Ethiop. J. Biol. Sci., **8(1): 1-14, 2009**
 ISSN: 1819-8678

THE ISOLATION RATE OF *STAPHYLOCOCCUS* AND *STREPTOCOCCUS* PATHOGENIC ISOLATES AND THEIR ANTIMICROBIAL RESPONSES IN NORTHWEST ETHIOPIA, AUGUST 2004 TO JULY 2006

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ABSTRACT: *Staphylococcus* and *Streptococcus* isolates are among the major pathogens causing different diseases in Ethiopia. The aim of this study was to determine the frequency of isolation and sensitivity pattern of *Staphylococcus* and *Streptococcus* against the commonly used antibiotics. A retrospective study was carried out in this investigation. A total of 51 (1.85 %) *Streptococcus* isolates and 217 *Staphylococcus* (7.03 %) isolates were recorded from 3829 different samples of patients at Gondar University Teaching Hospital. Nineteen (36.5%) of the *Streptococcus* strains were detected from CSF specimens and the rest were from different specimens. Out of the 217 *S. aureus* isolates, 10 (4.61 %) and 9 (4.15 %) were from urine and pus specimens, respectively. The remaining 198 (91.24 %) *S. aureus* strains were isolated from miscellaneous other clinical sources in different wards. In this study, all the isolates of *S. aureus* were resistant to less expensive, commonly available antibiotics, such as tetracycline (65.3%) and ampicillin (62.2%). On the other hand, *S. aureus* isolates were less resistant to gentamycin (12.9%), ciprofloxacin (13.5%), erythromycin (24.7%), chloramphenicol (28.8%) and trimethoprim-sulphamethoxazole (36.5%). Thus these antibiotics may be used as drugs of choice for empirical treatments of infections with the investigated bacteria. High rate of isolation of *Staphylococci* and *Streptococci* from the investigated specimens may indicate poor hospital and/or personal hygiene and environmental sanitation depending on the source. Thus, constant cleaning of the body with soap and water and improving sanitation of the environment can help to reduce the microbial load in the susceptible part of the body and the patient's environment.

Key words/phrases: Antimicrobial susceptibility, Frequency of isolation, Pathogens, *Staphylococcus, Streptococcus*.

INTRODUCTION

Bacterial infection causes different types of diseases that lead to high rate of morbidity and mortality in different parts of the world (Mondal *et al.*, 2003), but is more severe in the developing countries like Ethiopia. This is mostly aggravated by poor sanitation, malnutrition and lack of health education. The severity of infection varies with pathogencity and dose of the invading

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microorganisms and the strength of host defense. Of those Gram positive bacteria, *Staphylococcus* and *Streptococcus* strains are the common pathogenic bacteria in developing countries (Mondal *et al.*, 2003).

Staphylococcus aureus causes a variety of human infection in all age groups (Boyce, 1981). It remains one of the most frequently isolated pathogens in both community and hospital practices, which is mostly recovered from infections of blood stream, skin, soft tissue, pneumonia and hospital-acquired post-operative wounds (Doern *et al*., 1999; Sader *et al.*, 1998; Giacometti *et al.,* 2000). *Staphylococcus aureus* is an opportunistic pathogen of most immune-compromised individuals such as diabetic, old malnourished persons, HIV positive and other chronic cases (Burnett *et al*., 1996). *Staphylococcal pneumonia* can occur if staphylococcal infection spreads to the lungs (Klodkowaska-Farner *et al*., 1995).

In previous studies, Solomon Gebreselasie (2002) collected 500 different specimens from all age group patients in Ethiopia and isolated 47 (9.4%) and 26 (5.2%) *S. aureus* and *S. pneumonia,* respectively. According to Zeleke Wolde Tenssay (2000), out of 61 *S. aureus* isolates, 34 (55.7%), 15 (24.6%), 8 (13.1%), and 4 (6.6%) were recovered from pus and discharge, nasal swabs, blood, and environmental samples, respectively. Another study from Ethiopia (Lindtjorn *et al.,* 1989) has also reported that *Staphylococcus aureus* was one of the most frequent isolates from abscesses and infected wounds.

