PHARMACOECONOMIC EVALUATION OF ANTIBIOTICS IN URINARY TRACT INFECTION

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ABSTRACT

Background: Pharmacoeconomics is the study of drug therapy costs in health systems, which is important for choosing drugs for formularies, comparing prices of different therapies, and assessing the quality of life improvement that a medication product is predicted to provide. The assessment of cost reduction and pharmacoeconomic evaluation was the goal.

The primary purpose of antibiotics is to treat infections of the urinary system. We conducted a cost minimization study and compared the costs of generic and brand medicines used to treat urinary tract infections.

Methods and materials: The pharmacoeconomic assessment of antibiotics for urinary tract infections is carried out in this prospective observational research. It does a cost-minimization study and counts the number of branded and generic medications that are available.

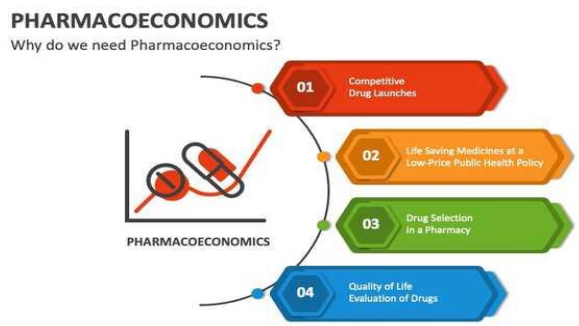
Results: Levofloxacin and ofloxacin are the most often prescribed quinolone antibiotics for treating UTIs among the 120 patients treated with cephalosporins (ciprofloxacin, cefipime). The two most seldom administered antibiotics are beta-lactams (Augmentin) and tetracycline (Doxycycline).

Conclusion: Patients should be prescribed the more affordable medications rather than the more expensive ones, and healthcare providers have an obligation to take the drugs' pharmacoeconomic value into account when writing prescriptions.

Keywords: Urinary tract infections, Cephalosporins, Antibiotics, Pharmacoeconomics, Cost minimization analysis.

INTRODUCTION

Pharmacoeconomics is a subfield of health economics that evaluates the relative merits of various drugs and medication therapies with an emphasis on balancing the costs and benefits of interventions with regard to the utilization of scarce resources. [1]



In pharmacoeconomics, the expenses and advantages of prescribing different medications are compared, along with their costs. Millions of people suffer and lose their lives due to a lack of access to healthcare or an inability to pay for it; many more suffer because they must borrow money or sell assets in order to make ends meet.[2]

SCOPE OF PHARMACOECONOMICS[3]

- To decrease the burden for patients, healthcare professionals and public.
- It is essential to find the optimal effective therapy at the lowest price.
- In government sector helps to determine program benefits and its operating expense.
- In pharmaceutical manufacturing industries helps to decide among specific research and development alternatives.
- In private sector it can be used for designing insurance benefit coverage.
- Additionally, it describes the economic relationship involving drug research, drug production, distribution, storage, pricing and its use by the society.

METHODS OF PHARMACOECONIMIC EVALUATION

The management of scarce health care resources and medical practice can benefit greatly from health care economic assessment. The goal of health care economics is to support decision makers in making choices by comparing the anticipated outcomes of choosing one course of action over another.

- Cost Minimization Analysis (CMA)
- Cost Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
- Cost Utility Analysis (CUA)

Cost minimization analysis (CMA)

The primary goal is to identify the least expensive alternative technology among those thought to result in comparable healthcare outcomes (~same efficacy/safety profiles).[5] The author performing the study must cite the equivalency evidence, which should have been completed before the cost-minimization analysis.[6]

Cost benefits analysis (CBA)

Cost-benefit analysis is more frequently employed in situations when identifying the monetary worth of a human life is not necessary since it is particularly difficult to determine the economic value of saving a life. It makes it possible to compare the costs and advantages of many, very distinct places.[7]

Cost utility analysis (CUA)

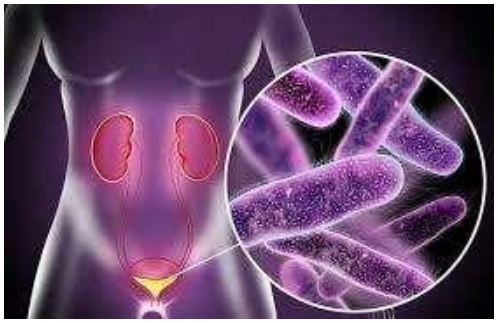
The study's conclusion and the expenses incurred to get there are expressed in monetary terms. The patient's well-being changes are used to gauge the result.[8] Debatable has also been the analysis of QALY as a health outcome assessed in conjunction with the addition of intangible cost. This type of CEA contrasts financial costs with health outcomes measured in QALYs, which represent utility and mortality.[9]

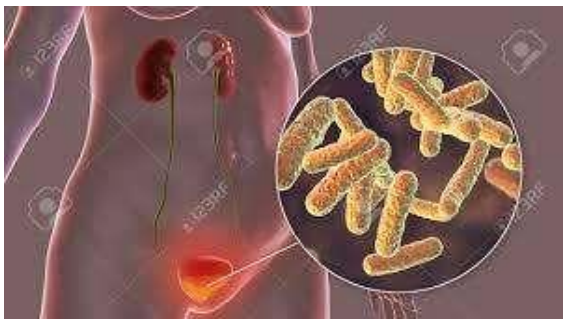
Cost effective analysis (CEA)

