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## Surgical hand antisepsis- comparison of alcohol based hand rub (propan-2-ol 45 gm, propan-1-ol 30 gm, mecetronium ethyl-sulphate 0.2gm) and povidone iodine scrub (7.5%)

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### Abstract

**Introduction:** One of the important causes of morbidity and mortality in post-surgical period is surgical site infection <sup>[1]</sup>. The main carrier of nosocomial and multi-drug resistant bacterial infection in hospital setting are healthcare workers <sup>[2]</sup>. Surgical site infections are avoidable with proper methodical antisepsis. The traditionally used disinfectant for hand antisepsis is povidone iodine. Newer Alcohol based hand rubs are present in commercial market, there are very few clinical studies that suggest the efficacy and comparison between povidone-iodine and alcohol based hand rubs in the pre surgical settings. There is a need to evaluate the antimicrobial based comparison between the hand antisepsis methods for better surgeon compliance and providing quality treatments to the patients. This study provides a basis in opting for a better alternative amongst the presurgical hand antisepsis methods.

**Methods:** An observational study was conducted at a tertiary care rural hospital. Patients undergoing clean surgeries were included in the study. The subjects representing the surgeons and the paramedical staff (n=200) were divided into two groups of 100 each (povidone iodine and alcohol based hand rub). Samples were then collected using sterile gloves and sterile culture tubes and were sent to the microbiology department for obtaining cultures. The efficacy of surgical hand antisepsis methods were compared, surgical site infection occurrences if found were accessed for seniority of surgeon, noted to deduce any relationship with the organism found on hand swabs and results were calculated.

**Result:** In concern with the two groups of hand antisepsis, bacterial growth profile was obtained, results showed a positive culture of 7% of which 4.5% positive cultures were found in Group A(povidone iodine) for Staphylococcus, Acinetobacter, Pseudomonas spp. and Streptococcus and 2.5% belonged to group B (Alcohol based hand rub) for Staphylococcus and Klebsiella. The statistical comparison of both groups A and B was done to calculate the p value which came out to be 0.267 which is not significant.

**Conclusion:** In 7% hand swabs the culture was positive for bacteria, with staphylococcus being the most common isolated commensal. No significant difference in efficacy of hand antisepsis was established in reducing the bacteria in surgical hand antisepsis protocol. No association was found between type of hand scrub and seniority of the surgeons. Since there was no incidence of surgical site infection in the patients, the better alternative between types of hand rub could not be deduced.

**Keywords:** hand antisepsis, povidone iodine, SSI, alcohol hand rub

### Introduction

Surgical site infection in patients are mainly caused due to nosocomial bacterial flora, the main carrier of nosocomial bacterial infection in hospital setting are healthcare workers <sup>[2]</sup>. The sole objective is control in surgical site infection (SSI) by reducing bacterial count on the skin of surgeons and assisting paramedical staff prior to surgery. Surgical site infections are avoidable with proper and methodical antisepsis.

The traditionally used disinfectant for hand antisepsis is povidone iodine. However preferences and compliance of povidone iodine maybe hindered by skin damage, allergy and time taken in performing the hand antisepsis protocol <sup>[4]</sup>. On the other hand alcohol-based hand rub is considered more satisfying and is more preferred in hand rubbing. It is a waterless handrub more time efficient but hindered by occurrences of dermatitis in some individuals.

Newer Alcohol based hand rubs are available in the market, with very few clinical studies that suggest the efficacy and comparison of antimicrobial antisepsis between the povidone and

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alcohol based hand rubs in the pre surgical antiseptics. Povidone iodine is mainly associated with dermatitis rashes and dryness on the skin irritation in some place in some cases [4].

The World Health Organization (WHO) guidelines refers that surgical antiseptics is a state of art suggesting that there are no optimal antiseptics that can totally eradicate the surgical site infection [5]. There is a need to evaluate the antimicrobial based comparison between the hand antiseptics methods for better surgeon compliance and providing quality treatments to the patients. This study provides a basis in opting for a better alternative amongst the presurgical hand antiseptics methods.

### Aims and Objectives

As there are very few studies that states the difference between the uses of hand antiseptics methods, this study aims to evaluate the comparative efficacy of conventional povidone iodine and alcohol based hand rub in presurgical setting.

