Antimicrobial Susceptibility Patterns of Isolates from Catheterized Patients at Kenyatta National Hospital Critical Care Unit

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Summary

BACKGROUND

Intensive care unit acquired urinary tract infection is a complication which is common in critical illness and has been associated with increased patient morbidity and mortality. Urinary tract infections are said to complicate the critically ill patients' clinical course and at the same time create substantial economic and human cost. Identification of the type of microorganisms causing the infections and their drug sensitivity profiles is essential in the management of these infections. The aim of this study was to identify microorganisms causing catheter associated urinary tract infection in the Kenyatta National Hospital critical care unit and their drug sensitivity.

METHODOLOGY

The study was conducted at Kenyatta National Hospital main critical care unit. The study population was two hundred and thirty eight patients admitted in the critical care unit between January 2019 and January 2020 and on urinary catheters. A prospective cohort design was adopted. Urine culture and sensitivity was done to identify infective microorganisms and their drug sensitivity profiles. Patients were recruited consecutively for the period of the study.

RESULTS

The microorganisms identified were *Enterococcus species* (32%), *Escherichia coli (20%), Klebsiella species (10.4%), Acinobacter baumaunnii (8%), Pseudomonas aeruginosa (6%), Candida albicans (6%), Serratia species (11.7%), Pantoea agglomerans (3.5%),* and *Raoultella planticola (2.4%). Enterococcus* species were 100% sensitive to Vancomycin, Linezolid and Teicoplanin and 73% to Nitrofurantoin and Ampicillin. *Staphylococcus haemolyticus* was also 100% sensitive

to Vancomycin, Linezolid and Teicoplanin. *Serratia* species was sensitive to Cefazolin, Nitrofurantoin, Amoxicillin/ Clavulanic Acid, Piperacillin/ Tazobactam, and Ampicillin/ Sulbactam. *Pantoea agglomerans* was 66.7% sensitive to Amikacin. *Klebsiella* species were sensitive to Amikacin and Meropenem. *Escherichia coli* was sensitive to Amikacin, Meropenem and Nitrofurantoin. *Acinetobacter baumaunnii* and *Raoultella planticola* were resistant. *Candida albicans* were highly sensitive to Fluconazole and Voriconazole.

CONCLUSION

The most common microorganisms (60.9%) causing catheter associated urinary tract infections in ICU are gram-negative: *(Escherichia coli 20%, Klebsiella* species *10.4%, Acinobacter baumaunnii 8%, Pseudomonas aeruginosa 6%, Serratia* species 8% and others 6.5%). Gram positive organisms were isolated at a proportion of 33.2%: (*Enterococcus* species*, 32% & Staphylococcus haemolyticus 1.2%). Candida albicans 6%.* Majority of the gram-negative microorganisms were sensitive to Amikacin, and Meropenem. Gram positive micro-organisms were sensitive to Vancomycin, Linezolid, and Teicoplanin. Fluconazole and Voriconazole therapy were the most appropriate choice for the treatment of Catheter-Associated Urinary Tract Infections (CAUTIs) caused by *C. albicans*.

Keywords: *Catheter-Associated Urinary Tract Infections, Critical Care Unit, Urinary Tract Infection, Microorganisms, Urinary Catheter, Anti –Microbial Drugs*

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Introduction

Approximately 150 million people worldwide are affected by urinary tract infections (UTI) [1]. Among hospitalized patients 15 – 25% with indwelling urinary catheters end up developing Catheter-Associated Urinary Tract Infections (CAUTIs) with increased days of catheterization. Among 40% of hospital associated UTI, CAUTIs contribute 80% of the infections [2]. Urinary catheters are associated with about 20% of cases of health-care acquired bacteremia in intensive care facilities and over 50% in long term care facilities [3]. The case fatality of nosocomial blood stream infections resulting from urinary system is 32.8%. Catheter –associated bacteriuria is associated with increased mortality, even after controlling for other factors associated with the urinary tract infections (e.g. comorbidities and severity of illness)[4,5]. Most of the microbes causing CAUTIs ascend to the bladder from the perineum. In 66% of the time the organisms migrate in the biofilm on the catheter's external surface. These organisms are the ones that colonize the patient's intestinal tract and the perineum (endogenous source) [6]. A total of 34% of the infections are from intraluminal contamination of the urine collection system (exogenous sources). This exogenous sources result from cross-transmission of microorganisms from healthcare workers' hands [6, 7].

