A Comparative Study To See The Efficacy Of Hand-Rubbing With Alcohol-Based Solution, Standard Handwashing With Soap And Handwashing With Soap Plus Alcohol-Based Solution: A Randomised Clinical Trial

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Introduction

Handwashing the most important measure to prevent cross-transmission of nosocomial infections.[1]However,under routine hospital practice compliance with this measure is still unacceptably low, less than 50% in most studies published in the past 20 years.[2,3]This constant finding is worrying because recent studies have shown that this level of compliance will not reduce the risk of transmission of multiresistant bacteria in the hospital.[4] Attempts to improve compliance have included increasing the number of accessible sinks[5] and educating healthcare workers,[6,7] but none of these interventions led to a marked and sustained improvement in compliance. **Hand-rubbing** with alcohol-based, waterless hand antiseptic seems to be the best method of increasing compliance with hand hygiene. Recent studies have shown a significant improvement in compliance after the introduction of hand-rubbing as a substitute for handwashing with plain soap and water.[7,8]**Now we are practising hand washing with soap and dried with hand dryer then take alcohol based hand rubbing solution to increases the compliance for the health worker.** However, the introduction of this new method as a substitute to standard handwashing after decades of enforcement of the latter can be a real challenge for infection control teams. Despite showing healthcare workers that only half of the opportunities of handwashing are completed, mainly because of lack of time, and that compliance can be improved by hand-rubbing, staff may be reluctant to use it. We surveyed in a representative sample of 500 healthcare workers in our hospital. The main reason raised for not adhering to the recommendation to use hand-rubbing was

the lack of confidence in its efficacy.[9]It seems there is still a reluctance to accept hand-rubbing as a substitute for handwashing, even among some infection control practitioners. There is growing evidence from experimental studies on artificial contamination of volunteer's hands that hand-rubbing is at least as effective as handwashing with either unmedicated soap or antiseptic agent.[3]To our knowledge only two clinical studies, one observational study and one randomised controlled trial, have evaluated handwashing with plain soap versus hand-rubbing in everyday practice, and both studies showed positive results in favour of handrubbing.[10,11]One randomised clinical study compared handwashing with an antiseptic soap versus hand-rubbing with an alcohol-based solution with the assessment of skin tolerance as the primary objective.[12]Hand-rubbing was better tolerated than handwashing and achieved comparable reduction in bacterial contamination. We performed a randomised clinical trial to **assess the efficacy of an alcohol-based solution after handwashing with soap and dried**, **compared with standard handwashing with soap** and **only alcohol-based solution** reducing hand contamination during routine patient care.

Methods

Enrolment of participants: We made three groups

Group A: Alcohol-based solution after handwashing with soap

Group B: Standard handwashing with soap

Group C: **Only Alcohol-based solution Hand rub.**

The study was a prospective randomised clinical trial. It was performed from July 2017 to Aug 2018 in intensive care units of a 16 bedded tertiary care and referral university hospital. Eligible healthcare workers were all permanent nurses and nursing assistants of unit.

Treatment-groups:

At the beginning of each session when each participant arrived at the unit (7 am) we used opaque sealed envelopes to assign randomly him or her to standard handwashing with a commercial soap (Dettol) and get dried then took hand rub a waterless alcohol-based solution (45% 2-propanol, 30% 1-propanol, 0.2% mecetronium ethyl sulphate, average 3-5 ml;(Sterilium, Bode Chemie, Hamburg, Germany). Another group of participants took only hand rub solution. And lastly,rest of the participants did standard hand wash with soap only. All participants had been previously instructed in the use of the alcohol-based solution when the hospital-wide hand rubbing policy follows. A written protocol was available for each group, and no additional information was provided to participants before the study started. The sole exclusion criteria applied to those participants who were assigned to hand rubbing but whose hands became visibly soiled (such as with body fluids). They then had to wash their hands with a standard antiseptic soap, and the session was ceased. In this paper, hand hygiene refers to either hand-rubbing or handwashing.

