Mansoura Nursing Journal (MNJ) Vol. 9. No. 2 – 2022
Print ISSN: 2735 – 4121 Online ISSN : 2735 – 413X

Original Article

Comparison of the Antiseptic Effects of Betadine and Sterillium on Microbial Load of Surgical Hands

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1.ABSTRACT

Background: The hands of surgeons and scrub nurses carry microorganisms identified as sources of microbial contamination. Surgical hand antisepsis is a cornerstone of the overall aseptic technique in surgery to eliminate transient microorganisms and reduce resident skin flora, preoperative hand disinfection is an important part of the strategy for surgical team to prevent surgical site infection. **Aim**: Compare the antiseptic effects of Betadine and Sterillium on microbial load of surgical hands. **Method**: One group, two periods, posttest experimental study designed was carried on a convenient sample of 54 surgeons and 44 scrub nurses. **Results**: The mean of microbial load were. 76.46 (178.97), and 31.58 (74.57) after hands washing with soap and water before hands scrubbing or rubbing by using Betadine, and Sterillium respectively, with statistically significant differences, P=.024. The mean of microbial load were. 4.06 (13.57), and 0.15 (1.08) after hands scrubbing or rubbing by using Betadine, and Sterillium respectively, with statistically significant differences, P=.005. Finally, the mean of microbial load were. 21.75 (104.65), and zero after doffing gloves by scrubbing with Betadine, and rubbing with Sterillium respectively, with statistically significant differences, P=.042. **Conclusion**: superiority of hands rubbing with Sterilium over hands scrubbing with Betadine in the terms of; total positive growth, or no growth of isolated bacteria. **Recommendation**: Assure continuous supply operating theater with Sterillium.

Keywords: Betadine, Hand Scrubbing, Rubbing, Sterillium, Surgical Site Infection

2.Introduction:

The hands of surgeons and scrub nurses carry microorganisms identified as sources of microbial contamination. Common organisms causing nosocomial infection are methicillin-resistant Staphylococcus aureus (MRSA), Acinetobacter baumannii, Pseudomonas aeruginosa, members of Enterobacteriaceae and Enterococci. Staphylococcus aureus, and coagulase-negative Staphylococci are the leading causes of surgical site infection (SSI), which is a globally recognized problem that results in significant morbidity and mortality, including delayed healing, wound breakdown, sepsis, negative economic impact and prolonged hospital stays and revision of surgery (Shen et al., 2015).

Surgical site infection is the general name of the preventable infections that occur in incisions, organs or cavities. Studies on SSI indicate that nearly 30%–70% of the infections are preventable with surgical hand washing(Ashraf et al., 2018). The most significant example of this finding is the surgical hand washing practice carried out by J. Lister, where the rate of the SSI rates decreased from 45% to 15%. The standard aseptic technique should be used with caution in every surgical procedure, regardless of the surgical technique, the unit (outpatient clinic, wards or operating room) and the size or the length of the operation (Ashraf et al., 2018).

As well, to help combat this problem, surgical scrubbing is performed to remove or destroy transient microorganisms and reduce resident flora (Forer, Block, & Frenkel, 2017).

Surgical hand antisepsis is a cornerstone of the overall aseptic technique in surgery to eliminate transient microorganisms and reduce resident skin flora, preoperative hand disinfection is an important part of the strategy for surgical team to prevent surgical site infection. The products used to disinfect hands before surgery should have broad antimicrobial power and fast-acting effect. In addition, these products should have durable effects to prevent microbial growth as well as skin irritation and sensitization during surgery. Therefore, the selection of a suitable antiseptic, which results in less skin damage and stronger and preferably more stable antimicrobial effect, is of fundamental importance (Chauveaux, 2015).

Traditional surgical hand antisepsis consists of an aqueous scrub with or without brush, using povidone iodine (PVP-I) or chlorhexidine-based

detergents. Some institutions worldwide have recently started using alcohol-based hand rub as an alternative to the traditional aqueous scrub, whilst continental Europe has used such alcohol-based hand rubs for more than 30 years (Shen et al., 2015).

