

Bacterial Urinary Tract Infection among Adult Renal Transplant Recipients at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

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Research article

Keywords: Kidney Transplantation, Urinary Tract Infection, Antimicrobial Susceptibility Testing, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

Posted Date: July 1st, 2019

DOI: <https://doi.org/10.21203/rs.2.10826/v1>

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Version of Record: A version of this preprint was published at BMC Nephrology on July 31st, 2019. See the published version at <https://doi.org/10.1186/s12882-019-1485-9>.

Abstract

Abstract Background: Despite significant advances in surgical techniques, immunosuppression protocols follow up periods and antimicrobial stewardship in modern medicine; post-renal transplantation urinary tract infection remained a major public health problem globally. This multiple serious sequel includes asymptomatic bacteriuria, cystitis and pyelonephritis. Among these, the bacterial origin of infection complications accounts for the most significant clinical, socio-economic impacts in many countries of the world. Therefore, the aim of the study was to investigate the prevalence of bacterial isolates that cause urinary tract infections, assess antibiotic susceptibility pattern among symptomatic and asymptomatic renal transplant recipients attending at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. **Methods:** A hospital-based cross-sectional study was conducted from December 2017 to August 2018 among 74 renal transplant recipients St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. A first morning voided clean-catch mid-stream urine specimens were collected and 0.001ml inoculated onto blood and MacConkey agar plates following the standard bacteriological protocols. It was incubated aerobically at 35–37°C for 24–48 hours. Cultural characteristics and series of biochemical tests were used for the identification of isolates to species level. **Results:** Significant bacteriuria was found in 11/74 (14.9%, 95% CI=8.2-24.7) patients. The prevalence among females 6/32 (18.75%) was higher among males 5/42 (11.9%) without significant association (COR=2.09, 95% CI=1.04-8.45, P=0.253). Urinary tract infection was higher in the age group of 35–49 years old (19.3%). Age was statistically significant and stronger independent associated risk factor with crude odds ratio=3.67, 95% CI=2.89-20.07 and P= 0.003, respectively. The most prevalent bacteria isolates were *Escherichia coli* 2(18.2%), *Staphylococcus aureus* 2(18.2%), *Acinetobacter* spp. 2(18.2%), *Enterococcus* spp. 2(18.2%), Coagulase-negative *Staphylococci* 2(18.2%) followed by *Portus mirabilis* 1(9.1%). The majority (80%) of Gram-negative bacteria were resistant to ciprofloxacin, chloramphenicol, and trimethoprim/sulfamethoxazole. **Conclusions:** In conclusion, the overall prevalence of urinary tract infection in the study participants was relatively low with a prevalence of 14.9%. Majority of the study participants were asymptomatic. The multidrug-resistant bacterial isolates in the present study account for 82%. **Keywords:** Kidney Transplantation, Urinary Tract Infection, Antimicrobial Susceptibility Testing, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Background

The urinary tract is protected against infections by several mechanisms unlike the kidney transplant patients are vulnerable to multiple infections like bacterial, viral, fungal and parasitic infections. Despite significant advances in surgical techniques, immunosuppression protocols and study designs; post-renal transplantation urinary tract infections particularly the bacterial origin continues to be a major public health problem globally with significant morbidity and mortality [1].

Post-renal transplantation urinary tract infections sequel including asymptomatic bacteriuria, cystitis, and pyelonephritis are the most common form of bacterial infection following renal transplantation. It could result in allograft graft loss, allograft function impairment and even death. These can occur at any time but with the highest incidence observed in the first 3-6 months after transplantation [2].

During the first month, asymptomatic bacteriuria is the most common phenomena regardless of the proven guidelines are lacking for both diagnosis and treatment in the global community. The globally reported prevalence of post-renal transplantation urinary tract infection may vary depending on several factors and conditions such the study design, selection of antimicrobial prophylaxis and lack of advanced diagnostic facility to track post-renal transplantation urinary tract infection. Hence, many authors described that it ranged from 4% to 75% [3]. Likewise, the overall incidence of UTI in solid organ transplant recipients was reported 0.23 episodes/1000 days of transplant. However, this incidence varies significantly depending on the type of transplanted organ being the renal transplants are the highest risk groups among any other organ transplants. In this case, infections develop more rapidly among renal transplants than any other organ transplant so that rigorous post-renal infection intervention strategies are highly demanded to diminish any grave impacts [4, 5].

