Which micro-organisms are transferred by healthcare personnel between hospital and home?

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Abstract

Background: The aim of ths study was to determine which micro-organisms are transferred from home to hospital, and which from hospital to home, by the hands of healthcare personnel.

Methods: A total of 10 doctors and 53 nurses, selected at random according to the clinics where they worked, were included. The study data were collected in two stages. In the first stage, the study participants completed a personal information form. In the second stage, samples were taken from the right and left hands of the healthcare personnel on entering and leaving the hospital.

Results: According to the samples taken, there was determined to be greater bacteria production on the hands of the healthcare personnel when entering the hospital. The greatest production was in the least washed area of the right hand (93.7% on entry, 74.6% on exit). Nurses and those working in surgical clinics were seen to have greater bacteria production on both entry to and exit from the hospital compared to other healthcare workers.

Conculusion: The study results showed that just as healthcare personnel transferred some micro-organisms from home to hospital on their hands, they also transferred some bacteria to home on leaving the hospital. With the necessary precautions taken to prevent the transfer of micro-organisms to or from hospital, the prevalence of hospital infections will decrease.

Introduction

Hospital infections, which were initailly attributed to acute care treatment, are now accepted as infections that develop related to the time spent in the environment where treatment is received (1). Infections originating from healthcare services not only increase healthcare costs, but also constitute a significant risk factor for morbidity and mortality (2,3). Hands are the most important mediator in the spread of hospital infections, are the body part most used by healthcare personnel in contact with patients, and are the primary pathway of spread for micro-organisms (4). Several studies in literature have reported that the hands of healthcare workers are the most important source of the spread of micro-organisms causing infection (5–7).

According to those previous studies, hand hygiene is the most important practice in the prevention of hospital infections. Therefore, when not bound to hand hygiene, the quality and safety of the care provided is impaired (8). Hand hygiene achieved with effective and correct hand washing or hand disinfection, is the most important practice to break this chain of transmission. The importance of this simple procedure is not sufficiently known by healthcare personnel, and there is extremely weak compliance among healthcare personnel (6,9).

However, healthcare professionals have been referred to a series of standards and training to take the necessary precautions in order to prevent hospital infections. Despite hand hygiene applications, the prevalence of hospital infection is still extremely high. In this context, healthcare personnel transfer and

spread several micro-organisms on their hands, but there are no studies in literature on this subject. The aim of this study was to determine which micro-organisms are transferred between home and hospital on the hands of healthcare personnel and the antibiotic resistance of these.

Methods

This descriptive cross-sectional study was conducted in a tertiary level public hospital between April and June 2019. Approval for the study was granted by the hospital Ethics Committee.

Participants

The research universe comprised doctors and nurses working in direct contact with patients in the relevant hospital. A total of 500 doctors and 550 nurses work in the hospital. The study sample was determined according to the units where the healthcare personnel worked. A total of 63 subjects were included, comprising 10 doctors and 53 nurses, as at least 2 nurses from each unit and at least 1 doctor from each branch. The study was conducted in 2 stages. In the first stage, the 63 healthcare personnel each completed a personal information form, including sociodemographic characteristics, hand hygiene habits, and informed consent to provide samples. In the second stage of the study, samples were taken from the hands of the healthcare personnel on entering the hospital (0800 hrs) and when leaving (1700 hrs). The participants were not aware of the days on which samples would be taken.

The clinics in which the doctors and nurses worked are shown in Table 1.

Obtaining The Samples

Samples were taken from two areas of both hands; the right and left fingertips (most frequently missed/least washed) and the right and left palms (less frequently missed/most washed) (Figure 1). The samples from the healthcare personnel who had completed and returned the personal information form were taken in front of the hospital staff entrance. Samples taken on leaving the hospital were taken on the hospital side of the staff exit. The study subjects were not informed about which days and times the samples would be taken.

Sterile swabs were moistened with sterile saline, then a total of 8 samples were taken (on entry to and exit from the hospital) from the two areas of both hands as the most frequently missed area and the less frequently missed area. The samples were taken to the microbiology laboratory, seeded in sheep blood agar and ENDO agar media, then incubated for 24 hours at 37°C. Following incubation, the colony morphology of gram positive isolates was examined, and identification was made with the application of gram staining, catalase, tube coagulase, and oxacillin tests. The bacteria identification and antibiotic sensitivity was determined using a BD Phoenix 100 automated system (Becton-Dickinson, USA). Anerobic and fungal cultures of the samples were not applied.

The regions of the samples that were isolated (Figure 1)

Statistical Analysis

Data obtained in the study were analyzed statistically using SPSS vn. 25.0 software. Data were prsented as number (n) and percentage (%) and were compared with the Chi-square test. Results were presented in a 95% CI. A value of $p<0.05$ was accepted as statistically significant.

Results

The sociodemographic characteristics of the healthcare personnel in the study are shown in Table 2.

