Research Article

Resistance profile of bacterial isolates of urinary tract infection from patients attending general hospital Dawakin-Kudu, Kano State-Nigeria

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Received: 11 November 2020

Revised: 20 December 2020

Accepted: 23 December 2020

Abstract

Objective: The study was aimed at determination of the resistance profile of bacterial isolates associated with urinary tract infection from patients attending general hospital Dawakin-Kudu, Kano State-Nigeria. **Methods:** A total of 85 bacterial isolates from urinary tract infection including; *Escherichia coli* (42 isolates), *Pseudomonas aeruginosa* (14 isolates), *Klebsiella pneumoniae* (12 isolates), *Proteus mirabilis* (7 isolates), *Staphylococcus aureus* (6 isolates) and *Staphylococcus saprophyticus* (4 isolates) were subjected to antimicrobial susceptibility testing according to Clinical Laboratory Standard Institute (CLSI) guidelines using standard discs of Imipenem (10mg), Meropenem (10mg), Nitrofurantoin (200mg), Tetracycline (30mg) and Erythromycin (15mg). **Results:** The result showed high sensitivity of isolates to Imipenem (100%), Meropenem (100%), Nitrofurantoin (83.33%), Tetracycline (100%) and Erythromycin (75%). On the other hand, high degree of resistivity rates to Ampicillin (100%), Co-trimoxazole (85.71%), and Cephalexin (100%) were detected. The bacterial isolates showed varied degree of multidrug resistance (MDR). Bacterial isolates that produced ESBL were more resistant to Ceftazidime, and Ceftriaxone compared to non-ESBL producers. Multidrug resistance strains were also tested for extended spectrum beta lactamase (ESBL), 29(58%) of the isolates were ESBL producers. According to this study, most of predominant species enumerated in this community was highly sensitive to Imipenem, Meropenem, Tetracycline, Erythromycin and Nitrofurantoin respectively and are recommended as antibiotics of choice against the pathogens. On the other hand, the increasing prevalence of bacterial resistance to commonly used antibiotics has made susceptibility testing a crucial aspect in the treatment of serious bacterial infections. **Conclusion:** Therefore, there is need for government to increase surveillance of ESBL-producing organisms as they pose serious threat to successful treatment of infections in this community and exacerbates the problem of antimicrobial resistance in the hospitals, especially in resource poor Community settings.

Keywords: Antibiotics, resistance profile, bacterial isolates, urinary tract infections, ESBLs

Introduction

The ESBL enzymes are mutant, plasmid-mediated beta lactamases derived from older, broad-spectrum β -lactamases (e.g., TEM-1, TEM-2, and SHV-1). Thus, they mediate resistance to extended spectrum (third generation) cephalosporin's (e.g. Ceftazidime, cefotaxime, ceftriaxone),

i.e., they are specific to third and fourth generation cephalosporin's but not to cephamycins (e.g. cefoxitin and cefotetan) or carbapenems (e.g. Meropenem or Imipenem). These enzymes are most commonly produced by *Klebsiella* spp and *Escherichia coli* but may also occur in other gram negative bacteria, including *Enterobacter*, *Salmonella*, *Proteus*, *Citrobacter*, *Morganella morganii*, *Serratia marcescens*, *Shigella dysenteriae*, *Pseudomonas aeruginosa*, *Burkholderia cepacia*, *Capnocytophaga ochracea* (Aubert et al., 2013).

The infection due to ESBL- producing organisms can cause the failure of treatment if one of the above classes of drugs

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DOI: <https://doi.org/10.31024/apj.2020.5.6.2>

