Research Article

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Hand Hygiene Evaluation of Three Disinfectant Hand Sanitizers Among Students in A Dental Outreach program at Bhubaneswar, Odisha

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ABSTRACT

Background: The word hygiene derives from the ancient Greek goddess Hygeia, the goddess of healing. Today, hygiene is associated with disease prevention and health promotion. The importance of hygiene is universally recognized and evidence based. Physical contact between people and between people and objects is a key vehicle for the transmission of pathogens. Therefore, effective hand hygiene is a key intervention in disease prevention. In the community, outside of the healthcare environment, studies have reported an association between improvements in hand hygiene and reductions in rates of infectious diseases.

Keywords: Hand hygiene, Health care, Dentistry.

INTRODUCTION

The word hygiene derives from the ancient Greek goddess Hygeia, the goddess of healing. Today, hygiene is associated with disease prevention and health promotion. The importance of hygiene is universally recognized and evidence based. Physical contact between people and between people and objects is a key vehicle for the transmission of pathogens. Therefore, effective hand hygiene is a key intervention in disease prevention. In the community, outside of the healthcare environment, studies have reported an association between improvements in hand hygiene and reductions in rates of infectious diseases. It is estimated that simple hand washing could save one million lives a year and many public health campaigns worldwide have addressed "hand hygiene" with varying success.[1] Globally, more than three billion persons do not have household-level access to piped water, which presents a formidable challenge to increasing rates of hand washing with soap and water.[2]

Identifying alternative hand hygiene methods like hand sanitizers for populations with limited water availability may be a critical step for reducing bacterial contamination. Hand sanitizers have been widely accepted for use in hospitals and health care facilities but have received little attention of their use in outreach programmes. To make hand washing easier there are various hand sanitizers available in the market today, unfortunately the efficacy of different formulations of hand disinfectants has rarely been investigated. , Hence the objective of the study will be to evaluate the antibacterial efficacy of the three sanitizers.

MATERIALS AND METHOD

Informed Consent

Informed consent was obtained from all the participants before the start of study.

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Study population: Interns from the Kalinga School of dental sciences, Bhubaneswar were included in the study.

Sample size determination:

Keeping a power of test 80% and alpha value at 0.5 significance a total of 60 subjects will be recruited in the study.

Sampling technique

Simple random sampling was done to select the sample.

Method and sample selection

Interns posted in the department of public health dentistry were included.

Ethical clearance

Ethical approval was obtained from the KIMS ethics committee.

Study period

The study was conducted over a period of 1 month after obtaining written informed consent from the participants.

Inclusion and Exclusion criteria:

Inclusion Criteria:

Participants who gave consent to participate were included in the study
Received no prior training in hand hygiene.
Students present on the day of study

Exclusion Criteria:

Students not giving written informed consent.
Absent on the day of study.
Suffering from skin diseases /on medication

Methodology:

The 30 volunteers were briefed to attend the two testing sessions at the Kalinga institute of dental sciences in the department of public health dentistry. During phase one on arrival at the college a microbial count of each subject's right palm and finger tips was taken and cultured on agar plates to determine a maximum spectrum of microbes present this will provide the base line for the testing.

The hand preference of the participants was not evaluated as it is known that 90% of the population is right handed as seen in many studies.

The volunteers were randomized into three groups of 10, each group was allocated one of the three hand sanitizers: Gender and age distribution was not significantly different between the three groups. Investigator and participants were blinded about the intervention (Double-blinded study). The subjects with no previous training in hand disinfection and were asked to use the supplied product without being given specific instructions. After applying the sanitizer, count was taken from each subject's right palm and Fingertips; and cultured on agar plates at 37degreeC overnight to determine a maximum spectrum of microbes present..

In phase two the students were be educated about correct hand disinfection technique before the project starts. After receiving training in the correct use of hand sanitizer, the participants were asked to apply their allocated hand sanitizer utilizing their recently acquired knowledge in an outreach programme. A count of their right palm and fingertips was taken and cultured on agar plates, incubated at 37degreeC for overnight and colonies were counted. Colonies counting was done in the Kiit School of biotechnology.

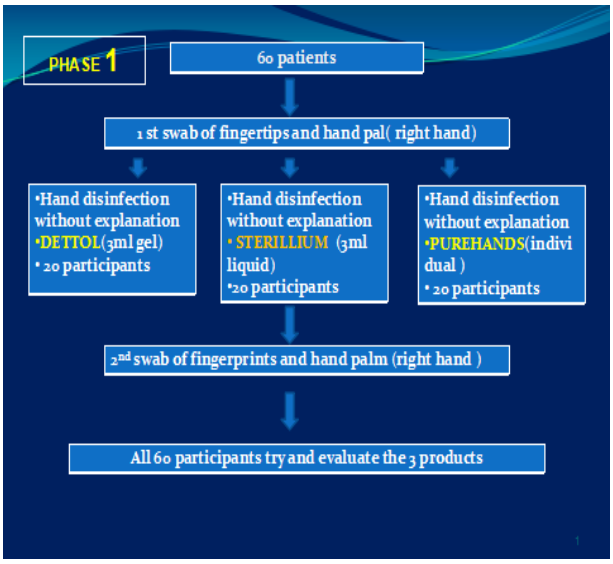


Fig 1: Flow chart of phase 1 treatment.