In many countries of the world, kidneys are the most frequently transplanted organs to resolve end-stage renal disease including our country Ethiopia. However, post-renal transplantation urinary tract infection has remained the leading cause of significant morbidity, mortality and graft failure, which reported globally. The discrepancies in diagnostic criteria like frequency of routine urine culture testing, uneven follow-up times as well as the lack of rigorous center infection prevention and control strategies enhance these multiple sequelae to disseminate globally. These clinical and socio-economic impacts are relatively higher in developing countries mainly due to the low availability of resources required for early screening and treatment of infections [6, 7]. Renal transplants are more prone to infections than non-transplanted population. The superimposed immune suppressions aimed to maintain the acute or chronic allograft rejection triggers antimicrobial selective pressure especially to the Gram-negative bacilli [8, 9]. In general, speaking bacterial species leading to

urinary tract infection in renal transplant recipients are similar to those causing UTIs in the general population. However, an influence of early intensive immunosuppression regimens and antimicrobial prophylaxis particularly at the post-operative procedure promotes drug susceptible and less virulent strains to cause infection in renal transplants unlike in the general population. As a result, management in renal transplant recipients is undoubtedly more complex compared with the general population. Several factors may contribute to kidney allograft loss and grave outcome impacts. These include anatomical factors, surgical factors, microbial factors and allograft factors [3, 10-14].

Methods

Study design, area and period

A hospital-based cross-sectional study was conducted between December 2017 and August 2018. The study was conducted at St. Paul's Hospital Millennium Medical College at the National Kidney Transplantation Center.

Study population

The study population were all adult kidney recipients aged ≥ 18 years who came for their check-up to the renal transplantation center suspected for both asymptomatic, symptomatic bacteriuria and who did not initiate of antibiotics therapy during the last two weeks and during data collection.

Sample collection and processing

Sample collection

Seventy-four early morning 5 ml of midstream urine specimens were collected from all kidney recipients using wide-mouthed, sterile, leak-proof re-usable plastic containers following standard bacteriological procedures. All of the specimens were analyzed within an hour of collection. All relevant data concerning socio-demographic characteristics, related risk factors to UTI, clinical signs and symptoms of the study participants were obtained using pre-designed structured questionnaires.

Bacterial culture and identifications

Relevant data on the etiological agents were obtained using standard microbiological laboratory tests. The laboratory procedures were performed at clinical Bacteriology and Mycology laboratory located at National Reference Laboratory of the Ethiopian Public Health Institute, Addis Ababa, Ethiopia. All the laboratory procedures were performed using standard bacteriological procedures. Briefly, using calibrated wire loop One μl (0.001ml) clean-catch midstream urine samples were inoculated into MacConkey (MAC) and 5 % sheep blood agar plate (BAP) (Oxoid, UK). Then, cultures were incubated in the aerobic atmosphere at 35-37°C for 24-48 hours. Colonies were counted to check the presence of significant bacteriuria. Colony count yielding bacterial growth of $\geq 10^5$ cfu/ml of urine was considered significant bacteriuria according to the Infectious Diseases Society of America (IDSA) guidelines [15]. All positive cultures with significant bacteriuria were then subjected to test identification to species level by their colony characteristics and patterns of biochemical profiles using standard bacteriological procedures. The Gram-negative bacteria (Enterobacteriaceae) were identified by indole production, H₂S production, lactose fermentation in triple sugar iron agar, citrate utilization, motility test, urease test, bile solubility, utilization of lysine in lysine decarboxylase agar. Oxidase test was also performed for non-fermenter Gram-negative rods. The Gram-positive bacteria were identified using routine bench tests such as catalase, coagulase and bile-esculin tests [3, 16].

Antimicrobial susceptibility testing

The antimicrobial susceptibility testing for every significant isolate was performed by adhering to the standard bacteriological procedures. Appropriate selection of antimicrobial agents was made based on the frequent prescription of antimicrobial agents in the study area, local market availability, expert opinion in conjunction to the criteria of the Clinical and Laboratory Standards Institute (CLSI) for the treatment of urinary tract infection. Mueller-Hinton agar (Oxoid, UK) was used to do the susceptibility testing for the isolated

bacteria. In brief, from a pure culture, a loopful of bacterial colonies was taken and subjected to a tube containing 5 ml of normal saline. The final preparation was mixed gently until it forms homogenous suspension throughout the tube. To assure with standard inoculum size for testing and resolve any associated errors during antimicrobial susceptibility testing, the turbidity of an even suspension was adjusted to the density of McFarland 0.5 g aseptically. Subsequently, a bacterial suspension was picked-up via a sterile cotton swab and gently rotated over the surface of the Mueller-Hinton agar at least three times including the rim of the agar plate adhering to the manufacturer's instruction to do susceptibility test [16]. Caution was taken to avoid any exposure to air bubbles including any excess suspensions during the procedure that could grossly alter the result and report. To avoid any excess moistures at any surfaces of the agar plate, which hastens diffusivity of antimicrobial agents, inoculated plates were left at room temperature to dry for 3-5 minutes. Then, antimicrobial agents were brought to the room temperature and placed over the working table. Using a sterile forceps, the antibiotic disc was put on the surface the agar plate at the reasonable diameter and a slight pressure was applied to ensure proper contact of the discs with agar plate. Finally, the plates were incubated at 35°C -37°C for 24-48 hours and then the isolates were typed susceptible, intermediate and resistant based on diameters of the zone of inhibition around the discs against the criteria of Clinical and Laboratory Standards Institute, 2018 [17].