The most typical kind of analysis is this one. The context of the condition determines which health outcome metric is best. This type of analysis contrasts the cost of therapy with the efficacy measure, which includes, among other things, the number of years of life saved, the number of lives saved, and the percentage of blood glucose lowered.[10] For instance, the most affordable treatment for hypertension may be the diuretic hydrochlorothiazide, although it frequently calls for a potassium supplement.This medication is not necessarily the most cost-effective therapy due to the increased costs associated with the treatment (Wertheimer, 2003). The most often used approach to cost outcome analysis is this one.[11]

URINARY TRACT INFECTIONS

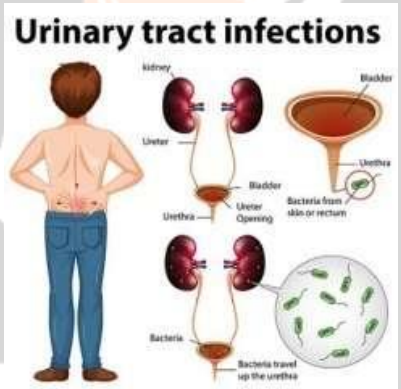
One of the most prevalent bacterial illnesses in the world is a urinary tract infection (UTI). UTIs include infections of the kidney (pyelonephritis), ureters (ureteritis), bladder (cystitis), and urethra (urethritis).[12] In the US, there are thought to be well over 8 million UTI cases every year, many of which need medical attention. Antibiotics are administered to almost all UTI patients; around 1% of patients need to be hospitalized..[13] Antibiotic-resistant infections are frequently associated with urinary system infections (USI). When treating an infectious condition, the least expensive medicines with the fewest side effects are appropriate as long as they can completely eliminate the infection within a reasonable amount of time.[14]





One of the more difficult and severe diseases is a urinary tract infection, which can cause chronic kidney disease and renal failure if ignored or improperly managed. The main treatment for urinary tract infections is antibiotics.[15]However, their inappropriate use raises the risk of bacterial resistance, lengthens the period of morbidity, and raises the overall cost of therapy. Choosing the right antibiotic is crucial when treating a urinary tract infection since failing to do so might harm kidneys or cause the illness to spread more widely.[16] An illness may recur or develop resistance to first-line common antibiotic therapy if the wrong antibiotic is chosen or left untreated. We will examine the prescribing trend for antibiotics used to treat urinary tract infections in this study. Reviewing antibiotic use in compliance with the most recent BGS Global Hospital Antibiotic Policy and researching cost-minimization strategies for treating urinary tract infections are the goals.[17]

Since E. coli may enter the kidney's epithelial cells and multiply there, the most often prescribed antibiotics for USI treatments are TMP-SMZ, ciprofloxacin, and fluoroquinolones.[18] Urinary tract infections (USI) are a serious health issue, particularly for women. Urinary tract infections affect between 10 and 35 percent of women. It is estimated that 5 million women in our nation are diagnosed with cystitis each year.[19]For everyone, recurrent urinary tract infections pose a significant issue in terms of expense or quality of life. The ongoing use of antibiotics owing to recurring illnesses presents a significant risk in terms of potential adverse effects and eventual antibiotic resistance.[20]



Types of Urinary Tract Infection:

Upper Urinary Tract Infections- Upper urinary tract infections are caused by infections of the kidneys or ureters, which are the tubes that carry urine from the kidneys to the bladder.

Acute pyelitis - Pyelitis is an inflammation of the kidney's calices and the pelvic mucous membrane.[21]

Acute pyelonephritis – Acute pyelonephritis, one of the most prevalent kidney illnesses, is caused by a bacterial infection that inflames the kidneys**.** A urinary tract infection (UTI) that ascends from the bladder to the kidneys and their collecting systems can result in pyelonephritis.

Cystitis- Urinary tract infections caused by bacteria nearly usually result in cystitis, an infection of the bladder. In women especially, it is the most prevalent kind of urinary tract infection (UTI). The muscular sac that houses the bladder is where the kidneys store pee.

Prostatitis- Prostatitis is a condition affecting the prostate gland that is typically accompanied by inflammation. In addition to pain in the groin, pelvic region, or genitalia, prostatitis frequently results in painful or difficult urinating. Some but not all instances of prostatitis are caused by bacterial infections.[22]

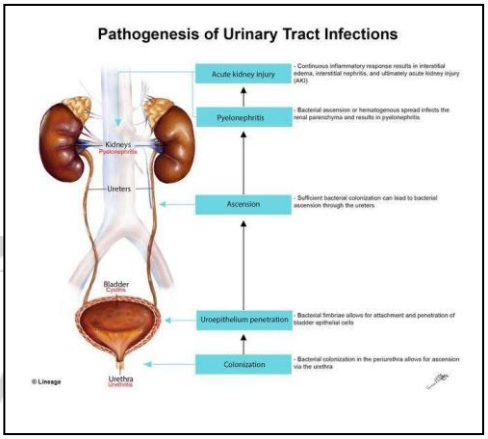
Urethritis : inflammation of the urinary tube that exits the body through the bladder. Urethritis can be brought on by viruses or bacteria. The microorganisms that cause this illness include chlamydia, gonorrhoea, and E. coli.