The study sample of healthcare personnel comprised 68.3% females, with a mean age of 29.3±7.3 years, 46% were university graduates, and 12.7% were specialist physicians. The mean duration in the profession was 5.84±4.4 years. Of the total sample, 76.2% stated that they kept their nails short, 85.7% did not wear a ring, and 42.9% used 11-20 pairs of gloves per day. The most preferred method of hand washing was with soap and water at the rate of 85.7%, and hand disinfectant was used regularly by 82.5%. Of the total sample, 31.7% reported excessively frequent patient contact (51-100 times per day), 84.1% stated that they complied with hand hygiene, 52.4% used a special hand application (eg, hand cream), and 46% stated that they washed their hands 11-20 times per day. The rates of those who had not had an infection and used antibiotics in the last 2 weeks were 85.7% and 88.9%, respectively.

The greatest region of bacteria production on entry to the hospital was the right hand least washed region (93.7%) and on exit from the hospital was also determined as the right hand least washed area (74.6%). In the samples taken on entering the hospital, the production rate was 92.7% in the most washed region of the right hand, 90.5% in the most washed region of the left hand, and 87.3% in the least washed region of the left hand.

The production rates were determined to be lower in the samples taken on leaving the hospital; 74.6% in the least washed region and 68.3% in the most washed region of the right hand, and 57.1% in the most washed region and 26% in the least washed region of the left hand (Figure 2).

The production percentages of the right and left hand regions on entering and leaving the hospital were compared and the data are shown in Table 3.

When the bacterial production on the hands of the healthcare personnel were compared on entering and leaving the hospital, production was found at a higher rate on entering the hospital, with a statistically significant difference determined especially in the left hand in both the least and most washed regions ($p=0.041$, $p=0.028$) (Table 3). Bacterial production was determined in the right hand most washed region in 58 subjects entering the hospital and in 43 when leaving, in the right hand least washed region in 59 on entering and in 47 on leaving, in the left hand most washed region in 57 on entering and in 46 on leaving, and in the left hand least washed region in 55 on entering and in 46 on leaving.

The hand regions from which the bacteria were isolated on entering and leaving the hospital are shown in Table 4.

The bacteria produced from the samples on entering and leaving the hospital were seen to be mostly MSSE and micrococcus, which are flora bacteria of the hand. Other than these, on entering the hospital, staphylococcus was determined on the most washed region of the left hand, streptococcus on the most and least washed regions of the left hand, bacillus strains on the most washed region of the left hand, and MRSE on the least washed region of the left and right hands. On leaving the hospital, staphylococcus was determined on the least washed region of the right hand, streptococcus strains on the least washed region of the left hand, and MRSE on the least washed region of the right hand.

When bacterial production was compared according to occupation, although there was no significant difference, greater production was determined in the nurses on both entering and leaving the hospital. In the comparisons of bacterial production according to the clinics where the study subjects worked, there was determined to be more production in the least washed region of the left hands of those working in surgical clinics on entering and leaving the hospital (p=0.001). No other significant difference was determined. The bacteria produced are shown in Table 5.

The bacteria produced from the samples taken on entering and leaving the hospital are shown according to occupation and clinics in Table 5.

On entering the hospital, *MSSE, micrococcus, streptococcus strains, staphylococcus strains and MRSE* were the bacteria most isolated from the hands of nurses and those working in surgical clinics. Unlike the nurses, the bacteria most produced from the samples taken from doctors were *Neisseria animaloris, Moraxella species, and Alcaligenes faecalis.*

On leaving the hospital, *MSSE, micrococcus, staphylococcus strains and MRSE* were isolated from the hands of nurses and those working in surgical clinics, and bacillus strains from the hands of doctors working in internal clinics. *Kytococcus sedantarius* was isolated from nurses in internal clinics.

The antibiotic sensitivity of the bacteria produced from the samples taken from the hands of the healthcare personnel on entering and leaving the hospital are shown in Table 6.

The antibiotics to which the bacteria isolated from nurses and those working in internal clinics on entering the hospital were most sensitive were amikacin, azteronem, ciprofloxacin, daptomycin, gentamicin, levoflaxocin, linezolid, teicoplanin, trimetoprimsulfamethoxazole, and vancomycin, and of those in internal clinics on leaving the hospital, amikacin, daptomycin, linezolid, teicoplanin, trimetoprim/sulfamethoxazole, and vancomycin.

The antibiotics to which the bacteria isolated from nurses working in surgical clinics on entering the hospital were most sensitive were amikacin, ciprofloxacin, daptomycin, fosfomycin gentamicin

levoflaxocin, teicoplanin, linezolid teicoplanin tetracycline, tigecycline, trimetoprim/sulfamethoxazole, and vancomycin, and on leaving the hospital, ciprofloxacin, daptomycin, gentamicin levoflaxocin, linezolid, teicoplanin, trimetoprim/sulfamethoxazole, and vancomycin (Table 6).

