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Prevalence, Antibiotic Resistance Pattern for Enterobacterales from Patients Above 50 Years with Urinary Tract Infections

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Abstract-- **Urinary tract infections (UTIs) are highly prevalent in the elderly population (>50–65 years), often presenting with high morbidity due to age-related co morbidities and increased exposure to healthcare settings. Enterobacterales are the leading cause of these infections, with rising rates of multi-drug resistance (MDR).**

Urinary tract infections (UTIs) are common in elderly patients and present a very significant public health concern, particularly due to the increasing prevalence of antibiotic-resistant pathogens. This study aims to assess the prevalence of UTI-causing pathogens and their antibiotic resistance patterns in an above 50 years population.

Antibiotic resistance presents a significant global public health challenge, particularly for urinary tract infections (UTIs), and is notably severe in developing countries. Surveillance of the antimicrobial susceptibility patterns of UTI-causing bacteria is crucial for effective treatment selection. This study aimed to analyze these patterns in enterobacteriaceae isolated from the urine samples of patients at Serum Analysis Center Pvt.Ltd., Howrah, West Bengal, India from January 2026 to March 2026; examined clinical and laboratory data from patients with positive urine cultures (≥10^5 CFU/mL). The study patients age old adults (>50 years). The Vitek® 2 systems is an automated, rapid, and accurate method for determining the Minimum Inhibitory Concentration (MIC) method was used to assess antibiotic sensitivity to common antibiotics.

Results--**In our study positive culture growth shows in enterobacteriaceae group 66 (19.88%) from 332 total samples of age group > 50 to 59 years and 215 (31.25%) from 688 total samples of age group >60 years.**

In this study all enterobacteriaceae bacteria shows increasing resistance rate of antibiotics in both age groups are Amxycillin/ clavulanic acid, Cephalosporis group, Quinolones [Fluoroquinolones] group and Colistin.

The findings underscore the need for ongoing surveillance and tailored antibiotic therapy to effectively manage UTIs in this vulnerable population.

Keywords--**Enterobacterales; UTI; Old Adult Patients (>50 years); Antibiotic Resistance.**

I. Introduction

Urinary tract infection is a common problem worldwide. Urinary tract infections (UTI) is one of the most important causes of morbidity and mortality in the developing countries like India. Urinary tract infections (UTIs) are counted among the most common infections in children. Urinary tract infections (UTI) are among the most frequently acquired infections in the community, but also in hospitals and other health care institutions, causing a huge amount of antibiotic consumption. During the last decade we have seen significant changes in the field of urinary tract infections regarding causative pathogens and antibiotic treatment calling for an update of current trends.

Enterobacterales, primarily *Escherichia coli* and *Klebsiella pneumoniae*, are the leading causes of UTIs in patients over 50, with a high prevalence of 34% or more in this age group, often exacerbated by comorbidities. Resistance to commonly used antibiotics like ampicillin, ciprofloxacin, and TMP/SMX is very high, frequently exceeding 50-80%. There is a significant, increasing trend of ESBL-producing and multi-drug resistant (MDR) isolates in the elderly population.

Urinary tract infections (UTIs) are among the most common infections affecting the elderly population, particularly those residing in long-term care facilities or with chronic comorbid conditions.[1] The incidence of UTIs increases with age, primarily due to age-related physiological changes, weakened immune systems, and the presence of underlying conditions such as diabetes and benign prostatic hyperplasia in men.[2] In elderly patients, UTIs can lead to serious complications, including urosepsis and acute kidney injury, making prompt and effective treatment essential.[3]

In patients over 50 years with UTIs, Enterobacterales (especially *Escherichia coli* and *Klebsiella pneumoniae*) show high prevalence and significant resistance, with up to 75% resisting common antibiotics like trimethoprim and piperacillin/Tazobactam. Resistance is particularly high in institutionalized elderly patients, with >35% non-susceptible to 3rd-generation cephalosporins and rising carbapenem resistance.

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The use of antibiotics in patients over 50 is heavily impacted by rising resistance, making the management of UTIs a complex, and high-risk endeavor that requires careful, individualized treatment decisions based on recent exposure history and laboratory testing to mitigate the risk of severe complications.

