilst alcoholic gels are in the state of development, there is no alcoholic gel which meets the EN 1500 within 30 s. Therefore we can not recommend any gel for use in hospitals today. The first choice in the hospital today is an alcoholic liquid product which meets the EN 1500 within 30 s.

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