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Prevalence and antimicrobial susceptibility pattern of *Staphylococcus aureus* among patients at university of Gondar hospital northwest Ethiopia: a retrospective study of 25870 cases

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RESEARCH ARTICLE

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ABSTRACT: **Emergence of antimicrobial resistance is a major public health problem worldwide, particularly in developing countries. The global spread of methicillin-resistant *Staphylococcus aureus* (MRSA) constitutes one of the most serious contemporary challenges to the treatment of hospital-acquired infections. The aim of this study was to determine the antimicrobial resistance pattern of *Staphylococcus aureus* isolate from different clinical specimens at University of Gondar comprehensive specialized hospital. A retrospective study used laboratory records of 25870 clinical specimens submitted for bacterial culture microbiology laboratory of University of Gondar comprehensive specialized hospital for bacterial culture and sensitivity testing from July 2018 and April 2022. Records from specimens positive for *Staphylococcus aureus* isolates were included for analysis. Standard bacteriological techniques were followed during culture preparation, sample collection, bacterial identification, and antibiotic susceptibility testing. Data was entered and analyzed using SPSS version 20. Of the total 25,870 samples culture records, 4653 (18%) were culture positive for bacteria. A total of 1057 *S. aureus* isolates were collected from clinical specimens such as: wound discharge (342; 32.4%), blood (312; 29.5%), cerebrospinal fluid (16; 1.5%), urine (21; 2%), other body fluids (71; 6.7%) and other discharge (295; 28 %). The prevalence of methicillin resistant *S. aureus* was 33.8% (233/698) and the overall prevalence of multi-drug resistant *S. aureus* out of 1057 *S. aureus* isolates was 36% (380/1057). We recommend further research on molecular studies evaluating the resistance genes and monitoring the epidemiology of multiple drug resistant *S. aureus* and MRSA.**

KEYWORDS: Methicillin resistant *Staphylococcus aureus,* Antimicrobial susceptibility pattern

INTRODUCTION

Staphylococcus aureus is the most virulent and pathogenic gram positive bacteria of human. *S. aureus* is a versatile bacteria naturally equipped with a variety of virulence factors that contribute to its pathogenicity [1]. Therefore, *S. aureus* causes a wide variety of infections, ranging from simple superficial skin lesions like folliculitis to deep-seated abscesses and various pyogenic infections like endocarditis, osteomyelitis, pneumonia, septicemia, and meningitis [2]. Furthermore, it is also responsible for a number of toxin-mediated illnesses, including food poisoning, toxic shock syndrome, and staphylococcal scalded skin syndrome [3]. However, *S. aureus* exists as normal flora on various body parts such as nasal passages, throat, intestines, skin, and mucous membranes in approximately 30% of healthy people [4] .

Staphylococcus aureus usually have unique propensity of developing resistance to commonly used antibiotics. It's common antimicrobial resistance mechanisms includes antibiotic inactivation by enzymes, lower affinity for antibiotics due to altered targets, efflux pumps, and antibiotic trapping [5]. *Methicillin resistant Staphylococcus aureus* (MRSA) is a strain of *Staphylococcus aureus* that is resistant to all β-lactam antibiotics, including methicillin, oxacillin, amoxicillin, and penicillin, as well as other β-lactams that are commonly used to treat staphylococcal infections [6-8].

Methicillin resistant Staphylococcus aureus (MRSA) poses significant health threats to both hospitalized patients and the general public, but they are particularly dangerous for elderly, children and patients with impaired immune systems [6, 9]. Antimicrobial resistance among nosocomial pathogens, especially MRSA, is a major health issue in many countries, with serious repercussions such as higher medical expenses, patient morbidity, and mortality [7]. Since the development of penicillin and methicillin-resistant *S. aureus* strains in 1948 and 1961 [10]. *Methicillin-resistant Staphylococcus aureus (MRSA)* has emerged, disseminated globally and become a leading cause of bacterial infections in both health-care and community settings. According to data published by the WHO in 2014, more than 80% of Staphylococcus aureus infections had MRSA [11]. However, there is marked geographical variation in *MRSA* burden due to differences in local infection control practices and pathogen-specific characteristics of the circulating clones [12].