The Betadine scrub has been traditionally utilized in Iran for many years. Betadine (povidone iodine) is a traditional antiseptic, consisting of iodine and polymers as carrier. This solution applies its decontamination effect by gradual release of inorganic iodine on the skin and mucous membrane. Iodine has a bactericidal effect on the Gram-positive and Gram-negative bacteria, acting against fungi, viruses, parasites, cysts, protozoa, yeasts, and spores (Tanner, Dumville, Norman, & Fortnam, 2016).

Sterillium is one of the most commonly used alcoholic solutions, containing 45% 2-propanol, 30% 1-propanol, 0.2% mecetronium ethyl sulfate. This product eliminates the microbes caused by sweating and protects the skin in case of surgical glove tear (Zandiyeh & Roshanaei, 2015).

Aim of the Study

Compare the antiseptic effects of Betadine and Sterillium on microbial load of surgical hands.

Study hypothesis

The Sterillium is more effective than Betadine on microbial load of surgical hands.

3. Method

Study design

One group, two periods, posttest experimental study designed was utilized to carry out the current study.

Setting

This study was conducted at operating theater at Emergency Hospital, Mansoura University. Operating theater has three operating rooms. Two rooms for orthopedic surgery, and one for plastic surgery.

Participants

Participants of the study included surgeons and scrub nurses at Emergency Hospital, Mansoura University. Surgeon-patient ratio was 1:6 while scrub nurse-patient ratio was 1:4. The following conditions would be excluded criteria:

- No use of any anti-bacterial products (e.g., ointment, cream, soap, and/ or shampoo) and systemic antibiotics one week before and during the study (to protect skin flora)
- No known history of upper limbs infections or recent trauma to the fingers and/ or hands
- Occurrence of any skin sensitivity during the study
- No observable hands' scratch
- Did not stick artificial nails
- No allergy to antiseptics
- No nail polish
- Short nails

Sample Size and Technique

Average number of study's participants was 60 surgeons and 50 scrub nurses. Sample size was calculated using Power Analysis and Sample Size software program (PASS) version 15.0.5 for windows (2017) using the results published by Entezari, Avazbakhsh, Mirhosseini, Ghasemi and Fatahi Bafghi, (2016), with the mean difference of the microbial load of the hands immediately after using the surgical scrub as the primary outcome. A sample size of 98 volunteer's surgical team members working in operating rooms is needed to achieve 80% power to detect a mean difference of 0.76 between the two agents with standard deviation of 3 for both agents using a one-sided paired samples t-test with a significance level of 0.05. Accordingly the study included convenience sample composed of 98 surgeons and scrub nurses (54 surgeons, and 44 scrub nurses).

Study Tools

There were five tools for data collection in this study; first, and fourth tools were developed by the researcher, second, third and fifth tools were adopted from Entezari, Avazbakhsh, Mirhosseini, Ghasemi and Fatahi Bafghi, (2016).

Tool I: Surgeons and scrub nurses' socio demographic and occupational characteristics self-administrated questionnaire

Tool II: Surgeons and scrub nurses' hands preparation protocols with Betadine. According to Entezari et al. (2016) scrubbing procedure consisted of 14 consequent steps starting from the participants wash their hands for 1 min with 5ml of liquid non-antibacterial soap, and then rinse and dry them with paper towels, scrubbing hands with 4ml of Betadine for 3 min from the fingertips to 5cm above the elbow then rinsing hands and arms by passing them through the water in one direction only and hand drying with a sterile towel, donning sterile gown and gloves.

Tool III: Surgeons and scrub nurses' hands preparation protocols with Sterillium. According to Entezari et al. (2016) scrubbing procedure consisted of 11 consequent steps starting

from the participants wash their hands for 1 min with 5ml of liquid non-antibacterial soap, and then rinse and dry them with paper towels, use of 12 ml of Sterillium washed hands for 3 min from the fingertips to 5cm above the elbow, donning sterile gown and gloves.

Tool IV: Surgeons and scrub nurses' performance observational checklist. It was used to observe surgeons and scrub nurses' performance by the researcher, which included the following items; scrubbing with Betadine, rubbing with Sterillium, and donning and doffing of surgical gloves.

