NASAL CARRIERS OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA), INFECTION SAFETY AND HAND HYGIENE AMONG HEALTH WORKERS IN SULAIMANI CITY

Narmeen Nasradden Fathi*, Sherko A Omer* and Mohammed O Mohammed**

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ABSTRACT

Background

Staphylococcus aureus, a well known constant human pathogen that also exploit human as carrier to new hosts when inhabiting area like nose and skin. Over years strains had emerged with ability to resist the effect of several antimicrobial agents. The ability to resist the methicillin caused by different genetic backgrounds was one of the problems in the fight against these organisms.

Objectives

This study was aimed to isolate and identify Methicillin resistant *Staphylococcus aureus* (MRSA) inhabiting the nose of health workers in the main hospitals in Sulaimani city and to identify the susceptibility of these strains to several antimicrobial agents, also to inquire about daily infection safety and hand hygiene practice of the health workers.

Methods

To those who agreed to participate in the study, questionnaires were documented. Nasal swabs were obtained and isolation of *Staphylococci* was done on selective media, then *S. aureus* was confirmed and subjected to antimicrobial susceptibility using disk diffusion method.

Results

The participants were grouped in to nine occupational groups. Gloves were always used by 30.5% of the participants, not used in 18.8% and the other 50.6% were selective in using gloves. Hand cleansing with antiseptic were practiced in 31.7% while face mask were used by 18.4%. Hand washing during work in health facility were not practiced in 58.6%, 1-10 times hand washing was reported in 20.4%, 11-20 times hand washing in 10.8% and more than twenty time washing in 10%. Forty five out of 249 nasal swabs yielded *S. aureus* making the carrier rate of 18% while methicillin-resistant *S. aureus* rate was 5.6% among the participants.

Conclusion

Hand hygiene practice and infection safety were suboptimal in our health facilities. Nasal carrier of *S. aureus* was 18% in health workers while MRSA strains were isolated in 5.6% of the health workers. Prompt measure for hand hygiene must be implemented urgently to control transmission of *S. aureus* and to limit development of antimicrobial resistance.

Keywords: *MRSA*, *Staphylococcus aureus*, *Health workers*, *Sulaimani*.

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*Department of Microbiology, School of Medicine, Faculty of Medical sciences, University of Sulaimani.
Corresponding email: sherko.omer@univsul.net

**Department of Medicine, School of Medicine, Faculty of Medical sciences, University of Sulaimani.

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INTRODUCTION

The staphylococci are gram-positive spherical cells, usually arranged in grapelike irregular clusters. They grow readily on many types of media and are active metabolically, fermenting carbohydrates and producing pigments that vary from white to deep yellow [1]. Rosenbach provided the first taxonomic description of *Staphylococcus* in 1884 when he divided the genus into *Staphylococcus aureus* and *Staphylococcus albus* [2]. *Staphylococcus aureus* is aerobic, facultatively anaerobic and non motile. It grows well in a variety of commercial broth media, including trypticase soy broth, brain–heart infusion broth and tryptose phosphate broth, with or without the addition of blood. Commonly used selective media include mannitol salt agar, lipase salt mannitol agar, Columbia colistin–nalidixic acid (CNA) agar and Baird–Parker agar base supplemented with egg yolk tellurite enrichment [3]. *S. aureus* possess several cellular and secreted components. Among important cell-surface associated and secreted proteins are Protein A, Clumping factor A and B, Fibronectin-binding proteins, Biofilm-associated protein and other binding proteins and it produces a group of functionally related pyrogenic toxins that cause fever and shock in its hosts such as staphylococcal enterotoxins (SEs) and toxic shock syndrome toxin-1(TSST-1) [3]. Most *S. aureus* strains (98–99%) exhibit coagulase activity [4].

Three *S. aureus* carriage patterns have been described in the healthy adult population, with approximately 20% of individuals being persistent *S. aureus* carriers, about 60% intermittent carriers and 20% persistent non-carriers [5]. The nose is the dominant ecological niche for *S. aureus*, as demonstrated by loss of carriage from other sites following nasal decolonization using a topical antibiotic. Throat carriage also occurs in some individuals, sometimes in the context of a negative nasal swab [3, 6].

