Prevalence and risk factors for methicillin resistant Staphylococcus aureus carriage among emergency department workers and bacterial contamination on touch surfaces in Erciyes University Hospital, Kayseri, Turkey

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Abstract

Objective: The aim of this study was to determine *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA) nasal carriage among emergency department (ED) workers, and bacterial contamination on hand-touch surfaces at ED.

Methods: This single-centered study enrolled 105 ED workers and 190 hand-touch surfaces at ED in June 2014. Nasal and environmental samples for *S. aureus* carriage and for bacterial contamination were obtained. For isolation swabs were cultured on ChromAgar *S. aureus* and environmental samples first cultured in broth and antibiogram obtained by clinical and Laboratory Standards Institute guidelines. A questionnaire was completed for each subject.

Results: The *S. aureus* carriage rate was 18.1% (n=19), with 2.9% (n=3) MRSA positivity. There were two (1.9%) mobile phone positivities for *S. aureus*, one of them was MRSA, and a computer keyboard contamination for MRSA was also detected. All MRSA isolates were susceptible for the tested antibiotics. There was significant difference between gender (p=0.044) in terms of nasal carriage of *S. aureus* and MRSA, all three MRSA isolates were from females.

Conclusion: Our study showed that the carriage of MRSA was not affected by clinical exposure in the hospital because of the existing infection control policy in our hospital.

Keywords: *Staphylococcus aureus*, carriage, risk factors, health care workers, bacterial contamination.

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Introduction

S. aureus is one of the most important human bacterial pathogens and methicillin-resistant *S. aureus* (MRSA) is currently the most commonly identified antibiotic resistant pathogen which is capable of causing a wide range of infections, especially through cross infection spread from patient to patient in hospitals and in other institutional settings. In contrast, healthy individuals have a small risk of contracting invasive infections caused by *S. aureus*. However, they can be carriers of the organism[1,2]. Infections caused by MRSA isolates are associated with longer hospital stay, prolonged antibiotic administration, and higher cost than infections caused by methicillin-susceptible *S. aureus* isolates. Next to colonized patients and contaminated environmental surfaces, colonized healthcare workers (HCWs) can act as a reservoir for the spread of MRSA to patients and other HCWs. Consequently, HCWs are frequently exposed to patients colonized with MRSA. Physical contact with patients and their environment is a known risk factor for MRSA acquisition. In general it's believed that HCWs are more likely to be colonized than persons in the general population, presumably because of increased exposure[1-5]. EDs may contribute to the spread of MRSA. Nurses, physicians, and ancillary staff care

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for multiple patients infected with MRSA during a single shift, increase the potential risk of spreading MRSA and other organisms from person to person with direct hand contact. Colonized HCWs and contaminated hand-touch surfaces are therefore potential risk factors for MRSA spreading in a busy ED[6].

Aims of the study

Determination of;

i. carriage rate of the *S. aureus* among ED workers, the risk factors and antibiotic susceptibilities

ii. MRSA contamination on hand-touch surfaces

iii. ED workers level of knowledge on the MRSA as an agent of hospital infection.

Materials and methods

The study was a cross-sectional one, conducted on ED workers in Erciyes Medicine Hospital. It was supported by Erciyes University Scientific Research Project Unit. The study was planned in three sections: i.) *S. aureus*/MRSA carriage rate, antibiotic resistance and risk factors among the ED workers. ii.) The carriage rate of *S. aureus*/MRSA on the mobile phones of ED workers and on different environmental samples iii.) the ED workers level of knowledge on the MRSA as an agent of hospital infection. In this article the nasal carriage of *S. aureus*, antibiotic susceptibilities and risk factors among ED workers; bacterial contamination on hand-touch surfaces such as mobile phones, stethoscopes, desktop surfaces, telephones, keyboards, curtains, ultrasound probes, sinks, chairs, blood pressure cuffs in the ED were discussed.

The samples were collected in June 2014 (2^{nd}, 3^{rd}, 9^{th},10^{th},16^{th}, 17^{th}, $23^{rd,}$ 24^{th} of June 2014). We planned to take all the workers in day shift (n=111), and we reached 105 of them (94.5%). The aim of this study was explained to the ED workers and all volunteers signed a consent form. The questionnaire elicited information on the followings: demographic characteristics (age, gender, profession, monthly income, smoking), risk factors for carriage (presence of chronic disease, antibiotic use in last one month, current use of antibiotics, hospitalization in past one year, number of persons in the same house, operation in last one year, living in the same house with another hospital staff).