The expansion of antibiotic resistance is growing at a rapid rate and is now becoming a serious public health concern [13]. The aggravating factors, linked to the rise in antibiotic resistance, such as antibiotic overuse, lengthy hospital admissions, lack of awareness, and taking antibiotics before going to the hospital, are a common practices in this study area [14]. Therefore, to mitigate such kinds of problem a regular surveillance of antimicrobial resistance pattern of *S. aureus* isolates should be undertaken. In addition, the feedback should be utilized to update healthcare professionals and discourage the misuse or unnecessary use of antibiotics [15].

Staphylococcus aureus causing serious, life-threatening infections and increasing antibiotic resistance has driven the search for alternate therapies [16]. Antimicrobial-resistant diseases are causing an alarming increase in the global burden of disease, resulting in more than half a million deaths per year [15, 17, 18]. According to a report commissioned by the UK government, the annual number of deaths attributable to resistance might reach 10 million by 2050 if no effective control strategies are implemented [18]. Antimicrobial resistance has a direct impact on healthcare, causing many deaths in Europe and around the world, but it also has a negative influence on quality of life, resulting in significant direct and indirect expenses [19]. Antimicrobial resistance, especially methicillin resistance, is a problem that affects all countries, regardless of their level of development or economy, because resistant microorganisms do not respect borders [20].

In both hospital and community settings, there have been reports of significant changes in *S. aureus* susceptibility to beta-lactam antibiotics, particularly penicillin and cephalosporin. In some countries, MRSA makes up to 75 % of all *S. aureus* isolates in hospitals [21]. The therapeutic options are restricted by multidrug-resistant bacteria, which put a financial and social load on the healthcare system. The spread of antibiotic-resistant determinants in the hospital environment is caused via horizontal gene transfer. Antibiotic resistance is also brought about by chromosomal mutation and antibiotic selection.

In Ethiopia, antibiotics can be obtained over-the-counter without prescription [22]. This type of behavior along with others of a similar practices mentioned before contributes to the emergence and spread of antimicrobial resistance, rendering the most infections non-treatable. In addition to that, the overall epidemiology of multi-drug resistant strains is neither synchronized nor coordinated, particularly in developing countries like Ethiopia, where the prevalence of *S. aureus* and their pattern of antibiotic resistance isolated from clinical samples are unknown, particularly in Gondar. Thence, this study will provide information about the prevalence and antimicrobial susceptibility profile of *S. aureus*.

MATERIALS AND METHODS

Study design, area and period

From July to August of 2022, a retrospective cross-sectional study was conducted out at the University of Gondar Comprehensive Specialized Hospital (UoG_CSH) in northwest Ethiopia. Data from patient culture records were collected for the study in the bacteriology lab of the UoGCSH, a teaching and referral hospital situated in Gondar City, 750 kilometers northwest of Addis Ababa, Ethiopia. With more than 1,200 beds, this hospital is among the biggest healthcare facilities in the nation. Around 7 million residents of Gondar and the surrounding areas are served by the hospital. The UoGCSH's accredited bacteriology laboratory is one of its noteworthy aspects and is essential to the treatment of infectious disorders [23].

Study population

We included all patients who were suspected for BSIs and had recorded blood culture results registered on the bacteriology culture registration books from July 2018 and April 2022. Records with incomplete patient and laboratory data were excluded from the study.

Data collection

We conducted a retrospective review of four-year (July 2018 and April 2022) laboratory re cords of all blood cultures from patients suspected of having infection from all departments and units of the UoG-CSH. We used a data abstraction form to collect patients' socio demographic and laboratory data (age, gender, diagnosis year, culture results, types of specimens, ward types, *S.aureus* isolated , and anti-microbial susceptibility testing (AST)) results from the laboratory record books.

Laboratory method

According to the standard operation procedures, clinical specimens were collected from various body sites of patients who developed infections, including blood, wound discharge or swabs, body fluids, urine, stool, ear and eye swabs from each patient. Within 2 hrs of collection, specimens were transported to the bacteriology laboratory of UoG-CSH for culture and AST. The specimens were directly inoculated on Mannitol Salt Agar (Liofilchem Ltd., Italy) [24], Chocolate agar (Oxoid Ltd., England) and Blood Agar Plates (BAP) (Oxoid Ltd., England).

