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Risk Factors Assessment of Methicillin Resistant Staphylococcus Aureus among Critical Ill Patients

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Abstract

Background: Methicillin resistant Staphylococcus aureus is endemic within many hospitals worldwide. **Aim:** The aim of the study was to assess risk factors of Methicillin-resistant Staphylococcus aureus among critical ill patients **. Research Design:** A descriptive exploratory research design was used. **Setting:** This study was conducted at intensive care units affiliated with Homyat Alabsia Hospital. , Cairo, Egypt. **Subjects**: A purposive sample of 80 adult patients divided into 40 develops (MRSA) and 40 not confirmed (MRSA) in intensive care units at the previously mentioned settings. **Tools:** Two tools were used for data collection; Tool I:-Structured patient questionnaire. Tool II: Risk factors assessment questionnaire**. Results**: The majority of the studied patients were in age group 50 ≥ 60 years , had chronic disease, Also, more than one third had ≥ 7 days of stay in ICU and less than three quarter the studied patients received incompetent nursing practices. **Conclusion:** a high prevalence of incompetent nursing practices related to infection control measures. Specifically, suboptimal adherence to hand hygiene protocols, improper disinfection of medical equipment, and inadequate care during invasive procedures such as intubation, urinary catheterization, and central line maintenance significantly increased the risk of MRSA transmission. Moreover, there was a highly statistical significant relation between Methicillin-resistant Staphylococcus Aureus and all procedures related to nursing practices among the studied patients. **Recommendation:** Investigate additional risk factors contributing to MRSA infections among different patient populations to develop targeted prevention strategies, examine the long-term outcomes of patients with MRSA in ICUs to understand the broader implications of infection control practices on patient recovery and hospital costs.

Keywords: Critical ill patient, Risk Factors, Methicillin Resistant Staphylococcus Aureus.

Introduction:

Methicillin-resistant Staphylococcus aureus (MRSA) has been the focus of much research due to its major contribution to the morbidity and mortality of hospitalized patients. S. aureus can cause serious infections at many body sites and is one of the most common causes of bacteremia. Methicillin resistant Staphylococcus aureus (MRSA) is endemic within many hospitals worldwide. Critically ill patients on intensive care units have increased risk factors making them especially prone to nosocomially acquired infections (***Turner et al., 2019).***

The incidence of nosocomial infection in intensive care units is about two to five times higher than in the normal ward due to the critically sick patients' extreme fragility and the frequent use of invasive treatments. The increased use of invasive advanced life-support systems has made the monitoring of device-associated infection in ICUs more necessary ***(Li , et al 2018).***

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The Center for Disease Control and Prevention (CDC) has evaluated the high increase in antibacterial resistance as one of the most important reasons threatening human health over the world. In addition, the prevalence of infections acquired in Intensive Care Units was higher than it was in other hospital units. This might be due to the severity of disease and prolonged stay in the ICU. Furthermore, immunosuppression of ICU patients and a higher number of invasive devices like central venous catheterization, mechanical ventilation, urinary tract catheters were among the main risk factors for Multi Drug Resistent bacterial infections ***(El mekes, et al 2020).***

Risk factors for HA-MRSA, Being hospitalized, remains a concern in hospitals, where can attack those most vulnerable older adults and people with weakened immune systems. Having an invasive medical device. Medical tubing such as intravenous lines or urinary catheters can provide a pathway for to travel into body. Residing in a long-term care facility, is prevalent in nursing homes. Carriers of have the ability to spread it, even if are not sick selves (***Evans et al., 2021)***.

Transmission can occur between healthcare providers and patients because some providers may neglect to perform preventative hand-washing between examinations. People in nursing home are at risk, further complicated by generally weaker immune systems. Intravenous drug users, Needle-required drugs have caused an increase of MRSA, with injection drug use . The unsanitary methods of injection causes an access point for the MRSA to enter the blood stream and begin infecting the host. Furthermore, with MRSA's high contagion rate, a common risk factor is individuals who are in constant contact with someone who has injected drugs in the past year (***Mitevska et al., 2021).***

So, health care providers have a significant role in the prevention of MRSA transmission in numerous healthcare settings. The knowledge acquired by health care providers about MRSA has a great effect on their practice to regularly take preventive measures in the direction of reducing MRSA infection, is evidenced that the knowledge and practice of health care providers concerning MRSA affect adherence to preventive practice guidelines such as standard precautions or contact precautions ***(De Jonge et al., 2019).***

Significance of the study

Methicillin-resistant Staphylococcus aureus rate of 0.6% was reported in Sweden and most nearby countries , In the US, the Center for Disease Control and Prevention (CDC) reported an approximately 50% methicillin resistance rate among Hospital acquired nosocomial infections in the ICUs. A considerable variation was reported in MRSA prevalence among Gulf Corporation Council Countries (GCC), with the highest rate (29.9%) from Saudi Arabia and the lowest rate (3.3%) from Kuwait ***(Taha, et al 2022)***

In Egypt Methicillin-resistant Staphylococcus aureus prevalence varies according to the geographical region. A low prevalence (24.4%) was reported from the Minia- University hospital. On the other hand, higher prevalence rates were reported from Cairo university hospitals (47.9%) and Alexandria University hospitals (up to 75%) ***(Algammal, et al 2020).***According to the statistics at Homyat Al Absia Hospital 2022 MRSA rate was 30%. ***(Department of medical statistics at Homyat Al Absia Hospital, 2022).***

Aim of the Study

The aim of the study was to assess risk factors of Methicillin-resistant Staphylococcus aureus among critical ill patients.

Research Questions

The present study intended to answer the following question:
What are the risk factors of Methicillin-resistant Staphylococcus aureus (MRSA) among critical ill patients?

