BACTERIOLOGY AND ANTIBIOTIC SENSITIVITY PATTERNS OF URINE IN UROLOGY PATIENTS WITH INDWELLING URINARY CATHETERS AT THE UNIVERSITY TEACHING HOSPITAL IN LUSAKA, ZAMBIA.

By

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Dissertation Submitted to the University of Zambia in fulfilment for the award of Master in Medicine-Urology

The University Of Zambia

Lusaka

DECLARATION

I, Misinzo Moono, hereby certify that this dissertation is a product of my own work and in submitting it for my Masters of Medicine in Urology further attest that it has not been submitted previously either wholly or in part for any other university.

Signature…………………………………… Date………………………………

CERTIFICATION OF COMPLETION

I, ………………………………………………………………, having supervised and read this dissertation, I am satisfied that this is the original work of the author Dr. Misinzo Moono and is ready for presentation to the examiners.

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APPROVAL

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ABSTRACT

Catheter associated urinary tract infection (C.A.U.T.I.) is the most common nosocomial infection in hospitals worldwide and the incidence has been reported to be upto 35%. The growing antibiotic resistance amongst the uropathogens isolated from CAUTI makes it difficult for its management.In Zambia,prolonged catheter use is a burden particularly in patients awaiting definitive surgery,the elderly and socioeconomically challenged.Bacterial colonisation following catheterization is inevitable with reports estimating the risk to be around 5-10% per day.By day 10,virtually all patients with urinary tract instrumentation have healthcare associated UTI with he duration of catheterization the most important factor.

The study was carried out because it offers an opportunity to show the pattern of microorganisms present in urine of patients with indwelling catheters at UTH and the aim is be to bring down the prevalence of CAUTI at the institution with the knowledge of the antibiotic sensitivity of pathogens isolated.

The study was a descriptive cross-sectional which was conducted at UTH over a period of 10 months. The cases were inpatients and outpatients with indwelling catheters in situ for not less than three calendar days. Simple random sampling was used to select candidates, which were inpatients awaiting definitive surgery and outpatients in the same category as they attended clinics. Data collection and collection of specimens were done by the principal investigator which were analyzed by the microbiologist based at the UTH microbiology laboratory. The patients were recruited at one point time and the data collection exercise employed with use of a questionnaire to collect socioeconomic demography and clinical information. The above variables were collected using the data collection sheet for each participant. The above data was entered into SPSS software, used to clean and analyze data. The categorical variables were presented as proportions. The main concerns arising during the collection of specimens was the duration between time of specimen collection and transfer to and processing at the main laboratory which was kept within one hour. Specimens received within two hours of collection were accepted

A total of 228 patients were enrolled from both outpatient and inpatient departments. Approximately 75% yielded growth of bacteria and 25.0% were negative. The pure growth yielded Klebsiella Pneumoniae 28.0% and E. coli 25.2%, as the most isolated pathogens .The antibiotic susceptibility testing revealed highest resistance of e.coli and klebsiella pneumonia to ampicillin, nalidixic acid, norfloxacin, ciprofloxacin and levofloxacin and borderline with cotrimoxazole. The organisms were least resistant to amikacin, imepenem, nitrofurantoin, and gentamycin. Acetinobacter and Citrobacter species were also highly resistant to the above drugs with nitrofurantoin in addition but least resistance to Ampicillin.

The study revealed that there is a high prevalence of catheter associated UTI in the urology section of the UTH and practices such as poor hand hygiene, open catheter drainage, non-aseptic methods of catheter insertion and poor catheter care are possible contributing factors. There is an association between insertion of indwelling catheters and subsequent development of CAUTI and the strongest factors noted are size of the catheters used and patients level of education .High resistance to antibiotics to many organisms of concern was noted.

Keywords: Catheter associated urinary tract infections, Uropathogens, Catheterization, Colonization, Prevalence, Antibiotic sensitivity, Resistance and Catheter size

DEDICATION

I dedicate this work to my late mother, Esther Muleya Moono and my father, Gideon H. Moono for the inspiration and discipline installed in me.

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ABBREVIATIONS

CAUTI	Catheter-Associated Urinary Tract Infections
UTI.	Urinary Tract Infections
UTH.	University Teaching Hospital
ICU	Intensive Care Unit
CFU	Colony Forming Units
CSU	Catheter Specimen of Urine
ESBL	Extended-Spectrum Beta Lactamase
MRSA	Methicilin-Resistant Staphylococcus Aureus
HAI	Hospital Acquired Infections
IUC	Indwelling Urinary Catheter
CDC	Centre for Disease Control
SPSS	Statistical Package for Social Sciences

DEFINITIONS

Indwelling Urinary Catheter : a thin, flexible, hollow tube that is inserted into the bladder either through the urethra or supra-pubic channel to allow drainage of urine

Catheter-associated Urinary Tract Infection (CAUTI) : is defined as a UTI where anindwelling urinary catheter was in place for more than 2 calender days on the date of the event with the day of device placement being day 1(with an indwelling catheter being in place for more than 2 calender days and then removed,the date of theeventfor UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated).

Bacteriuria **:** is defined as bacteria in urine with a count of more than 10^5 CFUs/ml [2].

Foley's catheter : is a hollow urinary drainage tube that is held in the bladder by a small, water inflated balloon.

Specialty Foleys catheter are determined by the tip configuration, number of lumens or channels and the size of the balloons. Four basic types of Foleys catheter exist:

- 2-way catheters(inflation and drainage)
- 3-way catheters(inflation, drainage and irrigation)
- 4-way catheters(inflation, drainage, irrigation and prostatic surgical irrigation)
- Diagnostic catheters(used to diagnose such medical conditions as urethral diverticulae)

CHAPTER ONE

INTRODUCTION

1.1 Background

Ever since the introduction of the first indwelling catheter with an inflated balloon in 1853 by Dr. Jean Francois Reybard, it has become clear what a useful instrument Urologists were given. Howeverat the same time over the years, it became obvious that the use of such a simple instrument goes along with some risks as well.To this date, every day urological practice cannot be imagined without a catheter but at the same time it has become clear that the use of the catheter has inevitably put the Urologist in a position where he has to deal with the complications that arise from catheterization. One of the most common complications of catheterization is catheter-associated urinary tract infection (Labib M.A. et al 2010).

Catheter associated urinary tract infection is the most common nosocomial infection in hospitals worldwide and the incidence rate has been reported to be approximately 35%.The duration of catheterization is a significant risk factor for catheter associated urinary infection.It is well accepted that bacterial colonisation with catheterisation is inevitable with some reports estimating the risk to be in the range of 5% per day with almost 100% colonisation risk at 7 to 10 days of catheterisation. The incidence of bacteriuria has been estimated to be about 3% to 10% higher each day after catheter insertion.Bacteriuria is therefore almost always present in these patients and unless symptomatic,it does not require treatment. Although most Catheter-associated urinary tract infections are asymptomatic, they often precipitate unnecessary antimicrobial therapy. Although there have been recommendations to treat CAUTIs only when they are symptomatic, the symptoms associated with CAUTI have not been clearly defined (Tambyah PA et al 2000, EUA Guidelines 2015).

A urinary catheter is indicated for both diagnostic and therapeutic purposes. For diagnosis a single use or rigid catheter is used to obtain sterile specimen of urine for laboratory purposes. These are usually one-time-use catheters which do not have a balloon at the end to hold it in place. Therapeutically a urinary catheter is used to overcome obstruction in the urinary tract which may be due to retention secondary to benign prostatic hypertrophy, tumors, bladder calculi, strictures, congenital abnormalities and injuries of the urinary tract. Other indications include urinary incontinence, urinary surgery on the prostate or genitals, and debilitating medical conditions. For therapeutic purposes, an indwelling catheter is the method of choice in intravesical instillation of cytotoxic drugs and BCG in treatment of bladder carcinoma.

Urodynamic investigations and supra-pubic catheterization without a balloon are other indications. A two-way Foley catheter on the other hand is an indwelling type of catheter that has two channels. One of the channels allows urine to flow from the tip to the end where it can drain into a collecting bag. The second channel allows inflation of balloon which holds the catheter in the bladder. A 3-way Foley's catheter has an extra channel for instilling medications or irrigation fluids following urological surgery or in case of bleeding from a bladder or prostate tumor to clear blood clots or debris. Condom catheters are most often used in elderly men with dementia and patients with incontinence. A condom-like device is placed over the penis with a tube which leads from this device to drainage bag. They are less irritating than the indwelling.

The different catheter types come in various materials and sizes. Issues considered when choosing a catheter are: ease of use, tissue compatibility, allergy, tendency for encrustation and formation of biofilm, and comfort for the patient. The materials include latex, which is made from natural rubber, a flexible material but has disadvantages which include potential discomfort, due to high surface friction, rapid encrustation by mineral deposits from urine, and implication of allergy reactions to latex in development of urethritis, urethral strictures or anaphylaxis. Its use is restricted to short term indwelling and is best avoided if possible. A silicone catheter, on the other hand, is very gentle for the tissue and is hypoallergic. Since it is uncoated, it has a relatively large lumen and has a reduced tendency to encrustation. However, the silicone catheter balloon has a tendency to lose fluid which increases risk of displacement. It also has a tendency to develop a cuff when deflated, resulting into uncomfortable catheter removal.

PTFE (polytetraflouroethylene) coated or Teflon has been developed to protect the urethra from latex. The absorption of water is reduced due to Teflon coating. It is smoother and this helps to prevent encrustation and irritation. However, its use is not advised in patients with latex sensitivity. Silicon-coated catheter are latex catheters coated inside and out with silicone. It has the strength and flexibility of latex and the durability and reduced encrustation typical of 100% silicone. Hydrogel coated catheters are soft and highly biocompatible. Since they are hydrophilic, they absorb fluid to form a soft cushion around the catheter, and reduce friction and urethral irritation. Silver-coated catheter is a combination of a thin layer of silver alloy and hydrogel which is antiseptic. Silver-hydrogel coated catheters are available in latex and silicone. This type reduces the incidence of asymptomatic bacteriuria but only for a week. There is also reduced incidence of symptomatic UTI. Catheter diameter size and length are measured in Charriere (Ch or CH)also known as French Gauge(F,Fr or FG) and indicate the external diameter.1Ch=0.3mm and sizes range from Ch6 to 30.For pediatric use size 6-10.For adultssize10:to clear urine, no debris, no grit(encrustation).Size 12-14:Clear,no debris, no grit, no hematuria,Size16:slightly cloudy urine, light hematuria, with, without small clots, no or mild grit, mild to heavy debris,Size18:moderate to heavy grit, moderate to heavy debris. Hematuria with moderate clots, Size 20-24: used for heavy hematuria, need for flushing (Geng V. 2006, 2012).

In general, use of urinary catheters in other regions of Africa and parts of the world has been associated with development of CAUTI. Unfortunately, it is inevitable that a number of patients awaiting definitive treatment in the urology section of the UTH cannot wait without the use of the catheters because of lower urinary tract symptoms. These patients are likely going to develop CAUTI. In Zambia, unlike other parts of Africa and the world, the types of microorganisms, their sensitivity pattern and their prevalence in the urine of these patients is unknown. Hence the reason the study has to be carried out at the UTH being the leading health institution in the country.

1.2 Statement of the Problem

A urinary catheter may be in site for short term(1-14 days),short to medium term(2-6 weeks) or medium to long term(6weeks -3months).Urinary catheterization should be avoided whenever possible in view of the associated risks. However, in some patients with certain urological conditions, prolonged catheterization is inevitable while awaiting definitive treatment. The presence of a catheter theoretically predisposes the patient to risks of catheter associated urinary tract infection (CAUTI).Most infections are derived from the patient's own colonic flora.However, the most important risk factor for the development of catheter-associated bacteriuria is the duration of catheterization (Savage A .R. 2013).

Patients with lower urinary tract symptoms are catheterized to relieve the symptoms whilst waiting for the definitive treatment for the primary cause of obstruction. However, the long waiting period prior to definitive surgical treatment, which may be long as 4 to 6months, results in prolonged catheterization which in turn may be associated with an increase in pre- and post-surgery morbidity and mortality.

1.3 Rationale of Study/ Justification

The use of urinary catheters in patients awaiting urological surgery at the U.T.H. is inevitable because of the long waiting list patients are subjected to prior to definitive treatment. The long waiting period leaves the patient with a catheter for a prolonged period of time and therefore with a higher risk of developing CAUTI. This will affect the pre and post-operative morbidity and mortality. Another risk factor is irregular catheter change (catheter overstaying) mostly due to lack of adequate catheters (silicone catheters can stay for long period of time) and patient compliance (not coming for scheduled catheter change).

Unlike in other parts of the world, the prevalence of infection, the types of microorganisms in the urine of these patients, their sensitivity patterns nor the type of prophylaxis that can be given to prevent morbidity are all unknown in our region.

This is the reason for carrying out this study in Zambia at the University Teaching Hospital.

Objectives

1.4 Main Objective:

To determine the microbiological profile of the urine and the sensitivity pattern of the isolated microorganisms in the urine of patients with indwelling catheters at the University Teaching Hospital, Urology Section, Department of Surgery.

1.5 Research Question

What is the microbiological profile of urine and sensitivity pattern of the microorganism’s isolated and epidemiological characteristics of patients with indwelling catheters in the Department of Surgery, Urology Section at University Teaching Hospital, Lusaka, Zambia?

1.6 Specific Objectives:

1. To identify the micro-organisms isolated in urine of patients with indwelling catheters.
2. To determine the prevalence of micro-organisms in urine and their sensitivity in patients with indwelling catheters.
3. To determine the demographic characteristics of patients with indwelling urinary catheters.

CHAPTER TWO

LITERATURE REVIEW

The rates of indwelling urinary catheter (IUC) insertion in hospitalized patients have been estimated at being between 12 and 40% in developed countries. Studies carried in Africa and around the world suggest that UTI is one of the commonest hospital acquired infections (HAI), while as many as 42-50% of patients with IUC may suffer from UTI in resource limited settings (Savage A. R. et al 2013).

