Research Article

Bacterial agents of urinary tract infection among patients attending general hospital Dawakin-Kudu, Kano State-Nigeria

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Abstract

Objective: The main objective of this study was to isolate and characterize bacterial pathogens from urine samples at General Hospital Dawakin-kudu Local Government Area. **Methods:** A total of 204 urine samples were from patients with suspected cases of urinary tract infection were subjected to isolation using standard bacteriological technique by streaking using a sterilized platinum wire loop onto the surface of freshly prepared Cysteine-Lactose Electrolyte Deficient (CLED) agar, MacConkey agar and Mannitol Salt agar plates followed by incubation at 35°C for 24 hours. The isolated bacteria were identified using standard biochemical tests including; Gram staining, Indole, Citrate utilization, Catalase, Urease, Methyl red, Voges-Proskauer, Oxidase and Coagulase tests. **Results and conclusion:** The results showed that, out of the total of 204 urine samples, 85 were positive for culture which accounted for 41.67%. The species identified include; *Escherichia coli* with infection rate of 49.41% (42 isolates), 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 with the least prevalent organism being *Staphylococcus saprophyticus* with 4 isolates (4.71%). The study showed that, Urinary tract infection is the most prevalent among adults with 41-50 years of age 28(93.33%) and least prevalent among children 0-10 years old are the most little infected 4(19.05%). The highest prevalence was observed among 21-30 years of age 22(45.83%), this is followed 31-40 years old 18(35.29%), 11-20 years and 51 to above old which has infection rate of 8(25.00%) and 5(22.73%) respectively. The study has shown that, the infection rate increases with increase in age. Females (especially at the child-bearing ages) had higher frequency of UTI (47.52%) as against their male counter parts (35.92%) in the area studied. However, there was no significant difference ($P < 0.05$) in relation to sex.

***Keywords*:** *Klebsiella pneumonia,* bacterial isolates, urinary tract infections

Introduction

Urinary Tract Infection (UTI) is caused by microorganisms anywhere in the region that comprises of kidney, renal pelvis, urinary bladder, urethra, and adjacent structures including perinephric fascia, prostate, and epididymis. The bacteria from digestive tract climb at opening of urethra and multiply therein to cause UTI. In contrast to males, females are more susceptible to UTI. More Susceptibility of UTI among female is due to short length of urethra, absence of prostatic secretion, pregnancy and easy contamination of the tract with faecal flora (Akram *et al.,* 2007). The prevalence of UTI is age- and sex- dependent. During first year of life, the prevalence of UTI is less than 2% in both

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males and females. The incidence in males lowers after one year of life and until approximately 60-years of age when enlargement of the prostate interferes with emptying of the bladder. UTI is, therefore, predominantly a disease of females. The previous studies have reported that, incidence of bacteriuria in girls at 5-years is 1% and increases to 3% as age advances to 17-years. The 10-12% prevalence of bacteriuria in older women increases gradually with age. In 20-40 years old females who had UTI up to 50% are more prone to re-infection within one year. The association of UTI with sexual intercourse, in addition, contributes to increased incidence because sexual activity raises the chance of bacterial contamination in female urethra. As a result of anatomical and hormonal changes that favour UTI, the incidence of bacteriuria increases during pregnancy. Further these consequences lead to serious infections in both mother and foetus (Gales and Safer, 2002).

UTI are important complications of diabetes, renal disease, structural and morphological abnormalities that interfere with urinal flow. UTI is the leading cause of gram-negative sepsis in hospitalized patients and the origin for about half of all nosocomial infections caused by urinary catheters. It is either symptomatic or asymptomatic. Patients with significant bacteriuria who exhibit symptoms referable to urinary tract are said to have symptomatic bacteriuria. Asymptomatic bacteriuria is a condition characterized by presence of bacteria in two consecutives clear-voided urine samples both yielding positive cultures ($\geq 10^5$ cfu/ml) of identical uropathogens, in patient without classical symptoms. *Escherichia coli* is major etiologic agent causing UTI which account for up to 90% of cases. *P. mirabilis, Klebseilla* species, *Pseudomonas aeruginosa* and *Enterobacter* species are less frequent offenders. Gram-positive organisms are common in which Group B *Streptococcus, Staphylococcus aureus, S. saprophyticus,* and *S. haemolyticus* are recognized organisms. Current management of UTI is empirical without the use of a urine culture or among the pathogens that cause UTI is increasing as a major health-problem in treatment of UTI (Foxman, 2003).