The inoculated agar plates were incubated at 35°C for 18–24 hours under aerobic conditions. After overnight incubation, the inoculated media was examined for golden yellow colonies on the MSA and complete hemolytic large colonies on the BAP that indicate the isolate could be *S. aureus*, which were subsequently identified by performing Gram staining, catalase test, and coagulase test. Isolates which had shown gram positive in clusters, coagulase and mannitol fermentation positive were identified as *S. aureus* [25].

Antibiotic susceptibility testing was carried out using the Kirby-Bauer Disc-diffusion technique [26]. The bacterial suspension was standardized using the 0.5 McFarland standard and inoculated on Mueller–Hinton agar. The antibiotic discs were dispensed after drying the plate for 3–5 min and were incubated at 37°C for 24 hrs. To test the susceptibility of bacterial isolates, penicillin G (10IU), cefoxitin (30g), ampicillin (10g), amoxicillin (10g), erythromycin (15g), clindamycin (2g), cotrimoxazole (25g), oxacillin (1g), augmentin (20/10g), azithromycin (15µg), clarithromycin (15µg), ceftriaxone (30g), gentamicin (10g), ciprofloxacin (5g).The control strains *S. aureus* American Type Culture Collection (ATCC 5923) and *E. coli* American Type Culture Collection (ATCC 25922) were used for quality control [27].

Laboratory quality control

The UoG-CSH bacteriology laboratory followed standard operating procedures during sample collection, transportation, and processing. The culture media were regularly checked for sterility by incubating five percent of the prepared media overnight and examining the presence of growth. Performances of the media were also checked by inoculating control strains before culture and sensitivity tests were performed. Selection of discs was based on local availability and following the CLSI(Clinical and Laboratory Standards Institute) guideline [28]. The reference strains such as *S. aureus* (ATCC 25923), and E. coli (ATCC 25922) and were used for quality control. The UoG-CSH bacteriology laboratory obtained all reference strains from the Ethiopian Public Health Institute (EPHI), Addis Abeba, Ethiopia.

Data analysis and interpretation

Data was entered and analyzed using SPSS version 20 software. The characteristics of the study population were summarized using frequencies, percentages, medians, and standard deviation. A P-value of < 0.05 was considered statistically significant.

RESULTS

Socio-demographic characteristics and frequencies of *S.aureus* isolates from different clinical samples

Over the four-year period, 25,870 clinical samples were collected and then tested in the University of Gondar Comprehensive Specialized referral hospital microbiology laboratory. From all 25,870 patients' samples analyzed, only 18% (4653) patients' samples had positive results. Out of 4,653 isolates identified, *S. aureus* was only identified in 22.7 % (1,057). Out of 1057 *S. aureus* isolates, the highest magnitude was isolated among male patients, 55.5% (587). The median age of the study participants was 14 years old, with a SD of ±20.4 and an age range of 1 day up to 98 years. The highest percentage of *S. aureus* was isolated among the 0-15 year age group 63.6% (673), followed by 22.3% (236) of the 16–30 -year-old age group. The percentage of *S. aureus* isolated from wound samples and body discharge was 32.4% (342) and (30.4%) 321, respectively. The magnitude of *S. aureus* in 2018 was 281 (26.6%), in 2017 it was 252 (23.8%), and in 2020 it was 228 (21.5%). The age and sex distribution of *S. aureus* isolates in this study are presented (Table 1).

Antibiotic susceptibility pattern of *Staphylococcus aureus* isolated from clinical samples

Antimicrobial susceptibility test was done on *S. aureus* isolates using the disk diffusion technique, and the results demonstrated a great degree of variability in susceptibility to each antibiotic tested. All of the 1057 *S. aureus* isolates were 100% (11/11) resistant to piperacillin, 88.4% (635/718) to penicillin, 75% (9/12) to ampicillin, 69.5% to tetracycline, and 62.1% to doxycycline. On the other hand, the majority of *S. aureus* isolates showed good susceptibility to amoxicillin, chloramphenicol, nitrofurantoin, cloxacillin, gentamycin, clarithromycin, and clindamycin by 83.3%(324/390), 82.7%(148/179), 76.9%(10/13), 76.1%(35/40), and 75%(551/735), respectively. The details of all *S. aureus* isolates' antimicrobial susceptibility profiles are presented in Table 2.