A one day point prevalence study performed in intensive care unit (I.C.U.) throughout Europe found that UTI was the most common ICU-acquired infection (17.6%), after pneumonia and lower respiratory tract infections. Prolonged duration in the ICU (48hrs) and urinary catheterization were among the most identified risk factors for ICU-acquired infections apart from surgical site infections, central line blood stream infections, hospital onset Clostridium difficile, hospital onset MRSA bacteraemia, ventilator associated and hypostatic pneumonia(Vincent L. et al 2006).

CAUTI is the most common nosocomial infection accounting for 1million cases each year in US hospitals and nursing homes. Nosocomial UTI among newly catheterized patients is frequently asymptomatic (90%) and the risk of UTI increases with increasing duration of catheterization[10].The overall incidence of bacteriuria ($\geq 10^5$ colony forming units/ml) is 8% and ranges from 3% to 10% per day. Escharichia coli was found to be the most common pathogen among the patients in addition to enterococci, pseudomonas and proteus mirabilis (Sedor J. et al, Hospital Acquired CAUTI; 1999 26:821-828).

According to a study done between 1996 and 2001 on the prevalence of catheter associated urinary tract infection in the inpatient and outpatient departments at a UK Teaching Hospital, out of a total of 8341 CSU collected in 1996,1998 and 2001,Escherichia coli was the most frequently isolated pathogen in all years, with its frequency declining over time (35.6%, 32.5% and 26.6%, respectively).Enterococcus was the second most frequent overall, with a significant increase in frequency with time (11.8%, 15.3% and 22.0%, respectively). There was also a considerable change in resistance patterns to antibiotics. As a result, in 1996, catheter associated infections were least often resistant to ciprofloxacin (8.0%) followed by co-amoxiclav (18.5%) and cephalexin (25.4%). In 2001, there were least often resistant to co-amoxiclav (22.5%), followed by ciprofloxacin (27.2%) and nitrofurantoin (28.8%).38.9% of the patients developed CA-UTI (Wazait D et al 2001).

In a prospective study done in January 2015 at Vaodgon Prune Hospital India, entitled catheter associated urinary tract infection and antibiotic sensitivity pattern from confirmed cases of CAUTI in a Tertiary Care Hospital out of 1380 catheterized patients, 34 developed CAUTI. The overall incidence was 4.59 per 1000 catheter days. Male patients were more than the female patients for catheterization. Catheterization days ranged from 2 days to 11 days. The most common uropathogens were E. coli (30.5%) and Klebsiella pneumoniae (30.5%) followed by Pseudomonas aeruginosa (16.6%) and Candida species (16.6%) from the cases of CAUTI revealed an overall incidence of CAUTI at 4.9 per 1000 catheterized days. The most common uropathogen was E. coli followed by Klebsiella pneumoniae. Very high antimicrobial resistance was found in Pseudomonas aeruginosa and Acinetobacter species. Bacterial uropathogens isolated from patients with CAUTI revealed the presence of multidrug resistant pathogens. Imipenem was the single best antibiotic for all pathogens except Pseudomonas aeruginosa where Amikacin was the drug of choice. The species also showed very high resistance to all antibiotics except Imipenem (Kazi et al 2015; CAUTI and Antibiotic Sensitivity Pattern from Confirmed Cases in a Tertiary Care Hospital. ClinMicrobiol 4:193. doi: 10.4172/2327-5073.1000193,).

A prospective study on catheter associated infections done in 4 ICUs at Alexandria University Hospital, Alexandria, Egypt from January 1, 2007 to January 31, 2008 using the standard CDC National Nosocomial Infection Surveillance (NNIS) case definition, out of 757 patients monitored after ICU admission, with either existing indwelling urinary catheters (239), or with catheters inserted after ICU admission (518),a total of 161 episodes of infection were diagnosed, a prevalence of catheter associated-UTI of **21.3%.** Important risk factors associated were female gender and previous catheterization within the same hospital admission. Patients admitted to the chest unit, aged 40 years, with prolonged duration of catheterization, and hospital and ICU stay had a significantly higher risk of acquiring CAUTIs. Out of 195 patients who had their urine cultured, 188 pathogens were identified for 161 infected patients; 51% were Candida, 33.5% gram negatives, 15.4% gram positives. The prevalence of ESBL producers among K. pneumonia and E. coli isolates was 56% and 78.6%, respectively (Maha T et al 2009).

Another study was conducted between October 2007 and March 2008 at Obafemi, Awolowo University Teaching Hospital, Ile-Ife, South-western Nigeria on ninety-two (92) patients on urethral catheter, to determine the spectrum of bacterial etiology and antibiotic resistance pattern of uropathogens causing CAUTI. Catheter stream urine samples were obtained from all patients and cultured on appropriate culture media. Suspected isolates were identified by a combination of standard tests and using Microbact Gna12a/B/E. Susceptibility of the isolates against thirteen (13) antibiotics was performed by the disc diffusion method. Significant bacteriuria was observed in 60.9% (56) catheter specimen urine (CSU) received, while 39.1% (36) were culture negative. Of the 56 positive culture, the predominant organisms were Klebsiella oxytoca, 28.6 %(16), Proteus vulgaris, 23.2% (13) and Staphylococcus aureus, 12.5% (7). Overall, the antimicrobial susceptibility results showed that all the isolates were highly resistant to the antibiotics tested. Over 50% resistance was recorded for trimethoprim/sulfamethoxazole, gentamicin and amoxicillin/clavulanic acid. More than 25% of the isolates were resistant to nitrofurantoin. This study indicates that catheter stream UTI caused by multiple resistant bacteria are common in our hospitals. Onipede A.et al (2010).

A study on the prevalence of urinary catheter related infections was done in the outpatient department of the federal medical centre, Abeokuta, Nigeria. Out of 200 samples examined, 41.10% yielded growth of bacteria while 59.00% were negative. The urine of the positive cases yielded E. coli 35.40%, Klebsiella pneumonia 20.9% Pseudomonas aeruginsa15.5%, S. aureus12.1%, Proteus mirabilis 9.75% and C. albican6.0%. The age group that was most affected was 26-35years (32.0%), followed by 36-45 years (20.70%), 46-55(9.80%), 66-75(8.50%) and 86-95(8.50%) while age group 56-65(7.31%) and 76-85(7.31%) had least. The antibiotic susceptibility testing revealed high sensitivity of E. Coli to Augmentin (41.4%), Klebsiella pneumonia, Ofloxacin (52.90%), and Proteus mirabilis (30.00%), Pseudomonas aeruginosa, Ofloxacin (21.42%) and Staphylococus aureus was sensitive to both Ofloxacin and Gentamycin (30.76%) Olarian O. et al (2016).

According to a prospective cross sectional study done in Zivine, Benin in November 2015 entitled: Catheter-Associated Urinary Tract Infections at a Hospital in Zivine, Benin (West Africa), 14 patients out of 60 patients (23.3%) presented with urinary tract infection within 48 hrs. of catheterization. One patient (1.66%) was already infected prior to catheterization. Gram negative bacteria were the most isolated organisms (79%) with E.coli as the most identified species followed by Pseudomonas spp(11%) and Actinetobacter spp(5%). Gram negative cocci (Staphylococcus aureus) made up 21% of the isolates. All bacteria isolates were multidrug resistant (Tamegnon D.et al 2016).

Lastly, a one year Study by Mbanga et al in 2010 entitled Prevalence and drug resistance in bacteria of the urinary tract infections in Bulawayo Province, Zimbabwe analyzed 257 urine samples from patients with suspected urinary tract infection in Bulawayo province. Patients were analyzed for bacteria by standard procedures and antimicrobial susceptibility testing of isolated bacteria was done using the disk diffusion method. Results of isolated bacteria population were as follows: Escherichia coli (40.3%), coagulase negative Staphylococcus (16.1%), Klebsiella species (11.2%), Staphylococcus aureus (8%).Approximately 84% of Coagulase negative Staphylococcus isolates showed resistance to 3 or more antibiotics and 12 Multi-Drug Resistance patterns were observed (Mbanga J et al 2000).

In Zambia such a study on the microbiological profile and sensitivity in patients with indwelling catheters has not yet been carried out hence my proposal to conduct the study at the department of surgery, urology section, U.T.H.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Type

A descriptive cross-sectional study which was conducted at the University Teaching Hospital

3.2 Study Site

Inpatient and outpatient urological sections at the UTH

3.3 Target population

Urological patients with indwelling catheters.

3.4 Study Populations

Urological patients seen in the outpatient and inpatient sections of urologyin the Department of Surgery at UTH

3.5 Inclusion Criteria

Urological patients in the outpatient and inpatient departments with indwelling catheters inserted by respective attending clinicians.

3.6 Exclusion Criteria

- Patients who refuse to give consent to the study.
- Patients with catheters for less than 3 days. The study is unable to determine state of the urine specimens prior to device insertion. Refer to study limitations.
- Patients with co-morbid conditions such as HIV patients not on treatment, uncontrolled diabetes, congenital urinary tract anomalies, acquired conditions such as bladder calculi

and posterior urethral valves as well as those on antibiotic prophylaxis for pending surgical procedures were excluded from the study.

3.7 Sample Size:

The sample size was calculated from the known prevalence of catheter associated urinary tract infections in Africa, obtained from Egypt which is 21.3%**.**

Formula: N$=Z^2 xP(1-P)/d^2$(Peacocks 2011)

N=Sample Required

P=available prevalence

Z=Confidence internal acceptable at 95% (1.96)

d=acceptable accuracy range (+/-0.05)

N=$1.96^2 x0.213(1-0.213)/0.05^2$

N=258.

3.8 Sampling Techniques

Simple random sampling was used to select candidates from inpatients with indwelling catheters awaiting definitive surgery as well as outpatients in the same category as they attend clinics.

3.9 Data Collection

3.9.1 Data Collection Tools

Two data forms (appendices 8.0 and 9.0) were used to collect data from the patients concerning demography and clinical/pathological information. Consent was obtained from patients to collect urine specimens for microbiological analysis whose data was entered into the same forms once the results were ready.

3.9.2Data collection Personal

Data collection and collection of specimens were done by the principal investigator which were analyzed by the microbiologist based at the UTH microbiology laboratory.

3.9.3 Data /Specimen Collection Procedure

The patients were recruited at one point time and data collection exercise employed by use of a questionnaire tool to collect socioeconomic demography and clinical information from each patient. With consent obtained, urine specimens were collected for analysis at that particular time from midstream urine samples of patients on either continuous drainage (for which catheters had to be clamped prior to collection) or those with spigotted catheter. The urine specimens were collected in sterile 20ml urine containers. The number of specimens collected by the end of the study was 230.

In both instances, initial 10mls is discarded allowing collection of the mid-stream specimen. Fluid intake encouraged in those with inadequate production. A urine wet preparation was done for microscopy as per approved Urine Processing Standards procedure. Urine was cultured on blood agar and MacKonkey agar. The subculture techniques available was broth, used particularly when there is no significant growth. Brothing allows faster growth of microorganisms since it’s a liquid media with readily available nutrients.

For the antibiotic susceptibility testing there two types of methods that were available. The traditional Diffusion Method which employs the use of discs and tablets and the Minimum Inhibitory Concentration Method which employs strips. The former is inexpensive in the short term but less accurate and more expensive in the long run. The Minimum inhibitory Concentration Method is expensive but more accurate and saves resources in the long term.

There are four major types of antibiotic discs used at the Main UTH laboratory which include Nalidixic Acid, Nitrofuranton, Norfloxacin and Ampicilin or Sulbacta-ampicilin. These drugs are mandatory. For Extended-spectrum beta-lactamases (ESBL), third-generation Cephalosporins are the main antibiotic discs used.For Pseudomonas species, the drugs of choice are Ciprofloxacin, Ceftazidine, Gentamycin and Imepenem. For Moraxella species, Erythromycin, Ampicillin and Cotrimoxazole are the main discs used. Vancomycin is used when Methicillin-resistant Stapphylococcus (MRSA) are identified or when all the available drugs are resistant.

CATHETERIZED URINE

Over growth

Colony count

Report No Growth

$\geq 10^5$CFU/ml

$<10^5$CFU/ml: Report Insignificant Bacteriuria

Mixed Growth?

Yes: No:

$\geq$2Colony Types

Gram Stain, set up identification according to GS results, set up Antimicrobials for urine isolates

Yes:

Report mixed growth And request repeat collection of an aseptic urine specimen

No:

If 2 colony types, perform the colony count for each

Report Susceptibilities and colony counts

If both colony types Are $\leq 10^5$CFU/ml, report Mixed Growth

if one or both types are $\geq 10^5$CFU/ml, for both gram stain, set up Identification According to GS result,

Setup antimicrobials for Urine isolates

Figure 1. Flow Chart for Catheterized Urine

3.10 Variable Identification

Variable	Indicator	Type of Variable	Measurement Scale
Age	Number of Years	Continuous	Ratio
Sex	Male or Female	Continuous	Nominal
Provincial Residence	Province	Categorical	Nominal
Education Status	Primary/Second/Tertiary	Categorical	Ordinal
Presence of infection	Yes/No	Dichotonous	Nominal
Bacterial Type	Bacteria	Categorical	Nominal
Colonies Isolated	Number of colonies	Numerical	Nominal
Antibiotic Sensitivity	Type of Antibiotics	Categorical	Nominal
Indication of catheter	Indication	Categorical	Ordinal
Duration of present catheter	Number of days	Continuous	Nominal
Time from 1st catheter	Number of days	Continuous	Nominal
Type of catheter	Catheter type	Categorical	

3.10.1 Data Analysis

The above variables were collected using the data collection sheet for each participant. The above data was entered into SPSS software, software used to clean and analyze data. The categorical variables will be presented as proportions (95% confidence interval while continuous variables were presented as means$\pm$ SD or Median. A P value $\leq$0.05 was considered significant.