Subjects and Methods:

A. Research design:

A descriptive exploratory research design was used to achieve the aim of this study.

Study Setting:

This study was conducted at intensive care units affiliated with Homyat Alabsia Hospital. Homyat Alabsia Hospital consists of thirteen wards

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and two intensive care units designed horizontally in separate building to prevent the spread of infection. Two intensive care units are emergency intensive care unit that located in emergency department and consist of 10 beds and general intensive care unit consists of 9 beds.

Sample:

Sample size estimation was determined according to the following equation**: (Thampson, 2012).** $n = \frac{N \times P\ (1-P)}{[(N-1)\times(d^2 - z^2)+P(1-P)}$

A purposive sample of 80 adult patients divided into 40 develops (MRSA) and 40 not confirmed (MRSA) in intensive care unit at the previously mentioned settings.

Tools of data collection:

Two tools were used to collect the data during the study*:*

Tool (I): **Structured patient interview questionnaire:**

It was developed by the investigator and was written in English language and translated in Arabic based on reviewing of relevant, current national and international literatures ***(Pourramezan , et al 2019) and (Mehta, et al 2020).*** It was divided into two parts:

Part (1): Patients characteristics:

It consisted of (6) closed ended questions as regard to age, gender, educational level, marital status, place of residence, occupation. It used to describe characteristics of the studied patients.

Part (2): Medical history:

This part concerned with patient present and past medical history and it consisted of (3) questions about chronic disease, smoking, duration of stay in ICU.

Tool (II): Risk factors assessment questionnaire:

It was developed by investigator based on review of relevant recent literatures (***Rodrigues et al., 2020)and (Taha et al.,2022)*** It was designed in English language to assess risk factors of MRSA. It included three parts as following.

Part (1): Risk factors related to patient:

It was designed to assess risk factors of MRSA among critical ill patient it consisted of (12) questions in the form of (Yes or No) questions included (Recent hospitalization within 30 days before admission, suffers from infection of Gastrointestinal , Patient suffers from infection of Skin /deep soft tissue, Patient suffers from infection of Urogenital infection /UTI , Patient suffers from infection of Respiratory system , Is there Prior antibiotic therapy , Is the Patient taking immunosuppression medication , Patient taking steroids medication , Presence of Central Venous Catheter during hospital stay ,Presence of Peripheral Vascular Catheter during hospital stay , Presence of Intubation or Tracheostomy during hospital stay and Presence of Urinary Catheter during hospital stay).

Part (2): Risk factors related to environment:

It was designed to assess risk factors of MRSA related to environment it included seven questions included (daily stay in poor hygienic conditions, equipments disinfected before used with patients, over bed tables and bed rails of patients clean and disinfected, sinks and faucet handles clean and disinfected, counter top clean and disinfected r, door knobs clean and disinfected , commodes clean and disinfected.

Part (3): Factors related to nurses' practices:

It was designed to assess risk factors of MRSA related to nurses' practices in five procedure included (Centeral Line Procedure , Intubation or tracheostomy suction and care, Urinary catheter insertion and care , Five Moments of Hand Hygiene and Disinfection of Equipment Used With Patient each step in the form of (DONE or NOT DONE)

1- **Central Line Procedure check list :**

Central venous catheter insertion check list included ten steps (Wash hands, Use full barrier precaution " wear mask –cap –sterile gown and gloves, Maintain sterile field throughout procedure, Prepare site with antiseptic solution, Drape patient from head to toe using sterile technique ,Apply sterile caps on all hubs, Clean site with antiseptic solution ,Apply sterile dressing , Discard the used equipment in suitable place ,Wash hands.

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Maintenance of asepsis &daily care included twelve steps : Wash hands ,Wear clean gloves, Remove old dressing, Assess insertion site for evidence of infection ,Discard gloves, Wash hands ,Wear sterile gloves ,Clean the site with sterile gauze and antiseptic solution, Apply sterile dressing ,Apply sterile caps on all hubs,

Intubation or tracheostomy suction and care:

A- It included four steps: Wash hand, Use sterile catheter (one use), Wear sterile gloves and Using sterile technique.
B- Daily care steps included nine steps: Wash hands, Wear clean gloves, Remove old dressing, Assess insertion site for evidence of infection, Discard gloves ,Wash hands, Wear sterile gloves, Clean the site with sterile gauze and antiseptic solution and Apply sterile dressing .

3-Urinary catheter insertion and care included ten steps :**(** Wash hands, Wear clean gloves, Assess insertion site for evidence of infection ,Discard gloves, Wash hands, Wear sterile gloves ,Clean the site with sterile gauze and antiseptic solution, Use sterile catheter, Maintain sterile technique Wash hands

5-Disinfection of Equipment used with patients. The procedure included four steps: (Are blood pressure cuffs clean and disinfected before use with patient, Are stethoscopes clean and disinfected before use with patient, Are thermometers clean and disinfected before use with patient, Are x-ray machines clean and disinfected before use with patient, Are blood pressure cuffs clean and disinfected before use with patient).

Operational Design:

The operational item included the preparatory phase, validity of the developed tool, reliability, pilot study, field work.

The preparatory phase:

This phase was conducted through the reviewing of past, current, national and international related literatures theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and magazines to develop tools for data collection. During this phase, the investigator also visited the selected place to get acquainted with the personnel and the study setting. The development of the tools was under a supervisor's guidance and experts' opinions were considered.

Pilot study:

The pilot study was done on 10% of the sample (8 patients) to test applicability, feasibility and clarity of questions and time needed to complete the study tools. Subjects were included and chosen randomly from the previously mentioned setting then later included in the sample. According to the results of the pilot study, no modifications were done for the used tools. So, patients shared in the pilot study were involved in the sample.