S. aureus is a leading cause of community-acquired infections and the first cause of nosocomially acquired bacteremia, along with coagulase-negative staphylococci [7, 8]. *S. aureus* have developed resistance to virtually all antibiotic classes available for clinical use. These encompass cell wall inhibitors such as β-lactams and glycopeptides, ribosomal inhibitors, aminoglycosides, tetracyclines, fusidic acid, and the new oxazolidinones, the RNA polymerase inhibitor rifampin, the DNA gyrase blocking quinolones, and the antimetabolite trimethoprim-sulfamethoxazole through different genes located on the bacterial chromosome, different plasmids or both [3, 9]. Penicillinase is a secreted enzyme that hydrolyzes penicillin and other penicillinase susceptible compounds into inactive penicilloic acid. [10]. Penicillinase-producing *S. aureus* emerged rapidly after penicillin was introduced as a therapeutic agent in the mid 1940s. They are prevalent both in the hospital and in the community, where it represents close to 80% of the isolates [9, 11]. The first penicillinase-stable β-lactams such as cephalosporins and semisynthetic methicillin and nafcillin became available in the late 1950s and the first MRSA was described at about the same time [12]. The gene encoding methicillin resistance (*mecA*) is carried by the chromosome of MRSA and methicillin-resistant *S. epidermidis* (MRSE), the mechanism for which is the synthesis of an altered low-affinity PBP termed PBP2a. *mecA* is part of a mobile genetic element termed staphylococcal cassette chromosome *mec* (SCCmec) [13].

The prevalence of MRSA progressively increased thereafter [14, 15]. One survey of the National Nosocomial Infections Surveillance System in United States reported that the hospital prevalence of MRSA increased from 2.1% in 1975 to 35% in 1991 [16], however different figures from different countries reported figures ranging from less than 2% (the Netherlands) up to 70% in Japan and Hong Kong [17].

Hospital infection control measures may prevent a proportion of nosocomial infections of *S. aureus*. Hand washing plays a central role, reducing transmission of pathogens between individuals and from the hands of a given individual to vulnerable sites such as wounds and dialysis catheters. Medical staff are educated and actively encouraged to follow guidelines that reduce infection rates in given settings [3]. Eradication of *S. aureus* carriage is usually achieved by the topical application of antibiotic to the anterior nose. The most common agent in use is mupirocin, which has also been applied to exit sites of prosthetic devices such as intravenous and peritoneal dialysis catheters [3].

The aim of this study was to address infection safety practice during work in health facilities among various health workers and identify the nasal carriers *S. aureus* and to identify

antimicrobial susceptibility pattern of these organisms especially to methicillin and to identify relation between carriage and daily safety practices.

MATERIALS AND METHODS

Health workers from different hospitals were included in this study after it was approved by ethical committee in School of Medicine. Prior permission to participate in the study was obtained. Participants were interviewed for a questionnaire, information concerning patient contact, use of gloves, masks and hand washing attitude were emphasised. The study included apparently healthy persons and persons whom have a recent antibiotic use were not included in the study.

Media and solutions were prepared as per manufacturer's recommendation. All used swabs, media and solution were disinfected properly before their discard.

Sterile cotton swab (Transport Swab, CITOTEST ^{TM}) moisturised with sterile normal saline solution (0.9 % NaCl in dH_2O) was used to obtain swabs from both anterior nares. The samples were preceded within at least 2 hours. For isolation of *S. aureus*, the swabs were inoculated on mannitol salt agar (HIMEDIA, India). The medium consist of 75 g NaCl, 10 g D-Mannitol, 10 g Proteose peptone, 1 g beef extract, 15 g Agar and 0.025g Phenol each per litter at pH 7.4 ± 0.2 at 25C°. Mannitol salt agar is a selective medium for the isolation of presumptive pathogenic *staphylococci*. Most other bacteria are inhibited by the high salt concentration with the exception of some halophilic marine organisms. Presumptive coagulase-positive *staphylococci* produce colonies surrounded by bright yellow zones whilst non- pathogenic staphylococci produce colonies with reddish purple zones [(18)]. Swabs were inoculated at 37ºC for 18-24 hours. Growth was observed and mannitol fermentation colonies were further investigated. Few strains of *S. aureus* may exhibit delayed mannitol fermentation, negative results were therefore re-incubated for an additional 24 hours before being labelled as mannitol non fermenter [(19)].