Uncomplicated UTI- A simple urinary tract infection (UTI) is a bladder and related tissues bacterial infection**.** Individuals with simple UTIs do not have any concomitant conditions, such as diabetes, immunocompromised states, recent urologic surgery, pregnancy, or anatomical abnormalities of the urinary tract.

Complicated UTI- When foreign devices, such an indwelling urethral catheter, are present or there are anomalies in the structure or function of the urinary system, the infection is referred to as a complex UTI.**[23]**

Pathogenesis[24]

- 4 routes of bacterial entry to urinary tract.



1. Ascending infection
2. Blood borne spread
3. Lymphatogenous spread
4. Direct extension from other organs

UTI: CLINICAL PRESENTATION

- Clinical manifestation depending on site of action
- Clinical manifestation depending on age of patient

Clinical manifestations depending on site of infection[25]

Urethritis: Discomfort in voiding **,** Dysuria ,Urgency and frequency

Cystitis: Dysuria, urgency, frequent urination**,** Pelvic discomfort andAbdominal pain

Haemorrhagic cystitis: Visible blood in urine and Irritating voiding symptoms

Pyelonephritis: Fever and chills, White blood cell casts in urine**,** Backpain, Nausea and vomiting.

Clinical manifestations depending on age

Babies and infants: Failure to thrive **,**Fever and Diarrhoea

Children: Dysuria, urgency, frequency Haematuria**,** Acute abdominal pain and Vomiting

Adults: Lower UTI-

- frequency, urgency, dysuria, haematuria.
- Upper UTI- fever, rigor and lion pain and symptoms of lower UTI.

Elderly patients:

- Mostly asymptomatic
- Not diagnostic as the symptoms are common with age

SIGNS AND SYMPTOMS

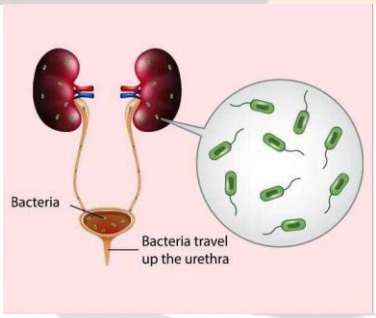
Lower urinary tract infections (UTTIs) are commonly characterized by frequent urination (pollakisuria), discomfort during micturition with minimal urine output (dysuria), urgency, and blood in the urine (hematuria). Upper UTIs, on the other hand, typically appear with fever and flank pain.[26]

Fig: 13 (Symptoms)

Kidneys(pyelonephritis)	Bladder(Cystitis)	Urethra(Urethritis)
Upper back and side pain	Pelvic pressure	Burning with urination
High fever	Lower abdomen discomfort	
Shaking and chills	Frequent painful urination	
Nausea	Blood in urine	
Vomiting		

COMPLICATIONS

- Recurrent infections, particularly in females who have four or more UTIs in a year, or two or more in a six-month period.
- irreversible kidney damage brought on by an untreated urinary tract infection (UTI) that is either acute or chronic (pyelonephritis).
- "Increased risk in pregnant women of delivering low birth weight or premature infants.[27]



RISK FACTORS

Some people are at greater risk than others of developing UTIs. These include:

Women - sexually active women are vulnerable, in part because the urethra is only four centimeters long and bacteria have only this short distance to travel from the outside to the inside of the bladder.[28]

People with urinary catheters (CKD) such as people who are critically ill, who can't empty their own bladder.

People with diabetes - changes to the immune system make a person with diabetes more vulnerable to infection.[29]

Diagnosis of UTI

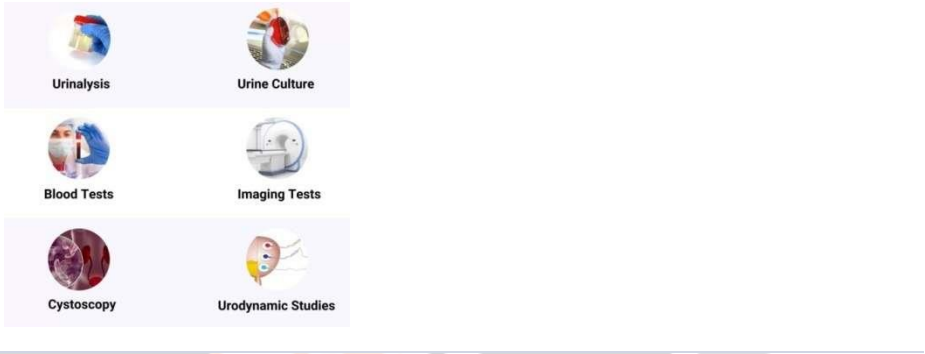
UTIs can be diagnosed by analyzing a patient's urine sample. The two most common tests to detect UTIs are a urinalysis and a urine culture with antimicrobial susceptibility testing:

Urinalysis: A series of physical, chemical, and microscopic examinations performed on a urine sample is known as a urinalysis. These examinations search for germs and white blood cells, two indicators of illness.

Urine culture: This test looks for certain bacteria and yeast that may be the source of a patient's urinary tract infection. The optimal antibiotic for treating a UTI can also be determined by doctors with the use of urine cultures.[30]

Susceptibility testing: Susceptibility testing measures how sensitive the bacteria is to an antibiotic or antifungal drug. This helps doctors determine which treatment is most appropriate.