In old adult patients with urinary tract infections (UTIs), antibiotic resistance is a significant challenge, with a high prevalence of **multidrug-resistant (MDR)** and **extended-spectrum beta-lactamase (ESBL)-producing** pathogens, especially *Escherichia coli*. Resistance rates are notably higher in this age group due to increased comorbidity, previous antibiotic use, and potential for hospital-acquired infections.

Appropriate use of antibiotics is the most important interventable factor in fight against AMR.[4] Thus, antimicrobial stewardship programs and societies published guidelines for defining appropriate treatments in each stage of UTIs.[5–8] On the other hand, antibiotic consumption trends and policies vary among countries which cause different susceptibility patterns that may lead to variable therapies.[9] Recently AMR showing increasing ratios of Enterobacterales producing extended-spectrum β-lactamases (ESBL), AmpC β-lactamases, and carbapenemases along with other resistance mechanisms threaten public health.[10] The European Committee on Antimicrobial Susceptibility Testing (EUCAST) is the reference method to apply and interpret AMST results, which is strongly recommended to monitor years by even local facilities.[11,12] The aim of this study is to share AMR status of our tertiary centre in urine isolates and to observe whether there is a significant alteration, or not.

II. Materials And Methods

Study Area:

The present retrospective study was carried out in the Referral Laboratory, Serum Analysis Centre Pvt. Ltd.; 177, Netaji Subhas Road, Halder Para, Howrah-711101, West Bengal, India.

Study Period:

This study was carried out a period of Three months from January 2026 to March 2026.

Study Samples:

The inclusion criteria for this study in all old adult patients above 50 years age of both sexes of outpatients of urine sample.

Collection Of Urine Samples:

Early morning mid-stream urine samples were collected using sterile, wide mouthed container with screw cap tops. [13] On the urine sample bottles were indicated name, age, sex, and time of collection along with requisition forms.

Sample Processing:

A calibrated sterile micron wire loop for the semi-quantitative method was used for the plating and it has a 4.0 mm diameter designed to deliver 0.01 ml. A loopful of the well mixed urine sample was inoculated on HiCrome UTI Agar media and EMB [Eosin Methylene Blue] Agar media. The plate was incubated aerobically at 37^0C for overnight. The plates were then examined macroscopically and microscopically (colony Gram stain) for bacterial growth. The bacterial colonies were counted and multiplied by 100 to give an estimate of the number of bacteria present per milliliter of urine. Culture results were interpreted according to the standard criteria and a growth of > 10^5 colony forming unit [CFU] /ml was considered as significant bacteriuria [14]. The urine samples were analyzed bacteriological using the methods [13, 15, 16].

Identification Of Isolates:

The isolates were identified using colony morphology, Gram staining, Motility test, Indole test, Citrate test [Simmons Citrate Agar media], Urease test [Urease Agar media + 40% Urea], Triple Sugar Iron Agar media, and ONPG [Ortho-nitrophenyl beta-D-galactopyranoside] [13, 16].

Sensitivity Testing Using Mic Technique

The Vitek® 2 system is an automated, rapid, and accurate method for determining the Minimum Inhibitory Concentration (MIC) (lowest antibiotic concentration inhibiting bacterial growth). It uses 64-well, miniaturized, disposable cards containing premeasured antibiotics, which are inoculated, incubated, and read automatically via turbidimetric/colorimetric technology. The system, often used for identifying Gram-positive/negative bacteria and yeasts, provides results usually within hours, aiding in the selection of effective, targeted antibiotic therapy based on CLSI or EUCAST breakpoints.

Key Aspects Of The Vitek MIC Method:

- *Technology:* The system uses a turbidity-based (sometimes fluorescence-based) detection method to measure bacterial growth in the presence of different antibiotics within the card.
- *Workflow:* A standardized bacterial suspension (0.5 McFarland) is prepared, and the Vitek card is filled,

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sealed, and incubated. The Vitek 2 Compact allows for manual loading, while the Vitek 2 automates the entire process.