Quality control

The quality of culture media was tested for sterility and performance. Sterility of culture media was checked by incubating overnight at 35-37 °C without specimen inoculation. Standard reference strains of *E. coli* (ATCC 25922), *S. aureus* (ATCC 25923) and *P. aeruginosa* (ATCC 27853) were used for quality control throughout the study for culture and antimicrobial susceptibility test.

Data management and analysis

All the patient's records were anonymized by giving a number to each sample and questionnaire before the analysis and secured at all levels. All data were analyzed taking due care for completeness, consistency, coding and sorting using SPSS (Statistical Package for Social Sciences) computer program (Version 20.0). Then, tables and texts were utilized to explain the descriptive data. In all cases, P-value < 0.05 was taken as statistically significant. Furthermore, to assess any associated risk factors for post-renal transplant UTI, bivariate and multivariate logistic regression risk factor analysis was done to calculate crude/adjusted odds ratio and 95% confidence interval.

Ethical Considerations

Ethical approval was obtained from the Department Ethics Research Committee (DERC), Department of Microbiology, Immunology, and Parasitology, School of Medicine, College of Health Sciences, Addis Ababa University (DERC committee's reference number: DERC/17/18/02-C). Subsequently, ethical approval was also obtained from St. Paul's Hospital Millennium Medical College (SPHMMC) Institutional Review Board (IRB reference number: P.m 23/409). Finally, the study secures at all levels and study participants were informed about the objective and benefit preceding the data collection procedure.

Results

Socio-demographic characteristics of studied participants

A total of 74 study participants (38 with symptoms and signs of UTI and 36 without symptoms and signs of UTI) were included in the study at St. Paul's Hospital Millennium Medical College. A majority, 42/74 (56.8%) of them were males. The mean age was 41.55 years old with a standard deviation of 11.33 (41.55±11.33) and a median of 40.5. Bacteriuric males were much younger than bacteriuric females (19 and 25 years old) respectively.

Majority of the study participants 31 (41.9%) were within the age group of 35-49 followed by 18-34 (29/74, 39.2%). While the marital status indicated that 40.5% were married. Significant bacterial UTI was diagnosed in 11/74 (14.9%, 95% CI=8.2-24.7). Bivariate logistic regression to assess the associated risk factors with post-transplantation UTI has shown no significant association except to age with crude odds ratio =3.67, 95%CI=2.89-20.07, P=0.003 (Table1).

Table 1: Sociodemographic characteristics of study participants with and without UTI, St Paul's Hospital Millennium medical college, Addis Ababa, Ethiopia.

Clinical characteristics of study participants

The average time since transplantation in months was 38.4 ± 4.8 (Table 2).

Table 2: Prevalence of UTI in related clinical variables of renal transplants recipients.

Prevalence of significant bacteriuria among renal transplant recipients

In the present study, significant bacteriuria was detected in 11/74 (14.9%) of the study participants investigated for urinary tract infection. In the meantime, the magnitude of significant bacteriuria has shown no association with the clinical signs and symptoms for post-renal transplantation urinary tract infection (Table 3). *E.coli*, *P.mirabilis* and *Acinetobacter spp.* were exclusively found in asymptomatic patients (Table 4).

Table 3: Significant bacteriuria from urine culture of renal transplant recipients

Table 4: Bacterial species isolated from asymptomatic and symptomatic UTI among renal transplant recipients, St Paul's Hospital Millennium medical college, Addis Ababa, Ethiopia.

Bacterial etiologies

A total of 11 bacteria were isolated (Table 5), out of these, 5 (45.4%) were Gram-negative bacteria and 6 (54.6%) were Gram-positive bacteria (P-value=0.741). The magnitude of early UTI (n=17patients, 3 isolates) varies significantly from late UTI occurring >6 months postoperative period (n=57 patients, 8 isolates).