### Materials and Methods

A prospective (observational) study was conducted at a tertiary care rural hospital in central India. Patients undergoing for clean surgeries were included in the study. The subjects representing the surgeons and the paramedical staff (n=200) were divided into two groups of 100 each. Both group followed the WHO guidelines for hand antiseptics protocol [5, 6]. Both the methods of hand antiseptics involved 3 to 5 minutes of hand washing protocol and hand swabs were taken before the volunteers proceeded to perform the surgery.

### Two methods of pre-surgical hand antiseptics

- Alcohol based hand rub (Sterilium). The solution is applied to hands for 1.5 minutes and then left to dry. Culture swabs were then taken from web spaces of hands.
- Povidone Iodine scrub (10%). The hands were washed with 5ml of scrub and water twice for a duration of 5 min each and then left to dry. Culture swabs were then taken from web spaces of hands.

Samples were collected wearing sterile gloves and using sterile culture tubes. Group A represented the volunteers undergoing traditional hand antiseptics with povidone Iodine, group B denoted the volunteers performing alcohol based hand rub for hand antiseptics. A sterile swab was taken from the web space of the fingers tracing inwards and towards the palm, the sample was preserved in sterile environment for the sake of transportation and sent to the microbiology department for obtaining cultures. The swabs were individually cultured on 5% sheep blood agar within an hour of swab taken from the concerned group. Individual culture plates were taken for each hand swab to prevent contamination by adjacent group. Culture sample was inoculated under all aseptic precautions to eliminate surrounding contamination and reduce errors in bacterial profile. Culture plates were incubated for 48 hours at 37 degree Celsius. After 2 days the culture plates were observed for any bacterial colony growth, if growth was observed the culture was identified, Gram-stained for the type of bacteria and antibiotic sensitivity tests were done for each bacterial strain. A condensed antibiotic profile was made for organisms found, under two

different groups A and B.

All the medical professionals performing surgery and paramedical staff assisting the surgery in the operation theatre were included in the presenting study. These participants fulfilled the inclusion criteria of having short and clean fingernails, no history of skin disorders, no cuts/abrasions on their fingers, no allergies to any ingredient in tested solutions, no recent antibiotic/antimicrobial use for at least 48 hours before undergoing hand sterilization. Volunteers having history of skin disease, wounds or any known allergy to povidone iodine and alcohol based hand scrub were excluded from the study.

For the sake of research, all participants received formal training on standard surgical hand scrubbing and sterile gloving. The informed consent of the volunteers and patients was taken prior to the procedure i.e. hand washing and surgery. All the subjects were informed about the risk and the benefits of the study.

The institutional ethics committee of our Hospital has approved this study and registered it. The details of the study will be kept confidential and will not be published in any form without prior consent.

The observed incidences of positive cultures were noted referring to either hand antiseptics groups, tabulated for better understanding, provided a detailed comparison in the prevalence of various bacterial flora. The prevalence was further compared according to the experience and seniority of the surgeon performing the surgery. The surgeons were divided into four groups as given below-

Code	experience in surgery
1	10 years after PG (Asso. Proff. And above)
2	5 years after PG (senior residents)
3	junior residents
4	assisting staff

Two groups were formed under each code and the incidence of positive hand cultures were recorded in both group A and group B. Accordingly results were calculated and plotted on a chart to study the relationship between the two methods of hand antiseptics under each code of seniority of surgeon.

The efficacy of surgical hand antiseptics methods were compared, surgical site infection occurrences were noted to deduce any relationship with seniority of surgeon and the organism found on hand swabs. Results were calculated on these findings.

The sample size was calculated using EPI INFO software version 7. Results were calculated and tabulated; a thorough analysis was done to reach to a defined conclusion. P values of more than 0.05 were considered insignificant.

### Result

In concern with the two groups of hand antiseptics, bacterial growth profile was obtained. The plotted results showed a positive culture of 7% of which 4.5% positive cultures were found in Group A and 2.5% belonged to group B.