Confirmation of isolated *S. aureus* was performed using Gram stain, tube coagulase test [(20, 21)]. *S. aureus* isolates were sub-cultured on less salt coating media such as nutrient agar before it was subjected to antimicrobial susceptibility test using Kirby-Bauer method [(22)], using five antimicrobial agents; Amoxicillin/Calvulinic acid 30 mcg, Oxacillin 1mcg, Vancomycin 30 mcg, Fusidic acid 10 Mcg, Methicillin 10 mcg (Bioanalyse Ltd., Turkey). The diameter of inhibition zone was considered to evaluate the susceptibility according to the National Committee for Clinical Laboratory Standards, Subcommittee on Antimicrobial Susceptibility Testing, 2011 [(23)], while for Fusidic acid a zone diameter of >21 mm was considered the breakpoint for susceptibility [(24)]. Chi-square test statistics was performed using "Biostatistics Student Edition" App for Ipad by Stephen S. Ashley [(25)].

RESULTS

This study was performed on health care personnel in four main teaching hospitals in Sulaimani city during a period of February 2010 to January 2011. Two hundred forty nine participants including 128 females and 121 males were included in the study. The age ranged between 22-63 years (average 35 ±9.00 SD) for females and from 21-64 years (average 34 ±9.22 SD) for males. The participants were working in four main hospitals; General Teaching Hospital for Internal Diseases (121 participants), Paediatric Teaching Hospital (60 participants), Maternity Teaching Hospital (39 participants) and 29 participants were working in the Surgical Teaching Hospital.

Study group working attitude

The participant for reason of data comparing were grouped into nine occupational groups. Table 1 shows these groups in relation to some daily infection safety practice during work in the health facility including using gloves, mask, antiseptics and hand washing. As shown, different occupations were included in order of their frequency, some with more contact with patients, others less. In general and regardless of the occupation the following were observed. Gloves were always used in 30.5%, not used in 18.8% and the other 50.6% were occasionally using gloves. Hand cleansing with antiseptic (Alcohol) were practiced in 31.7% while face mask were only used in 18.4%. Concerning the frequency hand washing during work in health facility, the response were categorised in to four groups, no washing in 58.6%, 1-10 times hand washing in 20.4%, 11-20 times hand washing in 10.8% and more than twenty time washing in 10 %.

Table 1. The participant's occupation groups in relation to some daily safety practice during work in the health facility.

Occupation	No.	Using gloves			Using antiseptics		Using mask		Times hand washing			
		Always	Never	Selective	Yes	NO	Yes	NO	0	1-10	11-20	>20
		No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Nurse	90	37 (41.1)	13 (14.4)	40 (44.4)	7 (7.7)	83 (92.2)	21 (23.3)	69 (76.6)	56 (62.2)	11 (12.2)	12 (13.3)	11(12.2)
Physician (HO, SHO)*	49	3 (6.1)	2 (4)	44 (89.7)	20 (40.8)	29 (59.1)	6 (12.2)	43 (87.7)	35 (71.4)	9 (18.3)	4 (8.1)	1 (2)
Cleaner	24	10 (41.6)	10 (41.6)	4 (16.6)	12 (50)	12 (50)	2 (8.3)	22 (91.6)	16 (66.6)	5 (20.8)	2 (8.3)	1(4.1)
Laboratory technician	22	13 (59)	1 (4.5)	8 (36.3)	15 (68.1)	7 (31.8)	3 (13.6)	19 (86.3)	9 (40.9)	10 (45.4)	3 (13.6)	0 (0)
Internist	21	2 (9.5)	4 (19)	15 (68.1)	8 (38)	13 (61.9)	2 (9.5)	19 (90.4)	14 (66.6)	5 (23.8)	1 (4.7)	1(4.7)
Official worker	20	2 (10)	15 (75)	3 (15)	7 (35)	13 (65)	2 (10)	18 (90)	12 (60)	4 (20)	3 (15)	1 (5)
Surgeon	10	2 (20)	0 (0)	8 (80)	8 (8)	2 (20	6 (60)	4 (40)	2 (20)	4 (40)	0 (0)	4 (40)
OT nurse**	7	7 (100)	0 (0)	0 (0)	2 (28.5)	5 (71.4)	4 (57.1)	3 (42.8)	1 (14.2)	0 (0)	1 (14.2)	5 (71.4)
Pharmacist	6	0 (0)	2 (33.3)	4 (66.6)	0 (0)	6 (100)	0 (0)	6 (100)	1 (16.6)	3 (50)	1 (16.6)	1(16.6)
Total	**249**	**76**	**47**	**126**	**79**	**170**	**46**	**203**	**146**	**51**	**27**	**25**
Percentage	100	30.5	18.8	50.6	31.7	68.3	18.4	81.5	58.6	20.4	10.8	10