Changes in the pattern of antimicrobial susceptibility of *S. aureus* and other organisms have been reported world-wide, especially in developing countries (Alborzi *et al*., 2000; Bukhari *et al*., 2004; Krishna *et al*., 2004), making antimicrobial agents increasingly less effective in treating the infections. Over the past few years, there have been dramatic changes in the susceptibility of *S. aureus* in both hospitals and community settings in Trinidad (Orrett, 1997; Orrett, 2001). The older β-lactams, penicillin and ampicillin were ineffective against more than 80% of isolated strains, and resistant to many of the non-β-lactam agents such as the tetracycline, gentamycin, chloramphenicol and erythromycin (Kunin, 1993; Mansouri and Khaleghi, 1997).

Antimicrobial sensitivity patterns of *S. aureus* were investigated in different parts of Ethiopia. More than 60.5%, 55% and 45% of *S. aureus* were resistant to tetracycline, co-trimoxazole and chloramphenicol, respectively. Most of *S. aureus* strains (89%) from Ethiopia were sensitive to gentamicin (Solomon Gebreselasie, 2002; Zeleke Wolde Tenssay, 2000). Among *S.*

aureus, isolates, a high frequency (84%) of multiple resistance was observed (Mogese Truneh, 1991; Zeleke Wolde Tenssay, 2000). Resistance of *S. aureus* to two antimicrobials such as penicillin and tetracycline was frequent among patients' strains (Mogese Truneh, 1991).

The predisposition to pneumococcal infection is probably due to dysfunctional host defenses rather than to increased colonization. Most patients with pneumococcal pneumonia (PCP) experience the acute onset of fever and productive cough, (Garcia-Leoni *et al.,* 1992), and the symptoms due to PCP commonly last more than one month (Bacchetti *et al*., 1990).

Pneumococcal infections usually respond to antibiotics such as penicillin, ciprofloxacin, amoxycillin or antibiotics belonging to the macrolide or second-generation cephalosporin families. Resistance of *S. pneumoniae* to penicillin and other antimicrobial agents is increasing in many parts of the world (Breiman *et al*., 1994). In Atlanta, 25% of 431 isolates from patients with invasive pneumococcal infections were resistant to penicillin (Hoffman *et al*., 1995), 26% other isolates were also resistant to trimethoprim-sulphamethoxazole, 15% were resistant to erythromycin and 25% to multiple drugs. In Ethiopia, the resistance pattern of *S. pneumoniae* to penicillin was 7.7% (Solomon Gebreselasie, 2002). The purpose of this study was to investigate and document the frequency of isolation and antimicrobial susceptibility of *Staphylococci* and *Streptococci* that were recovered from in-and out-patients of Gondar University Teaching hospital.

MATERIALS AND METHODS

Study design and period of study

A retrospective study was conducted on *Staphylococcus* and *Streptococcus* strains isolated from specimens collected from patients that were diagnosed at the Hospital Laboratory, University of Gondar during August 2004 to July 2006.

Description of patients

All age groups and all sexes were included in the study. A total of 3829 subjects were investigated from the data that were recorded in the hospital laboratory.

Clinical specimens

Clinical specimens were collected from abscess, ascitic fluid, pleural fluid, CSF, ear discharge, pus, wound, nasal swab, throat swab, blood, eye discharge, joint fluid, urine and vaginal discharge of in-and out-patients.

Isolation and identification

The presence of pathogenic bacteria was assayed by routine culture assays on selective media. Different types of selective and differential media such as blood agar (BBL) and chocolate agar (BBL) were used to culture different infectious bacteria. The collected specimens were plated on blood agar and chocolate agar after inoculation using a sterile loop. All the inoculated plates were incubated at 35-37º C for 24 hrs. By using a sterile straight wire, a single bacterial colony from the plates was picked and inoculated in about 3 ml of nutrient broth. This was incubated at 35-37^{0}C for 2-4 hours until growth was ascertained by turbidity. The suspension was then tested biochemically.

