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Original Research Article

A knowledge, attitude and practice study on hand hygiene and antibiotic susceptibility pattern in isolates of pathogens from hands in school children

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ABSTRACT

Background: Estimates in India indicate that gastrointestinal infections and respiratory infections are the most common childhood killer diseases. Infectious germs on hands are the commonest way that children spread infections. Present study mainly focused on creating awareness (by practical demonstration) about importance of hand hygiene in school children, which is one of the simplest, low cost and most advisable form of the infection prevention and transmission.
Methods: In a school of semi-rural setting, 300 swabs before and after hand wash (with a liquid soap) were collected randomly from dominant hands of 150 students of age group 5-13 years and then transported to laboratory for further processing.
Results: Hands of 96.7% students were found to harbor bacteria before handwash which included *Micrococcus* (60.6%), *CONS* (6.6%), *Neisseria spp.* (31.3%), *Bacillus spp.* (26%), *Diphtheroids* (9.3%), and potential pathogens like *Staphylococcus aureus* (16.6%), *Klebsiella spp.* (2.6%), *Escherichia coli* (2%). Data indicates that hands of female students are more contaminated than male. There is evidence of 58% reduction in the bacterial flora after hand wash.
Conclusions: It has been clearly demonstrated by an orientation programme to all students with results that the initial step in chain of infection can be controlled by proper hand wash technique to prevent communicable diseases and reduce the use of antibiotics.

Keywords: Hand wash, Infections, Maheshwara Medical College and Hospital, School children, Swab

INTRODUCTION

Infection is the leading cause of death. India being one among the five countries that collectively accounted for 49.3 percent of 7.6 million children who died of infections in 2012.[1] High rates of infections are due to poor access to- basic health care facilities, sanitary facilities and personal hygiene.

Recurrent gastro intestinal and respiratory tract infections in children are known to have deleterious effect on growth due to impaired nutrient absorption and reduced appetite.[2]

The basic approach in controlling any infection is, to identify the susceptible point to break the weakest link in the chain.[3] Skin hygiene, particularly of hands, is considered to be one of the primary mechanisms to reduce risk of transmission of infectious agents.[4] According to the Center for Disease Control (CDC, 2002) hand hygiene is a general measure that contributes to the prevention and control of communicable diseases. Millions of lives can be saved through simple, proper hand washing and educational interventions which are cost effective in the developing world. Prevention of spread and control of multi drug resistant organisms (MDRO) are critical and urgent as the number of antibiotics available to treat these infections are also limited. Improved hand hygiene practices reduce cross transmission of MDRO.[5,6]

India has one of the largest number of school going children. There is lot of literature documented on hand hygiene of health care workers by swab test in health care settings but very few publications on hand hygiene by swab test are among community especially in schools where there is a great need to focus. Improper fencing in government schools of rural areas allows domestic animals to enter into school premises that makes children vulnerable to many zoonotic infections. Children playing in such grounds with animal dong contaminate their hands and eventually spread it to their friends. Thus school environment gets converted into a reservoir for many kinds of health hazards due to poor hand hygiene.[7] So children should be targeted for such studies because it is at an impressionable age that behavioral attitudes and habits are formed which continue into their adulthood knowledge is contagious. Once infected transmits to others. School children communicate hand washing knowledge to their colleagues, parents and siblings thus becoming a change by improving their practice.[8]

"If you cannot measure it, you cannot improve it" these words from Lord Kelvin an Irish Physicist quoted in public health to justify the need for surveillance data to evaluate the extent of health issue and the impact of interventions for its prevention and control.[9]

Present study aimed at determining the bacterial count in school children before and after hand wash by swab test and also to explain importance of proper hand washing technique in breaking the chain of infection.

METHODS

After approval of Institutional Ethical Committee, under ICMR STS 2017 (Reference Id: 2017-06070), descriptive study was conducted between June-July 2017 in a local school of Isnapur, Chitkul. Study group included 150 school children at the point of time of age group 5-13 years of 1st to 7th grade and excluded students with fever, cough, cold and hands with abrasion, lacerations. After informed consent, dominant hand of each student, both before and after hand wash (with liquid soap) was swabbed with sterile cotton swab soaked in saline solution beginning from the wrist, followed by the palm area and finally leading up to all the five fingers which included the creases and the nail beds and ending in the dorsal aspects of the hand. These swabs were transported to Microbiology Research Laboratory of Maheshwara Medical College and Hospital in nutrient broth within one hour for processing. Total of 300 swabs were streaked on blood agar and Mac Conkey agar and incubated at 37°C for 24 hours. Bacteria were identified by conventional gram staining, catalase test, coagulase test, morphological and biochemical properties according to standard lab protocols. All isolated pathogens were screened for antibiotic susceptibility testing by modified Kirby-Bauer disc-diffusion method as per clinical laboratory standards institute guidelines. Results were analyzed using paired t-test in Microsoft excel.