Discussion

The contaminated hands of healthcare workers play an important role in the transmission of hospital infections and are a potential source of infections related to healthcare services (10). This study results showed that on entry to the hospital, there was production at the rate of 93.7% in the least washed region of the right hand, and this rate fell to 74.6% on leaving the hospital. The increase in bacteria production on entering the hospitl could be due to the hands having been in contact with surfaces where bacteria can remain for a long time such as on public transport or using their own car to come to the hospital, on personal possessions or on the hospital doors.

Correspondingly, the lower rate on leaving the hospital could be due to having washed the hands before leaving the clinic and having less contact with contaminated surfaces on the way out of the hospital. Other factors lowering this rate include the healthcare personnel complying with hand hygiene throughout the day and the use of gloves. In a previous study, it was determined that the majority of healthcare personnel washed ther hands more after patient care (11). A multi-centre study conducted in dialysis units in Spain found the rates of compliance with hand hygiene to be 13.8% before contact with a patient and 35.6% after patient contact(12).

In the current study, the area of greatest bacteria production on entering and leaving the hospital was found to be the least washed region of the right hand (93.7%, 74.6%, respectively). That production was greater on the right hand could be because the right hand is used more, and that it was in the least washed region of the hand could be associated with ineffective hand washing. In addition, when the bacterial production on the hands was compared on entering and leaving the hospital, the production rate on entering the hospital was determined to be statistically significantly higher, especially than the areas of the left hand, both those which are washed less and more frequently ($p=0.041$, $p=0.028$, respectively). Approximately 10% of people worldwide have left hand dominance, and the remainder are known to predominantly use the right hand (13). Therefore, these findings may have been due to the greater use of the right hand. Similarly in a study in 2001 in Argentina, two groups of healthcare personnel were compared as Group A who did not wash their hands before physical examination of a patient, and Group B who washed their hands before the examination. A statistically significantly higher number of CFU were determined in Group A ($p<0.001$) (14). However, with the recent determination of occupational carriers of hospital infections, there has been an increase in compliance with hand hygiene in different occupational groups (15).

In the current study, colonisation of the hands of the healthcare personnel with gram positive bacteria was found to be higher than with gram negative bacteria. Some previous studies have also reported colonisation of the hands of healthcare personnel with gram positive bacteria. Sepehri et al.

(2009) showed bacterial contamination in approximately 40% of healthcare personnel, the majority with *S. epidermidis,* and in 6% the contamination was with nosocomial pathogens(16). Paul et al. (2011) also reported a higher rate of gram positive contamination (15). In contrast to the current study, there are also studies in literature that have found a higher rate of gram negative colonisation (17,18).

In the current study, in all the hand regions from which samples were taken on both entering and leaving the hospital, the bacteria strains showing the most production were methicillin sensitive *Staphylococcus epidermidis* (MSSE), which is accepted as flora bacteria of the skin, followed by micrococcus and other coagulase negative staphylococcus strains. *Staphylococcus epidermidis* and other coagulase negative staphylococci (CNS) are accepted as the primary bacterial colonisers of the skin (19). These bacteria are not accepted as a pathogen in healthy skin, but may cause infection in a sterile body cavity, the eyes, or unhealthy skin (20). In various studies, the bacteria most isolated from the hands have been single or multiple members of established flora, as in the current study (16,21,22).

In the current study, MRSE was determined in the least washed region of the right and left hands on entering the hospital and on the right hand when leaving. All the MRSE were isolated from the hands of nurses (7.14%), and of these nurses, 19.8% worked in surgical units, and 4.21% in internal medicine units. This finding can be attributed to nurses having more contact with patients throughout the day than doctors do, and that there are moore procedures in surgical units that require contact. However, that there was greater production of MRSE in the least washed regions of the hands shows that the hands had not been washed effectively.

As CNS are normally found in human skin and mucosa membranes, they have been rejected as culture contaminants for a long time, but it is now accepted that CNS may have a potentially important role as pathogens and incidence is increasing (23). Resistant *S. epidermidis*, is the main one of these organisms in infection (24). Previous studies have reported oxacillin resistance rates of 26%-79% in CNS on the hands of nurses (25,26) and higher rates in those with direct and frequent contact with patients (27,28).

In the current study, staphylococcus strains were produced more from the most washed region of the left hand on entry to the hospital, and from the least washed region of the right hand when leaving the hospital (Table 4). This rate of production from the samples on entering the hospital was found to be higher in the 16 personnel who worked in surgical units and among nurses (24 nurses). On leaving the hospital this rate was determined to be higher, again in surgical units than the rate on entering the hospital (n:22) and in nurses compared to doctors (23 nurses). Staphyococcus was isolated from the hands of 14 healthcare personnel in internal medicine units on entry to the hospital, and in 4 on leaving (Table 5). This could have been high because there is more patient contact in surgical units (emergency interventions, invasive interventions, care, treatment, etc) and it could also be that the nurses in internal medicine units washed their hands more effectively than the surgical unit nurses.

