

**EVALUATION AND BEHAVIOURAL ASPECTS OF HAND WASHING IN HEALTH CARE PROVIDERS****VINAY KHANNA^{1*}, KRITI TILAK¹, RUCHEE KHANNA²
AND CHIRANJAY MUKHOPADHYAY¹**¹*Department of Microbiology, Kasturba Medical College, Manipal University, Manipal, Karnataka, India*²*Department of Pathology, Kasturba Medical College, Manipal University, Manipal, Karnataka, India***ABSTRACT**

Proper hand hygiene is the single most essential, simplest and economical means of reducing the prevalence of hospital acquired infections and the spread of antimicrobial resistance. The current study was conducted on fifty health care providers (including doctors, respiratory therapists, physiotherapists, nurses and ward boys) who were inquired on their awareness and habit of handwashing. Samples were also collected before and after hand wash using different combinations of plain soap or antiseptic soap with or without alcohol based hand rub. Pre-wash and post-wash samples were cultured on blood agar and bacterial colonies were counted. Data was analysed using SPSS software ver 20.0. It was found that all the health care providers were aware of the benefits and proper technique of handwashing. Median reduction in colony forming units/ml following handwashing was maximum in subjects using plain soap and water and alcohol based hand rub (66.98%) exceeding marginally to those using antiseptic soap and water and alcohol based hand rub (66.15%). Frequency of handwashing >5 times per day was seen mostly in nurses. Median number of colony forming units/ml grown from sample collected from hands of doctors before handwashing was maximum indicating worst hand hygiene. Thus, we conclude that the health care practitioners in our country need to brace themselves to inculcate the simple, basic and effective practice of hand hygiene in their daily patient care activities. Handwashing should become an educational priority, increasing the emphasis on infection control.

KEYWORDS: Handwashing, hand hygiene, health care providers

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INTRODUCTION

Nosocomial infections (NIs) continue to be a major world-wide concern. The most frequently encountered NIs are urinary tract infections, lower respiratory tract infections, surgical-site infections, and primary septicaemia¹. They lead to additional days of hospital stay², increase the possibility of death³, and increase treatment expenditures.⁴ Approximately one-third of all NIs are regarded as preventable⁵. Hand hygiene is now considered as one of the most vital element of infection control activities. In view of the growing load of health care associated infections (HCAIs), the increasing severity of illness and intricacy of treatment, superimposed by multi-drug resistant (MDR) pathogen infections, health care practitioners (HCPs) are retreating back to the fundamentals of infection preventions by simple measures like hand hygiene. Proper hand hygiene is the sole most significant, simplest, and economical means of reducing the prevalence of HAIs and the spread of antimicrobial resistance⁶. Several studies have validated that handwashing practically eradicates the carriage of MRSA which perpetually occurs on the hands of HCPs working in ICUs⁷. An increase in handwashing compliance has been found to be accompanied by a fall in MRSA rates⁸. The hand hygiene liaison group recognised nine controlled studies, all of which showed noteworthy reductions in infection related outcomes, even in settings with a high infection rates in critically ill patients⁹. Transmission of Health-care-associated *Klebsiella* sp. has also been documented to reduce with improvement in hand hygiene¹⁰. In 2002, a new Centres for Disease Control and Prevention (CDC) guideline for hand hygiene in health care settings, titled *Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force*, was published¹¹. As a clinical guideline, its principal aim is to decrease the incidence of NIs by providing detailed recommendations on two main features of hand hygiene: (i) choice of the most suitable agents for hand hygiene in terms of efficacy and dermal tolerance and (ii) different