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is used. Besides, ESBL producing bacteria are typically associated with multidrug resistance (MDR). Antibacterial choice is often complicated by multi-resistance. Thus infection due to ESBL producing bacteria can result in avoidable failure of treatment and increased cost in patients who have received inappropriate antibiotic treatment. Colonization and infection with these bacteria have also been associated with indiscriminate use of antibiotics, prolonged hospitalizations, increasing numbers of immunocompromised patients, and medical progress resulting in increased use of invasive procedures and devices. Updated knowledge of the susceptibility pattern of bacteria is important for the proper selection and use of antimicrobial drugs and for the development of appropriate prescribing policies. Without gathering the information about the existing MDR strains, we cannot reduce the morbidity and mortality due to infections caused by MDR pathogens; reduce the rate of emergence and spread of antimicrobial resistance (Baby et al., 2011). Numerous studies have barbed towards high incidence rate of UTI associated with pathogens and antibiotic resistance. The emergence of Multi Drug Resistant (MDR) variant of pathogens has been accounted. MDR is defined as resistance to at least two antibiotics of different classes including aminoglycosides, chloramphenicol, tetracycline and/or erythromycin. MDR in many bacteria is due to the action of multi-drug efflux pumps and by the accumulation on Resistance (R) plasmids or transposons, of genes with each coding for resistance to a specific agent. Nowadays, in UTIs Extended Spectrum Beta-Lactamase expressing Gram Negative Bacilli (ESBLGNB) generally causes community-acquired infections. The resistance of Gram-negative bacteria is typically owed to plasmid mediated enzymes called Extended- Spectrum Beta-Lactamase (ESBL). ESBL producing bacteria are typically associated with MDR and antibacterial choice is often complicated by multi drug resistance (Clinical Laboratory Standard Institute, 2009). Extended-spectrum β -lactamase and metallo β -lactamase producing bacteria are up-and-coming apprehension for health professionals. Patients with increased threat of increasing colonization or infection with ESBL producing microorganisms are repeatedly fatally sick patients with prolonged hospital stays. They are frequently resistant to numerous antibiotic classes, including fluoroquinolones and aminoglycosides. Resistance to β -lactam antibiotics has increased significantly in the last two decades and has been documented in both community and hospital settings (Shrestha, et al., 2005). Current updated knowledge of the susceptibility pattern of bacteria is vital for the appropriate assortment and utilization of antimicrobial drugs and, also for the succession of suitable prescribing guidelines. The infections caused by MDR pathogens, the rate of emergence and spread of antibiotic resistance cannot be reduced without gathering information

about the existing MDR strains. Although, ESBL have been studied well in Awka community but scanty information has been witnessed related to multi drug resistant variant of *E. coli* reported from the Southern Anambra state of Nigeria (Ejikeugwu and Ugwu, 2013).

With this background, this research study was aimed to test the resistance profile of bacterial isolates associated with Urinary Tract Infections among patients attending General Hospital Dawakin-Kudu with the following objectives.

- To determine the resistance profile of the isolated bacteria using commercially available antibiotics disc in the study area.
- To screen multi-drug resistant isolates for Extended Spectrum Beta-lactamase (ESBLs) production.

Materials and methods

Study Design

The study was a descriptive survey aimed at finding out and describing the current resistance profile of bacterial isolates associated with Urinary Tract Infections in the study area.

Sample Processing

The samples collected were aseptically inoculated on to the surface of well-prepared Cysteine-Lactose-Electrolyte Deficient (CLED) agar plates using sterilized wire loop and then streaking on to surface of the agar plates. The plates were then incubated aerobically in an incubator at 37°C for 24 hours and extended to 48 hours in culture negative cases. After incubation, the plates were then examined macroscopically for the following morphological characteristics; growth of the pathogens, size of colony, Shape of colony, elevation, odour, pigmentation, haemolysis and swarming movement. Gram's reaction was carried out in order to differentiate the bacteria in to Gram-positive, Gram-negative and also to identify the cell shape of the organisms (Brook et al., 2002).

Identification of Bacteria

In order to identify the microorganisms, the isolates were subjected to various biochemical tests. Indole medium was used to detect Indole (Macfaddin, 1980). Catalase test was carried out to differentiate between *Streptococcus* and *Staphylococcus* species (Cappuccino, 2002). Other biochemical reactions such as Coagulase, Citrate utilization, Lactose fermentation, Methyl-red, Voges-proskauer, Urease, Oxidase tests were used to identify and differentiate the organisms (APHA, 1999; Cheesbrough, 2000).

Inoculum Standardization

A loopful of 18-24 hour old colonies of bacteria was taken

from solid media and added into 5 ml sterile Normal Saline and the concentration adjusted to 1×10^6 colony forming unit per milliliter (Cfu/mL) by comparing with 0.5 McFarland standard (CLSI, 2014).