The prevalence of multi-drug resistant *Staphylococcus aureus* isolates

In this study, the prevalence of methicillin resistant *S. aureus* was 33.8% (233/698) and the prevalence of multi-drug resistant *S. aureus* out of 1057 *S. aureus* isolates was 36% (380/1057). The prevalence of multi-drug resistant *S. aureus* in different socio-demographic variables was significantly different. The prevalence of multi-drug-resistant *S. aureus* among female patients was 36.8% (173/470). It's slightly higher than the male patient, which was 35% (207/587).In contrast, the prevalence of MRSA was 60.1% among males, which is higher when compared to the 39.9% prevalence of MRSA among female study participants. In addition, the prevalence of multi-drug resistant *S. aureus* was significantly higher among the 31–45 year-old age groups, 48% (36/75), 37% (16/43) among the 46–60 year-old age group and between 0–15 year-old age groups. MDR *S. aureus* had a prevalence of 37.3% (165/233) and MRSA had a prevalence of 70.8% (165/233). The prevalence of MDR *S. aureus* in the urine sample isolates was 62% (13/21), 39.2% (123/312) in blood, and 35.2% (113/321) in discharge sample isolates. Furthermore, in this study, the prevalence of MDR *S. aureus* was high in the ICU at 38.2% (113/296), in the surgical ward at 35.9% (51/142) and in the medical OPD at 34.9% when compared with other wards. Further details of MDR *S. aureus* and *MRSA* prevalence and distribution in the socio-demographic characteristics are presented in Table 3.

Table 1. Frequencies of *S. aureus* isolates with socio-demographic variables at the University of Gondar comprehensive specialized hospital, Northwest Ethiopia, from July 2018 and April 2022.

Variables		Total No. of *S. aureus* (n=1057)	
		Frequency(N)	Percentage (%)
Sex	Male	587	55.5 %
	Female	470	44.5%
Age	0-15	673	63.6%
	16-30	236	22.3%
	31-45	75	7.1%
	46-60	43	4.1%
	>60	30	2.9%
Types of clinical specimen	Blood	312	29.5%
	Wound discharge	342	32.4%
	CSF	16	1.5%
	Urine	21	2%
	Other body fluids	71	6.7%
	Other discharges	321	30.37%
Wards types	Ortho-Pedi	12	1.1%
	Pedi emergency	131	12.4
	Surgical ward	142	13.5%
	Medical outpatient department(MOPD)	163	15.4%
	ICU	296	28%
	Others	313	29.7%
Year of diagnosis	2018	281	26.6%
	2019	252	23.8%
	2020	228	21.5%
	2021	89	8.6%
	2022	207	19.5%

Key: Other wards include wards, Gynecology, Dermatology,TB, Wing and a like

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Table 2. The antimicrobial susceptibility pattern of isolated *S. aureus* at the University of Gondar comprehensive specialized hospital, Northwest Ethiopia, from July 2018 and April 2022.

Antibiotics	No. of *S. aureus* tested	*Staphylococcus aureus* antimicrobial susceptibility profile		
		Sensitive N (%)	Intermediate N (%)	Resistant N (%)
Tetracycline (TTC)	393	106 (27%)	14 (3.6%)	273 (69.5%)
Doxycycline (DOX)	322	111(34.5%)	11 (3.4%)	200 (62.1%)
Penicillin (PEN)	718	72 (10%)	11 (1.5%)	635 (88.4%)
Azithromycin (AZM)	44	28 (63.6%)	0	16 (36.4%)
Clarithromycin (CLR)	4	3 (75%)	0	1 (25%)
Ciprofloxacin (CIP)	390	324 (83.1%)	9 (2.3%)	57 (14.6%)
Erythromycin (ER)	750	447 (59.6%)	18 (2.4%)	285 (38%)
Chloramphenicol (CHL)	179	148(82.7%)	6 (3.4%)	25 (14%)
Gentamycin (GEN)	503	380 (75.5%)	17 (3.4%)	106 (21.1%)
Nitrofurantoin (NIT)	13	10 (76.9%)	0	3 (23.1)
Norfloxacin (NOR)	48	36 (75%)	1 (2.1%)	11 (22.9%)
Trimethoprim sulfamethoxazole (SXT)	507	265 (52.3%)	8 (1.5%)	234 (46.2%)
Cefoxitin (CXT)	698	542 (65.6%)	7 (1%)	268 (33.8%)
Clindamycin (CLI)	735	551 (75%)	7 (1%)	177 (24%)
Pipracilin (PEP)	11	0	0	11 (100%)
Ceftriaxone (CRO)	68	27 (39.7%)	4 (5.9%)	37 (54.4%)
Cloxacillin (CLO)	46	35 (76.1%)	1 (2.2%)	10 (21.7%)
Amoxicillin (AMX)	6	5 (83.3%)	0	1(16.7%)
Ampicillin (AMP)	12	2 (16.7%)	1 (8.3%)	9 (75%)
Augmenting (AUG)	17	7 (41.2%)	0	10 (58.8%)

