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Antiboitic Resistance of Uropathogenic *Eshcherichia coli* in Pateints of Hargeisa Group Hospital, Hargeisa, Somaliland

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Abstract

Background: Urinary tract infection is a common disease in Somaliland society. The predominant causative organism of Urinary tract infection is *Escherichia coli*. This research studies antibiotic resistance of uropathogenic *E. coli* in patients of Hargeisa Group Hospital. The study selected commonly prescribed antibiotics for urinary tract infection treatment. **Methodology**: Urine samples of patients were cultured to isolate causative organisms of the urinary tract infection. Chromo-agar media, CLED, and biochemical tests are applied to identify the type of bacteria. Antibiotic reactions to *E. coli* bacteria are measured to differentiate between sensitive and resistant drugs with the guidance of the Clinical and Laboratories Standard Institute (CLSI). Kirby Bauer disc diffusion method is applied to assess antimicrobial activity against *E. coli*. Data of patients such as age, sex, symptoms of UTI, previous UTI infection, and history of antibiotic use were recorded. SPSS and Microsoft Excel are applied to analyze and interpret data. **Results**: The predominant organism that caused urinary tract infection was *Escherichia coli* (55%), Klebsiella spp (15%), Candida spp (15%), Enterococcus spp (10%), Staph spp 2.5%, and Pseudomonas spp 2.5% while other 55% were negative. The study assessed antibiotic resistance of *E. coli*, which reported resistance to Tetracycline at (70%), Ampicillin (64%), and Cotrimoxazole (61%). The bacteria showed moderate resistance to Ceftriaxone (43.5%), Nalidixic acid (43%), and Ciprofloxacin (36%). The bacteria are sensitive to Amikacin (100%), Nitrofurantoin (96%), Levofloxacin (73%) and gentamicin (74%). **Conclusion**: The

overall incidence of antibiotic resistance to *E. coli* is high because the bacteria show a percentage of resistance to each antibiotic except Amikacin which gives (100%) sensitivity. The research recommends public awareness of the risks associated with antibiotic use and periodic evaluation of antibiotic resistance to accomplish better managing urinary tract infections.

1. Introduction

Urinary Tract Infection (UTI) is inflammation of the urinary tract system after microbial infection. Some of the symptoms of UTI include fever, dysuria, and lower abdominal pain, and the disease could be a community-acquired or nosocomial disease that affects patients after admission [1].

Urinary tract infection is a common bacterial infection that distresses human health. Reports show a yearly incidence of 150 million cases each year worldwide. In 2007, United States reported 10.5 million patient complaints of UTI symptoms and 2 - 3 million emergency admissions [2].

Different bacteria cause UTIs, but Gram-negative bacteria is the highest pathogen identified in urinary tract infections, more specifically, *Escherichia coli* shows 75% of urinary tract infections [3].

A troublesome issue is that antibiotics used for the management of urinary tract infections are getting weak, and sometimes it gets difficult to treat urinary tract infections [2].

Research conducted in India revealed that there was a statistically significant increase in the prevalence of antibiotic resistance of isolated uropathogenic organisms from 2009 to 2014. There was an increase in the resistance to Ampicillin (from 40.2% to 58.7%), Amoxiclav (from 26.2% to 40.5%), Nitrofurantoin (from 28.8% to 39.0%), and Norfloxacin (from 30% to 41.4%) and the highest cotrimoxazole from 35.5% in 2009 to 63.3% in 2014 [4].

Another research conducted in Kenya has shown an increase in antibiotic resistance that *E. coli* and *K. pneumonia* have shown poor susceptibility to Penicillins (8% - 48%), Cephalosporins of (16% - 43%), monobactams (17% - 29%), fluoroquinolones (22% - 44%) and trimethoprim-sulfamethoxazole (7%) [5].

In Somalia, research conducted in Mogadishu has exposed resistance of *E. coli* to antibiotics of cephalosporin such as Ceftriaxone 97% and Cefixime 61%. This shows that ceftriaxone does not give any results against the bacteria [6].