Validity:

The study tools were tested for validity (Content and face validity) face validity aimed to determine whether the tools measure what was supposed to measure. Content validity was conducted to determine whether the tools covered in the aim. It was measured by a jury of 5 experts, in the field of critical and medical surgical nursing, Helwan University. The experts reviewed the tool for appropriateness, comprehensiveness, accuracy, clarity, relevance, understanding and applicability and necessary modifications were done. Their opinions were elicited regarding tools consistency, rephrasing for some statements and scoring system.

Reliability:

Reliability of the tool was applied by the investigator for testing the internal consistency of the tool by administration of the same tools to the same subjects under similar condition on one or more occasion. Answers from repeated testing were compared (test-re-test reliability).

Fieldwork:

An approval was obtained from the director of Homyat Alabsia hospital.

Data of the current study were collected within 6 months from the beginning of December 2023 to the end of May 2024, official permissions were granted. A total number of 80 patients who fulfilled the criteria of inclusion were recruited into the present study.

The investigator collected data 2 days/week in the morning shift from 8 AM to 2 PM to detect risk

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factors of MRSA with patients that were admitted ICU during the time of the study.

Each patient was assessed individually and the patient's acceptance to be included in the study was obtained after explaining the purpose and the nature of the study and the structured questionnaire was filled. The investigator assessed and observed about (1-3) patients per day.

The structured patient questionnaire Tool (I) was filled in a time ranged between (10-15) minutes according to patients' tolerance and every patient could ask any question to clear any misunderstanding. Tool (II) The investigator started to fill in this tool by observing factors that may lead to MRSA, the investigator observing factors related to patient then observe environmental factors and then factors related to nurse practice ,filled in a time ranged from (10-30) minutes. As regard to factors related to nurses practice the investigator observe nurses when they preforming the procedures related to (Centeral Line Procedure, Intubation or tracheostomy suction and care, Urinary catheter insertion and care, Five Moments of Hand Hygiene and Disinfection of Equipment Used With Patient). In the form of (Done / Not done) .It took (20-30 minutes).

Administrative Design:

To carry out the study, An official permission was obtained by submission of formal letter issued from the Dean of the Faculty of Nursing, Helwan University to the Director of Homyat Alabasia hospital at which the study was conducted. The aim and expected outcome of the study had been illustrated asking for cooperation and permission to conduct the study.

Ethical considerations:

An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee Helwan University. Participation in the study was voluntary and subjects given complete, full information about the study and their role before participating in the study. The ethical considerations were included explaining the purpose and nature of the study, stating the possibility to withdraw at any time, confidentiality of the information where it was not accessed by any other party without taking the permission of the participants. Ethics, values, culture and beliefs were respected.

Statistical Design:

Upon completion of data collection, data was computed and analysed using the Statistical Package for the Social Science (SPSS), version 24 for analysis. For quantitative data, numbers, percentage, mean and standard deviation (SD) were used to describe the results. For qualitative data, Frequency and percentage distribution of each category were calculated. Appropriate significance was adopted at $p < 0.05$ for interpretation of results. The observed differences were considered as not significant if $p > 0.05$, significant if $p < 0.05$ and highly significant if $p < 0.005$. Appropriate inferential statistics such as chi-square was used as well

Results: Table (1): Frequency and percentage distribution of the studied patients according to personal characteristics.

Personal characteristics	N	%
Age (in years)		
20- > 30 year	4	5.0
30- >40 year	4	5.0
40- >50 year	8	10.0
50 ≥ 60 year	64	**80.0**
Mean +SD	51.5+7.92	
Gender		
Male	58	**72.5**
Female	22	27.5
Educational level		
Can't read or write	0	0.0
Read and write	8	10.0
Secondary education	22	27.5

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Higher education	50	**62.5**
Marital status		
Single	6	7.4
Married	55	**68.8**
Widow	19	23.8
Divorced	0	0.0
Residence		
Rural	23	28.7
Urban	57	**71.3**
Occupation		
working	47	**58.8**
Not working	15	18.7
Housewife	18	22.5

Table (1) shows that, 80.0% of the studied patients were in age group 50 ≥ 60 years with mean age 51.5+7.92and 72.5% of studied patient were male. Also, 62.5% of studied patient had higher education and 68.8% of studied patient were married. Additionally, 71.3% of studied patient were from rural area and 58.8% of studied patient were working.

Table (2): Frequency and percentage distribution of the studied patients according to their medical history**.**

Medical History	N	%
Chronic Disease		
Yes	66	**82.5**
No	14	17.5
If yes, disease (n=66)		
COPD	18	27.3
Diabetes Mellitus	23	**34.8**
Cancer	12	18.2
Renal Disease	12	18.2
Cardiac disease	13	19.7
Others	2	3.0
Smoking		
Yes	15	18.7
No	65	**81.3**
Duration of Stay In ICU		
1 - <3 Days	23	28.7
3 -<5 Days	14	17.5
5 -<7 Days	12	15.0
≥ 7 Days	31	**38.8**
Patients had MERSA		
Yes	40	50.0
No	40	50.0

Table (2) shows that, 82.5% of the studied patients had chronic disease, and Diabetes mellitus had the highest percentage **34.8**% followed by COPD **27.3**% of patient who had chronic disease while, **81.3%** were non-smokers. Also, **38.8%** of them had ≥ 7 days of stay in ICU.

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Table (3): Frequency and percentage distribution of risk factors related to patients among the studied patients.