Table 3. The proportion of multi-drug resistant *S. aureus* isolates from clinical samples at UOGCSH, Northwest Ethiopia, from July 2018 and April 2022.

Variables	Frequency *S. aureus (n=1057)*	Multi-drug resistant (MDR) *S. aureus*					Total MDR	No MDR
		MRSA (233)	R3	R4	R5	≥R6	380 (36%)	677(63%)
Sex	Male (587)	140 (60%)	113	55	27	12	207(35.3%)	380(64.7%)
	Female (470)	93 (40%)	92	42	27	12	173(36.8%)	297(63.2%)
Age	0-15 (673)	165 (70.8%)	137	66	34	14	251(37.3%)	422(62.7%)
	16-30 (236)	32 (13.7%)	36	17	10	5	68(28.8%)	168(71.2%)
	31-45 (75)	20 (8.6%)	17	8	7	4	36(48%)	39(52%)
	46-60 (43)	9 (3.9%)	10	4	1	1	16(37%)	27(62/7%)
	>60 (30)	7 (3%)	5	2	2	0	9(30%)	21(70%)
Types of clinical specimens	Blood (312)	134 (57.5%)	63	24	25	11	123(39.2%)	190(60.8%)
	Wound discharge. (342)	32 (13.7%)	62	34	14	3	113(33%)	228(66%)
	CSF (14)	5 (2.1%)	4	0	0	0	4(25%)	12(75%)
	Urine (21)	7 (3%)	3	4	3	3	13(62%)	8(38%)
	Body fluids (71)	7 (3%)	11	2	1	0	14(20%)	57(80%)
	Other dis. (321)	48 (20.6%)	62	33	11	7	113(35.2%)	182(64.8%)
Types of wards	Ortho-Pedi (12)	-	0	2	0	1	3(25%)	9(75%)
	Pedi emerge (131)	44 (18.9%)	21	9	8	3	41(31.1%)	89(67.9%)
	Surg. ward (142)	20 (8.6%)	28	11	10	2	51(35.9%)	91(64.1%)
	Med OPD (163)	32 (13.7%)	36	14	5	2	57(34.9%)	106(65.1%)
	ICU (296)	78 (33.5%)	61	31	11	10	113(38.2%)	184(61.8%)
	Others (313)	59 (25.3%)	59	30	20	6	115(36.7%)	198(63.3%)
Year of diagnosis	2018 (281)	15 (6.4%)	72	33	14	8	127(45.4%)	153(54.6%)
	2019 (252)	71 (30.5%)	59	40	30	9	138(54.8%)	115(43.3%)
	2020 (228)	34 (14.6%)	29	9	8	4	50(21.9%)	178(79%)
	2021 (89)	21 (9%)	7	6	0	0	13(14.6%)	76(83.4%)
	2022 (207)	92 (39.5%)	38	9	2	3	52(25.1%)	155(74.9%)

Key: R3:- Resistant to three classes of agents, R4:- Resistant to four classes of agents, R5:- Resistant to five classes of agents, R6:- resistant to six and above classes of agent.

Year based distribution of *S. aureus* isolates at UOG-CSH, northwest Ethiopia.

The overall prevalence of *S. aureus was 38.9%*. The prevalence of *S. aureus* in 2018 was 26.5% (281/1057), 23.8% (252/1057) in 2019, and 21.5% (228/1057) in 2020. In 2021, the prevalence of *S. aureus* was 89(6.8%), but it increased in 2022 to 207(19.5%) (Figure 1).