3.11 Ethical Consideration

3.11.1 Benefits and risks to the patients

The study was a **cross-sectional study** which was **observational**; hence there were no risks to the patients that might be caused by taking part in this study as no particular intervention was instituted by the researcher.

The study did not have direct benefit to the patient but for the future it may offer possible solutions as far as prevention or treatment of catheter associated urinary tract infections is concerned.

All patients involved in the study were catheterized with a strict indication and were treated with the best knowledge and practice available. Hence no additional risks to the patient were expected during the study.

3.11.2. Voluntarism

Participants were never forced nor cohered in the study. Participation was completely voluntary. Participants were free to withdraw from the study at any point in time should they feel hurt or inconvenienced by the study without any consequences on the management of the patient. Patients with catheters inappropriately placed or presenting with complications such as acute urinary retention, infection or retained catheter were treated accordingly.

3.11.3 Confidentiality

Participation into the study by a particular participant was known only by the researcher and the participant. The information obtained was kept in the locker only accessible to the researcher and participant. It was also stored in a computer locked by a password only accessible by the researcher. Having considered the above ethical issues, clearance was sort from the University of Zambia Biomedical Research Ethical Committee (U.N.Z.A.B.R.E.C.).

3.11.4 Statistical Analysis

IBM SPSS version 21.0 was used for statistical analyses, and to produce some graphical output both SPSS and MS Excel were utilized. All statistical tests were at 5% significance level. Independent samples T-test was used to compare mean values between groups and the Pearson's chi-squared test was used for comparison of proportions between groups. The Fisher's exact test was used when one or more of the cells had an expected frequency of five or less. Some variable categories with less frequency were collapsed together accordingly. Study variables were checked for evidence of colinearity based on a Spearman Correlation Coefficient >0.8. The relationship between study variables and presence of infection was examined using Logistic Regression backward selection method. The backward selection method removes terms one at a time beginning with the largest p-value and continuing until all remaining effects are significant at a specified level or removing more terms results in poorer fit. The selection for entry into the logistic regression model was considered at level $p<0.20$ or known clinical significance.

3.11.5 Study Limitations

The study had the following limitations:

1. The researcher was unable to determine sterility of the patients’ urinary tract systems prior to catheterization as it required specimen collection beforehand. This would have doubled the required number of samples needed to be collected per patient. The resources and reagents could not allow pre-catheterization specimens to be collected. This, however, would have given the researcher a more accurate picture of the UTI burden in the clinic which is as a result of catheterization and would have shed more light on the evolution of the disease.
2. Secondly, the study could not determine the influence of other secondary factors such as altered immunity and anatomy on the infection rate. Thus patients with diabetics, immune deficiency syndromes and chronic renal failure as well as pre-existing urinary tract anomalies or disease were excluded from the analysis.
3. Due to limited resources, factors such as integrity of the drainage system, effects of the level of the tube to bladder and sterility of the environment during catheterization were not taken into consideration but would have added valuable information.
4. The duration of time between sample collection and processing in the laboratory may have varied according to the co-investigator particularly if there was a large number of samples collected requiring adequate amount of time before transfer to the laboratory. In such cases, specimens that may have taken longer to reach their destiny and may have altered the microbiological results.

CHAPTER FOUR

RESULTS

There were total 228 patients enrolled for this study.

Patient characteristics

The majority_of the enrolled patients were male, 211/228 (92.5%) versus 17/228 (7.5%) female patients. This difference in proportional distribution was statistically significant, P<0.001 (Figure 1.1). Slightly above three-quarters of the enrolled patients, 178/228 (78.0%), were from Lusaka province (Figure 1.2).Concerning age distribution, 15/228 (6.6%) patients were in the age range 18 – 25 years, while 30/228 (13.2%) were aged 26 – 35 years. Twenty eight patients [28/228] (12.3%) fell in the age range 36 – 45 years, with the majority, 155/228 (68%) aged 46 years and above (Figure 1.3). There were 31/228 (13.6%) patients without formal education, 109/228 (47.8%) with primary education, 65/228 (28.5%) with secondary level education and 14/228 (6.1%) with tertiary level education (Figure 1.4).There were 87/228 (38%) with BPH as indication for catheterization, 70/228(31%) with urethra stricture indication, while 71/228 (31%) had other indications for catheterization (Figure 1.5).

Figure 2 shows the distribution according to gender. The majority of the enrolled patients were male, 211/228 (92.5%), versus 17/228 (7.5%) female patients.

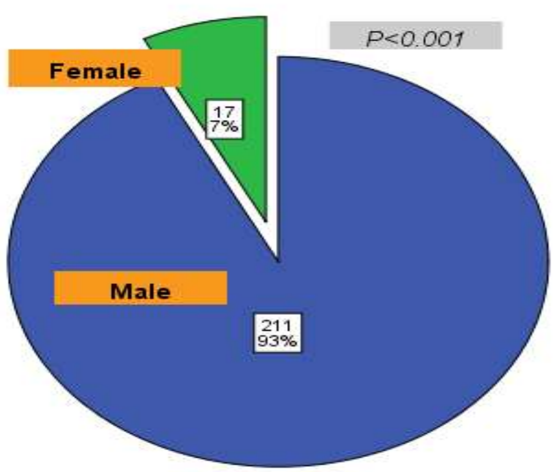

Figure 2 Patient frequency distribution by sex

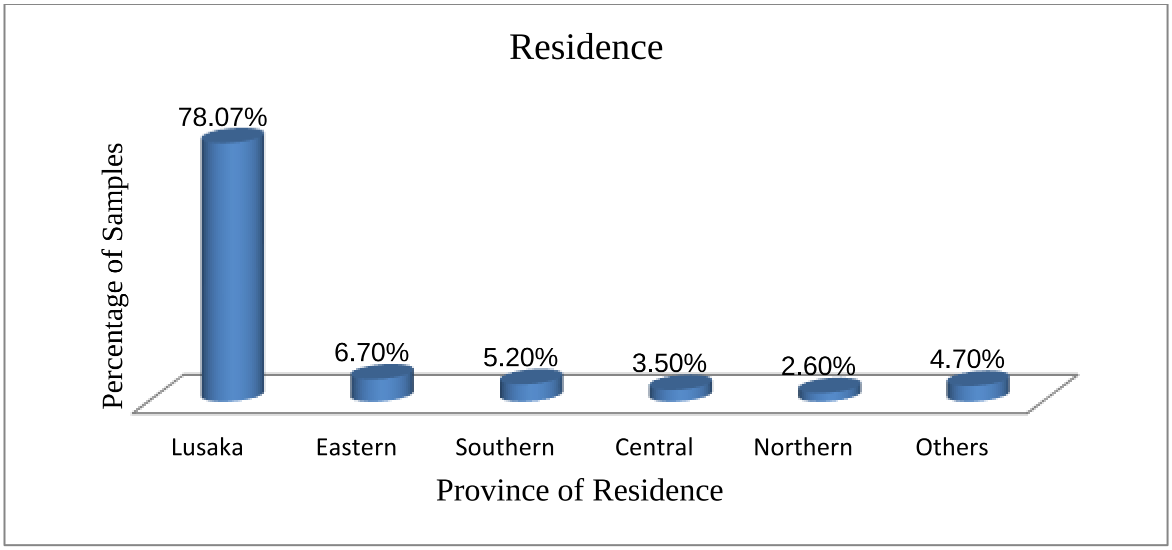

Figure 3 Distribution of Patients according to their residence

Figure 3 shows distribution of patients according to their residence. The majority of the samples were from Lusaka 78.07% (n=178), 6.7% (n=15) Eastern, 5.2% (n=12) Southern, 3.5% (n=8) central and 2.6% (n=6) from Northern Province, 4.7% accounting for other provinces

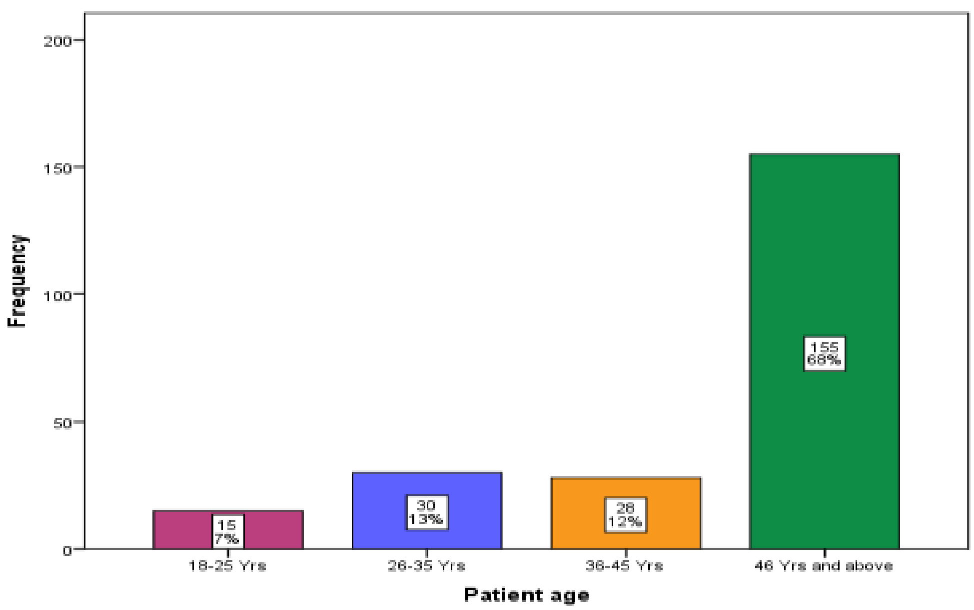

Figure 4 Patient frequency distribution by age

Figure 4 above shows the distribution of patients according to the age. There were 15/228 (6.6%) patients aged 18 – 25 years, 30/228 (13.2%) aged 26 – 35 years, 28/228 (12.3%) aged 36– 45 years, and 155/228 (68%) aged 46 years and above.

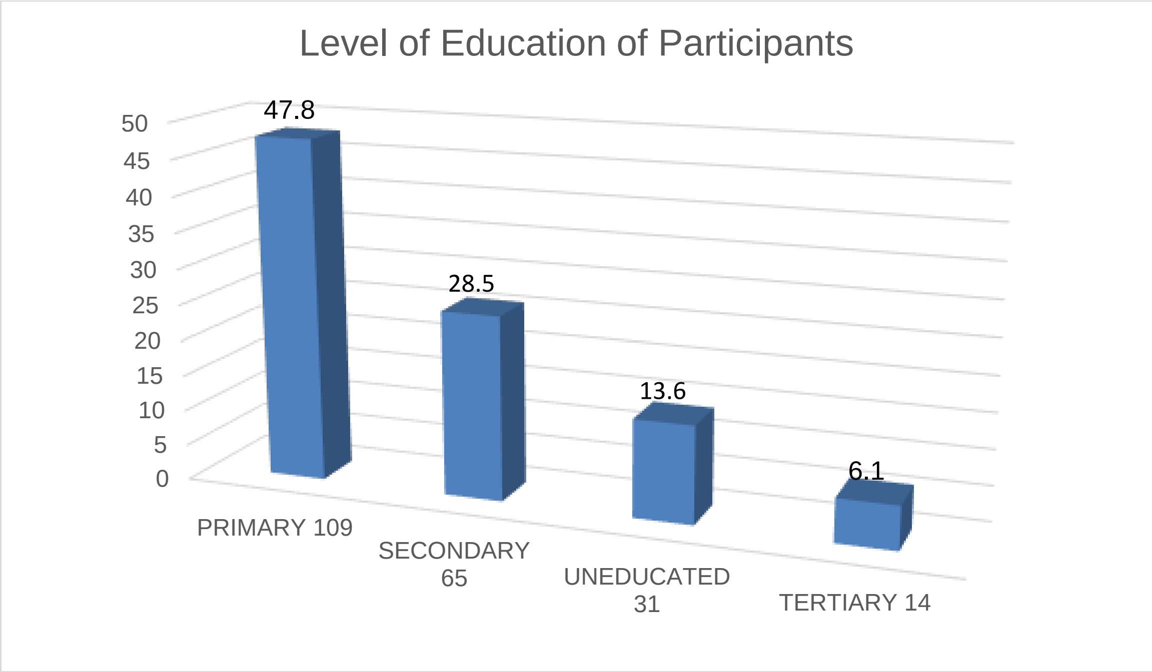

Figure 5 Level of education attained by study Participants

Figure 5 shows the level of education attained by participants. The level of education is segmented into never attended school, primary, secondary and tertiary. The study population consisted of 228 participants who were evaluated for urinary tract infection due to indwelling catheters. Of these, 47.8% (n=109) had attained primary education, 28.5% (n=65) had attained secondary education, 13.6% (n=31) had never entered primary school, 6.1 % (n=14) had attained tertiary education.

