

# The Frequency of MRSA carriers in Health care workers in Gorgan, North of Iran

Somayeh Rahimi Alang<sup>1</sup>, Abolfazl Amini<sup>2</sup>, Fatemeh Cheraghali<sup>3</sup>, Alijan Tabbaraei<sup>3</sup>, Ezzat Allah Ghaemi<sup>3</sup>

<sup>1</sup> Young Researchers Club, Gorgan Branch, Islamic Azad University, Gorgan, Iran,

<sup>2</sup> Laboratory Science Research Center, Golestan University of Medical Sciences, Gorgan, Iran,

<sup>3</sup> Infectious Disease Research Center, Golestan University of Medical Sciences, Gorgan, Iran.

## Abstract

Methicillin resistant *Staphylococcus aureus* (MRSA) is one of the most important pathogen in hospitals. Healthcare personnel are the main source of nosocomial infections and identification and control of MRSA carriers can reduce incidence of infections. The aim of this study was to determine the frequency of methicillin resistant *Staphylococcus aureus* (MRSA) and their antibiotic susceptibility profile among healthcare workers in Gorgan located in northern Iran. Three hundred and thirty three of healthcare workers were participated in this cross-sectional study in 2010. Samples were taken with sterile cotton swabs from both anterior nares. Swabs were plated onto Mannitol salt agar. *S. aureus* were identified by Gram stain, Catalase, Coagulase and DNase tests. MIC (micro dilution broth) method was used to determine resistance of strains to methicillin. Antimicrobial susceptibility pattern to other antibiotics was performed by diffusion method. Frequency of *S. aureus* and MRSA carriers among healthcare workers was 24% (80.33) and 3% (10.33) respectively. MIC of isolates was varied between 0.5 and 65.31 (39%) of cases were showed MIC of intermediate that ranged between 4 and 8. Penicillin and Imipenem resistance were seen in 97.5% and 1.4% of isolated *S. aureus* strains, respectively. Frequency of *S. aureus* carriers in healthcare workers in our area was median in compare with other region in Iran but the MRSA carriage in healthy staff was lower than most part of Iran. It would be considering to monitor healthy carrier staff because of high rate intermediate MIC in this group to prevent conversion to MRSA.

**Key words:** *Staphylococcus aureus*; MRSA; Healthcare Workers; MIC, Iran

## Introduction

Hospital infections represent an important public health problem and they possess several factors. Microorganisms that cause these infections, has changed over the years. From the decade of the 80s, the gram positive microorganisms, especially the *Staphylococcus aureus*, have emerged as main causes of nosocomial infections.<sup>1</sup> The ecological niche of *S. aureus* strains is the anterior or nasal.<sup>2</sup> About 20% of the population are carriers of *S. aureus*.<sup>3,4</sup> This organism causes wide range of infections such as, bacteremia, septicemia, skin and soft tissue infections, bone infections, and pneumonia. They can be transmitted through direct contact and fomites.<sup>5</sup>

Colonization rate of this organism is higher in health care workers (HCWs) and are one of the important sources of *Staphylococcus* in hospital infections.<sup>3</sup> HCWs that are involved in hospitals, are a major source of infection transmission in patients.<sup>1</sup> About 25% of the health care workers are permanent nasal carriers, and 30% to 50% of them also possess the bacteria on their hands.<sup>4</sup> In usual strains isolated from the hands is typically same as that in the noses.<sup>6</sup> Occasionally, health care workers who carry *S. aureus* in their nares can cause outbreaks of surgical-site infections.<sup>4</sup> Virulence and ability to acquire resistance to antimicrobial agents of *Staphylococcus aureus* results in a serious worldwide problem for hospitals and health professionals.<sup>3</sup>

MRSA is a major worldwide nosocomial pathogen with severe morbidity and mortality, and is known as a multidrug-resistant. This is a big challenge in treatment of staphylococcal infections.<sup>7</sup> MRSA is found endemically in many hospitals. The severity of *Staphylococcus aureus* diseases and cost of therapy justify an investment in prevention and control of this organism. Identification and treatment of *Staphylococcus aureus* carriers can reduce MRSA infections.<sup>3</sup> The aim of this study was to determine the frequency of methicillin resistant *Staphylococcus aureus* (MRSA) and their antibiotic susceptibility profile among healthcare workers (HCWs) in 5Azar, Talqani and Dezyani hospitals in Gorgan.