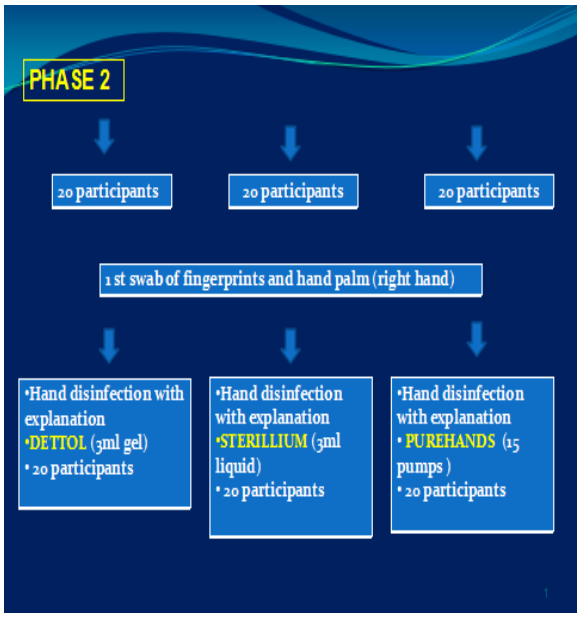


Fig 2: Flow chart of phase 1 treatment.

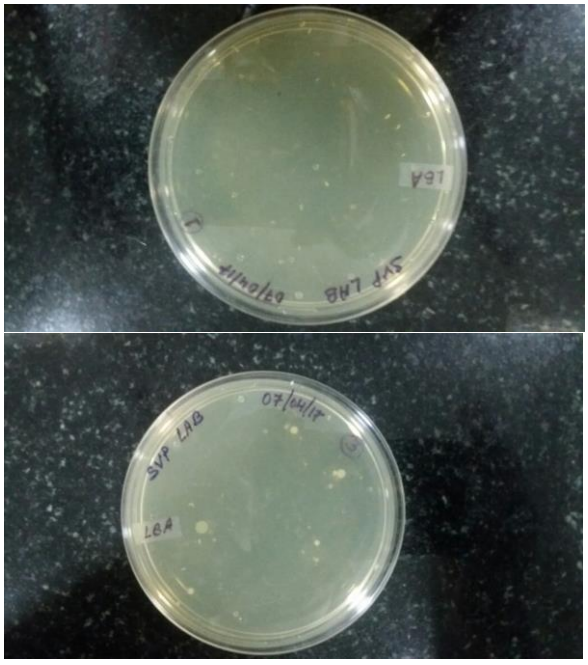
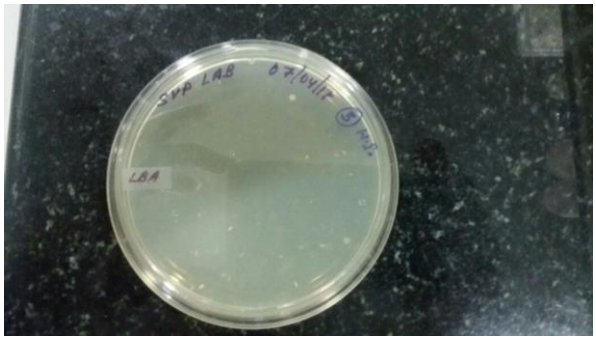


Fig 3: Pre - Intervention (CFU).



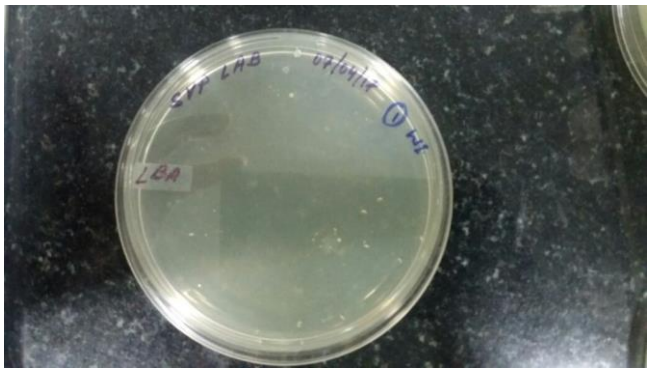


Fig 4: Post-Intervention (CFU).