Approximately 15% of episodes of bacteria associated nosocomial infections occurs in clusters due to intra-hospital transmission from one patient to another [7, 8]. The hospital-based outbreaks are mostly associated with

failure of the health personnel to observe proper hand hygiene protocols.

The most common pathogens associated with CAUTIs is the *Enterobacteriaceae* group. The most prevalent organism in intensive care unit setting are *Candida sp.* (18%), *Enterococcus sp.* (10%), and *pseudomonas aeruginosa* (9%) [8, 9]. According to Weiner *et al.*, the microorganisms associated with the incidence of CAUTIs are *Escherichia coli* in 24%, *Candida* in 24%, *Enterococcus* in 14% *Pseudomonas* in 10%, *Klebsiella* in 10% and other organisms 18% [10]. A study conducted at Salmaniya Medical Center, Bahrain by Elkhawana and co-authors identified the most frequently isolated microorganisms as *E. coli* (28.8%), *Klebsiella spp.* (26.9%), *Candida* (25%,) *Pseudomonas spp*. (11.6%), *Proteus mirabilis (ESBL) spp*. (7.7%) [11]. Another study done in ICUs in a University Hospital in Turkey by Keten *et al,* isolated *Candida spp*. (34.7%), *E. coli* (20.6%) *Klebsiella spp*. (9.9%) *Pseudomonas spp.* (14%) and *Acinetobacter spp*. (8.2%) [12].

Case fatality is three times higher (2-4%) in patients with CAUTIs presenting with bacteraemia, than non-bacteremic patients [13]. According to Murugan, Selvanayaki, and Al-Sohaibani, contamination of urinary catheters and other indwelling medical devices play an important role in hospital acquired infections. In this study, Murugan *et al* isolated *Pseudomonas aeruginosa*, *staphylococcus aureus*, and *Enterobacter faecalis.* The proportions of micro-organism isolated from 50 culture positive urinary catheters were *S. aureus* (24%), *P. aeruginosa* (18%), *E. faecalis* (14%) and others (44%) [15].

According to Elkhawana *et al.,* Meropenem used alone or combined with aminoglycoside seemed to be the most commonly chosen empirically for the treatment of CAUTIs among critically ill patients in the ICU [11]. In this study, *E. coli* isolates did not show any resistance to Carbapenems, while 31% of *Klebsiella* strains were resistant to the Carbapenems. *Escherichia coli* and *Klebsiella* were 100% sensitive to Tigecycline but resistant to Cotrimoxazole. Of the *E. coli* isolates, 28.4% were resistant to Piperacillin/tazobactum while *Klebsiella* isolates were resistant at 66.2%. Of the *Klebsiella* isolates 75%, were resistant to Norfloxacin while *E.coli* isolates were sensitive to it. *Pseudomonas aeruginosa* was found to be sensitive to Ceftazidime, Piperacillin-tazobactam, and Carbapenems.

All *Proteus* isolates were, sensitive only to Meropenem and Gentamicin, but resistant to all other tested antibiotics [11]. The study by Keten *et al,* found out that *Candida spp*. were sensitive to Amphotericin *B.* Caspofungin, Fluconazole and Voriconazole. *E. coli and Klebsiella spp.* were sensitive to third and fourth generation Cephalosporins. *Pseudomonas spp.* were sensitive to Carbapenem at 47.1% while *Acinobacter* was sensitive at 30% [12].

The Centers for Disease Cotrol and Prevention (CDC) NHSN report in 2006 to 2007 reported that 24.8% of all *Escherichia coli* isolates from CAUTIs patients were resistant to fluoroquinolones [14]. 21.2% of *Klebsiella pneumoniae* and 5.5% of *E. coli* isolates from patients with CAUTIs were resistant to Ceftriaxone or Ceftazidime. Of all *Klebsiella pneumoniae* isolates from CAUTIs 10.1% of patients were resistant to Carbapenems [14]. The culture and sensitivity results help the doctor to determine the drugs that are likely to be most effective in treating an infection.

