Hand contamination among Health Care professionals in the General Hospital of Korinthos - Greece

Saridi M.[1], Pappa V [1], Zervas E. [2], Kyriazis I. [3]

1. Registered Nurse, MSc Clinical Nursing
2. M.D, Coordinator of Asthma Working Group of Hellenic Thoracic Society
3. M.D, Internist – Diabetologist, Diabetes & Obesity Outpatient Clinic, Internal Medicine Dpt., Korinthos General Hospital

Background: Hand hygiene is a primary aspect in every infection control program. Cross-contamination via the hands of Health Care Professionals (HCPs) is considered the main mode of transmission of nosocomial infections.

Objective: The aim of this study was to evaluate the incidence of hand contamination among HCPs in the Internal Medicine and Surgical Departments, as well as to assess the sensitivity of the isolated bacteria to the widely used antibiotics.

Methods: This is a descriptive, prospective, correlational study. The study population consisted of 50 HCPs. Samples from the hands of the participants were collected by means of hand washing with sterile saline solution. The number of colonies per plate was counted and transient pathogens were identified. The sensitivity of the isolated bacteria was determined after performing an antibiogram.

Statistical analysis: The SPSS 13 software was used for the statistical analysis. The level of significance has been determined to be less than or equal to 0.5. P values less than 0.5 were considered significant.

Results: Hand contamination was present in 76% of the population under study. Gram-negative bacteria were present in 52.6% of the cases, while gram-positive bacteria were found in 89.5%. Finally, there were 8% cases of fungal contamination.

Conclusions: Unfortunately, most of the studies conducted in this field conclude that HCPs do not always adhere strictly to the hand hygiene procedures. Thus, it is imperative to take action in order to convey the importance of hand hygiene in the prevention of nosocomial infections.

Key Words: Hand Hygiene, Nosocomial Infections, Hand Contamination, Health Care Professionals (HCPs), Antibiotics Resistance.

Background:

Thorough adherence to the hand hygiene procedures is a primary aspect in every infection control program in hospitals (Rotter, 1999). Ignaz Semmelweis realised early the importance of this matter. Already since 1847 he established a strict hand hygiene policy in the Obstetrical Clinic in the Vienna General Hospital, thus decreasing radically maternal mortality rates due to puerperal fever.

The most common way of transmission of nosocomial infections is the transient hand contamination of Health Care Professionals HCPs, mainly doctors and nurses. The majority of microorganisms transferred and transmitted via the hands of HCPs are Enterobacteriaceae, Staphylococcus aureus and Enterococcus spp., which may be resistant against some antibiotics.[2]

Although there have been many interventions and developments in this field, the Infection Control Committees, as well as the Hospitals' administrations, are challenged by the personnel's low adherence to the hand hygiene guidelines published by national and international organizations (Rotter,1999- Boyce et al., 2002).

Based on this fact, on October 2002, CDC (Siegel, et al., 2007) issued new guidelines, where the notion of rapid hand disinfection, was introduced, by means of waterless antiseptic agents instead of the traditional hand washing with soap.

A hand hygiene policy, in accordance with guidelines issued by national and international organizations, could contribute significantly to the decrease of nosocomial infections.

Objective:

The aim of this study was to evaluate the incidence of hand contamination among HCPs in the Internal Medicine and Surgical Department in the General Hospital of Korinthos, as well as to assess the sensitivity of the isolated bacteria to the widely used antibiotics.

Methods:

We conducted a descriptive, prospective, correlational study.

Ethical Considerations:

We submitted research protocols to the research committee of the General Hospital of Korinthos, the doctors' administration and the nursing administration and we were given permission to conduct our study. The protocol was based on the rules of anonymity, discretion and confidentiality as far as the study population was concerned. There were no possible risks for the participants. An informed consent form was provided to each subject. Finally, the participants were informed about their right to withdraw from the study at any time.

Study Setting:

The study was conducted among HCPs in the Internal Medicine and Surgical Departments in the General Hospital of Korinthos.