Monitoring-and-data-collection:-

Patient care activities were monitored during daily sessions of two to three hours until a predetermined number of eligible activities had been performed. One session comprised five patient care activities that required hand hygiene before and after, which corresponded to 10 hand samplings (five samples obtained before and five after hand-cleaning). Eligible activities were direct contact with the skin of a patient before invasive care, after interruption of care, and after contact with any part of a patient that was colonised with multiresistant bacteria. We also recorded the type of care performed, duration of care, whether the participant wore gloves, the number of opportunities for hand hygiene according to the recent guidelines,[12]number of actual hand hygiene procedures performed, and duration of hand hygiene procedure (that is, duration of the use of antiseptic agent).

Microbiological samples and processing:

When an opportunity for hand hygiene occurred we took an imprint of fingertips and palm from the participant's dominant hand before and one minute after the procedure. If the participant wore gloves during the procedure the gloves were removed before we carried out sampling. Each fingertip and the palm were pressed on to commercial contact agar plates (one plate per finger and one per palm) that contained neutralisers (lecithin, polysorbate 80, sodium thiosulfate; Count-Tact, BioMérieux SA, Marcy l'Etoile, France). We incubated plates at 37°C under aerobic conditions. We recorded the total bacterial contamination of hands as the number of colony-forming units (CFU) recovered from both the fingertips and palm after 48 hours of incubation. We evaluated the precise count up to a maximum of 300 CFU, as beyond this point colonies formed a confluent growth.[10]We identified *Staphylococcus aureus* or other pathogenic bacteria not usually found in skin flora by using standard microbiological procedures and determined their susceptibility to antibiotics. We specifically looked for methicillin-resistant *S aureus* (MRSA), the most prevalent multiresistant organism at our institution. No-anaerobic-cultures-were done. We performed preliminary tests to assess the effective neutralisation of each tested product using a suspension of 104 MRSA per ml. Two observers (SL and FO) were responsible for the whole protocol (monitoring and sampling) in all units. They stayed in the unit without interfering with hand hygiene (that is, quality of hand hygiene) whatever the method used. The microbiologist who examined the culture plates and reported the microbiological results was unaware of the hand hygiene-method-used.

Statistical-analysis:-

Our primary objective was the reduction of total bacterial hand contamination. To detect a difference of 30% in the median reduction of hand contamination with the two techniques at a significance level of 5% and a power of 95% we calculated we would need 80 patient care activities. We extended the sample size to 100 to take into account possible technical difficulties at the beginning of the study. Our analyses were based on the intention to treat principle; one participant dropped out of the study after four samplings instead of five because his hands were visibly soiled with body fluids. The participants were the unit of analysis. Bacterial counts were

expressed as the number of CFU per hand. Firstly, we calculated the percentage reduction in hand contamination for each cleaning procedure. Secondly, we obtained the average percentage reduction for each participant by calculating the mean over the five procedures per participant and used Mann-Whitney tests to compare the percentage reduction between the two groups. We have expressed summary statistics on bacterial counts as means (SD) with 95% confidence intervals, medians, and interquartile ranges. We used Epi-Info 6.0 (Centers for Disease Control, Atlanta) to perform the analysis and considered $P < 0.05$ as significant.

Results:

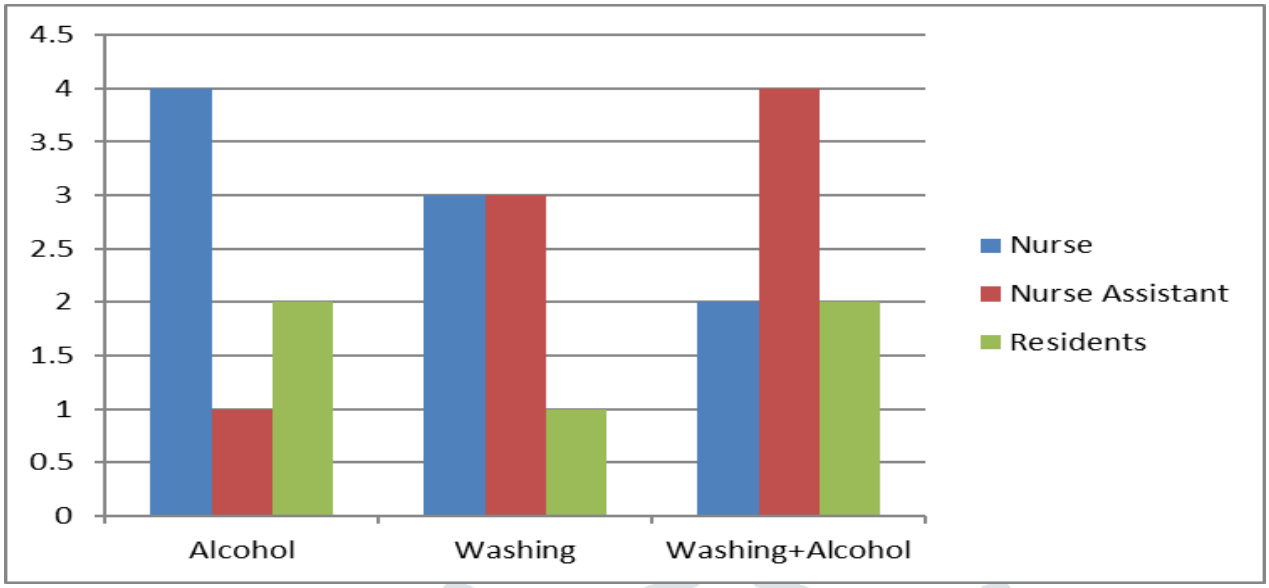
A total of 22 healthcare workers were included in the study and analysed; 7 were randomised to hand-rubbing and 7 to handwashing and 8 practising hand washing with soap and dried with hand dryer then take alcohol-based hand-rubbing solution (fig 1). Randomised participants performed 174 patient care activities (59 in the hand-rubbing group ,55 in the handwashing group and 60 in handwashing then rubbing). The distribution of activities was comparable between the three groups. Table 1 shows the baseline characteristics of the three randomised groups and the activities performed.

Table 1 :-Characteristics of three groups of health workers hand hygiene with an alcohol based solution after handwashing with soap and dried, compared with standard handwashing with soap and only alcohol based solution

	Hand rubbing (n=7)	**Handwashing (n=7)**	**Washing +Alcohol rub(n=8)**
Nurses	4	3	2
Nurse assistants	1	3	4
Residents	2	1	2

No of patient care activities included	59	55	60
Median (IQR) duration of patient care activities(min)	11(5-20)	15 (7-25)	12 (8-24)
No (%) activities when gloves were worn	51 (86)	46 (83)	44 (81)
Cumulative No (IQR) ofhand hygiene procedures performed during monitoring sessions	11 (7-15)	8 (7-13)	9(9-12)
Median (IQR) duration of monitoring sessions (min)	91 (58-177)	75 (35132)	88(55-164)
No of opportunities observed	184	158	162
Proportion (95% CI) compliance with hand hygiene	71 (45-96)	64 (36-93)	68 (42-94)

IQR-interquartile range



Gloves were worn during most activities with a similar frequency between the groups. In all groups bacterial counts were lower after hand hygiene (table 2).

Table 2 Bacterial counts (colony forming units) before and after different methods of hand cleaning

	Before		**After**		
	Mean(SD); 95% CI	**Median (IQR)**	**Mean(SD); 95% CI**	**Median (IQR)**	**Median % reduction (IQR)**
Hand-rubbing	271 (372); 174 to 368	101 (29-380)	35 (59); 20 to 50	7 (2-31)	86 (70-96)
Handwashing	232 (331); 143 to 321	117 (15-239)	69 (106); 41 to 97	9 (1-135)	73 (25-93)
Handwashing then Hand-rubbing.	255(355);141 to 314	121(18-269)	71(110);45 to 101	11 (3-55)	95 (28-95)