Streptococcus was produced most from the least washed region of the left hand on both entering and leaving the hospital (Table 4). This production was determined to be higher in those working in surgical units (n:22) and among nurses (30 nurses). On leaving the hospital the rate was equal in internal

medicine and surgical units (n:4) and was again determined to be highest among nurses (6 nurses) (Table 5).

Bacillus strains were produced most in the most washed region of the left hand on entering the hospital and in the least washed region of the right hand on leaving (Table 4). All the bacillus strains were from the hands of those working in internal medicine units both on entering (n:7) and leaving (n:5) the hospital. The bacillus strains were isolated from the hands of 6 nurses on entering the hospital and from 1 nurse on leaving (Table 5). This decrease in the hands of nurses shows that the nurses working in internal medicine units washed their hands effectively when leaving the hospital.

Acinetobacter strains were produced most from the most washed region of the right hand on entering the hospital and from the most washed regions of the right and left hands at the same rate when leaving (Table 4). These productions were isolated from the hands of 4 personnel in internal medicine units, and from 2 in surgical units, of which 4 were nurses and 2 were doctors on entering the hospital. On leaving the hospital, production was determined from the hands of 2 nurses working in surgical units (Table 5). In a study by Eksi et al. (2010), Acinetobacter strains were found to be higher among doctors, but in the internal medicine units, as in the current study.

When production rates were compared according to occupation, although there was no significant difference, greater production was determined in the nurses on both entering and leaving the hospital. From these results it can be concluded that the healthcare personnel in this study were not washing their hands effectively. Various studies have shown that nurses had greater compliance with hand hygiene than doctors (29–31). In two studies conducted in intensive care units, there was reported to be low compliance with hand hygiene in both nurses (25%, 22.7%) and doctors (20.8%, 25.2%) (32,33). In a study in an intensive care unit in Colombia, doctors were reported to show more compliance than nurses (25.2%, 22.7%, $p>0.05$) (33).

In the current study, as a result of the comparisons of bacterial production of the healthcare personnel according to the clinics where they worked, the production in the hands of those working in surgical clinics was determined to be higher than that of those in internal clinics before any procedures. On entering the hospital, MSSE (48%), micrococcus (17.4%), streptococcus strains (8.7%), staphylococcus strains (6.3%), and MRSE were determined to be the bacteria with most production in those working in surgical clinics. On leaving the hospital, these were MSSE (33.7%), micrococcus (13.0%), staphylococcus strains (8.7%), MRSE (3.5%), and streptococcus strains (1.5%) (Table 5). Hand hygiene is the most effective method in the prevention of nosocomial infections, and it has been recommended and supported by the WHO, CDC, and other institutions that training on hand hygiene is given to all healthcare personnel (34,35). Many studies in literature have reported that hand hygiene is effective in preventing the spread of infections (20,36,37). In the context of hand hygiene, it has been shown in studies in literature that compliance with hand hygiene has reduced bacterial production in the hands especially in the least washed regions and is effective in reducing the prevalence of general hospital infection (38–40). The determination of bacterial production in the hands of healthcare personnel when entering and leaving the

hospital suggests that there is a need to provide an environment that will ensure hand hygiene on entry and exit, and that the personal equipment of staff should be cleaned, and areas such as hospital lifts, stairs and corridors that are used by staff should be isolated and cleaned.

Furthermore, healthcare personnel must give importance to the hygiene of the clothes they wear both inside and outside the hospital. In a previous study it was shown that of 140 samples taken from surfaces in frequent contact with the clothes of healthcare personnel, there was bacterial production in 69 (49.3%). In another study, a total of 232 samples were taken from various places such as biometric devices, lift buttons, door handles, stair railings, telephones, and taps, and 219 bacteria were isolated from 181 of the samples. Of these, the most commonly isolated bacteria were *Staphylococcus aureus* (44/219), obtained mostly from lift buttons, biometric devices and door handles (41).

The study results showed that the antibiotics to which the bacteria isolated from the hands were most sensitive were ciprofloxacin, daptomycin, gentamicin levoflaxocin, linezolid, teicoplanin trimetoprim/sulfamethoxazole and vancomycin. Other studies in literature have found similar antibiotic sensitivity (21,42).

Conclusion

According to the data obtained in this study, healthcare personnel are a significant source of transferring community-based bacteria to the hospital environment, and are the means of transfer of several nosocomial infections to the community. Bacteria were isolated most from the right hand, which is used most, and from the least washed region. Increasing the awareness of healthcare personnel about hand hygiene is important in respect of preventing infections and this can be achieved with the placement of hand disinfectant and hand-washing facilities at hospital entrances and exits, the cleaning of staff lifts and staff entrance and exit areas, and personal equipment. From the bacteria produced, it can be understood that personal hygiene and cleaning of surfaces in working areas is important. There is a need for awareness and multidisciplinary effort to prevent hospital infections.

Declarations

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Author contributions All authors contributed to the study conception and design. All authors took samples from healthcare professionals. Zerife Orhan Arzu Kayış and Murat Aral conducted the laboratory study of the samples. Mehtap Sönmez and Zerife Orhan wrote the manuscript. Mehtap Sönmez also performed a statistical analysis of the study. All authors read and approved the final version of manuscript.