Sealed blood agar and Mac Conkey agar petri plates with bacterial growth were taken to school and the rate of hand contamination was demonstrated to all students in batches. After completion, an orientation program was conducted in school campus with results.

RESULTS

300 swabs (150 before and 150 after handwash) from 150 students were collected from 5-13 year age group. Among these 49 were female and 101 are male students.

In samples of before handwash, bacterial growth was observed in 145 (96.7%) and 5 (3.3%) samples did not show any growth (Table 1).

Table 1: Number of swabs showing growth.

	Before handwash N (%)	After handwash N (%)
Growth in swabs	145 (96.7)	122 (81.3)
No growth	5 (3.3)	28 (18.7)
Total swabs	150 (100)	150 (100)

Table 2: Number of bacterial isolates before and after handwash.

Bacteria isolated	No. of bacteria before wash	No. of reduction after handwash (%)
Micrococcus spp.	91	59 (36)
CONS	10	09 (10)
Moraxella spp.	47	30 (37)
Bacillus spp.	39	36 (08)
Diphtheroides	14	09 (36)
S. aureus	25	03 (77)
Escherichia coli	3	00 (100)
Klebsiella spp.	4	00 (100)

Out of 145 samples showing growth, 46 (37.7%) samples showed single type of bacterial colonies, 85 (58.6%) samples showed two types of colonies, 14 (9.6%) showed

three types of colonies. In samples of after hand wash, bacterial growth was observed in 122 (81%) and 22 (18%) samples did not show any growth (Table 1).

Out of total bacteria isolated, Gram negative bacilli (*Escherichia coli* and *Klebsiella*) shows 100% reduction and Gram positive cocci like *Staphylococcus aureus* shows 77% reduction of bacterial load after hand wash (p value less than 0.05 and t value=7, degrees of freedom-1 which shows significant reduction of pathogens) (Table 2).

Antibiotic susceptibility of isolated pathogens is shown in Table 3. All the isolates are 100% sensitive to amikacin, gentamicin and levofloxacin. In addition, *Staphylococcus aureus* also showed 100% susceptibility to cefaperazone, tetracycline and chloramphenicol. *E. coli* showed 100% sensitivity to ciprofloxacin, levofloxacin, ceftriaxone, cefaperazone, tetracyclin, cotrimoxazole, and chloramphenicol. 100% resistance to cefazolin and cefaperazone was observed in *Klebsiella*.

Table 3: Antibiotic susceptibility of isolated pathogens.

Antibiotic	Susceptibility	*E. coli* (n=3)	*S. aureus* (n=28)	*Klebsiella* (n=4)
		N (%)	N (%)	N (%)
Penicillin	S	-	4 (14.28)	-
	R	-	24 (85.71)	-
Ampicillin/sulbactam	S	1 (33)	13 (46.43)	2 (50)
	R	2 (67)	15 (53.57)	2 (50)
Ciprofloxacin	S	3 (100)	26 (92.85)	4 (100)
	R	0 (0)	2 (7.15)	0 (0)
Ofloxacin	S	0 (0)	21 (75)	4 (100)
	R	3 (100)	7 (25)	0 (0)
Levofloxacin	S	3 (100)	28 (100)	4 (100)
	R	0 (0)	0 (0)	0 (0)
Amikacin	S	3 (100)	28 (100)	4 (100)
	R	0 (0)	0 (0)	0 (0)
Gentamicin	S	3 (100)	28 (100)	4 (100)
	R	0 (0)	0 (0)	0 (0)
Cefuroxim	S	2 (67)	26 (92.85)	1 (25)
	R	0 (0)	8 (28.57)	0 (0)
Cefazolin	S	1 (33)	19 (67.85)	0 (0)
	R	2 (67)	9 (32.15)	4 (100)
Ceftazidime	S	2 (67)	2 (7.15)	1 (25)
	R	1 (33)	26 (92.85)	3 (75)
Cefoperazone	S	3 (100)	28 (100)	0 (0)
	R	0 (0)	0 (0)	4 (100)
Ceftriaxone	S	3 (100)	20 (71.43)	4 (100)
	R	0 (0)	8 (28.57)	0 (0)
Tetracycline	S	3 (100)	28 (100)	2 (50)
	R	0 (0)	0 (0)	2 (50)
Cotrimoxazole	S	3 (100)	17 (60.72)	2 (50)
	R	0 (0)	11 (39.28)	2 (50)
Chloramphenicol	S	3 (100)	28 (100)	3 (75)
	R	0 (0)	0 (0)	1 (25)

S = sensitivity, R = resistivity.