These steps were presented in a checklist with each step rated as completely done (2 Marks) incompletely done (1 Mark) and not done (0 Mark). Surgeons and scrub nurses' performance observed and checklist fulfilled by the researcher and categorized accordingly (Challenge, 2009).

According to the researcher's cut of point; the performance competency levels consist of two categories: Competent which was equal or more than 90% of the total score, and incompetent which is less than 90% of the total score.

Tool V: Bacteriological techniques, to culture the samples. To culture the samples, the researcher plated them on blood, and MacConkey's agars plates. Plates were labeled type of samples. The samples were incubated aerobically at 37 °C for 24 hours. The number of bacteria was estimated using the colony counting device (Entezari et al., 2016).

This process was performed for all the samples. All blood agars plates were transported to Microbiology Department, Faculty of Medicine, Mansoura University.

Phases of the Study

This study was accomplished throughout two main phases:

Phase I: Preparation

Administrative process an official letter was issued from the Faculty of Nursing, Mansoura University to the Director of Emergency Hospital, Mansoura University to permit for the researcher to carry out the study.

Literature review Review of national and international literatures on the various aspects of the hand scrubbing and rubbing and comparing the antiseptic effects of Betadine and Sterillium on microbial load of surgical hands using scientific published articles, internet search and textbooks. This review was a guide for developing the study tools.

Developing of the study tools First, and fourth tools were developed by the researcher, after reviewing the related literature. While second, third and fifth tools were adopted from, Entezari et al., (2016). The developed/adopted tools were tested for their face and content validity.

According Fink and Litwin, (1995); (Maruish, 2011); Miller et al., (2009); Polit and Beck, (2006); Tavakol and Dennick, (2011); Bolarinwa, (2015); To Litwin, (1995); Maruish, (2011); Miller, (2010); Polit and Beck, (2006) and Tavakol and Dennick, (2011), face validity was established when an individual (and or researcher) who was an expert on the research subject reviewing the questionnaire (instrument) concludes that it measures the characteristic or trait of interest. Content validity pertains to the degree to which the instrument fully assesses or measures the construct of interest. Study tools were tested for appropriateness and had relevant items, by five experts in the field of community health nursing, Faculty of Nursing, Mansoura University. The recommended modifications were done.

Tools reliability. It was 0.76 assured by means of Cronbach's coefficient alpha.

Pilot study. A pilot study carried out on 10% (10 surgeons and scrubbed nurses) of the study sample and was included in the main study sample.

Phase II: Op**erational**

Data collection. The researcher visited Emergency Hospital, Mansoura University six days/week (except Friday) from 9:00 AM to 2:00 PM and the operations that last for 2-4 hours were selected, which considered the average time of operations usually carried.

Samples collection. One to two sample(s) was/ were collected per day, during the period from 1st of February 2020 to 31st of October 2020; except the period of 1st of March to the 30th of June when the pandemic of Coronavirus Disease 19. Samples collection lasted for 121 days.

Assessment part was done by first tool that was used to assess surgeons, and scrubbed nurses' socio demographic, and occupational characteristics, second, and third tools were concerned with hand preparation protocols for surgeons, and scrubbed nurses with Betadine, and Sterillium, and fourth tool was addressing observation to surgeons, and scrubbed nurses' performance during scrubbing with Betadine, rubbing with Sterillium, and donning, and doffing sterile gown and gloves. Fifth tool was used to compare antiseptic effects of Betadine and Sterillium on microbial load of surgical hands.

Samples were collected in two periods; first period when scrubbed with Betadine, followed by second period when rubbed with Sterillium, which take place two days later for the scrubbed nurses, and subsequent day for the surgeons, according to their schedule in operating theater at Emergency Hospital, Mansoura University.

First period scrubbed with Betadine. According to Entezari et al. (2016), the researcher instructed surgeons, and scrubbed nurses to wash their hands for 1 min with 5 ml of liquid non-antibacterial soap, and then rinse and dry them with paper towels. Afterwards, the researcher collected the samples from the wrinkles of both palms and under the nails using sterile swabs. In the next stage, the hands were scrubbed with Betadine for 3 min using 4 ml of Betadine. After wetting the hands, they were brushed from the fingertips to 5 cm above the elbow. After rinsing the hands and drying them with a sterile towel, the samples were collected. In order to assess the sustainability of the Betadine, 3rd swabs were collected at end of surgery just immediately after gloves removal and before post-surgical hand decontamination.