Standard biochemical tests were carried out for identification of the study organisms. In brief, identification of bacteria was performed with the help of biochemical tests which routinely included triple sugar iron (TSI) agar slant, lysine iron (LI) agar slant, urea agar slant, Simmon`s citrate agar slant, SIM medium, mannitol broth (1%), glucose broth (1%), oxidase reagents and hydrogen peroxide (BBL) (Power and McCuen, 1988). The reference strain for *Shigella* (NBL SC 530) was used for control purposes throughout the study.

Bacteria strains used for quality control of commercial antimicrobial discs

Escherichia coli (ATCC 25922), *Pseudomonas aeruginosa (*ATCC 27853), and *Staphylococcus aureus* (ATCC 25923) isolates were used for *in vitro* experiments in order to determine the quality of commercial antibiotics. These strains were preserved on trypticase soy broth with 20% glycerol at 4^{o}C.

Antimicrobial sensitivity testing

The criteria for selection of antimicrobial agents used for antimicrobial sensitivity test were the information obtained from the records of different hospitals and health centers. They mostly used these antimicrobial agents to treat patients affected by *Staphylococcus* and *Streptococcus* strains. Susceptibility testing of all strains was done on Muller-Hinton agar with commercial antibiotic discs using Kirby-Bauer method (Bauer *et al*., 1966). The antimicrobial discs used were ampicillin (Amp)10µg; chloramphenicol (CAF)30µg; gentamycin(GM)10µg; tetracycline (TTC)30µg; ciprofloxacin (Cip)5µg; trimethoprim-sulphamethoxazole (SxT)25µg; penicillin (Pen)10 µg and erythromycin (Ery)15µg.

Finally, diameters of inhibition zones were measured in millimeters using a ruler, which was held on the back of the inverted plate. The sizes of the zones of inhibition were interpreted by using zone diameter interpretive standards. The intermediate readings were considered as sensitive for purpose of assessment of the data.

Statistical analyses

The data was entered and analyzed using SPSS for windows Version 10 statistical programme. A P-value less than or equal to 0.05 was taken to indicate statistical significance or association.

Ethical considerations

This retrospective study used data from the registration book of the hospital laboratory with the consent and permission of School of Public Health, College of Medical and Health Science, University of Gondar.

RESULTS

During the three-year study period, a total of 51 *Streptococcus* isolates were recorded from 3087 specimens. The frequency of isolation of *Streptococci,* 7 (43.75%) from throat specimen was the highest followed by its isolation rate 3 (23.08%) from nasal swabs. Frequency of *Streptococcus* strains from abscess, and wound were 4 (7.41%) and 3 (5.45%), respectively. On the other hand, the rate of isolation of *Streptococcus spp.* from wound and pus were relatively low (3.9%) for each tested samples.

In this study, a total of 217 (5.7%) *Staphylococcus* isolates were recorded from 3087 different clinical specimens. The major sources of *Staphylococcus* strains were urine, pus, wound and ear discharge which together accounted for 134 (61.75%) of all isolates. On the other hand, the frequency of isolation rate of *Staphylococcus spp* from blood, pleural fluid, ascitic fluid, abscess and throat swab were 18 (8.29%), 14 (6.45%), 11(5.07%), 11(5.07%) and 9 (4.15%), respectively (Table 1).

Species distribution of *Staphylococcus* and *Streptococcus* species isolated from different clinical specimens is shown on Table 2. From the total of 217 *Staphylococcus* isolates, 155 (71.4%) and 48 (22.1%) were *S.* aureus and *S. epidermidis*, respectively. From the total of 51 *Streptococcus* species, 48 (66.6%) was *Streptococcus pneumoniae.*

Table 1. The distribution of *Staphylococcus* and *Streptococcus* species isolated from different clinical specimens at Gondar University Teaching Hospital (August 2004-July 2006).