## Methods

This cross-sectional study, performed in three hospitals, in Gorgan north of Iran in 2010. Of 728 health care workers, 333 volunteers were participated in this study. Demographic information and length of employment recorded. The people who have taken antibiotic in last three weeks were excluded from sampling. Specimens were collected from the anterior nares with sterile dry cotton swabs and inoculated immediately onto Mannitol salt agar. Hands samples also were taken and cultured on Mannitol salt agar. The samples were sent to the laboratory less than 2 hours and incubated at 37°C for 48-72 h. Mannitol fermented colonies were identified as *S. aureus* based on morphology, gram stain, catalase, coagulase (by both slide and tube methods) and DNase test. *S. aureus* is a gram positive, catalase positive, coagulase positive and DNase positive bacteria. MIC by micro dilution broth method has been used for determination of methicillin resistant *S. aureus*, MIC between 4-8 µg/ml and MIC ≤ 16 µg/ml considered as intermediate and methicillin resistant strains (MRSA) respectively.<sup>8,9</sup> Susceptibility test to methicillin and other antibiotics was carried out by disc diffusion method (Kirby-Bauer) according to NCLS protocol. 14 antibiotics (HiMedia) including amoxicillin (30mcg), ciprofloxacin (5mcg), cephalexin (30mcg), chloramphenicol (30mcg), erythromycin (15mcg), gentamicin (10mcg), imipenem (10mcg), methicillin (5mcg), nalidixic Acid (30mcg), penicillin (10units), tetracycline (30mcg),

trimethoprim (5mcg), vancomycin (30mcg) were used in this assay.

Isolated strains were cultured on Mueller-Hinton agar and above antibiotic discs placed with appropriate distance on plate with sterile pans. Plates were incubated 24h, at 37°C. Zone sizes of each antimicrobial agent was interpreted and reported as 'Resistant', 'Intermediate' and 'Sensitive' strains. Statistical analysis of data performed with X<sup>2</sup> test and ANOVA and all cases with P<0.05 was considered significant.

## Results

Participated HCWs were aged between 20-59 years old (35±8.2 years) that 80 of them (24%) were *S. aureus* carriers. From those 11 cases (13.8%) isolated only from their hands and in 58 cases (72.4%) isolation were seen only in nose of *S. aureus* carriers. 11 cases (13.8%) of carriers were showed *S. aureus* in their nose and hands simultaneously.

Results reveals higher frequency of *S. aureus* carriage among physicians (34.8%) in compare with other groups (P=0.004). Frequency of *S. aureus* carriers in HCWs who had cold at the time of sampling, were significantly lower than healthy carriers (P=0.016). Our data shows high level of frequency of *S. aureus* carriage in the operating room (42.3%) in comparison to ICU with the lowest prevalence of *S. aureus* carriers (7.14%) that was significantly different (P=0.047). There was no significant difference between other variables such as age, sex, hospital, years of working of *S. aureus* carriers and non-carriers. Previous exposure of staphylococcal infections between two groups was not statistically significant. Further data is summarized in Table 1.

Of 80 carriers of *S. aureus*, 10 (12.5%) of them were MRSA cases by micro dilution method. Thus prevalence of MRSA carriers in the community was 3%. One of the MRSA isolated cases was from HCW's hands and rest of them was isolated from their nose. The highest rate of MRSA carriers was from Dezyani hospital personnel, in compare with other hospitals. There was no any significant differences (P=0.07). Rest of data about MRSA strains and their relation with other variables such as wards, professional activity and gender is shown in Table 1. None of them were showed any statistical significance.

Table 1. Distribution of *Staphylococcus aureus* and MRSA carrier's according to variables studied

Variables	n	Carrier status	
		<i>S.aureus</i> , n (%)	MRSA, n (%)
Hospital			
5Azar	191	43 (22.5)	4 (2.09)
Dezyani	72	18 (25)	5 (6.94)
Talqani	70	19 (27.1)	1 (1.4)
Gender			
Male	110	30 (27.3)	2 (1.8)
Female	223	50 (22.4)	8 (3.5)
Professional Activity *			
Servants, Skilled attendance	112	37 (33)	4 (3.5)
Nurses, Midwives, Technicians	198	35 (17.7)	5 (2.52)
Physician	23	8 (34.8)	1 (4.37)
Previous Staphylococcal Infection			
Present	45	14 (31.1)	0
Absent	288	66 (22.9)	0
Common cold *			
Present	77	11 (14.3)	2 (20)
Absent	255	68 (26.7)	8 (80)
Ward *			
Operating room	26	11 (42.3)	1 (3.8)
Pediatric	15	6 (40)	0
Emergency	54	16 (29.6)	2 (3.7)
General	91	24 (26.37)	3 (3.2)
Women Section	27	6 (22.22)	1 (3.7)
Surgery	56	10 (18.85)	3 (5.35)
Infectious	19	3 (15.78)	0
Laboratory	31	3 (9.68)	0
Intensive care unit	14	1 (7.14)	0
MRSA, methicillin-resistant <i>Staphylococcus aureus</i> .			
* Difference in this group is statistically significant			

