

Risk Factors for Colonization with *S.aureus* and Methicillin Resistant *Staphylococcus aureus* Among Health Care Workers in Al-Batool teaching hospital for maternity and children in Diyala, Iraq

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Abstract

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Background: *Staphylococcus aureus* colonization for the human nose representing a challenge that requires a cope with host defense and competing resident microorganisms.

Objective: To evaluate the risk factors for infection with *S. aureus* and MRSA among health care workers (HCWs) in Al-Batool teaching hospital for maternity and children in Diyala, Iraq.

Patients and Methods: A total of 27 swabs were taken from HCWs in Al-Batool teaching hospital for maternity and children in Diyala, Iraq (ATHMC) Standard microbiological procedures were used for diagnosis of *S. aureus* and Methicillin Resistant *Staphylococcus aureus* (MRSA).

Results: Significant correlation was reported between age and colonization with *S. aureus* & MRSA. Inverse correlation was reported between education level and colonization with *S. aureus* and MRSA. Significant correlation was reported between acne and colonization with *S. aureus*. Significant correlation was reported between sinusitis, years of experience, contact with farm animals and colonization with *S. aureus* and MRSA. Significant correlation was reported between ward of duty and colonization with MRSA.

Conclusion: Colonization with *S. aureus* and MRSA inversely correlated with younger age group, education level of HCWs. Colonization with *S. aureus* and MRSA correlated with sinusitis, years of experience (5 -6); contact with farm animals. Colonization with *S. aureus* correlated with acne. Colonization with MRSA correlated with ward of duty at children care floor.

Keywords: Health care workers, *S.aureus*, MRSA, Risk factors

Introduction

The *Staphylococcus aureus* has a colonization of the human nose represents a challenging impact that requires not only adherence to nasal epithelial cells but also competence to cope with host defense and competing resident microorganisms[1]. The continuous and heavy challenge of community- and hospital-acquired *S. aureus* infections poses a major threat for public health, mostly in children, pregnant women, and postpartum women [2].

Bloodstream infections with methicillin-susceptible(MSSA) and -resistant *S.aureus* (MRSA) raise of high-risk in hospitals death because the treatment requires frequent and prolonged hospitalization[3].At the same time, the hospital intensive care units represents the main site for MRSA, which is likely to cause and affect an outbreak[4].

S.aureus do not form spores or flagella, has possessed a capsule and produce gold-en-yellow pigment, with decomposed mannitol [5]. Furthermore, it has also been found that plasma test coagulase, lactose fermentation, additionally the deoxyribonuclease activity is positive in *S.aureus*[6].Most of *S.aureus* possess alpha-hemolytic activity, forming a perfect transparent hemolytic ring around bacterial colonies, seen on a blood agar[7].

For the species identification, slide and tube coagulase test, and PCR-based tests are utilized and molecular methods for the detection of *mecA* are employed for MRSA [8]. *S. aureus* invades and adheres to host epithelial cells using a diversity of molecules that are collectively called microbial surface the components recognizing adhesive matrix molecules [9].

To evaluate the risk factors for infection with *S.aureus* and MRSA among health care workers(HCWs) in Al-Batool teaching hospital for maternity and children in Diyala, Iraq, (ATHMC).

Patients and Methods

The study was conducted at Al-Batool teaching Hospital for Maternity and Children (ATHMC), Diyala. The study was performed consistent with local regulations. Informed consent and consistent with the (Declaration of Helsinki) was obtained of the take samples from HCWs. The Clinical Research Ethics Committee approved the study at (ATHMC, Diyala, Iraq).

Study Participants

Current study was conducted, from March to November 2020. The study included health care workers working in intensive care unit, children's care floor, Preterm care floor at ATHMC, Diyala, Iraq. Clinical and epidemiological data including: age, sex, smoking, using of hand disinfectants, education level, sinusitis, acne, years of experience, ward of duty, Contact with MRSA carriers, working with ambulant sector outside the work, contact with farm animals.

Study Samples

Nasal, mouth, and skin swabs from health care workers, were collected following a standardized protocol, inserting the swab tip from the places to be sampled and rotating and moving it for (five seconds) in each place. Transport swabs (AFCO, Origen Jordan) were used. The samples were submitted to microbiology laboratory of ATHMC, Diyala, Iraq. Isolation and diagnosis of *S. aureus* were based on

standard microbiological procedures, and methods and other interpretations were in accordance with the EUCAST guidelines [10].

Statistical Analysis

Health care workers demography and cross tabulation were calculated by SPSS for windows version 17 (SPSS, Armonk, NY: IBM Corp). Pearson's chi-square and Pearson's correlation coefficient were utilized for the correlation between parameters[11] . P value of ≤ 0.05 and ≤ 0.01 (2-tailed) were statistically significant [12, 13].

Results

As shown in Table (1), *S.aureus* was isolated equally from HCWs at the age group (22-24)year , (25-27) year ,2/27, (7.40%) ,followed by 1/27, (3.70%) for (28-30)year.

Significant difference p value= 0.024) and Inverse correlation (P value= 0.024)was re-

ported between age group(22-24) year of HCWs and colonization with *S.aureus*.