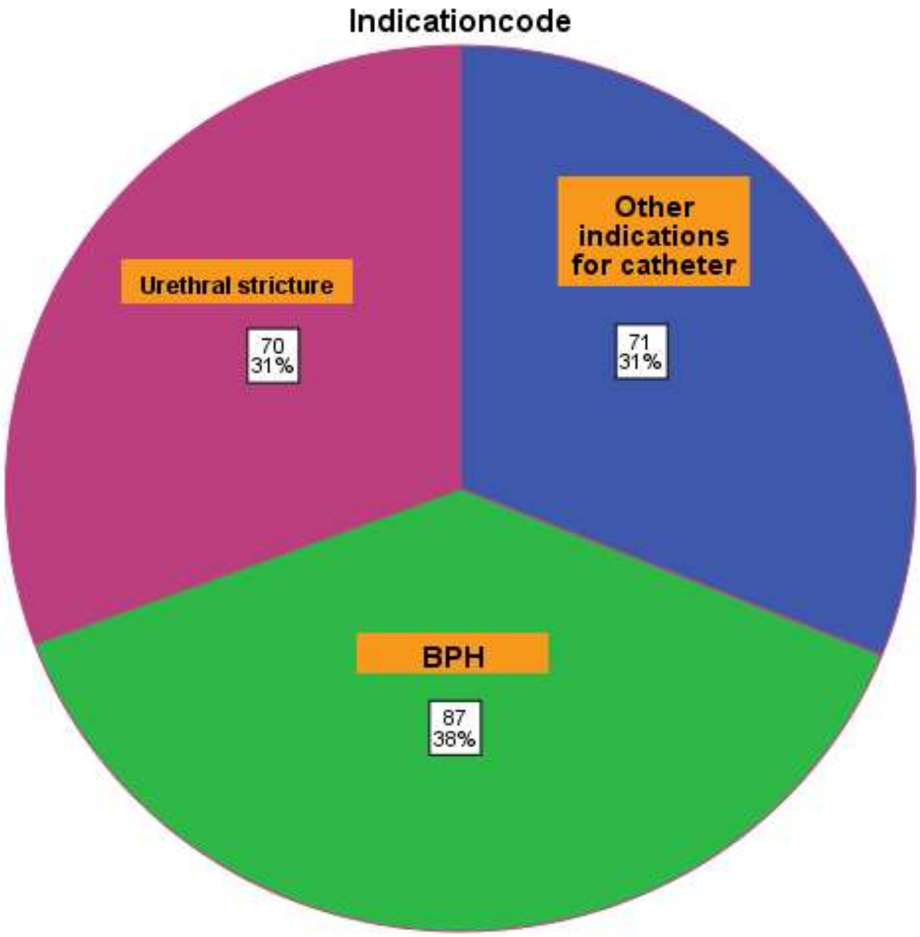

Figure 6 Indications of catheterization of patients.

Figure 6 shows indications for the catheterization of patients. There were 87/228 (38%) with Benign Prostate Hypertrophy, 70/228(31%) with urethra stricture, while 71/228 (31%) had other indications for catheterization.

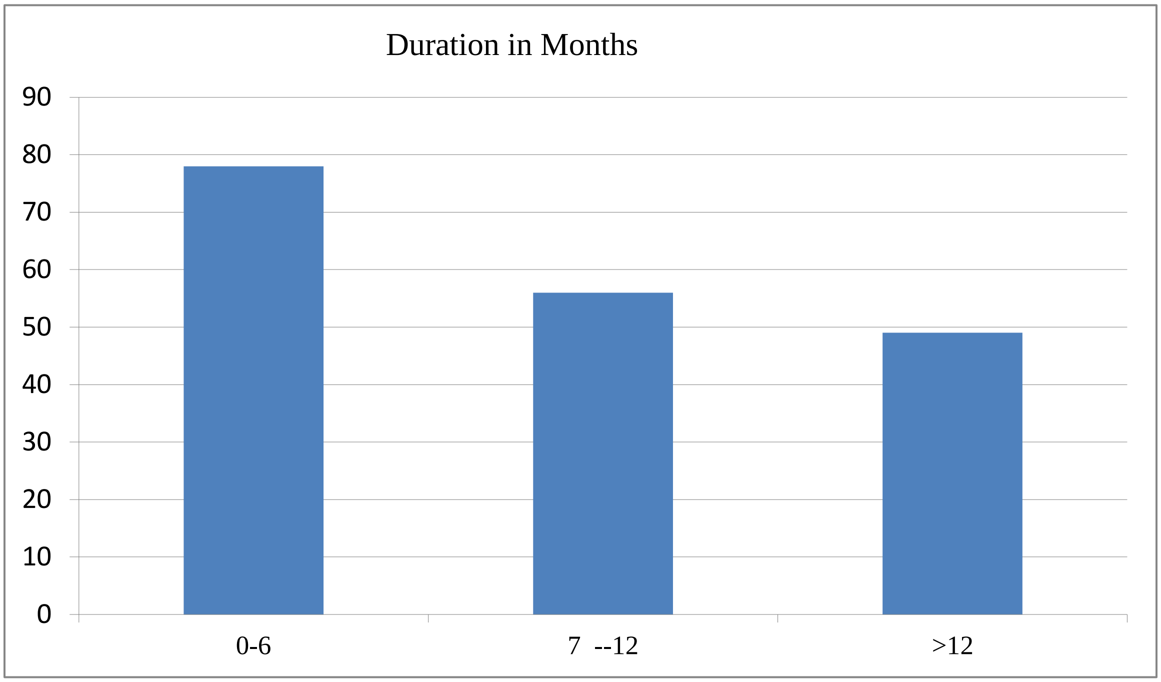

Figure 7 Duration of stay with indwelling catheter.

Figure 7 shows the duration of stay with catheter by patients under study. There were 34.2% (n= 78) patients from time of first catheterization between 0 – 6 months, 21.5% (n=56) between 7– 12 months, 24.6% (n=49) more than 12 months, and 19.7% (n=45) had unspecified time from first catheterization.

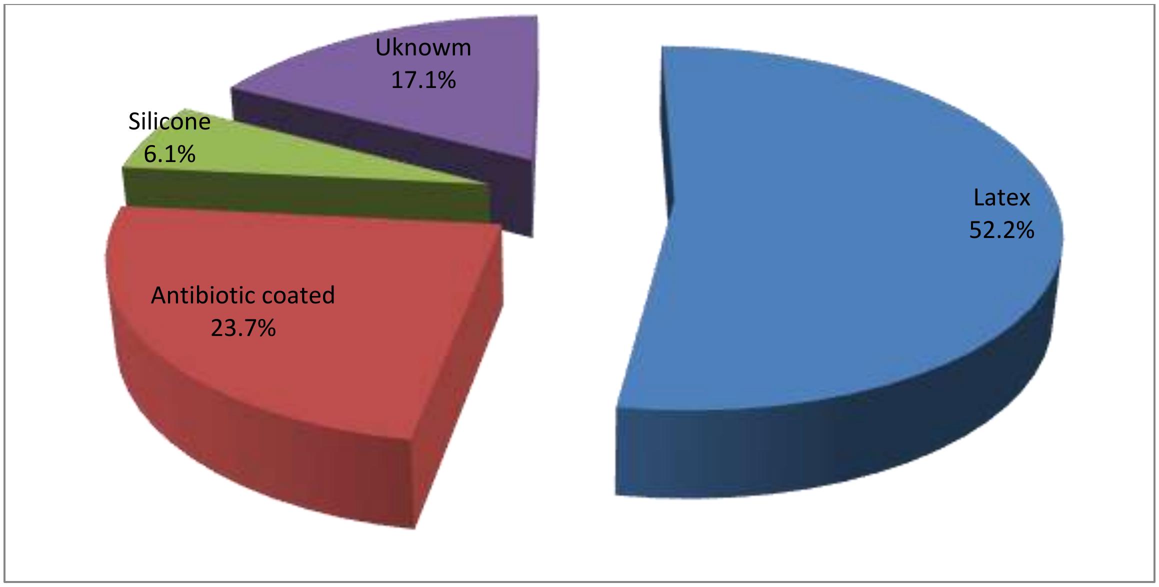

Figure 8 Types of Catheters

Figure 8 shows the type of catheters used by patients in the study. 52.2% (n= 119) had latex type of catheter inserted while 23.7% (n=54) had antibiotic coated ones. 17.1% (n=39) were unspecified. Silicon catheters made up 6.1% (n=14) of the patients.

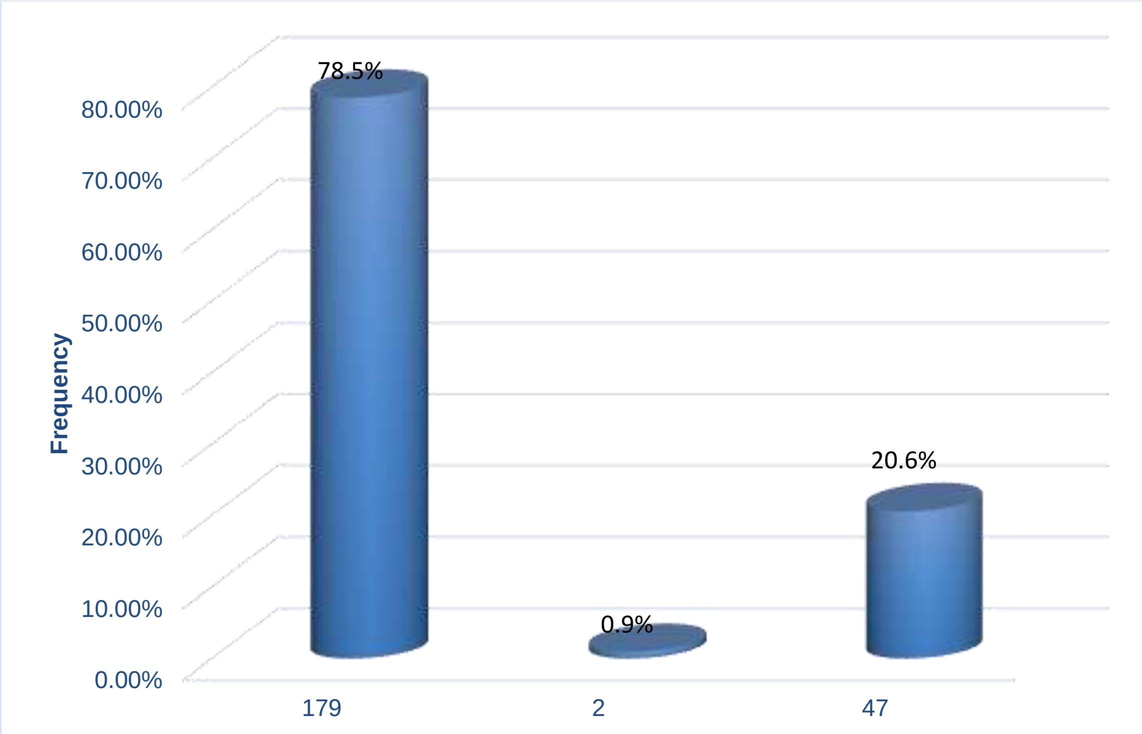

Figure 9 Type of catheter Channel

Figure 9 shows the types of catheters used according to channel type. A larger majority of the patients, 78.5% (n=179) had size 2 way catheter, while 0.92% (n= 2) used 3 way channel catheters. Channel types for 20.6% (n=47) participants were not recorded (unspecified).

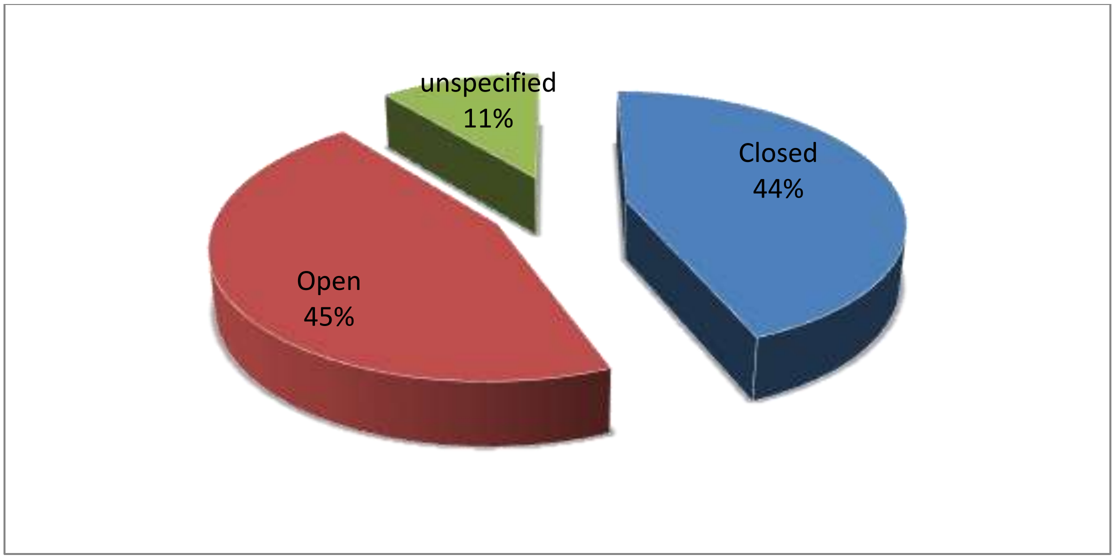

Figure 10 Drainage Types

Figure 10 shows the drainage types of the catheters used. There were 100/228 (44%) patients with closed urine bags, 103/228 (45%) patients spigotted while 25/228(11%) were unspecified as illustrated above.