Nasal swabs were obtained from the anterior nares of the volunteers. Samples were collected from both nares by rotating a sterile Stuart agar gel medium transport swab and sent to Erciyes University Halil Bayraktar Health Services Vocational School's Microbiology Laboratory (Kayseri, Turkey). The swabs were immediately streaked on CHROMagar *S. aureus* (Biolife, Italiana). After incubation for 24 h at 37^0C suspected violent colonies were isolated and subcultured on to 5% sheep blood agar plates. The samples from environmental surfaces; mobile phones, stethoscopes, desktop surfaces, telephones, keyboards, curtains, ultrasound probes, sinks, chairs, blood pressure cuffs were cultured in brain hearth infusion broth enriched with 7.5% NaCl for 48 h at 37^0C. Then subcultured to the ChromAgar *S.aureus* incubated for 24 h at 37^0C and suspected violent colonies were isolated and subcultured on to 5% sheep blood agar plates.

The suspected colonies were confirmed to be *S. aureus* by standard biochemical techniques and conventional methods (colony morphology, Gram stain, catalase activity, tube coagulase test). Test for methicillin-resistance was performed by the Kirby-Bauer disc diffusion method, using cefoxitin (potency 30 μg) disc and ChromAgar MRSA. The other tested antimicrobial agents were: gentamicin (10 μg), trimethoprim-sulfamethoxazole (TMP-SMX, 1.25/23.75μg), erythromycin (15 μg), clindamycin (2 μg), teicoplanin (30 μg), vancomycin (30 μg), rifampin (30 μg) (all Bioanalyse, Turkey), on Muller Hinton agar with 24 h incubation at 35.8^0C. Results were interpreted according to the criteria of CLSI 2007 guidelines[7]. The reference strain *S. aureus* ATCC 29213 was used as internal quality control. The isolates positive for MRSA (n=3) were tested by Phoenix (BD Diagnostic Systems, Sparks, MD) for both identification and antimicrobial susceptibilities.

This study was planned and performed in accordance with the Helsinki Declaration and was approved by the Ethics Committee of the Erciyes University Medical Faculty.

Statistical analysis: All data was expressed by numbers and frequencies. Chi-squared Fisher's exact test was used for comparison of categorical variables. A p value <0.05 indicated a statistically significant difference.

Results

The socio-demographic characterization of the ED workers was shown in Table 1.

Table 1. The socio-demographic characteristics of ED workers enrolled.

Characteristics	N	%
Age, years		
≤ 19	15	14.3
20-29	60	57.1
30-39	24	22.9
≥ 40	6	5.7
Gender		
Male	44	41.9
Female	61	58.1
Profession		
Physician	42	40.0
Nurse	14	13.3
Others (medical Secretary, paramedics, cleaning staff)	49	46.7

Out of 105 ED workers 57.1% were 20-29 years of age and 58.1% were female. Nasal *S. aureus* carriage rate was 18.1% (n=19). Three workers were MRSA positive (2.9%). The distribution of possible risk factors was shown in Table 2. Gender was the only risk factor for the nasal *S. aureus.* Carriage rate among sexes was statistically different (p= 0.044) (Table 2).

Table 2. Distribution of risk factors among nasal *S. aureus* carriers.

	***S. aureus* Negative (n=86)**		***S. aureus* Positive (n=19)**		**Chi square**	**p**
	N	%	N	%		
Age groups						
<30	63	84.0	12	16.0		
>30	23	76.7	7	23.3	Fisher	0.407
Gender						
Male	32	72.7	12	27.3		
Female	54	88.5	7	11.5	Fisher	**0.044**
Profession						
Physician	32	76.2	10	23.8		
Nurse	14	100.0	-	-		
Others	40	81.6	9	18.4	4.021	0.134
Chronic diseases						
No	82	82.8	17	17.2		
Yes	4	66.7	2	33.3	Fisher	0.297
Antibiotic use past one month						
Yes	12	85.7	2	14.3		
No	47	81.3	17	18.7	Fisher	1.000
Recent antibiotic use						
Yes	7	100.0	-	-		
No	79	80.6	19	19.4	Fisher	0.346
Hospitalization past one year						
Yes	3	75.0	1	25.0		
No	83	82.2	18	17.8	Fisher	0.566
Number of people live with						
<4	43	79.6	11	20.4		
≥4	43	84.3	8	15.7	Fisher	0.616
Another person in the same house Works in the hospital						
Yes	34	81.0	8	19.0		
No	52	82.5	11	17.5	Fisher	1.000
Smoke						
Yes	18	75.0	6	25.0		
No	68	84.0	13	16.0	Fisher	0.368
Another person smokes at the house						
Yes	28	84.8	5	15.2		
No	58	80.6	14	19.4	Fisher	0.784
Monthly income						
≤3000 YTL	57	80.3	14	19.7		
≥3001 YTL	29	85.3	5	14.7	Fisher	0.599

The only antibiotic resistance was to cefoxitin, two out of 19. All the MRSA isolates were susceptible for the antibiotics tested (gentamicin, TMP-SMX, erythromycin, clindamycin, teicoplanin, vancomycin, rifampin).