*** HO and SHO, house officers and senior house officers. ** OT, Operation Theater.**

Questioning the participants about average numbers of patients they come in contact during daily work in the health facilities. Those who came in contact with patients (214 participants) were categorized into three groups (< 20, 21-40 and >40 patients per day), table 2.

In table 3, hand washing was tabulated against the number of patients they exposed to. The data shows the poor practice of hand washing among the participants even with numerous exposures to patients.

Table 2. The participants' occupations against the number of patients exposed.

Occupation	Total	Patient exposure per day		
		< 20	21-40	> 40
		No. (%)	No. (%)	No. (%)
Nurse	90	38 (42.2)	25 (27.7)	27 (30)
Physician (HO, SHO)	49	27 (55.1)	13 (26.5)	9 (18.3)
Cleaner*	18	4 (22.2)	7 (38.8)	7 (38.8)
Laboratory technician*	6	1 (16.6)	1 (16.6)	4 (66.6)
Internist	21	12 (57.1)	7 (33.3)	2 (9.5)
Official worker*	10	3 (30)	2 (20)	5 (50)
Surgeon	10	9 (90)	0 (0)	1 (10)
OT nurse	7	1 (14.2)	0 (0)	6 (85.7)
Pharmacist*	3	0 (0)	1 (33.3)	2 (66.6)
Total**	**214**	**95 (44.3)**	**56 (26.1)**	**63 (29.4)**

*** Missing response, ** Participants who answered the questions (i.e. exposed to patients).**

Table 3. Association of number of patient exposed to by frequency of hand washing among participants.

		Hand washing per day				
Patient exposure		**0 No. (%)**	**1-10 No. (%)**	**11-20 No. (%)**	**> 20 No. (%)**	**Total No. (%)**
	< 20	58 (27.1)	20 (9.3)	6 (2.8)	11 (5.1)*	**95 (44.3)**
	21-40	46 (21.5)	6 (2.8)	2 (0.9)	2 (0.9)	**56 (26.1)**
	>40	29 (13.5)	11 (5.1)	12 (5.6)	11 (5.1)	**63 (29.4)**
	Total	**133 (62.1)**	**37 (17.2)**	**20 (9.3)**	**24 (11.2)**	**214 (100)**

*** Those that wash their hand at a frequency near the recommended rate.**

Carriers for Staphylococcus aureus

Among the 249 nasal swab samples, 167 (67%) yielded visible growth within 24-48 hours while 82 (32.9%) swabs were labelled negative for growth after 48 hours. Growth on mannitol salt agar resulted in mannitol fermentation (yellowish color) in 45 (18 %) of the samples while in 122 (48.9%) samples growth were observed without mannitol fermentation. From one isolate, a mixed growth was observed as both mannitol fermenter and non fermenter colonies were observed, this sample was included with the mannitol fermenter group. All mannitol fermenter (45 isolates) also gave a positive test for tube coagulase test and were all documented to be *S. aureus* so the overall, *S. aureus* were isolated from 45 persons (18 %) from heath workers in this study, table 4.

The relation of gender to bacterial isolation of nasal swab is shown in table 5. Among the male participants, 26 (21.4%) resulted in isolation of *S. aureus* and 66 (54.5%) resulted in growth of non mannitol fermenter (*S. epidermidis*) while in female participants there were 19 (14.8%) and 56 (43.7) for *S. aureus* and non mannitol fermenter respectively with observation of statistically significant less *S. aureus* and *S. epidermidis* colonization in comparison with male participants.

