

Realization of surgical hand preparations using alcohol-based hand rubs in operating rooms

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Abstract <p>The aim of the thesis was to examine the current level of surgical hand preparation among scrub nurses and surgeons when using alcohol-based hand rubs in a central hospital in Finland. The study was carried out as an observation study in a selected central hospital in Finland. The authors of the thesis observed the time and the technique used in the surgical hand preparation. The required time for a sufficient surgical hand disinfection is from one to three minutes depending on the hand rub used. The criteria for the correct technique were based on WHO's six basic steps of hand disinfection.</p> <p>The authors observed the nurses' and surgeons' pre-surgical hand preparation performed with an alcohol-based hand rub. The time used for the observation was 50 hours. The observations took place in two operating units. Unit 2 has 8 operating theaters where elective and on call operations are performed. Unit 3 has 6 operating theaters and works as a day-surgery unit, which means the all of its operations are elective. During the observation period a total of 97 occasions were observed.</p> <p>The study showed that the average times spent on hand rubbing were mostly insufficient. When using Dilutus 90 both the surgeons and scrub nurses were able to reach the required time. When using other alcohol-based hand rubs, the average times with the surgeons and scrub nurses were insufficient. The times used for hand disinfection varied greatly. Roughly 2/3 of the scrub nurses had the correct technique for hand rubbing. Of the surgeons only 40 % had the correct technique. The most common reason for an insufficient hand disinfection was that the hand rub was not smeared as far as to the elbow.</p>		
Keywords Surgical hand preparation, hand rub, observation, hand hygiene, operating room		
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Tiivistelmä <p>Opinnäytetyön tarkoituksena oli selvittää kirurgisen käsihygienian nykytilanne leikkausosaston hoitajien ja kirurgien keskuudessa erään suomalaisen keskussairaalan leikkausosastoilla. Tutkimus suoritettiin havainnointitutkimuksen valitussa suomalaisessa keskussairaalaassa. Havainnoijat seurasivat kirurgiseen käsidesinfektioon kulunutta aikaa sekä käytettyä tekniikkaa. Kirurgiseen käsidesinfektioon käytettävä aika vaihtelee käsihuuhdemerkistä riippuen yhdestä minuutista kolmeen. Tekniikkaa tarkkailtiin WHO:n laatimien ohjeiden mukaisesti.</p> <p>Havainnoijat tarkkailivat leikkausosaston hoitajien ja kirurgien ennen leikkausta tapahtuvaa kirurgista käsidesinfektiota. Yhteensä havainnointiin käytettiin 50 tuntia. Havainnoiteja suoritettiin kahdella eri leikkausosastolla. Leikkausosastolla 2 on yhteensä 8 leikkaussalia, joissa leikataan sekä elektiivisiä- että päivystysleikkauksia. Leikkausosastolla 3 on yhteensä 6 leikkaussalia, joissa tehdään pääasiassa päiväkirurgisiatoimenpiteitä, joten kaikki leikkausosastolla tapahtuvat leikkaukset ovat elektiivisiä. Havainnointijakson aikana havainnointitapahtumia kertyi yhteensä 97.</p> <p>Tutkimus osoitti, että kirurgiseen käsidesinfektioon käytetyt ajat olivat suurimmaksi osaksi riittämättömiä. Käytettäessä Dilutus 90 –käsihuuhdetta leikkaussalin hoitajat sekä kirurgit saavuttivat suositusten mukaisen aikarajan. Muita alkoholipohjaisia käsihuhuhteita käytettäessä sekä hoitajien että kirurgien käsidesinfektioon käytetyt ajat olivat riittämättömiä. Käsidesinfektioon käytetyt ajat vaihtelivat suuresti. Leikkaussalinhoitajista karkeasti katsottuna 2/3 suoritti käsidesinfektion teknisesti oikein, kirurgeista vain noin 40 % ylsi samaan. Yleisin syy teknisesti epäonnistuneeseen käsidesinfektioon oli käsihuhuhteen riittämätön levitys kynärtaipeisiin saakka.</p>		
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1 Introduction and background

Health care-associated infections are the cause of death for over 1500 patients every year in Finland (Syrjälä & Laine 2010, 39). The most common way for health care-associated infections to spread is via hands as a contact infection. That is why correctly performed hand hygiene is the most important way to prevent health care-associated infections. (Syrjälä & Teirilä 2010, 165). An estimated 20-30 % of all health care-associated infections can be prevented (Kanerva 2010). According to the decree of Ministry of Social Affairs and Health (A 6.4.2011/341) every public health care provider has to have a plan of action for improving patient safety. The plan of action has to include amongst other things a plan for prevention of health care-associated infections.

Surgical site infections are one part of the health care-associated infections and it has been estimated that every fifth health care-associated infection is a surgical site infection (Rantala 2010, 204). Surgical site infections are the leading cause of health care-associated infections. They increase morbidity and the use of health care resources. They also have an impact into the patient safety. (Widmer, Rotter, Voss, Nthumba, Allerganzi, Boyce & Pittet 2010, 112) A prevalence study made in 2005 showed that 29 % of all health care-associated infections were surgical site infections. The data of the study was collected in Finnish hospitals including all university and central hospitals and 10 other acute hospitals. (Syrjälä & Laine 2010, 38)

The surgical team should be able to perform correctly the surgical hand preparation since well performed hand rub is an effective and important way to prevent surgical site infections (Carro, Camilleri, Traore, Badrikian, Logault, Azarnoush, Dualé, De Riberolles 2007, 62). In a study made in 2009 at Oulu University Hospital different practises in nursing care inside operating theatres were measured. In the study many different areas were covered such as availability of alcohol based hand rubs, amount of professionals and traffic in operation rooms and usage of gloves. Also the surgical hand preparation of surgeons and scrub nurses was observed; more specifically the technique and time used in hand rubbing. The study showed that the average time spent on hand rubbing amongst scrub nurses was 3,3 minutes and with surgeons 2,6

minutes. Even though the average time amongst scrub nurses was good, the variability in times was large from 1,5 minutes to 5 minutes. Observations were made from 92 surgeries or procedures. (Similä & Teirilä 2010, 83-84.)

