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Hand Washing: A Cornerstone to Prevent the Transmission of Diarrhoeal Infection

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Abstract: The present study was on the effect of hand washing in reducing spread of diarrhoeal infection among students. A total of 400 hand swab samples of 100 students were analyzed before and after hand washing and hands of all students were found to harbor bacterial pathogens which include *Staphylococcus* sp. (23%), *Escherichia coli* (20%), *Klebsiella* sp. (10%), *Micrococcus* sp. (9%), *Proteus* sp. (7%), *Citrobacter* sp. (7%), *Streptococcus* sp. (7%), *Enterobacter* sp. (6%), *Enterococcus* sp. (4%), *Pseudomonas* sp. (3%) and *Salmonella* sp. (2%). While the percent reduction of these pathogens after hand washing were *Salmonella* sp. (100%), *Staphylococcus* sp. (88 %), *Escherichia coli* (59%), *Enterococcus* sp. (59%), *Proteus* sp. (55%), *Streptococcus* sp. (54%), *Citrobacter* sp. (45%), *Micrococcus* sp. (44%), *Klebsiella* sp. (39%), *Enterobacter* sp. (37%), and *Pseudomonas* sp. (31%). The data indicates that the hands of the male (42%) were less contaminated than female (58%). The present study showed clear evidence of 54% decrease in microbial flora after hand washing. Thus, it can be concluded that hand washing is a cornerstone to prevent the diarrhoeal infection.

Key words: Hand washing, hygiene, infection and students

INTRODUCTION

Infectious diseases that are commonly spread through hand to hand contact include common cold and several gastrointestinal disorders, such as diarrhea. Diarrhoea is a serious global public health problem. It is estimated that 2.2 million people in developing countries most of them children, die annually due to diarrhoea linked to lack of access to safe drinking water, inadequate sanitation and poor hygiene (WaterAid, 2006). It is transmitted by ingesting contaminated food or drink, by direct person-to-person contact, or from contaminated hands. Human hands usually harbors microorganisms both as part of person's normal microbial flora as well as transient microbes acquired from the environment (Lindberg *et al*., 2004). Many food borne diseases and pathogenic microorganisms are spread by contaminated hands. If pathogens from human faeces enter a person's mouth, will cause diarrhoea. School going children are exposed to greater risks of diarrhoeal disease by consuming contaminated water and food (Dasgupta, 2005). If proper treatment is not given, this can prove fatal, particularly to children (WHO, 2006). Many of these illnesses occur unnecessarily, since the feacal-oral routes of disease transmission are easily prevented (WHO, 2003). The students in schools or colleges are more likely to take meal and water without washing hands and may pose to risk of infection (Tambekar *et al*., 2007).

Hygiene has a measurable impact on reducing the burden of infections in the developing world (Aiello and Larson, 2002). The correct hand washing is the single most effective way to prevent the spread of communicable diseases. Good hand washing techniques is easy to learn and can significantly reduce the spread of infectious diseases among both children and adults. Hand washing is one of a range of hygiene promotion interventions that can interrupt the transmission of diarrhoea-causing pathogens (Ejemot *et al*., 2008). Hence the purpose of this study was to identify bacterial enteric pathogens associated with students hand and to find out percent reduction after hand washing to reduce diarrhea disease linked to poor hand hygiene.

MATERIALS AND METHODS

A total of 400 hand swabs samples from 100 students were collected from various school students, KG to PG in Amravati city (Maharashtra, India) from July to December 2008. Out of 100 students 35 each from KG, Primary and 30 students from PG were randomly selected for the study. The left and right hand of each students were swabbed with the help of sterile cotton buds, soaked in 0.85% saline solution from define (fixed) area on the palm as before and after hand washing. Hands were washed thoroughly with water and soap in their usual (regular) manner. These swabs were added into saline solutions of various dilutions under aseptic conditions and 0.2mL from each dilution was inoculated on sterilized MacConkey agar plate and uniformly spread and incubated at 37 ºC for 24h. After incubation, numbers of CFU were counted and different types of colonies were isolated. The distinct colonies were screened and selected

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on the basis of morphology, bacterial characteristics and identified by standard test.