Specimens	No. of Staphylococcus spp. (%)	No. of Streptococcus spp.(%)
Abscess (n = 54)	11 (20.37%)	4 (7.41%)
Ascitic fluid (n =431)	11 (2.55%)	3 (0.70%)
Pleural fluid (n =467)	14 (2.99%)	10 (2.14%)
CSF (n = 851)	4 (0.47%)	20 (2.35%)
Ear discharge (n =122)	30 (24.59%)	4 (3.28%)
Pus (n =114)	41 (35.96%)	3 (2.63%)
Wound (n = 55)	21 (38.18%)	3 (5.45%)
Nasal swab (n =13)	5 (38.46)	3 (23.08%)
Throat swab (n = 16)	9 (56.25)	7 (43.75%)
Blood (n =111)	18 (16.36)	-
Eye discharge (n =23)	3 (13.04)	-
Joint fluid (n =27)	5 (18.52)	-
Urine (n =751)	42 (5.59)	-
Vaginal discharge (n =52)	3 (5.77)	-
Total (n = 3087)	217 (7.03)	57 (1.85)

Table 2. Distribution of *Staphylococcus* and *Streptococcus* isolated from different clinical specimens at Gondar University Teaching Hospital (August 2004-2006).

Isolates	No (%)
Staphylococcus spp.	
S. aureus	155 (71.4)
S. epidermidis	48 (22.1)
Other species	14 (6.45)
Total	217 (100)
Streptococcus spp.	
S. pneumoniae	38 (66.6)
Other *Streptococcus spp.*	19 (33.4)
Total	57 (100)

Antimicrobial sensitivity test of 155 *S. aureus* isolates against the chosen 8 antimicrobial agents are presented on Table 3. Sensitivity of isolates/strains of bacteria in the present study varied greatly to the tested antibiotic agents but 12.9%, 13.5%, 24.7%, 28.8% and 36.5% of *S. aureus* strains were resistant to gentamycin, ciprofloxacin, erythromycin, chloramphenicol and trimethoprim-sulphamethoxazole, respectively. The highest number of resistance was observed to penicillin (65.9%), tetracycline (65.3%) and ampicillin (62.2%), respectively. In this investigation, 12.9% of *S. aureus* strains were resistant to gentamycin and the remaining (1%) were susceptible to gentamycin.

In this investigation, 10 (6.5%) strains were sensitive to all antimicrobial drugs, while 4 (2.6%) strains were resistant to all antimicrobial drugs. One or more resistance patterns were observed in 141 *S. aureus* strains. The majority (76.8%) of *Staphylococcus aureus* strains were multiple resistant.

As shown in Table 3, most strains (95.7%, 91.3%, 88.9%, 87.5% and 82.6%) of *S. epidermidis* were found to be sensitive to ciprofloxacin, gentamycin, penicillin, erythromycin and chloramphenicol, respectively. Out of 48 isolates, 11(22.9%) were sensitive to all antimicrobial drugs. The highest resistance observed was to tetracycline 56.5%). Out of all *S. epidermidis* strains, 30 (62.6%) were multiple resistant.

In the present study, 13.9%, 19.4%, 22.2% and 22.8% strains of *Streptococcus pneumoniae* were found to be respectively resistant to erythromycin, ciprofloxacin, chloramphenicol and gentamycin. Moreover, 8.7%, 12.5%, 25% and 30% of *Streptococcus isolates* were resistant to erythromycin, penicillin, gentamycin and ciprofloxacin, respectively. Resistance pattern of *S. pneumoniae* is shown in Table 6. Among the present isolates, 6 (15.8%) of *S. pneumoniae* and 1 (5.3%) of *Streptococcus* strains were sensitive to all antimicrobial drugs. None of the strains were found to be resistant to all antimicrobial drugs. Out of 38 *S. pneumoniae* and 19 *Streptococcus* spp, 29 (76.3%) and 13 (68.4%) were multiple resistant, respectively. In all, seven different patterns of resistance were observed.

Table 3. Sensitivity pattern of *Staphylococcus* and *Streptococcus* spp. isolated from different clinical specimens at Gondar University Teaching Hospital (August 2004-July 2006).

