American Journal of Microbiological Research, 2015, Vol. 3, No. 4, 144-147
Available online at http://pubs.sciepub.com/ajmr/3/4/4

DOI:10.12691/ajmr-3-4-4

Screening of MRSA in and outside Benghazi Hospitals

Saleh. H. Baiu[1], Nadia. E. AL-Abdli[2,*]

[1]Department of Botany, Faculty of Science, Benghazi University, Libya
[2]Department of Laboratory, Eye Hospital, Benghazi, Libya
*Corresponding author: batul.gr155@gmail.com

Received July 08, 2015; Revised July 25, 2015; Accepted August 05, 2015

Abstract **Background and Purpose:** Data on the carriage rate and antibiotic sensitivity pattern of *Staphylococcus aureus* strains prevalent in the community are not available for many developing countries including Libya. To estimate the extent of community *S. aureus* transmission, in particular methicillin-resistant *S. aureus* (MRSA), the prevalence of *S. aureus* nasal colonization in a population of healthy adults was determined. Factors associated with *S. aureus* nasal carriage and antibiotic sensitivity patterns of the isolates were also analyzed. **Methods:** A cross-sectional study involving 643 adults was conducted. Nasal swabs were examined for the presence of MRSA. Epidemiological information concerning risk factors for nasal carriage was also obtained. Antibiotic susceptibility testing was performed using the disk diffusion method according to the National Committee for Clinical Laboratory Standards guidelines. MRSA strains isolated were further subjected to Automated BD Phoenix. **Results:** Screening for suspected carriers of MRSA showed that most of the healthcare workers (technicians, nurses, and doctors) were asymptomatically MRSA-positive. *S. aureus* isolates were confirmed by various biochemical tests as per latest CLSI guidelines. Cefoxitin Disk Diffusion test was performed for the detection of methicillin resistance and antibiotic susceptibility was performed against different antibiotics as per CLSI guidelines. Statistical analyses showed that there was no significant relation between MRSA carriage and age and sex of the study population. The prevalence of MRSA nasal carriage was (21.4%) among HCWs, with some differences between hospitals, also prevalence of MRSA nasal carriage was (9.6%) among community. Hospital acquired MRSA were more susceptible to various antibiotics as compared to Community acquired MRSA. **Conclusion:** MRSA nasal colonization was found to be low outside of the health care environment.

Keywords: *Staphylococcus aureus, MRSA, health care workers, community*

Cite This Article: Saleh. H. Baiu, and Nadia. E. AL-Abdli, "Screening of MRSA in and outside Benghazi Hospitals." *American Journal of Microbiological Research*, vol. 3, no. 4 (2015): 144-147. doi: 10.12691/ajmr-3-4-4.

1. Introduction

MRSA is an abbreviation of methicillin resistant *S. aureus*, and is used to describe MRSA strains that are resistant to methicillin, a semi synthetic- penicillin [1], often described as superbug, is a serious health and global issue that is evolving to a general concern and deserves continues attention [2,3]. MRSA is one of the most important human pathogens. It is a common cause of hospital and community-acquired infections worldwide. In humans MRSA is able to cause a wide variety of different diseases, ranging from superficial skin inflammation to severe invasive infections in patients exposed to health care setting such as bacteremia, which leads to endocarditis and osteomyelitis [4,5,6,7]. MRSA colonization is mainly found in the anterior nares (40%) [8,9,10]. Nasal carriage of *S. aureus* is a potential source of infection and colonization often precedes infection. Humans may carry MRSA temporally or chronically. One of the important sources of staphylococci for nosocomial infection is nasal carriage among hospital personnel [11,12]. Occasionally, health care workers who carry MRSA in their nares can cause outbreaks of surgical-site infections [13,14]. Till recent times these MRSA strains were restricted to hospitals only as Health care associated MRSA (HA-MRSA). But now these strains have also emerged in the community, called as Community associated MRSA (CA-MRSA). In general, nasal carrier rates among hospital personnel and patients (60-70%) are much higher as compared to those among community carriers (30-50%) [9,10].

The aim of the current research was (a) to study the nasal carriage rate of MRSA, in community and in hospital settings and their antimicrobial susceptibility (b) to compare the nasal carriage rate of HA-MRSA with that of CA-MRSA and their antimicrobial susceptibility.