Availability of data and materials

All the data in this review are included in the manuscript

Declarations

Ethics approval and consent to participate

Approval for the study was granted by the Clinical Research Ethics Committee of Kahramanmaraş Sütcü Imam University Medical Faculty. Informed consent was provided by all the study participants in accordance with the Helsinki Declaration.

Consent for publication

Informed consent was obtained from the nurses and doctors to publish this report.

Competing interests

Authors declare that they have no competing interests.

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Tables

Table 1

Distribution of the clinics worked in by the doctors and nurses included in the study

Unit	Nurses	Doctors
Internal Medicine Clinics	14	4
Surgical Clinics	13	2
Internal Medicine Intensive Care	13	1
Surgical Intensive Care	13	3
Total	**53**	**10**

Table 2

The sociodemographic characteristics of the healthcare personnel in the study

Variables	n	%		n	%
Age Groups			**Product for be used hand hygien**		
<25	22	34.9	Soap	54	85.7
26-30	15	23.8	Liqid soap with alcohol	6	9.5
31 and over	26	41.3	Soap with antimicrobial	3	4.8
Gender			**Status of hand disinfectant**		
Female	43	68.3	Yes	52	82.5
Male	20	31.7	No	11	17.5
Education Status			**Frequent of contact with the patient (times/a day)**		
High School	18	28.6	0-10 times	10	15.9
Assocate Degree	6	9.5	11-20 times	10	15.9
Graduate	29	46.0	21-30 times	8	12.7
Assitan Doctor	2	3.2	31-50 times	14	22.2
Professional Doctor	8	12.7	51-100 times	20	31.7
Working Clinics			**Status of hand hygien adaption**		
Internal	26	41.3	Yes	53	84.1
Surgeon	37	58.7	No	1	1.6
Occupational			Sometimes	9	14.3
Nurse	53	84.1	**Is there a special application for hand hygien**		
Doctor	10	15.9	Yes	33	52.4
Working Years (5.84±4.4)			No	30	47.6
>=5 years	32	50.8	**Frequent of washinh hands (times/a day)**		
6-10 years	12	19.0	0-10 times	17	27.0
11 years and over	19	30.2	11-20 times	29	46.0
Nail status			21 times and over	17	27.0
Long	2	3.2			
Middle	13	20.6			
Short	48	76.2			

Status of Using Ring			Status of having an infection in the past two weeks		
Yes	9	14.3	Yes	9	14.3
No	54	85.7	No	54	85.7
Status of Glove			**Status of take antibiotic**		
0-10 gloves	22	34.9	Yes	7	11.1
11-20 gloves	27	42.9	No	56	88.9
21 and over gloves	14	22.2			
Total	**63**	**100.0**	**Total**	**63**	**100.0**

Table 3

Comparisons of bacteria production of the right and left hand regions of the healthcare personnel on entering and leaving the hospital

Processing time	Hand Areas*	Status of Organisms Isolated	Exit in Hospital		Total* n(%)	X/p**
			Isolated n(%)	Non-Isolated n(%)		
Entry in Hospital	Right-LFM	Isolated	40(31.0)	18(69.0)	58(92.1)	0.171/0.512
		Non-Isolated	3(60.0)	2(40.0)	5(7.9)	
	Right-MFM	Isolated	45(76.3)	14(23.7)	59(93.7)	1.365/0.263
		Non-Isolated	2(50.0)	2(50.0)	4(6.3)	
	Left - LFM*	Isolated	44(77.2)	13(22.8)	57(90.5)	**5.300/0.041****
		Non-Isolated	2(33.3)	4(66.7)	6(9.5)	
	Left-MFM*	Isolated	43(78.2)	12(21.8)	55(87.3)	**5.867/0.028****
		Non-Isolated	3(37.5)	5 (62.5)	8(12.7)	

*LFM= Less Frequently Missed, MFM= Most Frequently Missed. ** Qhi Square test p<0.005

Table 4

The hand regions from which the bacteria were isolated on entering and leaving the hospital