Organisms		Antibiotics							
		AMP No (%)	CAF No (%)	GM No (%)	TTC No (%)	CIP No (%)	SXT No (%)	PEN No (%)	ERY No (%)
Staphylococcus aureus (n = 155)	S	60 (38.8)	110 (71.2)	135 (87.1)	54 (34.7)	134. (86.5)	98 (63.5)	53 (34.1)	117 (75.3)
	R	95 (61.2)	45 (28.8)	20 (12.9)	101 (65.3)	21 (13.5)	57 (36.5)	102 (65.9)	38 (24.7)
S. epidermidis. (n = 48)	S	50.4	82.6	91.3	43.5	95.7	54.3	88.9	87.5
	R	49.6	17.4	8.7	56.5	4.3	45.7	11.1	12.5
Other *Staphylococcus* spp. (n = 17)	S	16 (94.1)	13 (76.5)	16 (94.1)	16 (94.1)	13 (76.5)	16 (94.1)	17 (100)	17 (100)
	R	1 (5.9)	4 (23.5)	1 (5.9)	1 (5.9)	4 (23.5)	1 (5.9)	0 (0)	0 (0)
Streptococcus pnemoniae (n = 38)	S	11 (27.8)	30 (77.8)	29 (77.2)	20 (52.7)	31 (80.6)	19 (50)	21 (55.6)	33 (86.1)
	R	27 (72.2)	8 (22.2)	9 (27.8)	18 (47.3)	7 (19.4)	19 (50)	17 (44.4)	5 (13.9)
Other Streptococcus spp. (n = 19)	S	7 (36.8)	10 (52.6)	14 (75)	9 (47.4)	13 (70)	15 (78.9)	17 (87.5)	18 (92.3)
	R	12 (63.2)	9 (47.4)	5 (25)	10 (52.6)	6 (30)	4 (21.1)	3 (12.5)	1 (7.7)

S = sensitive, R = resistance, AMP = ampicillin, CAF = chloramphenicol, GM = gentamycin, TTC = tetracycline, CIP = ciprofloxacin, SXT = trimethoprim-sulphamethoxazole, PEN = penicillin , ERY = erythromycin

Table 4. Drug resistance pattern of *Staphylococcus aureus* isolates.

Resistant to	Drug resistance Pattern	No (%)
One drug	PEN	6(3.9)
	CAF	3(1.9)
	TTC	6(3.9)
	AMP	5(3.2)
	SXT	1(0.6)
	CIP	1(0.6)
	Total	22(14.2)
Two drugs	TTC, PEN	13(8.4)
	AMP, PEN	12(7.4)
	TTC, AMP	5(3.2)
	TTC, CAF	2(1.3)
	TTC, SXT	2(1.3)
	AMP, SXT	1(0.6)
	AMP, ERY	1(0.6)
	TTC, ERY	1(0.6)
	CAF, GM	1(0.6)
	Total	38(24.5)
Three drugs	TTC, AMP, PEN	20(12.9)
	TTC, AMP, SXT	3(1.9)
	TTC, SXT, PEN	2(1.3)
	TTC, AMP, CAF	1(0.6)
	TTC, AMP, GM	1(0.6)
	AMP, PEN, ERY	1(0.6)
	AMP, SXT, GM	1(0.6)
	AMP, SXT, PEN	1(0.6)
	AMP, CAF, PEN	1(0.6)
	TTC, SXT, ERY	1(0.6)
	CAF, SXT, PEN	1(0.6)
	Total	33(21.3)
Four drugs	TTC, AMP, CAF, PEN	4(2.6)
	AMP, CAF, SXT, PEN	3(1.9)
	TTC, AMP, SXT, PEN	3(1.9)
	TTC, AMP, CAF, SXT	2(1.3)
	AMP, SXT, GM, PEN	1(0.6)
	TTC, AMP, SXT, PEN	1(0.6)
	TTC, AMP, PEN, ERY	1(0.6)
	AMP, CAF, SXT, ERY	1(0.6)
	AMP, GM, PEN, ERY	1(0.6)
	TTC, AMP, SXT, CIP	1(0.6)
	TTC, CAF, SXT, ERY	1(0.6)
	TTC, CAF, SXT, CIP	1(0.6)
	Total	20(12.9)
Five drugs	TTC, AMP, CAF, SXT, PEN	3(1.9)
	TTC, AMP, CAF, SXT, GM	1(0.6)
	TTC, AMP, SXT, CIP, PEN	1(0.6)
	TTC, AMP, CAF, SXT, CIP	1(0.6)
	TTC, AMP, SXT, GM, ERY	1(0.6)
	TTC, CAF, SXT, GM, ERY	1(0.6)
	TTC, AMP, CAF, SXT, CIP	1(0.6)
	TTC, AMP, CAF, PEN, ERY	1(0.6)
	TTC, AMP, CIP, PEN, ERY	1(0.6)
	AMP, CAF, SXT, GM, PEN	1(0.6)
	AMP, SXT, CIP, PEN, ERY	1(0.06)
	TTC, AMP, CA, SXT, ERY	1(0.6)
	Total	14(9)