This study aims to find out the current level of proper usage of alcohol-based hand rubs in surgical hand preparation with surgeon and scrub nurses in a Finnish central hospital's operating theatres. Study is implemented by observing scrub nurses and surgeons in surgical hand preparation.

The idea for this study came from the hygiene nurse of the operating rooms in a central hospital in Finland. The hygiene nurse had already made couple of minor studies concerning to hand hygiene but she wanted to have a wider study made of this subject. During these minor studies the hygiene nurse had noticed that there were some defects in the performing of the surgical hand hygiene among workers in surgery wards, especially in the time spent for hand rubbing before an operation. There was a need for this kind of study as there were not many previous studies done focusing on perioperative hand hygiene. The topic of this study raised interest among nurses and surgeons working in operating wards, and the study was seen as important and relevant. The study aims to show the current level of surgical hand preparation.

2 Surgical hand preparation

2.1 What is surgical hand hygiene/hand preparation?

The main aim of a surgical hand preparation is that the hand rub should decrease the amount of the bacteria from the skin of the hands of a surgical team. This reduction of the bacteria is necessary since the glove may puncture and then the bacteria from hands of for example a surgeon will get into the open wound. If the preoperative hand preparations are done correctly this could be prevented since the correctly performed hand rub will decrease the growth of the bacteria in hands. (WHO 2009, 54)

As normal hygienic hand wash or hand rub aims only to reduce the transient flora from hands, surgical hand preparation aims to eliminate the transient flora and to reduce resident skin flora from hands. Surgical hand preparation can be performed with medicated soap or with alcohol based hand rub. In this study the focus is on using alcohol based hand rubs. Surgical hand preparation is performed before a surgery. After the hand preparation sterile gowns and gloves are put on. (WHO 2009, 2)

2.2 Importance of hand hygiene

The microorganisms on skin can be divided in to two categories; resident or transient. Resident microflora is the normal flora on skin. It cannot be killed by disinfection, but the amount of growth can be reduced. Resident microorganisms are typically low on pathogenicity, and they are less likely to cause infections compared to transient flora. (Hoffman, Bradley & Ayliffe 2008, 49)

Transient microorganisms are colonized on the superficial layers of skin from the environment. Transient flora does not typically grow or multiply on skin, but it can survive long times. Transient microorganisms are responsible for most of the surgical site infections. These microorganisms can be easily removed by washing hands or using alcohol based hand rubs. (Hoffman et al. 2008, 49)

As health care professionals hands are the main transport for microorganism, efficient hand hygiene and disinfection is the most important measure on preventing surgical site infections (Hoffman et al. 2008, 49). Surgical hand disinfection means the removal or killing of transient microorganisms and suppressing the re-growth of resident microorganism on skin for the duration of the surgery. Glove punctures are common in surgeries, so maintaining a low level of bacteria on the hands of the surgical team is important. (Hoffman et al. 2008, 54)

According to WHO (2009, 54) after a surgery 18 % of sterile gloves have tiny punctures. Over 80 % of these cases are unnoticed. A punctured glove doubles the risk for surgical site infection. Using double gloves reduces the risk for punctures, but does not eliminate it. Studies have also shown that even

unused gloves cannot completely prevent bacterial contamination of hands. This is why the elimination and reducing bacterial flora in hands of surgical team is extremely important.

2.3 Use of alcohol-based hand rubs

Alcohol based hand rubs have the highest antimicrobial efficacy out of all surgical hand preparations. For surgical hand preparation only products that have passed the EU standard test EN 12791 or EN 1500 should be used. These two standards are comparable, but there are some differences in the ways these standards are tested. In EU 12791 the products are tested whether they meet the requirements of reducing the release of hand flora, and so are suitable to be used in surgical hand preparation. With EN 1500 the mean requirement is that hand flora release should not be inferior compared to the reference alcohol-based hand rub that contains isopropyl alcohol or isopropanol 60 % volume. With the high antimicrobial efficacy of alcohol-based hand rubs they are also low cost and well tolerated amongst health care workers. (WHO, 2009, 26, 56.)

Products used in the operating rooms, where the data was collected, are:

- Desinfektol G (Berner Oy), ethanol 70 %, required hand rub time 3 mins
- Avalon (Walki Medical Oy), ethanol 70 %, required hand rub time 3 mins
- LV (Berner Oy), ethanol 73,5 %, required hand rub time 3 mins
- Dilutus 90 (Berner Oy), ethanol 90 %, required hand rub time 1 min.

WHO (2009, 56) has created six basic steps for hygienic hand rub using alcohol-based hand rubs. (See Appendix 2.) The surgical hand preparation includes these six steps and additional steps for rubbing forearms. Hands must be completely dry before applying alcohol-based hand rub. First part of hand preparation includes rubbing hands and forearms, emphasizing rubbing of forearms. This phase will take approximately 1 minute. The second part focuses on rubbing hands according to the six steps of hygienic hand rub. Keeping hands wet from hand rub throughout the whole procedure is important, and the volume of hand rub needed varies according to the size of

hands. Approximately the needed amount of alcohol-based hand rub is 15ml. Studies have shown that the volume of rub used is not as important as keeping the skin area wet with rub during the whole hand rub procedure. The steps of hand rub should be performed as many times as needed applying more alcohol-based rub to keep hands wet, until the required time has passed (with this study 3 minutes or 1 minute, depending on the product used). After this hands should be left to dry completely before putting on sterile gowns or gloves.

According to WHO (2009, 57) the time needed for rubbing with alcohol-based hand rubs depend on the compounds that are used in the hand rub. Studies have shown that with the right technique surgical hand preparation with alcohol-based hand rubs require 3 minutes. New studies have outlined, that the same result can be met in 90 seconds with hand rubs containing a specific mixture of compounds, iso- and n-propanol and mecetronium estilsulfate. The manufacturers of products have outlined recommendations on the time that should be used.

3 Aim, Purpose and Research questions

The aim of this study was to find out the current level of proper usage of alcohol-based hand rubs in surgical hand preparation with surgeons and scrub nurses in a central hospital's operating theatres in Finland.