1. Statistical analysis of bacterial growth after two different methods of hand antiseptics (alcohol based hand rub and povidone iodine)

**Table 1:** Bacterial growth chart

Type of hand scrub	present	Bacterial growth		p value
		Absent	Total	
	N=14(7%)	N= 186(93.00%)	N=200(100%)	
Alcohol	5	95	100	0.267625
Betadine (povidone iodine)	9	91	100	

The statistical comparison of both groups A and B was done to calculate the p value which came out to be 0.267. Thus the study proves that there is no significance between the type of hand antisepsis methods and both methods *viz.* Alcohol based hand rubs and traditional povidone Iodine based hand rubs and had comparably same efficacy for hand antisepsis.

### Persistent bacterial flora after hand antisepsis

Among all the 100 samples taken in account in group A (Povidone Iodine), 9% samples were positive for some kind of

bacteria. Among the positive samples 55.5% belonged to Staphylococcus, Acinetobacter (22.2%) followed by Pseudomonas spp. and Streptococcus up to 11.11%. Group B represented the alcohol based hand rubs showed almost equal percentage of occurrences for both Staphylococcus and Klebsiella spp at 40% each followed by Acinetobacter (20%). The incidence of positive cultures were more in group A than group B depicting less sensitivity towards povidone iodine based hand rubs as the traditional hand rubs.

**Table 2:** Showing positive cultures and organisms isolated in group A and B.

Organism isolated	Povidone iodine (group A)		Alcohol based hand rub (group B)	
	Frequency	Percentage	Frequency	Percentage
Acinetobacter	2	22.20%	1	20%
Pseudomonas spp.	1	11.10%	0	0%
Staphylococcus	5	55.50%	2	40%
Streptococci	1	11.10%	0	0%
Klebsiella spp.	0	0%	2	40%
Total	9	100%	5	100%

A compiled data of bacterial profile is shown along with their antibiotic sensitivity and resistance patterns. These patterns can be further studied for determining better antibiotics and

preferable hand antisepsis methods against different organisms involved.

**Table 3:** Showing bacterial culture in alcohol based pre-surgical hand scrub and antibiotic sensitivity.

sr. no.	Bacteria	type of hand rub	type of bacteria	Sensitivity	Resistance
1	Acinetobacter	Alcohol	gram negative	alc, caz, ctr, imp, le, pit	nx, cd, g, nit
2	Klebsiella	Alcohol	gram negative	nx, cis, g, imp	cot, ctx, ctr, nit
3	Klebsiella	Alcohol	gram negative	Imp	ctx, cip, ctr, cxm, cis, g, pit
4	Staphylococcus	Alcohol	gram positive	nx, nit, va	e, cot, cx, cd
5	Staphylococcus	Alcohol	gram positive	cot, g, nit, va	amp, E, Cx, Nx, Cd

**Table 4:** Showing bacterial culture in povidone iodine based pre-surgical hand scrub and antibiotic sensitivity

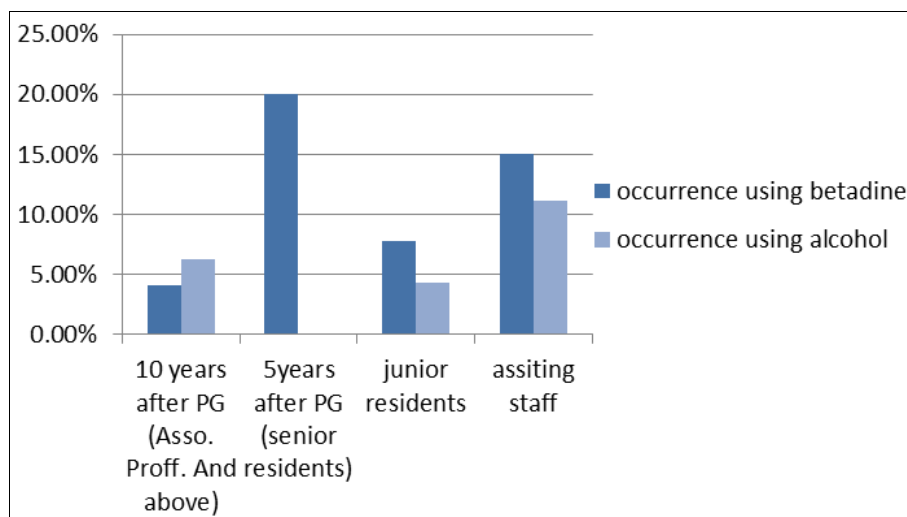
sr. no.	Bacteria	type of hand rub	type of bacteria	Sensitivity	Resistance
1	Acinetobacter	Betadine	gram negative	alc, caz, ctr, imp,	nx, g, nit
2	Acinetobacter	Betadine	gram negative	alc, caz, ctr, cis, cpm, imp, le, pit	, nx, cd, g, nit
3	pseudomonas spp.	Betadine	gram negative	Pit	AK, ctx, caz, ipm, Le, tob
4	staphylococcus	Betadine	gram positive	cx, va	e, cot, nx, cd, g, nit
5	staphylococcus	Betadine	gram positive	cd, TE, va	e, cot, cip
6	staphylococcus	Betadine	gram positive	TE, Va	E, cot, cip
7	staphylococcus	Betadine	gram positive	nx, nit, va	e, cot, cx, cd
8	staphylococcus	Betadine	gram positive	cot, g, nit, va	amp, E, Cx, Nx, Cd
9	Streptococci	Betadine	gram positive	Cis	cot, ctx, g, imp, nit