Items / Statement	Yes		No	
	N	%	N	%
Recent hospitalization within 30 days before admission	21	26.3	59	73.7
Patient suffers from infection of Gastrointestinal	14	17.5	66	82.5
Patient suffers from infection of Skin /deep soft tissue	17	21.3	63	78.7
Patient suffers from infection of Urogenital infection /UTI	40	**50.0**	40	50.0
Patient suffers from infection of Respiratory system	37	46.3	43	53.7
There prior antibiotic therapy	10	12.5	70	87.5
The patient taking immunosuppression medication	10	12.5	70	87.5
The patient taking steroids medication	45	**56.3**	35	43.7
Presence of central venous catheter during hospital stay	51	**63.7**	29	36.3
Presence of peripheral vascular catheter during hospital stay	17	21.3	63	78.7
Presence of intubation or tracheostomy during hospital stay	43	**53.7**	37	46.3
Presence of urinary catheter during hospital stay	11	13.7	69	86.3

Table (3) shows that, 50.0% of the studied patients suffers from infection of Urogenital infection /UTI and **56.3%** of studied patient were taking steroids medication. Also, **63.7%** of studied patient had central venous catheter during hospital stay and **53.7%** of them studied patient intubation or tracheostomy during hospital stay.

Table (4): Frequency and percentage distribution of risk factors related to environment among the studied.

Items / Statement	Yes		No	
	N	%	N	%
Daily stay in poor hygienic conditions	9	11.3	71	88.7
Equipment are disinfected before used with patients	52	65.0	28	35.0
Over bed tables and bed rails of patients are cleaned and disinfected	47	58.8	33	**41.2**
Sinks and faucet handles are cleaned and disinfected regularly	17	21.3	63	**78.7**
Counter top clean and disinfected regularly	56	70.0	24	30.0
Door knobs clean and disinfected regularly	30	37.5	50	**62.5**
Commodes clean and disinfected regularly	52	65.0	28	35.0

Table (4) shows that, over bed tables and bed rails of patients aren't cleaned and disinfected among **41.2%** of the studied patients. Also, sinks and faucet handles weren't cleaned or disinfected regularly among **78.7%** of studied patient. Additionally, door knobs weren't cleaned or disinfected regularly weren't cleaned or disinfected regularly among **62.5%** of studied patient

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Table (5): Relation between personal characteristics of the studied patients and MRSA.

Personal characteristics		Methicillin-resistant Staphylococcus Aureus (MRSA)				X^2	P-value
		Yes n (40)		No n (40)			
		No	%	No	%		
Age (in years)	20- > 30 year	2	5.0	2	5.0	2.250	**0.022***
	30- >40 year	2	5.0	2	5.0		
	40- >50 year	2	5.0	6	15.0		
	50 ≥ 60 year	34	85.0	30	75.0		
Gender	Male	26	65.0	32	80.0	2.257	0.133
	Female	14	35.0	8	20.0		

Table (5) shows that, there is a significant statistical relation between Methicillin-resistant Staphylococcus Aureus and age of the studied patients at P-value=0.022. While, there was no significant statistical relation between Methicillin-resistant Staphylococcus Aureus and gender of the studied patients at P-value=0.133.

Table (6): Relation between health history of the studied patients and **MRSA**

Health history		Methicillin-resistant Staphylococcus Aureus (MRSA)				X^2	P-value
		Yes		No			
		No	%	No	%		
Chronic Disease	Yes	35	87.5	31	77.5	1.385	**0.039***
	No	5	12.5	9	22.5		
Smoking	Yes	10	25.0	5	12.5	2.051	0.152
	No	30	75.0	35	87.5		
Duration of Stay In ICU	1 - <3 Days	0	0.0	23	57.5	4.773	**0.000****
	3 -<5 Days	6	15.0	8	20.0		
	5 -<7 Days	6	15.0	6	15.0		
	≥ 7 Days	28	70.0	3	7.5		

Table (6) shows that, there is highly statistical significant relation between Methicillin-resistant Staphylococcus Aureus and duration of stay in ICU among the studied patients at P-value=0.000. Also, there is a statistical significant relation between Methicillin-resistant Staphylococcus Aureus and chronic disease among the studied patients at P-value=0.039. While, there was no statistical significant relation between Methicillin-resistant Staphylococcus Aureus and smoking among the studied patients at P-value=0.152.

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Table (7): Relation between risk factors related to patient and MRSA among critical ill patients

Risk factors related to patient		Methicillin-resistant Staphylococcus Aureus (MRSA)				X^2	P-value
		Yes MRSA		No MRSA			
		N	%	N	%		
Recent hospitalization	Yes	20	**95.2**	1	4.8	3.309	**0.000****
	No	20	33.9	39	66.1		
GIT infection	Yes	8	**57.1**	6	42.5	0.346	0.556
	No	32	48.5	34	51.3		
Skin /deep soft tissue infection	Yes	4	36.4	7	**63.3**	0.949	0.330
	No	36	52.2	33	47.8		
Urogenital infection /UTI	Yes	12	**70.6**	5	29.4	3.660	**0.056***
	No	28	44.4	35	55.6		
Respiratory infection	Yes	30	**75.0**	10	25.0	20.263	**0.000****
	No	10	25.0	30	75.0		
Prior antibiotic therapy	Yes	32	**86.5**	5	13.5	6.656	**0.000****
	No	8	18.6	35	81.4		
Taking immunosuppression medication	Yes	8	**80.0**	2	20.0	4.114	**0.043***
	No	32	45.7	38	54.3		
Taking steroids medication	Yes	6	**60.0**	4	40.0	0.457	0.499
	No	34	48.6	36	**51.4**		
Presence of central venous catheter	Yes	40	**88.9**	5	11.1	6.222	**0.000****
	No	0	0.0	35	100.0		
Presence of peripheral vascular catheter	Yes	37	**72.5**	14	27.5	8.614	**0.000****
	No	3	10.3	26	89.7		
Intubation or tracheostomy	Yes	14	**82.4**	3	17.6	9.083	**0.003***
	No	26	41.3	37	58.7		
Presence of urinary catheter	Yes	32	**74.4**	11	25.6	2.175	**0.000****
	No	8	21.6	29	78.4		

Table (7) shows that, there was a statistical significant relation between Methicillin-resistant Staphylococcus Aureus and Recent hospitalization, Urogenital infection /UTI, Respiratory infection, Prior antibiotic therapy, Taking immunosuppression medication, among the studied patients at P-value= 0.000, 0.056, 0.000, 0.000 and 0.043 respectively.