- *Advanced Expert System (AES):* Vitek 2 includes an AES that validates results by analyzing the MIC pattern against a database to interpret resistance mechanisms (e.g., MRSA, ESBL).
- *Card Types:* Specific cards exist for Gram-positive, Gram-negative, and yeast, with a limited, though expanding, selection of antibiotics.
- *Advantages:* Offers rapid results (often in 4-18 hours), high reproducibility, and reduced manual labor.
- *Limitations:* It may not detect some novel resistance mechanisms, and certain bacteria (e.g., highly mucoid strains) may not be accurately interpreted.

In this study following Antibiotics use in Vitek® 2 system:

1. *Penicillin Group:*
   (A) Amoxicillin + Clavulanic acid
   (B) Piperacillin/Tazobactam
2. *Cephalosporins Group:*
   (A) Cefoxitin
   (B) Cefixime
   (C) Ceftriaxone
   (D) Cefipime
   (E) Cefoperazone/Sulbactam
3. *Quinolones Group [Fluoroquinolones]:*
   (A) Norfloxacin
   (B) Ciprofloxacin
4. *Aminoglycosides Group:*
   (A) Amikacin
5. *Carbapenem Group:*
   (A) Ertapenem
   (B) Meropem
6. *Sulfonamides Group:*
   (A) Co-trimoxazole [Trimethoprim+ Sulphamethoxale]
7. *Miscellaneous Anti-Infective Agents:*
   (A) Nitrofurantoin
   (B) Colistin

III. Results

Age Group:

- Old Adult Age: >50–59 years.
- Senior Adult Age: 60+ years.

Table: 1. Age Distribution of Sampled Population.

Age Group	Total Population of Patient	Male	Female
>50 to 59 years	332	166	166
>60 years	688	378	310

Table: 2. Prevalence of UTI in different age groups.

Age Group	Total Population	Positive culture	Negative culture
>50 to 59 years	332	66 (19.88%)	266 (80.12%)
>60years	688	215 (31.25%)	473 (68.75%)

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Table: 3. Prevalence of UTI in different age groups with Male & Female.

Age Group	Total Population in Male	Positive culture in Male	Total Population in Female	Positive culture in Female
>50 to 59 years	166	30 (18.07%)	166	24 (14.46%)
>60 years	378	64(16.93%)	310	80 (25.81%)

Table: 4. Prevalence of pathogens isolated on urine culture with age group of >50 to 59 years.

Pathogens	Total Isolates	Male Patient	Female Patient
Escherichia coli	48	26	22
Klebsiella pneumonia	14	08	06
Proteus mirabilis & others Proteus Spp.	04	03	01

Table: 5. Prevalence of pathogens isolated on urine culture with age group of >60 years.

Pathogens	Total Isolates	Male Patient	Female Patient
Escherichia coli	166	72	94
Klebsiella pneumonia	40	14	26
Proteus mirabilis & Others Proteus Spp.	09	04	05

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Table: 6. Percentage of Resistant & Susceptibility of isolated *Escherichia coli* to tested use of antibiotics: [>50 TO 59 YEARS]

Total Isolates: 48

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	36	75.0%	12	25.0%
Piperacillin/Tazobactam	20	41.0%	28	59.0%
Cefoxitin	36	75.0%	12	25.0%
Cefixime	40	83.0%	08	17.0%
Ceftriaxone	32	66.0%	16	34.0%
Cefipime	20	41.0%	28	59.0%
Cefoperazone/Sulbactam	08	17.0%	40	83.0%
Norfloxacin	12	25.0%	36	75.0%
Ciprofloxacin	40	83.0%	08	17.0%
Amikacin	04	8.0%	44	92.0%
Ertapenem	08	17.0%	40	83.0%
Meropem	04	8.0%	44	92.0%
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	20	41.0%	28	59.0%
Nitrofurantoin	10	21.0%	38	79.0%
Colistin	46	96.0%	02	4.0%