DISCUSSION

In present study among 150 volunteered students, 5-13 years girls constituted 49 and boys 101. Rate of hand contamination was slightly less in boys (22%) compared to girls (24%) and also enteric pathogens like *Escherichia coli* was found mostly in girls (Table 4).

This observation is in tandem with Tambekar et al, who reported more bacterial load on hands of girls.[10] In present study, 96.7% students harbored bacteria while Tambekar in 2013 reported 100% contamination.[14]

Bacterial pathogens isolated from students included *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella* similar to a study by Ray et al (Table 5).[11]

Variety of resident flora isolated in present study,

Micrococcus spp. (60.7%), *CONS* (6.7%), *Moraxella spp.* (31.3%), *Bacillus* spp. (26%), *Diptheroids* spp. (9.3%), (Table 2) may be because of sources of variability, both intrinsic and extrinsic factors, that influence hand microbiome composition.[12]

After handwash, reduction in bacterial count and type was observed. There was complete removal of bacteria from the hands of 28 (18%) students after hand wash. In present study resident flora which includes *Micrococcus* species and pathogenic *Staphylococcus* species were not readily removed (Table 2). Gram negative bacilli- *Escherichia coli*, *Klebsiella* were completely removed after hand wash when compared to *Staphylococcus* spp. which is in tandem with the study by Juhani.[13]

Table 4: Age and sex wise distribution of pathogen.

Pathogen	5-7 years		8-10 years		11-13 years	
	M	F	M	F	M	F
Staphylococcus aureus	3	3	4	4	13	1
Klebsiella	2	1	-	-	1	-
E. coli	-	2	-	1	-	-
Total boys (n=23)	5		4		14	
Total girls (n=12)		6		5		1

Table 5: Comparison of percentage of bacterial pathogens isolated in other studies.

Pathogens	Tambekar et al[10]	Ray et al[11]		Tambekar et al[14]	Present study 2017
Staphylococcus	23	37	17	51	17
Escherichia coli	20	4	27	8	2
***Klebsiella* spp.**	10	37	8	10	3
***Enterococcus* spp.**	4	18	2	5	-
***Enterobacter* spp.**	6	-	8	-	-
***Pseudomonas* spp.**	3	-	11	-	-
***Proteus* spp.**	7	-	9	-	-
***Salmonella* spp.**	2	-	1	-	-
***Citrobacter* spp.**	7	-	5	-	-
Streptococcus	7	-	5	-	-

Table 6: Comparison of reduction percentage of bacteria after hand wash.

Pathogen	Tambekar et al[10]	Tambekar et al[14]	Present study 2017
***Staphylococcus* spp.**	88	33	77
***Enterococcus* spp.**	59	42	-
***Micrococcus* spp.**	44	50	36
***Proteus* spp.**	55	53	-
Escherichia coli	59	55	100
***Streptococcus* spp.**	54	59	-
***Citrobacter* spp.**	45	60	-
***Enterobacter* spp.**	37	75	-
***Klebsiella* spp.**	39	79	100
***Salmonella* spp.**	100	100	-
***Pseudomonas* spp.**	31	63	-

Many studies demonstrated the beneficial impact of hand washing (Table 6). Present study also showed 58% reduction in bacterial load after hand wash. Ray et al observed decrease in colony count in 60% of samples, 56% reduction is reported by Tambekar.[11,14] However handwash with soap dispensed from open bulk-refillable dispensers was shown to increase the levels of opportunistic pathogens on children hands in an elementary school.[15]

Antibiotic susceptibility testing

Testing for antimicrobial susceptibility among the isolated pathogenic bacteria is valuable to know the baseline data which could be readily compared. In present study, among 35 isolates, 28 were *Staph. aureus*, 4 were *Klebsiella* and 3 were *Escherichia coli*. Antimicrobial susceptibility was tested by 15 different antibiotics is shown in Table 3.

To the best of our knowledge data on antibiotic susceptibility pattern on pathogens in school children's hands were not available to compare.

CONCLUSION

In conclusion, 96.7% of students were found to harbor bacteria on their hands before hand wash. Variation in rate of hand contamination is observed and significant (58%) decrease in bacterial load was seen after hand wash. Antibiotic susceptibility test pattern from isolates showed community pathogens are resistant to latest generation antibiotics. Orientation program helped students understand that proper hand wash technique is a must, and the best simplest, low cost, most advisable form of infection prevention. More such health education programs should be held in schools to bring change at root level.

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