Materials and Methods

Study Site

This study was conducted at the Kenyatta National Hospital (KNH) main critical care unit. Kenyatta National Hospital is the largest teaching and national referral hospital in East and Central Africa. The hospital was established in the year 1901 and became a corporate in 1987. It has a bed capacity of 1800 patients. The hospital is situated in Dagoretti constituency, Nairobi County, about 3 km from

the city center, off Ngong' Road on Hospital road and borders Mbagathi way to the south.

The Critical Care Unit (CCU) is situated at the first floor of the old hospital neighboring the renal unit, burns unit, cardiology unit, and the main theatres. The CCU is the largest in the country with a 21-bed capacity. The Unit is multidisciplinary and admits patients of all ages. The average monthly admission is 50 to 60 patients.

Study Design

This study adopted a prospective cohort design.

Study Population

All patients admitted to the CCU who met the inclusion criteria were recruited in the study.

Sampling

The patients were recruited consecutively for the period of the study (one year).

Sample size was determined using Fleiss (1981) formulae.

$$N = \frac{r+1}{r} \times \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{p_1 - p_2} \right)^2 \times \bar{p} \times (1 - \bar{p})$$

$$= \frac{1+1}{1} \times \left(\frac{1.96 + 0.84}{0.75 - 0.25} \right)^2 \times 0.5 \times (1 - 0.5)$$

$$= 28.88$$

$$approxmate \quad ly = 29 \; patients$$

$$total = 58 \; patients$$

The sample size was taken as the minimum sample size. Census was adopted whereby 238 participants were recruited consecutively over a period of one year.

Inclusion Criteria

For a patient to be included in the study they had to be free from UTI on admission to the CCU, have an indwelling urinary catheter fixed, a Glasgow Coma Scale of 15 to enable them give consent or have a next of kin consent on their behalf, if the Glasgow Coma Scale (GCS) was below 15.

Exclusion Criteria

Patients who were admitted being unknown persons were not recruited. Patients who were discharged before the third day (before the second urine sample was collected) were removed from the study. A patient who's GCS was below 15 and had no next of kin to give consent was excluded from the study.

Data Collection Procedure

After consent was obtained, a patient was assessed via history taking and physical examination. Data was collected using data collection forms, lab records and an observational checklist for recording information on each of the subjects. Urine samples were collected following the prescribed procedure to avoid contamination and to ensure whatever organism cultured were not a contaminant.

Data was entered in a form. The first urine specimen was collected within the first twelve (12) hours, second urine specimen at 72 hours, third specimen at 7 days and the fourth specimen at 14 days of a patient's admission.

Urine Collection Procedure

The equipment (sterile gloves, alcohol swabs, twenty milliliter syringe, urinalysis indicator strip, blunt cannula (G21), catheter clamp, a sterilized specimen jar, patient label, lab request form, plastic biohazard bag and a sterilized trolley) were prepared before the procedure. Informed consent was obtained from the patient, if conscious or from the next of kin after explaining the procedure and rationale of the study.

The investigator checked to make sure that the indwelling catheter possessed a rubber port for specimen collection. The equipment was organized and patient screened for privacy. The investigator washed his hands (Moment 1), clamped the catheter below the rubber and allowed at least twenty (20) minutes for urine to collect. Then he washed his hands again

(Moment 2) and put on a gown and sterile gloves. He put together a syringe and a sterile needle, then cleaned the catheter tubing with alcohol swab and allowed thirty seconds for it to dry.

The investigator then inserted the needle carefully into the port and withdrew twenty (20) milliliters of urine, he transferred most of the urine into sterile specimen jar (taking care not to contaminate the jar), transferred the remaining urine onto the urinalysis indicator strip and put the sharps in the sharps container for disposal. He then removed the clamp to release the catheter and appropriately disposed of other equipment. He ungloved and washed hands (Moment 3), attached patient address label to specimen jar and indicated time and date of collection and specimen contained.

The specimen was placed in biohazard bag (sealed plastic bag) and the request form sent to the laboratory without delay. Testing was done within two hours of collection. Chemical preservatives (boric acid used for culture and sensitivity) were used in the instance that the specimen was not to be processed within 2 hours of collection. This category of specimens was refrigerated at 2-8°C.