RESULTS

Table-1- Intra group comparison in reduction of microbial count (pre-intervention) shows significant reduction in microbial count in all the three groups.i.e.(50.25±9.25-42.50±8.64), (150.13±6.25-3.33±1.11), (70.20±2.36-24.93±1.62) respectively.

Table-2- Intra group comparison in reduction of microbial count (pre-intervention and post-intervention) shows post-intervention application of hand sanitizers' results in greater reduction in microbial count as compared to pre- intervention reduction for all three groups. (42.50±9.25-29.53±3.29), (3.33±1.11-1.06±0.26), (24.93±1.62-12.33±1.71).

Table-3- intergroup comparison among three hand sanitizers of mean and percentage reduction in microbial counts between different time intervals between base line - pre intervention use of sanitizers and base line – post intervention use of sanitizers shows a significant reduction in microbial count after the intervention. Comparison between baseline- pre intervention shows a reduction in [7.75±0.45 (15.42%)][146,8±5.11 (97.78%)],[45.27±0.72 (64.48%)] for the three groups respectively. Comparing baseline post-intervention shows reduction in microbial count of [20.72±5.92 (41.23%)], [149.07±5.99 (99.28%)], [57.87±0.72 (82.40%)] for the three groups respectively.

Figure-3 Shows the intragroup microbial load at different time intervals for first group (50.25, 42.5, and 29.53%) for second group (150.13, 3.33, and 1.06%) respectively for third group (.70.2, 24.93,

Table 1: Intragroup comparison of microbial count at different time intervals.

	Baseline	Pre Intervention	T value	P value
A	50.25±9.25	42.50±8.64	13.696	0.001
B	150.13±6.25	3.33±1.11	90.34	0.001
C	70.20±2.36	24.93±1.62	50.17	0.001

Table 2: Intragroup comparison of microbial count at different time intervals.

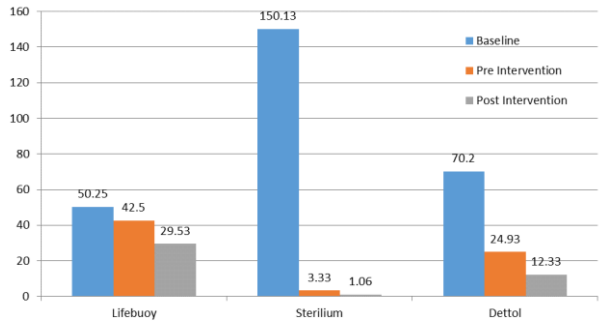
	Pre Intervention	Post Intervention	T value	P value
A	42.50±9.25	29.53±3.29	5.26	0.001
B	3.33±1.11	1.06±0.26	9.34	0.001
C	24.93±1.62	12.33±1.71	17.28	0.001

P≤0.05 –Significant Test Applied: Paired t test

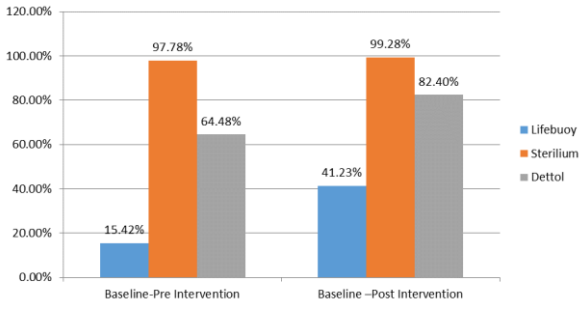
Table 3: Intergroup comparison among three hand sanitizers of mean and percentage reduction in microbial counts between different time intervals.

	A	B	C	P value
Baseline-Pre Intervention	7.75±0.45 (15.42%)	146,8±5.11 (97.78%)	45.27±0.72 (64.48%)	0.001
Baseline –Post Intervention	20.72±5.92 (41.23%)	149.07±5.99 (99.28%)	57.87±0.72 (82.40%)	0.001

P≤0.05 –Significant Test Applied: One Way ANOVA



Graph 1: Intragroup comparison of microbial count at different time intervals.



Graph 2: Intergroup comparison among three hand sanitizers of percentage reduction in microbial counts between different time intervals.

12.33%) at baseline to pre-intervention and baseline to post-intervention respectively.