Conducting research on antibiotic resistance of uropathogenic *E. coli* in Somaliland will provide very important evidence that will enforce patient treatment guidelines and policies (Table 1).

Table 1. Provides an explanation of the antibiotics chosen to evaluate against uropathogenic *E. coli* [7] [8].

Class of antibiotic	Antibiotic name	Generations	Mechanism of action
Penicillins	Ampicillin	Aminopencillins	Inhibits bacterial cell wall synthesis
Cephalosporins	Ceftriaxone	Third generation	Disrupts synthesis of the peptidoglycan layer of bacterial cell walls
Flouroqiunolones	Naldixic acid	Second generation	Blocks DNA replication of bacteria by inhibiting of DNA gyrase enzyme
	Levofloxacin		
	Norfloxacin		
	Ciprofloxacin	First generation	Block bacterial DNA replication by inhbiting DNA topoisomerase and gyrase enzyme
Aminoglycosides	Gentimicin	Second generation	Inhibits synthesis of bacterial proteins irreversibly binding to 30s subunit of the bacterial ribosome
	Amikacin	Third generation	
Tetracyclines	Tetracycline	First generation	Inhibit protein synthesis preventing binding of transfer RNA to Messenger RNA.
trimethoprim /sulfonamides	Cotrimoxazole	First line	Inhibit synthesis of folic acid
Nitrofurantion	Nitrofuration		Block protein sythesis of bacteria by disrupting nitroreductase enzyme of bacteria

2. Material and Methods

The chapter discusses the methodology of research on uropathogenic *E. coli* resistance to antibiotics, the study targets patients of Hargeisa Group Hospital.

2.1. Study Design

The study employed a crossectional study design. Ninety-eight samples were collected from Hospital visitors that have complaints of Urinary tract infection. All samples have been tested in the Microbiology Laboratory of Hargeisa group hospital to prove urinary tract infection, then *Escherichia coli* was selected to identify its antibiotic resistance.

2.2. Data Collection

Data collection tools developed for this study include a data form designed to collect information about patients visiting Hargeisa Group Hospital. The form contains personal information such as Name, Sex, Age, and Questions related to the patient's current complaints, history of UTI, and whether the patient had previous therapy to identify the possibility of antibiotic resistance. The data form is also used for recording post-analysis results.

2.3. Study Area

The study was conducted in the Hargeisa Group Hospital, which is Somaliland's national referral hospital; it locates in the capital city of Hargeisa. The hospital consists of 300 beds. It has several specialties such as renal diseases and dialysis section, surgery section, medical section, and gynecology section. There are a lot of patients who visit the hospital, thus appropriate target population for this re-

search is found in this hospital.

2.4. Population of the Study

The population of the study was selected patients in the Hargeisa Group Hospital (HGH). Selected patients are both Out-patients and inpatients. The study targets Hargeisa Group Hospital patients complaining of urinary tract infections.

2.5. Sampling Method

Non-probability convenient sampling method was used in this study.

2.6. Examination of Samples

Patients visiting Hargeisa Group Hospital were selected from urinary tract infection complaints. A data form was applied to fill in information from each selected patient. A urine sample was collected from each selected Patient, the samples were sent to a microbiology laboratory to examine and find out the presence of pathogenic bacteria. Samples were inoculated in CLED and Chromogenic agar media to find the growth of bacteria. Pathogenic bacteria have been listed to know the highest in number. *E. coli* is selected among the pathogenic bacteria to test against common antibiotics used for the treatment of UTIs.

Determination of resistance and sensitivity of antibiotics is based on the CLSI guideline for urinary pathogens. The selected antibiotics are Ciprofloxacin (5 mcg), Nitrofurantoin (100 mcg), Ceftriaxone (30 mcg), levofloxacin (5 mcg), Cotrimoxazole (25 mcg), Nalidixic acid (30 mcg), Tetracycline (30 mcg), Ampicillin (10 mcg), Gentamicin (10 mcg), and Amikacin (30 mcg), Norfloxacin (10 mcg). These antibiotic discs are the product of the HIMEDIA Company. Lastly, data containing patient details and results of the samples were summarized into a register to analyze.