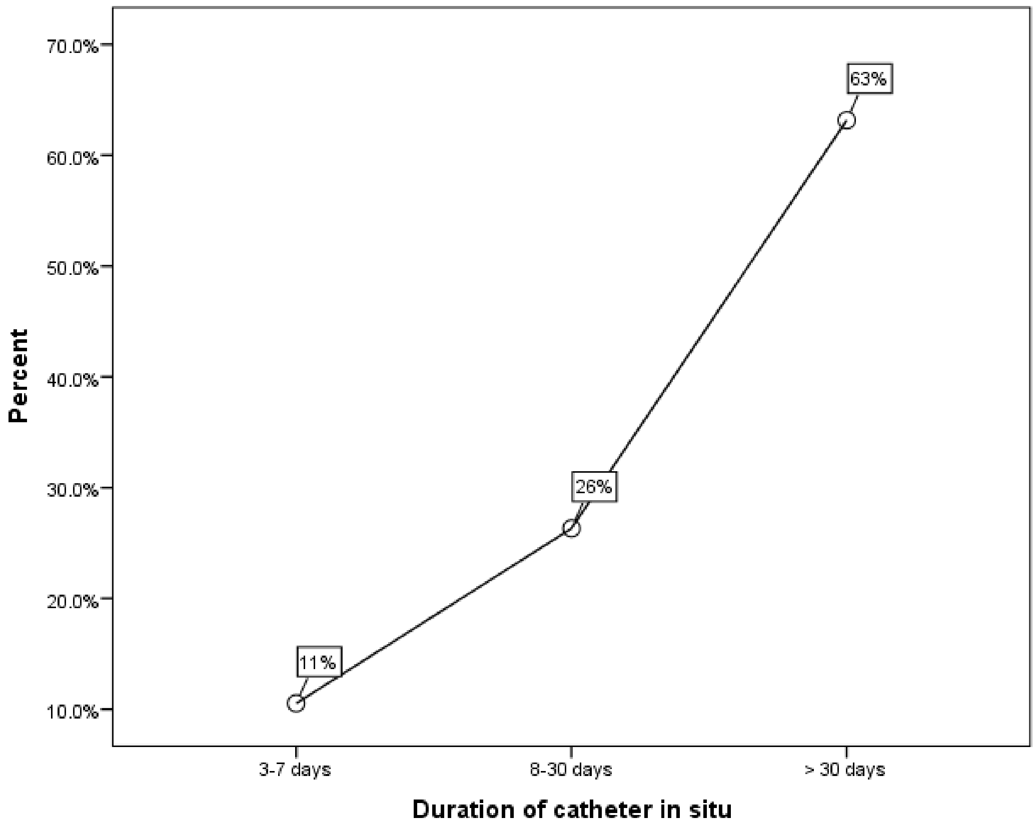

Figure 11 Duration **of current catheter in situ (in days)**

Figure 11 below shows the distribution of the patients according to the duration of current catheterization at time of interview. The majority of the patients had catheters in situ for more than 30 days, 63.2% (n=144), there were 26.3% (n=60) patients with the catheter in situ for 8 – 30 days, and 10.5% (n=24) had catheter in situ for 3 – 7 days.

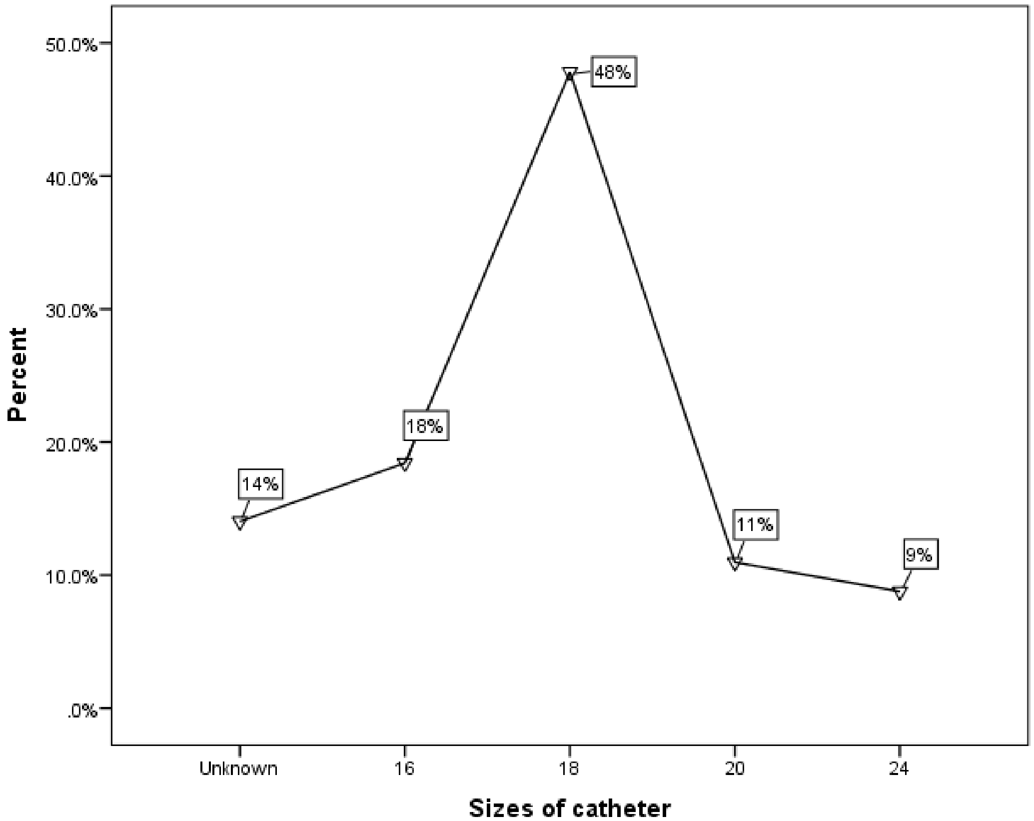

Figure 12 Size **of catheters used**

Figure 12 shows the distribution of patients according to the size of catheters inserted. There were 18.4% (n=42) patients with size 16 Ch catheter, 47.8% (n=109) with size 18 Ch catheter, 11% (n25/228 with size 20 Ch catheter, 20/228 (8.8%) with size 24 Ch catheter, while 32/228 (14%) patients had unknown catheter size.

There were 51/228 (22.4%) patients with pure infection, 26/228 (11.4%) with mixed-significant infection, 1/228 (0.4%) with mixed-insignificant infection, 25/228 (11%) with no growth/insignificant, while 3/228 (1.3%) samples were rejected and 122/228 (53.5%) were mixed but not isolated (Figure 7). Table 1 on page 30 shows the summary frequency distribution of patient characteristics.

Patients with pure and mixed-significant infection were grouped together as presence of infection, while patients with no growth/insignificant and mixed-insignificant were also grouped together as absence of infection. Bivariate analysis was conducted to investigate association with presence of infection among patient variables. Rejected and un-isolated samples were excluded from further analysis.

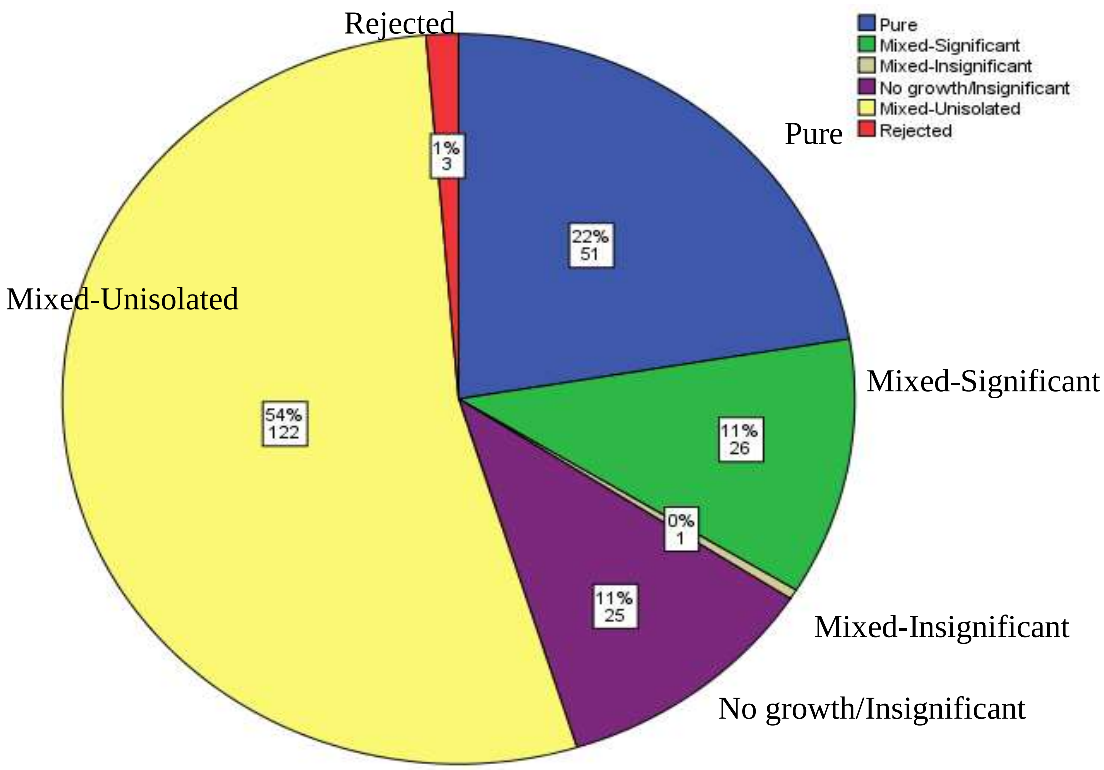

Figure 13 Presence of infection

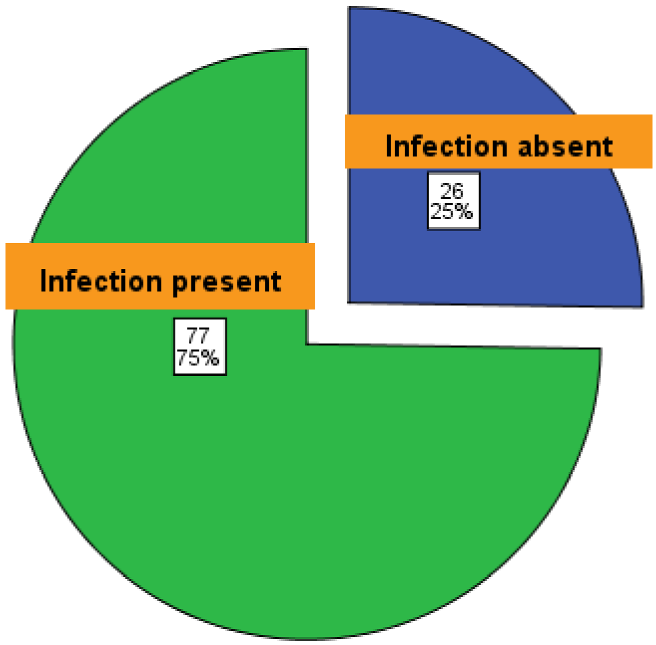

Figure 14 Patient infection distribution outcome

Figure 14 shows a pie chart of the patient infection distribution outcome. Thus, of the patients with laboratory test results, about 75% had infection and 25% had no infection, and this difference in proportion distribution was statistically significant, $P<0.001$.

Figure 15 below shows the **Bacterial Isolate Distribution**. Klebsiella and E.coli were the two most common organisms isolated at 28% (30) and 25.2% (27) respectively.

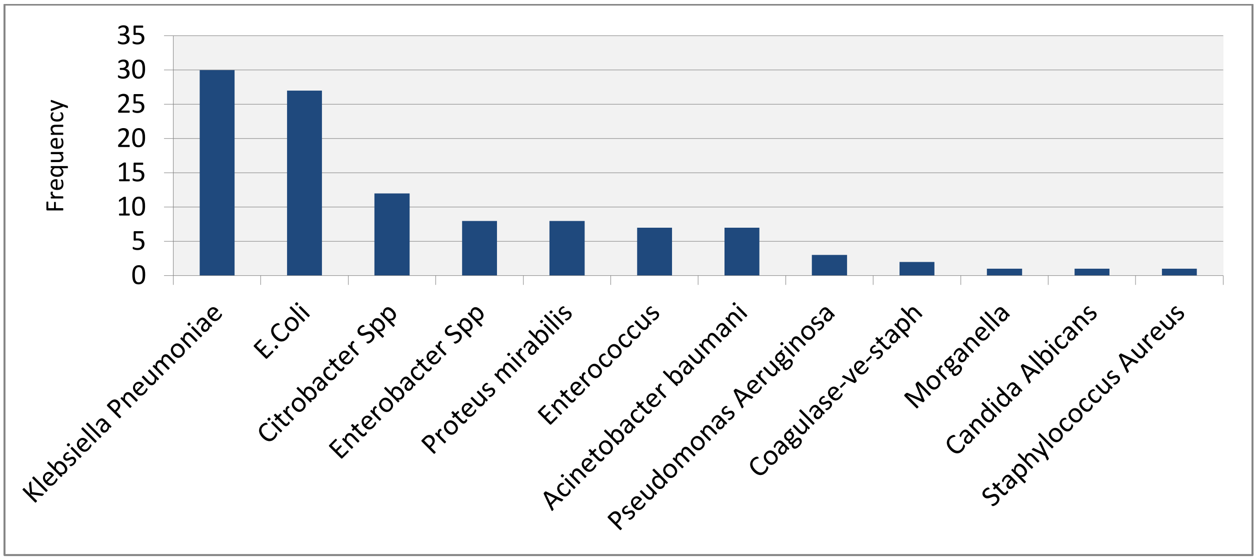

Figure 15 Bacterial Isolate Distribution

Table 1. Patient characteristics frequency distribution

Variable	Frequency (n=228)	Perc ent
Sex		
Male	211	92.5
Female	17	7.5
Age		
18-25 Yrs	15	6.6
26-35 Yrs	30	13.2
36-45 Yrs	28	12.3
46 Yrs and above	155	68
Province		
Lusaka	178	78.0
Copper belt	6	2.6
Muchinga	1	0.4
Southern	12	5.2
Northern	6	2.6
N/Western	2	0.9
Eastern	15	6.7
Western	2	0.9
Central	8	3.5
Education		
Uneducated	31	13.6
Primary level	109	47.8
Secondary level	65	28.5
Tertiary level	14	6.1
Unknown	9	3.9
Indications of catheter		
BPH	87	38.2
Urethral Stricture	70	30.7
Other	71	31.1

Table 1 (continued). Patient characteristics frequency distribution

Variable	Frequency (n=230)	Percent
Duration of catheter in situ		
3-7 days	24	10.5
8-30 days	60	26.3
> 30 days	144	63.2
Time from first catheterization		
0-6 months	78	34.2
7-12 months	49	21.5
>12months	56	24.6
Unknown	45	19.7
Types of catheter used		
Latex	119	52.2
Antibiotic-coated	54	23.7
Silicone	14	6.1
Other	2	0.9
Unspecified	39	17.1
Size of catheter used		
2 way	179	78.5
3 way	2	0.9
Unknown	47	20.6
Size of catheter (Ch)		
16	42	18.4
18	109	47.8
20	25	11
24	20	8.8
Unknown	32	14

Table 1 (continued). Patient characteristics frequency distribution

Procedure		
Urine bag	100	43.9
Spigotted	103	45.2
Unindicated	25	11
Presence of infection		
Pure	51	22.4
Mixed-Significant	26	11.4
Mixed-Insignificant	1	0.4
No growth/Insignificant	25	11
Mixed-not isolated	122	53.5
Rejected	3	1.3

The most commonly utilized antibiotic sensitivity discs during the research were norfloxacin, cotrimoxazole, and gentamicin as shown below **(**Figure 16).