strategies to improve compliance in hand hygiene, including hand hygiene practices among health care workers, behavioural theories, and methods for reducing adverse effects of agents. Health care workers have three opportunities for the post-contamination treatment of hands: (i) the social hand wash, which includes cleaning of hands with plain, non-medicated bar or liquid soap and water for removal of dirt, soil, and various organic substances; (ii) the hygienic (Europe) or antiseptic (United States) hand wash, which is the cleaning of hands with antimicrobial or medicated soap and water ("scrub"); most antimicrobial soaps contain a single active agent and are usually available as liquid preparations. The most commonly used agent is chlorhexidine, usually at a concentration of 4 or 2%. Triclosan can also be a constituent in medicated soaps, usually at a concentration of 1% and (iii) the hygienic hand disinfection, which normally consists of the application of an alcohol-based hand rub. This is a leave-on preparation and is applied to the skin without the use of water. In addition, non-alcohol-based waterless antiseptic agents are available for use by health care workers. Some of these contain quaternary ammonium-type compounds. They were not discussed in the CDC hand hygiene guideline because there was inadequate evidence at the time to encourage their use; therefore, they are not further evaluated here. Our study is intended to support the CDC guideline by in-depth comparison of the several options for hand hygiene among various sections of health care workers and effect on compliance in hand hygiene.

AIMS AND OBJECTIVES

- (1) To compare bacterial load on hands of various cohorts before handwashing.
- (2) To compare bacterial loads on hands before and after handwashing following standard protocol.
- (3) To compare awareness of benefits and proper technique of handwashing between various cohort

MATERIALS AND METHODS

Study population comprised of fifty health care providers who directly come in contact with patients which included doctors, physiotherapists, respiratory therapists, nurses, ward boys working in intensive care units and wards of a tertiary care hospital. Any health care provider with wound/ trauma/ skin infection were excluded from the study. The purpose of the study were explained to the subjects and informed consent was taken from them. Study was conducted for a duration of one month. Study population was divided into five cohorts (doctors, physiotherapists, respiratory therapists, nurses and ward boys), each cohort consisting of ten members. Questionnaire was developed to analyse handwashing awareness and behaviour of the subjects after assessment of international handwashing guidelines. Glove juice technique was used to collect the samples from the subjects.

Pre-washing sampling

A sterile non-powdered nitrile glove was aseptically applied to the test subject's hand. 25 ml of trypticase soy broth was then aseptically added to the gloved hand. The glove was secured to the wrist with self-adherent bandage. The gloved hand was palpated on all surface for the period of 1 minute. During this process the subject also clenched a fist twice and dislodged any material from underneath his/her fingernails. The glove juice was then aseptically transferred into a sterile disposable plastic pipette.

Handwashing procedure

Subjects were instructed to wash their hands using any one of the following test solutions: (a) Plain soap and water (b) Plain soap and water followed by alcohol based hand rub (c) Antiseptic soap (containing 0.2% Triclosan) and water (d) Antiseptic soap (containing 0.2% Triclosan) and water followed by alcohol based hand rub (e) Alcohol based hand rub alone. The hands were washed according to standard protocol explained to the subjects. The hands were then dried with paper towelling and the post wash sample was immediately taken.

Post washing sampling

A sterile glove was then applied to the same hand and participant samples were recovered and processed by the same procedure as the prewash hand samples.

Dilution, plating and incubating of the glove juice samples

1.0 ml sample was taken from the recovered TSB glove juice (pre wash and post wash) and diluted in sterile TSB. Optimal dilutions of 1:10 and 1:100 were done. These dilutions were chosen to attain countable plates. fifty microliter of undiluted as well as each dilution were then spread plated onto blood agar plates. All processing of samples was executed within 30 minutes of collection. The plates were then incubated at 37°C for 24 hours before visual examination.

Calculation of bacterial counts and classification

Bacterial counts were performed on countable plates that consisted of bacterial colonies. Each colony were assumed to be one bacterium and thus bacterial numbers were converted to colony forming units. To obtain CFUs/ml the number of colonies counted were divided by the dilution of the plate. The total number of colonies counted were divided by the dilution of the plate. The total number of bacteria were converted to log₁₀ counts (mean +/- standard deviation). Bacterial reduction for each solution were also calculated in per cent reduction (CFUs/ml). The data was analysed using SPSS software ver 20.0.

RESULTS

Eleven males and thirty nine females were included in the study. The median age of the subjects was twenty three years. Table 1 shows that all the health care providers were aware of the fact that handwashing helps in reducing infections and also proper technique of handwashing. All the doctors, respiratory therapists, nurses and 90% of physiotherapists and ward boys had received health education for handwashing. All the doctors while none of the ward boys knew about the types of infections transmitted through health care providers.