Urine Culture

The cultures were identified by standard microbiology techniques. Urine specimens were processed as per KNH microbiology procedure for urine culture and antimicrobial susceptibility testing.

Inoculation and Isolation Techniques

CLED/MacConkey agar plate was labeled with laboratory identification number. A sterile calibrated loop of 1µl was dipped vertically into a well-mixed specimen. One loop-full was streaked down the center of a CLED/ MacConkey agar plate. Without flaming, cross-streaks at a 90 degree angle were made perpendicular to the original streak. Inoculated plates were incubated inverted at 35°C for 18 hours.

Bacterial Identification and Interpretation of Cultures

The plates were read for growth and determined the colony count. If confluent/ heavy growth of pure culture was obtained (a report of $> 10^5$ per ml) it was considered significant. More than two colonies were considered as contaminants and repeat sample was requested. In children below five (5) years, all colony counts were reported regardless of pyuria. In antenatal women, all colony counts were reported.

Identification and Antimicrobial Susceptibility

Isolates of potential pathogens present in significant numbers were identified according to KNH microbiology identification using VITEK equipment.

Principle of Equipment

The VITEK 2 Compact is an automated system for microbial identification. It provides highly accurate and consistent results utilizing growth-based technology. The system fits in colorimetric reagent cards (GN, GP, and YST) that are incubated and interpreted automatically. It also provides an option of automatic pipetting and dilution for antimicrobial susceptibility testing (AST cards).

Gram Staining Procedure

Gram stain was performed using an isolated colony from a pure culture. Gram stain- is used to differentiate two large groups of bacteria based on their different cell wall constituent to determine the Gram reaction of organisms and assist in selection of the panel of reagent kit to be used in identification and antimicrobial susceptibility testing.

Briefly, the smear of the material or culture label was made and allowed to dry in room temperature, the dried smear was fixed by passing the slide through a flame once or twice or 95% Methanol (until the alcohol evaporates). The stain was then washed with clean water,

water tipped off and smear covered with grams iodine for 1 minute. The iodine was washed off with clean water. Acetone was used to decolorize rapidly (few seconds) then washed immediately with clean water. The smear was covered with neutral red for 1 minute. The stain was then washed off with clean water and air dried.

Data Processing and Analysis

After data collection, data cleaning and coding was done and then prepared for analysis. Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 23.0. The prevalence and antimicrobial susceptibility of the microorganisms were presented in proportions (percentages). Confidence interval of 95% was considered statistically significance.

Ethical Considerations

Ethical approval was granted by UoN/KNH Ethical Review committee. In addition, permission to conduct the study was also sought from the management of Kenyatta National Hospital specialized Unit department and the research department. Patient's consent was obtained before recruitment to the study and where not possible due to patient's level unconsciousness, relatives gave consent. For patients aged below 18 years parents/guardian were requested to give consent. Confidentiality of responses was emphasized. The respondents were informed about the risks they could be exposed to and the expected benefits of the study.

Results

A total of 238 patients were recruited into the study. Thirty four patients (34) had UTI as indicated by the first sample. A total of 174 patients had two or more samples collected and analyzed. Males were 162, constituting 68% of the study subjects. Majority (157; 66%) were on Foley's catheter. Those on silicon catheters were 26 (10.9%), while those on silicon coated catheters were 55 (23.1%). Of the 238 patients, 180 (75.6%) were aged below 50 years while those aged above 50 years were 58 (24.4%).

Conditions associated with the central nervous system contributed a total of 144 (60.5%) patients. Other systemic conditions were; musculoskeletal conditions 26 (10.9%), gastrointestinal illnesses 22 (9.2%), cardiovascular conditions; 11 (4.6%), multisystem; 10 (4.2%), gynecological conditions; 10 (4.2%), respiratory conditions; 7 (2.9%), endocrine; 4 (1.7%), ear nose and throat 2 (0.8%), and genital-urinary tract 2 (0.8%). Approximately 25% (60) had comorbid conditions. Table 1 displayed at the end of this article presents the demographic data.

Identified Microorganisms

The most common microorganisms (60.9%) causing catheter associated urinary tract infections in ICU are gram-negative. *Escherichia coli* was identified in 17 samples (20%; (95% CI 12.1% -30%), *Klebsiella* species were also common as they were isolated in nine urine samples. *Klebsiella pneumoniae* was cultured in seven urine samples (8%; 95%CI 3.4%-16.2%) and *Klebsiella oxytoca* isolated from two samples (2.4%; 95%CI 0.3%-8.2%).