Sensitivity Testing

The isolates were aseptically subculture by streaking onto prepared Mueller Hinton agar (MHA) plates. Then using sterile forceps, standard antibiotic discs were placed on the surface of the inoculated agar plates. These were then incubated at 37°C for 24 hours. After 24 hours, the plates were observed for the zones of inhibition. Sensitivity of the isolates was determined by measuring the diameter of each zone of inhibition around each disc and the values obtained were compared with the standard chart provided. The percentage resistance was calculated using the formula $PR = a/b \times 100$, where PR is percentage resistance, (a) was the number of resistant isolates and (b) was the number of isolates tested with the antibiotic. The percentage sensitivity was calculated using the formula $PS = c/d \times 100$, where PS was percentage sensitivity, (c) was the number of sensitive isolates and (d) was the number of isolates tested with the antibiotic (CLSI, 2007).

Screening test for ESBL production

This site was performing to screen for multi-drug resistance isolates by disc-diffusion method using standard methods as described in the guidelines. For detection of ESBL producing isolates, the isolates that were screened must be multi-drugs resistant exhibiting resistant to at least two or more of the third generation cephalosporin. The sensitivity of standard inocula of isolates to ceftriaxone (CFZ $30\mu\text{g}$) and Ceftazidime (CAZ $30\mu\text{g}$) Discs were determined on Mueller Hinton Agar (Biotech, India) using Kirby Bauer method. According to the CLSI guidelines, isolates showing inhibition zone size of ≤ 22 mm with Ceftazidime ($30\mu\text{g}$) and ≤ 25 mm with ceftriaxone were identified as potential ESBL producers and shortlisted for confirmation of ESBL production (CLSI, 2012).

Confirmation of ESBLs (Double Disc Synergy Method)

This test was carried out by using two discs of third-generation cephalosporin, Ceftazidime and Ceftriaxone. A Ceftazidime 30mg disc and an amoxicillin clavulanic acid 20+10 mg disc was then placed 15-20 mm apart, centre-to-centre on a lawn culture of the test isolate on Muller-Hinton Agar (MHA) plate. Incubate overnight in air at 37°C . And/or two amoxyl-clav (AMC $30\mu\text{g}$) discs were placed on Mueller Hinton agar (Biotech, India) inoculated with the bacterial isolates. After an hour at room temperature, the discs were removed and replaced with Ceftazidime (CAZ $30\mu\text{g}$) and Ceftriaxone (CFZ $30\mu\text{g}$). Each cephalosporin disc was also placed independent of the initial Augmentin discs onto plates were incubated at 37°C for 18-24 hours and read for evidence of ESBLs

production described by Casals and Pringler (1990).

Interpretation: ESBL production was inferred, when the zone of inhibition around the Ceftazidime disc was expanded by the clavulanate in a clover leaf fashion.

Results

As the result indicated in the table 1 that, *Escherichia coli* are the most prevalent organism with total of 42 occurrences which accounting for 49.41%, followed by *Pseudomonas aeruginosa* with total of 14 isolates (16.47%), *Klebsiella pneumoniae* with 12 isolates (14.11%), *Proteus mirabilis* with total of 7 isolates (8.24%), then *Staphylococcus aureus* has 6 which accounted for 7.06% each while the least prevalent organisms is *Staphylococcus saprophyticus* with 4 isolates (4.71%).

Table 2 shows that, *E. coli* have highest sensitive to Imipenem 41(97.62%) followed by Meropenem 40(95.24), Nitrofurantoin 33(78.57%), moderately sensitive to Ampicillin 28(66.67%). Low sensitive to Norfloxacin 14(33.33%), Cephalexin 12(28.57%), Co-trimoxazole 9(21.43%). As far as resistant pattern of *E. coli* is concerned by, it shows very high frequency of resistant to Co-trimoxazole 33(78.57%), followed by 30(71.43%) Cephalexin, moderately high resistant to Norfloxacin 28(66.67%). Low resistant to Ampicillin 14(33.33%), Nitrofurantoin 9(21.43%), Meropenem 2(4.76%) and Imipenem 1(2.38%).