Organisms Isolated	Entry in Hospital				Exit in Hospital			
	LEFT		RIGHT		LEFT		RIGHT	
	LFM	MFM	LFM	MFM	LFM	MFM	LFM	MFM
Non Isolated	6	8	5	4	27	17	20	16
MSSE	51	49	52	52	34	43	37	43
Micrococcus	20	20	25	20	11	16	11	22
Staphylococcus species	11	8	7	4	3	7	7	9
Streptococcus species	10	9	9	5	1	4	0	3
Bacillus species	4	1	2	0	1	1	1	2
MRSE	4	5	4	5	1	3	3	4
MRSA	1	0	0	0	1	0	0	0
Acinetobacter species	1	1	3	1	1	0	1	0
Pseudomonas species	2	1	0	3	1	0	0	0
Rhizobium radiobacter	2	0	3	1	0	0	0	0
Kingella denitrificans	1	1	1	1	0	0	0	0
Weeksella virosa	1	2	1	0	0	0	0	0
Serratia species	1	0	0	0	0	1	0	0
Neisseria animaloris	1	1	1	0	0	0	0	0
Moraxella Species	1	1	1	0	0	0	1	2
Alcaligenes faecalis	0	1	5	0	0	0	0	0
Mannheimia haemolytica	0	1	2	1	0	0	0	0
Rothia mucilaginosa	0	1	0	0	0	0	0	0
Brevibacterium species	0	0	1	0	0	0	0	0
Dermacoccus nishinomiyaensis	0	0	1	0	0	0	0	0
Enterococcus faecium	0	0	0	1	0	0	0	0
Kytococcus sedentarius	0	0	0	0	1	1	2	4
Comamonas testosteroni	0	0	0	0	1	1	1	2
Yersinia pseudotuberculosis	0	0	0	0	0	1	0	0

Paracoccus yeei	1	0	0	0	0	1	1	1
Achromobacter species	0	0	0	0	0	0	0	2

LFM= Less Frequently Missed, MFM= Most Frequently Missed

Table 5

The bacteria produced from the samples taken on entering and leaving the hospital according to occupation and clinics

Processing Time	Status of Organisms Isolated	Clinics		Profession	
		Internal Clinics n(%)*	Surgical Clinics n(%)*	Nurse n(%)*	Doctor n(%)*
Entry in Hospital	Non-Isolated	7(2.7)	16(6.3)	228(90.4)	1(0.3)
	MSSE	83(32.9)	121(48.0)	165(65.4)	39(15.4)
	Micrococcus	41(16.2)	44(17.4)	60(23.8)	25(9.9)
	Staphylococcus species	14(5.5)	16(6.3)	24(9.5)	6(2.4)
	Streptococcus species	11(4.3)	22(8.7)	30(11.9)	3(1.2)
	Bacillus species	7(2.7)	0(0.0)	6(2.4)	1(0.3)
	MRSE	8(3.1)	10(4.0)	18(7.1)	0(0.0)
	MRSA	1(0.3)	0(0.0)	1(0.3)	0(0.0)
	Acinetobacter species	4(1.5)	2(0.8)	4(1.5)	2(0.8)
	Pseudomonas species	2(0.8)	4(1.5)	4(1.5)	2(0.8)
	Rhizobium radiobacter	5(2.0)	1(0.3)	4(1.5)	2(0.8)
	Kingella denitrificans	4(1.5)	0(0.0)	3(1.2)	1(0.3)
	Weeksella virosa	4(1.5)	0(0.0)	3(1.2)	1(0.3)
	Serratia species	1(0.3)	0(0.0)	0(0.0)	1(0.3)
	Neisseria animaloris	3(1.2)	0(0.0)	0(0.0)	3(1.2)
	Moraxella species	1(0.3)	2(0.7)	0(0.0)	3(1.2)
	Alcaligenes faecalis	1(0.3)	5(2.0)	4(1.5)	2(0.8)
	Mannheimia haemolytica	3(1.2)	1(0.3)	4(1.5)	0(0.0)
	Rothia mucilaginosa	1(0.3)	0(0.0)	1(0.3)	0(0.0)
	Brevibacterium species	0(0.0)	1(0.3)	1(0.3)	0(0.0)
	Dermacoccus nishinomiyaensis	1(0.3)	0(0.0)	1(0.3)	0(0.0)
	Enterococcus faecium	0(0.0)	1(0.3)	1(0.3)	0(0.0)
	Paracoccus yeei	1(0.3)	0(0.0)	1(0.3)	0(0.0)

Exit in Hospital	Non-Isolated	29(11.5)	51(20.2)	72(28.5)	8(3.1)
	MSSE	72(28.5)	85(33.7)	125(49.6)	32(12.6)
	Micrococcus	27(10.7)	33(13.0)	37(14.6)	23(9.1)
	Staphylococcus species	4(1.5)	22(8.7)	23(9.1)	3(1.2)
	Streptococcus species	4(1.5)	4(1.5)	6(2.4)	2(0.7)
	Bacillus species	5(2.0)	0(0.0)	1(0.3)	4(1.5)
	MRSE	2(0.7)	9(3.5)	10(4.0)	0(0.0)
	MRSA	1(0.3)	0(0.0)	0(0.0)	0(0.0)
	Acinetobacter species	0(0.0)	2(0.7)	2(0.7)	0(0.0)
	Pseudomonas species	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Serratia species	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Neisseria animaloris	3(1.2)	0(0.0)	3(1.2)	0(0.0)
	Moraxella species	3(1.2)	0(0.0)	3(1.2)	0(0.0)
	Kytococcus sedentarius	6(2.4)	2(0.7)	7(2.7)	1(0.3)
	Comamonas testosteroni	0(0.0)	5(2.0)	5(2.0)	0(0.0)
	Yersinia pseudotuberculosis	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Paracoccus yeei	3(1.2)	0(0.0)	0(0.0)	3(1.2)
	Achromobacter species	2(0.7)	0(0.0)	2(0.7)	0(0.0)
	Pasteurella multocida	0(0.0)	0(0.0)	0(0.0)	0(0.0)

*samples taken from all regions and first, second, and third prodcutions are included. n=252.