Significant difference (p value= 0.033) and correlation (P value= 0.033)was reported between age group(28-30) year of HCWs and colonization with *S.aureus*.The main group at risk for getting *S.aureus* colonization was (22-24) with(2.159) time compared with , (0.341) time for (25-27) year.

MRSA was isolated from HCWs at the age group (22-24),(25-27) ,(28-30) years 1/27, (3.70%). Significant difference (p value= 0.050) and Inverse correlation (P value= 0.052)was reported between age group(22-24) year of HCWs in ATHMC and colonization with MRSA.

Significant difference (p value = 0.004) and correlation (P value= 0.003) was reported between age group(28-30) year of HCWs in ATHMC and colonization with MRSA. The main group at risk for getting MRSA colonization was (22-24), with(2.5)time compared with (0.500) time for (25-27) year.

Table (1): Age as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC”

Age group	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	CI 95%
	<i>S.aureus</i>							
	Negative	Positive						
22-24	19(70.37%)	2(7.40%)	5.067	0.024*	-0.433	0.024	2.159	0.729- 6.398
25-27	3(11.11%)	2(7.40%)	1.877	0.171	0.264	0.184	0.341	0.076- 1.532
28-30	0(0%)	1(3.70%)	4.569	0.033	0.411	0.033	ND	ND
Total	22(81.48%)	5(18.51%)	27(100%)					
Age group	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	CI 95%
	MRSA							
	Negative	Positive						
22-24	20(74.07%)	1(3.70%)	3.857	0.050	-0.378	0.052	2.500	0.500-12.510
25-27	4(14.81%)	1(3.70%)	0.491	0.484	0.135	0.502	0.500	0.080- 3.127
28-30	0(0%)	1(3.70%)	8.308	0.004	0.555	0.003*	ND	ND
Total	24(88.89%)	3(11.11%)	27(100%)					

*Significant

Sex

As shown in Table (2), *S.aureus* was detected mainly from females HCWs in ATHMC ,3/27, (11.11%) ,followed by males, 2/27, (7.40%). Neither significant difference (p value = 0.629) nor correlation(P Value= 0.885) were reported between sex of HCWs in ATHMC and colonization with *S.aureus*. The risk of getting *S.aureus* colonization among females (1.061) compared with (0.909) for males .

MRSA was detected primarily in females HCWs in ATHMC,2/27, (7.40%) compared with 1/27, (3.70%) for males HCWs in ATHMC. Neither significant difference (p value= 0.697) nor correlation(P Value= 0.893) were reported between sex of HCWs in ATHMC and colonization with MRSA. The risk of getting MRSA colonization among males (1.125) compared with (0.938) for females.

Table (2): Sex as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Sex	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	CI 95%
	<i>S.aureus</i>							
	Negative	Positive						
Male	8(29.62%)	2(7.40%)	0.023	0.629	0.029	0.885	0.909	0.272- 3.041
Female	14(51.85%)	3(11.11%)	0.023	0.879	0.029	0.885	1.061	0.485- 2.319
Total	22(81.48%)	5(18.51%)	"27(100%)"					
Sex	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	CI 95%
	MRSA							
	Negative	Positive						
Male	9(33.33%)	1(3.70%)	0.020	0.697	-0.027	0.893	1.125	0.066- 10.553
Female	15(55.56%)	2(7.40%)	0.020	0.697	0.027	0.893	0.938	0.397- 2.211
Total	24(88.89%)	3(11.11%)	27(100%)					

Smoking

As shown in Table (3), *S. aureus* was detected among 3/27, (11.11%) nonsmoker HCWs in ATHMC compared with 2/27, (7.40%) smokers. Neither significant difference (p value =0.221) nor correlation (p value = 0.184) were reported between smoking habit of HCWs ATHMC and colonization with *S.aureus*. The odd ratio for colonization of nonsmokers versus smokers was (4.222).The risk of getting *S.aureus*

among smokers was (0.341) time compared with (1.439) for nonsmokers.

MRSA was detected among 1/27, (3.70%) from smoker and 2/27,(7.40%) nonsmoker HCWs in ATHMC. Neither significant difference (p value =0.484) nor correlation (p value = 0.502) were reported between smoking habit of HCWs ATHMC and colonization with MRSA". "The risk of getting MRSA among smokers was (0.500) time compared with (1.250) for nonsmokers.

Table (3): Smoking as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Smoking	S.aureus		MRSA		
	Negative	Positive	Negative	Positive	Total
No	19(70.37%)	3(11.11%)	20(74.07%)	2(7.40%)	22(81.48%)
Yes	3(11.11%)	2(7.40%)	4(14.81%)	1(3.70%)	5(18.51%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	1.877		0.491		
P value	0.221		0.484		
R	0.264		0.135		
P value	0.184		0.502		
Odds ratio for Smoking (no /yes)	Value	95% CI	Value	95% CI	
	4.222	0.485-36.767	5.250	.269- 102.424	
Risk estimate Smoking =yes	0.341	0.076- 1.532	0.500	0.080-3.127	
Risk estimate for Smoking =No	1.439	0.690- 3.001	1.250	0.551- 2.838	

