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REVIEW ARTICLE

The Spread of MRSA in Ethiopia

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Abstract

Multidrug resistance *S. aureus* (MRSA) is an emerged pathogen responsible to cause infections both in the hospital and community. MRSA is distributed worldwide and causing high morbidity and mortality. The prevalence of MRSA is highest in developed countries; however, due to effective controlling measures implemented in developed countries, nowadays the prevalence of MRSA is decreasing substantially. On the contrary, in developing countries, the prevalence of MRSA is increasingly reported. In Ethiopia, the rate of isolation of MRSA from clinical samples is in the range of 30 to 100% in hospitals. Though the prevalence of MRSA in the community is not extensively explored, reports show that there is a high prevalence of MRSA in the community. The rate of isolation of MRSA from a hospital environment and medical equipment used in a non-clinical care setting is also high. MRSA shows wide antibiotic resistance patterns in Ethiopia, of which 100% resistance to Penicillin G, Ampicillin, Amoxicillin, and Cotrimoxazole were repeatedly reported. Vancomycin-resistant *S. aureus* is also reported, however Vancomycin remains the drug of choice to treat MRSA infection in the country. MRSA is quickly spreading in hospitals causing the treatment of common infection much more difficult. Therefore, urgent implementation of MRSA control measures tremendously important to control the further spread of the pathogen. In this view, the current review aimed to show the current trend of MRSA in Ethiopia.

Keywords

MRSA, Drug resistance, Prevalence, Infection

Introduction

Antimicrobial drug resistance is a major problem in both developing and developed countries, causing high morbidity and mortality and economic losses. Infections caused by multidrug-resistant strains are also associated with a longer hospital stay, prolonged antibiotic administration, and higher cost than infections caused by susceptible strains. Antibiotic resistance is accountable for more than 2 million infections and 23,000 deaths annually in the United States, causing total losses of $55 billion annually [1]. Similarly, in Europe, an estimated 25,000 deaths are due to antibiotic-resistant infections, costing €1.5 billion annually in direct and indirect costs [2]. In India, it is estimated that 58,000 neonatal sepsis deaths are because of antibiotic resistance [3]. In Africa, although reliable data related to economic losses due to antibiotic resistance is not available, several reports from Africa shows that antibiotic resistance associated with neonates deaths [4,5].

Among the different species of bacteria, *S. aureus* is known to develop drug resistance to multiple antibiotics very fastly due to its inherent features. Multidrug resistance *S. aureus* (MRSA) is an emerged pathogen that able to withstand the effect of different antimicrobials both in hospital admitted patients as well as in the community. Because of its ability to acquire resistance genes, *S. aureus* becomes resistant to broad types of antibiotics and became human bacterial infections across the world [6]. MRSA can cause minor infections such as pimples, boils, and other skin lesions and sometimes cause a fatal infection. MRSA usually transmitted from person to person through contact with secretions from infected skin lesions, nasal discharge or spread through the hands.

The emergence and spread of MRSA is due to the improper use of antibiotics which includes: patient's poor adherence to prescribed antibiotics, overuse of antibiotics,

Table 1: The rate of isolation of *S. aureus* and MRSA in different parts of Ethiopia.

The study area, and sampling site	Study period	Total number of *S. aureus* isolated	The rate of MRSA isolation (%)	Reference
Addis Ababa	1987-1988	249	30.5	[11]
Addis Ababa	1989		40	[26]
SWE, JUSH	2000	61	84	[12]
NWE, GU	2002	31	64.5	[23]
SWE, JUSH	2003	34	44.1	[17]
NWE, GU	2006	51	70	[24]
NWE, FHRH			55	[14]
NWE, FHRH	2009	31	96.7	[27]
NEE, DRH	2011	203	52	[28]
NWE, FHRH	2012	3	100	[29]
NWE, FHRH	2012	11	100	[30]
NWE, GU	2012	7	100	[25]
NWE, GU	2009-2012	54	NR	[31]
SWE, Jimma town	2010-2011	169	18.8%	[9]
SWE, JU	2011	73	86.2	[8]
Addis Ababa	2013		34	[32]
NEE, DRH	2014		49.7	[13]
SWE, Jimma town	2014		13.8	[15]

SWE: South Western Ethiopia; JUSH: Jimma University Specialized Hospital; NEW: North Western Ethiopia; GU: University of Gondar; FHRH: Felege Hiwot Referral Hospital; NEE: Northeastern Ethiopia; DRH: DebreMarkos referral Hospital.

broad-spectrum antibiotic use, self-antibiotic prescription, patient's poor awareness of antimicrobial drug resistance and lack of access to local antibiogram [7].