Second period rubbed with Sterillium. According to Entezari et al. (2016), the researcher instructed surgeons, and scrubbed nurses to wash their hands for 1 min with 5 ml of liquid non-antibacterial soap, and then rinse and dry them with paper towels. The samples were taken from under the nails and wrinkles of the palms were obtained. Subsequently, the hands were washed with alcoholic solutions for 3 min using 12 ml of Sterillium, without rinsing, and the second samples were collected after drying the hands. The 3rd swabs were collected at end of surgery just immediately after gloves removal and before post-surgical hand decontamination.

The researcher plated the samples using the same above mentioned procedure and transferred them to Microbiology Department, College of Medicine, Mansoura University.

Ethical Considerations

An approval was obtained from Research Ethics Committee, Faculty of Nursing, Mansoura University. The researcher introduced herself and a simple explanation about the aim of the study was given to them. Participants were assured that their participation in the study was voluntary and that collected data would be treated confidentially and only used for the purpose of the study. Participants were informed that they have the right to withdraw at any time from the study without giving any reason. Written informed consent was obtained from the participants.

Statistical analysis

Data were sorted, coded, organized, categorized and then transferred into especially designed formats.

Data was analyzed using IBM's SPSS statistics (Stand for Statistical Product and Service Solutions) for windows (version 25).

4. Results

Table (1) represents that 70.4%, 68.4% and 55.1% of the surgeons and scrub nurses aged 20 to <30 years, males and residence in rural areas respectively. Concerning level of education, 30.6% had technical institute of nursing and 37.8% had bachelor of medicine. Surgeons, and nursing technician were 55.1% and 42.9% respectively with 1 to <5 years of experience representing 61.2% of surgeons and scrub nurses.

Table (2) illustrates that all surgeons and scrub nurses competently prepared surgical hands before scrubbing with Betadine, as well, 92.9% of them competently performed process of surgical hands scrubbing with Betadine.

Table (3) reveals that all surgeons and scrub nurses competently prepared surgical hands before rubbing with Sterillium, as well, competently performed process of surgical hands rubbing with Sterillium.

Table (4) shows that 92.8% surgeons and scrub nurses competently performed donning of sterile gowns and gloves after hands scrubbing with Betadine, as well, all of them competently performed donning of sterile gowns and gloves after hand rubbing with Sterillium.

Table (5) declares that 92.8% surgeons and scrub nurses competently performed doffing of sterile gowns and gloves after hands scrubbing with Betadine, as well, doffing of sterile gowns and gloves after hands rubbing with Sterillium.

Table (6) demonstrates bacteriological culture results for samples obtained from surgeons' and scrub nurses' wrinkles of both palms and under the nails using sterile swabs. Seven types of bacteria were isolated; which were Staphylococcus Species, Micrococci, Enterococci, Streptococci, Staphylococci + streptococci, Staphylococci + enterococci, and Micrococci + enterococci. In case of Betadine, total counts of bacteria were isolated from 63 (64.28%), 13 (13.26%) and 26 (26.42%), surgeons' and scrub nurses' wrinkles of both palms and under the nails using sterile swabs after hand

washing with soap and water, after scrubbing with Betadine and after doffing gloves respectively. On the other hand, in case of Sterillium, total counts of bacteria were isolated from 47(47.95%), 2 (2.04) and none, surgeons' and scrub nurses' wrinkles of both palms and under the nails using sterile swabs respectively.

Table (7) illustrates the mean of microbial load were. 76.46 (178.97), and 31.58 (74.57) after hands washing with soap and water respectively, with statistically significant differences, P=.024. The mean of microbial load were. 4.06 (13.57), and 0.15 (1.08) after hands scrubbing with Betadine, and rubbing with Sterillium respectively, with statistically significant differences, P=.005. Finally, the mean of microbial load were. 21.75 (104.65), and zero after doffing gloves**,** in case of scrubbing with Betadine, and rubbing with Sterillium respectively, with statistically significant differences, P=.042.