Acinobacter baumaunnii was isolated in seven samples (8%; 95%CI 3.4%-16.2%), *Pseudomonas aeruginosa* was identified in five samples (6%; 95%CI 2% -13%), *Serratia* species also contributed to CAUTIs in the ICU, infecting 7 patients with *Serratia fonticola* and *Serratia marcescens* cultured three times each (each at 3.5%; 95% CI 1% -3%). *Serratia liquefaciens* was cultured once (1.2%; 95%CI 0.3% -6%).

Other gram negative organisms cultured were *Pantoea agglomerans* (3.5%; 95% CI 1% -3%), *Raoultella planticola (2.4%; 95% CI 0.2%-8%), Citrobacter freundii* (1.2%; 95% CI0.3% -6%) and *Morganella morganii* (1.2%; 0.3% -6%).

Gram positive organisms were isolated at a proportion of 33.2%. Among the Gram-

positive organisms isolated, *Enterococcus species* were the most common microorganisms cultured from the urine samples collected from the ICU patients having indwelling catheters. In 27 cultures *Enterococcus faecalis* was the most prevalent as it infected 22 patients (26%, 95% CI 17%-36.5%) and *Enterococcus gallinarum* five patients (6%; 95%CI 2%-13%). *Staphylococcus haemolyticus* was cultured once *(1.2%; 95%CI 0.3% -6%).*

Candida albicans was isolated in five cases (6%; 95%CI 2% -13%).

Sensitivity:

Gram-Positive Organisms

Enterococcus species*: Enterococcus faecalis* were 100% sensitive to Vancomycin, Linezolid, and Teicoplanin. They were also sensitive to Nitrofurantoin and Ampicillin at 73%. These microorganisms were 100% resistant to gentamycin, Vancomycin 100%, streptomycin, levofloxacin and Benzyl penicillin. They were 73% resistant to Tigecycline. *Enterococcus gallinarum* were 100% sensitive to Vancomycin, Linezolid, Teicoplanin. They were also 80% sensitive to Nitrofurantoin, and Ampicillin.

The organisms were resistant to Tigecycline, 80%, gentamycin 100%, vancomycin 100%, streptomycin 100%, levofloxacin 100% and Benzyl penicillin 100%. *Staphylococcus haemolyticus* were also 100% sensitive to Vancomycin, Linezolid, Tingecycline, Teicoplanin and Tetracycline.

Gram Negative Microorganisms

Escherichia coli was sensitive to Amikacin (76.5%), Meropenem (70.6%) and Nitrofurantoin (53%). They were resistant to gentamycin (76.5%), Amoxicillin/Clavulanic acid (82.4%), Piperacillin/Tazobactam (82.4%), Ciprofloxacin (82.4%), and Ampicillin/ Sulbactam (94.1%). The organisms were 100% resistant to Ceftriaxone, Cefepime, Cefuroxime, Cefazolin and Ceftazidime. *Serratia* species*: Serratia fonticola* were sensitive to Nitrofurantoin at 66.7%, Amoxicillin/Clavulanic acid (33.3%), Cefotaxime (33.3%), Ceftazidime (33.3%), Ceftriaxone (33.3%), Trimethoprim/Sulfamethoxazole (33.3%), Amikacin (33.3%), and Meropenem (33.3%). *Serratia liquefaciens* were sensitive to Nitrofurantoin (100%), Amoxicillin/Clavulanic Acid (100%), Ampicillin/Sulbactam (100%), Peperacillin/Tazobactam (100%), and Cefazolin (100%). *Serratia larcescens* were sensitive to Amikacin (33.3%). Pantoea agglomerans was 66.7% sensitive to Amikacin (66.7%), Tigecycline (33.3%) and levofloxacin (33.3%). *Klebsiella* species were sensitive to Amikacin and Meropenem.

Klebsiella oxytoca: was sensitive to Amikacin (100%), Meropenem (50%), and Nitrofurantoin (50%). *Klebsiella pneumoniae:* Amikacin (71.4%), Meropenem (42.9%), Gentamycin (28.6%), Cefoxitin (28.6%), Nitrofurantoin (28.6%), and Ciprofloxacin (28.6%).

