

# Comparison of Different Hand Washing Techniques to Control Transmission of Microorganisms

MUHAMMAD ZUBAIR, AIZZA ZAFAR, ANAM YAQOUB, HUMERA JAVED, HASAN EJAZ

## ABSTRACT

**Aim:** To determine the frequency of microbial flora on the hands during patient care activities and to compare the efficacy of different hand washing agents in a tertiary care paediatric hospital.

**Place and duration of study:** The study was conducted in the department of Microbiology, The Children's Hospital Lahore, from July 2013 to December 2013.

**Methodology:** A total of 240 samples from hands of health care workers (HCWs) were collected and processed for microbiological analysis using various microbiological techniques.

**Results:** There were 40 health care workers involved in different patient care activities were chosen and analyzed for bacterial contamination on hands. The random samples were collected from them before and after hand washing with water, soap and alcoholic hand rub. Frequency of reduction in bacterial growth was 8% with water, 52.5% with soap and 95% with alcoholic hand rub.

**Conclusion:** Identification of microbial contamination is an important factor in controlling the nosocomial infections transmitted by health care workers. Hand washing with alcoholic hand rub is more effective in removal of microbial flora.

**Keywords:** Hand washing, use of water, Alcohol hand rub, Soap in removal of organisms

---

## INTRODUCTION

Nosocomial infections have been recognized for more than a century as critical problem which can affect the quality of health care procedures in hospitals. Transmission of microorganisms by the hands of health care workers is the main route of transmission<sup>1</sup>. Correct hand washing technique, is often not practiced particularly in respect of duration. Major problems include insufficient facilities, lack of training and information, lack of time and a high patient care load, as well as cutaneous intolerance of soaps. Two major group of microorganisms which are found on the skin are resident flora, organisms that normally reside on the skin and transient flora which is responsible for transmission of infections in hospital environment during health care activities<sup>2</sup>. This microbial flora can be introduced into body tissues by trauma or medical devices such as intravenous catheters<sup>3</sup>. The pathogenic potential of the resident flora is quite low. Transient flora that causes most of the hospital acquired infections, due to cross contamination can be easily removed by hand washing<sup>4,5,6</sup>.

The hands may become contaminated by touching the patient's intact skin or inanimate objects in the patient's rooms<sup>7</sup>. Microorganisms are known to survive on the hands for up to 60 minutes following contact with a patient or contaminated surface. If hands are known to be suspected of being

contaminated, transient flora must be removed by washing or disinfecting the hands to make them safe for the next patient contact<sup>8</sup>.

Reasons for low hand hygiene compliance by Health Care Workers (HCWs), and physicians are poorly understood. Certain barriers (lack of access to sinks, empty dispensers, attitudinal beliefs and skin irritation) to low hand hygiene compliance by health care workers have been reported<sup>9, 10</sup>. Plain soap with water can physically remove a certain level of microbes, but antiseptic agents are necessary to kill microorganisms<sup>11,12,13,14</sup>. Hand disinfection is substantially more efficient than standard hand washing with soap and water or water alone<sup>15, 16</sup>. The present study aimed to determine the frequency of microbial flora on the hands during patient care activities and to compare the efficacy of different hand washing agents such as water, soap and alcoholic hand rubs.

## METHODOLOGY

This cross sectional observational study was conducted in the Microbiology Department, The Children's Hospital Lahore, from July to December, 2013. The samples were taken from the palm and fingertips of the hands of nurses by swabbing. Sterile cotton swabs dampened in 0.9% NaCl were used. In total, 240 samples were collected from 40 individuals who were selected randomly. Samples from hands were taken before and after the use of hand washing agents (water, soap and alcoholic hand rub). These swabs were transported to the Microbiology lab for further processing.

---

*Department of Microbiology, The Children's Hospital and Institute of Child Health, Lahore, Pakistan.*

*Correspondence to: Dr. Hasan Ejaz,*

*Email: hasanmicro@gmail.com*

The cultures were processed by streaking each cotton swab to one Blood and one MacConkey Agar plate. The agar plates were incubated aerobically for 24 hours at 37°C. Next day, the plates were examined for any visible growth. Each colony represented a bacteria capable of growth on the provided medium and under specific condition provided for its incubation. The organisms were identified on the basis of colony morphology, Gram's staining reactions and biochemical testing.

**RESULTS**

All of the hand samples were positive (100%) before the use of water for bacterial growth. Most commonly isolated organism was Staphylococcus epidermidis 20 (60.8%). Other organisms isolated were Klebsiella species 4 (8.69%), Bacillus species 4 (8.69%), Acinetobacter species 3 (6.5%), Pseudomonas species 3 (6.5%), Micrococcus species 3 (6.5%) and Staphylococcus aureus 1 (2.5%) (Table I). Bacterial growth was reduced to 8% after the use of water. The organisms isolated were Staphylococcus epidermidis 20 (42.5%), Pseudomonas species 10 (21.3%), Klebsiella species 5 (10.64%), Acinetobacter species 6 (12.7%), Bacillus species 3 (6.4%), Micrococcus species 2 (6.4%) and Staphylococcus aureus 1 (2.1%) (Table II).