Using of Hand disinfectants

“As shown in Table (4), *S.aureus* was detected among 4/27, (14.81%) of HCWs in ATHMC which regularly use hand disinfectant versus 1/27, (3.70%) who use hand disinfectants irregularly . Neither significant difference (p value =0.612) nor correlation (p value = 0.749) were reported between the use of hand disinfectant among HCWs in ATHMC and colonization with *S.aureus*. The risk of getting *S.aureus* among HCWs ATHMC that regularly use

disinfectant was lower, (0.909) compared with (1.364) for those irregularly use hand disinfectant. MRSA was detected among 2/27, (7.40%) of HCWs in ATHMC which claimed to regularly use hand disinfectant. Neither significant difference (p value =0.277) nor correlation (p value = 0.295) were reported between the use of hand disinfectant among HCWs in ATHMC and colonization with MRSA. The risk of getting MRSA among HCWs in ATHMC that regularly use disinfectant was (0.708) time

Table (4): Using of Hand disinfectants as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Using of Hand disinfectants	<i>S.aureus</i>		MRSA		
	Negative	Positive	Negative	Positive	Total
Regularly	16(59.25%)	4(14.81%)	18(66.66%)	3(11.11%)	20(74.07%)
Irregularly	6(22.22%)	1(3.70%)	7(25.92%)	0(0%)	7(25.92%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	0.112		1.181		
P value	0.612		0.277		
R	-0.064		-0.209		
P value	0.749		0.295		
Risk estimate Using of Hand disinfectants =regularly	0.909	.547- 1.510	0.708	0.548- 0.916	
Risk estimate for Using of Hand disinfectants =irregularly	1.364	.208-8.947	ND	ND	

Education level

As shown in Table, (5),*S.aureus* was isolated primarily from HCWs have Diploma of health care in ATHMC, 4/27, (14.81%) compared with 1/27,(3.70%) have Bachelor of nursing. Significant difference (p value =0.033) and inverse correlation (p value = 0.033) were reported between education level among HCWs in ATHMC and colonization with *S.aureus* . The risk for

colonization with *S.aureus* among those having Diploma of health care was (1.250).

MRSA was isolated from 2/27,(7.40%) ,HCWs in ATHMC . Significant difference (p value =0.004) and inverse correlation (p value = 0.003) were reported between education level among HCWs in ATHMC and colonization with MRSA. The risk for colonization with MRSA among those having Diploma of health care (1.500)time.

Table (5): Education level as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Education level	<i>S.aureus</i>		MRSA		Total
	Negative	Positive	Negative	Positive	
Bachelor of nursing	0(0%)	1(3.70%)	0(0%)	1(3.70%)	1(3.70%)
Diploma of health care	22(81.48%)	4(14.81%)	24(88.89%)	2(7.40%)	26(96.29%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	4.569		8.308		
P value	0.033*		0.004*		
R	-0.411		-0.555		
P value	0.033*		0.003*		
Risk estimate for Education level = Bachelor of nursing	ND	ND	ND	ND	
Risk estimate for Education level =Diploma of health care	1.250	0.806- 1.938	1.500	0.674- 3.339	

*Significant

Sinusitis

As shown in Table (6), *S.aureus* was isolated from 4/27, (14.81%) of HCWs in ATHMC have no sinusitis compared with 1/27, (3.70%) suffering from sinusitis. Significant difference (p value =0.033) and correlation (p value = 0.033) were reported between sinusitis among HCWs in ATHMC and colonization with *S.aureus*. The risk of getting *S.aureus* colonization among HCWs

in ATHMC without sinusitis was (1.250) time. MRSA was isolated from 1/27, (3.70%) of HCWs in in ATHMC have no sinusitis . Significant difference (p value =0.004) and correlation (p value = 0.003) were reported between sinusitis among HCWs in ATHMC and colonization with MRSA . The risk of getting MRSA colonization among HCWs in ATHMC without sinusitis was (1.500) time.

Table (6): Sinusitis as a risk factor for colonization with *S. aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Sinusitis	<i>S.aureus</i>		MRSA		Total
	Negative	Positive	Negative	Positive	
NO	22(81.48%)	4(14.81%)	24(88.89%)	2(7.40%)	26(96.29%)
Yes	0(0%)	1(3.70%)	0(0%)	1(3.70%)	1(3.70%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	4.569		8.308		
P value	0.033		0.004		
R	0.411		0.555		
P value	0.033*		0.003*		
Risk estimate for sinusitis=yes	ND	ND	ND	ND	ND
Risk estimate for sinusitis=No	1.250	0.806-1.938	1.500	0.674- 3.339	

*Significant

Acne

As shown in Table (7), *S. aureus* was isolated from 3/27, (11.11%) of HCWs in ATHMC have no acne compared with 2/27, (7.40%) suffering from acne. Significant difference (p value =0.002) and correlation (p value = 0.001) were reported between acne among HCWs in ATHMC and colonization with *S.aureus* .The risk of getting *S.aureus* colonization among HCWs in ATHMC without acne was (1.667) time.