Sample:

The study population consisted of 50 HCPs (N=50), both doctors (25) and nurses (25), (Table 1, Appendix). The subjects were selected by means of systematic sampling. Samples were collected in every shift, in the clinics of the Internal Medicine and Surgical Departments in the General Hospital of Korinthos, from 16-18 of September 2006.

Data Collection Method:

Samples from the hands of the participants were collected by means of hand washing with sterile saline solution. The residual rinsing water of each participant was collected in a sterile vessel. A number was appointed to each sample and the same number was written respectively to the data protocol of the participant.

Table 1: Study population

	Internal Medicine Dept	Surgical Medicine Dept	Total Number
DOCTORS	12	13	25
NURSES	8	17	25
TOTAL	20	30	50

All the samples were incubated under 37° C for 24 hours. Subsequently, each was coated with one of the following materials:

1. **MAC CONKEY 2**
2. **BLOOD AGAR**
3. **MANNITOL CHAPMAN AGAR**
4. **SABOURAUD DEXTROSE AGAR**

Sample cultivation was carried out under 37° C for 34-48 hours, under aerobic conditions.

The sensitivity of the isolated bacteria was determined after performing an antibiogram.

The data were encoded in the data protocol.

Statistical Analysis:

The SPSS 13 software was used for the statistical analysis.

The level of significance has been determined to be less than or equal to 0.5. Furthermore, P values less than 0.5 were considered significant. In order to avoid type I errors we used the Bonferroni correction due to the multiple comparisons.

The quantitave variables are being described by the mean value ± standard deviation.

In order to assess the correlation between two quantitave variables that fulfilled the normality criteria we used Pearson's correlation. In order to compare the mean values we used the analysis of variance (ANOVA).

Validity and reliability:

Internal consistency reliability was evaluated by Cronbach's alpha, which was found equal to 0.71. Since Cronbach's alpha is greater than 0.7, we conclude that the reliability of our questionnaire is adequate.

Results

Hand contamination

The population of the study consisted of 50 HCPs. Hand contamination was present in 38 of them (76%). Hand contamination involved several bacteria in 32 (84 %) participants. Specifically, hand contamination was present in 18/25 (72%) doctors and in 20/25 (80%) nurses. A difference which is not significant (p = 0.75).

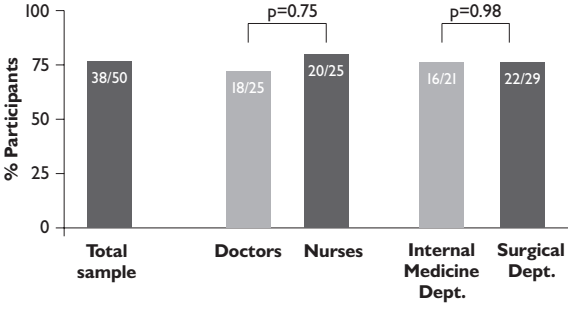
Furthermore, there was no significant difference regarding the prevalence of hand contamination in the Surgical (8/12 (67%)) and the Internal Medicine Departments (10/13 (77%)), (p = 0.68) (Table 2, Figure 1, Appendix).

Among the participants with hand contamination, 20/38 (52.6%) carried gram-negative bacteria, 34/38 (89.5%) carried gram-positive bacteria and 3/38 (8%) carried fungi. There was no significant difference regarding the type of bacteria among nurses and doctors or among the personnel in the Internal Medicine and Surgical Departments (Table 3, Figure2, Appendix).

Table 2: Prevalence of hand contamination

	Contamination of microorganisms		P Value
Total Sample	38/50	(76%)	
Doctors	18/25	(72%)	ρ = 0,75
Nurses	20/25	(80%)	
Internal Medicine Dept	16/21	(76%)	ρ = 0,98
Surgical Medicine Dept	22/29	(76%)	

Figure I: Prevalence of hand comtamination



Prevailing Bacteria

The following categories of prevailing bacteria can be formed:

Gram-negative bacteria (20 positive cultures):
Klebsiella 50% (10), E. Coli 45% (9), Acinetobacter 5% (1), Neisseria 5% (1) and Pseudomonas 5% (1).