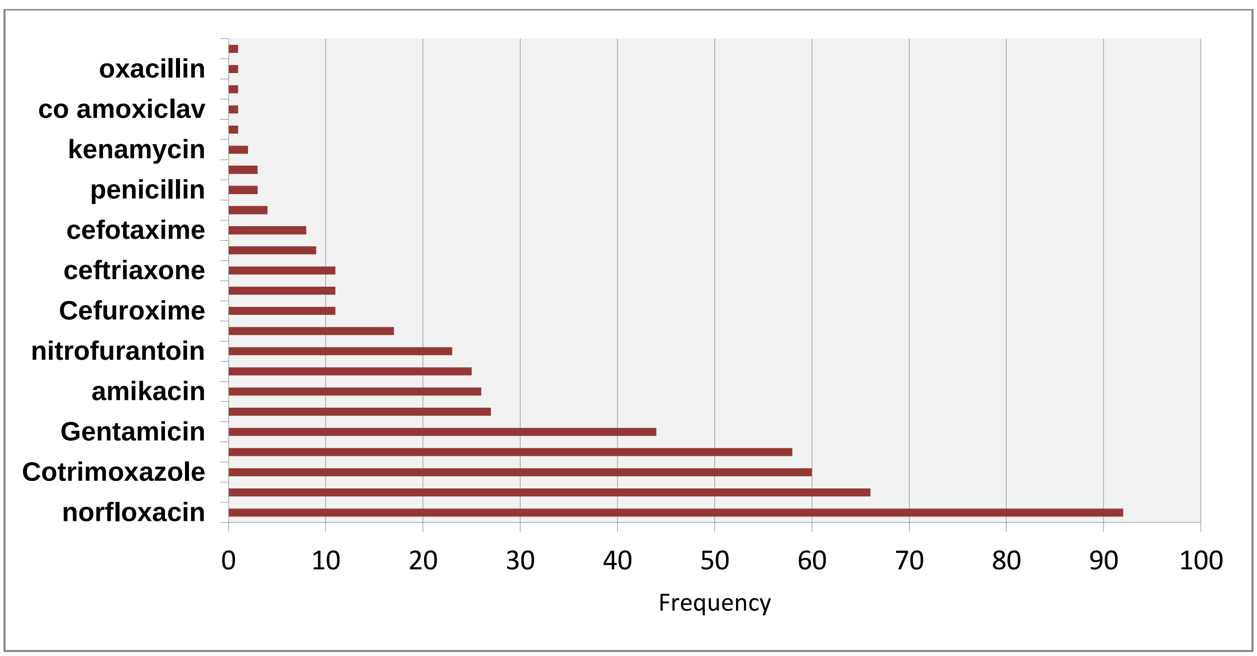

Figure 16 Antibiotic disc distribution

Figure 17 shows the antibiotic resistance and sensitivity patterns for the top 10 most prescribed antibiotics against the top 7 isolated organisms. Despite being widely prescribed, norfloxacin and nalidixic acid were mostly resistant to most organisms (Fig.17). Gentamicin was sensitive to Klebsiella (50%) and E. Coli (63.6%). Amikacin was also well sensitive to Klebsiella, 8/8 (100%).

	Organism													
Antibiotic	**Klebsiella**		**E.Coli**		**Citrobacter**		**Enterobacter**		**Proteus mirabilis**		**Enterococcus**		**Acinetobacter baumani**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Norfloxacin														
Resistant	26	89.7%	17	73.9%	8	72.7%	6	85.7%	6	75.0%	6	100.0%	3	75.0%
Sensitive	3	10.3%	5	21.7%	2	18.2%	1	14.3%	2	25.0%	0	0.0%	0	0.0%
Intermediate	0	0.0%	1	4.3%	1	9.1%	0	0.0%	0	0.0%	0	0.0%	1	25.0%
Nalidixic acid														
Resistant	20	90.9%	15	83.3%	8	80.0%	4	80.0%	5	71.4%	0	0.0%	4	100.0%
Sensitive	2	9.1%	3	16.7%	2	20.0%	1	20.0%	1	14.3%	0	0.0%	0	0.0%
Intermediate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	14.3%	0	0.0%	0	0.0%
Cotrimoxazole														
Resistant	12	70.6%	6	42.9%	9	90.0%	1	50.0%	7	87.5%	0	0.0%	7	100.0%
Sensitive	5	29.4%	6	42.9%	1	10.0%	1	50.0%	1	12.5%	0	0.0%	0	0.0%
Intermediate	0	0.0%	2	14.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Levofloxacin														
Resistant	15	88.2%	8	72.7%	5	62.5%	2	66.7%	6	75.0%	4	100.0%	3	75.0%
Sensitive	2	11.8%	3	27.3%	3	37.5%	1	33.3%	2	25.0%	0	0.0%	1	25.0%
Intermediate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Gentamicin														
Resistant	4	40.0%	4	36.4%	4	50.0%	1	50.0%	3	60.0%	2	100.0%	1	33.3%
Sensitive	5	50.0%	7	63.6%	4	50.0%	1	50.0%	1	20.0%	0	0.0%	2	66.7%
Intermediate	1	10.0%	0	0.0%	0	0.0%	0	0.0%	1	20.0%	0	0.0%	0	0.0%
Ampicillin														
Resistant	8	100.0%	8	100.0%	1	100.0%	1	50.0%	0	0.0%	1	16.7%	2	100.0%
Sensitive	0	0.0%	0	0.0%	0	0.0%	4	50.0%	0	0.0%	5	83.3%	0	0.0%
Intermediate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Amikacin														
Resistant	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	33.3%	3	100.0%	0	0.0%
Sensitive	8	100.0%	3	100.0%	3	100.0%	2	100.0%	2	66.7%	0	0.0%	3	100.0%
Intermediate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Ciprofloxacin														
Resistant	4	66.7%	4	66.7%	1	100.0%	1	100.0%	0	0.0%	5	100.0%	1	33.3%
Sensitive	2	33.3%	1	16.7%	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	33.3%
Intermediate	0	0.0%	1	16.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	33.3%
Nitrofurantoin														
Resistant	3	60.0%	3	30.0%	1	100.0%	2	40.0%	0	0.0%	0	0.0%	2	100.0%
Sensitive	0	0.0%	6	60.0%	0	0.0%	1	20.0%	1	100.0%	0	0.0%	0	0.0%
Intermediate	2	4000.0%	1	10.0%	0	0.0%	2	40.0%	0	0.0%	1	100.0%	0	0.0%
Tetracycline														
Resistant	0	0.0%	5	83.3%	1	50.0%	3	100.0%	0	0.0%	5	100.0%	2	100.0%
Sensitive	1	100.0%	1	16.7%	1	50.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Intermediate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Figure 17 Antibiotic disc Resistance and Sensitivity

Bivariate analysis

Bivariate analysis was conducted for association with presence of infection. At 5% significance level, size of catheter ($p<0.001$) and time from first catheterization ($p<0.001$) were associated with presence of infection (see Table 2). Education level was marginally associated with presence of infection (p0.06). The selection for entry into the logistic regression model was considered at level $p<0.20$ or known significance. Thus analysis yielding p-value <0.20 are considered significant.

Table 2. BIVARIATE ANALYSIS

Variable	Infection Absent		Infection present		P-value
	n	%	n	%	
Sex					
Male	24	92.3%	72	93.5%	0.99^{f}
Female	2	7.7%	5	6.5%	
Age					
18-25 Yrs	2	7.7%	5	6.5%	0.50^{f}
26-35 Yrs	5	19.2%	7	9.1%	
36-45 Yrs	2	7.7%	10	13.0%	
46 Yrs and above	17	65.4%	55	71.4%	
Province					
Lusaka	18	69.2%	56	72.7%	0.73^{c}
Other provinces	8	30.8%	21	27.3%	
Education level					
Uneducated	5	19.2%	5	6.7%	0.06^{f}
Primary	8	30.8%	40	53.3%	
Secondary or better	13	50.0%	30	40.0%	
Indications of catheter					
Other	14	53.8%	24	31.2%	0.12^{c}
BPH	7	26.9%	32	41.6%	
Urethral stricture	5	19.2%	21	27.3%	

Duration of catheter in situ					
3-7 days	3	11.5%	11	14.3%	0.09[f]
8-30 days	4	15.4%	28	36.4%	
> 30 days	19	73.1%	38	49.4%	
Time from first catheterization					
0-6 months	6	23.1%	37	48.1%	<0.001[f]
7-12 months	4	15.4%	13	16.9%	
>12months	2	7.7%	17	22.1%	
Unknown	14	53.8%	10	13.0%	
Types of catheter used					
Latex	7	58.3%	38	55.1%	0.66[f]
Antibiotic-coated	5	41.7%	23	33.3%	
Silicone/others	0	0.0%	8	11.6%	
Channel type used					
2 way	12	46.2%	53	68.8%	0.04[c]
3 way/unknown	14	53.8%	24	31.2%	
Size of catheter (Ch)					
16	6	23.1%	13	16.9%	<0.001[f]
18	2	7.7%	42	54.5%	
20	3	11.5%	8	10.4%	
24	1	3.8%	9	11.7%	
Unknown	14	53.8%	5	6.5%	
Drainage system					
Urine bag	16	72.7%	39	56.5%	0.17[c]
Spigotted	6	27.3%	30	43.5%	
Balloon size on deflation (m/s)					
(n,mean, SD)	12, 11.25, 3.22		72, 11.78, 3.78		0.65[t]

[t]=Independent Samples T-test, [c]=Chi-Square, [f]=Fisher's exact test

Variable correlation

Collinearity based on a Spearman correlation coefficient > 0.8 was checked for study variables with P <0.20 from Table 2 before entry into the logistic regression model. No study variables suggested high correlation (Table 3).

Table 3 Spearman correlation of study variables for logistic regression

Correlations

			Q5Indication	Q6DurationinSitu	Q7Timefromfirst	Q10Size	DrainageSysemt	Q4Education
Spearman's rho	Q5Indication	Correlation Coefficient	1.000	.075	.048	.029	.204**	.023
		Sig. (2-tailed)	.	.259	.515	.691	.004	.730
		N	228	228	183	196	202	219
	Q6DurationinSitu	Correlation Coefficient	.075	1.000	.280**	-.106	.164*	.029
		Sig. (2-tailed)	.259	.	.000	.138	.019	.671
		N	228	228	183	196	202	219
	Q7Timefromfirst	Correlation Coefficient	.048	.280**	1.000	-.014	.161*	.070
		Sig. (2-tailed)	.515	.000	.	.850	.041	.356
		N	183	183	183	181	162	178
	Q10Size	Correlation Coefficient	.029	-.106	-.014	1.000	-.104	-.023
		Sig. (2-tailed)	.691	.138	.850	.	.173	.757
		N	196	196	181	196	173	189
	DrainageSysemt	Correlation Coefficient	.204**	.164*	.161*	-.104	1.000	-.005
		Sig. (2-tailed)	.004	.019	.041	.173	.	.945
		N	202	202	162	173	202	194
	Q4Education	Correlation Coefficient	.023	.029	.070	-.023	-.005	1.000
		Sig. (2-tailed)	.730	.671	.356	.757	.945	.
		N	219	219	178	189	194	219

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Logistic regression analysis

Multivariate logistic regression analysis predicting presence of infection was conducted and final results presented in Table 4 below. Adjusting for confounders, education (primary p0.003) and size of catheter (18ch p0.004) were found to be independently associated with infection. Compared to patients with secondary school level education or better; patients with primary level education had on average 7 times increased odds for infection [Odds Ratio (OR) = 7.48, 95% confidence interval (CI) = 1.25 – 44.87. P-value = 0.03]. Compared to patients with size 24 catheter, patients with size 18 catheter had on average 21 times increased odds for infection (OR = 21.86, CI = 2.64 – 180.88, P-value = 0.004). Although unadjusted odds for uneducated patients and patients with sizes 16 and 20 catheters suggested increased odds for infection compared to the respective reference groups (Table 3), adjusted odds did not indicate significance.

Table 4. Multivariate logistic regression predicting presence of infection

Variable	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	P-value
Education level			
Secondary or better	1	1	
Uneducated	1.0 (0.29 - 3.45)	0.45 (0.06 - 3.62)	0.45
Primary	5.0 (2.34 - 10.68)	7.48 (1.25 - 44.87)	0.03
Size of catheter (Ch)			
24	1	1	
16	2.17 (0.82 - 5.70)	0.93 (0.22 - 3.99)	0.93
18	21.0 (5.08 - 86.75)	21.86 (2.64 - 180.88)	0.004
20	2.67 (0.71 - 10.05)	1.37 (0.19 - 10.10)	0.76

CHAPTER FIVE

DISCUSSION

Catheter associated urinary tract infections are a major cause of morbidity and subsequent mortality in patients due for surgery in the urological section of the Department of Surgery of the University Teaching Hospital, Zambia. It is unavoidable that such patients' urinary tracts get colonized with bacteria or fungi in the process of waiting. This study was conducted at the UTH from August 2015 to March 2016 in an attempt to demonstrate the magnitude of the problem.