It was important to highlight that, residual bacterial load noticed on two out of 98 surgeons' and scrub nurses' hands, after scrubbing with Betadine, and Zero bacterial growth after rubbing with Sterilium.

Table1: Socio demographic and occupational characteristics of surgeons and scrub nurses

Item	Frequency(n=98)	%
Age		
20 <30	69	70.4
30 <40	29	29.6
X(SD)	**27.70 (3.530) years**	
Sex		
Male	67	68.4
Female	31	31.6
Residence		
Rural	54	55.1
Urban	44	44.9
level of education of scrub nurses		
Diploma of nursing	12	12.2
Technical institute of nursing	30	30.6
Bachelor of nursing	2	2.0
level of education of surgeons		
Bachelor of medicine	37	37.8
Post graduate	17	17.3
Occupation		
Surgeon	54	55.1
Nursing specialist	2	2.0
Nursing technician	42	42.9
years of experience		
1<5 years	60	61.2
5<10 years	23	23.5
10 < 15 years	15	15.3
X(SD)	**4.70 (3.805) years**	

Table 2: Surgeons' and scrub nurses' surgical hands scrubbing with Betadine

Item	Competent		Incompetent	
	Frequency (n=98)	%	Frequency (n=98)	%
Preparation of surgical hands before scrubbing with Betadine	98	100	0	0.0
X(SD)	**14.00 (.00)**			
Process of surgical hands scrubbing with Betadine	91	92.9	7	7.1
X(SD)	**49.928 (0.4124)**			

Table 3: Surgeons' and scrub nurses' surgical hands rubbing with Sterillium

Item	Competent		Incompetent	
	Frequency (n=98)	%	Frequency (n=98)	%
Preparation of surgical hands before rubbing with Sterillium	98	100	0	0.0
X(SD)	**14.00 (.00)**			
Process of surgical hands rubbing with Sterillium	98	100	0	0.0
X(SD)	**14.00 (.00)**			

Table 4: Surgeons' and scrub nurses' donning of sterile gown and gloves after hand scrubbing with Betadine or Sterillium

Item	Competent		Incompetent	
	Frequency (n=98)	%	Frequency (n=98)	%
Donning of sterile gowns and gloves after hands scrubbing with Betadine	91	92.8	7	7.2
X(SD)	**34.9592 (1.15695)**			
Donning of sterile gowns and gloves after hands rubbing with Sterillium	98	100	0	0.0
X(SD)	**35.1531 (1.15189)**			

Table 5: Surgeons' and scrub nurses' doffing of sterile gown and gloves after hand scrubbing with Betadine or Sterillium

Item	Competent		Incompetent	
	Frequency (n=98)	%	Frequency (n=98)	%
Doffing of sterile gowns and gloves after hands scrubbing with Betadine	91	92.8	7	7.2
X(SD)	**11.9796 (.20203)**			
Doffing of sterile gowns and gloves after hands rubbing with Sterillium	91	92.8	7	7.2
X(SD)	**11.9796 (.20203)**			

Table 6 Types of isolated bacteria on surgeons' and scrub nurses' hands in case of scrubbing with Betadine or rubbing Sterillium

Type of isolated bacteria	Betadine N (294)			Sterillium N (294)		
	After hand washing with soap and water **N (98)**	After scrubbing with Betadine **N (98)**	After doffing gloves **N (98)**	After hand washing with soap and water **N (98)**	After rubbing with Sterillium **N (98)**	After doffing gloves **N (98)**
Staphylococcus species	54(55.1)	11(.22)	18(18.37)	45(45.92)	1(1.02)	0(0)
Micrococci	2 (2.04)	1 (1.02)	2 (2.04)	1 (1.02)	1 (1.02)	0
Enterococci	1 (1.02)	1(1.02)	·	0	0	0
Streptococci	2 (2.04)	0	3 (3.06)	0	0	0
Staphylococci + streptococci	2 (2.04)	0	2 (2.04)	0	0	0
Staphylococci+ enterococci	2 (2.04)	0	1(1.02)	0	0	0
Micrococci + enterococci	0	0	0	1(1.02)	0	0
Total positive growth	63 (64.28)	13 (13.27)	26 (26.53)	47 (47.96)	2 (2.04)	0
No growth	35 (35.71)	85 (86.73)	72 (73.47)	51 (52.04)	96 (97.96)	98 (100)