Gram-positive bacteria (34 positive cultures):
Staphylococcus epidermidis 59% (20), Micrococcus 47% (16), Enterococcus 38% (13), Staphylococcus Aureus 23.5% (8), Corynebacterium 5.8% (2) and b- haemolytic streptococcus 5.8% (2).

Fungi (3 positive cultures):
Candida Albicans 100% (3). (Table 4, Figures 3, 4, Appendix)

There was no significant difference regarding the prevalence of the prevailing bacteria among doctors and nurses or among the personnel in the Internal Medicine and Surgical Departments (Table 5, Figures 5, 6, Appendix).

Table 3: Type of bacteria's class in different categories of HCPS and their sector

	Gram -	ρ	Gram +	ρ	Fungi	ρ
Participants with hand contamination	52,6% (20/38)		89,5% (34/38)		8% (3/38)	
Doctors	55,5% (10/18)	0,73	89% (16/18)	0,98	----	0,23
Nurses	50% (10/20)		90% (18/20)		15% (3/20)	
Pathological sector	50% (8/16)	0,78	94% (15/16)	0,68	12.5% (2/16)	0.56
Surgical sector	54,5% (12/22)		86.5% (19/22)		4.5% (1/22)	

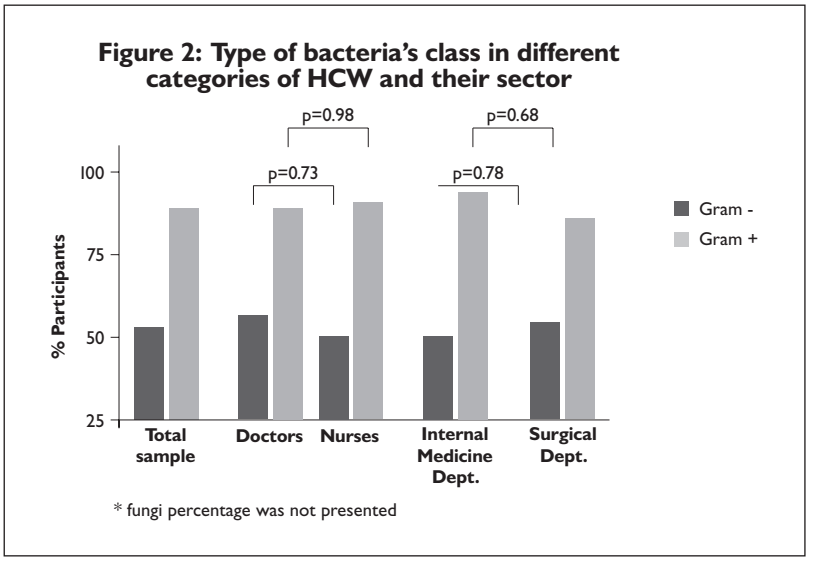


Table 4: Prevailing Bacteria in different bacteria's classes

Gram - bacteria	Klebsiela	10	**Gram + bacteria**	Staph. epidermitis	20	**Fungi**	Candinda Albicans 3
	E. Coli	9		Micrococcus	16		
	Acinetobacter	1		Enterococcus	13		
	Naiseria	1		Staph. Aureus	8		
	Pseudomonas	1		Corynobacterium β-hemolytic	2		
				Streptococcus	2		