2.7. Data Processing and Analysis

Data collected from the laboratory were analyzed using SPSS Version 16 to find the full meaning of the information. Data were summarized using graphs to ease understanding. The graphs used in the analysis chapter were Tables and Bar-chart.

2.8. Ethical Consideration

This interview questionnaire was designed to find out the antibiotic resistance of urinary pathogens. The study was purposed for an academic issue. We ensure that data will not be used for any other purpose. Your participation is highly expected.

3. Results

Demographics and Clinical Characteristics of Study Participants

The study registered 98 participants for the research of antibiotic resistance of

uropathogenic *E. coli*. As Table 2 shows the ages of participants were from 15 to 80 years that have been grouped into four age groups. Ages of group one were older than 50 years (29.6%), ages of group two were between 15 to 25 years old (27.6%), group three aged between 26 to 35 years old (22.4%), group four aged between 36 to 50 years old (22.4%).

Table 2 The age group of participants that starts at 15 to 80 years has been grouped into four groups.

Table 3 explains gender differences among interviewees; females were the majority of the research, 72.4% of interviewees while male participants were 27.6%.

The study revealed that 61.2% of the research participants have symptoms of urinary tract infection while 38.8% of participants have no symptoms of urinary tract infection. 49% of the respondents have a previous UTI and 51% percent of the respondents have no previous UTI.

As the data revealed 58% of the participants have negative results from UTIs while 42% have positive results. The study found that organisms that resulted in the infection were *Escherichia coli* (55%), Klebsiella spp (15%) Candida spp (15%) Enterococcus spp (10%), Staph spp (2.5%), and Pseudomonas spp (2.5%).

Figure 1 indicates the resistance of *E. coli* to certain antibiotics which are Tetracycline, Ampicillin and Cotrimoxazole. The worst case is Tetracycline which showed 70% resistance, Ampicillin exhibited 64% and Cotrimoxazole 61%. Ceftriaxone, Nalidixic acid, and Ciprofloxacin successively showed 43.5%, 43%, and 36%. *E. coli* showed the lowest resistance against Levofloxacin, Gentamicin, and Nitrofurantoin with a level of 23%, 17%, and 4%. Amikacin is the only antibiotic that *E. coli* did not give any resistance to it.

Figure 2 Explains that Amikacin and Nitrofurantoin performed wonderful activity against *E. coli*. The bacteria were extremely sensitive to the above-mentioned antibiotics with 100% and 96%. Levofloxacin and Gentamicin demonstrated lesser sensitivity than amikacin and Nitrofurantoin which were 73% and 74% respectively. *E. coli* developed approximately 50% sensitivity against ceftriaxone and Nalidixic acid. Cotrixamazole, Tetracycline, and Ampicillin antibiotics reported 39%, 27%, and 26% successively. The last three antibiotics displayed very poor performance against *E. coli*.

Table 2. Age distribution of research participants.

Ages of participants		
Age group	Frequency	Percentage
Older than 50 years	29	29.6
15 - 25 years	27	27.6
36 - 50 years	22	22.4
26 - 35 years	20	20.4
Total	98	100

Table 3. Gender differences among interviewees.

