

ORIGINAL RESEARCH ARTICLE

COMPARATIVE ANTIBACTERIAL EFFECTIVENESS OF FIVE HAND ANTISEPTICS AFTER HAND WASHING WITH COSMETIC, ANTISEPTIC AND AYURVEDIC SOAP

Authors:
Subramaniam R¹
Simpy Mittal²
Mahesh Hiregoudar³
Pooja Latti⁴
Prashant G M⁵
Chandu G N⁶

¹Reader
Department Of Public Health Dentistry
Indira Gandhi Institute of Dental Sciences
Nellikuzhi P. O.
Kothamanagalam, Kerala

²Reader
Department of Public Health Dentistry
Nims Dental College, Jaipur, Rajasthan

³Reader
Department of Public Health Dentistry
Al Badar Dental College
Gulbarga, Karnataka

⁴Reader
Department of Public Health Dentistry
Annoor Dental College, Muvattupuzha
Kerala

⁵Professor
Department of Public Health Dentistry
College of Dental Sciences
Davangere, Karnataka

⁶Professor and Head
Department of Public Health Dentistry
College of Dental Sciences
Davangere, Karnataka

Address for correspondence:
Dr. Subramaniam R
Department of Public Health Dentistry
Indira Gandhi Institute of Dental Sciences
Nellikuzhi P. O.
Kothamanagalam, Kerala

ABSTRACT

Introduction: Human skin is a reservoir of numerous microorganisms belonging to resident and transient flora. Hand washing with soap and water removes excess organic matter temporarily reducing the number of transient flora. Hand antiseptics enhance the antibacterial effect.

Objective: To compare the antibacterial effectiveness of five hand antiseptics routinely used after Hand Washing with Cosmetic, Antiseptic and Ayurvedic soap.

Methodology: Five hand antiseptics (savlon, dettol, sterilol, sterilium, betadine) were compared for antibacterial effectiveness using fingerprint contact sampling on blood agar with 12 subjects. Bacterial samples were obtained before and after hand washing (with antiseptic or cosmetic soap) and after hand disinfection. The antiseptics were rubbed onto the hands and left for 2 minutes before sampling.

Results: Showed increase in Colony forming units (CFU's) following use of different soaps when compared to the baseline values. Following the use of hand antiseptics there was a statistically significant reduction in the CFU counts when compared to the baseline. Sterilium showed the maximum reduction in the count followed by savlon and dettol. Among the soaps used, antiseptic soap showed a statistically significant reduction in the CFU counts when compared to cosmetic and ayurvedic soap.

Conclusion: Using antiseptic soap before hygienic hand disinfection using sterilium will provide maximum benefit in reducing the microbial count.

Key words: Antiseptic, disinfection, hand hygiene, microflora, hand wash.

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Introduction

The human skin acts as a reservoir of numerous microorganisms. Price, in 1938, divided the microorganisms recovered from hand into two categories: resident flora and transient flora. The resident flora are permanent inhabitants of the skin, colonize deeper layers of skin, usually non pathogenic in nature and are more resistant to removal. The transient flora on the other hand are mainly acquired from environment or by direct contact with patients, usually do not multiply on the skin, colonize superficial layers of skin and are most often responsible for cross infections in hospitals.¹

For generations, hand washing with soap and water has been considered a measure of personal hygiene. The concept of cleansing hands with an antiseptic agent probably emerged in the early 19th century. As early as 1822, a French pharmacist demonstrated that solutions containing chlorides of lime or soda could eradicate the foul odors associated with human corpses and that such solutions could be used as disinfectants and antiseptics.

Three main types of procedures can be used for the different procedures of hand hygiene.