The main objective of this study was to isolate and characterize bacterial pathogens from urine samples at General Hospital Dawakin-kudu Local Government Area.

The specific objectives include

1. To ascertain the prevalence of urinary tract infections among patients attending General Hospital Dawakin-kudu Local Government Area.
2. Determine the predominant species causing the infection in the study area.

The study was guided by the following research questions:

(a) What is the prevalence of UTI among the patients in relation to ages? (b) What is the prevalence of UTI among the patients by sex? (c) What types of Species are identified among various Urine samples?

The following null hypotheses were stated and tested at 0.05 level of significance: The number of male and female patients infected by UTI does not differ significantly. There is no significant difference in the prevalence of UTI by age of the patients.

Study Area

The study area was conducted in Dawakin-kudu Local Government Area of Kano State- Nigeria. The study communities lie within the elevation of 444 meters above river level of Northern Nigeria. The area of the Study was General Hospital Dawakin-kudu, the town of Dawakin-kudu lies between latitude 11º 50'5" N and longitude 8º 35'35" E. This hospital was chosen as the study site because it is a major health care provider for both outpatients and inpatients in the town.

Study Population

The population involved in this research study were patients with Urinary Tract infections attending General Hospital Dawakin-Kudu Local Government Area of Kano State- Nigeria. The population studied, was a heterogeneous population of different age group, ethnicity and educational status. A patient is said to have symptoms of UTI when she and/or he had one or more of any of the following symptoms on the basis of history: Complaining of lower abdominal pains, frequent or difficulty in urination, vaginal discharges and so on.

Sample Size

A single population proportion formula was used to calculate the sample size, (Carter, 2009). The sample size for the study was calculated based on a previous study done by Muhammad, Ali, and Muhammad, S. A. (2019), which showed a prevalence of 15.8% UTI in patients attending Murtala Muhammad Specialist Hospital Kano, Nigeria. Using the formula $N= z^2p\ (1-p)/d^2$, the sample size was calculated to be 204.

Sample Collection

Early morning clean catch midstream urine sample were aseptically collected in sterile containers in to which a trace of boric acid was added as preservative from 204 UTI patients attending General Hospital Dawakin-Kudu. The samples were maintained on cool box containing ice and transported to Microbiology laboratory for isolation, identification and confirmation by grams staining, colony morphology and standard biochemical tests (Barlow *et al.,* 2000).

Statistical Analysis

The statistical analysis adopted in analysing the data was Chi-square test of the association (Fedelis, 2000). This tool was employed to test the significance and goodness of fit to a theory. The members of a population need to be classified in to exactly one of the several categories.

Results

The results of present study showed that, out of the total of 204 urine samples which were processed for screened of urinary tract infections (UTI), 85 samples were diagnosed with urinary tract infections which accounted for 41.67% of the infections.

As shows in **table 1,** UTI is the most prevalent among 41-50 years of age 28(93.33%), followed by 21-30 years of age 19(39.58%) having the highest level of infection, 31-40 years old 15(29.41%), 11-20 years old 8(25.00%) and 51 to above years' old 5(22.73%). While children of 0-10 years old are the most least infected 4(19.05%).

Results were showed that, the prevalence of UTI was higher in females 48(47.52%) as compared to the males 37(35.92%). In effect, a urinary tract infection is more prevalence among females but it is not statistically significant (Table 2).