Also, there was a significant statistical relation between Methicillin-resistant Staphylococcus Aureus and presence of central venous catheter, presence of peripheral vascular catheter, Intubation or tracheostomy and presence of urinary catheter among the studied patients at P-value=0.000, 0.000, 0.003 and 0.000 respectively.

While, there was no statistical significant relation between Methicillin-resistant Staphylococcus Aureus and GIT infection, skin /deep soft tissue infection and taking steroids medication among the studied patients at P-value=0.556, 0.330 and 0.499 respectively.

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Table (8): Relation between risk factors related to environment and MRSA among critical ill patients.

Factors related to Environment		Methicillin-resistant Staphylococcus Aureus (MRSA)				X^2	P-value
		Yes		No			
		N	%	N	%		
Daily stay in poor hygienic conditions	Yes	5	**55.6**	4	44.4	0.125	**0.023***
	No	35	49.3	36	50.7		
Equipment disinfected before used	Yes	36	**69.2**	16	30.8	2.978	**0.000****
	No	4	14.3	24	85.7		
Over bed tables and bed rails of patients clean and disinfected	Yes	14	29.8	33	70.2	8.620	**0.000****
	No	26	**78.8**	7	21.2		
Sinks and faucet handles clean and disinfected regularly	Yes	6	35.3	29	46.0	1.867	0.172
	No	34	**54.0**	11	64.7		
Counter top clean and disinfected regularly	Yes	18	32.1	38	67.9	3.810	**0.000****
	No	22	**91.7**	2	8.3		
Door knobs clean and disinfected regularly	Yes	6	20.0	24	80.0	7.280	**0.000****
	No	34	**68.0**	16	32.0		
Commodes clean and disinfected regularly	Yes	12	23.1	40	76.9	4.077	**0.000****
	No	28	**100.0**	0	0.0		

Table (8) shows that, there was a highly statistical significant relation between Methicillin-resistant Staphylococcus Aureus and equipment disinfection before used, over bed tables and bed rails of patients clean and disinfected, counter top clean and disinfected regularly, door knobs clean and disinfected regularly, commodes clean and disinfected regularly among the studied patients at P-value= 0.000.

Also**,** there was a statistical significant relation between Methicillin-resistant Staphylococcus Aureus and daily stay in poor hygienic conditions among the studied patients at P-value= 0.023.

While, there was no statistical significant relation between Methicillin-resistant Staphylococcus Aureus and sinks and faucet handles clean and disinfected regularly among the studied patients at P-value=0.172 respectively.

Table (9): Relation between risk factors related to nurses practices and MRSA among critical ill patients.

Risk factors related to nurses practices		Methicillin-resistant Staphylococcus Aureus (MRSA)				X^2	P-value
		Yes		No			
		N	%	N	%		
Central Line Procedure	Competent	8	23.5	26	76.5	16.573	**0.000****
	Incompetent	32	**69.6**	14	30.4		
Intubation or Tracheostomy suction and care	Competent	8	21.6	29	78.4	12.175	**0.000****
	Incompetent	32	74.4	11	25.6		
Urinary catheter insertion and care	Competent	9	23.1	30	76.9	12.064	**0.000****
	Incompetent	31	75.6	10	24.4		
Five Moments of Hand Hygiene	Competent	0	0.0	21	100.0	28.475	**0.000****
	Incompetent	40	67.8	19	32.2		
Disinfection of Equipment Used With Patient	Competent	2	7.1	26	92.2	12.684	**0.000****
	Incompetent	38	73.1	14	26.9		

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Table (9) shows that, there was a highly statistical significant relation between Methicillin-resistant Staphylococcus Aureus and all procedures related to nursing practices among the studied patients at P-value= 0.000

Discussion:

Regarding the studied patients' personal characteristics, the current study results revealed that, more than four fifths of the studied patients in the age group of 50 years or older highlights the increased vulnerability of older populations to healthcare-associated infections. Aging is often associated with a decline in immune function and a higher prevalence of comorbid conditions, which can contribute to prolonged hospital stays and increased risk of MRSA acquisition. Furthermore, the predominance of male patients as near to three quarters of critically ill patients in the study.

As regards the educational level and marital status of the patients, the current study results revealed that near to two thirds of the studied patients had attained higher education, which may reflect their awareness and access to healthcare services. Similarly, more than two thirds of the studied patients were married. Regarding the studied patients residence, nearly three quarters of them live in urban areas. Lastly, more than half of patients who were working.

As regard the studied patients medical history the finding of current study showed that more than four fifths of patients had chronic diseases from the researcher's point of view this may underscores the strong association between chronic illnesses and susceptibility to hospital acquired infections, particularly in critically ill populations. Among these chronic conditions, diabetes mellitus was the most prevalent with more than one third, followed by chronic obstructive pulmonary disease (COPD) with more than one quarter. These conditions may compromise immune responses and increase susceptibility to healthcare-associated infections like MRSA. Diabetes mellitus, for example, is known to impair wound healing and immune defense, while COPD patients often require invasive procedures such as intubation, further heightening infection risk.