1. Social Hand wash - using plain non-medicated soap.
2. Antiseptic and surgical hand wash - using medicated soap.
3. Hygienic and surgical hand disinfection - using antiseptic leave on preparation.²

Hand washing with soap and water removes excess organic matter and temporarily reduces the number of resident and in particular transient flora. Antiseptics enhance the antibacterial effect and hence the transient flora is almost completely eliminated and resident flora is less affected.¹The antibacterial agents incorporated in the medicated soap are triclosan and chlorhexidine. The antibacterial agents available as hand rub / leave on preparations are chlorhexidine, chloroxyleneol, n-propanol, iso propanol, ethanol, povidone iodine, hexachlorophene, benzalkonium chloride etc.^{1,3,4}

The aim of hand washing in dentistry is to eliminate the transient skin microbes to minimize the risk of transferring microorganisms. Hygienic hand disinfection is performed to eliminate transient microorganisms from the skin. ⁵ Hand antiseptic agents are designed to rapidly eliminate most transient flora by their mechanical detergent effect and to

exert an additional sustained antimicrobial activity on remaining flora. The multiplication of resident flora may be retarded as well, so that hand disinfection may be useful in situations in which microbiologically clean hands are required for extended periods.⁶

Hand disinfection by antiseptics specifically aims at killing as much of the total hand microflora as possible to prevent cross infections during surgery.¹

While experts agree that hand washing with soap and water is effective at reducing the spread of disease-causing bacteria, there still remain doubts on the benefit of antimicrobial hand washes over nonantimicrobial soap and water.⁷ Antibacterial hand sanitizers are marketed to the public as an effective way to "wash one's hands" when traditional soap and water are not available. These "waterless" products are particularly popular with parents of small children.

However, The Guideline for Hand Hygiene in Healthcare Settings from the U.S. Centers for Disease Control and Prevention (CDC) points to alcohol-based hand sanitizing products playing a key role in improved hand hygiene practices among healthcare personnel as well as reduced infection rates.²

Objectives

- 1) To compare the antimicrobial effectiveness of five Hand Antiseptics routinely used in dental practice after hand washing with Cosmetic, Antiseptic or Ayurvedic soap.
- 2) To compare the antimicrobial effectiveness of hand washing with Cosmetic, Antiseptic and Ayurvedic soap.

Materials used

Soaps:

1. Cosmetic soap - LUX Petal Touch.
2. Antiseptic soap - Savlon Aloe Vera containing Triclosan.
3. Ayurvedic soap - Medimix.

Hand Antiseptics:

- a. 0.3% Chlorhexidine gluconate + 3.0% Cetrimide - SAVLON®
- b. 70% Ethanol + 10% Isopropyl alcohol - STERISOL®
- c. Chloroxyleneol 4.8% + Terpineol 9% - DETTOL®

- d. Povidone Iodine 10% - BETADINE®
- e. 2 Propanol 45% + 1 Propanol 30% – STERILIUM®

Methodology

A clinical trial with cross over design was planned. Twelve volunteers, nine of whom were post graduate students and three of whom were dental hygienists from Department of Preventive and Community Dentistry, College of Dental Sciences, Davangere, participated in the study. Ethical clearance was obtained from the ethical committee of College of Dental Sciences, Davangere.

Test Procedure: In all the tests, the twelve study subjects washed their hands with either cosmetic, antiseptic or ayurvedic soap and sterile distilled water for 30 seconds. After hand washing, the excess water was shaken off. 5 ml. of antiseptic solution was then applied on to hands and the hands were rubbed together until they were dry and left free of contamination for 2 minutes before bacterial sampling. The standard mode of application of hand rubs is described in EN 1500 was followed. It consisted of 6 steps:

Step 1: Palm to palm.

Step 2: Right palm over back of left hand and left palm over back of right hand.

Step 3: Palm to palm with fingers interlaced.

Step 4: Back of fingers to opposing palms with fingers interlocked.

Step 5: Rotational rubbing of right thumb clasped in left palm and vice versa.

Step 6: Rotational rubbing, backwards and forwards, with fingertips of right hand in left palm and vice versa.

The commercially available concentrations of the antiseptic solutions were used without any dilution.

Bacterial Sampling: Bacterial samples were taken from each test person on three occasions: before hand washing, after hand washing with hands still wet and after application of antiseptic. The samples were taken on human blood agar plates by fingerprint contact sampling method. The plates were incubated aerobically at 37°C for 24 hours. Neutralizing any residual activity in the sampling fluid after exposure is only a technical detail of the efficacy test but has a tremendous effect on the primary outcome. Hence, neutralization or inactivation was done using triclosan.