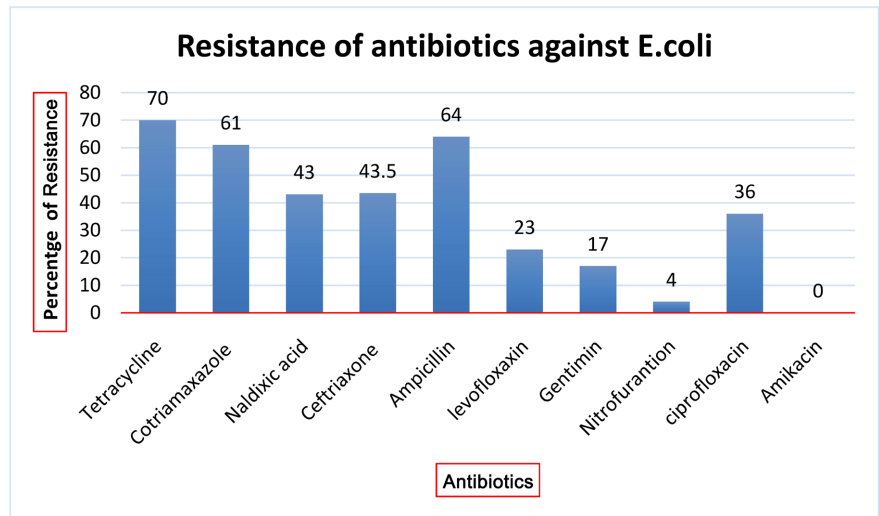| Gender of participants		
Gender	Frequency	Percentage
Female	27	27.6
Male	71	72.4
Total	98	100

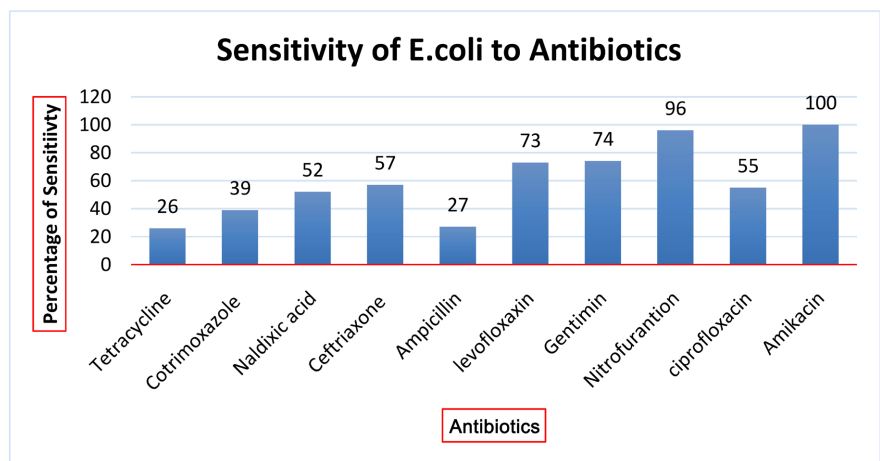Figure 1. Antibiotic resistance of *E. coli*.

Figure 2. Antibiotic sensitivity of *E. coli*.

4. Discussion

Identifying the antibiotic resistance pattern of uropathogenic *E. coli* is crucial for the health of society since UTI is common morbidity in Somaliland [9]. This study focused on identifying common bacteria that cause UTI and their patterns of antibiotic susceptibilities. The study recruited 98 participants who were tested for bacteria causing urinary tract infection and antibiotic resistance to uropathogenic *E. coli*. As the data revealed 58% of the participants had negative results

of UTI while 42% had positive results. This showed a lower UTI rate in Hargeisa society in comparison to the research conducted in Mogadishu that reported 67% of UTI cases [10].

Participants in the study were aged 15 - 80 years and divided into four age groups. Based on respondent data analysis, the largest research participants fall into the over-50 (>50) age group, which accounts for 29.6% of respondents. The second largest group in the ranking was the age group 15 to 25, which was 27.6%. The 36 to 50 age group was 22.4% and the 26 to 35 age group had the lowest percentage, 20.4% of the total respondents.

Gender differences of the data respondents revealed that females were the majority of participants in the research which was 72.4% while male participants were 27.6%. Analysis of results reported that female participants showed a higher UTI rate of 58% (26/45) than male 48% (13/27).