Table 5: Bacterial etiologic agents isolated from urine culture of renal transplants

Antibiotic susceptibility data

Gram-positive bacteria

Coagulase-Negative *Staphylococci* (CoNS) and *S. aureus* were highly sensitive to clindamycin (100%). Clindamycin was the most effective antibiotic (67%) among the tested groups (Table 6).

Table 6: Antibacterial susceptibility patterns of Gram-positive bacterial isolates.

Gram-negative bacteria

The most effective antibiotics against *E.coli* isolates were gentamycin (100%). The least effective antibiotics against *E.coli* were ciprofloxacin, trimethoprim/sulfamethoxazole. Gentamicin was the most effective antibiotic among the groups (100%) against the Gram-negative bacteria (Table 7).

Table 7: Antibacterial susceptibility patterns of Gram-negative bacteria isolates.

Multidrug resistance patterns of bacteria isolated from renal allografts

In the present study, Multidrug resistance (MDR = resistance in ≥ 3 drugs) was seen in 82 % of the isolates among diagnosed renal transplant recipients (Table 8).

Table 8: Multidrug resistance patterns of bacteria isolated from renal allografts.

Risk factors associated with Post -renal transplantation UTI

Multivariate regression analysis with post-renal transplantation UTI is schemed in (Table 9).

Table 9: Multivariate risk factor analysis among post renal transplantation UTI.

Discussion

Urinary tract infections mainly the bacterial origin are the most common infectious complication that has been remained the major concern of the global health community especially to kidney transplant recipients [18, 19]. Both formidable and none formidable associated risk factors are the leading consequences to either the allograft survival or patient survival besides the socioeconomic burdens. The influence of immunosuppression that leaves the patient immune quell is top priority [20-22].

The present study revealed that the majority (56.8%) of study participants were males. However, a substantially higher number of females were affected by post renal transplantation UTI than males (18.75% versus 11.9% respectively) with no statistical significance association (crude odds ratio=2.09, 95%CI=1.04-8.45 and P=0.253). In harmony to the present study, a research paper by Kotagiri et al., [23] in Australia, Shams et al.,[24] in Iran and Bispo et al.,[25] in Portugal has shown that a large number of females were affected (P=0.002, P < 0.001, P<0.005 respectively). Unlike to the present finding, study from Yemen by Gondos et al., [14], Portugal by Bispo et al.,[25] and Saudi Arabia by Alkatheri,[26] higher female prevalence of UTI (female 40.3%, males 29%, female 68%, male 23% and female 69.2%, male 30.8% respectively) were reported with no statistically significant association. This may be due to women are more susceptible to UTIs, which results from anatomical, hormonal, immunological and behavioural features [27, 28].

In the present investigation, the rate of UTI incidence was higher in the age group of 35-49 years old (19.3%) comparing the younger age groups (P=0.003, COR and 95%CI=3.67, 2.89-20.07 respectively). This is relatively in line with Gondos et al., [14] in Yemen that UTI was higher in the age group between 41–50 years (28%, P=0.010) but, inconsistency with Chuang et al., [11] has shown that patients at 65 years or older developed post-transplant UTI with 55% compared to younger patients (38% of patients at <30 years old). The possible explanation for this disparity may be probably associated with the reason that older patients may be at higher risk due to inefficient voiding because of poor bladder contractility or outflow obstruction. Impaired cellular immunity and immunosuppression tolerance are causes of old patients susceptibility to several infections [29, 30].

In the present study, the overall bacterial UTI was found 14.9% of the patients (95% CI=8.2-24.7). The present prevalence was quite smaller than the recent reports from different parts of the world. Shams et al.,[24] in Iran , Becerra et al.,[29] in the USA, Meneguetti et al., [31] in Brazil, Elkehili et al.,[32] in Libya and Ooms et al.,[33] in Netherland reported as 22.7 %, 28 %, 26.2 %, 29.5% and 28%, respectively. Not surprisingly, the highest incidence of UTI among renal transplant recipients was also reported by Khosravi et al., [7] in Iran, Gondos et al.,[14] in Yemen, Alkatheri,[26] in Saudi Arabia that was 33.56 %, 33.5 % and 55.5% respectively. However, the current result was nearly similar to reported results from Portugal (16.5%) by Bispo et al., [25] but much higher than the report by Kotagiri et al.,[23] in Australia (8%). This significant variation in UTI reported rates might be due to local ascribe of outbreaks, center-specific potent immunosuppressive therapy and lack the robust definition of UTI in many clinical settings [34].