Table 1. Prevalence of Bacterial Pathogens from UTI patients in relation to age

Age	No. of Patients Examined	Patients Positive (%)	Patients Negative (%)
0-10	21	4(19.05)	17(80.95)
11-20	32	8(25.00)	24(75.00)
21-30	48	22(45.83)	26(54.17)
31-40	51	18(35.29)	33(64.71)
41-50	30	28(93.33)	2(6.67)
51>	22	5(22.73)	17(77.27)
Total	204	85(41.67)	119(58.33)

Table 2. Prevalence of Bacterial Pathogens from UTI patients in relation to gender

Gender	No. of Patients Examined	Patients Positive (%)	Patients Negative%
Female	101	48(47.52)	53(52.48)
Male	103	37(35.92)	66(64.08)
Total	204	85(41.67)	119(58.33)

Table 3. Morphological, Physiological and Biochemical characteristics used in identifying test organism

S. No.	Cultural Characters	Grams reaction and Cell shape	Biochemical characteristics									Suspected organism
			1	2	3	4	5	6	7	8	9	
1	Deep yellow colony on CLED and MSA	Gram positive with cocci in cluster	+	+	-	-	-	+	-	+	-	*S. aureus*
2	White circle colony on CLED and Pale yellow on MSA	Gram positive with cocci in cluster	+	-	-	-	-	+	-	+	-	*S. saprophyticus*
3	Opaque yellow colony on CLED and rose pink colony on MAC	Gram negative with rod	+	-	-	+	+	+	-	-	-	*E. coli*
4	Yellow to white-blue Colony on CLED and Pink colony with large Glistening and mucoid on MAC	Gram negative with rod	+	-	+	-	+	-	+	+	-	*K. pneumoniae*
5	Translucent blue colony on CLED and colourless colony on MAC	Gran negative with rod	+	-	+	-	-	+	-	+	-	*P. mirabilis*
6	Green colonies with Typical matted surface and rough periphery on CLED and colourless, feathery on MAC	Gram negative with bacilli	+	-	+	-	-	+	-	+	+	*Ps. aeruginosa*

KEY: (1)=Catalase, (2)=Coagulase, (3)=Citrate utilization, (4)=Indole, (5)=Lactose fermentation, (6)=MR, (7)=VP, (8)=Urease, (9)=Oxidase, (+)=Positive, (-)=Negative

Table 4. Prevalence of Bacterial Pathogens isolated from the Urinary tract of patients.

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

Table 5. Summary of X^2 on the Ages of the Patients Infected by UTI

Source of variation	No. of infected patient	df	Cal X2	Cal X2	*P>0.05
0-10	4				
11-20	8				
21-30	22				
31-40	18				
41-50	28				
51>	5				
	85	5	69.416	11.070	0.05

*0.05 = Significant

Table 3 shows that, of the 85 bacterial pathogens obtained, 88.24% were Gram-negative while 11.76% were Gram-positive which were identified as members of the family Staphylococcaceae.

As the result indicated in the **table 4** 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%).

As shown in **table 5**, at 5 percent significant level and 5 degree of freedom, the calculated X^2 69.416 is greater than the critical X^2value 11.070. Therefore the $H0_2$ is rejected and the alternative accepted. Then the researcher concludes that there is significant difference in the Prevalence of urinary tract infections among patients by ages.

Discussion

In the present study, a total of 204 cases were considered of which 85 cases accounted for 41.67% were UTI positive while 119 cases (58.33%) were UTI negative. The overall prevalence of urinary tract infection among patients complaining of lower abdominal pains, frequent urinating in this study was found to be 41.67%. This result was in conformity with similar study conducted by Mikhail and Anyaegbunam (2005) in Northern Tanzania who found the prevalence of UTI as 46.4%. Another study conducted by Muhammad and Fareid (2012) found 34.6% as the percentage prevalence with Urinary tract infection. The result also correlates with that found in Khartoum, Sudan (39%). On the other hand, the result of the present study is in contrast with that of Nabbugodi *et al.* (2015) who found prevalence of UTI as 26.7%. The differences in prevalence may be explained due to differences in socio-economic status, environmental condition, social habit, personal hygiene and educational level.

As shows in table 1, UTI was the most prevalent among 41-50 years of age 28(93.33%), followed by 21-30 years of age 22(45.83%) having the highest level of infection, 31-40 years old 18(35.29%), 11-20 years old 8(25.00%) and 51 to above years' old 5(22.73%). While children of 0-10 years old were the less infected 4(19.05%). The prevalence of organism is age specific, which is found in age groups ranging from zero-month to hundred years old adult and most of the patents infected were between 41- 50 years old. The incidence of UTI in females was most commonly found from 21- 50 years whereas, in males was higher from 5–80 years of age. The reason for this can be due to the fact that, during these age females were sexually active. Our results are similar with the findings of Jalapour *et al.* (2011) who also showed that, UTI is less common in young men below

50 and who did not undergo any genitourinary procedure. Infection tends to rise after the age of 40 in men. Similarly, Barkun *et al*. (2007) observed that frequency of UTIs was found more in elderly patients (41.04 %). Whereas results observed by Zikra *et al*. (2012) and Roopa and Sadha, (2009) were inconsistent with our results who reported higher UTI incidence in patients between 18-20 years.