The study revealed that 61.2% of the research participants have symptoms of urinary tract infection while 38.8% of participants have no symptoms of urinary tract infection at the time of visiting doctors therefore symptoms were relevant to the presence of UTI.

Participants of the research that have a previous UTI before examination were 49%, while 51% percent of the respondents have no previous infection. People with previous UTIs exhibited a resistance level of 1.6 times higher than people with no previous UTIs. This proves that recurrent UTIs increase the risk of MDR.

Organisms isolated from participants were *Escherichia coli* (55%), Klebsiella spp (15.0%), Candida spp (15%), Enterococcus spp (10%), Staph spp (2.5%) and Pseudomonas spp (2.5%). The results of the research matched with Lee H.S. *et al.* and Vasuevan, R. research [11] [12]. 55% of respondents did not give any bacterial growth.

The study demonstrated a high degree of resistance to *E. coli* against Tetracycline antibiotics, which was 70%, thus similar to findings of Kibret, M. and Abera, B. research in Ethiopia [13].

On the other hand, the study observed that ampicillin and cotrimoxazole showed resistance levels against *E. coli* of 64% and 61% respectively. Other studies have indicated higher *E. coli* resistance to ampicillin and cotrimoxazole at 94.8% and 85.1% respectively [14]. Mohamoud, H. presented his research in Hargeisa that *E. coli* resistance to ampicillin is 50% [9], which was consistent with this study.

Ceftriaxone, Nalidixic acid, and Ciprofloxacin accounted for 43.5%, 43%, and 36% respectively. The rate of resistance of *E. coli* to ciprofloxacin was almost the same in association with the Mogadishu study which indicated 37.2% [6]. *E. coli* resistance to ceftriaxone (43.5%) is not at an alarming level compared to the findings of researchers in Mogadishu, which represented 97.1% and 80.6% respectively [12] [13] so, timely decisions are required to manage the use of this antibiotic in society. Nalidixic acid reaction against the bacteria showed 43%, this shows very near to the findings of other researchers [15].

Table 4. Comparison of study results with other associated researches [6] [9] [13] [14] [15].

Antibiotics List	Results of the study		Results of other researches	
	Resistance	Sensitive	Resistance	Sensitive
Tetracycline	70		72.6	
Cotrimoxazole	61		94	
Naldixic acid	43		38	
Ceftriaxone	43.5		97.1	
Ampicillin	64		85	
Levofloxaxin		73		37.5
Gentimin		74		61.3
Nitrofurantion		96		91.6
Ciprofloxacin	36		37.2	
Amikacin		100		93.2

Amikacin, Nitrofurantoin, Levofloxacin, and Gentamicin performed well in the control of uropathogenic *E. coli*. The bacteria were exceptionally sensitive to these antibiotics with a rate of 100% and 96%, 73%, and 74% respectively. Mohamed, A.H. *et al.* [14] reported an amikacin *E. coli* susceptibility of 93.2%, nitrofurantoin 91.6%, levofloxacin 37.5%, and gentamicin 61.3%. The results of the research carried out by Mohamed, A.H. *et al.* agree with this study except for levofloxacin, which gives lower reaction activity (Table 4).

5. Conclusion

The overall incidence of antibiotic resistance to *E. coli* is high because the bacteria showed a percentage of resistance to each antibiotic except Amikacin which gives (100%) sensitivity. The study recommends further research on the topic to identify the major factors that cause antibiotic resistance.

6. Recommendations

The study finally gives these recommendations:

- The Ministry of Health should develop awareness programs to teach society about the risk of antibiotic overuse. Programs should also emphasize the importance of clinicians' prescriptions and over-the-counter antibiotic problems.
- Health care institutions should develop treatment guidelines to find a clear route of patient treatment.
- Clinicians are encouraged to request a bacterial culture and antibiotic susceptibility test prior to treatment if they suspect a relapse of infection or antibiotic resistance.
- Research recommends further research in this area, such as identifying strains of *E. coli* that are more resistant.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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