MRSA was isolated from 2/27, (7.40%) of HCWs in in ATHMC have and do not suffering from acne versus 1/27,(3.70%)have acne.No significant difference (p value =0.069) nor correlation (p value = 0.074) were reported between acne among HCWs in ATHMC and colonization with MRSA. The risk of getting MRSA colonization among HCWs in ATHMC with acne was (0.080) time compared with those do not suffering from acne (1.438).

Table (7): Acne as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Suffering from acne	S.aureus		MRSA		
	Negative	Positive	Negative	Positive	Total
No	22(81.48%)	3(11.11%)	23(85.18%)	2(7.40%)	25(92.59%)
Yes	0(0%)	2(7.40%)	1(3.70%)	1(3.70%)	2(7.40%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	9.504		3.308		
P value	0.002		0.069		
R	0.593		0.350		
P value	0.001*		0.074*		
Risk estimate for Acne=yes	ND	ND	0.080	0.010-1.520	
Risk estimate for Acne=No	1.667	0.815-3.409	1.438	0.643-3.214	

*significant

Years of experience

As shown in table (8), *S.aureus* was isolated from 3/27, (11.11%) of HCWs in ATHMC have (1-2) years of experience compared with 1/27, (3.70%) for those with (3-4), (5-6) years of experience. No significant difference (p value = 0.686, 0.223) nor correlation (p value = 0.700, 0.239) respectively were reported between year of experience (1-2, 3-4) among HCWs in ATHMC and colonization with *S.aureus*. Significant difference (p value = 0.003,) and correlation (p value = 0.003) respectively were reported between year of experience (5-6) among HCWs in ATHMC and colonization with *S.aureus*. The risk of getting *S. aureus* colonization was higher among those with (3-4) years of experience (2.5) compared with those of (1-2) years ,(0.833).

MRSA was isolated equally from 1/27, (3.70%) of HCWs in ATHMC have (1-2), (3-4), (5-6) years of experience. Neither Significant difference (p value = 0.496, 0.885) nor correlation (p value = 0.515, 0.681) were reported between year of experience (1-2), (3-4) among HCWs in ATHMC and colonization with MRSA. Significant difference (p value = 0.004) and correlation (p value = 0.003) was reported between year of experience (5-6) among HCWs in ATHMC and colonization with MRSA. The risk of getting MRSA colonization was (1.625) among those with (1-2) years of experience compared with (1.375) for those with (3-4) years of experience.

Table (8): Years of experience as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Years of experience	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	C I 95%
	<i>S.aureus</i>							
	Negative	positive						
1-2	11(40.74%)	3(11.11%)	0.163	0.686	0.078	0.700	0.833	0.364- 1.909
3-4	11(40.74%)	1(3.70%)	1.485	0.223	-0.235	0.239	2.500	0.412- 15.157
5-6	0(0%)	1(3.70%)	4.569	0.003	0.411	0.003	ND	ND
Total	22(81.48%)	5(18.51%)	27(100%)					
Years of experience	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	C I 95%
	MRSA							
	Negative	Positive						
1-2	13(48.14%)	1(3.70%)	0.464	0.496	-0.131	0.515	1.625	0.315- 8.395
3-4	11(40.74%)	1(3.70%)	0.245	0.885	-0.083	0.681	1.375	0.262- 7.220
5-6	0(0%)	1(3.70%)	8.308	0.004	0.555	0.003*	ND	ND
Total	24(88.89%)	3(11.11%)	27(100%)					

*Significant

Ward of Duty

As shown in Table (9), *S.aureus* was isolated from HCWs in ATHMC at Children care floor, 3/27, (11.11%) ,followed by HCWs at Intensive care unit 2/27, (7.40%). Preterm care floor was clear. Neither significant difference(p value =0.726) nor correlation (; p value = 0.738) respectively were reported between ward of duty for HCWs in ATHMC and colonization with *S.aureus*. The risk of getting *S.aureus* colonization among HCWs at Intensive care unit in ATHMC was(0.795) versus (0.606) for those working in Children care floor . MRSA was isolated from HCWs in ATHMC at Children care floor, 3/27,

(11.11%) , workers at Intensive care unit and Preterm care floor were clear. Significant difference(p value =0.027) and correlation (p value =0.027) were reported between ward of duty at Children care floor for HCWs in ATHMC and colonization with MRSA.

Neither significant difference (p value =0.194) nor correlation (p value =0.209, 0.277) respectively were reported between working at intensive care unit, Preterm care floor for HCWs in ATHMC and colonization with MRSA. The risk of getting *S.aureus* colo-nization among HCWs at Children care floor in ATHMC was (0.333).