Table 7 Mean differences in colony count on surgeons' and scrub nurses' hands in case of scrubbing with Betadine or Sterillium

Application time	Betadine	Sterillium	*P-value
	M(SD)	M(SD)	
After hands washing with soap and water	76.46 (178.97)	31.58 (74.57)	0.024
After hands scrubbing/ rubbing	4.06 (13.57)	0.15 (1.08)	0.005
After doffing gloves	21.75 (104.65)	0	0.042
** P-value	.000**	.000**	

*Independent t-test; **Repeated measures ANOVA

5. Discussion

Surgical hand antisepsis is a cornerstone of the overall aseptic technique in surgeries to eliminate transient microorganisms and reduce resident skin flora, preoperative hand disinfection is an important part of the strategy for surgical team to prevent surgical site infection. The products used to disinfect hands before surgeries should have broad antimicrobial power and fast-acting effect. In addition, these products should have durable effects to prevent microbial growth as well as skin irritation and sensitization during surgeries. Therefore, the selection of a suitable antiseptic, which results in less skin damage and stronger and preferably more stable antimicrobial effect, is of fundamental importance (Chauveaux, 2015).

Accordingly, surgical site infection is the general name of the preventable infections that occur in incisions, organs or cavities. Studies on SSI indicate that nearly 30%–70% of the infections are preventable with surgical hand washing. The most significant example of this finding is the surgical hand washing practice where the rate of the SSI rates decreased from 45% to 15%. The standard aseptic technique should be used with caution in every surgical procedure, regardless of the surgical technique, the unit (outpatient clinic, wards or operating room) and the size or the length of the operation (Ashraf et al., 2018).

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. On the other hand, alcohol-based hand rub is considered more satisfying and is more preferred in hand rubbing. It is a waterless hand rub more time efficient but hindered by occurrences of dermatitis in some individuals (Deshmukh, Fulare, & Gokhale, 2021).

Several studies have shown that alcohol-based hand rub is more efficient than the currently practiced preoperative surgical hand scrub, both in vivo and in vitro in the form of its ability to reduce bacterial counts in samples taken from surgeons' hands, also longer lasting anti-microbial effect in comparison to the conventional surgical scrub (Leaper & Edmiston, 2017). The current study compares effectiveness of Sterillium and Betadine on microbial load of surgical hands after hand washing with soap and water and scrubbing and at end of surgery.

Results of the current study reveal that all surgeons and scrub nurses competently prepare surgical hands before scrubbing with Betadine and rubbing with Sterillium, as well; most and all of them competently perform process of surgical hands scrubbing with Betadine and rubbing with Sterillium respectively. Incompetent performed processes of surgical hands scrubbing with Betadine observed only among seven out of ninety eight surgeons and scrub nurses, compare with non in rubbing with Sterillium, this could be because observation of performed processes with Betadine preceding Sterillium, that could be attributed as pretest effect.

Results of the present study illustrate that most of surgeons and scrub nurses competently donning and doffing of sterile gowns and gloves after hands scrubbing with Betadine, as well, all of them competently donning and doffing of sterile gowns and gloves after hands rubbing with Sterillium.

Those results come in agreement with the finding of a study conducted by Byrd, Kavolus, Penrose, and Wellman, (2019), which found that most of participants performed the process of donning and doffing of sterile gowns and gloves after surgical hands scrubbing correctly. Although, less than half of scrub nurses had diploma of nursing and technical institute of nursing and less than two thirds of surgeons and scrub nurses have from one to less than five years of experience, otherwise, they do well in preparing surgical hands.

The current study reveals that Staphylococcus Species is counted on fifty four, eleven and eighteen surgeons' and scrub nurses'

hands in case of scrubbing with Betadine, compared with forty five, one and none of surgeons' and scrub nurses' hands in case of rubbing with Sterillium, after hands washing with soap and water and scrubbing or rubbing and after doffing gloves respectively. These results come in the same line with an Indian study by Deshmukh et al. (2021), who found that resident hands flora immediately decreased by use of Sterillium, containing 1-propanol 30%, the best effective Alcohol, and 2-propranol 45% (total 75%), Alcohol based hands rub resulted in a significant reduction in bacterial counts when compared along with traditional hands scrub methods.