The occurrence of bacterial growth in two hand antisepsis methods and the seniority of the surgeon and paramedical staff assisting the surgery. Among the betadine group, code 2 (experience- 5 years after post-graduation) showed more

occurrence of bacterial growth in the samples collected. While the group that performed alcohol based pre-surgical hand antisepsis had assisting staff as the major source of bacterial cultures growing positive.

**Table 5:** Showing positive cultures obtained according to the seniority of surgeon

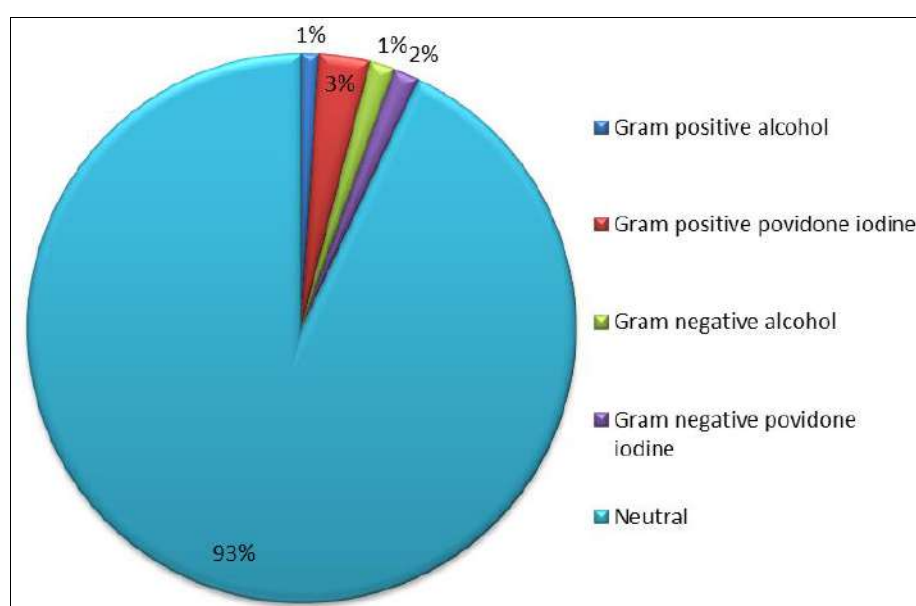
Code	Experience in surgery	Occurrence using betadine	Occurrence using alcohol
1	10 years after PG (Asso. Proff. And above)	4.10%	6.25%
2	5years after PG (senior residents)	20%	0
3	junior residents	7.80%	4.34%
4	assisting staff	15%	11.10%



**Fig 1:** Bar Diagram Showing comparison of groups of hand antisepsis on basis of seniority of surgeons

The below pie chart explains the proportion of bacterial nature according to their gram staining in both group A (povidone

Iodine based hand rub) and group B (alcohol based hand rub).