Table 2 shows that, the prevalence of UTI was higher in females 48(47.52%) as compared to the males 37(35.92%). It appeared that, UTI is more prevalent among females, but at 5% level of significant, the difference is not statistically significant ($P< 0.05$). This might be due to the close proximity of female urethral meatus to the anus, shorter urethra, and urothelial mucosa adherence to the muco-polysaccharide lining. This high possibility of UTIs in females is also due to the inherent virulence of *E. coli* for urinary tract colonization such as its abilities to adhere to the urinary tract and also association with other microorganisms moving from the perineum areas contaminated with fecal microbes to the moist warmth environment of the female genitalia. In women, fecal-perinatal- urethral contamination is the most probable explanation for infections caused by enteric bacteria Dennis *et al.* (2011). These findings were in agreement with the work by Jaz *et al.* (2006) who observed that in Pakistan females has 54% higher risk of getting UTI than males. Mehr *et al*. (2010) reported that in Pakistan prevalence of UTI in females is 63% as compared to males 37%. Khan *et al*. (2012) observed that male to female rate in Ghana as 34-81. Jamal and Kamal, (2011) observed in Benue that urinary tract infection was seen in 70.5% females and 29.5 males. Djaiid and Shahbazi, (2010) reported that among all the patients 82.5% were females. All these studies support our results of female preponderance in UTI.

Results showed in table 3 that, 85 bacterial isolates obtained were subjected to Gram's staining techniques and then 88.24% of the isolates were microscopically separated into Gram-negative with Bacilli (rod) cell shape, while the remained 11.76% of the isolates were Gram-positive with cocci (in cluster) cell shape. Standard biochemical characterization of 85(100%) of the isolates were taken into account to confirmed 88.25% as the members of the enterobacteriaceae while the 11.76% as the members of the family Staphylococcaceae. This might be as a result of the Gram-negative bacteria have much less peptidoglycan in their cell walls, so this step essentially renders them colorless, while only some of the color is removed from gram-positive cells, which have more peptidoglycan (60-90% of the cell wall). The thick cell wall of gram-positive cells is dehydrated by the decolorizing step, causing them to shrink and trapping the stain-iodine complex inside. The remaining clinical isolates were gram negative, which may be due to having a thinner peptidoglycan layer and presence of outer lipid membrane separated by periplasmic space. Crystal violet iodine complex (CV-I) binds both inner and outer wall; but during decolorization this outer lipopolysaccharide layer loses its integrity and inner membrane become exposed. Washing of CV-I complex and counter stain Saffranine presented the cell wall as red-pink appearance (Prescott *et al*., 2000).

As the result indicated in the table 4 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 less 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*, *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 results were 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 results. 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 results. *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 result and 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 result 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 result showing that *Staphylococcus aureus* was the commonest Gram- positive isolate (1.5%). Kashef *et al.* (2010) observed that 12.4% *Proteus* sp. caused UTI.

Conclusion

In this study, prevalence of UTIs from patients attending general hospital in Dawakin kudu local government area, Kano state of Nigeria, was found to be 85/204(41.67%). The prevalent rate is still high among age group (21-50 years.). *Escherichia coli* and *Pseudomonas aeruginosa* are the major causes of UTIs among patients attending the hospital. This study has demonstrated that, presence of Gram negative UTI bacteria means that infection was as a result of poor personal hygiene and close proximity of female urethral meatus to the anus, shorter length urethra, and urothelial mucosa adherence to the muco-polysaccharide lining are the most important factors associated with UTIs. Appreciate measures may help to reduce UTIs due to these associated factors. We recommend routine UTIs screening in patients with such factors. If these routine checks are put in place, prevention of UTI can be realized at lower cost.

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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.

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