2. Material and Methods

2.1. Collection of Samples and Isolation of Bacteria

This study was performed from April to August 2013 in ten hospitals of Benghazi, Libya. (Psychiatric hospital and Al-Erada sanatorium, Benghazi Medical Center, 7th of October hospital, Benghazi Childrens hospital, Al-Joumhouria hospital, Cardiac Center, Nephrology Center,

Al-Jala Hospital, Urology and ENT Centers and Eye hospital).This study utilized two main instruments, questionnaire and nasal swabs . *S. aureus* strains were gathered during this study from 472 health care workers (Physician, nurses, helpers and technicians) and 119 administrative staff as hospital group from the hospital and 52 samples (from healthy adults and children) as control group from the community in Benghazi-Libya. The samples of the control group were collected from children at the primary Qadesia school , while, the adults (control group) included teachers of Al- Khansa school, and Al- Etehad school. The samples were collected from the right and left anterior nares by using swabs. These included demographic data (gender and occupation) and data on clinical conditions (history of antibiotic usage in the past 2 weeks, history of chronic illnesses and smoking habits). The ages of all study population were from 6 year to 65 year.

2.2. Cultivation and Identification

Specimens were collected from the anterior nares with sterile dry cotton swabs (SPA Cultiplast, Melano-Italy), dipped in normal saline (0.9%). All swabs were inoculated on blood agar (BA-HiMedia, India) and subsequently on Mannitol salt agar plates (MSA-HiMedia, India) and were incubated at 37°C for 24-48 hours. Well isolated colonies were initially Gram-stained and then biochemical tests such as catalase, DNase and coagulase tests [15].

2.3. Methicillin-Resistance Test

Methicillin resistance was tested using Mueller- Hinton agar with Cefoxitin disc (30 µg) by Kirby-Bauer disc diffusion method [16]. Zone diameters were measured and recorded after a 24h incubation at 37°C. A zone size of >22 mm was considered sensitive and < 21 was considered resistant [16].

2.4. Antibiotic Susceptibility Testing

Standardized Kirby-Bauer disc diffusion method, was performed on Mueller-Hinton agar. Single isolated colonies were selected and inoculated in Mueller-Hinton broth and placed in incubator for 24 hours at 37°C. When its turbidity is comparable to 0.5 McFarland turbidity standards, the plates were inoculated with each broth culture and left to dry before the application of antibiotic discs. The plates were inverted and incubated at 35-37°C for 18-24 hours. Results were interpreted according to the criteria of CLSI (2012) [17].

2.5. BD Phoenix Automated Microbiology System

Detection of MRSA strains by using BD phoenix Automated Microbiology system is a reliable method [18]. The Phoenix automated microbiology system (BD Diagnostic Systems) was used for accuracy in identification and susceptibility testing of MRSA strains . MRSA were confirmed by BD phoenix system in nephrology Center laboratory in Benghazi .

2.6. Statistical Analysis

Data were tabulated and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 18. Data were presented as frequencies. Chi-square analysis ($\chi 2$) was used in findings on comparison of positively MRSA nasal carriage cases according to individual characteristics. Evaluations were carried out at 95% confidence level and $P< 0.05$ was considered statistically significant.

3. Result

Out of 472 healthcare workers screened, 21.4% were found to be positive for MRSA in the anterior nares based on culture results, antimicrobial susceptibility to Cefoxitin and Phoenix Automated method. Colonies isolated from 101 subjects were resistant to Cefoxitin, of the 52 of general population, all of them were also investigated for MRSA colonization, where 5(9.6%) MRSA. According to the result obtained the carriage rate of MRSA among study population was higher among HCWs than among general population and administrative staff. Of the 164 patients who said they had had antibiotics in the past, 41 (25%) could not remember the date, 81 (49%) stated they had the antibiotics prior to a month previously, 25 (15%) within the month; and 17 (10%) said they had had antibiotics within the week, there was no difference between carriers and non carriers with regard to antibiotic usage in the past 2 weeks or chronic disease. There was no association between MRSA carrier state and smoking habits. The classification of the subjects based on location of work (hospital unit), age, and sex is shown in Table 1.

Table 1. Univariate analysis of potential factors for MRSA

Factor	No	MRSA		P
		*No	%	
Occupation				
Physician	121	37	(30.6)	0.012[a]
Nurses	167	34	(20.4)	
Helpers	83	19	(22.9)	
Technicians	101	11	(10.9)	
HCWs	472	101	(21.4)	
Administrative staff	119	17	(14.3)	
Community	52	5	(9.6)	
Age (years)				
<25	44	12	(27.3)	0.608[a]
25-55	586	107	(18.3)	
>55	13	4	(30.8)	
Gender				
Male	157	39	(24.8)	0.112[a]
Female	486	84	(17.3)	
Antibiotic				
Absent	380	68	(17.9)	0.196[b]
Present	263	55	(20.9)	
Chronic disease				
Absent	447	86	(19.2)	0.504[b]
Present	194	37	(19)	
Smoking habit				
Non-smoker	590	114	(20.2)	0.172[a]
smoker	53	9	(17)	

[a]Pearson chi-squared test applied.
[b]Fisher's exact test applied.