Urodynamic testing: Tests how well your bladder, sphincters, and urethra are storing and releasing urine[31]



DRUG THERAPY

PHARMACOLOGICAL MANAGEMENT

- The most common antibiotics used for treatment of UTIs in children are:
- amoxicillin
- amoxicillin and clavulanic acid
- cephalosporins
- doxycycline, but only in children over age 8
- nitrofurantoin
- sulfamethoxazole -trimethoprim
- Pain medication to alleviate severe discomfort during urination also may be prescribed.

NON PHARMACOLOGICAL MANAGEMENT

- Take child's temperature if they seem to have a fever.
- Monitor child's urination frequency.
- drinks plenty of fluids.
- Change diapers frequently in children.
- Encourage child to use the bathroom frequently rather than holding in urine.[32]

UTI Treatment

First line therapy	**Dosing**	**Susceptibility**	**Resistance**
Nitrofurantoin	100mg BID x 5 days	• Escherchia coli • Many gram- negative species	• Proteus • Klebsiella

			• Some Enterobacter Strains
TMP-SMX	160/800mg BID x 3 days	• Methicillin-resistant Staphylococcus bacteria • Most gram-negative bacteria	• Pseudomonas
Fosfomycin	3g single dose	• S.aureus • Entercoccus • Pseudomonas aeruginosa	• Low levels of resistance
Second line drugs			
Beta- lactams	Varies by regimen; typically 3-7 days	• Most gram- negative bacteria	• Pseudomonas
Fluroquinolones	Varies by regimen; typically 3-7 days	• Most gram- negative bacteria	• Pseudomonas

METHODOLOGY

Study design: Prospective observational study

Study site: 4 community pharmacies

Study period: 5 months

Study sample: 120

It is a prospective observational study, this study has been performed in four community pharmacies (Apollo, Medpus, Adithya, Universal pharmacy) and the study period is 5 months with the sample size of 120 patients.

INCLUSION CRITERIA

- Patients diagnosed with urinary tract infection's including both male and female(age-16-45).
- Patients prescribed with oral antibiotic medication from community pharmacy.

EXCLUSION CRITERIA

- Patients who are having other comorbid conditions.
- Children diagnosed with urinary tract infections.
- Patients prescribed with IV antibiotic medication for UTI's.

RESULT:

The study was conducted at community pharmacies. Here in the study, the comparison between generic drugs and brand drug prices were taken to analyze the cost minimization analysis. A total of 120 subjects were followed up in the study.

TABLE: 1

GENERIC DRUG PRICE

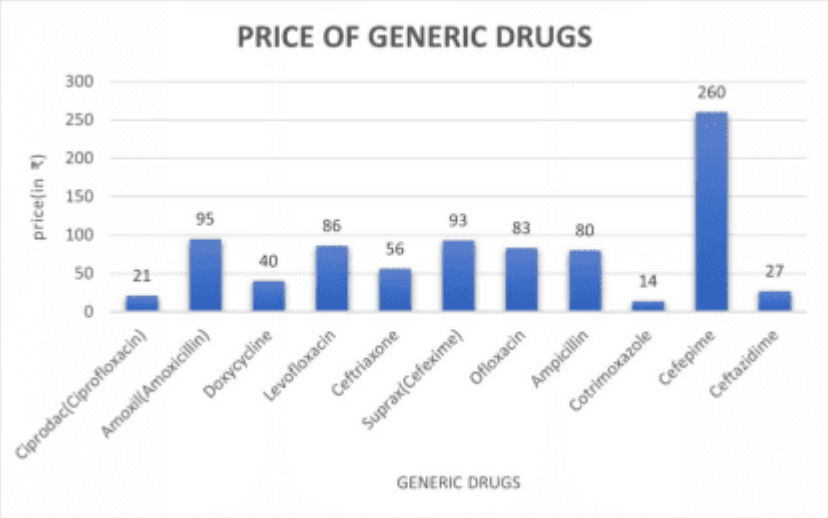
GENERIC DRUGS	PRICE (in Rupees)
Cipro(Ciprofloxacin)	21

Amoxil(Amoxicillin)	95
Doxycycline	40
Levofloxacin	86
Ceftriaxone	56
Suprax(Cefexime)	93
Ofloxacin	83
Ampicillin	80
Cotrimoxazole	14
Cefepime	260
Ceftazidime	27

Table 1 represents the Generic Drug Prices

GRAPH: 1

GENERIC DRUG PRICE

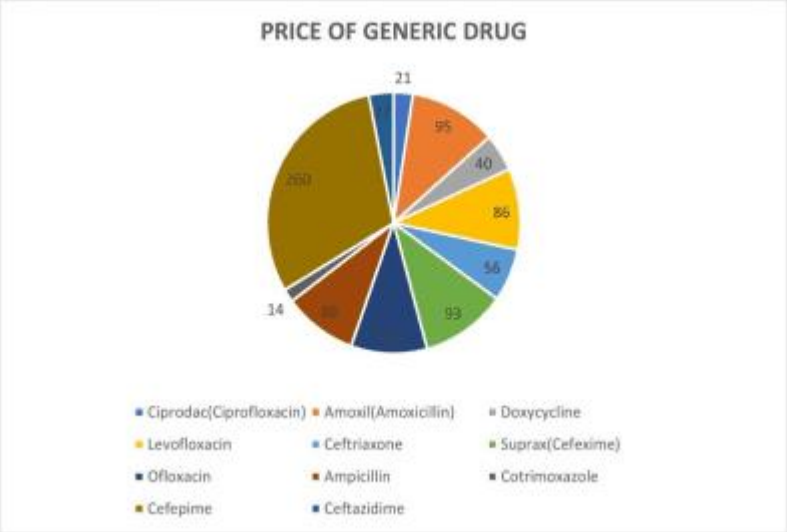


This graph shows that the cefepime is more costlier than other antibiotics with the price of 260 rupees followed by amoxicillin and cefexime and the least cost of antibiotic is cotrimoxazole and ciprofloxacin.