Figure-4 Shows intergroup comparison among three hand sanitizers of percentage reduction in microbial counts between different time intervals

DISCUSSION

Infection with environmental microbes is increasing alarmingly. Normal human skin always harbors bacteria (10^2 and 10^6 CFU/cm^2). The transfer of bacteria from the hands to food, objects, or people plays an important role in the spread of many communicable diseases. The critical density of micro-organisms on the hands needed for the spread of pathogens remains unknown, and it may depend on the type and duration of contact, the type of micro-organism, the patient's resident flora, and their colonization resistance.[3]

To overcome the negative impact of microbial contamination in health-care settings, hand sanitizers are recommended as an adjunct to plain hand washing. [3] Most commonly and easily available hand sanitizers in the Indian market were

selected for the study. Among the three hand sanitizers used in this study,

Alcohol was the main active ingredient in alcohol-based hand sanitizer which exerts antimicrobial activity by causing protein denaturation, disruption of tissue membranes, and dissolution of several lipids. Alcohol has increasing effectiveness from 60% to 90% with 1-propanol being most effective followed by 2-propanol and finally by ethanol, whereas Coriander, Lime, and Neem were the active ingredients responsible for antimicrobial activity in herbal hand sanitizer.

Many studies have been conducted to assess the antimicrobial effectiveness of hand sanitizers alone, but very few literature are available to assess the difference between various disinfectants and hand sanitizers. Disinfectants are chemical agents with an immediate and sustained activity which destroys micro-organisms to such a level mandated for hygienic and surgical indications. Sanitizers, on the other hand, are agents with an immediate activity that reduce the number of micro-organisms to a safe level to meet the public health requirements. Disinfectant uses a better form of alcohol (propanol) to achieve more bacterial reduction as compared to sanitizers (ethanol). Both can achieve bacterial reduction on contact (in 15–30 s).

Alcohol based hand sanitizer containing propanol was the most effective disinfectant among all the hand sanitizers against all the bacteria used in the present study. This might be attributed to the presence of alcohol (propanol 75%) in liquid form that soaks and penetrates the skin creases and nail folds unlike the gel form sanitizers that glide over and coat the skin. It also contains Mecetronium ethyl sulfate to contribute for residual effect for approximately 3–5 h which is lacking among other hand sanitizers.

The results of the present study are similar to the findings of Reena Rajkumari, where sterillium was more effective against *Candida albicans*, *E. coli*, and *Klebsiella pneumoniae*. A study conducted by Oke *et al*. revealed that Dettol hand sanitizer was effective only against *P. aeruginosa* whereas it was not effective against *S. aureus* and *E. coli*. Lifebuoy hand sanitizer also showed antimicrobial activity against the tested organisms; however, the exact and valid comparison could not be done with other studies due to lack of scientific literature.

Similar to the present study, several studies reported significantly better antimicrobial efficacy of hand sanitizers, as well as a decrease in nosocomial infection rates as compared to hand washing. Furthermore, a study conducted among school children showed significantly high efficacy of hand sanitizers in reducing micro flora on hand.

A study conducted by Mondal and Kolhapure showed that PureHands, the herbal hand sanitizer, was effective against *E. coli*, *Proteus mirabilis, Shigella sonnei*, *S. aureus*, and *S. epidermidis*. The present study also showed antimicrobial efficacy of PureHands against tested organisms; however, it was the least effective among all the hand sanitizers which may be probably due to low antimicrobial potency of Coriander, Lime, and Neem present in it. Further studies are required to find the exact cause of least effectiveness of PureHands herbal hand sanitizer against the tested organisms

In the new CDC guideline, "persistent" activity is defined as the prolonged or extended antimicrobial activity that prevents or inhibits the proliferation or survival of microorganisms after application of the product [23]. But it remains unclear how such a persistent effect can be determined. According to the European norm prEN 12791 (version 1997) on products for surgical hand disinfection, a preparation has sustained efficacy if the mean RF is not significantly lower after 3 h, compared with the reference treatment. This reference treatment itself leads to a mean bacterial density on the hands which is usually significantly lower after 3 h compared to baseline [23] which can be described as a sustained efficacy

A persistent efficacy was defined as an efficacy after 3 hours which is significantly superior compared with the reference treatment regardless of the presence of a non-volatile active agents

Hand sanitizers are more effective than plain soap and water alone in preventing transmission of bacteria from the hands of individuals. They play a significant role and could be an effective alternative to hand washing to achieve asepsis for all the health-care professionals in outreach program,

water scarcity areas, and in routine clinical practice. Hence, stressing proper hand hygiene is an important first-line defense against the spread of multiple infectious diseases.

The present study has its own limitations - as only the antimicrobial efficacy of different hand sanitizers was assessed. Further studies are required to assess the exact quantity and duration of application of hand sanitizer or disinfectant

CONCLUSION

Sanitizer with propanol as the constituent possessed maximum antimicrobial effect against all the Gram-positive as well as Gram-negative bacteria used in the study, followed by herbal and other alcohol based hand sanitizer respectively. Despite the claims of efficacy and 99.9% bacterial reduction by hand sanitizer manufacturers, there still exists a need for verification of these claims by regulatory bodies and higher authorities for the enforcement of good-quality measures.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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