The antibiotic susceptibility of community associated (CA-MRSA) and hospitals associated (HA-MRSA) to different antibiotics is shown in Table 2.

Table 2. Resistance patterns of *S. aureus* strains isolated from carriers among study population.

Antibiotics	HCWs(224) No(%)	Administrative (46) No(%)	Community (11) No(%)
Penicillin	224 (100)	24 (52.2)	2(18.2)
Cefoxitin	101(45.1)	17(37)	5(45.5)
Gentamycin	41 (18.3)	5(10.9)	0 (0.0)
Ciprofloxacin	16 (7.1)	6(13)	0 (0.0)
Augmentin	101(45.1)	17(37)	5(45.5)
Erythromycin	62 (27.7)	5(10.9)	1 (9.1)
Clindamycin	16(7.1)	0 (0.0)	(0.0)
Cotrimoxazole	22(9.8)	0 (0.0)	2 (18.2)
Vancomycin	4(1.8)	0 (0.0)	0 (0.0)
Oxacillin	101(45.1)	17(37)	5(45.5)
Rifampicin	9(4)	0 (0.0)	0 (0.0)

4. Discussion

The distribution of methicillin resistant *S. aureus* (MRSA) is worldwide but, the frequency varies among different countries. Understanding and evaluating the sources of bacterial infection, risk factors associated with it and mode of bacterial transmission help in putting the effective plan for preventing and control of the infections, because MRSA is one of the most important causes of nosocomial infections worldwide. MRSA colonization and infection in acute and non-acute care facilities have increased dramatically over the past two decades, evidenced by the increasing number of reported outbreaks in the medical literature [19]. Because of its resistance to antibiotics, management of MRSA infections requires more complicated, toxic, and expensive treatment. It is important for healthcare professionals to understand the difference between colonization and infection. Colonization indicates the presence of the organism without symptoms of illness. *S. aureus* permanently colonizes the anterior nares of about 20% to 30% of the general population. Hospital workers are more likely to be colonized than persons in the general population, presumably because of increased exposure. Estimates of healthcare worker (HCW) carriage from the worldwide literature vary widely depending on the country, hospital specialty, and setting (endemic, non-endemic, or outbreak) [20]. Our results demonstrated clearly a prevalence rate of MRSA nasal carriage (21.4%) among HCWs, with some differences between hospitals, also prevalence of MRSA nasal carriage (9.6%) among general population. These rates are higher than those reported in other areas of the world [21,22,23,24]. Also Similar results were reported by [25,26,27,28]. These rates are lower than those reported in other areas of the world [29,30,31,32,33,34]. All differences between countries and hospitals may be explained by microbiological methods (from sampling technique to culture media), local infection control standards, and the local prevalence of MRSA.

A comparison of antibiotic sensitivity patterns of *S. aureus* in the community in Libya from previous studies with those obtained the present study disclosed MRSA isolated from HCWs and community samples at Benghazi Hospitals were multidrug- resistant (MDR). In general, resistant strains were more prevalent in the hospital than at community. This result was similar to the results of other studies This result was similar to the results of other studies [35,36].

This study also showed that the spread of MRSA is still limited in this community of healthy adults. However, the results of this study cannot be generalized as it was a cross-sectional study involving a selected community in a particular area of Libya. A more comprehensive study involving a larger population should be conducted to represent the Libyan population.

5. Conclusion

This study showed that health workers are prone to infection and can be a potential source of pathogens such as *S. aureus* in hospitals. Prevalence of nasal carriage MRSA was higher in hospitalized patients as compared to healthy subjects. Hospital acquired MRSA were more susceptible to various antibiotics as compared to Community acquired MRSA.

The following recommendations are essential in the containment of resistance to antimicrobial agents:

1. introduce routine MRSA screening of health care workers as part of a suite of infection control measures and continuous surveillance and improvement of hygiene standards should be adopted in Benghazi hospitals.
2. reassess policies in antimicrobial drugs use within and outside the hospital environment.

References

[1] Damon,T; Arnold, M.D.; Director, M.P.H. (2008): MRSA in Illinois Descriptive Analysis of Hospital Discharge Data 2002-2006. Illinois Department of Public Health 2008.

[2] Klevens, R.M; Morrison, M.A; Fridkin, S.K; Reingold, A; Petit, S; Gershman, K. (2007) Invasive methicillin-resistant *Staphylococcus aureus* infections in the United States. *The Journal of the American Medical Association*. 298 (15):1763-1771.