The purpose of this study was to find out the possible short comes in surgical hand hygiene and raise awareness of this topic. This way the surgical hand hygiene can be improved and possible hospital infections can be prevented since the proper hand hygiene is the best way to reduce hospital infections. (Rintala, Routamaa 2013, 1120-1121) If any short comes are met this study can be used as concrete evidence for improving surgical hand preparation with alcohol based hand rubs.

To find out the current level of surgical hand preparation with using alcohol-based hand rubs we used the following research questions;

- For how long are hands rubbed with alcohol-based hand rubs in surgical hand preparation?
- Is the hand rubbing technique used in surgical hand preparation according to WHO recommendations?

4 Implimentation

4.1 Observing

The research method used in this study was observing. Observing is not only seeing and noticing things or events but conscious observation of specific subjects. When using observation as a study method we are able to gather information how people really act and we do not have to rely on how people say they act. (Vilkka 2006, 37) Researchers are also able to get instant results of the participants' acts with observing (Hirsjärvi, Remes & Sajavaara 2013, 213).

In this study structured observation was used, meaning that the observed objectives were clearly set beforehand. The whole situation is clearly planned and familiar to observers before data gathering. (Vilkka 2006, 38) Structured observation concentrates on specific behaviors and typically recording the frequency of those behaviors. Observed categories should be narrow, having only one or two clearly defined types of objects observed. (Gillham 2008, 9,13) The scale used in data collecting is carefully selected or made to make observation easier and to enable fast and effective data recording. For the scale to be used properly the observers have to have thorough knowledge of the observed field. Structured observation is commonly used in quantitative studies. (Vilkka 2006 38, 39) Gillham (2008, 4) has pointed out that with structured observation the collected data is easy to summarize. Collected data is typically quantitative and superficial, and it has no linkage with social context.

The research method also followed surveillant observing, where observers do not participate in the activities but watch and observe the situation as outsiders. The goal is to learn and collect data by only watching. This method is used especially in quantitative researches, where the data can be measured. This observing is also structured and done in beforehand planned situations. The object that is observed also is set and clarified before the actual situation. (Vilkka 2008, 43.)

4.2 Data collecting

The study was carried out in a Finnish central hospital's selected operating theatres in operating units 2 and 3 during one week in August 2013. Operating unit 2 contains 8 operating rooms. The operations made in the operating unit 2 can be both elective and on call. The unit 2 is also an on call unit during weekdays from 3pm until 7am and during weekends and holidays 24 hours. The operating unit 3 has 6 operating rooms and it works mainly as a day surgery unit so all the operations are elective. The number of operations performed daily with both operating units varies a lot depending on what kinds of operations are planned.

The researchers were observing the study participants for 50 hours. The planned operations were not selected according to any specific field and did not influence or have any effect on the outcome of this study. The operations included both elective and on call operations even though most of the operations were elective. The participants in this study included scrubbing nurses and surgeons who performed surgical hand preparation before operation. Because the study was implemented as observational study there was no recruitment of participants and participants were not obligated to participate in the study any other way than performing their normal routines before operation. The study participants knew only that the researchers were observing hand hygiene. They did not know the specific area of hand hygiene the researchers were observing. If the study participants had known all the

details of the observation they could have changed their behavior and that could have affected into the study results.

The data was collected by observing the time and technique of surgical hand preparation using alcohol based hand rubs. Researchers clocked the time for how long hands were rubbed and marked the time on the observation form. (See appendix 1) Also researchers observed the technique used in hand rubbing, more specifically if all steps according to WHO recommendations were performed. Marking was done by yes or no, answering the question whether all the steps were performed. If the technique of hand rubbing did not meet the requirements set by WHO additional comments were also recorded on where there were short comes or the technique was lacking. Researchers were in the background and did not participate in the operations or preparations. Each researcher observed one study participant at a time which means that there were only two study participants observed at once.

All the collected data was gathered on observation form (see appendix 1). The form was based on WHO Patient safety campaign's "Observation Form – Basic Compliance Calculation" with some small modifications to meet the needs of this research. In the form all the opportunities for surgical hand preparation, time of rubbing and is the technique according to recommendations were marked. All the different professions were marked separately. The average times spent on hand rubbing were calculated on every surgery, on every profession and in all the opportunities together.

4.3 Data handling

The data was collected on observation form during the observation situations. Into the observation form the researchers marked the time and the technique of each hand rub performed. Timing started from the beginning of rubbing when hands touched after hand rub was applied. Timing was stopped when rubbing ended and hands were left to dry. With the technique the following points were observed;

- applying enough hand rub; hands should be wet throughout the rubbing

- all the steps set by WHO are performed. First rubbing is performed to forearms and after that on hands until the elbows. When rubbing hands the order of the steps is not observed, only the fact that all steps are performed is observed.

If the hand rubbing was done according to these points the technique was marked passed. If these points were not fulfilled the technique was marked as failed. If the technique was failed additional comments on why the hand rubbing did not meet the requirements were marked down.

After all the data was collected the average times on hand rubbing of different professions separately and combined were calculated. The highest and the lowest times were also marked separately. The percentage of successful hand rubbing technique was calculated, again combined and for every profession separately. When all the calculations were done results were formed in to diagrams. The combined data was analyzed on how the results meet the recommendations set by WHO, and if any short comes occurred they were analyzed more in depth on what kind of issues they are.

When data was analyzed and the final report of the study was finished all the paper forms and documents related to this study were destroyed by using a shredder.

5 Results

The total amount of observation in this study was 50 hours in five days. 20 hours were spent in operating unit 2 and 30 hours in operating unit 3. Altogether 97 hand disinfection opportunities were recorded; 57 opportunities for surgeons and 40 opportunities for scrub nurses. One surgeon did not perform hand rubbing using alcohol based hand rubs before surgery, and that is why this result was left out from calculations.

5.1 Average times

The average times were calculated for scrub nurses and surgeons separately. The results were also calculated separately for each operating unit.