Quantitative determination of the antibacterial effect: The number of colony forming units (CFU's) was counted from samples obtained from the three occasions. Squares of 1 sq. cm. area were marked on the culture plates against the fingerprints and the number of colonies within each square was counted. The colony forming units were counted using the colony forming units counter. All counting was performed by a single person.

Statistical Analysis: Mean and standard deviation of different samples were tabulated. Statistical significance was measured by using one way Kruskal Wallis ANOVA followed by Mann Whitney U test for pair-wise comparison. p value <0.05 was considered statistically significant. The analysis of data was done by SPSS Version 16.0 (Statistical Package Software).

Results

Results showed a significant increase in CFU count following use of cosmetic, antiseptic and ayurvedic soap, in comparison to the baseline values. Following the use of all the five hand antiseptics studied, there was a statistically significant reduction in the CFU counts, when compared to the baseline. Sterilium showed the maximum reduction in the count followed by savlon and dettol preparations. Among the soaps used, antiseptic soap showed a statistically significant reduction in the CFU counts when compared to cosmetic and ayurvedic soap.

Table 1 shows the comparative antibacterial effectiveness of the antiseptics after cosmetic soap hand wash as compared to baseline. There was an increase in the CFU following hand wash with cosmetic soap which was highly significant. (p=0.001). Similarly, the CFU count reduced significantly after application of antiseptic. Comparison between the five hand antiseptic groups revealed that there was no significant difference in CFU counts between all the groups at baseline (p=0.262) and after hand wash with cosmetic soap (p=0.08). However, there was a significant difference in CFU counts, following the use of different hand antiseptics. (p = 0.001). Pairwise comparison showed maximum reduction in CFU counts following sterilium use, followed by savlon and dettol

Table 2 shows the comparative antibacterial effectiveness of the antiseptics after antiseptic soap hand wash as compared to baseline. There was an

increase in the CFU following hand wash with antiseptic soap which was highly significant. ($p=0.001$). Similarly, the CFU count reduced significantly after application of antiseptic. Comparison between the five hand antiseptic groups revealed that there was no significant difference in CFU counts between all the groups at baseline ($p=0.908$) and after hand wash with cosmetic soap ($p=0.05$). However, there was a significant difference in CFU counts, following the use of different hand antiseptics. ($p = 0.001$). Pairwise comparison showed maximum reduction in CFU counts following sterilium use, followed by savlon, dettol, and sterilol. Betadine showed least antimicrobial activity significantly lower than sterilium.

Table 3 shows the comparative antibacterial effectiveness of the antiseptics after ayurvedic soap hand wash as compared to baseline. There was an increase in the CFU following hand wash with antiseptic soap which was highly significant. ($p=0.001$). Similarly, the CFU count reduced significantly after application of antiseptics. Comparison between the five hand antiseptic groups revealed that there was no significant difference in CFU counts between all the groups at baseline ($p=0.269$) and after hand wash with ayurvedic soap ($p=0.06$). However, there was a significant difference in CFU counts, following the use of different hand antiseptics. ($p = 0.002$). Pairwise comparison showed maximum reduction in CFU counts following sterilium and savlon, followed by dettol, and sterilol. Betadine showed least antimicrobial activity significantly lower than sterilium.

Table 4 shows the comparison of mean CFU count following hand wash with cosmetic, antiseptic and ayurvedic soap. It was observed that there was a significant reduction in the CFU count following use of antiseptic soap in comparison to cosmetic and ayurvedic soap.