Bar Diagram-1: Graphical representation of Generic Drug Prices

PIE CHART: 1

GENERIC DRUG PRICE



This pie chart shows that the cefepime is more costlier than other antibiotics followed by amoxicillin,cefexime and the least cost of antibiotic is cotrimoxazole and ciprofloxacin.

Pie chart 1: Graphical representation of generic drug prices

TABLE: 2

PRICES OF BRAND DRUGS

BRAND DRUGS	PRICE (in Rupees)
Ciprodac(Ciprofloxacin)	25
Novamax(Amoxicillin)	110
Doxicip(Doxycycline)	90
Levoflox(Levofloxacin)	100
Solecet plus(Ceftriaxone)	170
Taxim O(Cefexime)	108
Floxin(Ofloxacin)	500
Baciphem(Ampicillin)	345
Bactsol(Cotrimoxazole)	105
Zedorax(Cefepime)	800
Fortaz(Ceftazidime)	100

Table 2: Represents the Brand Drug Prices

GRAPH: 2

PRICES OF BRAND DRUG

Bar Diagram-2: Graphical representation of Brand Drug Prices

This graph shows that zedorac antibiotic is more costlier than other antibiotics with the price of 800 rupees followed by and the least cost of antibiotic is ciprodac.

PIE CHART: 2

PRICES OF BRAND DRUG

Pie Chart 6: Graphical representation of prices of brand drugs

This pie chart shows that zedorac antibiotic is more costlier than other antibiotics followed by and the least cost of antibiotic is ciprodac.

TABLE: 3

COMPARISION BETWEEN GENERIC AND BRAND PRICES

Table 3: Represents comparison between generic and brand drug prices

DRUG	GENERIC PRICE	BRAND PRICE
Ciprofloxacin	21	25
Amoxicillin	95	110
Doxycycline	40	90
Levofloxacin	86	100
Ceftriaxone	56	170
Cefexime	93	108
Ofloxacin	83	500
Ampicillin	80	345
Cotrimoxazole	14	105
Cefepime	260	800
Ceftazidime	27	100

GRAPH: 3

COMPARISION BETWEEN GENERIC AND BRAND PRICES

Bar Diagram-3: Graphical representation of Comparison of Price between Generic Drug & Brand Drugs

TABLE: 4

AGE WISE DISTRIBUTION OF PATIENTS

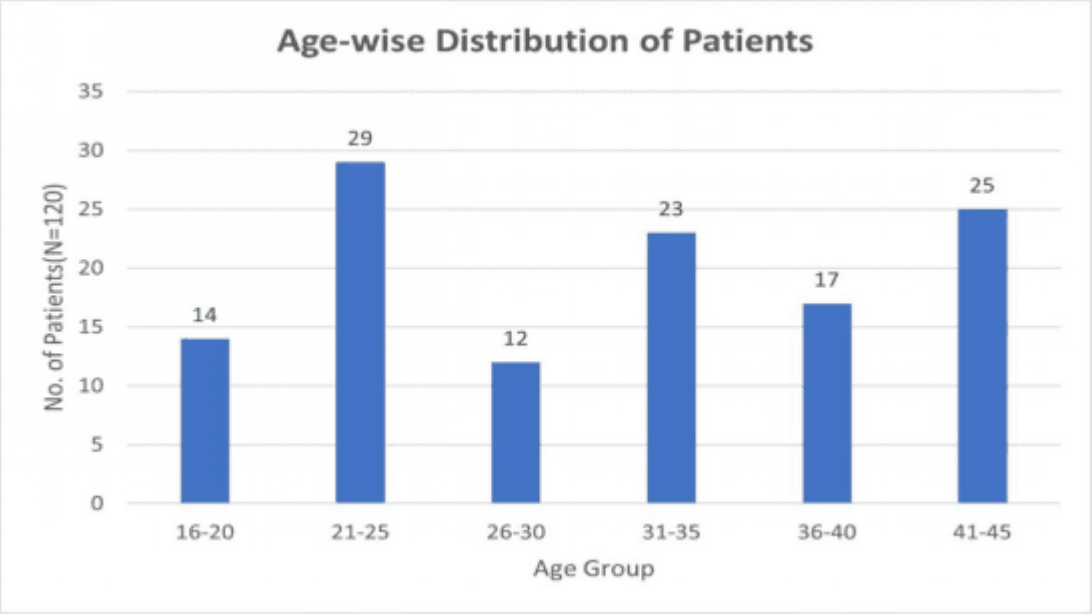
AGE GROUP	NO OF PATIENTS (N=120)