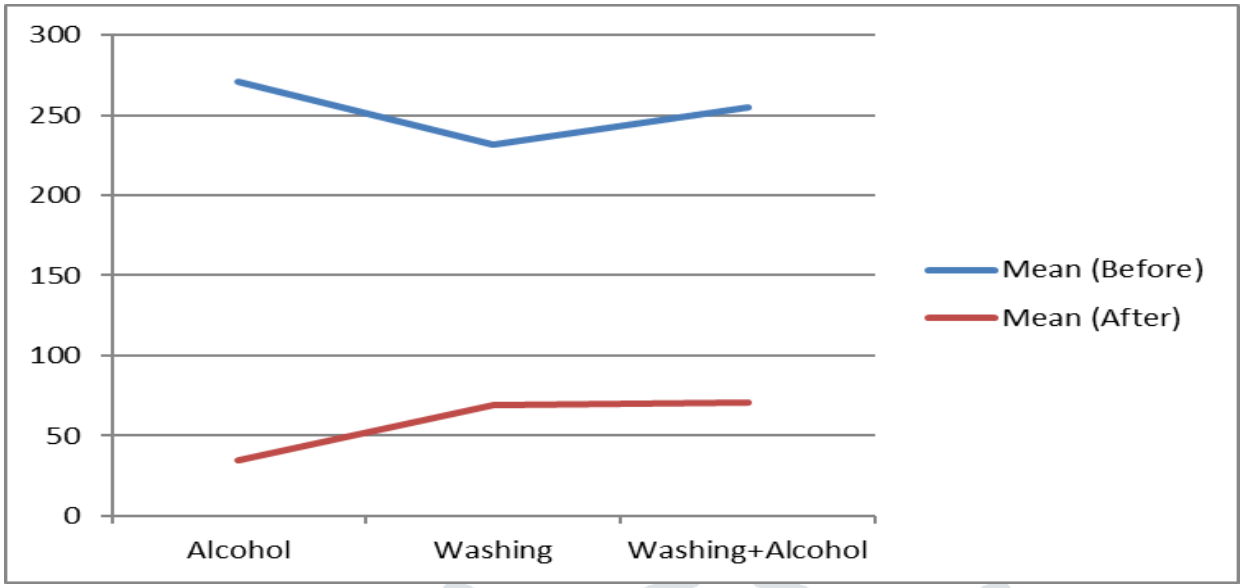
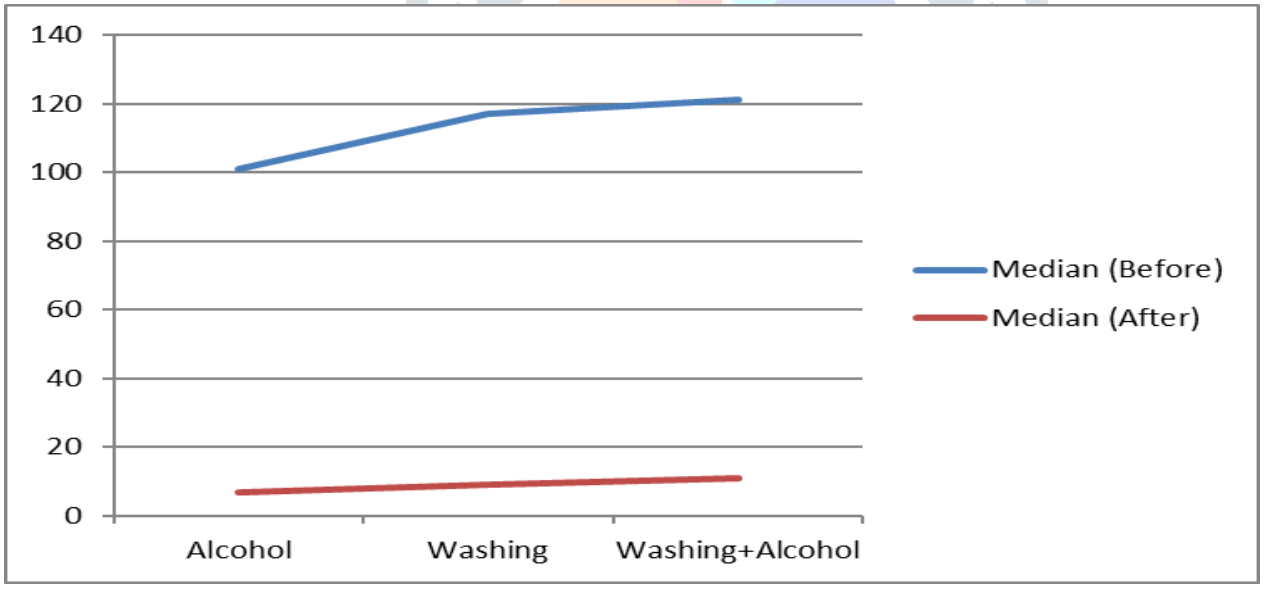