Also, significant proportion of patients (more than one third) with ICU stays of more than 7 days further underscores the relationship between prolonged hospitalization and MRSA acquisition. Extended ICU stays expose patients to invasive devices, broad-spectrum antibiotics, and potential cross-contamination, creating an environment conducive to MRSA colonization and infection. Notably, half of the studied patients were confirmed to have MRSA, illustrating the substantial burden of this pathogen in ICU settings.

The relatively low percentage of smokers (less than one fifth) among the studied population contrasts with the high prevalence of chronic diseases, suggesting that factors beyond smoking, such as comorbidities, may play a more prominent role in MRSA susceptibility in this cohort. These findings collectively highlight the importance of addressing underlying chronic conditions, optimizing infection control practices, and reducing ICU stays through timely and effective medical interventions.

The result of current study is in the same line with **Cheng et al., (2016)** in the study entitled "Emergence of carbapenem-resistant Acinetobacter baumannii in nursing homes with high background rates of MRSA colonization"**, Hübner et al., (2017)** in the study entitled " Infection control measures and prevalence of multidrug-resistant organisms in non-hospital care settings in northeastern Germany: results from a one-day point prevalence study" **and Meneguin, Torres & Fernandes Pollo, (2020)** in the study entitled "Factors associated with staphylococcus aureus methicillin resistant infections in intensive care unit" who reported that the majority of patients with MRSA infection were older in age than 50 years.

Also, **Nucleo et al., (2018)** in the study entitled "Colonization of long-term care facility residents in three Italian Provinces by multidrug-resistant bacteria. Antimicrobial Resistance & Infection Control" and **Kohler et al., (2025**) in the study entitled **"** Males are at higher risk of colonization and infection with multi-drug-resistant organisms than females" both reported that the risk of MRSA colonization was higher in males than in females across the studies. Regarding the chronic diseases among patients with MRSA **Brugnaro et al., (2009**) and **McKinnel et al., (2016)** reported that the majority of patients acquired MDRO (MRAS) were suffering chronic diseases such as diabetes,

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dementia or COPD. Regarding hospital stay **Hübner et al., (2017)** and **Meneguin, Torres, & Fernandes Pollo, (2020)** who stated that more than half of patients with MRSA was hospitalized for more than one week to two weeks.

Regarding the risk factors related to patients among the studied patients the current study results revealed that half of the patients suffered from urogenital infections or urinary tract infections (UTIs), from the researcher's perspective could be linked to the use of invasive devices such as urinary catheters. These infections not only compromise the immune system but also serve as potential entry points for multidrug-resistant organisms like MRSA. Additionally, more than the half of patients were taking steroids, it could be a factor to suppress the immune response and increase vulnerability to opportunistic infections, including MRSA.

Regarding risk factors related to environment among the studied patients the current study results revealed that over bed tables and bed rails were not cleaned or disinfected regularly among slightly more than two fifths of the studied patients. This could be due to these surfaces are among the most frequently touched by patients, healthcare workers, and visitors, making them high-risk vectors for the transmission of infectious agents. Over bed tables, often used for eating, writing, or holding personal items, can harbor microorganisms that transfer between individuals or items placed on them. Bed rails, similarly, are in constant contact with patients and caregivers, particularly in scenarios where patients require assistance with mobility or positioning. Failure to clean and disinfect these surfaces regularly can lead to the accumulation of harmful pathogens, increasing the likelihood of cross-contamination.

Also, the results of the current study indicated that more than three quarters of sinks and faucet handles were found to be inadequately cleaned or disinfected. From the researcher's perspective these areas are critical points of hygiene because they are frequently touched during handwashing, a fundamental practice to prevent infection. However, without proper cleaning, sinks and faucet handles can become reservoirs for microbial growth, particularly in the presence of moisture and organic matter. The failure to maintain these areas compromises the effectiveness of hand hygiene practices, which rely on clean fixtures to reduce microbial load. This finding highlights the need for targeted interventions to ensure that these high-risk areas receive the attention they require.

The results also showed that near to two thirds of doorknobs were not cleaned or disinfected regularly. Doorknobs are among the most commonly touched surfaces in any healthcare facility, with multiple individuals coming into contact with them daily, including staff, patients, and visitors. The lack of regular cleaning of doorknobs creates a potential pathway for the transfer of pathogens between individuals, particularly if proper hand hygiene is not consistently practiced. Given their ubiquity and high contact frequency, doorknobs must be prioritized in cleaning protocols to prevent the spread of infections within the facility.

In addition, findings indicated significant inconsistencies in environmental hygiene practices. While some areas, such as countertops (cleaned regularly in near to three quarters of cases) and commodes (nearly two thirds), demonstrate better adherence to cleaning protocols, the irregularity across different surfaces suggests gaps in standard operating procedures. These inconsistencies may stem from inadequate staff training, lack of sufficient resources or cleaning supplies, or limited oversight and accountability. The variability in cleaning practices across different surfaces reflects a fragmented approach to hygiene that fails to address the comprehensive needs of the healthcare environment.

The current study in agreement with **Rehmani, et al., (2024).** In the study entitled "Use of nursing care bundles for the prevention of ventilator-associated pneumonia in low-middle income countries: A scoping review" who reported that non-compliance with sterile glove usage and aseptic techniques was a significant contributor to increased rates of VAP in ICU settings. **Lai et al., (2020)** in the study entitled "What influences the infection of COVID-19 in healthcare workers?" and found similar issues with site assessment, with over 80% of cases showing neglect in identifying early

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infection signs, resulting in delayed interventions. On the other hand, **Rehmani et al., (2024)** who observed the majority of nurses were in compliance with this items in a well-resourced hospital with regular training programs, demonstrating that proper education and resources can significantly improve adherence. **Zhang et al., (2023)** in the study entitled "Effects of the implementation of Intelligent Technology for Hand Hygiene in Hospitals: systematic review and Meta-analysis" and highlighted the positive impact of routine audits and feedback mechanisms, with compliance rates for sterile practices including majority of nurses.