Tentative identification of isolates were made by gram staining, motility, biochemical tests and cultural characteristics by subculturing on CLED such as yellow colored colonies of lactose fermenting *E. coli*, greenish color colonies of *Proteus* sp., greenish blue or blue colonies of *Ps. aeruginosa*, mucoid yellow to whitish blue colonies of *Klebsiella* sp. and deep yellow opaque colonies of *S. aureus* (Hi-Media Manual, 2003). Confirmation of various bacterial pathogens were made by subculturing on Xylose Lysine Deoxycholate agar (XLD agar; M1108, Himedia, Mumbai), Salmonella-Shigella agar (S-S agar M108, Himedia, Mumbai) for *Salmonella* sp., Mannitol salt agar for *Staphylococcus aureus*, Cetrimide agar for *Pseudomonas* sp. MacConkey agar for other enteric pathogens and various special biochemical tests. For confirmation of the pathogens, typical colonies were inoculated into Rapid Microbial Limit Test kits, which are a combination media in liquid and solid phase in a single bottle for simultaneous enrichment, isolation, and confirmation of pathogens.

Along with hand swab samples, information, or data on name, age, socio-economic back ground of family, sex, domestic and personal hygienic practices, nail hygiene, places of eating tiffin, sources of water etc were collected and data was interrelated with bacterial contamination in hand swab. All data were analyzed with the Statistical Package for Social Sciences 15 for Window (SPSS inc.: Chicago, IL, USA) software.

RESULTS AND DISCUSSION

A total of 400 hand swabs samples from 100 students were collected from various KG, primary and PG students in Amravati, Maharashtra, India. Out of 100 students 35 from KG, 35 from primary and 30 from PG were selected. Hand swabs of each student were found to harbor bacteria before hand washing.

The swab samples were collected from 45 male students and 55 female students. Out of these the hands of female (58%) were more contaminated than male (42%). *S. aureus* and *E. coli* were showed higher percentage of contamination in both male and female's hand (Table 1). Tambekar *et al*., (2009) reported that bacterial load on the hands of the female was more than male students.

There was a variety of bacterial species found on the hands of the students. Bacterial pathogens isolated include *Staphylococcus* sp. 135 (23%), *Escherichia coli* 121(20%), *Klebsiella* sp. 61(10%), *Micrococcus* sp. 52(9%), *Proteus* sp. 45 (7%), *Citrobacter* sp. 42 (7%), *Streptococcus* sp. 40 (7%), *Enterobacter* sp. 37(6%), *Enterococcus* sp. 27(4%), *Pseudomonas* sp. 17(3%) and *Salmonella* sp. 13(2%) (Table 1).

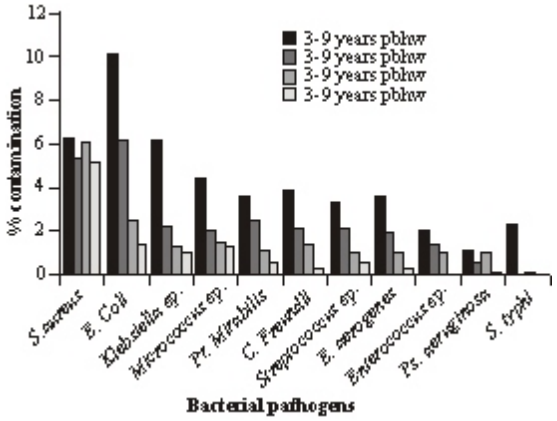
Aiello *et al.* (2004) reported occurrence of *Enterobacter* sp. and *Staphylococcus* sp., *Klebsiella pneumoniae*, *Pseudomonas* sp. on the hands. Tambekar *et al.* (2009) reported the presence of *E. coli, Pseudomonas* sp., *Proteus* sp., *Citrobacter* sp., *Klebsiella* sp., *Salmonella* sp., *Enterobacter* sp and S*taphylococcus aureus* from hand swabs of students. Prescott *et al,* (2005) observed the incidence of *Staphylococcus aureus, Bacillus subtilis, E. coli*, *Lactobacillus* and *Actinobacillus* in human palms.

