

Comparative study of effectiveness of different germicidal hand washing agents in clinical and paraclinical health care personnel

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Abstract

Objective: This comparative, prospective study was conducted to estimate the effectiveness of five different germicidal hand washing agents and to obtain comparative data among clinical and paraclinical personnel.

Methods: Five different hand washing agents were compared. Pre and post swabs were collected and cultured aerobically. Percentage reduction in colony counts was obtained and compared between different hand-washing agents among clinical and paraclinical personnel.

Results: Sixty nine (22 (31.88%) males; 47 (68.11%) females) health care personnel who fulfilled the intake criteria were included in study. Of these, 32 (4 (12.5%) males; 28 (87.5%) females) were clinical personnel and 37 (18 (48.64%) males; 19 (51.3%) females) were paraclinical personnel. The mean age of the participants was 30 years (SD: 11.3 years; range: 18-56 years). There was a significant difference ($Z = \geq 2$; $p \leq 0.05$) in colony forming units (CFUs) after application of each agent on bare hands, in both groups. The reduction CFUs was significant ($p = 0.190196$; < 0.05) with use of Povidone iodine scrub.

Conclusion: Povidone-iodine scrub is most effective agent amongst all tested. Bactericidal efficacy of all the agents was superior among paraclinical personnel.

Keywords: Hand-washing agents, clinical and paraclinical personnel, alcohol, chlorhexidine, povidone-iodine.

1. Introduction

Infections acquired in healthcare settings are amongst the major causes of increased mortality and morbidity among hospitalized patients [1]. The sources of nosocomial infections in many patients are, often, found to be virulent species with multidrug-resistance pattern [2]. Despite the efficacy of hand cleansing in removal of transient bacteria, the hands of healthcare workers have been repeatedly implicated as vehicles of transmission of nosocomial pathogens [3]. Over a period, various guidelines are published in regards to hand washing practices [4-7]. The impact of hand hygiene depends not only on the regularity of thoroughness of the procedures used but also on the type of hand-washing agent selected [8]. In view of above, the study was conducted to estimate the effectiveness of the different germicidal hand washing agents and to obtain comparative data among clinical and paraclinical personnel in a tertiary care teaching hospital.

2. Materials and Methods

This comparative, prospective study was conducted in the tertiary care hospital in a metropolitan city for a period of three months, after obtaining Institutional Ethics Committee permission. Prospective participants were explained about the study. The participants were demonstrated the technique of hand washing recommended by the World Health Organization [9] and it was scrupulously enforced throughout the study.

2.1 Inclusion criteria

Health care personnel of either sex, aged eighteen years and above, who gave written informed consent to participate in the study.

2.2 Exclusion criteria

Health care personnel who did not consent to participate or those who had any type of allergy to hand washing agents.

2.3 Sample collection and processing:

Sterile pre-moistened swabs were rubbed over palm including the inter-digital spaces and fingertips of both hands (pre-swabs). After hand washing with the agents mentioned below, hands were allowed to air dry without use of any cloth/paper and post-swabs were taken in the similar manner under all aseptic precautions. Each participant washed both hands with the following agents - plain water, non-medicated soap, alcohol-based hand sanitizer (Sterilium®, containing 2-propanol, 1-propanol; Bode-chemie, Germany), chlorhexidine-based cleaning agent (Microbat®, containing chlorhexidine gluconate solution I.P. 20%; UPS Hygienes Pvt. Ltd. Dortmund Lab Pvt Ltd, Dombivli East, Maharashtra) and povidone iodine based antiseptic (Betadine Scrub®, 7.5% povidone iodine; Purdue Products, L.P., Stamford, CT, USA). There was a time gap of at least 48 hours (“wash out” period) between the use of each agent. The swabs were cultured on blood agar and plates were incubated at 37°C for 24 hr.

The growth of various bacteria and fungi, if any, was studied in terms of colony characteristics, colony forming units (CFU). Further identification was done by Gram staining and biochemical reactions [10]. The percentage reduction in CFU counts with different hand washing agents was compared between clinical and paraclinical personnel.

2.4 Statistical tests

The data were analysed using chi-square test, Z test with standard error of difference of mean (SEDM). Statistical significance was accepted at $p \leq 0.05$.