[3] Ahmed, M. O; Abuzweda, A.R; Alghazali, M. H; El ramalli, A.K; Amri, S.G; Aghila,E.Sh; and Abouzeed, Y.M.(2010a). Misidentification of methicillin resistant *Staphylococcus aureus* (MRSA) in hospitals in Tripoli, Libya. *Citation: Libyan J Med*. 5: 5230.

[4] Bassetti, M; Trecarichi, E.M; Mesini, A; Spanu, T; Giacobbe, D.R; Rossi, M; Shenone, E; Pascale, G.D; Molinari, M.P. (2011). Risk factors and mortality of healthcare-associated and community-acquired *Staphylococcus aureus* bacteraemia. *Clin. Microbiol. Infect.* 18(9):862-869.

[5] Changchien, C.H; Chen ,Y.Y; Chen, S.W; Chen ,W.L; Tsay, J.G; Chu, C .(2011). Retrospective study of necrotizing fasciitis and characterization of its associated methicillin resistant *Staphylococcus aureus* in Taiwan. *BMC Infect. Dis*. 11:297.

[6] Burdette, S.D; Watkins, R.R; Wong, K.K; Mathew, S.D; Martin, D.J; Markert, R.J. (2012). *Staphylococcus aureus* pyomyositis compared with non- *Staphylococcus aureus* pyomyositis. *J Infect*. 64:507-512.

[7] Vainio, A. (2012). Molecular Methods for the Epidemiological Analysis of Methicillin- Resistant *Staphylococcus aureus* (MRSA) and *Streptococcus pneumoniae*. National Institute for Health and Welfare (THL), Research 71, 164 pages. Tampere, Finland.

[8] Lowy, F.D.(1998). *Staphylococcus aureus* infections. N Engl J Med; 339:520-32.

[9] Smith, T.L; Pearson, M.L; Wilcox, K.R; Cruz, C; Lancaster, M.V; Robinson-Dunn, B. (1999). Emergence of vancomycin resistance in *Staphylococcus aureus*. N Engl J Med; 340: 493-501.

[10] Kaplan, S.L. (2005). Implications of methicillin-resistant *Staphylococcus aureus* as a community acquired pathogen in pediatric patients. Infect Dis Clin North Am; 19: 747-57.

[11] Wilson, J.A; Loveday, H.P; Hoffman, P.N. and Pratt, R.J. (2007). Uniform: an evidence review of the microbiological significance of uniforms and uniform policy in the prevention and control of healthcare-associated infections. Report to the Department of Health (England). *J. Hosp. Infect*. 66(4):301-307.

[12] Al-Abdli, N.E; Baiu, S.H.(2014). Nasal Carriage of *Staphylococcus* in Health Care Workers in Benghazi Hospitals. *American Journal of Microbiological Research*, 2 (4): 110-112.

[13] Cespedes, C; Miller, M; Quagliarello, B; Vavagiakis, P; Klein, R.S; and Lowy, F.D. (2002). Differences between *Staphylococcus aureus* Isolates from Medical and Nonmedical Hospital Personnel. *J. Clin. Microbiol*. 40:2594-2597.

[14] Luzar, M.A; Coles, G.A; Faller, B; Slingeneyer, A; Dah, G.D; Briat, C; Wone, C; Knefati,Y; Kessler, M; and Peluso, M (1990). *Staphylococcus aureus* nasal carriage and infection in patients on continuous, ambulatory peritoneal dialysis. *N. Engl. J Med*., 322: 505-509.

[15] Cheesbrough, M, District Laboratory Practice in Tropical Countries. Cambridge university, UK, 2009, 2 (2): (65-67).

[16] Bauer, A. W; Kirby, W. M; Sherris, J. C. and Turck, M, Antibiotic susceptibility testing by a standard single disk method. *Am. J. Clin. Pathol*, 1966; 45: 493-496.

[17] Clinical and Laboratory Standards Institute, Performance Standards for Antimicrobial Susceptibility Testing, Twenty-second Informational Supplement. CLSI document M100-S22. Wayne. PA, 2012.

[18] Deal, M; Votta, M; Halvis, S; Turng, B; Wiles, T; Reubenbd, J. (2002). Diagnostic Systems 2002. Detection of glycopeptide intermediate or *Staphylococcus aureus* strains by using BD phoenix Automated. 87-Microbiology system BD *Diagnostic Systems. 7 Loveton Circle. Sparks, MD, USA 21152*.

[19] Sydnor, R.M; Perl, T.M. (2011). Hospital Epidemiology and Infection Control in Acute-Care Settings. J Hosp Infect 77: 285-289.