Continued from Table 4

Resistant to	Drug resistance Pattern	No (%)
Six drugs	TTC, AMP, CAF, SXT, PEN, ERY	3(1.9)
	TTC, AMP, CAF, SXT, GM, CIP	1(0.6)
	TTC, AMP,SXT,CIP PEN, ERY	1(0.6)
	TTC, CAF, SXT, GM, CIP, PEN	1(0.6)
	AMP, CAF, SXT, GM, CIP, ERY	1(0.6)
	TTC, AMP, CAF, SXT, GM, CIP	1(0.6)
	AMP, CAF, SXT, GM, CIP, PEN	1(0.6)
	Total	9(5.8)
Seven drugs	TTC,AMP,CAF,SXT,CIP,PEN,ERY	2(1.3)
	TTC,AMP,CAF,SXT,GM,CIP,PEN	1(0.6)
	TTC, AMP, SXT, GM, CIP, PEN, ERY	1(0.6)
	TTC, AMP, CAF, SXT,GM, PEN, ERY	1(0.6)
	Total	5(3.2)
	Sensitive to all	10(6.5)
	Resistant to all	4(2.6)
Total isolates		**5(100)**

AMP = ampicillin, CAF = chloramphenicol, GM = gentamycin , TC = tetracycline, CIP = ciprofloxacin, SXT = trimethoprim-sulphamethoxazole, PEN = penicillin, ERY = erythromycin

Table 5. Drug resistance pattern of *Staphylococcus epidermidis* isolates.

Resistant to	Drug resistance pattern	No (%)
One drug	PEN	2(4.2)
	TTC	2(4.2)
	PEN	2(4.2)
	AMP	2(4.2)
	Total	8(16.7)
Two drugs	TTC, PEN	2(4.2)
	TTC, SXT	2(4.2)
	AMP, SXT	2(4.2)
	TTC, CAF	1(2.1)
	AMP, PEN	2(4.2)
	Total	9(18.8)
Three drugs	TTC, AMP, PEN	2(4.2)
	TTC, CAF, SXT	1(2.1)
Four drugs	TTC, AMP, SXT, PEN	1(2.1)
	TTC, CAF, SXT, PEN	2(4.2)
	AMP, SXT, PEN	1(2.1)
	Total	4(8.3)
Five drugs	AMP, CAF, SXT, GM, PEN	2(4.2)
	TTC, AMP, SXT, CAF, PEN	3(6.3)
	TTC, AMP, CAF, SXT, PEN	2(4.2)
	AMP, CAF, SXT, CIP, PEN	1(2.1)
	Total	8(16.7)
	Sensitivity to all	11(22.9)
	Resistant to all	-
Total isolates		**48**

AMP = ampicillin, CAF = chloramphenicol, GM = gentamycin , TTC = tetracycline, CIP = ciprofloxacin, SXT = trimethoprim-sulphamethoxazole, PEN = penicillin, ERY = erythromycin

Table 6. Drug resistance pattern of different *Streptococcus* isolates.