Table 2. Antibiotic resistant pattern of MRSA, MSSA strains isolated from HCWs

Antibiotic	MSSA (N = 70), (%)	MRSA (N = 10), (%)
Vancomycin	0	0
Imipenem	1.4	0
Ciprofloxacin	1.4	0
Gentamicin	4.3	0
Trimethoprim	7.2	0
Erythromycin	14.5	10
Tetracycline	11.6	20
Nalidixic Acid	33.3	50
Methicillin	66.7	80
Cephotaxime	60.9	90
Amoxicillin	91.3	90
Chloramphenicol	94.2	90
Penicillin	97.1	100
MSSA, methicillin-sensitive <i>Staphylococcus aureus</i> ; MRSA, methicillin-resistant <i>Staphylococcus aureus</i> .		

MIC for methicilin was assessed by microdilution method. MIC of isolates was varied between 0.5 and 65. 10 strains (12.5%) were resistant to methicilin by MIC of 16-64. 31 of cases (39%) were showed MIC of intermediate that ranged between 4 and 8.

By disc diffusion method highest rate of antibiotic resistance in both MRSA and MSSA cases was observed to penicillin, and 100% of MRSA strains and 97.1% of MSSA strains were resistant to penicillin. Antibiotics has been tested and their antibiogram results in both MRSA and MSSA strains is shown in Table 2.

## Discussion

Prevalence of *Staphylococcus aureus* carriers in Gorgan's health care workers was 24%. As it compared in Table 3, similar studies in Iran has been shown vary data in different parts of country. As the prevalence is differ from 12.7% in Yazd,<sup>21</sup> to extreme 45% in Meshgin shahr's HCWs.<sup>10</sup> Infact Gorgan's HCWs with 24% *Staphylococcus aureus* carriers is mean in the country. Similar foreign studies also shown vary results from 13% to 47.06% in HCW *Staphylococcus aureus* carriers.<sup>2,3</sup> Result of this study reveals average range of frequency of *Staphylococcus aureus* carriers in the world.

In contrast with some studies such as Sherertz who has been stated respiratory infections caused by cold viruses in *S. aureus* carriers, increases likely release of this organism,<sup>22</sup> our data demonstrated lower frequency of *S. aureus* carriers in HCWs who had cold at the time of sampling. This finding was significantly lower than people who had not cold. It is not clear whether this is an antagonistic phenomenon between *Staphylococcus aureus* and common cold viruses or is an accidental phenomenon? Further studies need to be done to explain this inconsistency.

Prevalence of MRSA carriers among health care workers was 3% in our study similar to Saderi's study with 2.87% frequency of MRSA that performed in Iran.<sup>17</sup> But most of Studies in Iran such as searches performed by Nikbakht,<sup>10</sup> Nafisi<sup>16</sup> and Khalili,<sup>21</sup> showed higher prevalence of MRSA Carriers with 16%, 13.23% and 7.6% respectively, however Karmastaji have gained 0% MRSA strains in her investigation on HCWs.<sup>20</sup>

Prevalence of MRSA carriers in HCWs in foreign countries has been ranged between 0.5% in Tambic study,<sup>23</sup> to 18.3% in Alghaity study.<sup>24</sup> In study that performed by Farzana on 129 HCWs prevalence of MRSA was 14%,<sup>4</sup> in contrast with two studies was performed on 260 HCWs<sup>25</sup> and 100 surgery ward staff,<sup>2</sup> showed 2% MRSA carrier in HCWs. Another study was performed on 340

Table 3. Frequency of *Staphylococcus aureus* carriers in different areas of personnel in health centers of Iran

City	Year	Number of Staff	S.aureus, n (%)	MRSA, n (%)	Reference
Meshkin shahr	2006	200	90 (45)	32 (16)	10
Sanandaj	2001	118	51 (43)	19 (16)	11
Qaem shahr	2003	100	36 (36)	ND	12
Tehran	2002	774	241 (31.1)	85 (11)	13
Mashhad	2009	90	28 (31.1)	ND	14
Shiraz	2006	600	186 (31)	32 (5.3)	7
Tehran	2006	253	65 (25.8)	ND	15
Shahrekord	2007	204	52 (25.5)	27 (13.23)	16
Tehran	2002	348	87 (25)	10 (2.8)	17
Gorgan	2010	333	80 (24)	10 (3)	This study
Ahvaz	2003	240	76 (22.5)	47 (17)	18
Rafsanjan	2007	220	44 (20)	17 (7.6)	19
Bandar abas	2008	200	33 (16)	0	20
Yazd	2006	742	94 (12.7)	57 (7.6)	21

MRSA, methicillin-resistant *Staphylococcus aureus*; ND, Non Determined.