Table 1. Prevalence of Bacterial Pathogens isolated from the Urinary tract of patients

S. No.	Pathogens isolated	No. of isolates	Percentage
1	<i>Escherichia coli</i>	42	49.41
2	<i>Klebsiella pneumoniae</i>	12	14.11
3	<i>Proteus mirabilis</i>	7	8.24
4	<i>Pseudomonas aeruginosa</i>	14	16.47
5	<i>Staphylococcus aureus</i>	6	7.06
6	<i>Staphylococcus saprophyticus</i>	4	4.71
7	Total	85	100

Table 2. Antibiotic resistance profile of *Escherichia coli* isolates (N= 42)

Antibiotics	S (%)	R (%)	I (%)
Ampicillin	28(66.67)	14(33.33)	-
Co-trimaxazole	9(21.43)	33(78.57)	-
Cephalexin	12(28.57)	30(71.43)	-
Norfloxacin	14(33.33)	28(66.67)	-
Nitrofurantoin	33(78.57)	9(21.43)	-
Imipenem	41(97.62)	1(2.38)	-
Meropenem	40(95.24)	2(4.76)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

Table 3 shows that, *Klebsiella pneumoniae* have 100% sensitive to Imipenem as well as Meropenem but moderately high sensitive to Ampicillin 7(58.33%) followed by Co-trimoxazole 5(41.67%). Low sensitive to 4(33.33%) Cephalexin. *Klebsiella pneumoniae* showed 8(66.67%) resistant to Cephalexin, followed by 7(58.33%) to Co-trimoxazole but moderately resistant to Ampicillin 5(41.67%), low resistant to Nitrofurantoin 2(16.67%).

Table 4 shows that, *Pseudomonas aeruginosa* was highly sensitive to Imipenem 11(78.57%), Meropenem 10(71.43%) and moderately to Amikacin 8(57.14%), low sensitive to Carbenicillin 4(28.57%). The pattern of highest resistant shown by these organisms was Gentamicin 11(78.57%), Carbenicillin 10(71.43%), but low resistant to 28.57% of Amikacin as well as Meropenem respectively.

Table 5 shows that, *Proteus mirabilis* was 100% sensitive to Imipenem as well as Meropenem. Moderately sensitive to

Gentamicin 3(42.86%). Highest resistant was against Ampicillin (100%) as well as Cephalexin 7(100%), followed by Co-trimoxazole 6(85.71%), and 4(57.14%) to Gentamicin.

Table 6 shows that, Imipenem and Meropenem were found the most effective against the isolated *Staphylococcus aureus*, with percentage of 100% and 100% respectively. While the effective agent was Cephalexin 5(83.33%), Tetracycline 4(66.67%) as well as Erythromycin and Co-trimoxazole. Moderately high resist to Amoxicillin 4(66.67%) but less to Tetracycline 2(33.33%) as well as Co-trimoxazole and Erythromycin respectively.

Table 7 shows that, *Staphylococcus saprophyticus* have 100% sensitive to Imipenem, Meropenem, Tetracycline and Co-trimoxazole followed by Erythromycin 3(75.00%) but moderately sensitive to Cephalexin 3(57.00%) while less sensitive to Amoxicillin 1(25.00%). The pattern of resistant rate showed by these organisms was 3(75.00%) Amoxicillin but less

Table 3. Antibiotic Resistance Profile of *Klebsiella pneumoniae* isolates. (N= 12)

Antibiotics	S (%)	R (%)	I (%)
Ampicillin	7(58.33)	5(41.67)	-
Co-trimaxazole	5(41.67)	7(58.33)	-
Cephalexin	4(33.33)	8(66.67)	-
Nitrofurantoin	10(83.33)	2(16.67)	-
Imipenem	12(100)	0(0)	-
Meropenem	12(100)	0(0)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

Table 4. Antibiotic Resistance Profile of *Pseudomonas aeruginosa* isolates (N= 14)

Antibiotics	S (%)	R (%)	I (%)
Ampicillin	8(57.14)	4(28.57)	2(14.29)
Carbenicillin	4(28.57)	10(71.43)	-
Gentamicin	3(21.43)	11(78.57)	-
Imipenem	11(78.57)	3(21.43)	-
Meropenem	10(71.43)	4(28.57)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

Table 5. Antibiotic resistance profile of *Proteus mirabilis* (N= 7)

Antibiotics	S (%)	R (%)	I (%)
Ampicillin	0(0.0)	7(100)	-
Co-trimaxazole	1(14.29)	6(85.71)	-
Cephalexin	0(0.0)	7(100)	-
Gentamicin	3(42.86)	4(57.14)	-
Imipenem	7(100)	0(0.0)	-
Meropenem	7(100)	0(0.0)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

to Erythromycin and Cephalixin 1(25.00%) and 1(25.00%) respectively. *Pseudomonas aeruginosa* and the least was 42.86% of *Proteus mirabilis*.