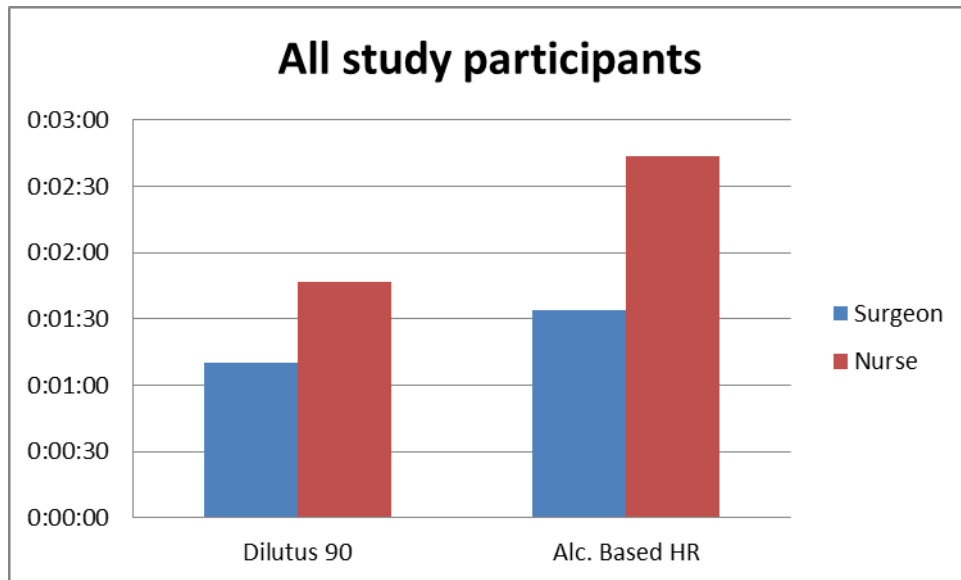


Figure 1. Average times of all study participants.

The average time for scrub nurses in hand rubbing using Dilutus 90 was 1:47. Times varied greatly; the lowest time spent for hand rubbing was 0:26 and the highest time were 2:34. For surgeons with using Dilutus 90 the average time was 1:10. Highest time was 2:55 and lowest was 0:11. With scrub nurses 87 % of all who used Dilutus 90 had the required time. For surgeons the percentage was 51 %.

With using alc. based hand rubs (HR) amongst nurses the average time was 2:44. Lowest recorded time was 0:31 and the highest 4:12. For surgeons the average times spent on hand rubbing was 1:34. Highest time was 3:13 and the lowest 0:35. Out of all opportunities with using alc. based HR 53 % of scrub nurses managed to reach the required time. 25 % of surgeons who used alc. based HR had the required time.

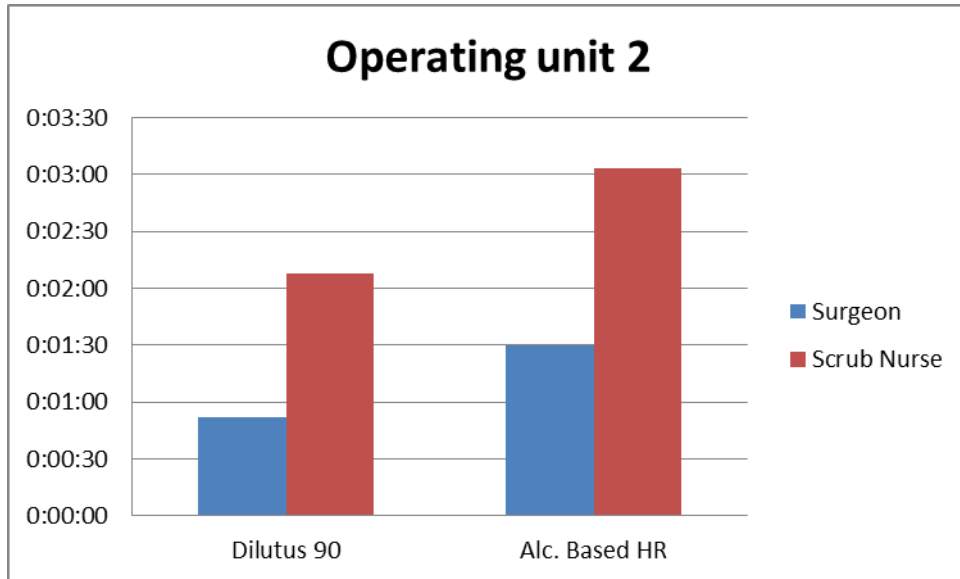


Figure 2. Average times in operating unit 2.

In operating unit 2 the scrub nurses who used Dilutus 90 had an average time of 2:08. Highest time was 2:34 and the lowest 1:38. With surgeons using the same product average was 0:52; highest time was 2:05 and lowest time 0:19.

Scrub nurses in operating unit 2 using alc. based HR had an average time of 3:04. Highest time was 4:16 and the lowest time was 1:19. For surgeons the average time was 1:30. The highest time was 3:05 and the lowest 0:35.

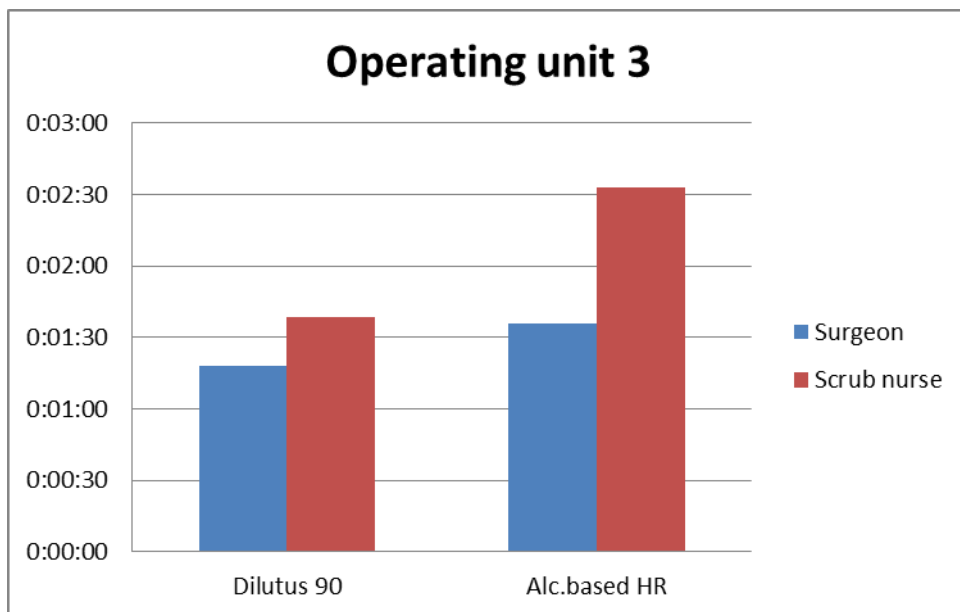


Figure 3. Average times in operating unit 3.

