



## Systematic Review

**Effectiveness of Surgical hand Washing with Chlorhexidine, Providone iodine and Alcohol on Reducing the Microorganisms on the Hands: A Systematic Review****Haris Widodo, Tiffany Gita Sesaria, M. Ruli Maulana and Nyein Moh Moh Myint**

Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia

**ABSTRACT**

**Background:** Postoperative infection is one of the causes of mortality and the hands of the surgical team are the most common cause. According to the *The Center for Disease Control and Prevention (CDC)*, proper hand washing can reduce the occurrence of nosocomial infections by up to 30%. The aim of this study is to determine the effectiveness of surgical hand washing using chlorhexidine, providone iodine and alcohol in reducing the microorganisms on the hand.

**Method:** The data was collected from the following electronic databases: Science Direct, Springer link, Scopus and ProQuest. The search obtained 11 articles in accordance with the inclusion criteria and we obtained the literature in full text form.

**Result:** The results of the study found three articles that mentioned hand washing with an alcohol hand rub as being more effective than iodine and chlorhexidine providone. There was one article described that both alcohol hand rub and chlorhexidine are more effective than iodine providone, Another article mentioned that chlorhexidine, providone iodine and alcohol hand rub were equally effective at reducing microorganisms contaminating the hand.

**Conclusion:** The conclusion of the study is that surgical hand washing using chlorhexidine, providone iodine and alcohol are all effective at reducing microorganisms.

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Gevi Melliya Sari

✉ [haris.widodo-2018@fkip.unair.ac.id](mailto:haris.widodo-2018@fkip.unair.ac.id)

✉ Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia

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**INTRODUCTION**

Healthcare-associated infection (HCAI) / nosocomial infection is an infection that occurs when the patient is in the hospital and it is caused by exposure to microorganisms during the delivery of health care services (Gaspar et al., 2018). This infection is a serious problem for hospitals because it can increase the morbidity and mortality rate of the patients and treatment may be a little bit difficult because of bacterial resistance to antibiotic drugs. One of the nosocomial infections is surgical site infection. This is one of the causes of mortality in patients after surgery. The most common cause is the hands of the surgical team (Abdollahi, Tabrizi, Jodati, Safaie, & Moradi-joo, 2017). Perioperative hand hygiene is one of the most critical factors affecting the risk of surgical site infection (SSI) as well as the safety of the medical

staff (Tsai, Lin, Huang, Loh, & Wen, 2016). The hands of the surgical team are known to be the most important source of micro-organisms from the skin during surgery (Ghorbani, Shahrokhi, Soltani, Molapour, & Shafikhani, 2012). Staff, when preparing for surgery, must decontaminate their hands prior to donning sterile gowns and gloves in order to significantly reduce the number of transient and resident micro-organisms on their hands. This is so then the microorganisms due to the skin flora are not transmitted to the patient during surgery. An effective way to reduce the number of micro-organisms is to undertake surgical hand scrub (Ghorbani et al., 2012).

A study conducted in 16 European countries identified that 20% of all notified healthcare-associated infections were related to surgical procedures (Gaspar et al., 2018). In the United States, 38% of all nosocomial infections were due to surgical

site infection (SSI). In Florida, SSI represented one-third of all cases of healthcare-associated infection (Gaspar et al., 2018). SSI in the United Kingdom was around 10% with a cost of up to 1 million pounds per year and length of stay increased to 7-10 days. WHO surveys showed that the incidence of SSI in the world ranged from 5% to 34%. Based on the data from the WHO, 40% of infections that occur in the health care setting can be prevented. Surgical hand wash preparation is recommended by both the Center for Disease Control and Prevention (CDC) and the WHO for preventing SSI in all kinds of surgical procedures. According to the CDC, proper hand washing can reduce the occurrence of nosocomial infections (HCAI) to 30% (Abdollahi et al., 2017). The application of surgical hand washing is recommended by the CDC and WHO to prevent SSI in all types of surgical procedure (Gaspar et al., 2018). There are several methods of surgical hand washing; there is dry-fast scrubbing and traditional water-based scrubbing (Chen, Chou, Huang, & Tang, 2014). Surgical hand washing can be done using 4% chlorhexidine, providone iodine and also 1% chlorhexidine gluconate and 61% ethyl alcohol. The purpose of this systematic review was to determine the effectiveness of surgical hand washing using chlorhexidine, providone iodine and alcohol on reducing microorganisms on the hands.

## MATERIALS AND METHODS

### Research Design

This study used a systematic review design, with a questioning search: "What is the effectiveness of a surgical hand washing using chlorhexidine, providone iodine and alcohol on reducing microorganisms on the hand?"

### Search Strategy

The PICOT framework was used in searching for articles that were in accordance with the theme of the systematic review. PICOT can be described as follows: Population - operating room staff; Intervention - the effectiveness of the use of chlorhexidine, providone iodine and alcohol in surgical scrubs; Control - ; Outcome - reducing organisms; Time: 2012 - 2018 using the keywords 'surgical scrubs', 'scrubbing' and 'microorganisms'.