Table 8 indicated that, out of 75 of the total organisms obtained, 50(66.67%) showed resistant to two antibiotics of the third generation cephalosporin. Both Ceftazidime (30mg) and ceftriaxone (30mg) detected 66.67% of the suspected ESBL producers when used alone.

Table 9 showed that, among 50 suspected ESBL producers, 29(58%) were confirmed as ESBL producers by phenotypic confirmatory test with double disk diffusion method. Out of 29 confirmed ESBL producers, *Klebsiella pneumoniae* was the predominant ESBL producers which account for 75.00%, followed by 73.81% of *Escherichia coli*, 50.00% of

Discussion

As the result indicated in the **table 1** that, *Escherichia coli* were the most prevalent organism with total of 42 occurrences which accounting for 49.41%, followed by *Pseudomonas aeruginosa* with total of 14 isolates (16.47%), *Klebsiella pneumoniae* with 12 isolates (14.11%), *Proteus mirabilis* with total of 7 isolates (8.24%), then *Staphylococcus aureus* has 6 which accounted for 7.06% each while the least prevalent organisms were *Staphylococcus saprophyticus* with 4 isolates (4.71%). Several studies conducted on prevalence of bacteria on urinary tract infection showed that, the presence of *E. coli*,

Table 6. Antibiotic Resistance Profile of *Staphylococcus aureus* isolates (N= 6)

Antibiotics	S (%)	R (%)	I (%)
Tetracycline	4(66.67)	2(33.33)	-
Amoxicillin	2(33.33)	4(66.37)	-
Erythromycin	4(66.67)	2(33.33)	-
Cephalexin	5(83.33)	1(16.67)	-
Co-trimaxazole	4(66.67)	2(33.33)	-
Imipenem	6(100)	0(0.0)	-
Meropenem	6(100)	0(0.0)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

Table 7. Antibiotic Resistance Profile of *Staphylococcus saprophyticus* isolates (N= 4)

Antibiotics	S (%)	R (%)	I (%)
Amoxil	1(25.00)	3(75.00)	-
Erythromycin	3(75.00)	1(25.00)	-
Co-trimaxazole	4(100)	0(0.0)	-
Cephalexin	3(75.00)	1(25.00)	-
Tetracycline	4(100)	0(0.0)	-
Imipenem	4(100)	0(0.0)	-
Meropenem	4(100)	0(0.0)	-

KEY; S- Sensitive, R- Resistance, I- Intermediate

Table 8. Screening for the occurrence of ESBL among bacterial isolates

S/N	Pathogens isolated	No. of screened	No. of potential ESBL Producers (%)
1.	<i>Escherichia coli</i> .	42	28(37.33))
2.	<i>Klebsiella pneumoniae</i>	12	7(9.33)
3.	<i>Proteus mirabilis</i>	7	5(6.67)
4.	<i>Pseudomonas aeruginosa</i>	14	10(13.33)
	Total	75	50(66.67)

Table 9. Confirmed Occurrence of ESBL producers among the Isolates by Using Double Disk Synergy Test

Pathogens isolated	No. of Suspected ESBL	Number Confirmed	% of ESBL Producers
<i>Escherichia coli</i>	31	13	(26)
<i>Klebsiella pneumoniae</i>	9	6	(12)
<i>Proteus mirabilis</i>	3	2	(4)
<i>Pseudomonas aeruginosa</i>	7	8	(16)
Total	50	29	(58)