Scrub nurses using Dilutus 90 in operating unit 3 had an average of 1:39. Highest time was 2:54 and the lowest 0:26. For surgeons the average time was 1:18, highest time being 2:55 and the lowest 0:11.

In operating unit 3 using alc. based HR scrub nurses had the average time of 2:33. The highest time was 4:12 and the lowest 0:31. Surgeons had an average of 1:36. Highest time was 3:13 and lowest 0:35.

5.2 Technique

Also the technique used in pre-surgical hand disinfection was observed, more specifically if the technique was correct or not. The technique was based on the WHO's regulations for right technique for pre-surgical hand disinfection. The requirements of the correct technique were not fulfilled in most of the opportunities. In these cases the most common reason with both scrub nurses and surgeons was that the hand rub was not smeared until the elbows.

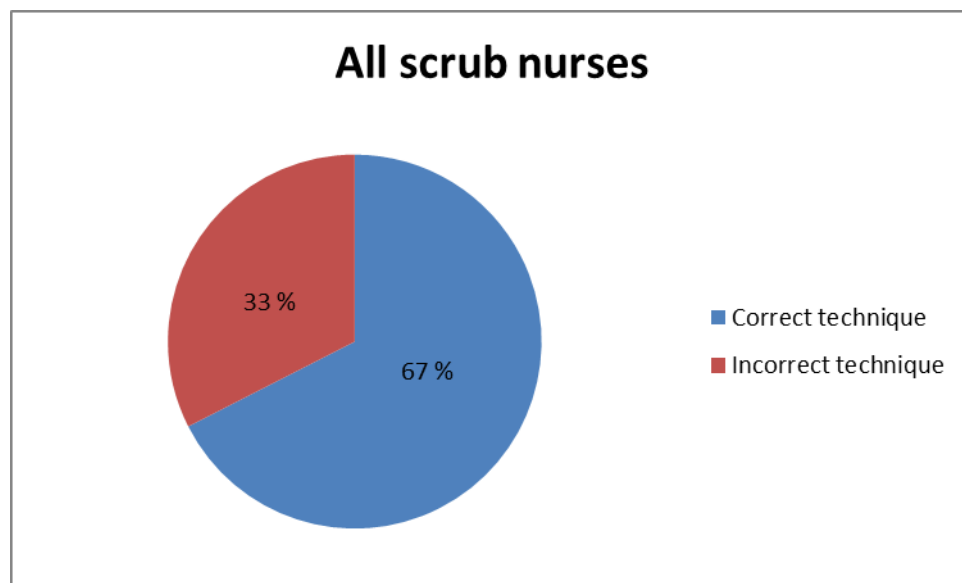


Figure 4. Technique of all scrub nurses.

Among the scrub nurses there were all together 40 opportunities. 27 scrub nurses performed surgical hand rub with a correct technique and 13 scrub nurses technique did not meet the criteria for correctly performed hand rub. The only reason for incorrect technique with scrub nurses was that the hand

rub was not smeared until elbows. Usually the smearing of the hand rub was stopped approximately 5cm before elbow.

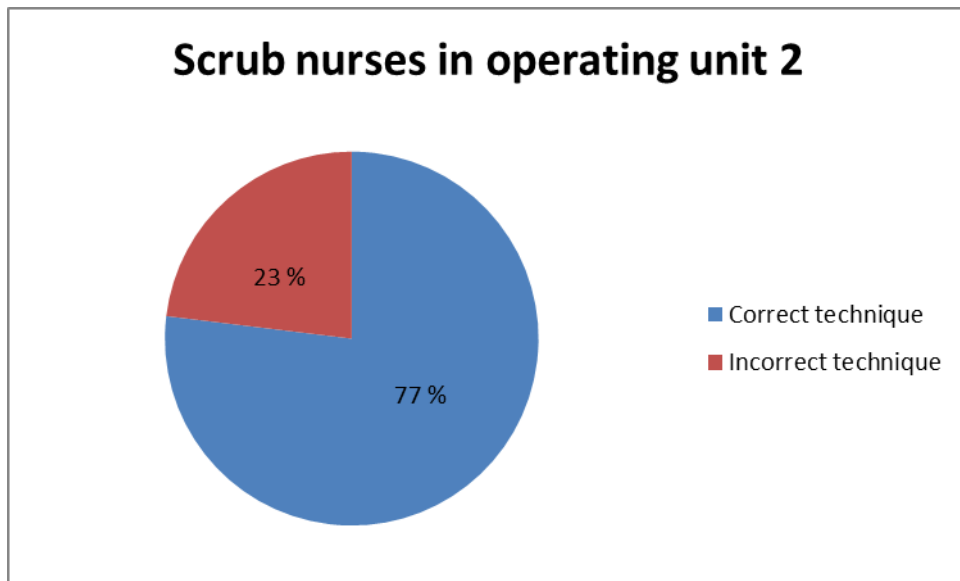


Figure 5. Technique of scrub nurses in operating unit 2.

In the operating unit 2 among nurses there were 13 opportunities. In 10 of these 13 opportunities the technique was correct. In three opportunities the technique was incorrect.