Table (9): Ward of Duty as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Ward of Duty	Type of isolates from HCWs in ATHMC		χ^2	P value	R	P value	Risk estimate	C I 95%
	<i>S.aureus</i>							
	Negative	Positive						
Intensive care unit	7(25.92%)	2(7.40%)	0.123	0.726	0.067	0.738	0.795	0.231-2.737
Children care floor	8(29.62%)	3(11.11%)	0.943	0.332	0.187	0.351	0.606	0.24- 1.497
Preterm care floor	7(25.92%)	0(0%)	2.148	0.143	-0.282	0.154	ND	ND
Total	22(81.48%)	5(18.51%)	27(100%)					
Ward of Duty	Type of isolates from HCWs in ATHMC"		χ^2	P value	R	P value	Risk estimate	C I 95%
	MRSA							
	Negative	Positive						
Intensive care unit	9(33.33%)	0(0%)	1.688	0.194	-0.250	0.209	ND	ND
Children care floor	8(33.33%)	3(11.11%)	4.909	0.027	0.426	0.027	0.333	0.189- 0.587
Preterm care floor	7(25.92%)	0(0%)	1.181	0.277	-0.209	0.277	ND	ND
Total	24(88.89%)	3(11.11%)	27(100%)					

Contact with MRSA

Carriers As show in in Table (10) *S.aureus* was isolated from 5 /27, (18.51%) HCWs who as-sumed that they do not have contact with MRSA carriers in hospital with neither signifi-cant difference(p value=0.057) nor significant correlation (p value=0.061).The risk of getting *S.aureus* colonization among HCWs who assumed that they do not have contact with MRSA carriers in hospital was (0.545). MRSA was isolated from 2 /27,

(7.40%) HCWs who assumed that they do not have con-tact with MRSA carriers in hospital. Neither significant difference (p value=0.828) nor significant correlation (p value=0.887). The risk of getting MRSA colonization among HCWs who assumed that they do not have contact with MRSA carriers in hospital was (1.063) versus (0.438) for those not sure if they have contact with MRSA carrier or not.

Table (10): Contact with MRSA carriers as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC

Type of isolates from HCWs in ATHMC					
Contact with MRSA carriers	<i>S.aureus</i>		MRSA		Total
	Negative	Positive	Negative	Positive	
No	12(44.44%)	5(18.51%)	15(55.55%)	2(7.40%)	17(62.96%)
I am not sure	10(37.03%)	0(0%)	9(33.33%)	1(3.70%)	10(37.03%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	3.610		0.022		
P value	0.057		0.828		
R	-0.366		0.029		
P value	0.061		0.887		
Risk estimate =I am not sure	ND	ND	0.438	0.159-1.206	
Risk estimate for =No	0.545	0.372- 0.799	1.063	0.459- 2.462	

Working with ambulant sector outside the work

As show in Table (11) *S.aureus* was isolated from 4 /27, (14.81%) HCWs in in ATHMC who do not work in ambulant sector versus 1/27, (3.70 %) Working with ambulant sector outside the work with neither significant difference (p value=0.484) nor significant correlation (p value=0.502). The risk of getting *S.aureus* colonization among HCWs who do not working in ambulant sector outside the work (1.136) time versus

(0.455) for those working in ambulant sector outside the work. MRSA was isolated equally from 1 /27, (3.70%) HCWs in ATHMC who do /do not work in ambulant sector outside the work with no significant difference(p value=0.069) nor correlation (p value=0.074).

The risk of getting MRSA colonization among HCWs who do not working in ambulant sector outside the work (1.840) versus (0.160) for those working in ambulant sector outside the work.

Table (11): “Working with ambulant sector outside the work as a risk factor for colonization with *S.aureus* and MRSA among HCWs in ATHMC”

Type of isolates from HCWs in ATHMC					
Working with ambulant sector outside the work	<i>S.aureus</i>		MRSA		Total
	Negative	Positive	Negative	Positive	
No	20(74.07%)	4(14.81%)	22(81.48%)	2(7.40%)	24(88.88%)
Yes	2(7.40%)	1(3.70%)	2(7.40%)	1(3.70%)	3(11.11%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	0.491		1.688		
P value	0.484		0.194		
R	0.135		0.250		
P value	0.502		0.209		
Risk estimate for working	0.455	0.051- 4.083	0.160	0.023- 1.092	
Risk estimate for not working	1.136	0.719- 1.796	1.840	0.458- 7.393	

Contact with farm animals

As show in Table (12) *S.aureus* was isolated from 4 /27, (13.33%) HCWs in ATHMC who do not have Contact with farm animals versus 1/27, (10%) they have contact with farm animals with significant difference(p value=0.033) and significant correlation (p value=0.033).

The risk of getting *S.aureus* infection among HCWs who have do not contact with farm animals (1.250) time. MRSA was

isolated equally from 2 /27, (7.40%) HCWs in ATHMC who do not have Contact with farm animals versus 1/27, (3.70%) have contact with farm animals with significant difference(p value=0.004) and correlation (p value=0.003). The risk of getting MRSA infection among HCWs who do not have contact with farm animals (1.500) time versus (0.250) for those contacted with farm animals.

Table (12): “Contact with farm animals as a risk factor for infection with *S.aureus* and MRSA among HCWs in ATHMC”

Type of isolates from HCWs in in ATHMC					
Contact with farm animals	<i>S.aureus</i>		MRSA		“Total”
	Negative	Positive	Negative	Positive	
No	22(81.48%)	4(14.81%)	24(92.59%)	2(7.40%)	26(96.29%)
Yes	0(0%)	1(3.70%)	0(0%)	1(3.70%)	1(3.70%)
Total	22(81.48%)	5(18.51%)	24(88.89%)	3(11.11%)	27(100%)
χ^2	4.569		8.308		
P value	0.033*		0.004*		
R	0.411		0.555		
P value	0.033*		0.003*		
Risk estimate for Contacting with farm animals =yes	ND	ND	0.250	0.031- 1.999	
Risk estimate for Contacting =No	1.250	0.806-1.938	1.500	0.674- 3.339	

*Significant

Discussion

In the present study, significant differences and inverse correlations were reported between age group (22-24) years of health care workers and colonization with *S. aureus* and MRSA. The main group at risk for getting *S. aureus* colonization was (22-24) with (2.159) time compared with the same group of age MRSA colonization was (22-24), with (2.5) time in ATHMC.