According to WHO 2014, MRSA is among the top three pathogenic bacteria of greater concern associated with both hospital and community-acquired infections. MRSA resistance rates exceed 20 percent in all WHO regions and are above 80 percent in some regions [2].

However, due to the strong controlling measures were taken in most developed countries the prevalence of MRSA has been decreasing while in developing countries like Africa increasingly reported. For instance, MRSA incidence was declined in Europe to 18%, United States to 44% and Canada to 16% over the past eight years [2].

In different Ethiopian hospitals, there is a continuous report that shows an increase in the prevalence of MRSA indicating the pathogen has been spreading in very high rate than ever [8-10]. Although MRSA is highly prevalent in Ethiopian hospitals, the knowledge, and awareness about MRSA among both the medical staff and community is very low [7]. To this end, the current review aimed to summarize the current trend of MRSA in Ethiopia based on published research papers which enable concerned bodies to intervene the problem before it resulted in a dire consequence.

Isolation Rate of *S. aureus* and MRSA in Ethiopia

Normally, *S. aureus* is a bacterium found on the skin, nostrils, and throat of 30% of healthy people [6]. However, the carriage rate of *S. aureus* may be higher than the normal rate due to various reasons. In Ethiopia, Prevalence of MRSA has been increasingly reported since 1987. The rate of isolation of MRSA among *S. aureus* isolated from clinical samples ranges from 30.5 to 100% (Table 1). MRSA was first reported in Ethiopia by [11] after examining clinical specimens from different health institutions referred to National Research Institute of Health (NRIH) for analysis and prevalence of MRSA was reported as 30.5%. In 1997, the isolation rate of MRSA in Jimma Hospital was reported as 43% [12].

Similarly, in the study conducted at Debre Markos Referral Hospital, of the 184 surgical patients who had developed a surgical site infection, *S. aureus* isolated from 73 (39.7%) patients, and the rate of MRSA isolation was reported as 49.7% [13]. In

another study conducted at the Felege Hiwot Referral Hospital, the isolation rate of methicillin-resistant staphylococci (MRSA) was found to be 55% [14]. Reta, et al. [15] reported that the overall frequency of isolation of *S. aureus* from primary school children of Jimma town was 41% (123/300) [15]. The isolation rate of MRSA from different clinical and environmental samples summarized in Table 1.

The isolation rate of MRSA is also high from an animal product like milk, and other environmental samples. Although further surveillance studies are so necessary, it is possible to say that MRSA is increasing in both hospital and community in Ethiopia. If MRSA continues at the present rate it would make the treatment of common infections much more difficult resulting in high morbidity and mortality and also economic losses.

Hospital-Associated MRSA and Community-Associated MRSA in Ethiopia

CDC has defined a community-associated MRSA (CA-MRSA) case as a patient with MRSA infection and no history of the following: Surgery, hospitalization, residence in a long-term care facility, or dialysis within one year prior to infection; presence of a percutaneous device or indwelling catheter; hospitalization > 48 hours before the culture; or history of previous MRSA infection or colonization [16]. Conversely, a case of HA-MRSA can be defined as MRSA infection that does not qualify as CA-MRSA.

In Ethiopia, both HA-MRSA and CA-MRSA has been increasingly reported. Many studies showed that HA-MRSA is highly prevalent in Ethiopian hospitals and the prevalence rate ranges from 28-60% [17,18]. Similarly, CA-MRSA is also reported among school children. Kejela and Bacha [9] reported that MRSA is prevalent among healthy primary school students and prisoners. Another study by Reta, Gedefaw, Sewunet, Beyene, [15] also described that the isolation rate of MRSA among school students is high. The inference of these two studies shows that CA-MRSA is quite prevalent in the community.