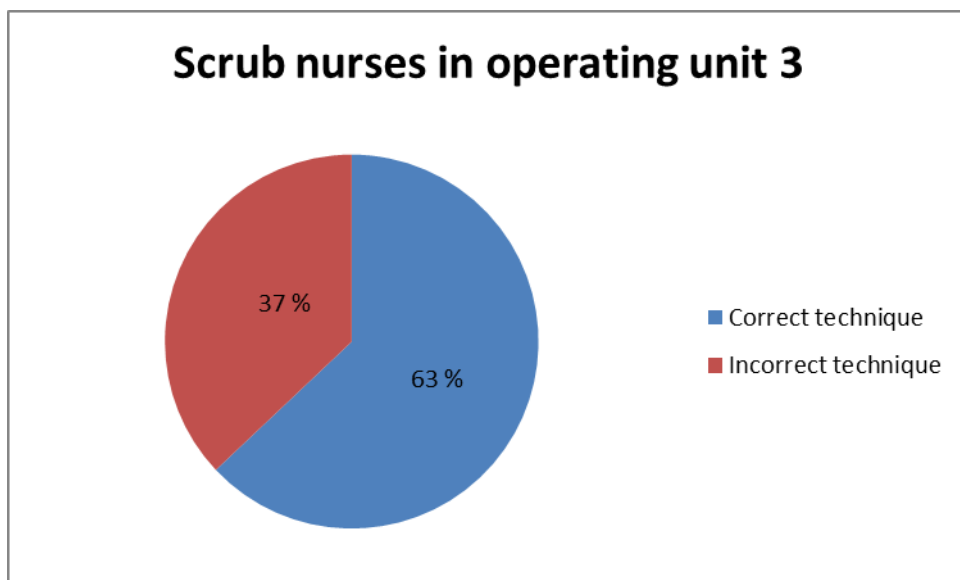


Figure 6. Technique of scrub nurses in operating unit 3.

In the operating unit 3 among scrub nurses there were all together 27 opportunities. In 17 of the 27 opportunities the technique was correct and in 10 opportunities the technique was incorrect.

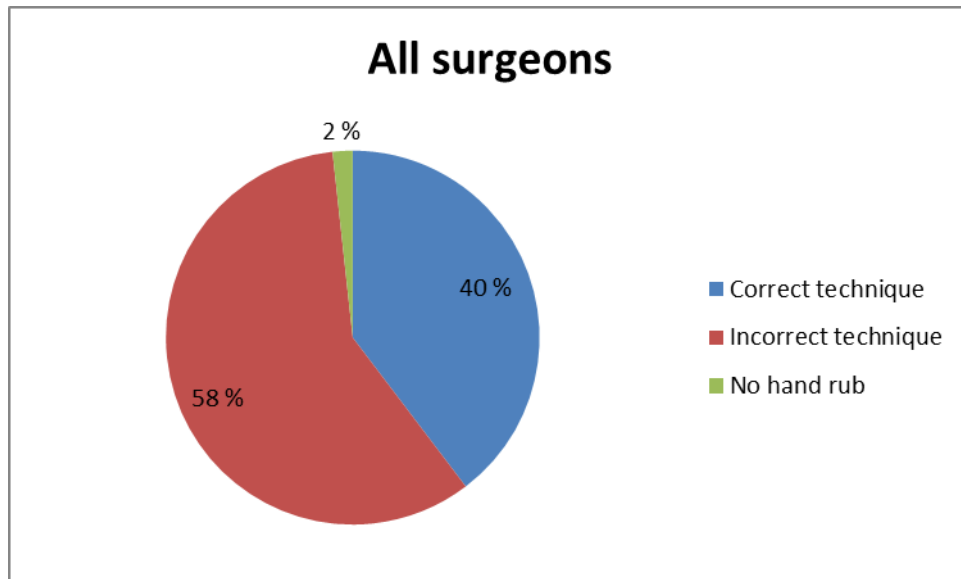


Figure 7. Technique of all surgeons.

Among surgeons there were all together 57 opportunities where the hand preparation was performed by using alcohol based hand rub. In 23 opportunities of 57 the technique was correct. The technique was incorrect with 34 opportunities. With surgeons the most common reason for incorrect technique was also the inadequate smearing of the hand rub. The hand rub was not smeared until the elbows. There were also minor reasons for incorrect technique for example drying hands with a paper towel before the hand rub has evaporated. There was also one surgeon who did not perform surgical hand preparation at all and this surgeon has been added into this chart so that the total amount of surgeons is 58.

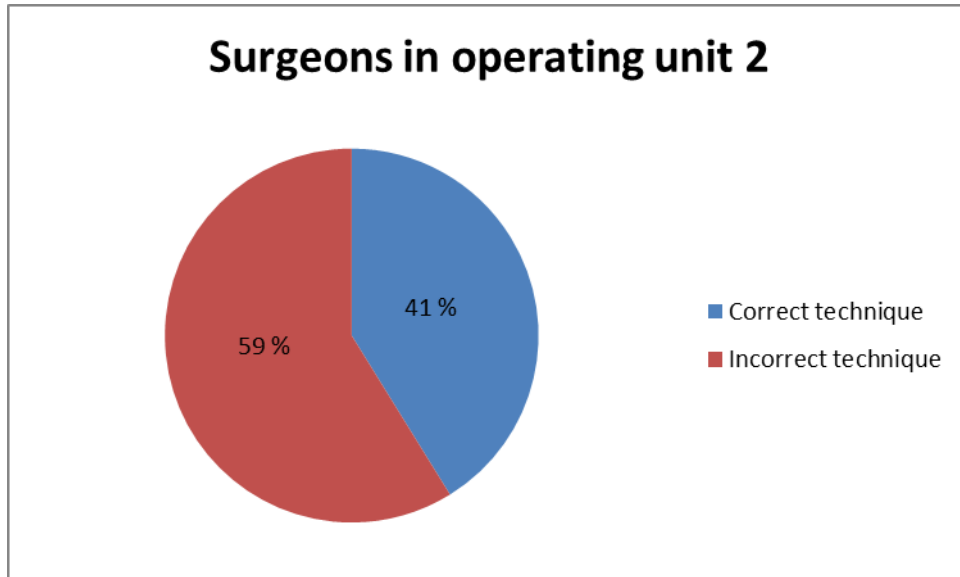


Figure 8. Technique of surgeons in operating unit 2.