Current results come in accordance with a study achieved among HCWs at Evliya Celebi hospital in Turkey by [14], and [15, 16] in Ethiopia and [17] in Egypt, and [18] in Spain and [19] in Iran, they stated that the age of HCWs play no role in infection with *S.aureus* or MRSA. Although there are differences in the main group at risk for getting *S. aureus* and MRSA infection they weren't significant nor had a correlation between the age of HCWs and infection with *S. aureus* and MRSA.

In Brazil, [20], stated that the HCWs of younger age group (20-28) years were more colonized with *S.aureus* at (33.9%) which is at higher risk at 3.5 time greater than older age groups, (12.7%).

In current study, no correlation was reported between the sex as a risk factor for HCWs and colonization with *S. aureus* and MRSA for ATHMC which come in line with [21] in Iran, [22] in Nepal and [15] in Ethiopia, [18] in Spain, [19] in Egypt and [23] in Oman.

In current study, *S. aureus* was detected mainly among females HCWs, (11.11%), and males, (7.40%) while MRSA was detected among females HCWs, (7.40%) compared with (3.70%) for males. These results come in accordance with that reported in Brazil by, [20], who reported that *S.aureus* was isolated from (26.5%) of females HCWs versus (22.2%) for males HCWs without significant correlation between the sex of

HCWs and MRSA . Similar conclusion was recorded by [19] from Iran. Current results come in contrary with several studies around the world such as [22] who stated that colonization of MRSA was high among males (8.7%) than in females (4.3%) ($p > 0.05$). Accordingly [24], reported higher MRSA colonization in males (7.2%) in comparison to females (5.8%) in Argentina , while [25] from Nepal ,reported that colonization was higher in fe-males (8.3%) in comparison to males (5.1%).

The risk of getting *S. aureus* colonization among females HCWs in ATHMC was (1.061) versus (0.909) for males HCWs which come in agreement with [26] who stated that the risk of colonization of *S.aureus* was more frequent among males HCWs working at chil-dren hospitals in Bangladesh”. “The risk of getting MRSA colonization among males HCWs in ATHMC (1.125) compared with (0.938) for females HCWs.

A study achieved by [14],in Turkey come agreement with current result. In Azadi teaching hospital in Kirkuk city\Iraq, [27] stated that the prevalence of *S.aureus* was higher in males (52.4%), versus (47.6%) for females on the other hand the prevalence of MRSA infection was (1.6%) for males versus for (1.2%) females including HCWs. While in current study MRSA was detected among females HCWs, (7.40%) versus (3.70%) for males . Here the variation may have attributed to the differences in the samples size and demographic distribution beside the quality of collected samples and differences in the quality of hospital environment as well as in the microbiological procedures that used for diagnosis and differences in the

infection control measures in different countries . On the other hand [15, 16, 22] stated that ,sex play no role as risk factor for carriage rate of MRSA.

In the present study, *S.aureus* was detected among (11.11%) of nonsmoker health care workers compared with (7.40%) of smokers, while MRSA was detected among (3.70%) of smokers and (7.40%) of non-smoker healthcare workers. No correlation was reported between the smoking habit of HCWs and colonization with *S. aureus* and MRSA in ATHMC which come in line with that reported by [26, 28]. The result of current study come in line with that reported by a study achieved in the college of dentistry at Karbala University, Iraq, who stated that non-smokers are more likely to have *S.aureus* infec-tions[29]. In contrary to the present result [22],stated that significant correlation was re-ported between smoking and *S.aureus* isolation from HCWs in Nepal and similar conclu-sion was reported in Taiwan [30].

In ATHMC, *S. aureus* was detected among (14.81%) of HCWs, who regularly use hand disinfectants versus (3.70%) who use hand disinfectants irregularly. MRSA was detected among (7.40%) of HCWs who claimed to regularly use hand disinfectant. No correlation was reported between the use of hand disinfectant among HCWs colonized with *S. aureus* or MRSA.

A study achieved by [31] in among Indian HCWs confirmed that, (51.61%) of HCWs were positive for MRSA and after the use of an alcohol-based hand sterilization a total of (9.68%), HCWs were remained positive for MRSA. This corresponds with cur-rent study, and the possibility for persistence of MRSA

may attributed insufficient time for hand rubbing and superficial cleaning of hand dirt's as well as direct contact with contaminated surfaces such as walls, tools, patients skin and clothes beside the role of the length of the nails of HCWs (especially females) which is a reason for not fully sanitizing the hand despite using sterilization. Current study come in contrary with [15, 16], who stated that hand washing practice among HCWs have no role in minimizing of infection with *S.aureus* and MRSA. On the other hand the contentious exposure of gloves and gown of HCWS for contamination with *S.aureus* and other pathogens especially during health care activities and exposure to the contaminated secretions[32], which facilitate the second line of problem as the HCWs will be the source for contamination for patients and hospital environment [33, 34]. Another source for contamination was the mobile phone which was used even at duty that permit the possibility of cross contamination and failure of safety precautions[35].