A) Drug resistance pattern of *Streptococcus pnemoniae*		NO (%)
One drug	PEN	2(5.3)
	GM	1(2.6)
	Total	3(8.9)
Two drugs	TTC, SXT	3(8.9)
	TTC, AMP	2(5.3)
	CAF, PEN	2(5.3)
	SXT, GM	2(5.3)
	AMP, PEN	2(5.3)
	SXT, CIP	1(2.6)
	Total	12(31.6)
Three drugs	SXT, GM, PEN	2(5.3)
	TTC, AMP, PEN	2(5.3)
	CAF, SXT, CIP	1(2.6)
	TTC, CAF, SXT	1(2.6)
	TTC, SXT, PEN	1(2.6)
	Total	7(18.4)
Four drugs	TTC, SXT, GM, PEN	2(5.3)
	TTC, AMP, SXT, GM	1(2.6)
	TTC, AMP, SXT, PEN	1(2.6)
	Total	4
Five drugs	TTC, AMP, CAF, SXT, CIP	2(5.3)
	TTC, AMP, SXT, GM, PEN	1(2.6)
	AMP, CAF, GM, CIP, PEN	1(2.6)
	Total	4(10.5)
Six drugs	TTC, AMP, CAF, CIP, PEN, ERY	1(2.6)
	Total	1(2.6)
Seven drugs	TTC, AMP,CAF, SXT, CIP,PEN, ERY	1(2.6)
	Total	1(2.6)
	Sensitivity to all	6(15.8)
	Resistant to all	-
Total isolates		38(100)
B) Drug resistance pattern of *Streptococus* spp.		NO (%)
One drug	TTC	1(5.3)
	PEN	1(5.3)
	SXT	1(5.3)
	GM	1(5.3)
	AMP	1(5.3)
	Total	5(26.3)
Two drugs	TTC, PEN	2(10.5)
	Total	2(10.5)
Three drugs	TTC, SXT, Gm	2(10.5)
	TTC, CAF, SXT	15.3)
	TTC, AMP, SXT	1(5.3)
	TTC CAF, PEN	1(5.3)
	TTC, AMP, GM	1(5.3)
	Total	6(31.6)
Four drugs	AMP, SXT, GM, PEN	1(5.3)
	Total	1(5.3)
Six drugs	TTC, AMP, SXT, GM, CIP, PEN	1(5.3)
	TTC, AMP, CAF, SXT, GM, CIP	1(5.3)
	TTC, AMP, CAF, SXT, CIP, PEN	1(5.3)
	Total	3(18.8)
Seven drugs	TTC,AMP,CAF,SXT,CIP,PEN,ERY	1(5.3)
	Total	1(5.3)
	Sensitive to all	1(5.3)
Total isolates		19 (100)

AMP = ampicillin, CAF = chloramphenicol, GM = gentamycin, TTC = tetracycline, CIP = ciprofloxacin, SXT = trimethoprim-sulphamethoxazole, PEN = penicillin, ERY = erythromycin

DISCUSSION

In this study, *Staphylococcus* and *Streptococcus* strains were found to be important pathogens in Ethiopia. It was observed that the highest isolation rates were from CSF specimens. Isolation rate of *Staphylococci,* 20 (36.5%), from CSF in the present study was higher than the rate (7.7%) reported earlier (Weiss *et al.*, 1998).

Staphylococcus is an important pathogen in humans, causing a wide spectrum of diseases; infections of the skin, soft tissues, bones and urinary tract (Murray *et al*., 2003). In the present study, *S. aureus* was the most frequently isolated abscesses (20.37%) and wounds (38.18%) which is in line with Lindtjorn *et al.* (1989). The isolation rate of *Staphylococcus* in this study was 19.4% and 17.5% from urine and pus, respectively. The 14.3% frequency of isolation of *Staphylococcus* in this study was the same as that of the earlier works reported by Chigbu *et al*. (1999). High frequency of isolation of *Staphylococcus* from the investigated sources may be attributed to poor sanitation of the individuals in particular and the community in general. Thus, improving personal hygiene and environmental sanitation can help to reduce the microbial load in the individual patients and the hospital wards.