Table 1
Table showing awareness of the subjects on hand hygiene.

Category of subject	Subjects having knowledge about effect of handwashing in reducing infection (%)	Subjects who received health education for handwashing (%)	Subjects having knowledge about the types of infections spreading through health care providers (%)	Subjects having knowledge about proper technique of handwashing (%)
Doctors (n=10)	100	100	100	100
Physiotherapists (n=10)	100	90	70	100
Respiratory therapists (n=10)	100	100	80	100
Nurses (n=10)	100	100	60	100
Ward boys (n=10)	100	90	0	100

Table 2 shows median reduction in colony forming units/ml following handwashing was maximum in subjects using plain soap and water and alcohol based hand rub (66.98%) exceeding marginally to those using antiseptic

soap and water and alcohol based hand rub (66.15%). This was followed by antiseptic soap and water (65.75%), plain soap and water (50.53%), and alcohol based hand rub alone (47.70%).

Table 2
Median reduction in colony forming units/ml following handwashing

Type of hand wash used	Median reduction in colony forming units/ml
Plain soap and water and alcohol based hand rub	66.98%
Antiseptic soap and water and alcohol based hand rub	66.15%
Antiseptic soap and water	65.75%
Plain soap and water	50.53%
Alcohol based hand rub alone	47.70%

Table 3 shows frequency of handwashing >5 times per day was seen mostly in nurses followed by ward boys, doctors, respiratory therapists and physiotherapists.

Table 3
Percentage of subjects washing hands >5 times per day

Category of subject	Subjects washing hands > 5 times per day (%)
Doctors	60
Physiotherapists	30
Respiratory therapists	40
Nurses	100
Ward boys	80

Table 4 shows median number of colony forming units/ml grown from sample collected from hands of doctors before handwashing was maximum indicating worst hand hygiene among all the categories of health care providers included in the study.

Table 4
Median number of colony forming units/ml grown from sample collected from hands of subjects before handwashing

Category of subject	Median number of colony forming units/ml before handwashing
Doctors	161.5
Physiotherapists	68
Respiratory therapists	76
Nurses	67.5
Ward boys	60

DISCUSSION

A study conducted by Song and colleagues showed that when hand hygiene compliance increased from poor (<60%) to excellent (90%), each level of progress was associated with a 24% decline in the risk of MRSA acquisition. This risk decreased considerably (by 48%) with hand hygiene compliance levels above 80%. Two other clinical studies reinforced this data, showing lower incidence rates of MRSA¹², resistant *E. coli* and carbapenem resistant *P. aeruginosa*¹³ in wards attaining compliance levels higher than 70% and the greatest degree of compliance increase. Handwashing was perceived primarily as a mechanism of self-defence against harmful organisms. Children understood the concept of microbes and agreed that, although water can get cleared of surface dirt on hands, it is essential to use soap to ensure that "germs" are killed. Handwashing behaviour was also influenced by the appearance of their hands. Handwashing was perceived as an act that not only physically but also psychologically "cleaned" their hands of microorganisms and "dirt," which may be either visible or otherwise emotionally sensed. Nurses described their handwashing behaviour in similar terms, as an unconscious practice. This is clearly reflected in our study where frequency of handwashing is found maximum amongst nurses. Although nurses appeared to believe that they habitually washed their hands without thinking about it, a number of factors seemed to affect the significance that they placed on handwashing in the healthcare settings, including the condition of their patients, the magnitude of patient contact, their valuation of the task involving a patient, and workload. Nurses believed that patients are a potential reservoir of infection because patients have little understanding of infection transmission. They assessed the risk of infection due to contact with individual patients on the basis of several criteria, including the patient's diagnosis, physical appearance, and perceived general cleanliness; visibility of the patient's body fluids; and the patient's age. An assessment was made in terms of the degree of "dirtiness" or the lack of "cleanliness" of a patient. Our study shows median number of colony forming units/ml grown from sample