Before the use of soap the organisms isolated were Staphylococcus epidermidis 24(41.4%),

Pseudomonas species 10(17.2%), Acinetobacter species 8(13.8%), Micrococcus species 6(10.3%), Klebsiella species 5(8.6%), Bacillus species 3 (5.2%), Staphylococcus aureus 1(1.7%) and Candida species 1(1.7%) (Table I). The bacterial load was reduced to 52.5% after the use of soap along with water. Soap proved to be a good hand washing agent as compared to water in the removal of many Gram negative as well as Gram positive organisms. Organisms isolated were Staphylococcus epidermidis 8(57.1%), Pseudomonas species 3(21.4%), Klebsiella species 1(7.1%), Acinetobacter species 1(7.1%) and Staphylococcus aureus 1(7.1%) (Table II).

Before the use of alcoholic hand rub, the organisms isolated were Staphylococcus epidermidis 19(47.5%), Pseudomonas species 7(17.5%), Klebsiella species 4(10%), Acinetobacter species 3 (7.5%), Micrococcus species 2 (5.0%), Candida species 2(5%), Proteus species 1(2.5%), Staphylococcus aureus 1(2.5%) and Escherichia coli 1 (2.5%) (Table I). Alcoholic hand rubs were rapid in application as compared to conventional hand washing and were efficient in the removal of microorganisms. Bacterial growth was reduced to 95% after the use of alcoholic hand rub. Pseudomonas species 2(100%) was the only organism isolated after the use of alcoholic hand rubs (Table II).

Table I: Organisms isolated before the use of hand washing techniques

Organisms isolated	Water	Soap and water	Alcoholic hand rub
Staph epidermidis	28 (60.8%)	24 (41.4%)	19 (47.5%)
Staph aureus	1 (2.17%)	1 (1.7%)	1 (2.5%)
Pseudomonas Spp.	3 (6.5%)	10 (17.2%)	7 (17.5%)
Klebsiella spp.	4 (8.69%)	5 (8.6%)	4 (10.0%)
Bacillus spp.	4 (8.69%)	3(5.2%)	0 (0.0%)
Acinetobacter spp.	3 (6.5%)	8 (13.8%)	3 (7.5%)
Micrococcus spp.	3 (6.5%)	6 (10.3%)	2 (5.0%)
Candida spp.	0	1 (1.72%)	2 (5.0%)
Proteus spp.	0	0	1 (2.5%)
Escherichia coli	0	0	1 (2.5%)

Table II: Organisms isolated after the use of hand washing techniques

Organisms Isolated	Water	Soap and water	Alcoholic hand rub
Staph epidermidis	20 (42.5%)	8 (57.1%)	0 (0.0%)
Staph aureus	1 (2.12%)	1 (7.1%)	0 (0.0%)
Klebsiella spp.	5 (10.64%)	1 (7.1%)	0 (0.0%)
Acinetobacter spp.	6 (12.7%)	1 (7.1%)	0 (0.0%)
Pseudomonas spp.	10 (21.3%)	3 (21.4%)	2 (100%)
Bacillus spp.	3 (6.4%)	0	0
Micrococcus spp.	2 (4.25%)	0	0

**DISCUSSION**

The purpose of hand washing is to reduce the level of potentially pathogenic transient microorganisms. Hands play a major role in the transmission of blood borne, enteric and respiratory tract infections. Hand hygiene is considered to be the most important tool in the control of nosocomial infections. The hands of

health care workers are frequently contaminated by direct contact during routine patient care or while touching a contaminated surface or device. Multiple epidemics have been reported due to contaminated hands of health care workers. Hand hygiene is therefore considered as the most important, cheapest and more effective infection control measure in

preventing horizontal transmission of nosocomial pathogens.

According to the present study, the organisms isolated mostly from the hands after the use of water were *Klebsiella* species 5(10.64%), *Acinetobacter* species 6(12.7%), *Bacillus* species 3(6.4%), *Micrococcus* species 2(6.4%), *Staphylococcus aureus* 1(2.1%) and with soap *Pseudomonas* species (21.4%), *Klebsiella* species (7.1%) and *Staphylococcus aureus* (7.1%). We observed that hand rubbing with an alcohol based solution was more effective (95%) than hand washing with water (only 5%) and soap (52.5%) in reducing bacterial contamination of health care workers hands during routine patient care. This was due to inadequate time spent on washing hand conventionally. A study was conducted in Choithram Hospital and Research center in which 204 samples were collected from nurses in the ICU of the hospital before and after use of hand washing and hand rub. The bacterial growth was seen in 92.2 % of samples before washing and hand rub application. Conventional hand wash resulted in drastic results in transient bacterial flora on the hands in 50% cases whereas alcoholic hand rub achieved the effect in 95% of the samples<sup>17</sup>. Another study carried out to determine the effect of hand rub and washing with soap on the hands of nurses in reducing bacterial contamination. Bacterial growth was reduced to 52% with hand rub and with soap 27%<sup>18</sup>. A study was also done to compare the efficacy of alcohol based hand rub with conventional hand washing in reducing bacterial contamination during routine patient care<sup>19</sup>.