### Inclusion and Exclusion Criteria

The inclusion criteria in this review were that they could be an experimental study and non-experimental study published from 2012 to 2018, where the participants were nurses and doctors, where the language used was English and where it focused on surgical hand washing before surgery. The exclusion criteria were studies that did not involve hand hygiene before surgery.

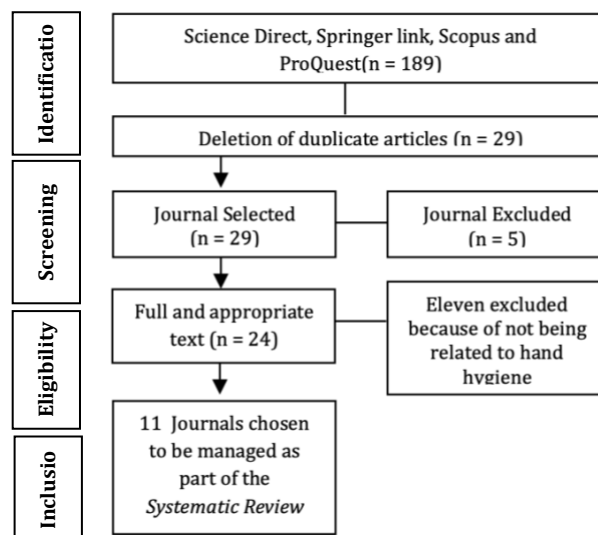


Figure 1. Literature Search Flow

### Article Searching Process

The searching of the articles was done using the keyword 'surgical scrubs', 'scrubbing' and 'microorganisms' in accordance with the PICOT method that was determined and we also used the Boolean logic search method on the Ebsco, Science Direct, Springer link, Scopus and ProQuest databases with a time limitation of 2012 - 2018. In the search process, 189 articles were found and 11 articles were in accordance with the inclusion criteria to be explored further. The complete explanation can be seen in Table 1.

## RESULTS

The *systematic review* obtained 11 selected articles originating from Brazil, Australia, Taiwan, Iran, the USA and Austria. The results of the systematic review and the scoring of all 11 articles have been attached to the existing Matrix in Table 2. It was found that 9 journals were of good quality and that two journals had moderate quality. The number of samples varied between 20 - 6344 respondents. The measuring instruments used in all of the studies included observation sheets, questionnaires and assessment sheets.

We have showed the results referring to the use of chlorhexidine, providone iodine and alcohol at reducing the microorganisms on the hands in Table 2.

## DISCUSSION

### Providone Iodine

Providone iodine is a material consisting of polyvinylpyrrolidone. It is an antimicrobial, and it leads to the iodination and oxidation of the molecular membrane and cytoplasm of an organism (Collection, 2003). In a study conducted by Edlich et al (1969), they examined a wound infected with staphylococcus aureus. The wound had providone iodine applied for 5 minutes followed by irrigation with normal saline. The infected wound showed improvement. The

Table 2. List of Articles About the Use of Chlorhexidine, Providone Iodine and Alcohol