Figure 3: Gram negative bacteria

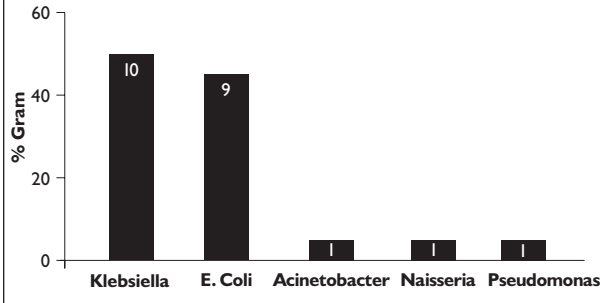


Figure 4: Gram positive bacteria

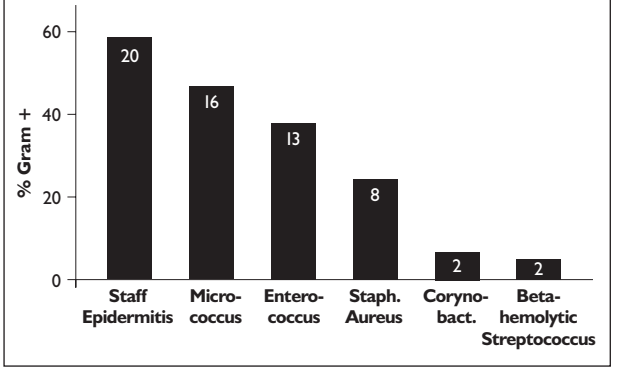
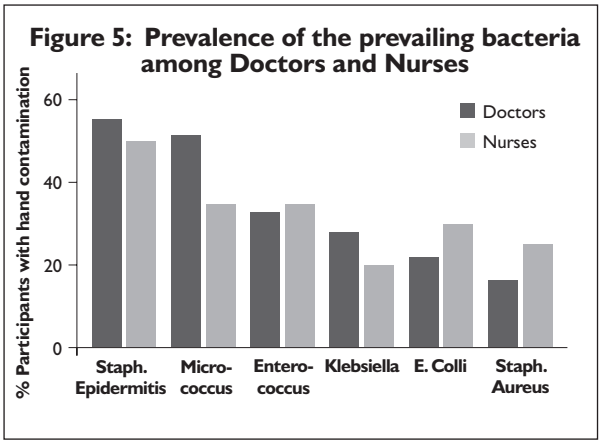
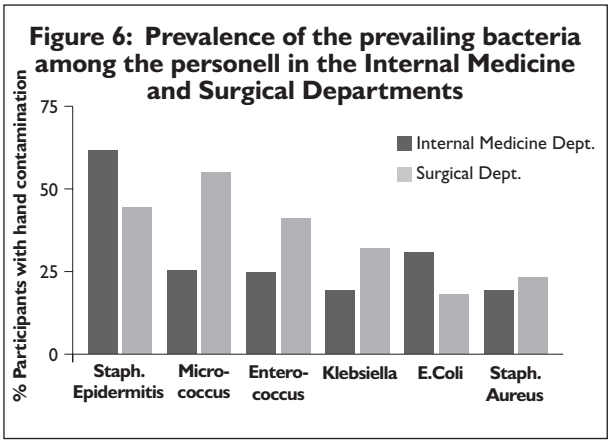


Table 5: Prevalence of the prevailing bacteria among doctors and nurses and among the personnel in the Internal Medicine and Surgical Departments

	Doctors	Nurses	p	Internal Medicine Dept.	Surgical Dept.	p
Gram - bacteria						
Klebsiela (10)	22% (4/18)	30% (6/20)	0,72	19% (3/16)	32% (7/22)	0,47
E. Coli (9)	28% (5/18)	20% (4/20)	0,71	31% (5/16)	18% (4/22)	0,45
Gram + bacteria						
Staphyloc. Epidermidis (20)	55% (10/18)	50% (10/20)	0,73	62% (10/16)	45% (10/22)	0,34
Micrococcus (16)	52% (9/18)	35% (7/20)	0,35	25% (4/16)	55% (12/22)	0,11
Enterococcus (13)	33% (6/18)	35% (7/20)	0,91	25% (4/16)	41% (9/22)	0,41
Staphyloc. aureus (8)	17% (3/18)	25% (5/20)	0,70	19% (3/16)	23% (5/22)	0,78





Sensitivity of the Isolated Bacteria

The sensitivity test for the isolated bacteria was carried out using the following drug and antibiotic categories (Table 6, Appendix):

The sensitivity of each bacterial category against the main antibiotic categories can be seen in the following table (Table 7, Appendix). The isolated bacteria from the nurses were more resistant than those isolated from the doctors against several antibiotic categories (Table 8, Appendix).