3. Results

Sixty nine (22 (31.88%) males; 47 (68.11%) females) health care personnel who fulfilled the intake criteria were included in study. Of these, 32 (4 (12.5%) males; 28 (87.5%) females) were clinical personnel (resident doctors, interns and nurses) and 37 (18 (48.64%) males; 19 (51.3%) females) were paraclinical personnel (attendants, technicians and medical students). The mean age of the participants was 30 years (SD: 11.3 years; range: 18-56 years). The average colony forming units (CFU) count before and after application of water, soap-water, sterilium, chlorhexidine and povidone-iodine scrub (Table-1) and percentage reduction in CFU after applying different germicidal agents in clinical and para-clinical personnel (Table-2) were compared. There was a significant difference ($Z = \geq 2$; $p \leq 0.05$) in CFUs after application of each agent on bare hands, in both groups. The reduction CFU was significant ($p=0.190196$; <0.05) with use of povidone-iodine scrub.

Table 1: Comparison of an average bacterial count (CFU) before and after application of hand washing agents

Personnel	Swab type	Average bacterial Count				
		Water	Soap-water	Sterilium	Chlorhexidine	Povidone iodine scrub
Clinical (n=32)	Pre-swab	123	123	71	87	74
	Post-swab	60	24	7	7	0
Para-clinical (n=37)	Pre swab	72	72	91	64	84
	Post-swab	42	33	17	7	1

Table 2: Percentage reduction in CFU after applying various disinfectants

Personnel	Reduction in CFU (%)				
	Water	Soap-water	Sterilium	Chlorhexidine	Povidone iodine scrub
Clinical (n=32)	42	53	85	89	97
Para-clinical (n=37)	58	84	90	89	99

CFU = Colony Forming Units

4. Discussion

The skin is not only an effective barrier between the organism and the environment, but also an ecosystem composed of different habitats rich in invaginations, pockets, and niches [11]. In addition to the resident flora and transient flora, infectious flora consisting of *Staphylococcus aureus* and beta-hemolytic streptococci, has been reported [12]. Hands are contaminated by this flora during contact with patients or environmental flora contaminated by patients' environment [8]. The duration and type of patient care affects the microbial flora of HCW. The number of bacteria increases with the duration of clinical activities, on average by 16 CFU /min [13].

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4.1. Demographic differences:

In the current study, there were no significant age- or gender-related differences in reduction of CFU due to use of hand washing agents.

4.2. Comparison between the different hand washing agents

The use of plain soap and water reduces the numbers of microorganisms and viruses by mechanical removal of loosely adherent microorganisms from hands [14]. When used in a liquid soap, chlorhexidine usually has a concentration of 4% and exhibits a bactericidal activity against various gram-negative and gram-positive bacteria [15, 16].

In this study, the mean pre-treatment bacterial count was 95.76 (± 119.87) CFU. Similar results were reported by studies from Alexandria, Egypt [8] and Vienna, Austria [17].

The significance of differences in reduction of CFU after application of hand washing agents were - water ($p=0.0069$), soap water ($p<0.00001$), alcohol ($p<0.00001$), chlorhexidine ($p<0.00001$), Povidone iodine scrub ($p<0.00001$).

Other studies [2, 8] have reported reduction in bacterial count with use of soap water in range of 30-76%; while alcohol-based hand wash was found to reduce bacterial count by 82.5% [2].

In our study, the reduction in CFU with alcohol-based hand wash was significantly higher than that with soap-water. (Table-2) Similar findings have been reported in a study conducted in a university hospital in France [18]. Povidone iodine scrub showed 97-99% reduction in all isolated bacteria. (Table 2) In most studies on hand antisepsis that included plain soap, alcohols were found to be more effective than soap. [3, 8, 18]

4.3. Comparison between clinical personnel and para-clinical personnel:

In current study, the pre-swab CFU counts in clinical and paraclinical personnel were comparable. A New York-based study [19] has also reported comparable carriage of *S. aureus* on hands of medical and non-medical personnel.

Reduction in CFU after applying water, soap-water and alcohol based hand-wash was significant in para-clinical personnel in the present study.

A Nigerian study [20] reported lower pre-swab bacterial counts in medical personnel due to higher frequency of hand washing and also found higher antimicrobial resistance among the isolates from medical personnel due to over-exposure to anti-microbial agents. The marginal reduction in CFU among clinical personnel in the present study could be because of the same reason.

4.4. Limitations

This study compared the percentage reduction in CFU counts using 5 different hand washing agents in a relatively small number of clinical ($n=32$) and paraclinical ($n=37$) personnel. Individual bacteria-wise efficacy and anti-microbial susceptibility of isolates were not tested.

5. Conclusion

Povidone-iodine scrub was found to be the most effective amongst the 5 hand washing agents tested. Bactericidal efficacy of all the agents was found to be higher in paraclinical personnel probably because of reduced exposure to anti-microbial agents.

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Conflict of Interest: None

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