Trends in multidrug resistant *S.aureus* isolates from July 2018 and April 2022 at UOG-CSH

The overall MDR trend of *S. aureus* species was determined by dividing MDR isolates in each year by the total number of isolates over the corresponding year. The MDR rates of 54.8% (138/252) and 45.2% (127/281) were highest in 2019 and 2018, respectively; while MDR rates of 6/89 (6.7%) were lowest in 2021 (Figure 2).

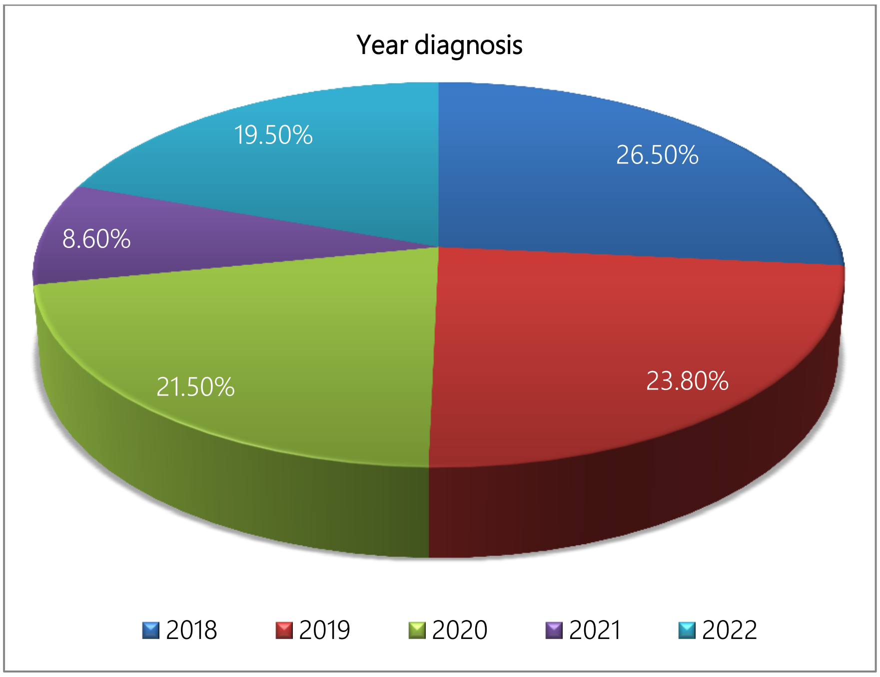

Figure 1. Year based distribution of *S.aureus* isolates at the University of Gondar comprehensive specialized referral Hospital, from July 2018 and April 2022.