In the present study, the multivariate logistic regression has shown that 35-49 age groups (P = <0.001, adjusted odds ratio = 2.61, 95%CI = 2.06-18.19), the previous history of pre-transplantation UTI (P = 0.02, adjusted odds ratio = 3.48, 95%CI = 2.12-9.38) and the previous history of catheterization (P=0.003, adjusted odds ratio = 3.29, 95% CI = 2.05-11.85) were associated risk factor. Discordant to the present finding, Ooms et al., [33] unveiled that older age groups (>65 years old) were the risk factors for post renal transplantation UTI (P=<0.001, AOR=3.58, 95%CI=2.16-5.91).

This mismatch may be due to study design on one side and the impact of potent immunosuppressive drugs, empirical antimicrobial prophylaxes on the other sides that altogether fosters antimicrobial selective pressure. In line to the present report Bispo et al., [25] and Kumar et al.,[30] have shown the presence of pre-transplant UTI history as a risk factor for post-transplant UTI. Prompt catheter removal or replacement has been associated with a drop in UTI rates [35, 36].

In the contemporary study, the most prevalent bacteria isolates causing post-renal transplant UTI were *Escherichia coli* (18.18%), *Acinetobacter spp.*(18.18%), *P. mirabilis* (9.1%), *S. aureus* (18.18%), *Enterococcus spp.* (18.18%), Coagulase-negative *Staphylococci* (18.18%). This result is incomparable with recently published research paper by Gozdowska et al., [1]; *E.coli* (42%) and *Enterococcus spp.* (10%). Similarly, the current finding dissimilar to a retrospective study done by Kotagiri et al.,[23] that found *E.coli* (32%) and

Enterococcus spp.(35%) which were responsible for post-renal transplantation UTI. In addition, another study unveils that *E. coli* (46%), *P. mirabilis* (26%), *S. aureus* (25.8%) and Coagulase-negative *Staphylococci* (6.8%) were etiologies of post-renal transplantation UTI which were relatively higher than the present result except to Coagulase-negative *Staphylococci* [37,38].

The present finding was discordant with Elkehili et al.,[32] that ciprofloxacin (51.6%), followed by amoxicillin-clavulanic acid (22.6) were choices of the drug for treating the Gram-negative. Similar to the present results, Ooms et al.,[33] noticed that 24% of tested Enterobacteriaceae were resistant to ciprofloxacin and 86% to trimethoprim/sulfamethoxazole were not effective. This could be justified by bacterial antibiotic prophylaxis selection should have adhered to conventional urinary culture so that prophylaxis should be tailored based on appropriate antibiogram batteries. Gondos et al.,[14] in Yemen have shown that ciprofloxacin was the most effective antibiotic against Gram-positive cocci. These disparities with present findings may be due to the lack of access or local market availability of antibiotics like nalidixic acid and ampicillin were not tested in our center in the present study. Any discrepancy toward susceptibility results and different isolates varied depending on the study area, design, selection of antimicrobial agents and antibiotic stewardship program [14, 39-41].

The grave impact of post-renal transplantation urinary tract infection caused by multidrug-resistant bacterial isolates is becoming a great concern in kidney recipients. However, this growing threat to transplant population is in its infancy to the researcher community [42].

In the present study, multidrug-resistant strains were seen in 82% of the isolated bacteria. This is similar to the current study done by Yuan et al., [39] in China, which claimed that 86.4% of the tested organisms were multidrug-resistant. Gozdowska et al.,[1] and Bodro et al., [41] were reported much lower than our finding(37%). Kotagiri et al., [23] from Australia and Adamska et al., [43] from Poland reported relatively much smaller (37% and 47% respectively) than the present finding. The disparity in the present study might be due to potent immunosuppression protocols and selective antibiotic pressure that cumulatively enhance the emergence of antibiotic-resistant strains. This is a threat to kidney transplants because it increases health care costs, prolongs hospital stays, can result in treatment failure, increased morbidity and mortality [44-50].

Conclusion

In conclusion, the overall prevalence of UTI in our population was relatively low with a prevalence of 14.9%. Majority of the UTIs were asymptomatic. A higher percentage of females were involved. Intensive longitudinal research activities to identify the risk factors as well as to elucidate the existing controversies of post-renal-transplantation UTI over allograft outcome are highly demanding.

In countries like Ethiopia where the resources are limited especially of advanced diagnostic facilities to screen and monitor renal transplants, it is better to establish routine urine cultures especially in the first 6-12 months after kidney transplantation for recipients on follow up. The current study is indicating of the evolution of multidrug-resistant isolates among kidney transplants. To endorse judicious treatment, careful and systemic selection of antimicrobial agents together with rigorous infection preventions and control strategies should be employed to mitigate both hospital and community-acquired Urinary tract infections.