Discussion

Hand washing is an important health measure, and improper hand washing has been linked to illness. The transfer of bacteria from the hands to food, objects, or people play an important role in the spread of disease.^{2,3,4}

Since alcohols have excellent activity and the most rapid bactericidal action of all antiseptics, they are the preferred agents for hygienic hand rubs, so-called "waterless hand disinfection." In addition, alcohols are more convenient than aqueous solu-

tions for hygienic hand rubs because of their excellent spreading quality and rapid evaporation. Alcohol-based hand rubs are well suited for hygienic hand disinfection for the following reasons: optimal antimicrobial spectrum (active against all bacteria and most clinically important viruses, yeasts, and fungi); no wash basin necessary for use and easy availability at bedside; no microbial contamination of health-care workers' clothing; and rapidity of action. After extensive reduction following hand disinfection with an alcohol preparation, it takes the resident skin flora several hours to become completely restored. Since alcohol alone has no lasting effect, another compound with antiseptic activity may be added to the disinfection solution to prolong the effect.⁶

Hence, an attempt was made in this study to compare and evaluate the effects of hand washing with cosmetic, antiseptic and ayurvedic soap, followed by use of hand antiseptics. All the soaps and hand antiseptics used in this study are commercially available, used commonly and have proved safety and acceptability

The study demonstrated a statistically significant increase in colony forming units count after hand washing. The observed effect can be attributed to the mobilisation of the microbes from the deeper layers of the skin. Although the study demonstrated a significant reduction in microbial count following antiseptic soap use, in comparison with cosmetic and ayurvedic soap, this social hand wash has only a few indications in hospitals and community dentistry.

Hygienic hand disinfection with an alcohol-based hand rub is the preferred treatment to be carried out after patient care activities that could lead to contamination of the hands of the health care workers. The use of antiseptic soaps alone in all these situations will probably be less effective in preventing nosocomial infections.

In a study conducted by Myklebust S, in Norway in the year 1985, wherein chlorhexidine, ethanol, isopropanol and iodine hand disinfectants were used after hand washing with soap, it was seen that there was a significant increase in microbial counts after hand wash with soap and propanol and chlorhexidine preparations having better antibacterial properties than ethanol, the results being similar to this study.

In another study conducted by Presterl E et al, in Austria in the year 2007, on action of alcohols,

chlorhexidine, hydrogen peroxide and iodine on *S. epidermidis*, it was observed that chlorhexidine and alcohols had comparable antibacterial effectiveness and povidone iodine had significantly lower antibacterial effectiveness.⁹

A study conducted in Arizona by Fuls JL et al in 2008 wherein, the effect of antimicrobial and non-antimicrobial soaps on hand contamination were compared, it was observed that antibacterial soaps showed significant reduction in microbial counts compared to non-antimicrobial soaps.⁷

In a study conducted in U.K. by Jarvis JD et al in 1979 showed that alcohols and chlorhexidine preparations showed significant reduction in microbial counts compared to povidone iodine which was in contrast with the results of this study that showed that povidone iodine ethanol have similar antibacterial effectiveness that is less than that of propanol.¹⁰

Skin irritation by hand hygiene agents is an important barrier to appropriate compliance. The superficial skin layers contain water to keep the skin soft and pliable and lipids to prevent dehydration of the karyocytes. Hand cleansing can increase skin pH, reduce lipid content, increase transepidermal water loss, and even increase microbial shedding. Soaps

and detergents are damaging when applied to skin on a regular basis, and health-care workers need to be better informed about their effects. Lack of knowledge and education on this topic is a key barrier to motivation. Alcohol-based formulations for hand disinfection (whether isopropyl, ethyl, or n-propanol, in 60% to 90% vol/vol) are less irritating than antiseptic or nonantiseptic detergents.⁶

According to Centre for Disease Control and prevention and other experts, washing hands with soap and clean water for 10-20 seconds is a sensible strategy for hand hygiene in non-healthcare settings. If soap and clean water are not available, an alcohol-based hand hygiene product is recommended. However, when hands are visibly soiled, they should be washed with soap and water.²

Conclusion

Use of antiseptic soaps before hygienic hand disinfection using sterilium will provide maximum benefit in reducing microbial counts.

Recommendations

- The hand-hygiene products that have low irritancy potential, good fragrance and skin tolerance should be used to maximize their acceptance.

