

Comparative Efficacy of Hand Disinfection Potential of Hand Sanitizer and Liquid Soap among Dental Students: A Randomized Controlled Trial

Mahesh R Khairnar¹, Anitha G², Tanushri M Dalvi³, Shrivardhan Kalghatgi⁴, Uma V Datar⁵, Umesh Wadgave⁶, Shrushti Shah⁷, Lucky Preet⁸

ABSTRACT

Background: Hands are the most common medium for initiation and spread of infection in clinics. Hand hygiene is the simplest and most economic method for reducing the healthcare-associated infections (HCAs).

Aim: The aim of the present study was to compare the efficacy of hand sanitizer, liquid soap, and their combination for reducing the microbial colonies on hands.

Materials and methods: The study was a single-blinded randomized controlled trial executed in a dental college on 90 participants, which were randomly assigned into three intervention groups of 30 each. The participants were instructed to contaminate their hands followed by a hand hygiene protocol for the liquid hand-wash group, the alcohol-based hand sanitizer (ABHS) group, and the combination group according to WHO guidelines. The swabs were collected pre- and post-intervention and mean colony-forming units were determined for each group.

Results: Median percentage reduction was highest for the combination group (100%), followed by the ABHS group (94.29%) and lowest for the liquid soap (92.31%). This difference in the amount of colony-forming units (CFU) among all the groups was nonsignificant ($p = 0.114$).

Conclusion: The results of the study show that there was no significant difference in hand disinfection potential among hand sanitizer, liquid soap, or their combination. All the three interventions were equally effective with the reduction of total bacterial contamination from participants' hands.

Keywords: Antibacterial agents, Hand hygiene, Hand sanitizers, Randomized controlled trial.

Indian Journal of Critical Care Medicine (2020): 10.5005/jp-journals-10071-23420

INTRODUCTION

Healthcare-associated infections (HCAs) are a major problem for patient safety as they may lead to prolonged hospital stays, long-term disability, increased antibiotic resistance, high costs for patients and their families, and excess deaths.¹ It is estimated that 5–10% of patients admitted to acute care hospitals in developed countries acquire HCAs.² Developing countries in particular are at high risk of HCAs because of unfavorable factors such as understaffing, poor hygiene and sanitation, lack or shortage of basic equipment, and overcrowding.^{1,2}

In hospitals, hands of healthcare workers are the most common medium for transmission of organisms and initiate the infection. Contaminated hands of healthcare workers have been associated with several HCAs^{3,4} and outbreaks.^{5–7} Physical contact between people and objects is a key vehicle for the transmission of pathogens.⁸ Hand hygiene is considered a simple and effective measure to reduce HCAs across all the healthcare settings.⁹ It is assumed that simple handwashing with liquid soap could save 1 million lives a year and many public health campaigns worldwide have addressed "hand hygiene" with varying success.¹⁰ However, even after handwashing, approximately 80% of individuals retain some pathogenic bacteria on their hands.¹¹ The other common method of hand hygiene is the use of high-quality hand disinfectant products such as alcohol-based hand sanitizers (ABHS) that do not require the use of water. This ABHS contain additional skin care substances, such as emollients and humectants, which help replace some of the water that is stripped by the alcohol.¹²

^{1,3,4,7,8}Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India

²Department of Periodontology, ESIC Dental College, Gulbarga, Karnataka, India

⁵Department of Oral Pathology and Microbiology, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India

⁶Department of Public Health Dentistry, ESIC Dental College, Gulbarga, Karnataka, India

Corresponding Author: Mahesh R Khairnar, Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University), Dental College and Hospital, Sangli, Maharashtra, India, Phone: +91 7045653288, e-mail: kmahesh222@gmail.com

How to cite this article: Khairnar MR, Anitha G, Dalvi TM, Kalghatgi S, Datar UV, Wadgave U, *et al.* Comparative Efficacy of Hand Disinfection Potential of Hand Sanitizer and Liquid Soap among Dental Students: A Randomized Controlled Trial. *Indian J Crit Care Med* 2020;24(5): 336–339.

Source of support: Nil

Conflict of interest: None

The available research literature reveals the evaluation of the hand hygiene procedure using variety of hand sanitizers and handwashing using medicated or nonmedicated soaps.¹³ However, the literature showing antibacterial effect of combined use of liquid soap and hand sanitizer is scarce. Hence, the present study was

designed with an aim to compare the efficacy of the hand sanitizer product and liquid soap with their combined use.

MATERIALS AND METHODS

The present study was a single-blind parallel group randomized controlled trial (Flowchart 1). The study protocol was designed and implemented considering the Declaration of Helsinki—ethical principles for medical research involving human subjects. The study was approved by institutional ethical committee. The trial has been registered with Clinical Trial Registry—India (CTRI No. CTRI/2018/01/011191).

The study was conducted on a total of 90 dental undergraduate students (3rd-year students, 4th-year students, and interns). A written informed consent was obtained from participants after being informed about all procedures and possible discomfort. Participants with any fresh injury or wound on hands, history of allergy to liquid soap or hand sanitizer, and who were not willing to give informed consent were excluded.