Table 6

The antibiotic sensitivity of the bacteria produced from the samples taken from the hands of the healthcare personnel on entering and leaving the hospital

Sensitive Antibiotics	Clinics				Profession			
	Internal		Surgical		Nurse		Doctor	
	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit
Amikacin	4	3	9	4	9	7	4	0
Amoxicillin	1	0	5	1	3	1	3	0
Ampicillin	1	0	3	1	2	1	2	0
Aztreonam	4	0	1	0	8	1	3	0
Cefepime	1	0	5	1	5	1	1	0
Cefetoxin	0	0	0	0	1	1	1	0
Ceftazidime	1	0	4	0	4	0	1	0
Ceftriaxone	1	0	1	1	1	1	1	0
Cefuroxime	0	0	0	0	6	1	1	0
Ciprofloxacin	6	3	17	6	16	8	7	1
Clindamycin	2	2	6	4	5	5	3	1
Colistin	0	0	0	0	1	1	1	0
Daptomycin	6	5	9	7	11	10	4	1
Erythromycin	0	1	6	1	4	1	2	1
Ertapenem	1	1	2	2	1	1	1	1
Fosfomycin	4	2	8	5	8	6	4	1
Fusidic acid	3	1	6	3	5	3	4	1
Gentamicin	5	2	22	8	16	7	6	1
Imipenem	1	1	6	6	5	5	2	2
Levofloxacin	6	3	12	5	13	7	5	1
Linezolid	6	4	11	6	12	7	5	1
Netilmicin	3	1	3	1	2	1	1	0
Nitrofurantoin	1	1	1	1	0	0	1	1
Oxacillin	1	0	5	2	3	1	3	1
Penicilin G	0	0	0	0	0	0	0	0
Quinopuristin/ dalfoprispin	2	1	6	4	7	4	1	1

Piperacillin	1	0	4	1	4	1	5	1
Piperacillin tazobactam	1	0	4	1	4	1	1	0
Rifampin	0	0	0	0	0	0	0	0
Streptomycin	1	1	1	1	1	1	1	1
Teicoplanin	6	4	12	6	13	9	5	1
Tetracycline	4	3	10	5	7	8	4	1
Tigecycline	4	2	8	5	9	6	3	1
Tobramycin	3	0	7	4	8	3	2	1
Trimethoprim/sulfamethoxazole	6	4	13	6	12	9	7	1
Vancomycin	5	4	12	7	12	10	5	1