Acinetobacter baumaunnii was 100% resistant to Amikacin Meropenem, Amoxicillin/Clavulanic acid, Piperacillin/Tazobactam, Ampicillin/ Sulbactam and ampicillin. They were only sensitive to Ciprofloxacin (42.9%), and Gentamycin (42.9%). *Raoultella planticola* were 100% resistant to Amikacin Meropenem, Amoxicillin/Clavulanic acid, Piperacillin/Tazobactam, Ampicillin/ Sulbactam and ampicillin. They were sensitive to Cefuroxime (50%). *Pseudomonas aeruginosa* was sensitive to Amikacin, Meropenem and Nitrofurantoin at 60%. *Citrobacter freundii* was sensitive to Trimethoprim/Sulfamethoxazole only.

Candida albicans were sensitive to Fluconazole and Voriconazole (60%). They were also sensitive to Amphotericin B (40%), Fencitocine (40%), Caspofugine (40%), and Micafugin (40%).

Discussion

In this study, we realized that gram negative microorganisms are the most common pathogens in Catheter-Associated Urinary Tract Infections (CAUTIs) (60.9%). *Escherichia coli* was the most prevalent gram negative micro-organism (20%). *Klebsiella* species were the second most prevalent at 10.6% followed by *Acinetobacter baumaunnii* and *Serratia* species at 8.2% each. *Pseudomonas aeruginosa* had a prevalence of 5.9%. Other gram negative organisms cultured were *Pantoea agglomerans* (3.5%), *Raoultella planticola* (2.4%), *Citrobacter freundii* (1.2%) and *Morganella morganii* (1.2%).

The gram-positive organism contributed 33.2% of the pathogens. *Enterococcus* species were the most common gram positive microorganisms (32%).*Enterococcus faecalis* had a proportion of 26% while *Enterococcus gallinarum* (6%). *Staphylococcus haemolyticus* was cultured once (1.2%). *Candida albicans* formed a proportion of 6%.

The results showed some similarity to a study done in Salmaniya medical center in Bahrain by Elkhawana *et al* that showed *E. coli* was the most isolated micro-organism (28.8%) followed by *Klebsiella* species (26.9%), *Candida albicans* (25%), and *Pseudomonas* species (11.6%) and *Proteus mirabilis* species (7.7%) [11].

A study conducted in Turkey by Inan *et al*., showed that, the most frequently isolated causative agents were *Candida* spp. in 37.1% of the UTIs, *E. coli* in 21.1% of the UTIs and *Pseudomonas* spp. in 16.5% of the UTIs [16]. The prevalence of *E. coli* in the Inan *et al's* study was almost similar to the present study.

In another study done in ICU at a university hospital in Turkey by Keten *at al*. *Candida* species was the most prevalent organisms at 34.7%, followed by *E. coli* at 20.6%, *Pseudomonas* species at 14%, *Klebsiella* species at 9.9% and *Acinetobacter* species at 8.2% [12]. The microorganisms cultured in the Keten *et al* study were similar to those cultured in this study save for the proportion of *Candida* species which was less prevalent here. The prevalence of *E. coli* in all these other studies is consistent with the finding of this study.

Escherichia coli was sensitive to Amikacin (76.5%), Meropenem (70.6%) and Nitrofurantoin (53%) and resistant to gentamycin (76.5%), Amoxicillin/Clavulanic acid (82.4%), Piperacillin/Tazobactam (82.4%), Ciprofloxacin (82.4%), and Ampicillin/ Sulbactam (94.1%). The organisms were 100% resistant to Ceftriaxone, Cefepime, Cefuroxime, Cefazolin and Ceftazidime. This is inconsistent with the study by Keten *et al*. that showed *E. coli* was sensitive to third and fourth generation cephalosporin [12]. In the Elkhawana *et al*. study, the gram negative organisms were sensitive to Aminoglycosides and Meropenem as a mono therapy [11]. This was consistent with our study.