In table 4, the isolation of organism is shown according to the occupation in the health facility. *S. aureus* was more isolated in internist group (38%), followed by laboratory technician (31.8%), other physician group and then the nurse group. There was less isolation of *S. aureus* among cleaner group in comparison to other groups.

The frequency of hand washing and isolation of *S. aureus* or Methicillin-resistant *Staphylococcus aureus* (MRSA) among the participants were shown in table 6. As shown among 146 participant responding with no hand washing 33 of them resulted isolation of *S. aureus*, 8 isolates of those were MRSA. No significant correlation between frequency of hand washing and isolation of *Staphylococcus aureus* or Methicillin-resistant *Staphylococcus aureus* (MRSA) was observed.

Table 4. Occupation of the participants in relation to isolation of organisms from nasal swab.

Occupation	NG * No. (%)	NMF ** No. (%)	SA *** No. (%)	Total No. (%)
Ward nurse	39 (43.3)	37 (41.1)	14 (15.5)	90 (100)
Physician (HO, SHO)	11 (22.4)	28 (57.1)	10 (20.4)	49 (100)
Cleaner	7 (29.1)	14 (58.3)	3 (12.5)	24 (100)
Laboratory technician	3 (13.6)	12 (54.5)	**7 (31.8)**	22 (100)
Internist	3 (14.2)	10 (47.6)	**8 (38)**	21 (100)
Official worker	5 (25)	12 (60)	3 (15)	20 (100
Surgeon	6 (60)	4 (40)	0 (0)	10 (100)
OT nurse	5 (71.4)	2 (28.5)	0 (0)	7 (100)
Pharmacist	3 (50)	3 (50)	0 (0)	6 (100)
Total	**82 (32.9)**	**122 (48.9)**	**45 (18)**	**249 (100)**

*** NG: no growth, ** NMF: non mannitol fermenter, *** SA: *Staphylococcus aureus.***

Table 5. Gender in relation to isolation of organisms from nasal swab.

	Total	NG* No. (%)	NMF** No. (%)	SA*** No. (%)	P value
Female	128	53 (41.4)	56 (43.7)	19 (14.8)	χ^2=8.7 *df 2* *P=0.01*
Male	121	29 (23.9)	66 (54.5)	26 (21.4)	

*** NG: no growth. ** NMF: non mannitol fermenter and *** SA: *Staphylococcus aureus***

Table 6. Frequency of hand washing in relation of isolation of *Staphylococcus aureus* or Methicillin-resistant *Staphylococcus aureus*.

Frequency of hand washing	NG or NMF*	SA**	MRSA**
0	146	**33**	**8**
1-10	51	**7**	**2**
11-20	27	**2**	**1**
> 20	25	**3**	**3**
Total	249	**45**	**14**

*** NG: no growth or NMF: non mannitol fermenter**
**** SA: *Staphylococcus aureus*, Chi-square test χ2=3.8588, df 3 , P=0.2771**
***** Chi-square test χ2=2.0428, df 3 , P=0.5636**

Antimicrobial susceptibility profile of S. aureus

Antimicrobial profiles by Kirby-Bauer method for five antimicrobial agents (table 7). Among the 45 *S. aureus* isolates, 14 isolates (31.1%) were resistant for methicillin (MRSA), 42 isolates (93.3%) were resistant to Amoxicillin/Calvulinic acid, 22 isolates (48.8%) were resistant for Oxacillin and 11 isolates (24.4) showed resistance response to Fusidic acid or Vancomycin. Concerning all the 249 participant swabs, 14 isolates of MRSA (5.6%) were documented while the rate of Vancomycin resistant *S. aureus* (VRSA) was 4.4%. The response of MRSA strains to other antimicrobial agents is shown in table 8, all the fourteen isolates were also resistant to Amoxicillin/Calvulinic, half of the isolates were resistant to Oxacillin and resistance to Vancomycin and Fluidic acid was observed.

Table 7. Antimicrobial susceptibility of *Staphylococcus aureus* isolates tested by Kirby-Bauer method. N=45.