Figures

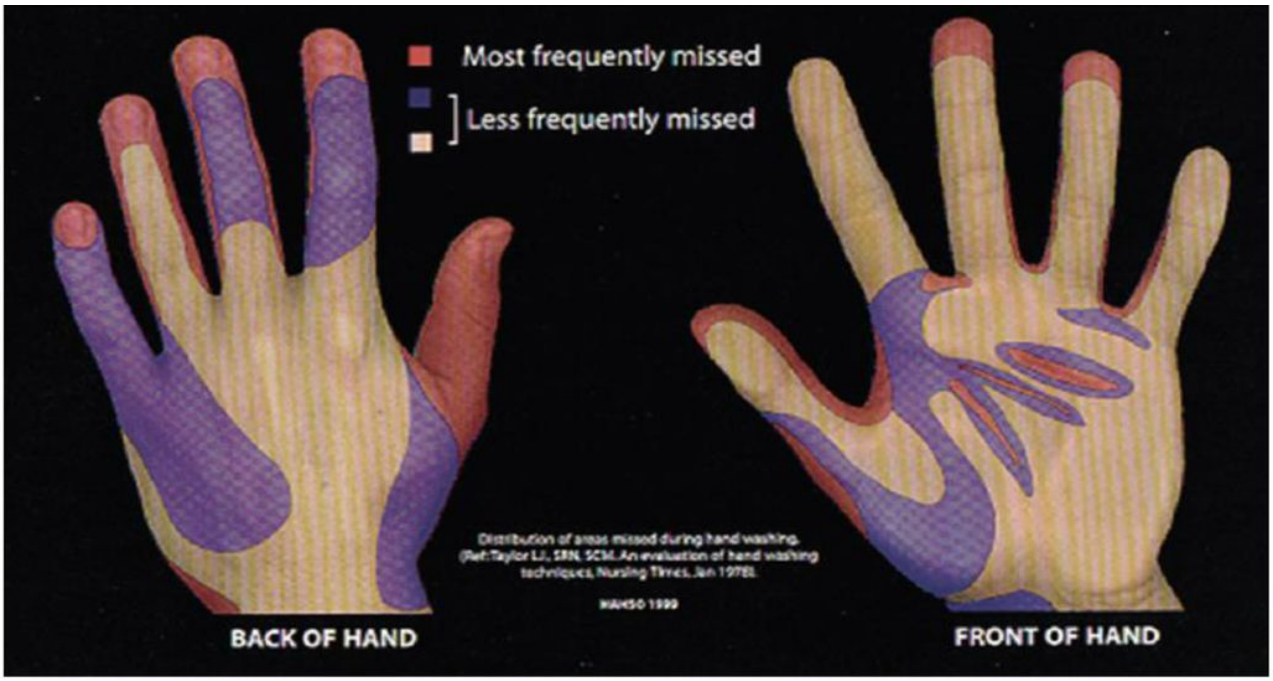

Figure 1 The hands areas of less scrubs and impact of the detergent solution has shown. The fingertip, between fingers, and palm lines areas are points of the hands that often left out of the affected of eluting (this picture was taken out from Google image search by fraise; hand washing methods and most frequently missed which is available **on:** http://image.slidesharecdn.com/slidesforhandhygienecoordinator-111120194340-phpapp02/95/hand-hygiene-practices-35-728.jpg?cb = 1321819019**)**

Figure 1

See image above for figure legend.

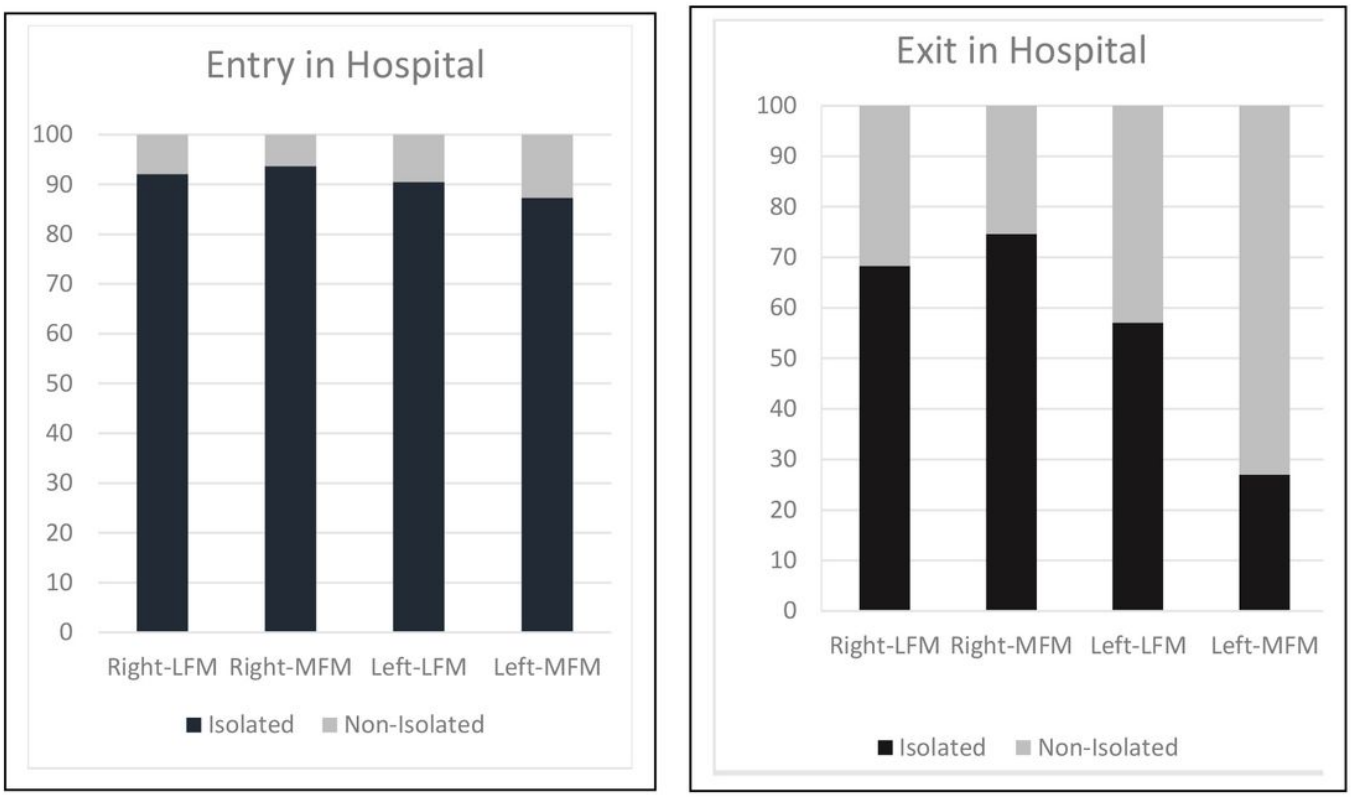

Figure 2 The bacteria production in the samples isolated from the hands of the healthcare personnel when entering and leaving the hospital

Figure 2

See image above for figure legend.