HCWs's saliva demonstrated 4.1% MRSA carrier.<sup>3</sup> Considering to these results, it seems prevalence of MRSA carriers in our area is relatively low.

There was not seen any significant relationship between MRSA prevalence and factors assessed in this study such as age, gender, wards etc. However, number of MRSA isolation in nurses, midwives and technicians personnel's was higher than other professions (14.3%) but this difference failed to be significant. In the case of disc diffusion antibiotic resistance to penicillin, chloramphenicol, amoxicillin, cephotoxime and methicillin is very high. In fact, most of strains were multi-drug resistant. On the other hand as we expected 100% of MRSA strains and 97.1% of MSSA strains were resistant to penicillin as it has been shown in de Carvalho study 100% of the MRSA strains were resistant to penicillin.<sup>3</sup> Other researches such as Farzana's study was shown more than 80% resistant to penicillin of *S. aureus* carriers. And sensitivity and specificity of disc diffusion method in determining resistance to methicillin in this study, is 80% and 34.3% respectively.

Sensitivity of MRSA and MSSA strains, to vancomycin, immipenem, ciprofloxacin, gentamycin, trimethoprim, and even erythromycin, is more remarkable and their use in empirical treatment of *Staphylococcus* infections can be considerable.

### Acknowledgments

This research carried by financial support of infectious disease research center of Golestan university of medical science.

### References

1. Silva EC, Antas MG, Monteiro B Neto A, Rabelo MA, Melo FL, Maciel MA. Prevalence and risk factors for *Staphylococcus aureus* in health care workers at a university hospital of Recife-PE. *Braz J Infect Dis* 2008; 12: 504-508.
2. Vinodhkumaradithyaa A, Uma A, Srinivasan M, Ananthalakshmi I, Nallasivam P, Thirumalaikolundusubramanian P. Nasal carriage of methicillin-resistant *Staphylococcus aureus* among surgical unit staff. *Jpn J Infect Dis* 2009; 62: 228-229.
3. de Carvalho MJ, Pimenta FC, Hayashida M, Gir E, da Silva AM, Barbosa CP, et al. Prevalence of methicillin-resistant and methicillin-susceptible *S. aureus* in the Saliva of health professionals. *Clinics* 2009; 64: 295-302.
4. Farzana K, Rashid Z, Akhtar N, Sattar A, Khan JA, Nasir B. Nasal carriage of staphylococci in health care workers: antimicrobial susceptibility profile. *Pak J Pharm Sci* 2008; 21: 290-294.
5. Treacle AM, Thom KA, Furuno JP, Strauss SM, Harris AD, Perencevich EN. Bacterial contamination of health care workers' white coats. *Am J Infect Control* 2009; 37: 101-105.
6. Blok HE, Troelstra A, Kamp-Hopmans TE, Giggengack-Baars AC, Vandenbroucke-Grauls CM, Weersink AJ, et al. Role of healthcare workers in outbreaks of methicillin-resistant *Staphylococcus aureus*: a 10-year evaluation from a Dutch university hospital. *Infect Control Hosp Epidemiol* 2003; 24: 679-685.
7. Askarian M, Zeinalzadeh A, Japoni A, Alborzi A, Memish ZA. Prevalence of nasal carriage of methicillin-resistant *Staphylococcus aureus* and its antibiotic susceptibility pattern in healthcare workers at Namazi Hospital, Shiraz, Iran. *Int J Infect Dis* 2009; 13: 241-247.
8. Japoni A, Alborzi A, Rasouli M, Pourabbas B. Modified DNA extraction for rapid PCR detection of methicillin-resistant *Staphylococci*. *Iran biomed J* 2004; 8: 161-165.
9. Gradie E, Valera L, Aleksunes L, Bonner D, Fung-Tomc J. Correlation between genotype and phenotypic categorization of staphylococci based on methicillin susceptibility and resistance. *J clin microbial* 2001; 39: 2961-2963.
10. Nikbakht M, Hasannejad S, Rezazadeh B, Naghizadeh Baghi A, Ghorbani F, Faraji F, et al. Antibiotic resistance pattern of isolated strains of *Staphylococcus aureus* from personnel nasal specimens in Meshgin Shahr Valiasr Hospital. *J Ardabil Univ Med Sci Health Services* 2009; 9: 80-88.
11. Rashidian M, Taherpoor A, Goodarzi S. Nasal carrier rates and antibiotic resistance of *Staphylococcus aureus* isolates of Beasat hospital staff. *J Kurdistan Univ Med Sci* 2000; 21: 1-7.