List Of Abbreviations

Not applicable

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Department Ethics Research Committee(DERC), Department of Microbiology, Immunology, and Parasitology, School of Medicine, College of Health Sciences, Addis Ababa University (DERC committee's reference number: DERC/17/18/02-C). Subsequently, ethical approval was also obtained from St. Paul's Hospital Millennium Medical College (SPHMMC) Institutional Review Board (IRB reference number: P.m 23/409).

Consent for Publication

Not applicable

Availability of data and materials

Data supporting the results reported in the article can be found from different datasets. The minimal dataset that would be necessary to interpret, replicate and build upon the findings reported in the article are obtained from google, PubMed and other popular search engines. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors' contribution

TK was the primary researcher, conceived the study, designed, participated in data collection, conducted data analysis, drafted and finalized the manuscript for publication. ZA, ET assisted in data collection and reviewed the initial and final drafts of the manuscript. DA interpreted the results, and reviewed the initial and final drafts of the manuscript and approved for publication. All authors read and approved the final manuscript.

Acknowledgments

Authors want to thank the staff in St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia for their kind support and advice in this study. In addition, the authors are grateful to the study participants for their voluntary participation.

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Tables

: Sociodemographic characteristics of study participants with and without UTI, St Paul’s Hospital Millennium medical , Addis Ababa, Ethiopia.

Variables	Total (%)	UTI no (%)	No UTI no (%)	Bivariate analysis		P-value
				COR	95%CI	
Gender						
Male	42(56.8)	5(11.9)	37(88.1)	0.848	0.57-11.31	0.419
Female	32(43.2)	6(18.75)	26(81)	2.09	1.04-8.45	0.253
Age						
18-34	29(39.2)	4(13.8)	25(86.2)	1.42	0.64-14.05	0.338
35-49	31(41.9)	6(19.3)	25(80.6)	3.67	2.89-20.07	0.003
50-64	10(13.5)	1(10)	9(90)	3	2.91-10.00	0.914
Over 64	4(5.4)	0(0.0)	4(100)	0.88	0.58-3.27	0.444
Marital status						
Single	23(31)	6(26.1)	17(74)	5.64	0.73-13.22	0.222
Married	30(40.5)	4(13.3)	26(86.7)	1.724	1.081-6.82	0.391
Divorced	12(16.2)	1(8.3)	11(91.7)	7	4.36-9.15	0.284
Widowed	5(6.8)	0(0.0)	5(100)	0.23	0.11-3.74	0.058
Lower	4(5.4)	0(0.0)	4(100)	8.04	2.05-10.09	0.701
Educational level						
Illiterate	11(14.9)	2(18.2)	10(91)	1	0.37-4.12	0.348
Primary	31(41)	5(16)	26(83.9)	2.872	0.81-5.06	0.579
Secondary	13(17.6)	2(15)	11(84.6)	4	2.01-6.19	0.441
Intermediate	15(20)	2(13)	13(86.7)	2.11	1.90-17.48	0.990
Post degree	4(5.4)	0(0.0)	4(100)	0.81	0.36-1.34	0.007

: Prevalence of UTI in related clinical variables of renal transplants recipients.

Variables	Total (%)	UTI no (%)	No UTI no (%)	Bivariate analysis		p-value
				COR	95%CI	
Time transplantation						
0-6 months	17(22.9)	3(17.6)	14(82.3)	2.29	0.42-2.96	0.391
7-12 months	19(25.7)	4(21)	15(79)	2.57	1.09-11.03	0.555
13-24 months	19(25.7)	2(10.5)	17(89.5)	0.71	0.54-6.38	0.081
>24 months	19(25.7)	2(10.5)	17(89.5)	1.23	0.98-7/11	0.661
Transplant UTI history						
Yes	5(6.8)	2(40)	3(60)	4.32	2.09-17.10	0.010
No	69(93.2)	9(13)	60(87)	0.51	0.26-2.11	0.997
Site of the transplantation						
Local	54(73)	9(16.7)	45(83.3)	4.01	0.18-19.06	0.481
Abroad	20(27)	2(10)	18(90)	0.89	0.69-8.81	0.671
Donor's gender						
Male	40(54.1)	5(12.5)	35(87.5)	3.1	2.19-3.70	0.561
Female	34(45.9)	4(11.8)	30(88.2)	2.07	1.04-7.31	0.549
History of Catheterization						
Yes	5(6.8)	1(20)	4(80)	1.90	1.11-11.38	0.001
No	69(93.2)	10(14.5)	59(85.5)	0.53	0.21-0.98	0.941
Donor category						
Female to male	17(23)	2(11.8)	15(88.2)	0.23	0.10-1.93	0.234
Female to female	22(29.7)	5(22.7)	17(72.3)	1.09	1.07-13.03	0.306
Male to male	17(23)	2(11.8)	15(88.2)	0.91	0.54-2.41	0.773
Male to female	18(24.3)	2(11.1)	16(88.9)	1	0.62-6.78	0.009