16-20	14
21-25	29
26-30	12
31-35	23
36-40	17
41-45	25

Table 4: Age wise distribution of patients

GRAPH: 4

AGE WISE DISTRIBUTION OF PATIENTS

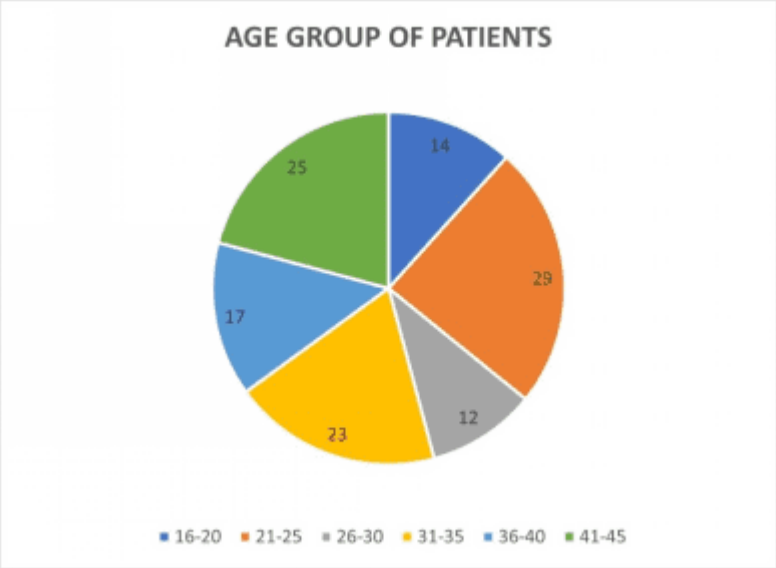


Bar Diagram-4: Graphical representation of Age Group Distribution

Bar graph shows the age wise distribution of patients undergoing urinary tract infection. X axis represents the age distribution and Y axis represents the number of patients in each age group. Maximum patients 29 were found between 21-25years of age.

PIE CHART: 3

AGE WISE DISTRIBUTION OF PATIENTS



Pie chart shows the age wise distribution of patients undergoing urinary tract infection. Maximum patients 29 were found between 21-25years of age.

Pie Chart 2: Graphical representation of age

TABLE: 5

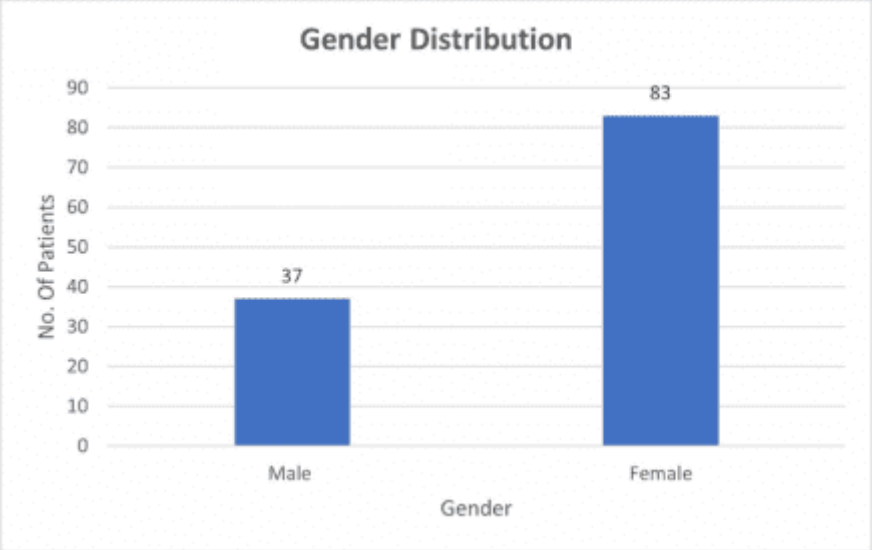
GENDER WISE DISTRIBUTION

GENDER	NO. OF PATIENTS
Male	37
Female	83

Table 5: Distribution of Gender

GRAPH: 5

GENDER WISE DISTRIBUTION



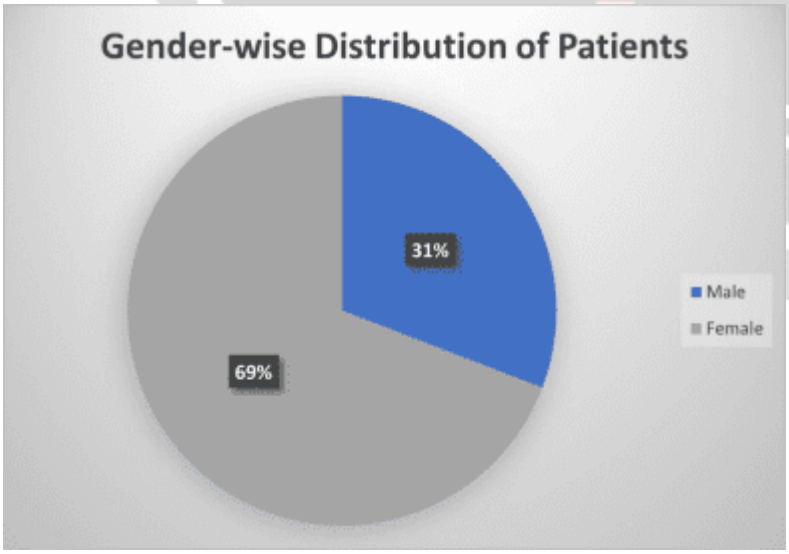
Bar Diagram-5: Graphical representation of Gender