In the operation unit 2 for surgeons there were all together 17 opportunities. In 7 opportunities the technique was correct and in 10 the technique was incorrect.

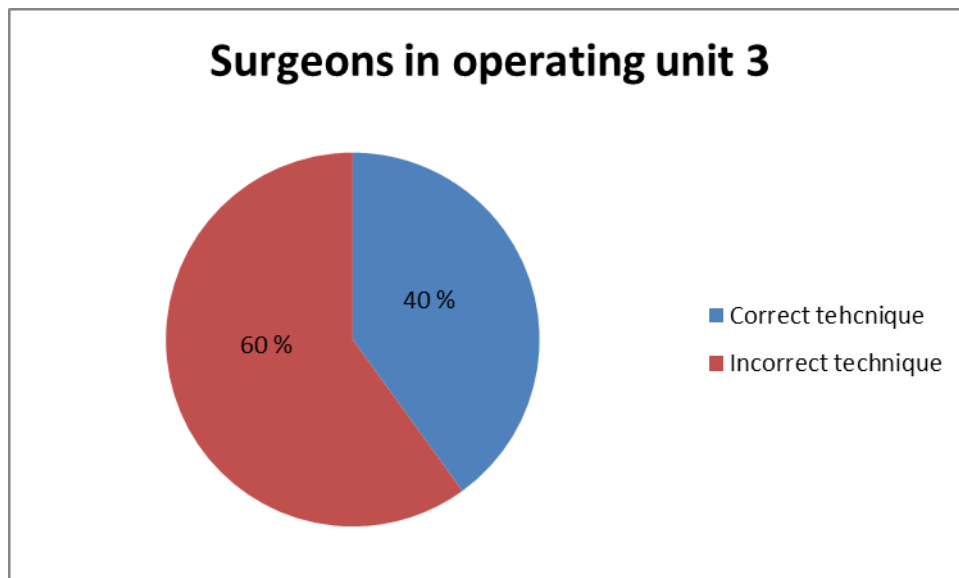


Figure 9. Technique of surgeons in operating unit 3.

In the operation unit 3 amongst surgeons there were 40 opportunities. In 16 opportunities the technique was correct and in 24 the technique did not meet the criteria of the correct hand disinfection.

6 Reliability

With observations there are always risks for diminished validity or reliability. If the participants are aware of the observation they can change their behavior and change the outcome of the study. This way the results would not be correct and reliable. Also the lack of knowledge of observers can reduce the reliability of the study. Systematic observing and careful data recording can increase the reliability. (Guthrie, 2010, 110) Even with longer periods of observation the results can vary greatly. Observing can only show the short section of the whole truth, and it would require extended studies to be absolutely sure about the results. (Gillham, 2008, 14)

There were no misunderstanding situations with the form because the form itself was very simple and clear. Both researchers had also a good understanding how to perform the observation. Researchers had also made a test observation before the actual observation to see how the observation form works in real situations and to see that both researchers had the same idea and understanding from the observation. During the test observation researchers did not come up with any shortcomings with the observation form. If there had been any shortcomings or problems with the observation form researchers would have corrected them immediately and made the needed changes into the observation form. Researchers also had identical idea and understanding how to perform the observation.

There were some things that may have had an effect to the results of the observation. Especially with the first operations of the day the starting times of operation were almost the same. This meant that there were hand rub opportunities for different surgeries going on at the same time, and with only two observers this may have reduced the total amount of opportunities recorded. In the operating wards the hand rub was available both outside and inside operating theaters. Some nurses and surgeons preformed the hand rubbing outside the theater, while others preformed it inside the theater. Some started the hand rubbing outside, but entered the theater and continued it inside. If the hand rubbing was done inside the theater, observers were easy to miss the starting point of hand rubbing because they were observing from

outside of theaters. Nurses suggested, that observing could be done also inside the theaters, but this way it would have been difficult to observe many theaters and hand rubbings done in other surgeries at the same time. All theaters had small windows on the doors so observers were able to see inside the theaters and observe from outside.

One problem with clocking the times of hand rubbing occurred, when some nurses and surgeons stopped the rubbing for a few seconds, and continued again. This made it difficult to determine when the hand rubbing was actually stopped. The researchers decided to stop the timing when the surgeon or scrub nurse had been 3 seconds without rubbing his/her hands.

The most common fact that resulted to incorrect technique in hand rubbing was that hand rubbing was not preformed up to elbows, but only to some length of forearm. Otherwise mostly the other criteria for successful technique were met.

A point that observers noticed outside from the topic of this study, was that after hand rubbing was preformed some did not let hands to dry before dressing on sterile gowns and gloves. Some dried the excessive hand rub off with a sterile paper towel or started putting on the sterile gown while hands were still wet from hand rub.

Overall nurses and doctors were interested about the study and its outcomes. The topic was seen as important area of study, and this area needs to be researched more.

7 Discussions

Observation study was made in a central hospital's two operating units in Finland. Surgical hand preparation was observed for all together for 50 hours; 20 hours in operating unit 2 and 30 hours in operating unit 3. Observers recoded the time spent on surgical hand rub using alcohol based hand rubs and whether the technique used was correct. Total of 97 opportunities were observed. Overall the times spent on hand rubbing using Dilutus 90 were good, but with other alcohol based hand rubs average times were inadequate

amongst surgeons and scrub nurses. Even though nurses had higher average time with using other alcohol based hand rubs, it still was under the required time. Highest and lowest times varied greatly. In operating unit 2 scrub nurses managed to have required average times with both Dilutus 90 and other alcohol based hand rubs.

For scrub nurses roughly 2/3 had the right technique for surgical hand rubbing. Operating unit 2 had slightly better percentage of successful techniques. Amongst surgeons 40 % had the correct technique. There were no great variations between the two operating units. The factor that led to most of incorrect techniques was that hand disinfection was not preformed up to elbows, which is one of the main criteria for successful surgical hand disinfection. This problem was seen with both scrub nurses and surgeons. Otherwise the hand disinfections were mostly correct.