In current study, *S.aureus* was recovered from (14.81%) of HCWs who have a diploma in health care, compared with (3.70%) among those who have a Bachelor of nursing.

In ATHMC, MRSA was isolated from (7.40%), of HCWs in had a diploma in health care, and (3.70%) with a bachelor of nursing. “No significant correlation was reported between education level among HCWs, which come in line with that reported by [36, 37] while inverse correlation was reported between education level among HCWs and colonization with *S. aureus* and MRSA in ATHMC”.

“The risk for colonization with *S.aureus* among those having a diploma in health care was (1.250), while the risk for colonization with MRSA among those having a diploma in health care was(1.500) time in ATHMC. These results come in agreement with [38], who stated that nurses was at 2.58 times higher than other HCWs for getting MRSA.

On the other hand [39], reported that the risk for nursing staff of being colonized with MRSA was almost two-fold higher than for medical staff and three-fold higher than for other healthcare staff. Results of current study come in partial agreement with [14], in turkey and [40] in Gaza Strip-Palestine and [41] in Saudi Arabia, stated that the education level play no role in infection with *S.aureus* and MRSA among HCWs. The possible explanation for high isolation rate of *S. aureus* and MRSA from those with diploma in health care may attributed to their adherence with patients and entry for different hospital wards during their shift, change of patients dressing and continuous exposure for several possible sources for infection.

In current study, *S.aureus* was in (14.81%) of HCWs have no sinusitis versus (3.70%) suffering from sinusitis, while MRSA was in (3.70%) of HCWs who have no sinusitis.

Significant correlations was reported between sinusitis among HCWs and colonization with *S. aureus*, and marginal correlation was reported between sinusitis among HCWs and colonization with *S. aureus* and MRSA, in ATHMC. These results come in accordance with [39] and in contrary with that reported by [36] who stated that there was no significant correlation between *S. aureus* and MRSA colonization and sinusitis among HCWs.

In the present study, *S.aureus* was isolated from (11.11%) of HCWs , who have no acne versus (7.40%) suffering from acne, while MRSA was isolated from (7.40%) of HCWs who do not suffer from acne. Significant correlations were reported between acne among HCWs colonization with *S. aureus*, in ATHMC which come in line with that re-ported by [38],who stated that acne represent a important risk factor for MRSA coloniza-tion among HCWs.

In the present study, in ATHMC. *S. aureus* was from (11.11%) of HCWS have (1-2) years of experience compared with (3.70%) for those with(3-4),(5-6) years of experience, while MRSA was isolated equally from (3.70%) of HCWs have (1-2),(3-4),(5-6) years of experience. Significant correlation respectively were reported between years of experience (one, two) among HCWs and colonization with *S.aureus* which come in agreement with In ATHMC, No correlation respectively was reported between years of experience (1-2, 3-4) among HCWs and colonization with *S.aureus* and MRSA, while significant correla-tion was reported between years of experience (5-6) among HCWs colonized with *S.aureus* and MRSA which come in line with [16, 36, 41] .

Contradictory result reported by [42],who stated that HCWs with few years of experi-ence were more susceptible for colonization with *S.aureus* and MRSA. The possible ex-planation for the correlation between the years of experience and the coloniza-tion/infection rate of *S.aureus* may have attributed to the continuous exposure for microbes due to the heavy duty especially at the first years of occupation as a medical staff that required adhesion with clinical

cases furthermore the limited awareness about personal protection during the routine work which is usually noticed with those of limited years of experience .

In current study, In ATHMC *S.aureus* was isolated from HCWs on the Children's care floor, (11.11%), followed by HCWs in the Intensive care unit (7.40%), while MRSA was from HCWs on the children's care floor, (11.11%). These results come in approximate of that recorded in Sultan Qaboos University hospital in Oman, where the prevalence of MRSA reach up to 9.1% in neonate intensive care unit however they reported a high prevalence in surgery unit 21.4%[23].

No correlation was reported between ward of duty and colonization with *S. aureus* and MRSA in ATHMC. Which come in accordance with that reported in Iran by [21] and in Oman by [23].

Significant correlations were reported between wards of duty on the children's care floor for HCWs colonization with MRSA in ATHMC. One of the reasons that lead to high rates on the children's floor is the basic design of the building that is not designated as a hospital and the large number of children admitted at a ward that exceeds the basic capacity of the rooms, which certainly leads to cases of contamination and cross-contamination .

This lead to subsequent spread of the pathogens from one place to another, whether in the hospital environment or to the skin of the coming patient. This happened due to the lack of awareness of the necessity to perform hand disinfection with alcoholic solutions to reduce the number of germs and thus the possibility of transmission of the pathogens to the medical staff and to the

largest possible number if we take into account the frequent use of tools such as tables and desks on which the mobile phone or papers are placed of the patient, which is very likely to contain pathogenic germs. In a study achieved by [16], they stated that there was no significant relationship between specialties and *S. aureus* or MRSA infection .