Figure 2 shows that for each participant the median reduction of bacterial contamination achieved by hand-rubbing after washing was significantly higher than the reduction achieved by handwashing or hand-rubbing alone (95% *vs* 86% and 73%)



Discussion:-

Our results show that in routine conditions, hand-rubbing was at least as effective as handwashing with an antiseptic detergent. The reduction of total bacterial contamination of participants' hands was significantly higher after hand-rubbing of dried hand after handwashing than either after hand-rubbing with alcohol-based solution alone or after antiseptic handwashing. In a study, Larson et al found that hand-rubbing was equivalent to antiseptic handwashing in reducing hand contamination.[11] However, the product tested contained less alcohol than the one we used (61% versus 75%) and contained another antiseptic compound. Also, it was not clear whether hands were sampled during patient care activities. The sampling method used was the glove juice technique, which is difficult to perform during routine care activities.

Several experimental studies in which hands were artificially contaminated with various micro-organisms have shown that hand-rubbing with alcohol based products after washing and drying of hands is more effective than hand-rubbing with alcohol based solution and handwashing with unmedicated or antiseptic soap.[14–18] Most of these studies incorporated supervised hand hygiene techniques to ensure conformity to usual recommendations or at least insisted on the quality of the technique. Despite these specifications, standard techniques of hand-washing were always found to be less efficient than hand-rubbing in removing transient contamination on hands. Our study was designed not to interfere with the actual practice of participants in terms of compliance with and quality of hand hygiene, our main objective being to evaluate the efficacy in routine care.

We have shown that hand-rubbing after hand washing with an alcohol based solution is more effective than either handwashing with an antiseptic soap or hand-rubbing alone in reducing bacterial contamination of healthcare workers' hands during routine patient care. This was due in part to the inadequate time spent washing hands conventionally.

Limitations:-

One potential limitation of our study includes the fact that we assessed bacterial contamination by taking agar fingerprints of the dominant hand and did not use the glove juice technique, which may be more effective in recovering the whole bacterial burden on hands.[12] Our technique may have underestimated the degree of hand contamination, though we are not aware of a direct comparison of the two techniques in terms of assessment of bacterial burden on hands. However, bacterial counts beforehand hygiene were consistent with baseline hand contamination found in two other clinical studies that used fingerprinting.[10 11] The design of our study, which was planned not to interfere with regular activities, did not allow using the glove juice technique. However, we believe the comparison of the two procedures tested, using the same technique for culture, remains valid.

The rapid efficacy of alcohol-based solutions and their availability at the bedside make these solutions an ideal substitute for conventional handwashing and should help in achieving increased compliance with hand hygiene during patient care. Improving hand hygiene compliance can lead to reduced rates of nosocomial infection and acquisition of multiresistant bacteria.[24]

References:

1 Conly JM, Hill S, Ross J, Lertzman J, Louie TJ. Handwashing practices in an intensive care unit: the effects of an educational program and its rela-tionship to infection rates. *Am J Infect Control* 1989;17:330-9.

2 Pittet D, Mourouga P, Perneger TV, and the Members of the Infection Control Program. Compliance with handwashing in a teaching hospital. *Ann Intern Med* 1999;130:126-30.

3 Rotter ML. Hand washing, hand disinfection and skin disinfection. In: Mayhall G, ed. *Hospital epidemiology and infection control*. 2nd ed. Baltimore: Williams and Wilkins, 1999:691-709.

4 Austin DJ, Bonten MJM, Weinstein RA, Slaughter S, Anderson RM. Vancomycin-resistant enterococci in intensive-care hospital settings:transmission dynamics, persistence, and the impact of infection control programs. *Proc Natl Acad Sci U S A* 1999;96:6908-13.