Risk Factors for HA MRSA and CA-MRSA in Ethiopia

In most cases, the people found to be at risk of developing a CA-MRSA infection is young and healthy people who lack health care risk factors. Although no established risk factors for CA MRSA nasal colonization, it was reported that: having recurrent AOM (Acute Otitis Media), Children aged 6-12 years and overcrowding in schools are among the risk factors significantly associated with *S. aureus* and MRSA nasal colonization in school children in Jimma town [9]. It is also reported that overcrowding, a poor hygienic condition in the correctional center (prison) in Ethiopia is also highly associated with nasal carriage of *S. aureus*.

According to Kahsay, et al. (2014) [13], laparotomy type of surgery and duration of operation was significantly associated with HA-MRSA infection among inpatients of Debre Markos hospital. In another study conducted at Gondar University, patients having cases of tonsilopharyngitis, upper respiratory tract infection and sinusitis are much more associated with MRSA carriage. It is also reported that MRSA carriage is highest among healthcare workers [18]. The high carriage of MRSA among healthcare workers favours the transmission of MRSA from one patient to the other.

Contaminated Equipment and Hospital Environments as a Source of MRSA in Ethiopia

S. aureus is among pathogenic bacteria commonly colonizing medical equipment and hospital environments. Due to the absence or poor disinfection of medical and related equipment used in a non-critical care setting in hospitals, they can easily get contaminated with pathogenic bacteria. According to Shiferaw, et al. [19], of 176 stethoscopes examined for bacterial contamination in Jimma hospital, 151 (85.8%) were considerably contaminated with different bacteria species and the rate of isolation of *S. aureus* was reported as 30.9% [19]. The higher rate of contamination of stethoscopes with MRSA in the hospital may increase the chance of spread of the

Table 2: Antibiotics resistance patterns of *S.aureus* in Ethiopia.

The study area, and sampling site	Study period	Study group	Specimen	Decreasing order of rate of resistance of MRSA isolates to antibiotics	Reference
SWE, JUSH	2000	Patients	Body fluid	PEN > AMP > TTC > CHL/STR > CPI	[12]
NWE, GU	2002	Inpatients and outpatients	Urine	TTC > CHL > SXT > PEN > AMP > GEN > ERY > CIP	[23]
NWE, GU	2006	Inpatients and outpatients	wound	AMP > PEN > TTC > SXT > CHL > ERY > GEN > CIP	[24]
NWE, FHRH	2009	Inpatients and outpatients	Urine	TTC > PEN > STR > AMP > CHL > SXT > ERY > GEN	[27]
NEE, DRH	2011	Inpatients and outpatients	Ear discharge	AMX > TTC > SXT > ERY > CHL > GEN > CIP	[28]
NEE, DRH	2010	Inpatients and outpatients	wound	AMX > TTC > SXT > CHL > ERY > GEN > CIP	[33]
NWE, GU	2011	Surgically operated patients	wound	AMX > AMP > SXT > GEN/CHL > ERY > CIP > TTC/MET	[34]
NWE, FHRH	2012	Pregnant women	Urine	TTC/AMP/SXT > GEN/CIP > CHL > AMX	[29]
NWE, FHRH	2012	Surgically operated patients	Wound and blood	AMP > CHL > AMX > SXT > TTC/ GEN/PEN > CIP > ERY	[30]
NWE, GU	2012	Diabetic patients	Urine	TTC/SXT/CIP/PEN > AMP/CHL > ERY > GEN	[25]
NWE, GU	2009-2012	Inpatients and outpatients	Ear discharge	AMX > AMP > TTC > SXT > ERY > GEN > PEN > CHL > CIP	[31]
SWE, Jimma town	2010-2011	School children and prisoners	Nasal	PEN > AMP > CHL > ERY > MET > TTC > SXT > GEN > VAN	[9]
SWE, JU	2011	Inpatients and outpatients	wound	PEN > AMP > ERY > MET > CHL > SXT > VAN > GEN > CIP	[8]

pathogen from patient to patient if it is not disinfected.