As regard relationship between personal characteristics of the studied patients and the prevalence of Methicillin-resistant Staphylococcus aureus (MRSA). The results indicate a statistically significant association with age but there is no significant association with gender. the study results showed that MRSA prevalence is significantly associated with the age of patients. As more than four fifths occurred in patients aged 50 years and older. This could be attributed to several factors. The lower prevalence in younger age groups (20–50 years) may reflect stronger immune systems, fewer underlying health conditions, and reduced exposure to healthcare settings.

While the study results did not show a statistically significant relationship between MRSA prevalence and gender. While a higher percentage of males nearly two thirds were affected compared to females just above one third, this difference was not statistically significant. The lack of significance suggests that other factors, such as underlying health conditions, exposure to healthcare environments, or procedural risks, may play a more critical role in determining MRSA prevalence than gender alone.

In the same line, **Chenet al., (2024)** in the study entitled "Investigating the relationship between muscle mass and nasal Methicillin-Resistant Staphylococcus aureus (MRSA) colonization: Analysis of the National Health and Nutrition Examination Survey" who reported a significant association between older age and MRSA prevalence, attributing this to increased healthcare exposure and age-related immune decline. Also **Huang et al., (2019)** in the study entitled "Decolonization to reduce post discharge infection risk among MRSA carriers" who found that elderly patients with multiple comorbidities were more likely to develop MRSA infections, consistent with the findings of the present study. Also, **Shih et al., (2021)** in the study entitle "High prevalence nasal carriage of methicillin-resistant Staphylococcus aureus among long term care facility healthcare workers in relation to patient contact" who reported no significant relationship between gender and MRSA prevalence, suggesting that risk factors such as healthcare exposure and underlying conditions are more critical determinants.

Regarding Relation between health history of the studied patients and MRSA, the current study results revealed that there were significant associations between Methicillin-resistant Staphylococcus aureus prevalence and certain health history variables among the studied patients. The duration of ICU stay was found to have a highly significant relationship with MRSA prevalence. Patients who stayed in the ICU for 7 days or longer accounted for near to three quarters of MRSA cases. While, A statistically significant relationship was observed between MRSA prevalence and the presence of chronic diseases, with majority of MRSA-positive patients having chronic conditions compared to more than three quarters of MRSA-negative patients. from the researcher's point of view, Chronic diseases such as diabetes, cardiovascular disorders, and respiratory conditions weaken the immune system, making patients more susceptible to infections, including MRSA. In addition, the patients often require more frequent healthcare interactions, increasing their exposure to hospital-acquired pathogens.

The results of the present study in agreement with , **Dadi et al., (2021)** in the study entitled "Impact of healthcare-associated infections connected to medical devices—An update" who reported a strong correlation between prolonged ICU stays and MRSA infections, attributing the increased risk to prolonged exposure to invasive devices and hospital environments. Also, **Fanelli et al., (2024)** in the study entitled "Infection Prevention and Control Strategies According to the Type of Multidrug-Resistant Bacteria and Candida

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auris in Intensive Care Units: A Pragmatic Resume including Pathogens R0 and a Cost-Effectiveness Analysis" who highlighted that ICU patients with stays of more than 7 days had significantly higher MRSA colonization rates compared to those with shorter stays.

In addition, **Huang et al., (2019)** found that patients with diabetes and other chronic conditions were at higher risk for MRSA due to impaired immunity and increased healthcare exposure. Also, **Smith et al. (2019)** Emphasized that chronic diseases predispose patients to prolonged hospital stays, further increasing their risk of MRSA. Additionally **Chang et al. (2020)** reported no significant association between smoking and MRSA prevalence, aligning with the current study's findings. While **Chenet al., (2024)** in the study entitled "Investigating the relationship between muscle mass and nasal Methicillin-Resistant Staphylococcus aureus (MRSA) colonization: Analysis of the National Health and Nutrition Examination Survey (NHANES)" who suggested that smoking may contribute indirectly to infection risk through general immune suppression rather than being a direct determinant.

Regarding relation between risk factors related to patient and MRSA among critical ill patients the current study results revealed that, there was a statistically significant relation between MRSA and recent hospitalization, urogenital infection /UTI, respiratory infection, prior antibiotic therapy, taking immunosuppression medication, among the studied patients. According to researcher point of view this reflects the increased exposure to healthcare environments, where MRSA is commonly found, and the risk of colonization or infection during hospital stays. and MRSA prevalence was significantly higher in patients with respiratory infections three quarters. The respiratory tract is highly susceptible to colonization by MRSA, especially in critically ill patients, and is a major site for healthcare-associated infections, such as ventilator-associated pneumonia. Broad-spectrum antibiotics disrupt the normal microbiota, creating favorable conditions for MRSA colonization or infection. Also, there was a significant statistical relation between Methicillin-resistant Staphylococcus Aureus and presence of central venous catheter, reflecting the high risk of bloodstream infections due to breaches in aseptic technique during insertion or maintenance. presence of peripheral vascular catheter, Intubation or tracheostomy and presence of urinary catheter among the studied patients. While there was no statistically significant relation between Methicillin-resistant Staphylococcus Aureus and GIT infection, skin /deep soft tissue infection and steroids medication among the studied patients. The current study results are consistent with, **Huang et al., (2019)** who highlighted a strong relation between recent hospitalizations and MRSA prevalence due to prolonged healthcare exposure. Also, **Miller et al. (2021)** in the study entitled "Prevalence of and factors associated with multidrug resistant organism (MDRO) colonization in 3 nursing homes" who reported a high risk of MRSA bloodstream infections in patients with central venous catheters, emphasizing the importance of device management. In addition, **Smith et al. (2019):** demonstrated that prior broad-spectrum antibiotic use was a significant predictor of MRSA colonization.