[20] Hawkins, G; Stewart, S; Blatchford, O; Reilly, J. (2011). Should healthcare workers be screened routinely for meticillin-resistant *Staphylococcus aureus*? A review of the evidence. Clin Microbiol Rev 24: 141-173.

[21] Ghasemian, R; Najafi, N; Shojaei Far, A.(2004). Prevalence of *Staphylococcus aureus* carriages among Razi health care workers of Ghaemshahr, Iran. *Mazandaran Uni Med J*. 44:79–85.

[22] Cesur, S; Cokça, F. (2004). Nasal carriage of methicillin-resistant *Staphylococcus aureus* among hospital staff and outpatients. *Infect ion Control and Hospital Epidemiology*. 25(2):169-71.

[23] Fadheel, Z.H; Perry, H.E; Henderson, R.A.(2008). Comparison of methicillin-resistant *Staphylococcus aureus* (MRSA) carriage rate in the general population with the health worker population. *NZ J Med Lab Science* 62: 4-6.

[24] Mohammad Bagher, K; Mohammad Kazem, S.Y. (2009). Nasal Colonization rate of *Staphylococcus aureus* strains among Health Care Service Employee's of Teaching University Hospitals in Yazd. *Acta Medica Iranica* 47(4):315-317.

[25] Johnston, C.P; Stokes, A.K; Ross, T; Cai, M; Carroll, K.C; Cosgrove, S.E. (2007). *Staphylococcus aureus* colonization among healthcare workers at a tertiary care hospital. Infection Control and Hospital Epidemiology. 28:1404-1407.

[26] Mathanraj, S ; Sujatha, S; Sivasangeetha, K; Parija, S.C. (2009). Screening for methicillin-resistant *Staphylococcus aureus* carriers among patients and health care workers of a tertiary care hospital in south India. *Indian Journal of Medical Microbiology*. 27:62-64.

[27] Zorgani, A; Elahmer,O; Franka,E; Grera, A; Abudher, A; Ghengheah, K.S.(2009). Detection of meticillin-resistant *Staphylococcus aureus* among healthcare workers in Libyan hospitals. *Journal of Hospital Infection*. 73:91-92.

[28] Akhtar, N.(2010). *Staphylococcal* Nasal Carriage of Health Care Workers. Journal of the College of Physicians and Surgeons Pakistan. 20 (7): 439-443.

[29] Yazgi, H; Ertek, M; Ozbek, A; Kadanali, A. (2003). Nasal carriage of *Staphylococcus aureus* in hospital personnel and the normal population and antibiotic resistance of the isolates. *Mikrobiyol Bul* . 37(2-3):137.

[30] Mansour, M.K; Abd Rahman, S.A.(2006).Colonization By Methicillin Resistant *Staphylococcus aureus* Among Health Care Workers In Intensive Care Units. *Egyptian Journal of Medical Microbiology*. 15(3): 531-539.

[31] Shakya, B; Shrestha, S; Mitra, T.(2010) : Nasal carriage rate of methicillin resistant *Staphylococcus aureus* among at National Medical College Teaching Hospital, Birgunj. *Nepal Nepal Med Coll J*. 12(1):26-29.

[32] Shibabaw, A; Abebe, T; Mihret, A (2013). Nasal carriage rate of methicillin resistant *Staphylococcus aureus* among Dessie Referral Hospital Health Care Workers; Dessie, Northeast Ethiopia. *Antimicrobial Resistance and Infection Control*. 2:25.

[33] Truong, H; Shah, S.S; Ludmir, J; Twananana, E.O; Bafana, M; Wood S.M; Moffat, H; Steenhoff, A.P.(2011). *Staphylococcus aureus* skin and soft tissue infections at a tertiary hospital in Botswana. *S Afr Med J* 101(6):413-416.

[34] Fadeyi, A; Bolaji, B.O; Oyedepo, O.F(2010). Methicillin Resistant *Staphylococcus aureus* Carriage amongst Healthcare Workers of the Critical Care Units in a Nigerian Hospital. *Am J Infect Dis* . 6 (1) :18-23.

[35] Elgadi, S.A. (2000). Carriage rate and antibiotic sensitivity of *Staphylococcus aureus* in & outside Children's hospital-Benghazi Libya. An M.Sc, Gar younis University, Faculty of medicine.

[36] Opal, S.M; Mayer, K.H; Stenberg, M.J.(1990). Frequent acquisition of multiple strains of methicillin- resistant *Staphylococcus aureus* by healthcare workers in an endemic hospital environment. *Infect Control Hosp Epidemiol*. 11:479-485.