Table 3: Significant bacteriuria from urine culture of renal transplant recipients

Significant bacteriuria	Frequency(n)		Percent (%)		
Yes	11		14.9		
No	63		85.1		
Total	74		100		
Renal transplant recipients	Significant bacteriuria			COR(95%CI)	P-value
	Yes	No	Total		
Asymptomatic no (%)	8(22.2)	28(77.8)	36(48.7)	1.01(0.547-3.829)	0.847
Symptomatic no (%)	3(7.9)	35(92.1)	38(51.3)		
Total no (%)	11(14.9)	63(85.1)	74(100)		

Table 4: Bacterial species isolated from asymptomatic and symptomatic UTI among renal transplant recipients, St Paul's Millennium medical college, Addis Ababa, Ethiopia.

Bacterial isolates	Asymptomatic RTX no (%)	Symptomatic RTX no (%)	Total (%)
Gram-negative	5(62.5)	0(0.0)	5(45.4)
<i>E.coli</i>	2(25)	0(0.0)	2(18.18)
<i>metobacter spp.</i>	2(25)	0(0.0)	2(18.18)
<i>P.mirabilis</i>	1(12.5)	0(0.0)	1(9.1)
Gram-positive	3(37.5)	3(99.9)	6(54.6)
<i>terococcus spp.</i>	1(12.5)	1(33.3)	2(18.18)
CoNS	1(12.5)	1(33.3)	2(18.18)
<i>S.aureus</i>	1(12.5)	1(33.3)	2(18.18)
Total	8(72.7)	3(27.3)	11(100)

CoNS=Coagulase Negative *Staphylococci*

5: Bacterial etiologic agents isolated from urine culture of renal transplants

Bacterial isolates	Frequency(n)	Percent (%)
Gram-Negative	5	45.4
<i>E.coli</i>	2	18.2
<i>Acinetobacter spp.</i>	2	18.2
<i>P.mirabilis</i>	1	9.1
Gram-positive	6	54.6
<i>Enterococcus spp.</i>	2	18.2
CoNS	2	18.2
<i>S.aureus</i>	2	18.2
Total	11	100

Antibacterial susceptibility patterns of Gram-positive bacterial isolates.

Culture out put			Antibacterial agents tested										
			VA	CTR	CHL	NIT	AMC	PEN	TET	SXT	ERY	CLN	CN
Bacterial isolates	Total	Pattern	no(%)	no(%)	no(%)	no(%)	no (%)	no(%)	no(%)	no(%)	no (%)	no (%)	no (%)
<i>S. aureus</i> (n=2)	2	R	0(0)	2(100)	2(100)	2(100)	1(50)	2(100)	1(50)	1(50)	0(0)	0(0)	0(0)
		I	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
		S	0(0)	0(0)	0(0)	0(0)	1(50)	0(0)	1(50)	1(50)	2(100)	2(100)	2(100)
CoNS (n=2)	2	R	1(50)	1(50)	2(100)	2(100)	2(100)	0(0)	2(100)	0(0)	0(0)	0(0)	2(100)
		I	0(0)	1(50)	0(0)	0(0)	0(0)	1(50)	0(0)	1(50)	2(100)	0(0)	0(0)
		S	1(50)	0(0)	0(0)	0(0)	0(0)	1(50)	0(0)	1(50)	0(0)	2(100)	0(0)
<i>terococcus</i> <i>pp.</i> (n=2)	2	R	0(0)	2(100)	0(0)	0(0)	2(100)	1(50)	1(50)	2(100)	2(100)	2(100)	2(100)
		I	2(100)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
		S	0(0)	0(0)	1(50)	2(100)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)
Total (n=6)	6	R	1(17)	5(83)	4(67)	4(67)	5(83)	3(50)	4(67)	3(50)	2(33)	2(33)	4(67)
		I	4(67)	1(17)	1(17)	0(0)	0(0)	1(17)	0(0)	1(17)	2(33)	0(0)	0(0)
		S	1(17)	0(0)	1(17)	2(33)	1(17)	2(33)	2(33)	2(33)	2(33)	4(67)	2(33)

Abbreviations: R = Resistant S = Sensitive I = Intermediate, **AMC**= Amoxicillin Clavulanate acid, **CTR**=Ceftriaxone, **CHL**=Chloramphenicol, **CLN**=Clindamycin, **ERY**=Erythromycin, **CN**=Gentamicin, **NIT**= Nitrofurantoin, **TET**=Tetracycline, **VA**= Vancomycin, **PEN** =Penicillin

7: Antibacterial susceptibility patterns of Gram-negative bacteria isolates.