5 Preston GA, Larson EL, Stamm WE. The effect of private isolation rooms on patient care practices, colonization and infection in an intensive care unit. *Am J Med* 1981;70:641-5.

6 Simmons B, Bryant J, Neiman K, Spencer L, Arheart K. The role of hand-washing in prevention of endemic intensive care unit infections. *Infect Control Hosp Epidemiol* 1990;11:589-94.

7 Bischoff WE, Reynolds TM, Sessler CN, Edmond MB, Wenzel RP. Hand-washing compliance by health care workers: the impact of introducing an accessible, alcohol-based hand antiseptic. *Arch Intern Med* 2000;160:1017-21.

8 Maury E, Alzieu M, Baudel JL, Haram N, Barbut F, Guidet B, et al. Avail-ability of an alcohol solution can improve hand disinfection compliance in an intensive care unit. *Am J Respir Crit Care Med* 2000;162:324-7.

9 Girou E, Oppein F. Handwashing compliance in a French university hos-pital: new perspective with the introduction of hand-rubbing with a waterless alcohol-based solution. *J Hosp Infect* 2001;48(suppl A):S55-7.

10 Pittet D, Dharan S, Touveneau S, Sauvan V, Perneger TV. Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med* 1999;159:821-6.

11 Zaragoza M, Sallés M, Gomez J, Bayas JM, Trilla A. Handwashing with soap or alcoholic solutions? A randomized clinical trial of its effectiveness. *Am J Infect Control* 1999;27:258-61.

12 Larson EL, Aiello AE, Bastyr J, Lyle C, Stahl J, Cronquist A, et al. Assess-ment of two hand hygiene regimens for intensive care unit personnel. *Crit Care Med* 2001;29:944-51.

13 Larson E, and the Association for Professionals in Infection Control and Epidemiology. APIC guideline for handwashing and hand antisepsis in health care settings. *Am J Infect Control* 1995;23:251-69.

14 Cardoso CL, Pereira HH, Zequim JC, Guilhermetti M. Effectiveness of hand-cleansing agents for removing Acinetobacter baumannii strain from contaminated hands. *Am J Infect Control* 1999;27:327-31.

15 Guilhermetti M, Hernandes SE, Fukushigue Y, Garcia LB, Cardoso CL. Effectiveness of hand-cleansing agents for removing methicillin-resistant Staphylococcus aureus from contaminated hands. *Infect Control Hosp Epi-demiol* 2001;22:105-8.

16 Wade JJ, Desai N, Casewell MW. Hygienic hand disinfection for the removal of epidemic vancomycin-resistant Enterococcus faecium and gentamicin-resistant Enterobacter cloacae. *J Hosp Infect* 1991;18:211-8.

17 Bartzokas CA, Gibson MF, Graham R, Pinder DC. A comparison of triclosan and chlorhexidine preparations with 60 per cent isopropyl alcohol for hygienic hand disinfection. *J Hosp Infect* 1983;4:245-55.

18 Ayliffe GAJ, Babb JR, Davies JG, Lilly HA. Hand disinfection: a compari-son of various agents in laboratory and ward studies. *J Hosp Infect* 1988;11:226-43.

19 Coignard B, Grandbastien B, Berrouane Y, Krembel C, Queverue M, Salomez JL, et al. Handwashing quality: Impact of a special program. *Infect Control Hosp Epidemiol* 1998;19:510-3.

20 Gould D. Nurses' hand decontamination practice: results of a local study. *J Hosp Infect* 1994;28:15-30.

21 Lund S, Jackson J, Leggett J, Hales L, Dworkin R, Gilbert D. Reality of glove use and handwashing in a community hospital. *Am J Infect Control* 1994;22:352-7.

22 Voss A, Widmer AF. No time for handwashing!? Handwashing versus alcoholic rub: can we afford 100% compliance? *Infect Control Hosp Epide-miol* 1997;18:205-8.

23 Paulson DS, Fendler EJ, Dolan MJ, Williams RA. A close look at alcohol gel as antimicrobial sanitizing agent. *Am J Infect Control* 1999;27:332-8.

24 Pittet D, Hugonnet S, Harbath S, Mourouga P, Sauvan V, Touveneau S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet* 2000;356:1307-12.