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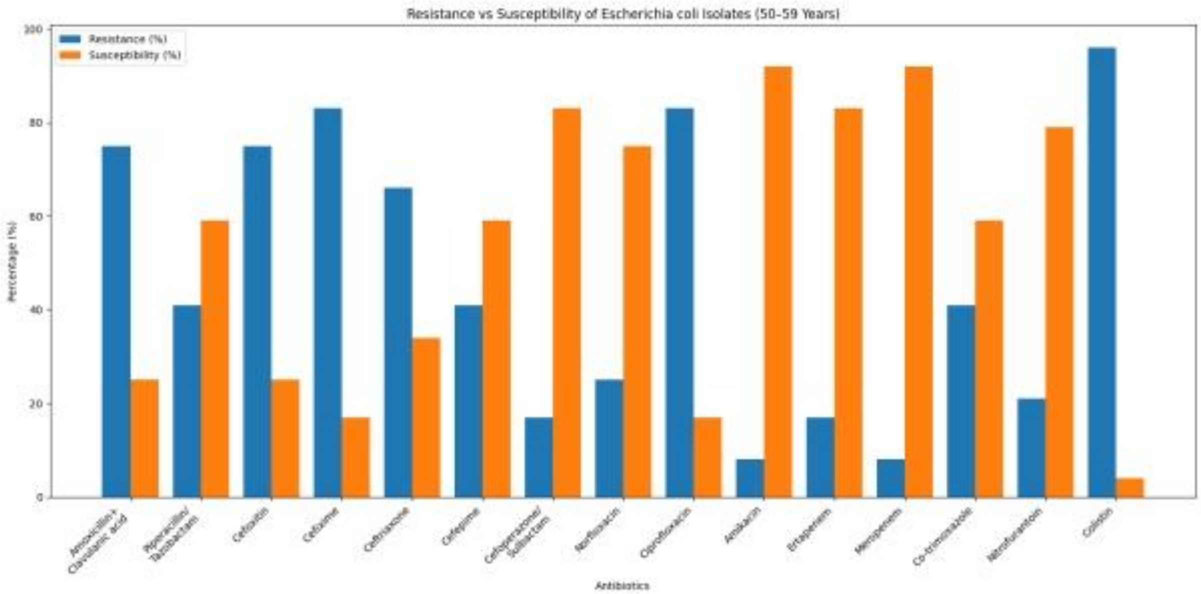

Fig: 1. Pattern of *Escherichia coli* Resistant & Sensitive [>50to 59 Years]

Table: 7. Percentage of Resistant & Susceptibility of isolated *Klebsiella pneumoniae to* tested use of antibiotics: [>50 TO 59 YEARS]

<u>Total Isolates: 14</u>

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	10	71.0%	04	29.0%
Piperacillin/Tazobactam	10	71.0%	04	29.0%
Cefoxitin	10	71.0%	04	29.0%
Cefixime	10	71.0%	04	29.0%
Ceftriaxone	12	86.0%	02	14.0%
Cefipime	12	86.0%	02	14.0%
Cefoperazone/Sulbactam	10	71.0%	04	29.0%
Norfloxacin	09	64.0%	05	36.0%
Ciprofloxacin	09	64.0%	05	36.0%

Amikacin	**12**	**86.0%**	**02**	**14.0%**
Ertapenem	**10**	**71.0%**	**04**	**29.0%**
Meropem	**08**	**57.0%**	**06**	**43.0%**
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	**10**	**71.0%**	**04**	**29.0%**
Nitrofurantoin	**10**	**71.0%**	**04**	**29.0%**
Colistin	**12**	**86.0%**	**02**	**14.0%**