While the percent reduction of these pathogens after washing hands were *Salmonella* sp. (100%), *Staphylococcus* sp. (88 %), *Escherichia coli* (59%), *Enterococcus* sp. (59%), *Proteus* sp. (55%), *Streptococcus* sp. (54%), *Citrobacter* sp. (45%), *Micrococcus* sp. (44%), *Klebsiella* sp. (39%), *Enterobacter* sp. (37%), and *Pseudomonas* sp. (31%) (Table 1). In present study bacterial pathogens were isolated from left hand (51%) showed less contamination than right hand (52%). *S. typhi* was completely removed after hand washing from left and right hand. *S. aureus* and *E. coli* were showed highest percent of contamination from before hand washing samples of students (Table 1). In the present study about 54% reduction observed after hand washing. Tambekar *et al*., 2007 also reported similar finding that 43% reduction of bacterial contamination after hand washing.

Table 1: Pathogens isolated from before and after hand washing from students

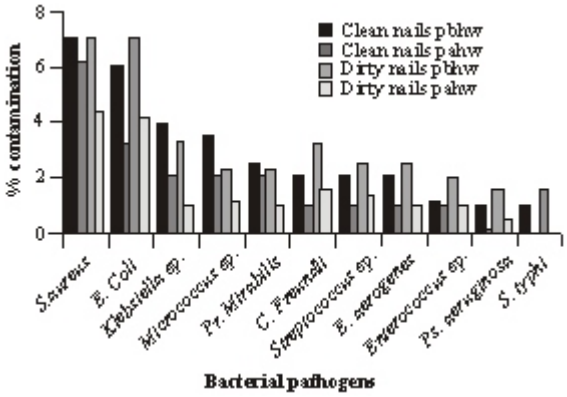
Bacterial pathogens	BHW				AHW				Total pathogens	Total % contamination		Reduction AHW
	L.H.		R.H.		L.H.		R.H.			M	F	
	M	F	M	F	M	F	M	F				
Salmonella typhi	2	4	3	4	0	0	0	0	13	1	1	100%
Staph. aureus	19	16	19	18	18	16	17	12	135	12	11	88%
Escherichia coli	9	20	19	28	4	12	12	17	121	7	13	59%
Enterococcus sp.	3	6	5	3	3	2	4	1	27	3	2	59%
Proteus mirabilis	7	12	6	4	4	4	2	3	45	3	4	55%
Streptococcus sp.	6	8	7	5	4	2	5	3	40	4	3	54%
Citrobacter freundii	5	10	3	11	1	9	1	5	42	2	6	45%
Micrococcus sp.	8	12	3	13	1	6	1	8	52	2	7	44%
Klebsiella sp.	10	12	9	13	5	5	2	5	61	4	6	39%
Enterobacter sp.	6	7	7	7	3	3	2	2	37	3	3	37%
Ps. aeruginosa	2	5	4	2	1	0	1	2	17	1	2	31%
Total	77	112	85	108	44	59	47	58	590	42		5854%

BHW-Before hand washing; AHW-After hand washing; LH-Left hand; RH-Right hand; M-Male; F-Female