Klebsiella pneumoniae was sensitive toAmikacin (71.4%) and Meropenem (42.9%). *Pseudomonas aeruginosa* was sensitive to Amikacin, Meropenem and Nitrofurantoin at 60%. *Acinetobacter baumaunnii* was 100% resistant to Amikacin Meropenem, Amoxicillin/Clavulanic acid, Piperacillin/Tazobactam, Ampicillin/ Sulbactam and ampicillin. They were only sensitive to Ciprofloxacin (42.9%), and Gentamycin (42.9%). This was inconsistent with Keten *et al*'s study that showed that *Acinetobacter baumaunnii* was sensitive to Meropenem at 30% [12].

Candida albicans were sensitive to Fluconazole and Voriconazole (60%), Amphotericin B (40%), Fencitocine (40%), Caspofugine (40%), and Micafugin (40%). The results were consistent with Keten *et a'sl* study [12].

Conclusion

According to the study results, Fluconazole and Voriconazole therapy seems to be the most appropriate choice for the treatment of CAUTIs caused by *C. albicans.* Third and fourth generation Cephalosporin should not be used for empirical treatment because of the high resistance among *E. coli* and *Klebsiella* isolates. Amikacin, and Meropenem seem to be sensitive to majority of the gram-negative microorganisms. *Acinetobacter baumaunnii* is resistant to majority of the drugs available. Gram positive micro-organisms were sensitive to Vancomycin, Linezolid, and Teicoplanin.

Recommendations

1. There should be judicious use of antimicrobials in the management of CAUTIs to prevent multidrug resistant UTIs.
2. Consider avoiding third and fourth generation cephalosporin as empirical treatment because of high prevalence of extended spectrum beta-lactamase production among *E. coli* and *Klebsiella* isolates

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Appendix

Table 1: Demographic Information

	Frequency	Percent	95% Confidence Interval	
			Lower	Upper
Patient's Gender				
Female	76	31.9	26.1	37.4
Male	162	68.1	62.6	73.9
Type of catheter				
Silicon	26	10.9	7.1	15.1
Silicon coated	55	23.1	17.7	28.2
Foley's Catheter	157	66	60.1	71.8
Age group				
below 50 years	180	75.6	69.7	81.1
Above 50 years	58	24.4	18.9	30.3
Systemic diagnosis				
Cardiovascular	11	4.6	2.1	7.6
Respiratory	7	2.9	0.8	5
Neural	144	60.5	54.6	66.4
Musculoskeletal	26	10.9	6.7	15.1
Gastro-intestinal	22	9.2	5.9	13
Genital urinary	2	0.8	0	2.1
Multisystem	10	4.2	1.7	6.7
Endocrine	4	1.7	0.4	3.4
ENT	2	0.8	0	2.1
Gynae/obstetric	10	4.2	1.7	7.1
Comorbidity				
Present	60	25.2	19.7	30.7
Absent	178	74.8	69.3	80.3

Table 2 Anti-Microbial Sensitivity (Gram-Positive Microorganisms)

Staphylococcus haemolyticus		**Enterococcus gallinarum**		**Enterococcus faecalis**		**Micro-organism**
						Sensitivity
Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	
0	100%	0	100%	0	100%	Vancomycin
0	100%	0	100%	0	100%	Linezolid
0	100%	0	100%	0	100%	Teicoplanin
100%	0	20%	80%	27%	73%	Nitrofurantoin
100%	0	20%	80%	27%	73%	Ampicillin
0	100%	80%	20%	73%	27%	Tigecycline
100%	0	100%	0	100%	0	Gentamycin
100%	0	0	0	100%	0	Clindamycin
100%	0	100%	0	100%	0	Streptomycin
100%	0	100%	0	100%	0	Levofloxacin
100%	0	100%	0	100%	0	Benzyl penicillin
0	100%	100%	0	100%	0	Tetracycline

Table 3a Anti-Microbial Sensitivity (Gram-Negative Microorganisms)