One factor that can contribute in the incorrect techniques and insufficient times used in hand rub can be the lack of knowledge about correct hand rubbing guidelines. Swenne and Alexandrén (2012) showed in their study about surgical teams' knowledge and compliance with hand hygiene that some areas need improvement. The study was conducted in intraoperative field and carried out as an observation and questionnaire. The questionnaire aimed to find out the attitudes and knowledge about hand hygiene amongst surgical team members. Study showed that the majority of respondents had received lectures or other information about basic hand hygiene, which had improved their attitudes towards hand hygiene. 7 % felt they already had all needed information concerning hand hygiene and did not need any further information or lectures.

With their study Swenne and Alexandrén were able to show that surgical team members' knowledge about hand hygiene was incomplete and implementation of hand hygiene needs to improve. Nurses and doctors attitudes and knowledge about surgical hand preparation should be researched more so it could be measured if further education about hand rubbing is needed. This area has not been studied much even though it would be important to know the nurses' level of knowledge before an observational study.

Our study shows that there are still some needs of improvements on the performing of surgical hand disinfection. Especially performing the surgical hand rub up to elbows and spending the needed time are areas of improvement. For further research this study could be implemented on larger sampling. This study is only indicative of the current situation in this Finnish central hospital's operating units 2 and 3.

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Appendices

Appendix 1. Observation form – Basic Compliance Calculation

Observation Form – Basic Compliance Calculation

Session N°	Facility:			Period:			Setting:			Total per session					
	Prof.cat. Surgeon			Prof.cat. Scrub Nurse			Prof.cat. Surgeon (2)			Prof.cat. Scrub nurse (2)					
	Opp (n)	Tech. (Y/N)	HR (time)	Opp (n)	Tech. (Y/N)	HR (time)	Opp (n)	Tech. (Y/N)	HR (time)	Opp (n)	Tech. (Y/N)	HR (time)			
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
Total															
Calculation	HR (time) =			HR (time) =			HR (time) =			HR (time) =			HR (time) =		
	Opp (n) =			Opp (n) =			Opp (n) =			Opp (n) =			Opp (n) =		
Compliance															

$$\text{Compliance (\%)} = \frac{\text{Actions}}{\text{Opportunities}} \times 100$$

WHO (World Health Organization). 2013. Clean Care is Safer Care. Observation Form- Basic Compliance Calculation. Referred 10.5.2013 <http://who.int/gpsc/5may/tools/en/>

Appendix 2. WHO's six basic steps of hand disinfection

The handrubbing technique for surgical hand preparation must be performed on perfectly clean, dry hands. On arrival in the operating theatre and after having donned theatre clothing (cap/hat/bonnet and mask), hands must be washed with soap and water. After the operation when removing gloves, hands must be rubbed with an alcohol-based formulation or washed with soap and water if any residual talc or biological fluids are present (e.g. the glove is punctured).

Surgical procedures may be carried out one after the other without the need for handwashing, provided that the handrubbing technique for surgical hand preparation is followed (Images 1 to 17).



1
Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the dispenser



2
Dip the fingertips of your right hand in the handrub to decontaminate under the nails (5 seconds)



3
Images 3–7: Smear the handrub on the right forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)



4
See legend for Image 3



5
See legend for Image 3



6
See legend for Image 3



7
See legend for Image 3



8
Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your right hand, using the elbow of your other arm to operate the dispenser



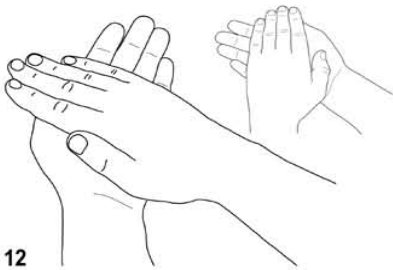
9
Dip the fingertips of your left hand in the handrub to decontaminate under the nails (5 seconds)



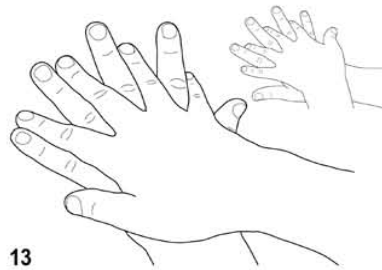
10
Smear the handrub on the left forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10-15 seconds)



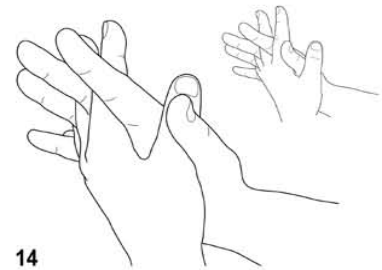
11
Put approximately 5ml (3 doses) of alcohol-based handrub in the palm of your left hand, using the elbow of your other arm to operate the distributor. Rub both hands at the same time up to the wrists, and ensure that all the steps represented in Images 12-17 are followed (20-30 seconds)



12
Cover the whole surface of the hands up to the wrist with alcohol-based handrub, rubbing palm against palm with a rotating movement



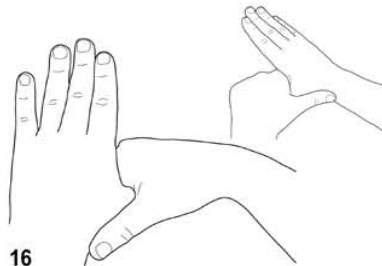
13
Rub the back of the left hand, including the wrist, moving the right palm back and forth, and vice-versa



14
Rub palm against palm back and forth with fingers interlinked



15
Rub the back of the fingers by holding them in the palm of the other hand with a sideways back and forth movement



16
Rub the thumb of the left hand by rotating it in the clasped palm of the right hand and vice versa



17
When the hands are dry, sterile surgical clothing and gloves can be donned

Repeat the above-illustrated sequence (average duration, 60 sec) according to the number of times corresponding to the total duration recommended by the manufacturer for surgical hand preparation with an alcohol-based handrub.