pbhw: pathogens before hand wash
pahw: pathogens after hand wash

Fig 1: Bacterial pathogens isolated from various age group students

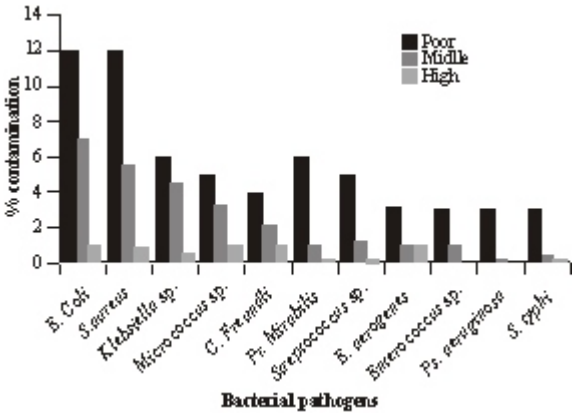


pbhw: pathogens before hand wash
pahw: pathogens after hand wash

Fig 2: Percent contamination on the basis of nail hygiene of students

The bacterial pathogens were found to be higher in before (65%) hand washing than after (35%) hand washing sample. *E. coli*, *S. aureus*, *Klebsiella* sp. were showed highest percent of contamination from before hand washing samples of students. *S. typhi* was completely removed after hand washing (Table 1). Tambekar *et al.* (2007) studied the effect of hand washing in preventing the enteric infections among students. Griffith *et al.* (2003) documented the ability of the various stages of hand washing to decrease skin-surface microbial counts.

Pathogens isolated from hands of the students were differentiated on the basis of age group. Prevalence of bacterial pathogens was higher in students of 3-9 y as compared to 21-24 y. The graph showed the higher percentage of *S. aureus* and *E. coli* in all age group Fig. 3:



Bacterial pathogens isolated from students of different socio-economic condition

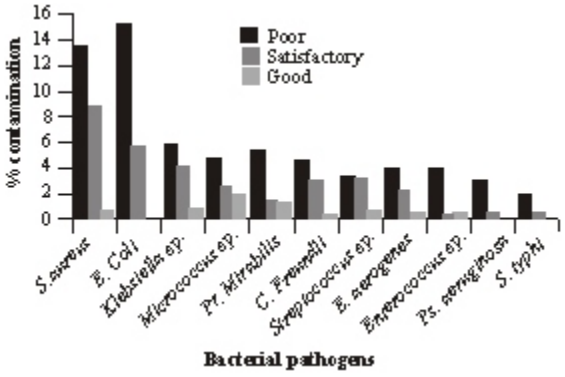


Fig. 4: Bacterial contamination on the basis of personal hygiene of the students

students (Fig. 1). Students don't wash their hands often or well. Children play indoor as well as outdoor games and always come in contact with contaminated surfaces and dirt or soil.

Nail hygiene is responsible for the good health. The results showed the higher percentage of *S. aureus* in both clean and dirty nail of students but percentage of *E. coli*, *Streptococcus* sp. and *E. aerogenes* was higher in dirty nail of students (Fig. 2). Lin *et al.* (2002) stated that long nails tend to harbor more microorganisms than short nails and reported presence of *E. coli* on the hands with natural or artificial fingernails. Hedderwick *et al.* (2000) isolated greater quantities of pathogenic organisms from the surface of artificial nails than the surface of native nails which includes *S. aureus, Acinetobacter baumanii*, *E. cloacae*, *E. agglomerans*, *Klebsiella oxytoca*, *Ps. aeruginosa*, Aeromonas *hydrophilla* and also gm-ve bacilli. Socio-economic status is one of important factor in hygiene behavior. The student of poor and middle economic status showed highest % of bacterial prevalence while students with high economic status had low bacterial contamination (Fig. 3). Tambekar *et al.*, (2009) had reported similar findings.

Personal hygiene of students play significant role in the bacterial contamination. It was observed that the bacterial contamination was higher in students, which has poor and satisfactory personal hygiene than good hygiene (Fig. 4). Similar results reported by Strina *et al.* (2002) that the prevalence of diarrhea among children for whom mainly unhygienic behavior recorded was 2.2 times than among children in mainly hygienic group. The home and school environments were of particular concern for the transmission of infections among young children. Unfortunately, most schools in developing countries do not provide appropriate hand washing facilities. Where these facilities are available, they may be poorly located, have insufficient hand washing materials, be inaccessible, or be improperly used. Effective hand washing (including drying) is important in infection control.

CONCLUSION

Hand washing prevents the enteric pathogens being transferred that cause diarrhoeal diseases. Proper hand washing can control the most of the diarrhoeal diseases. The present study showed clear evidence of 54% decrease in microbial flora after hand washing. Thus, it can be concluded that hand washing is a cornerstone to prevent the diarrhoeal infection.

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