12. Ghasemian R, Najafi N, Shojaiifar A. Nasal carriage and antibiotic resistance of *Staphylococcus aureus* isolates of Razi hospital personnel, Qa-emshahr; 1382. *J Mazandaran Univ Med Sci* 2003; 44: 79-86.
13. Rahbar M, Yaghoobi M, Fattahi A. Comparison of Different laboratory methods for detection of methicillin resistant *Staphylococcus aureus*. *Pak J Med Sci* 2006; 22: 442-445.
14. Naderinasab M, Ghabouli MJ, Naderi HR, Zarif R, Gholoubi A, Saeid Hedayati E, et al. Nasal carriage of *Staphylococcus aureus* and its relation to hand contamination of the staff of Imam Reza hospital. *Iranian J Otorhinolaryngology* 2009; 21: 95-99.
15. Zohorinia M, Soleimani E, Nobari H, Ahmadi K, Jafarian S, Bahmani N, et al. Frequency comparison of nasal and hand carriage of *Staphylococcus aureus* among the medical and non-medical staffs in Iranian Air Force Be' saat medical center. *J Army Univ Med Sci* 2006; 4: 901-907.
16. Nafisi MR, Kalhor H, Zamanzad B, Karimi A, Farokhi E, Validi M. Comparison of agar screen and duplex-PCR in determination of methicillin resistant *Staphylococcus aureus* (MRSA) strains isolated from nose of personnel in Hajar hospital of Shahre-kord, 2007. *J Arak Univ Med Sci* 2008; 11: 94-101.
17. Saderi H, Owlia P, Zafarghandi N, Jalali Nadoshan MR. Evaluation of antibiotic resistance in *Staphylococcus aureus* isolated from nose of two teaching hospitals staff of Shahed University. *J Mazandaran Univ Med Sci* 2004; 42: 69-75.
18. Alavi SM, Rajabzadeh AR, Dezfoulian A, Haghizadeh MH. Determination of nasal carriage of *Staphylococcus aureus* and anti microbial resistance among hospital personnel in Razi hospital Ahwaz, spring 2003. *J Ahwaz Univ Med Sci* 2006; 5: 381-384.
19. Zia Shekholeslami N, Rezaeian M, Tashakori M. Determination of the prevalence of *Staphylococcus aureus* nasal carriers and antibiotic resistance pattern in clinical wards staff of Ali- Ebne Abitaleb Hospital, Rafsanjan. *J Rafsanjan Univ Med Sci* 2009; 8: 27-36.
20. Karmostaji A, Moradi N, Boushehri E, Jahed M, Dadsetan B, Sanginabadi F. Nasal carrier rates and antibiogram pattern of *Staphylococcus aureus* strains isolated from hospital staff in teaching hospitals in Bandar Abbas. *J Hormozgan Univ Med Sci* 2008; 12: 95-101.
21. Khalili MB, Sharifi-Yazdi MK, Dargahi H, Sadeghian HA. Nasal colonization rate of *Staphylococcus aureus* strains among health care service employee's of teaching university hospitals in Yazd. *Acta Medica Iranica* 2009; 47: 315-317.
22. Sherertz RJ, Reagan DR, Hampton KD, Robertson KL, Streed SA, Hoen HM. A cloud adult: the *Staphylococcus aureus*-virus interaction revisited. *Ann Intern Med* 1996; 124: 539-547.
23. Tambic A, Power EG, Tambic T, Snur I, French GL. Epidemiological analysis of methicillin-resistant *Staphylococcus aureus* in a Zagreb trauma hospital using a randomly amplified polymorphic DNA-typing method. *Eur J microbiol Infect Dis* 1999; 18: 335-340.
24. Alghaithy AA, Bilal NE, Gedebou M, Weily AH. Nasal carriage and antibiotic resistance of *Staphylococcus aureus* isolates from hospital and non-hospital personnel in Abha, Saudi Arabia. *Trans R Soc Trop Med Hyg* 2000; 94: 504-507.
25. Brady RP, McDermott C, Graham C, Harrison EM, Eunson G, Fraise AP. A prevalence screen of MRSA nasal colonization amongst UK doctors in a non-clinical environment. *Eur J Clin Microbiol Infect Dis* 2009; 28: 991-995.

Corresponding author

Ezzat Allah Ghaemi,

Infectious disease Research Center,

Golestan University of Medical Sciences,

Iran,

E-mail: eghaemi@yahoo.com