Antimicrobial agent	Susceptible No. (%)	Intermediate No. (%)	Resistant No. (%)
Amoxicillin/Calvulinic acid	3 (6.6)	0 (0)	**42 (93.3)**
Fusidic acid	34 (75.5)	0 (0)	11 (24.4)
Methicillin	27 (60)	4 (8.8)	**14 (31.1)**
Oxacillin	21 (46.6)	2 (4.4)	**22 (48.8)**
Vancomycin	34 (75.5)	0 (0)	11 (24.4)

Table 8. Antimicrobial susceptibility for fourteen Methicillin-resistant *S. aureus* isolates tested by Kirby-Bauer method.

Antimicrobial agent	Susceptible No. (%)	Resistant No. (%)
Amoxicillin/Calvulinic acid	0 (0)	14 (100)
Fusidic acid	11 (78.5)	3 (21.4)
Oxacillin	7 (50)	7(50)
Vancomycin	5 (35.7)	9 (64.2)

DISCUSSION

Reasons for *S. aureus* to gain a close watch include its continuous persistence with human [26], virulence and responsibility to many infections [17, 27] and its ability to develop resistance to antimicrobial agents [13]. For the hands of health care workers to be a major source of staphylococcal transmission, several events must occur [28]; the worker must acquire the bacteria by touching the skin of a patient, his nose or a surface where the bacteria have been shed. The organisms must survive for some period; hand hygiene must be inadequate, perhaps because it is not performed properly, or at all, or is performed with an inappropriate agent; and the worker must then transfer the bacteria by touching another patient or a surface that the patient subsequently touches [29].

Despite the evidence that proper hygiene can reduce the spread of bacteria, hand hygiene continues to be poor in hospitals, in part because of real or perceived barriers to strict compliance with hygiene protocols [30]. The introduction of new guidelines in 2002 aimed to address some of these issues [28], unfortunately although widely implemented at the administrative level in hospitals, the guidelines have had little apparent effect on the actual performance of hand hygiene in clinical practice [31]. Institutional implementation of changes that have a lasting effect on good hand hygiene practices will be needed to substantially reduce the incidence of nosocomial outbreaks of staphylococcal disease. Sustained educational efforts in the community may also be needed to reduce the spread outside the hospital setting [29].

This may answer the question why we inquired about health safety and hand hygiene in our study. Forty seven participants (18.8%) were not using gloves and other 50.6% were selective in using gloves. The same applied for antiseptic hand cleansing and using masks as 68.3% and 81.5% were negative for such practice respectively. The mentioned figures were for all the groups regardless their occupation but as seen in table 1, these practices were also poor among more health oriented groups.

Hand hygiene obedience was also poor, as the answer to frequency of hand washing may not always be an exact number. The responses were grouped into 4 categories. More than half of the

participants were reported not washing their hands (58.6%) and another 20.4% admitted hand washing between 1-10 times which is also below the recommended hand washing [28] taking in account how many times the health workers may come in contact with the patients (table 2) and, beside this we could not document the correctness of hand washing techniques as recommended [28, 32]. These indicate the poor compliance to hand hygiene in our study group. This problem is not a local one. In a study in Saudi Arabia, hand hygiene compliance rate among healthcare professionals was investigated and they reach a conclusion that the overall hand hygiene compliance rate of healthcare professionals reached 50% after a long education campaign, and was highest among the nurses [30, 33]. An exception to this study was the surgical unit nurse as they were compliant with hand washing according to their more critical work in operation theatre and this was also showed by Bukhari *et al*. [33].

Hand hygiene should be addressed with health authorities to enhance compliance among all health workers as this will limit spread of infection [34-36].

A more urgent cause to implement more active hand hygiene in our locality is the greater number of patients seen or come in contact with health workers each day. As seen in table 2, not all the participants gave a response, according to their occupation in the health facility, some were more in direct contact with patients, other not such as in officer work and pharmacist. The responses were categorised into three groups and it showed that the number of contact ranged from less contact (<20) to more than 40 contacts per working day with more than half of participants exposed to more than 20 patients. When hand washing frequency was related against contact to patients (table 3), it is shown that only in 5.1 % of those came in contact with patients wash their hand at a frequency near the recommended one provided the technique is correct. There was poor compliance with hand washing as no washing or washing hand few times a day. Contact to the patients may be with the same patient or a different patient and this contact is ranged from nursing, physical examination, obtaining samples or casual contact. This may show the scale of transmission of some infective agents such as *S. aureus* especially when the compliance to hand hygiene is well below the recommend values for the number of contacts [28].