**Chart 1:** Showing gram staining of organisms found in both groups.

## Discussion

The main aim of the pre-surgical hand scrub using different hand antisepsis methods is to reduce the incidence of surgical site infection thereby reducing the complications. The skin flora consists of various micro-organisms, the population of the bacteria and the composition is influenced by various factors like age, sex, moisture, Ph of the skin and the immune status of the patient. It has been estimated that about  $10^2$  -  $10^6$  CFU/cm<sup>2</sup> bacteria inhabit on the skin of human adult.

In the present study, there was no significant SSI found in patients where presurgical handscrubs (alcohol based) or Povidone iodine based hand rub was used.

The study by Zandiyeh *et al.* showed that all three alcoholic hand rubs significantly reduced the skin colony count immediately. Sterillium was considered best for hand antisepsis. This was in coherence with our study [25].

Gram-positive cocci (*Staphylococcus epidermidis* and *Micrococcus* sp.) and corynebacteria such as *Propionibacterium* spp. are the skin microbes commonly found in the most superficial layers of the epidermis. Generally nonpathogenic or

commensal in nature some of them are mutualistic (offer a benefit). Surgical incision may result in SSI, most commonly by *S. aureus* and *S. epidermidis*. One of the major predisposing factor of SSI is the microorganisms carried by the hands of surgical team. Hence, surgical hand antisepsis is carried out to eliminate the transient flora and diminish the resident skin flora as much as possible [25].

In our study, resident hand flora immediately decreased by use of Sterillium, containing 1-propanol 30%, the best effective alcohol, and 2-propanol 45% (total 75%). Kareem *et al.* showed that alcohol based hand rubs resulted in a significant reduction in bacterial counts when compared along with traditional hand scrub methods [20]. In a similar study, Gaspar *et al.* stated that alcohol based hand rubs when used for surgical hand antisepsis reduces the duration of preparation and is equally effective when compared with traditional handrubs [21].

A study in southern Taiwan involving 156 healthcare personnel evaluated the microbial load reduction after pre-surgical hand preparations. They found that ABHR (alcohol based handrubs) had highly persistent effect (P=0.001). Efficacy of, PVPI,

chlorhexidine and ABHRs was compared in a systematic review of 14 randomized clinical trials. ABHR was equally or more effective than any other antiseptic agent solution.

The least evidence of bacteria was detected in nail scrubbing. However, the SSI rates were similar. The SSI rates were similar for antiseptic agent solution and ABHR in a randomized clinical trial conducted in France. Kadam *et al.* in their study showed that there was a higher number of bacterial growth for sterilium based hand preparations than the traditional betadine hand scrubs [22]. This was in contrast to our study.

The presenting study found no occurrence of surgical site infection on follow-ups of any patients with positive swab culture in correspondence to the samples taken prior to the surgery. According to WHO Surgical Site Infection Prevention Guidelines Web Appendix 10 (Summary of a systematic review on surgical hand preparation) five studies showed no significant difference in SSI when ABHR was compared to hand scrubbing with an antimicrobial soap (CHG 4%). The same results were found in a, cross-over trial, randomized, cluster trials comparing ABHR to hand scrubs with plain soap.

The persisting bacterial flora after pre-surgical hand preparation is documented in our study along with their antibiotic sensitivity profile. Very few of such studies can be found. Further studies are required to significantly state the common persisting flora after hand rubbing protocols. Our study has demonstrated the occurrence of various hand commensals in relation with both hand antisepsis methods. The common bacterial flora found in our study are *Staphylococcus epidermidis*, *Acinetobacter*, *Pseudomonas* and *Klebsiella*. Similar results were found in a study conducted by Kadam *et al.* and are mainly responsible for surgical site infections.

## Conclusion

In 7% hand swabs the culture was positive for bacteria, with *staphylococcus* being the most common isolated commensal. Alcohol based hand rubs and povidone iodine were both equally efficacious in reducing the bacteria in surgical hand antisepsis protocol. Nature of hand scrub doesn't preferentially eliminate bacteria on the basis of their gram staining. No association was found between type of hand scrub and seniority of the surgeons. Since there was no incidence of surgical site infection in the patients, the better alternative between types of hand rub could not be deduced. To study the correlation between the bacteria causing surgical site Infection and its sensitivity, antibiotic profile was observed. Proper hand scrub protocols should be followed to reduce the persistent hand flora to reduce the incidence of surgical site infections.

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