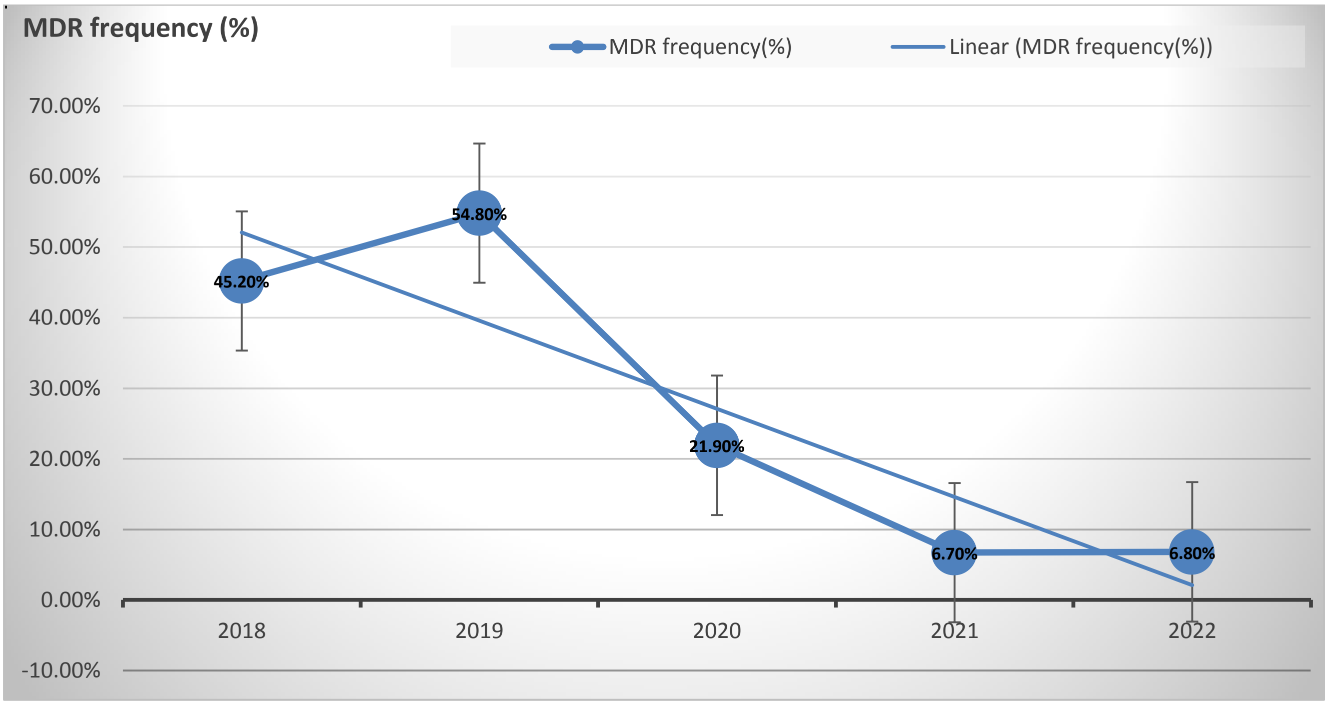

Figure 2. The trend of MDR isolates among patients at the University of Gondar Comprehensive specialized hospital, 2018-2022.

DISCUSSION

Staphylococcus aureus, is one of the most common nosocomial and community-acquired pathogens, has now emerged as an ever-increasing problem due to its increasing resistance to several antibiotics. Antibiotic resistance is escalating at a greater rate than the production of new antimicrobial in clinical practice, leading the world to a global health problem [30]. In this retrospective study, we analyzed the four-year antimicrobial resistance patterns of *Staphylococcus aureus* isolated from clinical specimens with a special focus on methicillin resistance.

In this study, the prevalence of *S. aureus* was 1,057 (22.7%), which is similar to a study conducted in this area in five governmental urban elementary schools in Gondar town and five governmental rural elementary schools surrounding Gondar town from January to May, 2018, 143/622 (23%) [31]. But our finding was lower than reports from Debre Markos Referral Hospital, Ethiopia 100 (31.5%) [32] and the three major government hospitals in the Tamale [33]. Metropolis of Ghana, 47/120 (39%) [34]. These differences may be due to variations in sample size, geographical location, and sampling techniques.

The present study showed that males had a higher isolation rate of *S. aureus* 55.5% (587/1057) than females. This finding was less than that of a study conducted in Aminu Kano Teaching Hospital, of 62% [35] and in Peshawar, Pakistan 69% [36]. These differences may be due to the diagnostic techniques and inconsistency in sample size. Among different clinical specimens, the highest prevalence of *S. aureus* (32.4%) was observed in wound specimens. This result is in line with studies conducted in Jordan's northern region and Aminu Kano Teaching Hospital Nigeria (37.5%) and (40%) [22, 37] respectively. In addition, 55.4% and 41.4% of wound infections were reported in Yekatit 12 Hospital Medical College, Addis Ababa, Ethiopia and Debre Markos Referral Hospital, Ethiopia [22, 32]. These differences may be due to the inconsistency in sample size.

Regarding the antimicrobial susceptibility pattern results, there were 88.4%, 62.1%, and 69.5% resistance to penicillin, doxycycline, and tetracycline, respectively. In this study, antimicrobial susceptibility tests showed that penicillin, doxycycline, and tetracycline were the least effective agents. The result of penicillin resistance was in agreement with the findings of a study conducted in Debre Markos Refeeral Hospital, Ethiopia (89.7%) [22].

But our finding was less than the five governmental urban elementary schools in Gondar town and five governmental rural elementary schools surrounding Gondar town (99.3%) [31], at Yekatit 12 Hospital Medical College, Addis Ababa, Ethiopia (96.4%) [38] and in ASUHs, Egypt (97%) [39].