The investigation showed that as much as three-quarters (75%) of the patients with indwelling urinary catheters ended up with significant UTIs with Klebsiella pneumonia and E.coli leading as the most prevalent organisms isolated. The isolates, in turn, showed high levels of resistance to commonly used antibiotics administered. The result may seem high but it is reasonably comparable to an outcome of a study done by Mbata T. et al (2007) which revealed prevalence of UTI in catheterized patients to be as high as 77.9% in south eastern Nigeria and 60% in north-western Nigeria. On the contrary, the prevalence has been as low as 7% as seen in the researches done in Turkey (Arslan H. et al 2005) and 10% in Singapore with E. coli which seems to be omnipotent over time, place and person. In a Western study conducted in 1999,causative organisms included Escherichia coli (85%), Proteus mirabilis (6%), Klebsiella pneumonia (4%) as most prominent(Wright SW et al 1999).In a Nigerian study Staphylococcus aureus was the most predominant pathogen isolated followed closely by E.coli, Klebsiella pneumoniae and Proteusmirabilis. Pseudomonas aeruginosa was the least isolated pathogen.(Pondel K.et al 2012).This supports suggestions of local and regional differences in prevalence of CAUTI in various settings (Nandini C. et al 2015).This section will discuss in detail the findings of the research conducted.

The research was carried out over a period of ten months capturing 228 patients of which 92.5 % (211/228) were male patients against 7.5 % (17/228) female. The difference between the genders was statistically significant with p value at >0.20. The number of catheterized female patients was far less than the male counterparts for the gender factor to be considered .In comparison to other studies such as the one conducted by Kazi M. et al (2015) which had 34.4% versus 65.6% men, a balanced number of male and females would be required to compare gender as a factor in rate of infection .However, the anatomical differences between men-long urethra:14-15cm - compared with women- 4cm,in addition to the presence of the prostatic gland in the former, predisposes male subjects more to urinary outflow obstruction compared to their counterparts worse off as they advance with age(Prostatic pathology). Additionally, the longer urethra leaves men vulnerable to both in vitro injury (iatrogenic injuries as in traumatic catheterization) as well as external trauma (pelvic fractures and falling astride).The above factors are disputed from results such as those from a research done by Rolf Nyau-tuku N. et al (Aug 2016) on CAUTI in Yaoundé, Cameroon which were as follows: of the 55 significant samples out of 92 sampled, 46 were female while 9 were male. Analyzing prevalence with respect to gender, females (83.6%) had a higher prevalence of infection than males (16.4%). UTI prevalence was thus significantly related to gender (p value 0.002) contrary to our findings ($p>0.20$).

The research conducted enrolled clients from both outpatient and inpatient sections of the department. It is worth noting that nearly 80% of the candidates emanated from Lusaka province with less than a quarter coming from the rest of the country. Lusaka province: 78.08 % (178/228) provided the most participants since most were within the reach of UTH, whether from the peri-urban or the more affluent low density areas. In contrast, North western, Western and Muchinga provinces were the least represented contributing only five out of 228 patients (2.2%).Patients with urological challenges but from far off places may have sought intervention from nearest institutions with specialized capacities such as Ndola Teaching Hospital Urology section (Luapula, Muchinga and North-western) or Livingstone General Hospital as in the case of Western province or Southern province to a lesser extent. Thus proximity to higher health institutions logically explains the distribution according to residence.

From the perspective of age, slightly above two-thirds of the candidates were aged 46 years or over showing that the majority of the patients were gradually transiting into the non-reproductive age group. Patients aged 18-25 years made up only 6.6%(15/228) of the pool while the 26 to 35 year olds contributed about 13.4%(30/228).The 36 to 45 group was almost equally represented at 12.3%(28/228).However, as mentioned, the above 46 year olds made up approximately two-thirds[68%(155/228)] of the candidates enrolled which is in contrast to a study done on the prevalence of urinary catheter related infections in the outpatient department of the federal medical centre in the city of Abeokuta, Nigeria. This study showed that the most frequently affected age group was the 26-35year olds (32.0%): Olarian O.et al (2016). The study by Rolf Nyau-tuku N. et al(2016) revealed a mean age of 39.2 ± 17.6 years with median of 35 years, age lower than what was revealed by our research. The higher age distribution in Zambia may be related to an increased number of patients with bladder outflow obstruction conditions such as BPH and prostate cancer which happen to be age-related although urethral stricture diseases tend to present at a younger age. They were approximately an equal number of patients with benign prostatic hypertrophy and urethral strictures (about a third each) but the average age may have been offset by the remaining third (Others) of which prostate cancer is a part of. Age did not meet the criteria with a p value above 0.20.

The level of education of the participants revealed an interesting pattern which did not show proportionality in relation to the rate of infection. Nearly half of the participants had attained primary school education while the tertiary group were the least represented. Almost a third were secondary school leavers while 13.6% never stepped into a classroom. The majority of the patients seen were thus from low income homes. A few of these attained tertiary level education. Patients with access to high cost facilities were not captured adequately in this study as compared to those accessing low cost facilities. Hence the research mostly captured individuals from the lower bracket of the economic spectrum and lower educational standards. A comparison of primary and secondary school leavers in the group revealed a significant relationship with rate of infection with p value at 0.003 with use of the regression method. Thus, patients who attained primary school education had a higher chance of infection compared to their secondary school counterparts. There were no specific studies that compared levels of patient education to the rates of CAUTI. However, intervention of patient education has been seen to reduce the prevalence by as much as half as demonstrated by the quasi-experimental study by Alison et al (2014) which reduced incidence rates from 8.2 to 4.3 per 1000 catheter days following a three month intervention. Overall p value for education was 0.06.

There were various reasons patients attended to were catheterized as they were attended to in the clinics or urological wards .Overall, two indications were found to be the most frequent as displayed by Fig 1.5. These were BPH and urethral stricture diseases both making up approximately two-thirds of the patients and contributing a third (31% each) of the population. BPH is exclusively a disease of the elderly, frequency increasing from 30-40% around age of 45 in the general population or 40 in a candidate with family history of the disease, to 80% as patient approaches 9^{th} decade. On the other hand, urethral stricture diseases have a varied frequency but affecting mostly the patients in the productive age. The remaining third included such conditions as prostate cancer, pelvic tumours, incontinence and patients requiring post-operative care among the other reasons. BPH and prostatic cancer have a racial biasness towards the negroid race particularly for the population residing in the urban or peri-urban premises, hence higher frequency is of no coincidence. There was an association between the indications and rate of infection with a p value of 0.12.

The following are indications according to an article by Uro Today on indications for an indwelling foley catheter (2013):

1) Short term for acute urinary retention: a)sudden and complete inability to void, b)need for immediate and rapid bladder decompression c)monitoring of intake and output
2) Temporary relief of bladder outlet obstruction secondary to:

    - Enlarged prostate gland
    - Urethral stricture
    - Obstructing pelvic organ prolapse

3) Others: chronic urethral obstruction or urinary retention and surgical interventions, or failure of intermittent catheterization, short term use following a urological or gynaecological surgical procedure, irreversible medical conditions are present (e.g., metastatic terminal disease, coma, end stages, of other conditions) or presence of stage III or IV pressure ulcers. From the above indications, it is clear that BPH and urethral stricture patients are catheterised for temporary relief of obstruction but end up with chronic catheter stay in our local settings.

The researcher had an opportunity to assess how long each patient had the indwelling catheter from the time of first insertion to the time of enrolment into the research program. Figure 1.6 is a bar graph that demonstrates how long the patients had indwelling catheters from the first day of insertion. All in all, the time periods were longstanding lasting from six (6) months to over a year. Slightly over a third of the candidates (34.2% n=78/228) had indwelling devices for not more than six (6) months whilst a quarter (24.7% n=49/228) had catheters exceeding twelve (12) months with over a fifth (21.7% n=56/228) having catheters in place for more than seven (7) months but not more than twelve (12) months. This is in agreement with the notion that most urological patients awaiting surgical intervention to relieve urinary outflow obstruction endure chronic catheter stay exposing them to subsequent development of urinary tract infections along the way.

The pie chart in figure 1.7 illustrates the various catheter materials utilized by the patients interviewed during the research, basically a reflection of what is available in the institution and country for the patients. In general, latex catheters are the most easily accessible as they are cheap to procure and hence are readily available despite the fact that they are only suitable for short term use(3 to 7 days).Used for longer than this period, they leave the client vulnerable to developing CAUTIs, bladder stones(grits),ascending UTIs and subsequent sepsis. The basis revolves around the high friction rate of the latex rubber with subsequent tendency to encrustation and biofilm formation (Kirmusaoglu S. et al 2017).The catheter type in question made up slightly over half of the tubes used (52.2% n=119/228) while on the other hand, the improved antibiotic coated and silicon catheters with their upgraded properties together made up only under 30% (n=68/228) of the devices. This is a mirror image of catheter availability scenario in most sub-Saharan African countries including Zambia. With a p value >0.20, catheter type had no influence on infection rate in this study.

The bar graph (Fig 1.8) reveals the channel types of the catheters used by the participants. The two-channel version made up almost 4 out of every 5 as this is the first choice by clinicians as the rest, for instance, three-way or one-way have their specific indications such as bladder washing or urinary incontinence due to lower motor neuron disorder, respectively. Significance is noted after running the results in SPSS with a p value of 0.09.However there are no available studies on this factor.

There were two drainage types seen among the candidates screened, namely spigoted (open type) and continuous (closed type) drainage. From the pie chart shown in Figure 1.9, it is clear that they were nearly equivalent numbers of open and closed drainage types with the former slightly ahead (45% or 103/228 versus 44% or 100/228).Due to human error or lapses, a tenth of the drainage types were not documented accurately by the co-investigators and hence not considered in the analysis. In theory, open drainage systems are prone to infections compared to the closed type as the catheter lumen is exposed to the atmospheric bacteria as well as skin microorganisms during the time of draining particularly when hygiene is not observed. However, according to the statistical analysis in Table 2, closed bags were found to have a higher rate of infection compared to the open type, a phenomenon which cannot be explained in this study. However, statistics revealed marginal significance to influence of over infection rate with p value of 0.17. It goes without mentioning that bacteria colonizing urine bags of catheterized patients have been reported to be a source for outbreaks of resistant organisms even in acute care situations as published by Nicolle L. (2014) in BioMedCentral. Leelakrishna P. et al (2018) demonstrated that breach in the closed urine drainage system was among the factors that raised the risk of CAUTI which is an inevitable trend in our patients. Thus in contrast, open drainage systems are a higher risk to urinary infections.

In contrast to duration from first time of catheterization (Fig 1.6), figure 2.0 demonstrates the duration of current indwelling catheter in place with the participant. Only 11% of the patients investigated had current catheters in place for 3 to 7 days or less, the ‘ideal' time period for latex catheters to avoid infection whilst in situ. On the other hand, the remainder, nearly 90% had catheters in place for more than 8 days, with nearly two-thirds of these (144/228) further exceeding one month. It is inevitable that in such a situation, patients will be prone to CAUTI especially that patients awaiting surgery are allowed to keep indwelling catheters for an average of 30 days in our setting. It is this new accepted ‘norm' that undermines efforts to curb catheter associated infections. In theory and practice, duration of catheterization is the single most important factor responsible for the development of CAUTI not only in Africa but world-wide resulting into bacteraemia (Warren et al 1992), chronic pyelonephritis and chronic renal inflammation (Warren et al 1994).This was confirmed with p value of 0.001 strongly associating duration with the rate of infection.

The most commonly utilized size of indwelling catheter in patients with BOO was the 18Ch catheter. The main purpose was to bypass urinary obstruction by via drainage. Figure 2.1 depicts the frequency of the most widely used sizes. Clearly size 18Ch made up nearly half (109/228) of the devices with size 16Ch contributing nearly a fifth (42/228). Sizes 20 and 24 Ch together made up another 20%.On the other hand, the recommended sizes of 14Ch or even 12 Ch were never encountered during the enquiry. According to Geng V et al (2006,2012) the recommended adults sizes are as follows: Size 10 Ch :to clear urine from bladder with no debris or encrustation: Size 12 to 14:Clear urine, no debris, no grit, no haematuria;Size16:slightly cloudy urine, light haematuria, with or without small clots, no or mild grit, mild to heavy debris,Size18:moderate to heavy grit, moderate to heavy debris, haematuria with moderate clots, Size 20-24: used for heavy haematuria, need for flushing!Leelakrishna P et al (2018) demonstrated the following findings in his study on risk factors of CAUTI: Size 18Ch 60%,16Ch 36.7% while 22 Ch made up 3.3% showing that size 18 is in most cases the most widely used catheter size. However, the SPSS analysis revealed a p value of >0.20 confirming no association between catheter size and infection rate for our study.

From the above statistics, the research showed that catheters were inserted indiscriminately without considering the specified indications. The majority of the clients had no cloudy urine or haematuria and yet none had 12 or 14 Ch catheters for drainage. The recommended sizes in outflow obstruction remain sizes 12 to 14 to as small as size 10 Ch unless the urine is heavy, blood stained or encrusted. The larger sizes are associated with increased rate of UTI due to impediment of epithelial mucous gland secretions. Susan H et al (2006) in a study entitled The association between indwelling urinary catheters and use in the elderly revealed that 73% of the patients in ICU who received an IUC were above 65 years of which 46% of the catheters were inappropriately placed and 54% were appropriately placed resulting in 28% developing UTI. Such patients with long term indwelling catheters experienced bacteraemia with increasing length of catheterization (Warren et al 1992).Catheterization for more than 90 days was further associated with chronic pyelonephritis and chronic renal inflammation (Warren et al 1994).Further analysis with logistic regression showed a strong relation between catheter sizes 18 Ch and size 24 Ch to be associated independently with rate of infection (p=0.004). This supports the call for indications for indwelling urethral catheter placement to be clearly defined.

The pie chart in figure 2.2 displays the results obtained after microbiological analysis of the urine specimens of the 228 participants. The outcomes were divided into six sections depending on the outcome. It is clear that the mixed un-isolated group made up the bulk of the results contributing over half of the results (54%).These unfortunately were microbiology outcomes that could not be isolated further due to inadequate antibiotic discs. A portion of the mixed un-isolated specimens(about 40 samples) were further broken down, the outcomes added to the pre-existing pure, mixed significant or mixed-insignificant groups only, totalling 22%(51/228), 11%(26/228) and 0%(1/228) respectively. The other outcomes were: no growth at 11% (25/228) and rejected samples registering only 1% (3/228). Patients with pure and mixed-significant infection were grouped together as presence of infection, while patients with no growth/insignificant and mixed-insignificant were also grouped together as absence of infection.