Investigators, year, country study design	Antiseptic compared	Result
Gilberto et al, 2018, Brazil(Gaspar et al., 2018) Quasi-experimental Study	<ul style="list-style-type: none"> <li>• 2% Chlorhexidine</li> <li>• Alcohol</li> </ul>	Washing your hands with alcohol is more effective at reducing microbes and it takes a shorter time than 2% chlorhexidine
JD Howard et al, 2014, Australia(Howard, Jowett, Faoagali, & Mckenzie, 2014) Randomized controlled trials	<ul style="list-style-type: none"> <li>• 4% aqueous chlorhexidine</li> <li>• 70% isopropyl alcohol</li> </ul>	4% aqueous chlorhexidine is as effective as 70% isopropyl alcohol at reducing the microorganisms on the hands
N.-J. Shen et al.2013, Taiwan(Shen, Pan, Sheng, & Chen, 2015) Prospective observational study	<ul style="list-style-type: none"> <li>• 1% chlorhexidine gluconate and 61% ethyl alcohol</li> <li>• Gluconate 4% chlohexidine</li> </ul>	Wash with alcohol is more effective compared with chlorhexidine
Jui-Chen Tsai, RN, MSN et al, 2016, USA(Tsai et al., 2016) Randomized Controlled Trial	<ul style="list-style-type: none"> <li>• 4% chlorhexidine</li> <li>• 10% povidone-iodine</li> <li>• 1% chlorhexidine gluconate and 61% che Ebahwa thyl alcohol</li> </ul>	Conventional hand washing with chlorhexidine scrubs and a waterless hand rub more effective than providone iodine.
Fe chen Chiang, et al, 2012, Taiwan(Rn, Han, Rn, Chen, & Wei, 2012)	<ul style="list-style-type: none"> <li>• chlorhexidine</li> <li>• alcohol</li> </ul>	Waterless scrub hands (alcohol) are equally able to decrease microorganisms
Ghorbany A et al, 2012, Iran(Ghorbani et al., 2012) Prospective observational study	<ul style="list-style-type: none"> <li>• Alcohol</li> <li>• providone iodine</li> </ul>	Equally effective at reducing microorganisms
SH. Chen et al., 2014, Taiwan(Chen et al., 2014) Experimental study	1% chlorhexidine gluconate and 61% ethyl alcohol 7.5% povidone-iodine	There is no difference in the number of colonies generated with fast dry-scrubbing and a standard surgical scrub
Brad S, 2016, USA(Oriel, Chen, & Itani, 2016) Retrospective cohort study	<ul style="list-style-type: none"> <li>• Alcohol</li> </ul>	From the results of the research conducted, it showed that the alcohol-based rub does not cause surgical site infection
Hennig et al.2017, Germany(Hennig, Werner, Naujox, & Arndt, 2017) Comparative study	<ul style="list-style-type: none"> <li>• Alcohol hand rub (45% ethanol, 18% propanol and emollients) B. 1%</li> <li>• Surgical hand scrub (chlorhexidine gluconate, 61% ethanol and emollients)</li> </ul>	Hand washing with alcohol hand rub can reduce microbes more than using chlorhexidine gluconate, 61% ethanol and emollients
Suchomel et al.2018, Austria(Suchomel, Brillmann, Assadian, Ousey, & Presterl, 2018) Experimental study	Surgical glove coated with chlorhexidine gluconate	Surgical glove coated chlorhexidine gluconate can reduce hand flora for 3 hours
JY Kawagoe et al.2015(Kawagoe et al., 2015) Quasi-experimental Study	<ul style="list-style-type: none"> <li>• Traditional surgical hand scrubbing (TSHS)</li> <li>• Alcohol-based formulation (ABF) in</li> </ul>	Alcohol-based formulation (ABF) had excellent/good acceptance by the members of surgical team. It results in considerable savings in water and healthcare

effectiveness of providone and iodine is also studied by Andrson (1989) and another study also proved that it can kill pseudomonas bacteria (Hand, Weight, Lee, & Palmer, 2010). The use of iodine providone in hand washing is proven to reduce microorganisms but there is a need to use water a lot and it can cause irritation to the hands.

### Chlorhexidine Gluconate (CHG)

Chlorhexidine is one type of disinfectant and antiseptic solution. Chlorhexidine skin disinfectant is usually used to prepare for surgery. The CHG antiseptic could be more effective than iodine providone. It is active against Gram-positive organisms and Gram-negative react in facultative anaerobic and aerobic solutions, and yeast. It is

effective against Gram-positive bacteria (in a concentration of  $\geq 1$  g / l). The concentration was significantly higher (10 to more than 73 ug / ml) as required for bacteria and fungi that are Gram-negative. Chlorhexidine is ineffective against the polio virus and adenovirus. The use of CHG to wash hands is proven to reduce microorganisms but you have to use a lot of water which might increase the cost of water for the hospital. Moreover, it can irritate the hands.

### Alcohol Chlorhexidine

Alcohol chlorhexidine is a mixture of alcohol and chlorhexidine. This liquid is very effective at destroying microorganisms. By using this solution, the cost is relatively cheap and effective when used in surgical hand washing.

There are some limitations to this systematic review. There is no unique protocol for evaluating the journals homogeneously, but we observed differences in the sample dimensions, the procedures for recruiting / selecting the journals, and in the inclusion and exclusion criteria for the patients. The journal literature items that we have included in this systematic review are not considered to involve a difference in the time taken when hand washing as carried out by the participants.

### CONCLUSION

Surgical hand washing (scrubbing) is a procedure that must be performed prior to performing a surgical procedure to reduce the risk of surgical site infection (SSI). Especially in hospitals, the operating room needs to set the standard operating procedures (SOPs) in terms of the use of antiseptics for surgical hand washing (scrubbing). The standard of service is to serve as a reference for doctors and nurses in the operating room during surgical hand washing (scrubbing). SOP that heads in the right direction must have been referred to in the literature and in recent studies focusing on patient safety to prevent the occurrence of surgical site infection (SSI). Based on the results of the systematic review, it can be considered that the use of antiseptics is the most effective at meeting the SOP. There are three antiseptics that can be used to reduce the number of microorganisms on the hand. They are alcohol chlorhexidine, chlorhexidine and providone iodine. Through Systematic Review, the authors identified and compared the three antiseptics and which one was more effective to use. The third antiseptic, chlorhexidine alcohol, is the most effective in use and it should be considered because of how effective and efficient it is in terms of functionality and price. In addition to the use of alcohol hand rubs, it is proven to be effective. The time required for hand washing is not too long (2 minutes) and the cost is more affordable.

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