In this investigation, the frequency of resistance of *S. aureus* strains to gentamycin, ciprofloxacin, erythromycin, chloramphenicol and trimethoprim-sulphamethoxazole were 12.9%, 13.5%, 24.7%, 28.8% and 36.5, respectively. Thus, these antimicrobial agents may be used as the drug of choice for treatment of *S. aureus* infection after sensitivity tests. On the other hand, percent of resistant strains of *staphylococci* to penicillin, tetracycline and ampicillin were 65.9%, 65.3% and 62.2%, respectively. The sensitivity of *S. aureus* to genetamycin was greater than 89% in a previous study (Abraham Aseffa and Gebre Yohannes, 1996) but 87.1% in the present study. In this investigation, resistance of *S. aureus* to tetracycline was 65% which is greater by 5% compared to that reported by Abraham Aseffa and Gebre Yohannes (1996). Double resistance to penicillin and tetracycline was frequent among different isolates which is in agreement with Mogese Truneh (1991). The high frequency of isolation of multiple drug resistance (90.9%) of *S. aureus* indicates a serious need for broad-based local antimicrobial resistance surveillance. This may help to track antibiotic resistance among all clinical relevant isolates and introduce effective intervention mechanisms to reduce multiple drug resistance in such pathogens. Among *S. epidermidis* strains, 95.7%, 91.3%, 88.9%, 87.5% and

82.6% were sensitive to ciprofloxacin, gentamycin, penicillin, erythromycin, and chloramphenicol, respectively. These antimicrobial drugs may be used as a good drug of choice for the empirical treatment of *S. epidermidis.*

In this finding, most isolates of *S. pneumoniae* were resistant to erythromycin (86.1%), ciprofloxacin (80.6), chloramphenicol (77.8%) and gentamycin (77.2%). The sensitivity of trimethoprim-sulphamethoxazole, tetracycline, and penicillin ranged from 50% to 55.6%. The resistance pattern of *S. pneumoniae* strains to penicillin in this study was 44.4% while the resistance pattern of this pathogen to penicillin was 7.7% in the study of Solomon Gebreselassie (2002). Multidrug resistance is very common in *S. pneumoniae* and other streptococci strains: for instance, 29 (76.6%) and 13 (68.4%) of *S. pneumoniae* and other streptococci isolates in the present study were resistant to two or more antimicrobials. According to the present study, only 55.6% of *S. pneumoniae* isolates were sensitive to penicillin. As opposed to the present finding, Berhanu Andualem *et al.* (2006) reported that 93% of *S. pneumoniae* strains were sensitive to penicillin. Thus, the use of penicillin for the treatment of *S. pneumoniae* infection needs review in light of increasing resistance of organisms to this antibiotic (Chapp-Jumbo, 2006).

In the present study, all the isolates were resistant to the less expensive, commonly available antibiotics, such as tetracycline, ampicillin, trimethoprim-sulphamethoxazole and chloramphenicol. The high frequency of isolation of multidrug resistant bacteria indicates a serious need for broad-based, local antimicrobial resistance surveillance for continuous tracking of antibiotic resistance among all clinical relevant isolates and introduction of effective interventions to reduce multidrug resistance in such pathogens.

Several consequences may result from bacterial resistance to antimicrobial drugs. Due to limited therapeutic options and the high cost of alternative effective agents, resistant organisms are leading to longer hospitalization and an increased risk of death. Therefore, knowledge of antimicrobial susceptibility in bacteria is indispensable for the proper selection of antimicrobial drugs. Moreover, resistance studies assist health authorities in the formulation of their own drug policies (Ahmed *et al.,* 2000). The development of combination therapy and new antimicrobial agents may offer short-term solution to this problem and measures such as health education, prevention of infections through quality environmental sanitation and personal hygiene and immunization should be emphasized.

ACKNOWLEDGEMENT

We are grateful to Ato Mohamond Beshir for providing the materials for data collection. Many thanks to my daughter, Tizeta Berhanu, for her assistance to register and download data to the computer.

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