MALE PERCENTAGE IS: **37**

FEMALE PERCENTAGE IS**: 83**

PIE CHART: 4

GENDER WISE DISTRIBUTION



MALE PERCENTAGE IS: **37**

FEMALE PERCENTAGE IS: **83**

Pie Chart 5: Graphical representation of gender

TABLE: 6

DIFFERENT CLASSES OF DRUGS USED

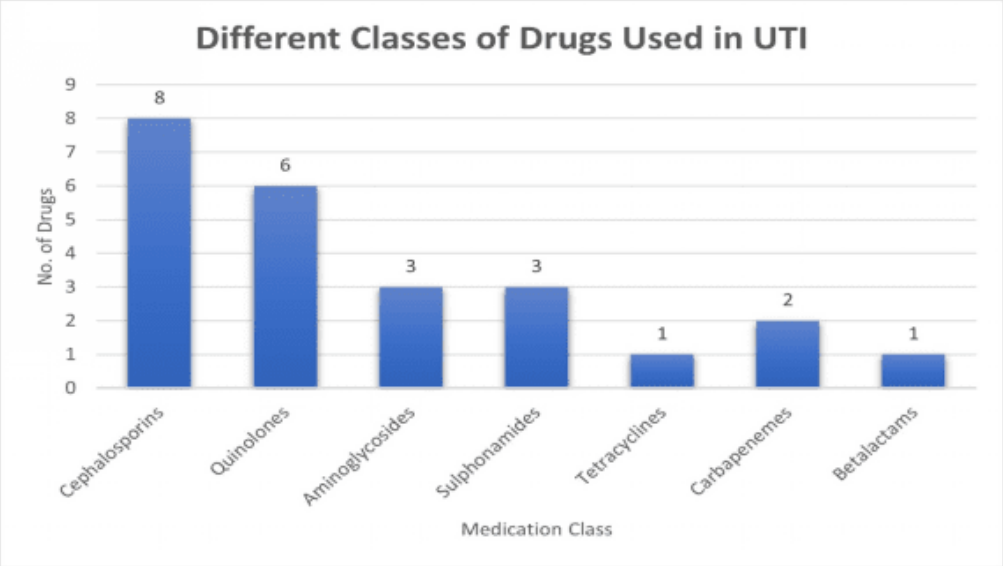
Table 6: Different classes of Drugs

CLASS	**NO. OF DRUGS**

Cephalosporins	8
Quinolones	6
Aminoglycosides	3
Sulphonamides	3
Tetracyclines	1
Carbapenemes	2
Betalactams	1

GRAPH: 6

DIFFERENT CLASSES OF DRUGS USED

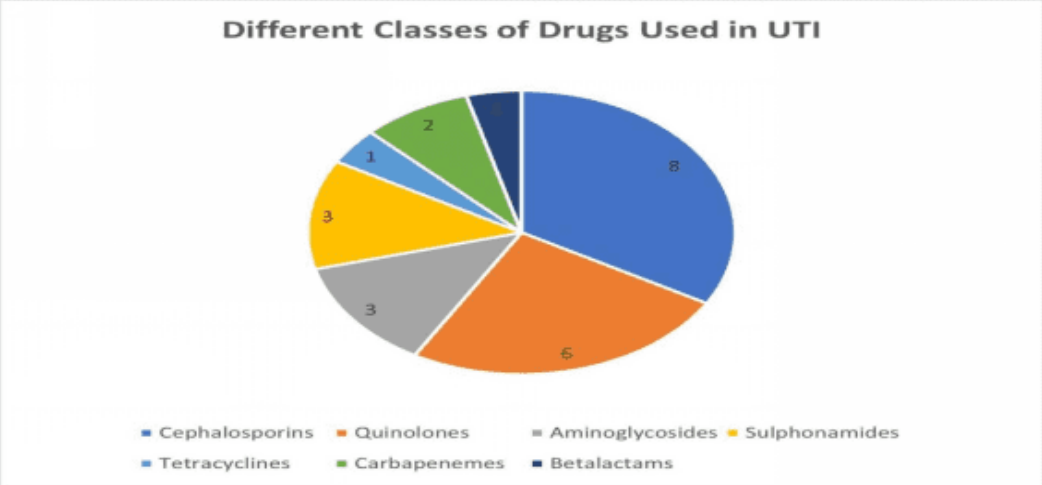


Bar Diagram-6: Graphical representation of different Classes of Drugs

The mostly prescribed antibiotics are cephalosporins followed by quiolones and the least prescribed antibiotics are tetracyclines and beta lactams.

PIE CHART: 5

DIFFERENT CLASSES OF DRUGS USED



Pie Chart 4: Graphical representation of classes of drugs

The mostly prescribed antibiotics are cephalosporins followed by quiolones and the least prescribed antibiotics are tetracyclines and beta lactams.