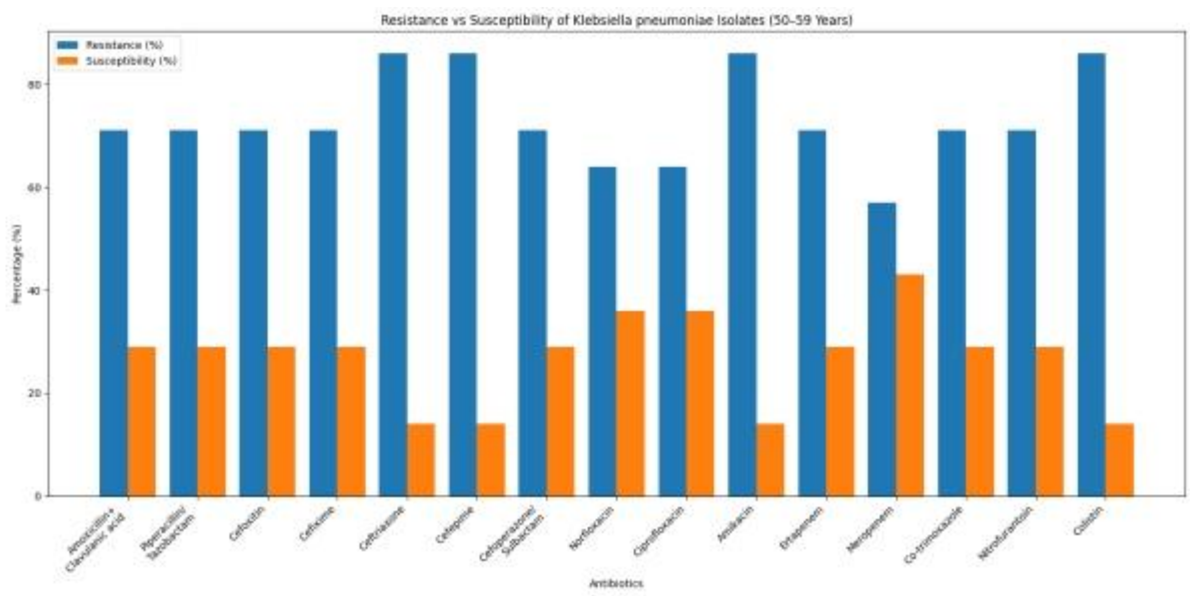

Fig: 2. Pattern of *Klebsiella pneumoniae* Resistant & Sensitive [>50 to 59 Years]

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Table: 8. Percentage of Resistant & Susceptibility of isolated others *Proteus mirabilis & Others Proteus Spp.* to use of antibiotics: [>50 TO 59 YEARS]

Total Isolates: 04

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	03	75.0%	01	25.0%
Piperacillin/Tazobactam	02	50.0%	02	50.0%
Cefoxitin	03	75.0%	01	25.0%
Cefixime	03	75.0%	01	25.0%
Ceftriaxone	03	75.0%	01	25.0&
Cefipime	02	50.0%	02	50.0%
Cefoperazone/Sulbactam	02	50.0%	02	50.0%
Norfloxacin	02	50.0%	02	50.0%
Ciprofloxacin	03	75.0%	01	25.0%
Amikacin	02	50.0%	02	50.0%
Ertapenem	02	50.0%	02	50.0%
Meropem	01	25.0%	03	75.0%
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	02	50.0%	02	50.0%
Nitrofurantoin	01	25.0%	03	75.0%
Colistin	03	75.0%	01	25.0%