In the present study, in ATHMC. *S. aureus* was isolated from (18.51%) of HCWs who assumed that they do not have contact with MRSA carriers, while MRSA was isolated from (7.40%) of HCWs who assumed that they do not have contact with MRSA carriers, with no significant correlation for *S. aureus* and MRSA in ATHMC. These results come in line with that reported by [38], stated that contact with MRSA carrier with or without protective clothes have no effect on the possibility of colonization among HCWs. Current results indicate the limited awareness about the presence of *S. aureus* and MRSA around in hospital and their critical role in serious consequences for patient and medical staff equally.

In current study, *S. aureus* was isolated from (14.81%) of HCWs who do not work in the ambulant sector versus (3.70 %) of those working in the ambulant sector outside the work.

These results come in agreement with [38, 43] ,they stated that working in ambulant sector outside the work represent a considerable risk for getting *S. aureus* /MRSA and then transmitted to the patient and /or hospital environment.

In ATHMC, *S. aureus* (13.33%) of HCWs hospitals that do not have contact with farm animals versus (10%) that have contact with farm animals, the risk of getting *S. aureus*

colonization among HCWs who have contact with farm animals (3.500) times. These results come in agreement with [44], who stated that the German HCWs how have direct or indirect contact with calves and /or pigs have 10 fold possibility of getting *S. aureus*. Current results come in agreement with [38, 43]. In the other hand ,the possibility of cross-transmission from farm or even pets animals to human leads to form a status of transient to stable colonization especially if they have sinusitis or dermatitis among HCWs who have contact with these animals [39] ,and subsequently they act as a vector for transmission of *S. aureus* /MRSA to the following patients during their ward duty [43].

Conclusions

Inverse correlation was reported between younger age group , education level of HCWs and colonization with *S. aureus* and MRSA .Significant correlation was reported between age group (28-30) year of HCWs in ATHMC and colonization with MRSA. Significant correlation was reported between sinusitis , years of experience (5-6) years ,contact with farm animals and colonization with *S. aureus* and MRSA .Significant correlation was reported between acne and colonization with *S. aureus* .Significant correlation was reported between ward of duty at children care floor and colonization with MRSA.

Recommendations

Take care for the role of health care workers in the transmission of *S. aureus* and MRSA for the patients and hospital environment.

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Conflict of interest: Nil

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عوامل الخطر للاستعمار بالمكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين بين العاملين في مجال الرعاية الصحية في مستشفى البتول التعليمي للولادة والأطفال في ديالى ، العراق

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الملخص

خلفية الدراسة: يمثل استعمار المكورات العنقودية الذهبية في أنف الإنسان تأثيراً صعباً يتطلب التعامل مع دفاع المضيف والكائنات الحية الدقيقة المقيمة المنافسة.

اهداف الدراسة: عوامل الخطر للاستعمار بالمكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين بين العاملين في مجال الرعاية الصحية في مستشفى البتول التعليمي للولادة والأطفال في ديالى ، العراق.

المرضى والطرائق: تم أخذ ما مجموعه ٢٧ مسحة من العاملين في مجال الرعاية الصحية في مستشفى البتول التعليمي للولادة والأطفال في ديالى ، العراق ، واستخدمت الإجراءات الميكروبيولوجية القياسية لتشخيص بكتريا العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين.

النتائج: وجد علاقة ارتباط إحصائي بين العمر والاستعمار ببكتريا المكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين. وجد ارتباط عكسي بين مستوى التعليم والاستعمار ببكتريا المكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين. وجد ارتباط كبير بين حب الشباب والاستعمار ببكتريا المكورات العنقودية الذهبية. وجد ارتباط كبير بين التهاب الجيوب الأنفية ، وسنوات الخبرة ، والتواصل مع حيوانات المزرعة والاستعمار ببكتريا المكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين. وجد ارتباط كبير بين ردهه الواجب في طابق رعايه الاطفال و الاستعمار ببكتريا المكورات العنقودية الذهبية المقاومة للميثيسيلين

الاستنتاجات: الاستعمار ببكتريا المكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين مرتبطان عكسياً بالفئة العمرية الأصغر ، والمستوى التعليمي للعاملين في مجال الرعاية الصحية . الاستعمار ببكتريا المكورات العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين مرتبطان بالتهاب الجيوب الأنفية ، عدد سنوات الخبرة (٦-٥) ، ملامسة حيوانات المزرعة. الاستعمار ببكتريا المكورات العنقودية الذهبية مرتبط بحب الشباب. الاستعمار ببكتريا المكورات العنقودية الذهبية المقاومة للميثيسيلين مرتبط بجناح الواجب في طابق رعايه الأطفال.

الكلمات المفتاحية: العاملون في الرعاية الصحية ، بكتريا المكورات العنقودية الذهبية ، بكتريا المكورات العنقودية الذهبية المقاومة للميثيسيلين، عوامل الخطر

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