TABLE: 7

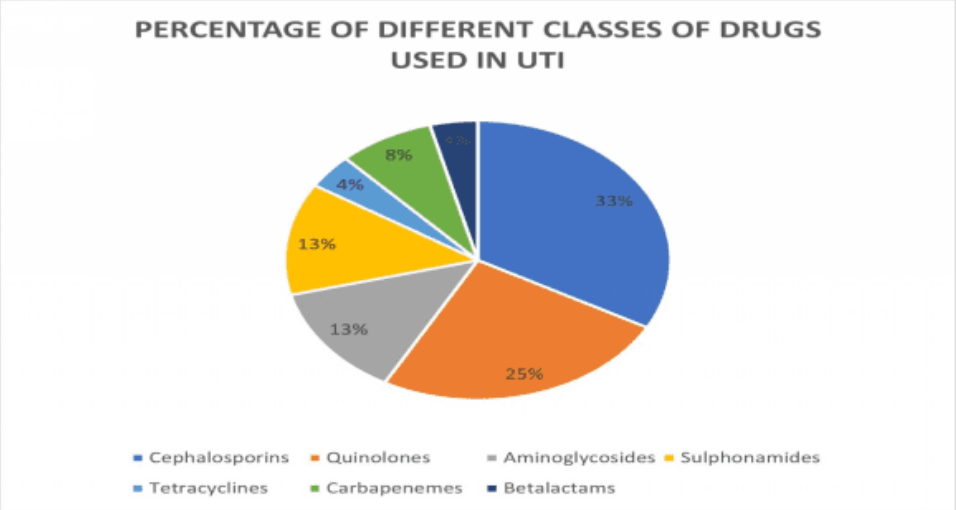
PERCENTAGE OF DIFFERENT CLASSES OF DRUGS USED

CLASS	NO. OF DRUGS IN PERCENTAGE
Cephalosporins	33%
Quinolones	25%
Aminoglycosides	13%
Sulphonamides	13%
Tetracyclines	4%
Carbapenemes	8%
Betalactams	4%

Table 7: Percentage of Antibiotics

PIE CHART: 6

PERCENTAGE OF DIFFERENT CLASSES OF DRUGS USED



Pie Chart 3: Graphical representation of percentage of drugs

Percentage of cephalosporins are more with 33% and the least prescribed antibiotics are tetracyclines and beta lactams.

	Generic drug	**Brand drug**	**Generic and Brand drug**
P Value	<0.0011	<0.0060	0.0080
Significant	Yes	Yes	Yes

Discussion

A Prospective observational study conducts pharmacoeconomic evaluation on antibiotics in urinary tract infection. It does a cost-minimization study and counts the number of brand-name and generic medications that are available.

Pharmacoeconomics is the area of economics that compares pharmaceutical goods and treatment plans using cost-benefit, cost-effectiveness, cost-minimization, cost-of-illness, and cost-utility assessments.Finding the lowest-priced medications is one of the primary goals of cost reduction analysis.

The investigation was carried out from January to May of 2024 during a period of five months. Before beginning any actual work, a procedure was created and a literature review was done. Using inclusion and exclusion criteria, data from 120 patients' community pharmacies was gathered.

By definition, generic medications are strong, safe, effective, and bioequivalent to branded medications. Comparatively speaking, generic medications are less expensive than branded ones. Even yet, a lot of treating physicians hardly ever prescribe generic medications.
Our research indicates that the most commonly prescribed antibiotics for UTIs are Amoxicillin, Ciprofloxacin, Doxycycline, Levofloxacin, Ceftriaxone, Cefixime, Ofloxacin, Ampicillin, Cotrimaxazole, Cefepime, and Ceftizidime.

The brand-name medications include ciprodac, novamax, doxcicip, taxim, and fluoxin, while the generic medications include Cipro, amoxil, suprax, ceftriaxone, and cefixime.
Patients that are female are the most impacted. due to the proximity of the urethra to the anus. Additionally, the bladder and the urethral entrance are near. This facilitates the entry of germs around the anus into the urethra and subsequent passage to the bladder.

Utilizing generic medications is crucial.Treatment costs may be lowered by using generic medications.They have distinct names, but the drug is the same in both.
Out of 120 individuals, quinolones (ofloxacin, levofloxacin) are the most often prescribed antibiotics for treating UTIs, followed by cephalosporins (cefipime, ciprofloxacin).The least often administered antibiotics include beta-lactams (Augmentin) and tetracyclines (Doxycycline).

Patients that are female are the most impacted. due to the proximity of the urethra to the anus. Additionally, the bladder and the urethral entrance are near. This facilitates the entry of germs around the anus into the urethra and subsequent passage to the bladder.

Conclusions

With uropathogens becoming more resistant to fluoroquinolones, cephalosporins (ciprofloxacin, cefipime) are an essential therapy choice for uncomplicated UTIs, followed by quinolones (levofloxacin, ofloxacin). Ciprofloxacin is probably less expensive than cefepime in the majority of cases. Our results are consistent with prior research showing that, when it comes to treating simple UTIs, the effectiveness and tolerability of ciprofloxacin and cefepime are similar.

Clinicians, local guidelines, and payers should advocate for the use of ciprofloxacin as a first-line choice for empirical treatment of uncomplicated UTIs due to its effectiveness, affordability, and relatively little impact on the development of further antimicrobial resistance.

Overall, the current prospective study suggests that patients should be administered less expensive medications rather than more expensive ones. We compared the costs of brand-name and generic medications in our study.

Generic medicine costs ought to be lower than those of brand-name medications. When comparing the cost of a cephalosporin generic against brand, the generic is less expensive.
Additionally, our research indicates that tetracyclines are the least frequently used antibiotics for urinary tract infections, whereas cephalosporins are the most frequently utilized.

By using Graph pad prism we analysed the P values for generic drugs,brand drugs and compared between generic and brand drug prices and the study was found to be significant.

- The P value for generic drug prices is 0.0011
- The P value for brand drug prices is 0.0060
- The P value for comparison of generic and brand drug prices is 0.0080

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