Raoultella planticola		**Klebsiella pneumoniae**		**Klebsiella oxytoca**		**Escherichia coli**		**Micro-organism**
Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Sensitivity
100%	0	28.6%	71.4%	0	100%	23.5%	76.5%	Amikacin
100%	0	57.1%	42.9%	50%	50%	29.4%	70.6%	Meropenem
100%	0	71.4%	28.6%	50%	50%	47%	53%	Nitrofurantoin
100%	0	71.4%	28.6%	100%	0	76.5%	23.5%	Gentamycin
100%	0	100%	0	100%	0	82.4%	17.6%	Amoxicillin/ clavulanic acid
100%	0	100%	0	100%	0	82.4%	17.6%	Piperacillin/ Tazobactam
100%	0	71.4%	28.6%	100%	0	82.4%	17.6%	Ciprofloxacin
100%	0	100%	0	100%	0	94.1%	5.9%	Ampicillin/ Sulbactam
100%	0	100%	0	100%	0	100%	0	Trimethoprim/ Sulfamethoxazole
100%	0	100%	0	100%	0	100%	0	ampicillin
100%	0	100%	0	100%	0	100%	0	Cefoxitin
100%	0	100%	0	100%	0	100%	0	Cefazolin
50%	50%	100%	0	100%	0	100%	0	cefuroxime
100%	0	100%	0	100%	0	100%	0	Ceftazidime

Table 3 b: Anti-Microbial Sensitivity (Gram-Negative Micro-Organism)

Citrobacter freundii		*Serratia fonticola*		*Serratia Marcescens*		*Pseudomonas aeruginosa*		**Micro-organism**
Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Sensitivity
100%	0	66.7%	33.3%	66.7%	33.3%	40%	60%	Amikacin
100%	0	66.7%	33.3%	100%	0	40%	60%	Meropenem
100%	0	33.3%	66.7%	100%	0	40%	60%	Nitrofurantoin
100%	0	100%	0	100%	0	100%	0	Gentamycin
100%	0	66.7%	33.3%	100%	0	100%	0	Amoxicillin/ clavulanic acid
100%	0	100%	0	100%	0	100%	0	Piperacillin/ Tazobactam
100%	0	100%	0	100%	0	100%	0	Ciprofloxacin
100%	0	100%	0	100%	0	100%	0	Ampicillin/ Sulbactam
0	100%	94.1%	5.9%	100%	0	100%	0	Trimethoprim/ Sulfamethoxazole
100%	0	100%	0	100%	0	100%	0	ampicillin
100%	0	100%	0	100%	0	80%	20%	Cefoxitin
100%	0	100%	0	100%	0	80%	20%	Cefepine
100%	0	66.7%	33.3%	100%	0	100%	0	cefuroxime
100%	0	66.7%	33.3%	100%	0	80%	20%	Ceftazidime

Table 3c: Anti-Microbial Sensitivity (Gram-Negative Micro-Organism)

Pantoea agglomerans		***Serratia Liquefaciens***		***Morganella moganii***		***Acinetobacter baumannii***		**Micro-organism**
Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Sensitivity
33.3%	66.7%	100%	0	0	100%	100%	0	Amikacin
100%	0	100%	0	0	100%	100%	0	Meropenem
100%	0	0	100%	100%	0	100%	0	Nitrofurantoin
100%	0	100%	0	100%	0	25%	75%	Gentamycin
100%	0	0	100%	100%	0	100%	0	Amoxicillin/ clavulanic acid
100%	0	0	100%	100%	0	100%	0	Piperacillin/ Tazobactam
66.7%	33.3%	100%	0	100%	0	100%	0	Tigecycline
100%	0	100%	0	100%	0	25%	75%	Ciprofloxacin
100%	0	0	100%	100%	0	100%	0	Ampicillin/ Sulbactam
100%	0	100%	0	100%	0	100%	0	Trimethoprim/ Sulfamethoxazole
100%	0	0	100%	100%	0	100%	0	Cefazolin
66.7%	33.3%	100%	0	100%	0	100%	0	Levofloxacin
100%	0	100%	0	100%	0	100%	0	Cefepine
100%	0	100%	0	100%	0	100%	0	cefuroxime
100%	0	100%	0	100%	0	100%	0	Ceftazidime

Table 4: Anti-Microbial Sensitivity (Fungal)

Micro-organism	Candida albicans		
Sensitivity	Sensitive	Resistant	
Fluconazole	60%	40%	
Voriconazole	60%	40%	
Caspofungin	40%	60%	
Micafungin	40%	60%	
Amphotericin B	40%	60%	
Flucytocin	0	100%	
Fencitocine	40%	60%	