Regarding relation between risk factors related to environment and MRSA among critical ill patients there was a highly statistical significant relation between MRSA and equipment disinfection before used, over bed tables and bed rails of patients clean and disinfected, counter top clean and disinfected regularly, door knobs clean and disinfected regularly, commodes clean and disinfected regularly among the studied patients .Also**,** there was a statistical significant relation between MRSA and daily stay in poor hygienic conditions among the studied patients while there was no statistical significant relation between MRSA and sinks and faucet handles clean and disinfected regularly among the studied patients.

From the investigator point of view this highlights the importance of thorough disinfection of medical equipment before use, as contaminated equipment can serve as a direct vector for pathogen transmission. Patients with unclean over bed tables and bed rails had a significantly higher MRSA prevalence of more than three quarters compared to those with cleaned and disinfected surfaces with more than one quarter. These high-contact surfaces are frequently touched by patients and healthcare

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workers, making these factors critical points for the spread of MRSA if not properly disinfected. The study findings goes in the same line, **Allegranzi et al. (2021)** who found that inadequate disinfection of medical equipment was a major contributor to MRSA prevalence in ICU settings. Also **Huang et al., (2019)** reported similar relations between unclean high-touch surfaces and increased MRSA transmission, particularly in critical care environments.

Regarding relation between risk factors related to nurses practices and MRSA among critical ill patients the results of present study demonstrate a highly significant statistical relationship between Methicillin-resistant Staphylococcus aureus prevalence and nurses practices in various critical procedures. This underscores the pivotal role of nursing care in preventing MRSA transmission among critically ill patients. The findings highlight that lapses in nursing practices substantially increase the risk of MRSA colonization and infection, which are preventable through adherence to evidence-based protocols.

Competent nursing practices were associated with markedly lower MRSA prevalence across all procedures, such as central line care, respiratory suction, urinary catheter care, hand hygiene, and equipment disinfection. This emphasizes the importance of proper aseptic techniques and adherence to infection control protocols in minimizing MRSA risk. While Incompetent practices, such as poor hand hygiene, inadequate equipment disinfection, and breaches in aseptic techniques during invasive procedures, were strongly associated with higher MRSA prevalence. These incompetent practices facilitate the direct transmission of pathogens, compromising patient safety and increasing healthcare-associated infection (HAI) rates. Central line care, urinary catheter care, and respiratory suction are particularly high-risk procedures where lapses in aseptic techniques can lead to bloodstream infections, urinary tract infections, or ventilator-associated pneumonia. These conditions provide a favorable environment for MRSA colonization and subsequent systemic infections.

The study results comes in the same line with , **Akinsulie et al., (2024)** in the study entitled "The Implications of Handwashing and Skin Hygiene on Infectious Disease Dynamics: The African Scenario" who highlighted that adherence to hand hygiene protocols reduced MRSA transmission by over the half in critical care settings. Also **Boatman et al., (2022).** In the study entitled "Infection Control in the Outpatient Setting" found that lapses in central line care and urinary catheter care significantly increased the risk of bloodstream and urinary tract infections, both linked to MRSA prevalence**. Rosenthal et al. (2019):** Emphasized the role of proper equipment disinfection in reducing HAIs, particularly in ICU environments.

Conclusion

Based on the study results, the current study concluded that, advanced age, chronic diseases such as diabetes mellitus and chronic obstructive pulmonary disease (COPD), and prolonged ICU stays are key patient-related risk factors contributing to MRSA infections. Additionally, prior antibiotic use, immunosuppressive therapy, and the presence of invasive devices such as central venous catheters, urinary catheters, and mechanical ventilation further increase susceptibility to MRSA colonization and infection.

Furthermore, environmental factors, including inadequate hygiene practices and poor disinfection of frequently touched surfaces, were significantly associated with MRSA occurrence. Specifically, failure to clean and disinfect equipment such as over-bed tables, bed rails, door handles, and commodes was identified as a major contributor to MRSA transmission.

Meanwhile, a high prevalence of incompetent nursing practices related to infection control measures. Specifically, suboptimal adherence to hand hygiene protocols, improper disinfection of medical equipment, and inadequate care during invasive procedures such as intubation, urinary catheterization, and central line maintenance significantly increased the risk of MRSA transmission. Moreover, there was a highly statistical significant relation between Methicillin-resistant Staphylococcus Aureus and all procedures related to nursing practices among the studied patients.

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Recommendations

Based on the current study finding the following recommendations were proposed:

For Patients:

- Allocate resources to provide adequate staffing levels, ensuring that nurses have sufficient time to perform infection control measures competently.
- Establish a system of continuous monitoring and feedback for infection control practices, coupled with regular audits to identify and mitigate risks promptly.

For Nurses:

- Strict adherence to infection control protocols, especially the five moments of hand hygiene and proper disinfection of medical equipment.
- In service training sessions focused on infection prevention and control, emphasizing the care of invasive devices like catheters and central lines.

For Further Research:

- Investigate additional risk factors contributing to MRSA infections among different patient populations to develop targeted prevention strategies.
- Examine the long-term outcomes of patients with MRSA in ICUs to understand the broader implications of infection control practices on patient recovery and hospital costs.

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