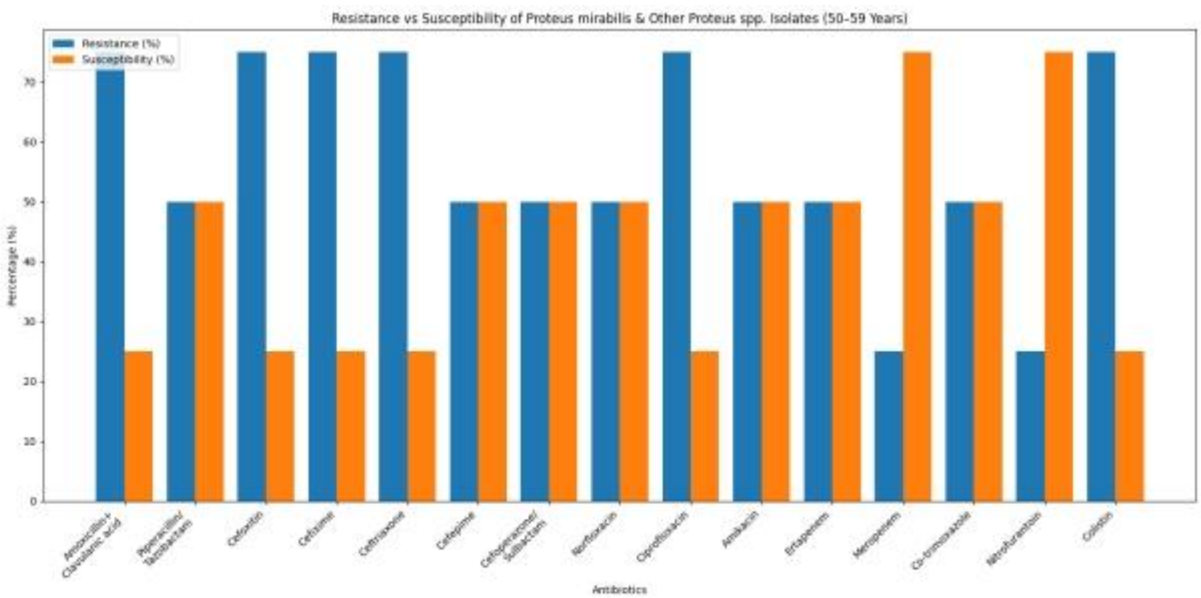

Fig: 3. Pattern *Proteus mirabilis* & Others *Proteus Spp.* Resistant & Sensitive [>50 to 59 Years]

Table: 9. Percentage of Resistant & Susceptibility of isolated *Escherichia coli* to tested use of antibiotics: [>60 YEARS]

Total Isolates: 166

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	77	46.39%	89	53.61%
Piperacillin/Tazobactam	79	47.59%	87	52.41%
Cefoxitin	90	54.22%	76	45.78%
Cefixime	104	62.65%	62	37.35
Ceftriaxone	99	59.64%	67	40.36%
Cefipime	87	52.41%	79	47.59%
Cefoperazone/Sulbactam	79	47.59%	87	52.41%
Norfloxacin	66	40.00%	100	60.00%
Ciprofloxacin	118	71.08%	48	28.92%

Amikacin	**58**	**34.94%**	**108**	**65.06%**
Ertapenem	**67**	**40.36%**	**99**	**59.64%**
Meropem	**51**	**30.72%**	**115**	**69.28%**
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	**99**	**59.64%**	**67**	**40.36%**
Nitrofurantoin	**33**	**19.88%**	**133**	**80.12%**
Colistin	**107**	**64.46%**	**59**	**35.54%**