S. aureus, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus* spp as the most dominant species Emmanuel et al. (2007) and Lesner et al. (2009). Presence of members of Enterobacteriaceae family such as *E. coli*, *Klebsiella* spp and *Proteus* spp means that infection was as result of poor personal hygiene because the organisms were of fecal origin. This may also be connected with the close proximity of anus to female vagina. The domination of Gram-negative UTI bacteria could be attributed to an increase in the levels of amino acids and lactose during pregnancy that particularly encourages *E. coli* growth. It could also be due to infection by faecal contamination due to poor hygiene Bolu et al. (2009). Kumbu and Eze (2010) attributed the high prevalence of Staphylococcal infection to poor personal hygiene. These findings were in agreement with the works reported by Zufhad and Onile, (2001) in Ilorin, Sunday, (2003) and Matthew, (2007) in Enugu and Lagos with *E. coli* being the most common causative agent of UTI with infection percentage from 40%-90%. Cedi et al. (2010) suggests that *E. coli* accounts for 32% of UTI cases in Enugu and Anambra State. In terms of frequency of occurrence, the result was in accordance with those conducted in other countries such as Ejaz et al. (2006) observed 37% prevalence of *E. coli* in Pakistan. These studies also support our result. Whereas Ana et al. (2009) reported that *Staphylococcus aureus* (67.9%) was most common causative agent in children in Nigeria which is inconsistent with our result. *Pseudomonas aeruginosa* (16.47%) is the second most prevalent organism in our study. It is inconsistent to the most of the previous studies. Bano et al. (2012) from Pakistan reported *Klebsiella pneumoniae* being the second most prevalent organism with percentages as 16 and 18 respectively. Queen et al. (2011), and Yaks et al. (2010), all reported *Klebsiella* (11% - 37%) being second most prevalent organism causing UTI. On the other hand, the results disagree with study conducted by Lucy, (2005) from Pakistan observed that *E. coli* (1%) is the least common causative agent of UTI. Similar finding of least incidence of *Pseudomonas* sp. as a causative agent of UTI that is in contrary to our results was observed by Kashfar et al. (2009) in Iran. The percentage distribution of *Proteus* sp. (8.24%), *staphylococcus aureus* (7.06%), *staphylococcus saprophyticus* (4.71%) shown in our results which is similar to the previous studies. Peter, (2007) observed prevalence of *S. aureus* (9.04%), *staphylococcus saprophyticus* (4.81%) in

Nigeria. Results reported by Mahveer et al. (2011) from India are similar to our results showing that *Staphylococcus aureus* was the commonest Gram- positive isolate (1.5%). Kashef et al. (2010) observed that 12.4% *Proteus* sp. caused UTI.

The antibiotic susceptibility profile of the isolate in this study indicated that most of the isolates were susceptible to some antibiotics used. According to this study, *E. coli* have highest sensitive to Imipenem 41(97.62%) followed by Meropenem 40(95.24), Nitrofurantoin 33(78.57%), moderately sensitive to Ampicillin 28(66.67%). Low sensitive to Norfloxacin 14(33.33%), Cephalexin 12(28.57%), Co-trimoxazole 9(21.43%). *Klebsiella pneumoniae* have 100% sensitive to Imipenem as well as Meropenem but moderately high sensitive to Ampicillin 7(58.33%). Low sensitive to Cephalexin 4(33.33%). *Pseudomonas aeruginosa* was highly sensitive to Imipenem 11(78.57%), Meropenem 10(71.43%) and moderately to Amikacin 8(57.14%). Low sensitive to Carbenicillin 4(28.57%). *Proteus mirabilis* was 100% sensitive to Imipenem as well as Meropenem. Moderately sensitive to Gentamicin 3(42.86%) but low sensitive to Co-trimoxazole 1(14.29%). Imipenem and Meropenem were found the most effective against the isolated *Staphylococcus aureus*, with percentage of 100% and 100% respectively. While the effective agent was Cephalexin 5(83.33%), Tetracycline 4(66.67%) as well as Erythromycin and Co-trimoxazole. *Staphylococcus saprophyticus* have 100% sensitive to Imipenem, Meropenem, Co-trimoxazole and Tetracycline followed by Erythromycin 3(75.00%) but moderately sensitive to Cephalexin 3(57.00%) while less sensitive to Amoxicillin 1(25.00%). The finding of this study showed that Imipenem and Meropenem was the most effective antibiotic for treatment of urinary tract infection among Gram-negative isolates. In addition to that, Nitrofurantoin and Ampicillin were also moderately active against the isolates, followed by Co-trimoxazole and amoxicillin. This finding was in conformity with the finding of Basee et al. (2014) who found Imipenem and Meropenem among Uropathogens. Imipenem and Meropenem were used in this study and found to be most sensitive drugs against all isolated uropathogens.