In this study we used a selective media for *Staphylocooci* and which is also differential for mannitol fermenting *S. aureus*. Screening for *S. aureus* or MRSA can be done with several methods [37]. The Oxacillin agar screen test has been a mainstay for the detection of MRSA in diagnostic laboratories for many years [3] but our aim was to isolate not only MRSA but all *S. Aureus,* so we used mannitol salt agar with availability of new chromogenic medium for the detection of nasal carriage of MRSA and other methods [37-40].

The result of culturing nasal swabs showed that 45 swabs (18 %) resulted in isolation of S. *aureus*, 122 swabs (48.9%) resulted in non mannitol fermenter organism with capability to tolerate 7.5% NaCl and organism with such property is *Staphylococcus epidermidis*. Negative growth as confirmed in the methods was the result of the other 82 swabs (32. 9%). No growth doesn't mean that there were no bacteria in the nose. High salt in mannitol salt agar allows few organisms that tolerate salt to grow such as Staphylococci. To be sure in identification of *S. aureus,* mannitol fermenter colonies on mannitol salt agar was confirmed by tube coagulase test and not the slide method which detects a less specific clumping factor which may be positive in strains other than *S. aureus* [1, 20, 41].

Different carrier figures of *S. aureus* were reported. Cross-sectional surveys reported carriage rates between 20% and 55%. [42] and the prevalence of *S. aureus* nasal carriage was 30.5% in a study from Italy [43]. The carriage affected by ethnic group [44], family predisposition [45]. Carriage rates are also higher in individuals with insulin-dependent diabetes, in patients on continuous ambulatory peritoneal dialysis and haemodialysis and in intravenous drug abusers when compared with the healthy population [26] or from the oral cavity of patient with type II diabetes mellitus compared with healthy not diabetics [6]. Our figures of carriage (18%) among health worker fall in this range and also showed more carrier tendency to *S. aureus* and *S. epidermidis* as other studies showed [37]. Lower and higher figures are expected due to the pattern of carriage as approximately 20% of individuals being persistent carriers, about 60% intermittent carrier [26].

In this study carrier rate was varying among different occupational groups and gender (table 4 and 5). With the note of the relatively low sample size specially for some groups, our data showed higher carrier rate among the internist, laboratory technician and other physicians group which could be explained for internist and other

physicians as they have more direct contact with patients but not laboratory technician as they have less direct contact with persons but with samples but as this bug is not only transmitted inside health facilities but also in community, this also play a role in the carrier rate but no doubt carriers who don't wash hand (table 6) are more transmitting the bug to others and hence more infections may occur in hospital environment.

Methicillin-resistant *S. aureus* carriage was documented in 14 swabs, which make 5.6 % of the participants carriers to MRSA, table 7. Our figures were more than those reported by Albrich and Harbarth, from south Africa (4.6%), Amorim *et al*. from Portugal (4.8%), Brady *et al*. from UK (2% and 4.8% in surgical speciality) [46-48]. Testing the response of *S. aureus* to other agents showed multi resistant nature of *S. aureus*. In a local study of oral flora in type II diabetes mellitus, the antimicrobial susceptibly of 31 oral isolates of *S. aureus* showed multiple resistance against many antimicrobials used to treat oral infections [6].

In the current study , choosing such antibacterial agent was based on reasons, still our local practice of antimicrobial treatment goes with giving agents such Amoxicillin/Calvulinic or Oxacillin to many suspected staphylococcal infections while Fusidic acid and Vancomycin were selected due to many resistance reports to these powerful antimicrobial agent which was conserved to treat staphylococcal infection [3, 27]. According to our results MRSA strain are existing in our health facilities and more to that these strain are also resistant to other antimicrobial agent (table 8) which eventually cause infections that are difficult to treat which urge us to play a more responsive role to employ strategies to control emergence and spread of multiply resistant staphylococci [17].

In conclusion, the main points concluded from this study are that correct and full compliance hand hygiene must be followed by education and close observations as these practices were suboptimal in our health facilities. A population of 18% of those studied were carriers of *S. aureus* and 5.6% were carrying MRSA strains and these staphylococci.

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