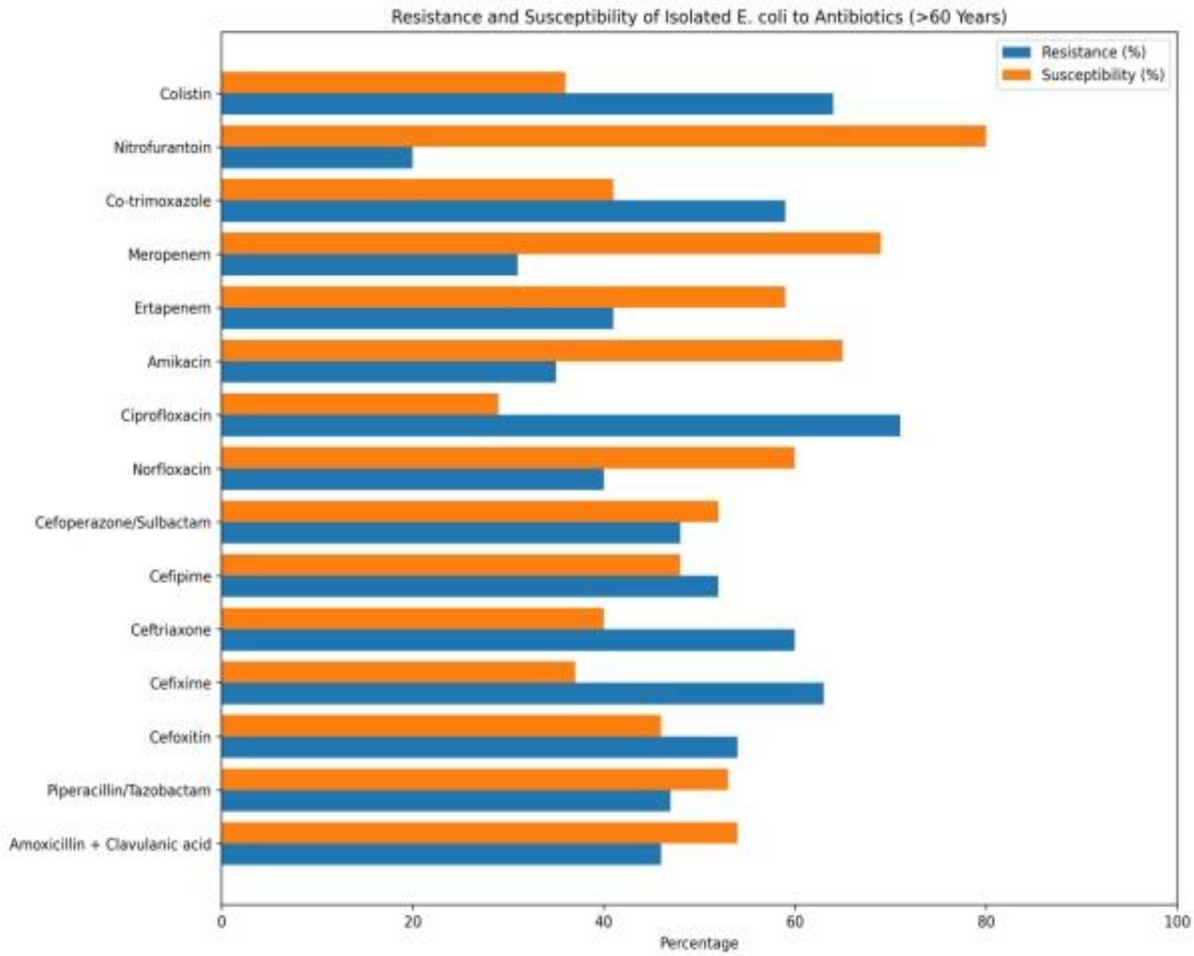

Fig: 4. Pattern of *Escherichia coli* Resistant & Sensitive [>60 Years]

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Table: 10. Percentage of Resistant & Susceptibility of isolated *Klebsiella pneumoniae to* tested use of antibiotics: [>60 YEARS]

Total Isolates: 40

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	28	70.00%	12	30.00%
Piperacillin/Tazobactam	22	55.00%	18	45.0%
Cefoxitin	25	62.50%	15	37.50
Cefixime	23	57.50%	17	42.50%
Ceftriaxone	21	52.50%	19	48.50%
Cefipime	28	70.00%	12	30.00%
Cefoperazone/Sulbactam	26	65.00%	14	35.00%
Norfloxacin	23	57.50%	17	42.50%
Ciprofloxacin	29	72.50%	11	28.50%
Amikacin	26	65.00%	14	35.00%
Ertapenem	19	47.50%	21	52.50%
Meropem	20	50.00%	20	50.00%
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	23	57.50%	17	42.50%
Nitrofurantoin	21	52.50%	19	47.50%
Colistin	09	22.50%	31	77.50%