Bivariate analysis using SPSS software was conducted to investigate association with presence of infection among patient variables. The rejected and un-isolated samples were excluded from further analysis. Thus, of the patients with laboratory test results, about 75% had infection and 25% had no infection as illustrated by diagram 2.3.This difference in proportion distribution was statistically significant($P<0.001$).Prevalence this high are not uncommon in sub Saharan Africa as demonstrated by the study by Onipede et al (2010) south-western Nigeria, which showed a rate of CAUTI at 60.9% and Mbata T. et al (2007) with prevalence of UTI in catheterized patients to be as high as 77.9% in south eastern Nigeria .On the other hand rates as low as 23% and 21% were reported in Benin (Tamegnon D.et al 2016) and Egypt(Maha T et al 2009) respectively. A rate of 7% was reported in Turkish study.

The bacteriogram shown in figure 2.4 revealed that Klebsiella pneumoniae was the most frequently isolated microorganism at 28% (30/107) of the isolates closely followed by E.coli at 25.7%(27/107). This is however in contrast to many studies which revealed E.coli to be the most prevalent microorganism. For instance, in a research done on CAUTI by Mbanga J et al(2000) in Bulawayo, Zimbabwe showed E.coli(40.3%) as the most prevalent in catheterized patients followed by Coagulase negative staphylococcus aureus(16.1%), with Klebsiella species at 11%. In Benin, Tamegnon D et al (2015) also revealed E.coli (79%) as by far the most prevalent followed by pseudomonas spp (11%).Similar outcomes were seen in Abeokuta, Nigeria with E. coli at 35.40% while Klebsiella pneumonia accounted for 20.9% (Olarian O. et al 2016).A UK Teaching Hospital research showed E.coli leading at 26.6% in 1996 but dropping to 22% by Wazait D et al 2001.

However, a few research findings had matching outcomes like the 2008 study at Obafemi, Awolowo University Teaching Hospital, Ile-Ife, South-western Nigeria by Onipede A.et al (2010) showing Klebsiella oxytoca at 28.6 % and Proteus vulgaris at 23.2% in that order. Equal frequencies were observed in research at Vaodgon Prune Hospital India: E. coli (30.5%) and Klebsiella pneumoniae (30.5%) carried out by Kazi et al 2015.It is clear that Klebsiella pneumonia and E.coli are commonly isolated pathogens for the following reasons: Escharichia coli was found to be the most common pathogen among the patients in addition to enterococci, pseudomonas and proteus mirabilis because it naturally existing resident of the colon which is in close proximity to the urinary tract (Sedor J. et al, Hospital Acquired CAUTI; 1999) and Klebsiella pneumonia commonly resides in patients with long standing urethral catheterization which involve urinary bag colonization. K. pneumoniae is a frequently encountered hospital-acquired opportunistic pathogen that typically infects patients with indwelling medical devices. Biofilm formation on these devices is important in the pathogenesis of these bacteria, and in K. pneumoniae, type 3 fimbriae have been identified as appendages mediating the formation of biofilms on biotic and abiotic surfaces as described by Haili W.et al (2017) in an article entitled: Emergency of two sub-populations of Klebsiella pneumoniae grown in the simulated microgravity environment.

The antibiotic sensitivity pattern outcome were largely influenced by the antibiotic discs accessible during the ten month course of the investigation. Ideally, four categories of antibiotic discs are required to carry out a microbiological profile if equivocal results are to be obtained. The discs are grouped as follows: Penicilins (e.g. coamoxyclauv, amoxicillin, oxacillin), Aminoglycosides (e.g. gentamycin, erythromycin, amikacin), Floroquinolones (e.g.ciprofloxacin, levofloxacin, norfloxacin) and Cephalosporins (e.g. cefalexin, cefuroxime, cefotaxime). However, as illustrated by figure 2.5, the antibiotic disc availability during the course of the investigation was uneven with bias towards norfloxacin, cotrimoxazole and gentamycin with cephalosporins modestly represented while penicillins and quinolones were hardly available.

The unequal distribution can be explained by the limited supply of the items in the microbiology laboratory employed. The ideal situation was beyond the capacity of the researcher. Thus the antibiotic sensitivity results may not reflect the actual frequency distribution but can be tailored to the settings under which the research is carried out. Despite all this high resistances was noted with norfloxacin and nalidixic acid as well as favourable outcomes with gentamycin, nitrofurantoin, amikacin and imepenem. It is generally clear that microorganisms colonizing the urinary tracts of these patients are becoming increasingly resistant to the commonly prescribed antibiotics leaving hope of eradication of infection to newly developed but more expensive drugs such as imepenem and amikacin which are in intravenous formulations. Adegun P.et al (2018) demonstrated in a research on Nigerian patients with outflow obstruction that nitrofurantoin was the best drug for all men with CAUTI though elderly men had higher rates of multi-resistance. Many studies have reported presence of ESBL producers which are related to high resistance in catheterized patients. Maha T et al (2009) reported a 21.3% prevalence with ESBL producers among which were E,coli and Klebsiella pneumonia isolates making up 78.6% and 56.0% respectively.

The strength of the relationship between infection rate and the various factors was verified using the 2.1 version of SPSS software with significance level of 5%.The variables with p value<0.20

after analysis met the criteria to be run through the logistic regression model. Thus, factors such as size of catheter (p value <0.001) and time from first catheterization (p value <0.001) were strongly associated with presence of infection. Others were education levels (p=0.06), indication of catheterization (p=0.12), duration of (current) catheter in situ (p=0.09), channel types (p=0.04) and drainage system used (p=0.17) as illustrated in Table 2. The factors with p value more than 0.20, namely: gender, age of patient, residence, catheter type and size of balloon inflation did not meet the criteria, hence did not influence the infection rate in this study and were dropped. The analyst further run the significant factors using the Multivariate Logistic Regression method further eliminating weaker variables. Ultimately, the levels of education (primary education verses secondary p0.003) and the catheter sizes (18ch catheter verses 24Ch p0.004) were found to be independently associated with infection as demonstrated in Table 3.Thus primary school leavers were 7 times more likely to get infected than their secondary school colleagues and patients with size 18 Ch tubes were 21 times more likely to get infected than the ones with size 24Ch catheters. From the study these two factors were of most importance as opposed to the duration of catheterization and types of catheters used.

In a similar study done by Leelakrishna P. and Karthik R.B. (2018) carried out in Tamil Nadu, India entitled: Study of the risk factors for catheter associated urinary tract infection, following univariate analysis, the following factors were all significantly associated with development of CAUTI (p value 0.000): purpose for urine catheterization, place of catheterization, breach in the closed system of drainage, duration of catheterization. Sex of the patient (p value 0.279) and catheter size (p value 0.279) were not found to have a significant correlation with increased risk of CAUTI. On multivariate analysis, age, catheter size, diabetes, duration of catheterization, a breach in the closed system of catheter drainage and sex were found to be the significant risk factors associated with CAUTI (p<0.05).Thus, it is worth noting that catheter size was a factor in both studies but duration of catheterization and urine bag (integrity or) type did not influence rate of CAUTI in our study.

From five (5) prospective studies that conducted multivariate analysis on risk factors affecting CAUTI, Tambyah P. et al (2004) showed that the most important risk factors were duration of catheterization, being of female gender, catheterizing outside the sterile environment of the operating room, other infections, anatomical abnormalities, altered immunity in form of diabetes and malnutrition or renal failure as well as keeping the drainage tube above the level of the patient. Antibiotics were protective against infection but when it occurred, it tended to be caused by multidrug resistant organisms.

CHAPTER SIX

CONLUSION AND RECOMMENDATION

6.1 CONCLUSION

In summary, the researcher revealed that the prevalence rate of CAUTI in the urological section of the UTH was as high as 75% of patients with indwelling catheters pending surgery with K. Pneumoniae and E. Coli accounting for over 50% of the isolates. Multi drug resistance was noted to be high particularly among the commonly prescribed antibiotics such as ciprofloxacin, norfloxacin and the penicillin's even though the distribution of the sensitivity discs was uneven. Univariate analysis revealed an association between the infection rates with: gender, the size of catheters used, time from first catheterization, patient's education level, indication of insertion, duration of current catheter, the channel types and the drainage system utilized.

It is worth noting that despite gender factor having a significant impact on the rate of infection with the male factor more susceptible than their female counterparts, the ratios were not balanced enough to come to a conclusion. The drainage system was marginally related with the infection rate despite the closed type having a higher infection rate than the open type and nearly a tenth of clients not accurately accounted for. Multivariate analysis singled out education levels (primary seven-fold more likely than secondary school leavers) and catheter size (size 18Ch 21 times more likely than 24 Ch) as independently the cardinal factors influencing the rate of CAUTI.

The age of the patient, residence, type of catheter material used and volume of balloon inflation were all found not to have effect on the rate of infection. Other factors such as breach in the drainage system, influence of the tube level above the bladder as well as the immunity and anatomical abnormalities were outside the realms of the study.

6.2 RECOMMENDATIONS

Following analyzing of the results, the recommendations below were drawn

1. As a result of the high levels of CAUTI in Sub-Saharan Africa, Zambia inclusive, in comparison with Europe and other western countries, universal hygiene practices during catheterization such as pre-procedural urethral meatal or perineal cleaning and personal hygiene and maintenance of the integrity of drainage systems should be emphasized and included among clinical protocols. For the same reasons, microscopy and sensitivity guided treatment of UTIs should be promoted as opposed to empirical treatment in suspected cases.
2. The long waiting list in surgery is a major contributor to the increase in the duration of stay of indwelling catheters in these patients. Hence it is imperative that measures to reduce the elective list by the department such as increase in time allocated for such procedures be supported. Staff members should be educated on treating catheterization as a temporary measure particularly in patients with BPH and urethral structures and that catheter duration guidelines ought to be adhered to strictly.
3. Follow up research to include factors such as influence of immunity or pre-existing disease or malnutrition on the rate of infection as well as confirmation of the sterility of patients' urinary tract prior to catheterization would accurately give a clear picture of the evolution and disease burden of CAUTI at the UTH.

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APPENDICES

APPENDIX I: Information sheet

Introduction

This form is given to let you know more about the study. After understanding it, you can decide whether to take part in the study or not.

Who is carrying out this study?

The study is being conducted at the urology section, department of surgery, UTH by Dr. Misinzo Moono, a postgraduate student University of Zambia.

The purpose of the study

The study aims to look at the significance of urinary infections in patients with catheters awaiting definitive treatment at the university teaching hospital, department of urology.

The study will also look at the nature of the condition of the patient and reason for catheterization.

Finally the study will focus on the microbiological characteristics and sensitivity of the urine of patients catheterized. The urine specimens collected will be submitted to microbiology laboratory for analysis.

Benefits

All patients who agree to be included in the study will be seen immediately and managed according to the protocol within the shortest possible time. They will be regularly followed up to monitor their condition at no additional cost. All patients will have easy access to the study team should they have any questions or problems.

Risks

The study will not perform any additional treatments other than what any other patient with suspected catheter associated urinary tract infection will be exposed to at the UTH. Any injury which the patient suffers during the course of treatment will be treated expeditiously by the research team.

Confidentiality

Taking part in this study is voluntary, as such you may choose whether to participate or not.

Your name and other personal identifiers will not be used in this study. The information of this may be revealed by the study investigator to the examiners appointed by the University of Zambia. You are free to ask any questions regarding the study.

Questions

Should you seek any clarifications concerning this study or your rights as a research participant? Feel free to contact;

Address:	Dr. Misinzo Moono,	The Chairman,
	Department of Surgery	Biomedical Research Ethics Committee
	School of Medicine	University of Zambia
	University of Zambia	Box 50110, Lusaka, Zambia
	P/B RW 1X, Lusaka.	
	Tel: +260 977 423634	

APPENDIX 2: CONSENT FORM

I**………………………………………………….…………...**have been informed about the study and accept to be entered for a project to determine the pattern of microorganisms in urine of patients with indwelling catheters at the University Teaching Hospital, Urology Section, Department of Surgery.

Signed **……………………………..** Thumbprint**……………………………….**

Witness **……………………………**

Date **………………………………..**

APPENDIX 3: Questionnaire

Please tick ☐ √ *in the box below where appropriate*

1. Gender: M ☐ F ☐
2.
3. Age Between 18-25 yrs ☐ Between 26-35 yrs ☐

   Between 36 – 45yrs ☐ 46 yrs and above ☐

4. Provincial Residence:

Lusaka ☐ Copperbelt ☐ Muchinga ☐ Southern ☐ Northern, ☐

N/Western ☐ Luapula ☐ Eastern ☐ Western ☐ Central ☐

5. Educational Status:
   - Uneducated ☐
   - Primary Level ☐
   - Secondary Level ☐
   - Tertiary Level ☐

6. Indications of catheter: ……………………………………………………………………………

7. Duration of the current catheter in situ:

   3days-7days ☐

   8days- 1month ☐

   >1month ☐

8. Time from first catheterization ever (with continuous change to the present):

………

9. Types of catheters used:

Latex ☐ Antibiotic-coated ☐

Silicone ☐ Others ☐

10. Catheters Channel Types used:

3 way ….

2 way….

1 way….

11. Sizes of Catheter …………Ch

12. Balloon size on inflation ……….mls

13. Presence of infection:

Present ☐

Absent ☐

14. Types of Micro-organisms isolated if present:

………………………………………..

15. Number of Bacterial Colonies Formed

………………………………………….

16. Antibiotic Sensitivity:

Organism……………………………. Antibiotic…………………...

Sensitivity/Intermediate/Resistance