Culture output			Antibacterial agents tested											
			CIP	TET	CN	AMC	CHL	NIT	SXT	CPM	CTR	MEM	DC	
l	Total	Pattern	no (%)	no (%)	no(%)									
1=2)	2	R	2(100)	1(50)	0(0)	1(50)	2(100)	2(100)	2(100)	2(100)	2(100)	2(100)	0(0)	1(50)
		I	0(0)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2(100)	0(0)
		S	0(0)	1(50)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(50)
bacter =2	2	R	2(100)	0(0)	0(0)	2(100)	2(100)	2(100)	2(100)	2(100)	1(50)	2(100)	1(50)	0(0)
		I	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(50)	0(0)
		S	0(0)	2(100)	2(100)	0(0)	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	2(100)
bilis)	1	R	0(0)	1(100)	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)
		I	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)
		S	1(100)	0(0)	1(100)	1(100)	0(0)	0(0)	0(0)	0(0)	1(100)	1(100)	1(100)	0(0)
1=5)	5	R	4(80)	2(40)	0(0)	3(60)	4(80)	5(100)	4(80)	3(60)	4(80)	4(80)	1(20)	2(40)
		I	0(0)	0(0)	0(0)	1(20)	0(0)	0(0)	1(20)	0(0)	0(0)	0(0)	3(60)	0(0)
		S	1(20)	3(60)	5(100)	1(20)	0(0)	0(0)	0(0)	0(0)	2(40)	1(20)	1(20)	3(60)

Abbreviations: R = Resistant, S = Sensitive, I = Intermediate, AMC= Amoxicillin-Clavulanate acid, Cefepime, CTR=Ceftriaxone, CHL=Chloramphenicol, CIP= Ciprofloxacin, CN=Gentamicin, MER=Meropenem, Nitrofurantoin, TET=Tetracycline, SXT=Trimethoprim-Sulfamethoxazole, DC=Doxycycline.

8: Multidrug resistance patterns of bacteria isolated from renal allografts.

Bacterial isolates	Total (%)	Antibacterial patterns					
		R ₀	R ₁	R ₂	R ₃	R ₄	≥R ₅
Gram-negative	5(45.4)	0(0.0)	0(0.0)	0(0.0)	2(40)	1(20)	2(40)
<i>E.coli</i>	2(40)	0(0.0)	0(0.0)	0(0.0)	1(50)	0(0.0)	1(50)
<i>Pseudomonas spp.</i>	2(40)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(50)	1(50)
<i>Acinetobacter spp.</i>	1(20)	0(0.0)	0(0.0)	0(0.0)	1(100)	0(0.0)	0(0.0)
Gram-positive	6(54.6)	0(0.0)	1(16.7)	1(16.7)	0(0.0)	3(50)	1(16.7)
<i>S.aureus</i>	2(33.33)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(100)	0(0.0)
CoNS	2(33.33)	0(0.0)	1(50)	0(0.0)	0(0.0)	1(50)	0(0.0)
<i>Staphylococcus spp.</i>	2(33.33)	0(0.0)	0(0.0)	1(50)	0(0.0)	0(0.0)	1(50)
Total	11(100)	0(0.0)	1(9.1)	1(9.1)	2(18.2)	4(36.4)	3(27.3)

No antibiotic resistance, R₁= Resistance to one, R₂=Resistance to two, R₃=Resistance to three, R₄=Resistance to four, R₅=Resistance to five and more drugs.

9: Multivariate risk factor analysis among post renal transplantation UTI.

Risk factor	Significant bacteriuria		AOR	95% CI	P-value
	Yes no (%)	No no (%)			
Age(years)					
18-34(n=29)	4(13.8)	25(86.2)	1	1	
35-49(n=31)	6(19.3)	25(80.6)	2.61	2.06-18.91	<0.001
50-64(n=10)	1(10)	9(90)	1.531	0.341-3.271	0.245
>64(n=4)	0(0.0)	4(100)	N/A	N/A	
e-transplant UTI history					
Yes(n=5)	2((40)	3(60)	3.48	2.12-9.39	0.02
No(n=69)	9(13)	60(87)	N/A	N/A	
History of previous catheterization					
Yes(n=5)	1(20)	4(80)	3.29	2.05-11.85	0.003
No(n=69)	10(14.5)	59(85.5)	1.84	0.27-15.38	0.195

AOR=Adjusted Odds Ratio, 95% CI =95% Confidence Interval & N/A= Not Applicable.