S. aureus was isolated from 1.9% of the tested mobile phones, (2 out of 105). One phone and one of the 14 keyboards were MRSA positive. *S. aureus*/MRSA was not isolated from the other environmental surfaces tested (Table 3).

Table 3. The samples taken from ED.

Samples	N	*S. aureus* isolated
Mobile phones	105	2
Stethoscope	17	-
Keyboard	14	1
Phone	7	-
Wheeled bed	15	-
Chair	9	-
Ultrasound probes	2	-
Blood pressure cuffs	5	-
Curtains between patients	5	-
Faucet	3	-
Basin interior	3	-
Desktop surface	5	-

Discussion

Nasal colonization with *S. aureus* and MRSA can precede infection in patients and contacts. Although general population *S. aureus*/MRSA rates are well described, the prevalence of *S. aureus* and MRSA nasal colonization in ED HCWs is not defined[8]. We aimed to determine the prevalence of *S. aureus* and MRSA nasal carriage among ED HCWs without evidence of an active site of staphylococcal infection and to identify the variables associated with carriage. We found a carriage rate of 18.1% for *S. aureus* and 2.9% for MRSA among ED workers. There were also two studies done by the same researchers in military hospital staff and chest hospital workers from our region (Kayseri, Middle Anatolia). The rates for *S. aureus* carriage were 13.2% and 15% respectively. MRSA carriage rate was 5.4% (one strain) in the first study and no MRSA was detected in the second[9,10]. A study from another city in Turkey, found 13.8% *S. aureus* carriage and 1.8% MRSA in a state hospital staff[11]. These carriage rates are similar to ours. The isolates from these studies were resistant to some antibiotics in different rates but in our study including MRSA isolates were all susceptible to the tested antibiotics. From the world there are many studies[2,3,12-14] (Table 4).

Table 4. Studies and prevalence of *S. aureus* and MRSA around the world.

Country	Study year	Study population	Prevalence for %	
			S. aureus	MRSA
USA (12)	2010	HCWs	43.8	6.6
Saudi Arabia (3)	2014	HCWs	-	73
Iran (13)	2009	Surgical ward and ED workers	25.7	5.3
Ethiopia (2)	2013	Nurses and other HCWs	28.8	12.7 and in nurses 21.2
India (1)	2013	Nurses	17.5	14.3
Sri Lanka (14)	2014	Nurses	39.4	13.3

Albrich et al.[5] provided data from 41 studies which studied HCWs carriage rates for *S. aureus* and MRSA. They found 23.7% *S. aureus* carriage among 10 589 HCWs. In 127 investigations with denominator data, the average MRSA carriage was 4.6%. Hawkins et al.[15] from a literature review identified 18 papers published between April 2006 and March 2010 on carriage rates of HCWs ranging from 2% to 15%. A systemic search for literature which conducted in MEDLINE and EMBASES databases was made by the authors, 31 studies were included in this review[16]. The MRSA colonization rate was 1.8%-4.4%. The highest carriage rate was found in the nursing staff (6.9%).

Kei et al.[6] study 20 different inanimate objects in an ED and found only one MRSA from the ambulance bay security door keypad. Merlin et al.[17] studied 50 stethoscopes for MRSA and found 32%. Julian et al.[18] sampled 123 mobile phones of veterinary teaching hospital staff. The MRSA was found 2.4% of the mobile phones. Roberts et al.[19] found 21% dental students and 8.4% surfaces positive for MRSA.

In our study *S. aureus*/MRSA nasal carriage among ED workers (18.1%, 2.9%) was not different from the similar studies especially from our country and studies from Europe, but studies from different countries out of Europe showed different and high carriage rates[1-3, 12-14]. Nearly all the researchers say the same thing that HCWs have higher *S. aureus*/MRSA nasal carriage because of exposure[1-3]. HCWs are likely to be important in transmission of MRSA most frequently acting as vectors not as the main sources of MRSA transmission. Thus, good hand hygiene practices remain essential to control the spread of MRSA[5].

In our hospital, the standard precautions on infection control policy, consistently highlighted with a booklet, prepared by infection control committee, which found all services and clinics and also brochures which highlighted the importance of hand washing. Also we think the studies about contamination and carriage with nosocomial pathogens raise the awareness in HCWs and must be followed up.

Conflict of interest

No conflict of interest.

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