TABLE 1: ANTIBACTERIAL EFFECTIVENESS OF THE ANTISEPTICS AFTER COSMETIC SOAP HAND WASH AS COMPARED TO THE BASELINE

	SAVLON	STERISOL	DETTOL	BETADINE	STERILIUM	KW ANOVA
BASELINE	69.67 ± 10.49	74.67 ± 11.37	75.33 ± 12.10	77.17 ± 12.41	67.92 ± 12.34	0.262
AFTER COSMETIC SOAP	87.33 ± 10.04	95.75 ± 11.98	92.08 ± 11.62	93.83 ± 14.54	78.67 ± 11.94	0.08
AFTER ANTISEPTIC	1.83 ± 1.03	2.08 ± 1.16	1.58 ± 0.90	2.83 ± 0.72	1.08 ± 0.66	0.001
KRUSKAL WALLIS TEST	0.001	0.001	0.001	0.001	0.001	
MANN WHITNEY U TEST	2>1>3	2>1>3	2>1>3	2>1>3	2>1>3	

TABLE 2: ANTIBACTERIAL EFFECTIVENESS OF THE ANTISEPTICS AFTER ANTISEPTIC SOAP HAND WASH AS COMPARED TO THE BASELINE

	SAVLON	STERISOL	DETTOL	BETADINE	STERILIUM	KW ANOVA
BASELINE	72.83 ± 13.90	71.50 ± 10.69	72.92 ± 13.54	70.08 ± 13.09	68.67 ± 11.73	0.908
AFTER ANTISEPTIC SOAP	86.33 ± 14.13	86.33 ± 12.09	84.83 ± 15.73	78.92 ± 11.25	72.42 ± 11.74	0.05
AFTER ANTISEPTIC	1.67 ± 0.98	2.08 ± 0.79	1.75 ± 0.75	1.83 ± 0.94	1.00 ± 0.74	0.001
KRUSKAL WALLIS TEST	0.001	0.001	0.001	0.001	0.001	
MANN WHITNEY U TEST	2>1>3	2>1>3	2>1>3	2>1>3	2>1>3	

TABLE 3: ANTIBACTERIAL EFFECTIVENESS OF THE ANTISEPTICS AFTER AYURVEDIC SOAP HAND WASH AS COMPARED TO THE BASELINE

	SAVLON	STERISOL	DETTOL	BETADINE	STERILIUM	KW ANOVA
BASELINE	70.17 ± 10.44	75.08 ± 10.69	75.83 ± 12.35	76.75 ± 11.88	68.67 ± 11.73	0.269
AFTER AYURVEDIC SOAP	87.50 ± 10.46	95.67 ± 11.73	92.58 ± 10.79	94.50 ± 14.52	87.42 ± 11.74	0.06
AFTER ANTISEPTIC	1.75 ± 0.96	2.67 ± 0.73	1.93 ± 0.85	2.67 ± 0.94	1.75 ± 0.78	0.002
KRUSKAL WALLIS TEST	0.001	0.001	0.001	0.001	0.001	
MANN WHITNEY U TEST	2>1>3	2>1>3	2>1>3	2>1>3	2>1>3	

TABLE 4: COMPARISON OF MEAN CFU COUNT FOLLOWING HAND WASH WITH COSMETIC, ANTISEPTIC AND AYURVEDIC SOAP.

SOAP	MEAN CFU COUNT	KRUSKAL WALLIS ANOVA	MANN WHITNEY U TEST
COSMETIC	89.53 ± 13.22	$\chi^2 = 6.846$ $p = 0.001$	Ayurvedic, Cosmetic > Antiseptic.
ANTISEPTIC	81.77 ± 13.77		
AYURVEDIC	89.88 ± 13.74		

- The cost of hand hygiene products should not be the primary factor influencing product selection.
- Avoid growing nails, wearing artificial fingernails, rings when having direct contact with patients at high risk.
- Use gloves wherever necessary.
- Educate health care personnel regarding the types of patient-care activities that can result in hand contamination and the advantages and disadvantages of various methods used to clean their hands.
- Make improved hand-hygiene adherence an institutional priority and provide appropriate administrative support and financial resources.

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