There was no significant difference concerning the kind of antibiotic resistance among HCPs in the Internal Medicine and Surgical Departments.

Table 6: Classes of antibiotics

Classes of antibiotics	Generic Name
Aminopenicillins	Amoxicillin Clavulanate Ampicillin Sulbactam
Antipseudomonad penicillins	Piperacillin plus tazobactam Ticarcillin plus clavulanic acid
Cephalosporins	Ceftazidime Ceftriaxone Cefuroxime
Carbapenems	Imipenem/Cilastatin
Aminoglycosides	Netilmicin
Macrolides	Erythromycin Clarithromycin
Glycopeptides	Teicoplanin Vancomycin
Tetracyclines	Doxycycline Minocycline
Sulfonamides	Trimethoprim-Sulfamethoxazole
Quinolones	Ciprofloxacin Norfloxacin Ofloxacin

Table 7: Sensitivity of each bacterial category against the main antibiotic categories

Classes of antibiotics	Gram - bacteria		Gram + bacteria	
Aminopenicillins	E	37%	E	41%
	ME	21%	ME	33%
	A	42%	A	26%
Antipseudomonad penicillins	E	79%	E	40%
	ME	7%	ME	27%
	A	14%	A	33%
Cephalosporins	E	25%	E	17%
	ME	25%	ME	39%
	A	50%	A	44%
Carbapenems	E	67%	E	64%
	ME	33%	ME	36%
	A	0%	A	0%
Aminoglycosides	E	40%	E	---
	ME	0%	ME	---
	A	60%	A	---
Macrolides	E	---	E	11%
	ME	---	ME	17%
	A	---	A	72%
Glycopeptides	E	---	E	25%
	ME	---	ME	71%
	A	---	A	4%
Tetracyclines	E	---	E	65%
	ME	---	ME	31%
	A	---	A	4%
Sulfonamides	E	31%	E	10%
	ME	25%	ME	42%
	A	44%	A	48%
Quinolones	E	47%	E	65%
	ME	29%	ME	31%
	A	24%	A	4%

S= sensitive I= intermediate R= resistant

Table 8: Differences of isolated bacteria's resistant between doctors-nurses (selected)

	Doctors	Nurses	ρ
Gram – bacteria resistance			
Aminopenicillins	22%	62%	0,04
Sulfonamides	28%	56%	0,04
Gram + bacteria resistance			
Aminopenicillins	15%	37%	0,04
Cephalosporins	28%	55%	0,04

Discussion

Our study results show that hand contamination in HCPs is distressingly high (76%). Additionally, 84% of the participants with hand contamination carried several bacterial species (Brunetti, et al. 2006).

The human skin is colonized by a plethora of bacteria3. In studies, where the hand contamination in HCPs was assessed, the bacterial count was found to vary from 3.9 x 104 to 4.6 x106 colonies (Krammer, et al., 2002). The most common bacteria, are Staphylococcus Aureus, gram-negative rods, Enterococci and Fungi. (Andrew, 2007, Roberts, et al., 2005).

In a study conducted in England (Carvel,2006.), the most common isolated bacteria in HCPs included: Staphylococcus Aureus, resistant Enterococci, Clostridium Difficile, Streptococcus Pneumoniae, Acinetobacter spp, Escherichia Coli and Candida spp.