In another study conducted at Gondar University Hospital indicated that computer keyboards and mouse in the internet café in Gonder University hospital is highly contaminated with pathogenic bacteria in which *S. aureus* is dominant [20]. According to this study, *S. aureus* exhibited a high level of resistance to penicillin (87%), oxacillin (87%), and amoxicillin (80%), and *S. aureus* were susceptible to ceftriaxone (97%), ciprofloxacin (91%), and vancomycin (100%). Contamination of MRSA on computers keyboards and mouse were obviously due to the absence of washing/disinfection of hands that contribute the spread of MRSA to the community.

Similarly, in the study of bacterial contamination of mobile phones of health care workers at Jimma University Specialized Hospital, of 112 bacteria isolated, 33 of them were *Staphylococcus aureus* of which 13 of them were identified as MRSA [21]. The study concluded that healthcare workers mobile phones were more likely contaminated with methicillin-resistant *S. aureus* than non-health care workers' mobile phones (OR = 12.83; 95% CI 2.15-37.45) [21]. MRSA also prevalent in wastewaters in the hospital and nonhospital environment [22]. The high carriage of MRSA among health care workers and the poor disinfection habits result in high contamination rate of medical equipment and related materials.

Therefore, from the studies conducted so far, one can conclude that medical equipment, as well as non-medical equipment commonly used in non-critical care setting in hospitals, have high chances to get contaminated with MRSA and this creates a favorable environment for the spread of MRSA both in the hospital and in the community in Ethiopia.

Drugs Resistance Patterns of *S. aureus* in Ethiopia

S. aureus displayed different drug resistance pattern across the country. The available report showed that *S. aureus* developed resistance to the common antibiotics, which have been commonly used in the country. The resistance to β-lactam antibiotics dominates in all the studies (Table 2). Although the drug resistance pat-

tern of MRSA varies from place to place, according to the currently available data, the top four antibiotics that *S. aureus* developed resistance were Penicillin, Ampicillin, Tetracycline and Trimethoprim/Sulfamethoxazole [12,23,24]. Hundred percent resistance of MRSA to Penicillin G, Ampicillin, Amoxicillin, and Cotrimoxazole was reported [25]. MRSA resistance to vancomycin is also reported both in the hospital and the community [8,9]. The incidence of vancomycin-resistant Staphylococci in the hospital as well as in the community is alarming because vancomycin is currently the main antimicrobial agent available to treat life-threatening infections associated with MRSA in Ethiopia [8].

From the reports one can conclude that majority of MRSA isolates demonstrated multiple resistance against different antimicrobial classes, therefore, treatment of wound infections has to be made based on the *in vitro* antibiotic susceptibility tests. Nevertheless, if one could not have access to the result of antibiotic tests, ampicillin, penicillin, methicillin, trimethoprim-sulphamethoxazole, and chloramphenicol are not good choices to treat wound infections [8]. Moreover, periodic monitoring of the etiology and antimicrobial susceptibility of isolates from wounds in hospital settings is beneficial to the patient and assists the physician in a selection of chemotherapy in areas where no culture facilities.

Awareness of MRSA among Medical Staffs in Ethiopia

In a study on knowledge and beliefs on antimicrobial resistance among Physician and nurses in hospitals of Amhara region, medical staffs were asked for their awareness about MDR and the majority of the medical staff did not mention the existence of antibiotic-resistant bacteria. Specifically, only 22.3% of physicians and 2.4% of nurses had information regarding MRSA [7]. This shows that physicians and nurses working in hospitals had an information gap on the antimicrobial resistance pattern of their area. Lack of information on drug resistance pattern of clinically important pathogens would lead the physician not to select the effective antibiotic for the treatment of infections. This would lead to further spread of MRSA and makes treatment of wound infections much more difficult.

Conclusions

MRSA is spreading quickly both in hospital and community at a very alarming rate than ever in Ethiopia. Although the resistance pattern of MRSA varies from place to place, the resistance of MRSA to commonly used antibiotics almost the same in all the studies conducted areas across the country. In the majority of the report of MRSA in Ethiopia, Vancomycin was a relatively effective drug for the treatment of MRSA infections. However, the resistance of MRSA against Vancomycin is also increasingly reported which is the best option in the area to treat MRSA infections. If MRSA resistance to antibiotics continues in the current trend, it makes the treatment of infections more complicated which may lead to high morbidity and mortality and also economic losses. To this end, antibiotic policy and treatment guidelines must be established in the country to decrease MRSA spreading rate.

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