A study carried out to see the effectiveness of hand washing and its role in prevention of diarrhoeal disease reported that hand washing with plain soap and water reduce the presence of bacteria to 8%, while water reduces the bacterial load to 23%<sup>20</sup>. A prospective randomized clinical trial study was done to compare the effectiveness of an alcoholic solution with the standard hygienic hand washing procedure during regular work in clinical ward and Intensive care unit of a large public university hospital in Barcelona. Reduction in bacterial growth after hand washing for soap was 49.6% and for alcoholic hand rub was 88.2%<sup>21</sup>.

Another study carried out to determine the impact of hand washing with soap on the risk of diarrhoeal diseases in community. They found that hand washing with soap can reduce bacterial risk from 42% to 44%<sup>22</sup>.

## CONCLUSION

It is concluded from the present study that hand washing with alcoholic hand rub is more effective as compared with conventional hand wash in reducing

the transient bacterial flora on the hands of Hospital workers. It is more convenient and time saving.

## REFERENCES

1. Bauer TM, Ofner E, Just H and Daschner F. An epidemiological study assessing the relative importance of air borne and direct contact transmission of microorganisms in a medical intensive care unit. *J Hosp Infect* 1990; 15(4): 301.
2. Rotter LM. Hand washing and hand disinfection. In: M CG. ed. *Hospital Epidemiology and Infection Control*. Baltimore: William & Wilkins 1996;1052-1068.
3. Selwyn S and Ellis H. Skin bacteria and skin disinfection reconsidered. *BMJ* 1972; 1(5793): 136-140.
4. Lowbury EJJ, Lilly HA and Bull JP. Disinfection of hands: removal of transient organisms. *BMJ* 1964; 2(5403): 230-233.
5. Ayliffe GAJ, Babb JR and Quoraihi AH. A test for hygienic hand disinfection. *J Clin Pathol* 1978; 31(10): 923-928.
6. Rotter ML, and Koller W. European test for the evaluation of the efficacy of procedures for the antiseptic handwash. *Hygiene und Medizin* 1991; 16: 4-12.
7. WHO Guidelines on Hand Hygiene in Health Care. First Global Patient Safety Challenge. Clean Care is Safer Care.. [Online] Available at: <http://www.who.int/patientsafety/en/> [Accessed 24 August 2010].
8. Boyce JM, Pittet D et al. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Morbidity and Mortality Weekly Report* 2002; 51(16): 1-45.
9. Chaggar A, Banez C, Lopez R and Cafazzo, JA. Challenges of Hand Hygiene in Healthcare: The development of a tool kit to create supportive processes and environments. *Healthcare Quarterly* 2010; 13: 59-66.
10. Haas J and Larson E.L. Compliance with Hand Hygiene. *Am J Nurs* 2008; 108: 40-44.
11. Larson EL. APIC guideline for hand washing and hand antiseptics in health care settings. *Am J Infect Control* 1995; 23: 251-69.
12. Lowbury EJJ, Lilly HA and Bull JP. Disinfection of hands: removal of transient organisms. *BMJ* 1964; 2(5403): 230-233.
13. Garner JS and Favero MS. CDC guideline for hand washing and hospital environmental control. *Infect Control* 1986; 7: 231 -235.
14. Ehrenkrantz NJ, Alfonso BC. Failure of bland soap handwash to prevent hand transfer of patient bacteria to urethral catheters. *Infect Control Hosp Epidemiol* 1991; 12: 654-662.
15. Rotter ML. 150 years of hand disinfection-Semmelweis heritage. *Hyg Med* 1997; 22: 332-339.
16. Rotter ML. Hand washing and hand disinfection. In: Mayall CG, editor. *Hospital epidemiology and infection control*. 2nd ed. Philadelphia: Lippincott, Williams & Wilkins 1999; 1339.
17. Maliekal M et al. Comparison of traditional hand wash with alcoholic hand rub in ICU setup. *IJCCM* 2005; 9(3):141-144.
18. Oguz K et al. Compliance and Efficacy of Hand. *Medical Principles and practice* 2005; 14: 313-317.
19. Emmanuelle G et al. Efficacy of handrubbing with alcohol based solution. *BMJ* 2002; 325: 1-5.
20. Burton M et al. The effect of handwashing with water or soap on Bacterial. *Int J Environ Res Pub Health* 2011;8(1): 97-104.
21. Magda Z et al. Handwashing with soap or alcoholic solutions? A randomized clinical trial of its effectiveness. *American Journal of Infection Control* 1999; 27(3): 258-261.
22. Curtis V and Cairncross, S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet Infectious Diseases* 2003; 3(5): 275-281.