collected from hands of doctors before handwashing was maximum indicating worst hand hygiene among all the categories of health care providers included in the study. The reason behind this can be less availability of time. Therefore, it is seen that introduction of less complex and time saving procedures of maintaining hand hygiene like alcohol based hand rub can improve the compliance of handwashing. The median reduction in colony forming units/ml growing from the sample taken after washing hands with alcohol based hand rub alone was analysed and was found to be the least among all the combinations, suggesting that alcohol based hand rubs should not be considered as a substitute to handwashing using soap and water. Alcohol based hand rubs can be used in addition to hand wash using soap and water. Some studies have examined only microorganisms that are left on the hands after a hand wash. Washing hands with soap and water has been described to be ineffective in eliminating adenovirus from the culture-positive hands of a physician and patients, indicating that mechanical removal was partial¹⁴. Transient gram-negative bacteria remained on the hands of all the health care workers despite five successive hand washes with soap and water¹⁵. Furthermore, transmission of gram-negative bacteria from hands has been shown to occur in 11 of 12 cases when a simple hand wash is carried out¹⁶. One risk of using soap and water is the contamination of hands by the washing process per se. This has been stated for *P. aeruginosa*¹⁷. A likely source is the sink itself, when splashes of contaminated water come in contact with the hand of the health care worker¹⁸. The reason is that the microorganisms are not killed during the hand wash but only removed and distributed in the immediate surroundings of the person, including the clothes. Non-medicated soaps may also become contaminated and lead to colonization of the hands of personnel and to NIs, e.g., with *S. marcescens*¹⁹ or *Serratia liquefaciens*²⁰. In a prospective crossover study over 4 months with plain soap and a 4% chlorhexidine soap among health care workers in two surgical units, plain soap was found to be significantly more effective than chlorhexidine in reducing bacterial counts from

the hands of health care workers²¹. After contamination of hands with *Klebsiella* spp., a 98% reduction was described in 19 of 23 experiments in which a soap based on 4% chlorhexidine was used²². Chlorhexidine failed to eliminate MRSA from the hands²³. In contrast, gram-negative bacteria were more likely to be eliminated after the use of chlorhexidine²³. The mean resident flora of the hands of surgeons was reduced by a 3-min application of 4% chlorhexidine from 3.5 log₁₀ units (preoperatively) to 3.15 log₁₀ units (postoperatively) in operations lasting less than 2 h. It has been shown that for operations continuing for more than 3 h, 4% chlorhexidine was unable to keep the resident skin bacteria below the baseline value (4.5 preoperatively and 5.2 postoperatively)²⁴. In comparison to plain soap, at 0.2% triclosan does not further reduce bacterial counts on the hands²⁵. This was consistent with the results found in our study. Under clinical conditions, a hand wash with 1% triclosan was reported to be less effective on the total bacterial count than a 4% chlorhexidine hand wash²³. Triclosan was able to eliminate MRSA from the hands²³. In contrast, gram-negative bacteria were less likely to be eliminated after the use of triclosan²³. The wide spread use of triclosan in antibacterial household products such as liquid soaps is cause for concern that selection for bacteria with an intrinsic resistance to triclosan may be occurring²⁶. Triclosan can be found in 76% of antibacterial liquid soaps in the United States²⁷, which has led to the recommendation that it should not be used in consumer products²⁸. It is therefore not surprising that highly resistant bacteria were

detected in compost, water, and soil²⁹. Two species, *Pseudomonas putida* and *Alcaligenes xylosoxidans*, were even capable of metabolizing triclosan and thereby of actively “digesting” the active agent²⁹.

CONCLUSION

One of the reasons microbes have endured in nature is possibly their simplicity: a simple genomic framework with genetic encryption of basic survival strategies. To tackle these microbes, human beings will have to follow basic and simple protocols of infection prevention. The health care practitioners in our country need to brace themselves to inculcate the simple, basic and effective practice of hand hygiene in their daily patient care activities and serve as a role model for future generations of doctors, nurses and paramedical personnel. Handwashing should become an educational priority. Educational interventions for medical students should provide strong evidence that HCWs hands become grossly contaminated with pathogens upon patient contact and that alcohol hand rubs are the easiest and most effective means of decontaminating hands and thereby reducing the rates of HAIs. Increasing the emphasis on infection control, giving the charge of infection control to senior organizational members, changing the prototype of surveillance to uninterrupted monitoring and operative data feedback are some of the essential measures which need to be introduced in Indian hospitals.

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