On the other hand, we observed that the isolates were sensitive to ciprofloxacin (83.1%), chloramphenicol (82.7%), gentamycin (75.5%), clindamycin (75%), and cefoxitin (65.6%). This finding was in line with studies conducted in five governmental urban elementary schools in Gondar town and five governmental rural elementary schools surrounding Gondar town from January to May, 2018(>90%) [31].

In this study, 380(36%) of the total 1057 *S. aureus* species were MDR. This finding was higher than a study conducted in Jordan's northern region (31%) [40]. This could be due to the continuous and empirical usage of broad-spectrum antimicrobials and the lack of an appropriate antibiotic treatment strategy. On the other hand, our finding is lower than study conducted at Tribhuvan University, Nepal 44% (12/27) [41] and in Guangzhou, China 60.08% (152/253) [42]. These differences among multidrug resistance in *S. aureus* strains could result from the differences in the use of antibiotics at the regional level.

The present study showed that the prevalence of methicillin resistant *S. aureus* (MRSA) was accounted for by 33.8% (233/698). This finding was consistent with the study conducted at Dhaka Medical College Hospital, Bangladesh 15/44(34%) [43], but higher than a study conducted in Jordan's northern region between January 2008 and November 2012 (31.6%) [37], three major government hospitals in the Tamale Metropolis of Ghana from February to March 2015 8/47(17%) and Peshawar, Pakistan from August 2012 to March 2013,45/855 (5.26%) [44, 45]. However, our finding was less than study from ASUHs, Egypt 51/69 (74%) [39]. These differences may be due to variations in sample size, study design or diagnostic techniques.

Limitation of the study

This study was retrospective and might not reflect the current situation. In addition, clinical data was missed, such as specimen type, collection date, age of the patient, clinical information, previous antibiotic use, duration of patient stay in the hospital, and outcome of the therapy.

CONCLUSIONS AND RECOMMENDATIONS

In this study, *S. aureus* antibiotic resistance and MDR rates declined year over year. But still, our study observed a multidrug *S. aureus* isolate. As a result, immediate action toward infection prevention practices is required, and patient care should be guided by antimicrobial susceptibility testing. *Staphylococcus aureus* is one of the organisms most frequently isolated in hospital and community-acquired infections. Our study showed that 0–15 age group and intensive care unit patients had the highest (70.0%) and lowest (33.5%) proportion of MRSA isolates. We recommend further research on molecular studies evaluating the resistance genes and monitoring the epidemiology of multiple drug-resistant *S. aureus* and MRSA. Additionally, we would like to suggest to microbiologists that consistent drug susceptibility testing for isolated *S. aureus* can be incorporated into the CLIS guideline. We would like to recommend that healthcare facilities develop an infection prevention strategy.

DECLARATIONS

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Authors' contribution

T.Gashaw S.Belay, A.Ambachew and D.Belete collected data. D.Belete wrote the manuscript, gave valuable suggestions on the manuscript, and revised the manuscript. All authors read and approved the final version of the manuscript.

Data availability

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Ethics approval and consent to participate

We would like to confirm that the study protocol was thoroughly reviewed and approved by the University of Gondar College of Health Sciences, School of Biomedical and Laboratory Sciences Research Ethics committee (REC) (Permission letter's Reference number: SBMLS/347/2022, Date 21/06/2022. A permission letter was obtained and sent to all concerned bodies, and the study was secured at all levels. Furthermore, the Research Ethics Committee (REC) has waived the need for consent due to the retrospective study and the utilization of secondary and anonymized data. We conducted the study following the Declaration of Helsinki [46].

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Competing interests

The authors declare that they have no competing interests in this work.

Abbreviations

AST, antimicrobial susceptibility testing; CLSI, Clinical and Laboratory Standards Institute; CSF, cerebrospinal fluid; MDR, multidrug resistance; MHA, Muller Hinton Agar; MRSA, methicillin resistant *Staphylococcus aureus*; MSSA, methicillin sensitive *Staphylococcus aureus*; SBMLS, School of Biomedical and Laboratory Sciences; UOG-CSH, University of Gondar Comprehensive specialized hospital.

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