Study participants were randomly divided into three intervention groups of equal size (30 in each group): Intervention A: hand cleaning using 3 mL of liquid soap and water for 40–60 seconds (Dettol Original Liquid Handwash containing aqua sodium laureth sulfate, glycol stearate, methyl isothiazolinone, and sodium hydroxide); Intervention B: hand cleaning using 3 mL of ABHS for 20–30 seconds (Sterillium containing 2-propanol IP 45.0 g, 1-propanol 30.0 g, mecetronium ethylsulfate 0.2 g, skin-protecting substance, and emollients); Intervention C: hand cleaning using liquid soap and water followed by application of hand sanitizer (Dettol Liquid Soap followed by Sterillium).

The sample size was determined by the GPower software considering the data obtained from a previous study.¹⁴ Keeping the level of significance at 5% and power of the study at 95%, sample size achieved was 30 participants per group for each intervention. Since we had three groups, total sample size estimated was 90.

Participants were demonstrated about the proper hand hygiene technique using liquid soap and sanitizer based on

the WHO hand hygiene protocol.¹ After this, participants were instructed to contaminate their hands by touching typical everyday surfaces (i.e., door handles, tables, stools, routine dental instruments, and dental chair) with both hands prior to testing. A swab of each participant was taken by rotating the swab 360° once on middle three fingertips of left hand and palm and cultured on agar plates to determine a maximum spectrum of microbes present [number of colony-forming units (CFU)]. This provided the baseline for the testing. After this, the participants performed hand hygiene using allocated intervention within stipulated time and a swab was taken again from same hand. A trained person demonstrated and dispensed either liquid soap or hand sanitizer or both as recommended by the manufacturer, depending upon the intervention group. Participants then performed the hand-cleaning technique as per the WHO guidelines.¹

Statistical Analysis

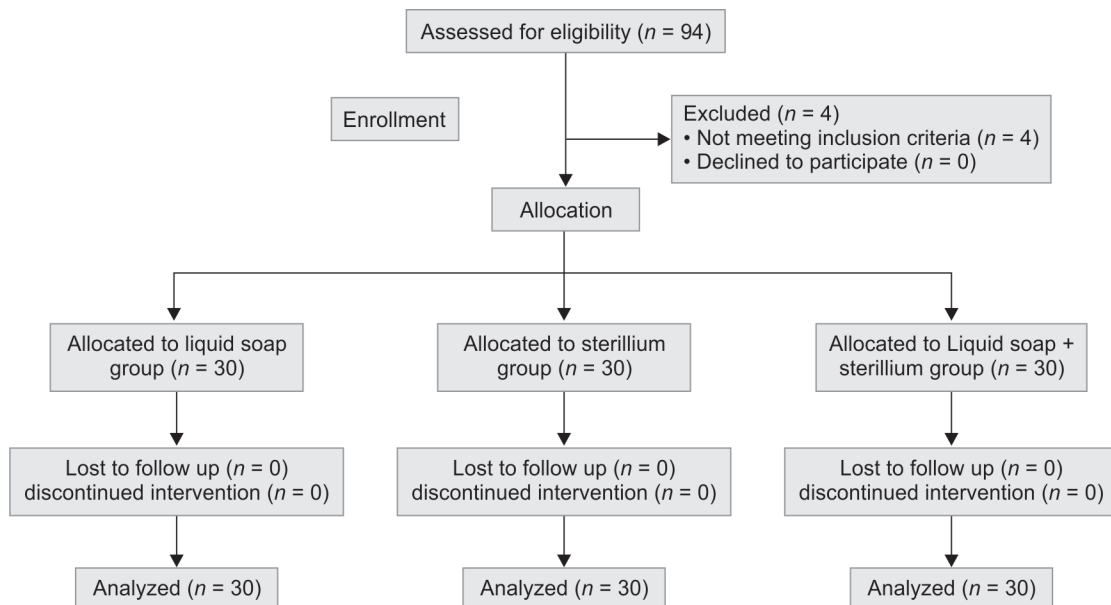
Data were analyzed using the SPSS Software Version 19. The data were tested for normality using the Shapiro–Wilk test and found to be nonnormally distributed. Descriptive statistics like median and the interquartile range of microbial count were evaluated. The Kruskal–Wallis ANOVA test was employed to compare the difference in outcomes between the groups followed by the Mann–Whitney *U* test for pairwise comparison.

RESULTS

Table 1 presents the demographic and clinical characteristic of the study participants. Table 2 shows the comparison of amount of reduction in CFU among all the groups. Median percentage reduction was highest for the combination group (100%) followed by the ABHS group (94.29%) and lowest for liquid soap (92.31%). This difference in the amount of CFU among all the groups was nonsignificant ($p = 0.114$).

Table 3 shows pairwise comparison of amount of reduction in CFU. Difference in reduction of CFU between the ABHS and liquid soap group was nonsignificant ($p = 0.390$). Difference in

Flowchart 1: CONSORT 2010 flowchart of the study



reduction of CFU between the ABHS and combination group was nonsignificant ($p = 0.114$). Difference in reduction of CFU between the liquid soap and combination group was also nonsignificant ($p = 0.063$).