In addition, an Iranian study carries by Zandiyeh and Roshanaei, (2015) shows that all alcoholic hands rubs significantly reduced the skin colony count immediately. Sterilium is considered best for hands antisepsis. As well a study carries in Taiwan by Shen et al. (2015) which compared an alcohol-based hands rub against a traditional 7.5% PVP-I scrub and fined those alcohol-based hands rub has a lower positive culture rate after operations, compared to the traditional scrub.

Results of the current study demonstrate bacteriological culture results for samples obtained from surgeons' and scrub nurses' wrinkles of both palms and under the nails using sterile swabs are almost two thirds have total positive growth of isolated bacteria after hands washing with soap and water, this percentage decline to less than one fifth after scrubbing with Betadine and turned to increase to reach more than one fourth after doffing gloves.

On the other side, the results of the current study declare bacteriological culture results for samples obtained from surgeons' and scrub nurses' wrinkles of both palms and under the nails using sterile swabs are almost half have total positive growth of isolated bacteria after hands washing with soap and water, this percentage decline to only two out of the total number after rubbing with Sterillium and none of them after doffing gloves. In supporting the current study results a review study conducts in Turkey by Gök, Kabu and Özbayir, (2016) state, most of the retrieved articles reported that Sterillium have more fact-acting effects, compared to Betadine.

In addition to, Noroozinia, Mahoori, Hassani and Behmagham, (2012) demonstrate that there is a significant difference between the effects of Betadine and Sterillium on the reduction of the microorganism growth of the surgical team members' hands and skin complications. As a result, they recommended Sterillium as a proper choice in situations when the time of starting the surgery is a vital issue.

Furthermore, in a study performed at the University of Sao Paulo, Brazil by Gonçalves, Graziano and Kawagoe, (2012) conclude that surgical hands antisepsis using alcohol preparations are effective and have benefits related to cost reduction, water saving, lower application time, lower skin damaging effects, and ecological gains.

Results of the current study indicate significant decrease in colony count on surgeons' and scrub nurses' hands in case of rubbing with Sterillium comparing to scrubbing with Betadine; which come in agreement with a study carries out in China by Feng et al. (2020), who found that the Sterillium is more effective in decreasing the count of bacteria on surgeons' hands than Betadine or other antiseptic solution.

Inconsistent with the results of the current study, Kameli et al. (2020) report that the microorganism reduction was higher in the Betadine group, compared to the Sterillium group after using these antiseptics. Since this study was conducted in the Intensive Care Unit (ICU), this discrepancy can be ascribed to the fact that the microorganisms presented in the ICU are different from those in the operating room.

This contradiction with another an Indian study by Ekka et al. (2016) conclude that there is a higher number of bacterial growth for Sterilium based hands preparations than the traditional betadine hands scrubs, the difference in the results may be due to the study design in which the number of individuals subjected to the study was only 9, also the use of highly concentrated iodine 10% for a longer time -5 minutes- while they used Sterilium for only 1.5 minutes.

6. Conclusion

It is concluded that; superiority of hands rubbing with Sterilium- over hands scrubbing with Betadine in the terms of; total positive growth, or no growth of isolated bacteria on surgeons' and scrub nurses' hands. As well there were statistically significant differences in colony count on surgeons' and scrub nurses' hands after hands washing with soap and water, after hands scrubbing/ rubbing, and after doffing gloves in case of scrubbing with Betadine or rubbing with Sterillium

7. Recommendations

On light of the study findings, the following recommendations are suggested:

- Assure continuous supply operating theater with Sterillium.

- Assure continuous supply scrubbing basins with soap and disposable towels.
- On job training programs to surgeon and scrub nurse about routine hand hygiene with soap and water before rubbing or scrubbing.
- On job training programs to surgeon and scrub nurse about donning and doffing personal protective equipment.
- Display signage illustrates detailed steps of rubbing and scrubbing and donning and doffing of personal protective equipment at operative theater.
- Further research on larger sample to confirm superiority of Sterillium on Betadine

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