Both the drugs were 100% sensitive to *Klebsiella pneumoniae* and *Proteus mirabilis*, but *Escherichia coli* was 2.38% and 4.76% and *Pseudomonas aeruginosa* 21.43% and 28.57% resistant to Imipenem and Meropenem respectively. Imipenem and Meropenem were found to be 98% and 100% sensitive against highly resistant Gram negative bacilli, found in another study by Gebril and Ogbulie (2006). In King Fahd Hospital, Saudi Arabia showed that Meropenem and Imipenem were 95.8% and 91.71% sensitive respectively against Gram negative rods Biswas et al. (2014). *Staphylococcus aureus* and *Staphylococcus saprophyticus* both were 100% sensitive to Imipenem, Meropenem and Co-trimoxazole in our study. Another study in Square Hospital, Awka, Nigeria. (November 2011 to February 2013) found 93.3% resistant to Imipenem and Meropenem which does not correlate with our study by Ekwealor et al. (2016). So, UTI caused by Gram positive cocci may be treated by Erythromycin, Co-trimoxazole, Imipenem and Meropenem according to the finding of this study. The higher antibiotic resistance in the present study might be due to the fact that common antibiotics are sold over the counter in our locality and people of any age can buy them without doctor's prescription. All the isolates were screened for antibiotic resistance, and they differently offered relatively high degree of resistance against some commonly used antibiotics in bacterial urinary tract infection.

As far as resistant pattern of *E. coli* is concerned by, it shows very high frequency of resistant to Co-trimoxazole 33(78.57%), followed by 30(71.43%) Cephalexin, moderately high resistant to Norfloxacin 28(66.67%). Low resistant to Ampicillin 14(33.33%), Nitrofurantoin 9(21.43%), Meropenem 2(4.76%) and Imipenem 1(2.38%). *Klebsiella pneumoniae* showed 8(66.67%) resistant to Cephalexin, but moderately resistant to Co-trimoxazole 7(58.33%). Low resistant to Ampicillin 5(41.67%). The pattern of highest resistant shown by *Pseudomonas aeruginosa* was Gentamicin 11(78.57%), Carbenicillin 10(71.43%), but low resistant to 28.57% of Amikacin as well as Meropenem respectively. *Proteus mirabilis* shows highest resistant against Ampicillin (100%) as well as Cephalexin 7(100%), followed by Co-trimoxazole 6(85.71%), and 4(57.14%) to Gentamicin. *Staphylococcus aureus* shows moderately resistant to Amoxicillin 4(66.37%) but less to Tetracycline 2(33.33%) as well as Erythromycin and Co-trimoxazole respectively. The pattern of resistant rate showed by *Staphylococcus saprophyticus* was Amoxicillin 3(75.00%) but less to Erythromycin and Cephalexin 1(25.00%) and 1(25.00%) respectively. The result is consistent with the findings of previous studies. This is in conformity with the findings reported by Noor et al. (2004) and Asad and Muid (2006). Multiple drug resistance was observed among all the screened isolates, and this agrees with the reports from other findings (Hammer et al., 2001). Mechanisms of resistance such as plasmid mediated and/or reduced outer membrane permeability could be involved in the resistance to

different antibiotics and beta-lactams. The production of Extended Spectrum Beta-Lactamase (ESBL) among *E. coli* and *K. pneumoniae* also contributed significantly to the resistance of those isolates. Resistance of Ciprofloxacin and Co-trimoxazole in Gram negative bacilli is often mediated by beta-lactamases which are unaffected by exposure of the bacterium to the potential drugs (Marwa et al., 2004). The resistance to amoxicillin (AM), Ampicillin (AMP), Norfloxacin (NRF) and Gentamicin (GN) has been the most common in this study. However, the resistance observed among most organisms against these antibiotics may be because these antibiotics have been in use for a long period and must have been abused and as a result the organisms must have developed mechanisms of circumventing their mode of action (Ibeawuchi and Mbata, 2002). A high percentage of multi-drug resistance was also observed for most of the isolated strains especially for *Escherichia coli*, *Proteus* spp and *Klebsiella* spp. The highest level of resistances to those commonly used antibiotics might be due to easy access, affordability and indiscriminate use of these antibiotics as well as poor patient's adherence to recommended dosage regimens. Although variations in isolate resistance exist between the different age groups, the overall most effective antibiotics were the Imipenem and Meropenem. The low level of resistance to these antibiotics may be due to their better efficacy and high price; therefore not readily available and affordable. The two classes of antibiotics may therefore be used as an alternative to commonly used antibiotics in patients with UTIs. Those isolates showed little or no susceptibility to cephalexin, ciprofloxacin, tetracycline, amoxicillin, ampicillin and co-trimoxazole (Hamdan et al., 2011).