DISCUSSION

This study found no difference in hand disinfection potential among hand sanitizer, liquid soap, or their combination. All the three interventions were equally effective with the reduction of total bacterial contamination from participants' hands. Though statistically nonsignificant, the hand disinfection potential of combination of hand sanitizer and liquid soap was slightly more than for each of the individual agents.

Similar findings were observed in a study where hand rubbing with an alcohol-based product was equivalent to antiseptic handwashing in reducing hand contamination.¹⁵ Another study comparing the effect of two hand hygiene regimens (handwashing vs alcohol sanitizer) on infection rates and skin condition and microbial counts of nurses' hands in neonatal intensive care units showed no significant difference between two products tested.¹⁶ However, several other experimental studies have shown contradictory results and proved that handrubbing with an alcohol-based products was more effective than handwashing with nonmedicated or antiseptic soap in reducing bacterial count on hands.¹⁷⁻²³ One *in vitro* study that compared the efficacy of Sterillium, Lifebuoy, and Dettol soap also showed higher bacterial inhibition by Sterillium compared to other agents.²⁴ As per our knowledge, this is the first study to compare the efficacy of liquid soap and ABHS in combination; hence, the results of the combination group could not be compared with previous studies.

Alcohol-based hand sanitizers have been shown to be effective against a range of viruses and bacteria.²⁵ Findings from the clinical studies have supported the effectiveness of ABHS for preventing HCAs.²⁶ Several viruses are eliminated by using ethanol-based hand rubs including rotavirus (acute diarrhea), rhinovirus (common cold), parvovirus (diarrhea), hepatitis A virus (liver infection), and adenovirus (conjunctivitis). The ABHS containing n-propanol or isopropanol have demonstrated significantly greater skin irritation compared to ethanol-based ones.²⁷ Suchomel et al. demonstrated that glycerol-containing handwash significantly decreases the efficacy of alcohol-based hand disinfectants in surgical application.²⁸ In the present study, propanol-based hand sanitizer (Sterillium) was compared and used along with a liquid soap (Dettol). Handwashing with liquid soap eliminates the body's own fatty acids from the skin, which may give rise to cracks on skin that provide an entry portal for microorganisms.¹⁵

Dental professionals, especially dental students, throughout their academic and clinical hours visit several rooms and come in contact with numerous clinical and nonclinical objects while treating patients; their hands may become a mode of infection transmission and therefore maintaining hand hygiene is critical during the entire course of patient care.⁹

Hand sanitizers are generally time saving whereas handwashing with liquid soap is cost-effective. Hand sanitizers generally work well in clinical settings and may work well in field settings, where there is limited availability of water and where hands come into contact with germs but generally are not heavily soiled. Healthcare workers can depend on alcohol-based hand sanitizers as a "go-to" product in their array for prevention of healthcare-associated infections. Healthcare workers should use soap and water if their hands are visibly soiled, or after several uses of hand sanitizer. Hand sanitizers kill the microorganisms on hands, but the dead microbes remain on hands until they are eventually rinsed down the drain.

The present study findings can be generalized to the dental practitioners working in a clinical setting because of the similar environmental conditions, but not to other healthcare professionals because of different working conditions. Future hand-hygiene interventions should seek to incorporate information on the frequency and duration for hand hygiene episodes. Further research should include a detailed microbial analysis against a variety of bacteria and viruses.

CONCLUSION

The present study concluded that all three interventions were equally potent in reducing the microbial count from contaminated hands of dental students working in clinics. Therefore, it is recommended to use either the hand sanitizer or the liquid soap alone for hand hygiene in the clinical setting depending upon the conditions and availability of the resources.

Table 1: Demographic and clinical characteristics of participants

Variable	Mean/n (%)
Age in years (mean)	21.44
Gender	Males—24 Females—66
Year of study	Interns—45 Final-year BDS—45
Mean colony-forming units	
Sterillium	Pre—38.47 (23.27) Post—2.00 (1.44)
Liquid soap	Pre—28.6 (12.82) Post—3.73 (5.29)
Combination	Pre—43.8 (33.39) Post—2.8 (7.60)

Table 2: Comparison of amount of reduction in colony-forming units among all the groups

Groups	n	Median reduction (in %)	Interquartile range	Min	Max	Chi-square value	p value
Sterillium	30	94.29	88.8–100	80	100	4.335	0.114 (NS)
Liquid soap	30	92.31	82.1–100	38.24	100		
Combination	30	100	95.4–100	75	100		

Kruskal–Wallis ANOVA; NS, nonsignificant

Table 3: Pairwise comparison of amount of reduction in colony-forming unit

Pair	Z value	p value
Sterillium vs liquid soap	-0.859	0.390 (NS)
Sterillium vs combination	-1.579	0.114 (NS)
Liquid soap vs combination	-1.861	0.063 (NS)

Mann-Whitney U test; NS, nonsignificant

ACKNOWLEDGMENTS

We would like to acknowledge Department of Microbiology, BVDU Medical College, for the microbial analysis and also the study participants for volunteering in the study.

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