Another study showed that after coming into contact with the patients, the staff was colonized by a mean of 100 bacterial colonies. Staphylococcus aureus (10%) and gram-negative bacteria (15%) prevailed (Pittet, et al., 1999). A discrepancy with our results is reported in a study by Lucet et al., where only 4.3 % out of the 43 HCPs in a French hospital presented pathogens on their hands. Moreover, in a study by Widmer et al., 2004, results showed that Staphylococcus aureus founded at 13% of the sample and gram-negative bacteria at 6.7%. The low percentages are justified by the high educational standards and the frequent controls by the Infection Control Committee.

In our study the isolated bacteria, in accordance with the results of other international studies are the following (Table 5, Appendix):

Gram-positive bacteria: Staphylococcus epidermidis (50%) and Micrococcus (47%)

Gram-negative bacteria: Klebsiella (50%) and E. Coli (45%)

Fungi: Candida Albicans (100%).

In our study, 72% of the doctors and 80% of the nurses presented hand contamination, which is a non significant difference. Furthermore, there is no significant difference in regard to the bacterial load on the hands of the staff in the Surgical and the Internal Medicine Departments.

Nevertheless, there were small differences regarding the isolated bacteria in the working departments, which are worth to be mentioned. Specifically, the staff of the Surgical Departments was colonized by Micrococcus (55%), followed by Staphylococcus epidermidis (45%), Enterococcus (41%) and Klebsiella (32%). However, the staff of the Internal Medicine Department was colonized by Staphylococcus epidermidis (55%) and Micrococcus (52%), followed by Enterococcus (33%) and E. coli (28%) (Table 5, Appendix). Similar international studies showed that HCPs in the Internal Medicine Departments have lower adherence to the hand hygiene procedures (Pittet, et al., 2004). Apparently, the heavy work load in combination with the lack of invasive procedures, are some of the contributing factors to the low hand hygiene adherence.

As far as the resistance against the antibiotics is concerned (Table 7, Appendix), the gram-negative bacteria are highly resistant against aminoglycosides (60%), cephalosporins (50%), sulfonamides (44%) and aminopenicillins (40%). On the other hand, gram-positive bacteria are resistant against macrolides (72%), sulfonamides (48%) and cephalosporins (44%).

An auspicious result is the low resistance of both gram-negative and gram-positive bacteria against quinolones (24% and 4% respectively) and carbapenems (0% in both categories). Another study reported that 41% out of the specimens taken from HCPs showed hand contamination with VRE (Hayden, 2000).

There was no significant difference regarding the bacterial resistance among the isolated bacteria in the personnel in the Internal Medicine and the Surgical Departments. However, there is a significant difference in regard to the resistance among the bacteria isolated in doctors and nurses ((p=0, 04 after Bonferroni).

Isolated bacteria in nurses show higher resistance than those isolated in doctors (Table 8, Appendix). In accordance with our results, a study conducted in Japan (Furukawa, et al. 2005), reported that the bacterial count on the hands of the nursing staff was 5.0 x 103 colonies.

Specifically, in nurses gram-negative bacteria were resistant against aminopenicillins (60%) and sulfonamides (56%) and gram-positive bacteria were resistant against cephalosporins (55%) and aminopenicillins (37%). However, in doctors, resistance was remarkably lower. Gram-negative bacteria were resistant against aminopenicillins (22) and sulfonamides (28%) and gram-positive bacteria were resistant against cephalosporins (28%) and aminopenicillins (15%).

These results can be discomforting considering that nurses come more frequently into contact with the patients.

Conclusions:

Transient hand contamination in HCPs is one of the most common modes of nosocomial infection transmission. Moreover, bacterial resistance against antibiotics is becoming a serious threat (Widmer, et al., 2004) . Our results are in accordance with those statements. It is imperative to increase HCPs' adherence to hygiene rules including hand washing (Pittet, et al., 2004). In order to achieve that, new strategies have to be employed, where a change in HCPs behavior has to be stressed (Larson, et al.2000, Widmer, 2000). Moreover, continuous education programs about the transmission of nosocomial infections should be implemented (Fogg, et al., 2001). Finally, posters and frequent interventions by the Infection Control Committee have proven to be of value (Larson, et al,2000).

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