Multi drug resistance (MDR = resistance in ≥ 2 drugs) was seen among the isolated bacterial uropathogens. Study in Felege Hiwot Referral Hospital, Ethiopia reported the overall multiple drug resistance for isolated uropathogens was 93.1% (Moges et al., 2002), and a lower finding was reported in Tikur Anbessa specialized Hospital Addis Ababa, Ethiopia 74% (Warren et al., 2008). This indicates that multi drug resistance was found to be very high to the commonly used antibiotics. A study conducted somewhere else revealed that the antibiotic resistance has been recognized as the consequence of antibiotic use and abuse (Abubakar, 2009). Therefore, the reasons for this alarming phenomenon might be inappropriate and incorrect administration of antimicrobial agents in empiric therapies and lack of appropriate infection control strategies, which can cause a shift to increase prevalence of resistant organism in the community.

The occurrence of suspected ESBL producers is 66.67% in this study. This is agree with the findings from other studies in Nepal

have shown ESBL production ranging from 18% to 62.7% by Thakur et al. (2013) and Poudyal et al. (2011). Variation might have occurred due to low number of samples studied. Similarly, variation in occurrence of ESBL producing organisms were found in other countries like in a research conducted by Agrawal, et al. (2008) and Wiegand, et al. (2007). Significant increase in ESBL organisms were published from India by Agrawal et al. (2008) and Sharma et al. (2012), Pakistan by Ali et al. (2004) and Ullah et al. (2009), Nigeria by Yusha'u et al. (2010), Hong Kong by Ho et al. (2000), and Germany by Wiegand et al. (2007). During a six years period (1997-2003), Prevalence of ESBL producing *Klebsiella* spp was reported from Latin America (42.7%) and Europe (21.7%) and North America (5.8%) by Biedenbach et al. (2004). In USA, Enterobacteriaceae producing ESBL ranged between 0-25percent in different institutions, while the national average was around 3% by CDC (2010). Strict antibiotic policies might be the reason for lower rate of ESBL organisms in Europe and America.

In the present study, all the screened organisms were confirmed as ESBL producers by phenotypic confirmatory tests. The sensitivity of both Ceftazidime and ceftriaxone to detect ESBL production was 58% positive. In Hong Kong, the sensitivity of different Extended Spectrum Beta-Lactam drugs was studied. The study found Ceftazidime and ceftriaxone as 100% sensitive to indicate ESBL activity by Ho et al. (2000). Paudyal et al. (2011) found Ceftazidime as the reliable screening agent for ESBL detection with sensitivity and positive predictive value of 98.6% and 76.4% respectively. This finding is consistent with a study done by Walmart et al. (2008) in India which found ESBL producers resistant to Ceftazidime and ceftriaxone by 83.7% and 81.2% respectively. This implies that Ceftazidime (30mg) can be the drug of choice to screen out ESBL producers.

Conclusion

The study clearly showed that, urinary tract Infection is still posing problem in Dawakin Kudu Local Government Area of Kano State. It is quite alarming to note, there should be high prevalence of extensively resistant ESBL producing isolates in our setup, which is posing a major clinical crisis of treatment failure with β -lactam antimicrobials. According to this study, most of predominant species enumerated in this community was highly sensitive to Imipenem, Meropenem, Tetracycline, Erythromycin and Nitrofurantoin respectively and are recommended as antibiotics of choice against the pathogens. On the other hand, the increasing prevalence of bacterial resistance to commonly used antibiotics has made susceptibility testing a crucial aspect in the treatment of serious bacterial infections. Therefore, there is need for government to increase surveillance of ESBL-producing organisms as they pose serious threat to successful treatment of infections in this

community and exacerbates the problem of antimicrobial resistance in the hospitals, especially in resource poor Community settings.

Acknowledgement

All praises and salutations go to the Almighty Allah (S.W.A) for protecting and giving me insight at all times. He provides guidance through his undying love. I always have a pillar of strength in Him.

Firstly, I am grateful to God for the good health and well-being that were necessary to complete this programme.

I would like to express my sincere gratitude to my supervisors Dr. Muhammad Yusha'u and Prof. Lawan Dan-Larai for their continue guidance, advice and supervision of this dissertation. Their immersed knowledge really helped me during the course of this research work.

Conflicts of interest

We declared that, no conflicts of interest

Ethical Clearance

An approval of the study was obtained from the research ethics committee of Kano State Ministry of Health, Nigeria.

Source of Funding

This work did not received any fund from any organization

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