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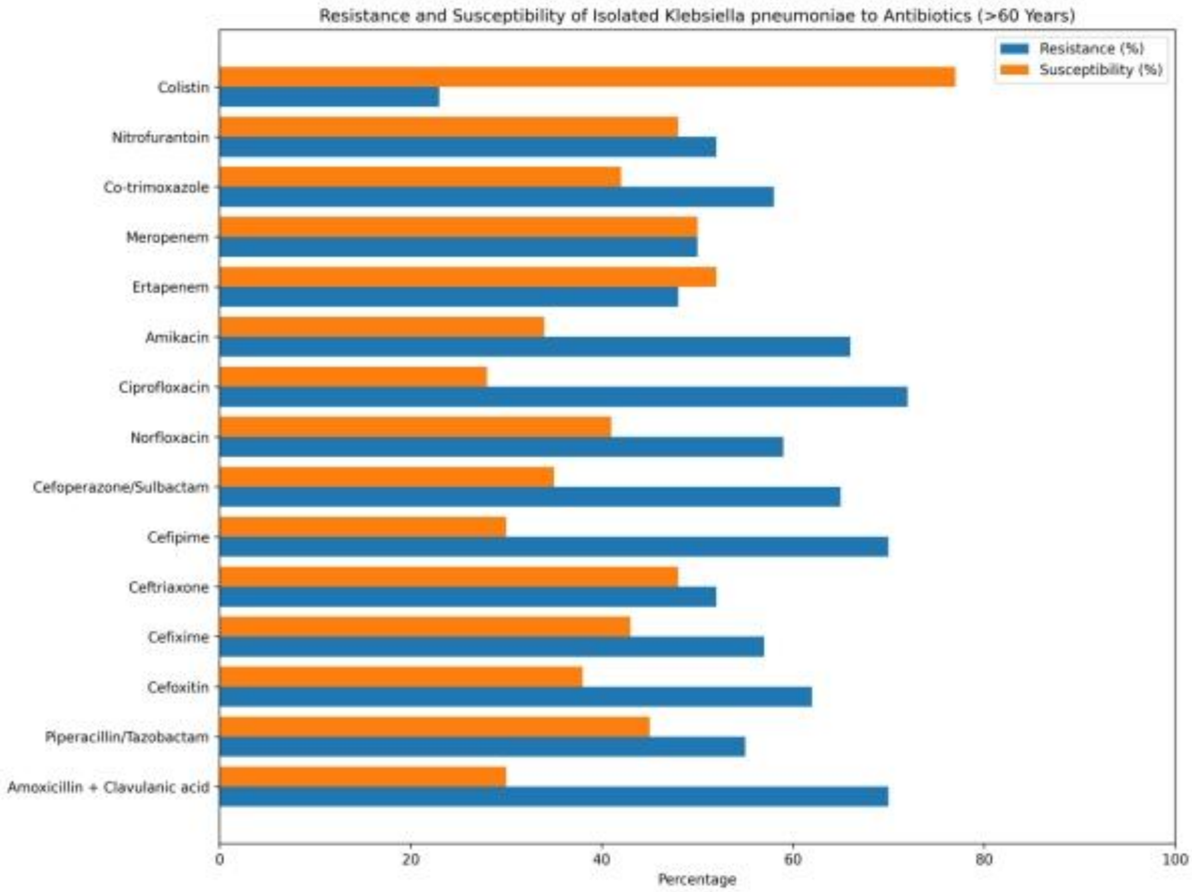

Fig: 5. Pattern of *Klebsiella pneumoniae* Resistant & Sensitive [>60 Years]

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Table: 11. Percentage of Resistant & Susceptibility of isolated *Proteus mirabilis & Others Proteus Spp.* to tested use of antibiotics: [>60YEARS]

Total Isolates: 09

Antibiotics	R (No.)	R (%)	S (No.)	S (%)
Amoxicillin + Clavulanic acid	07	77.78%	02	22.22%
Piperacillin/Tazobactam	02	22.22%	07	77.78%
Cefoxitin	05	55.56%	04	44.44%
Cefixime	05	55.56%	04	44.44%
Ceftriaxone	05	55.56%	04	44.44%
Cefipime	05	55.56%	04	44.44%
Cefoperazone/Sulbactam	04	44.44%	05	55.56%
Norfloxacin	05	55.56%	04	44.44%
Ciprofloxacin	06	66.67%	03	33.33%
Amikacin	03	33.33%	06	66.67%
Ertapenem	04	44.44%	05	55.56%
Meropem	02	22.22%	07	77.78%
Co-trimoxazole [Trimethoprim+ Sulphamethoxale]	03	33.33%	06	66.67%
Nitrofurantoin	05	55.56%	04	44.44%
Colistin	06	66.67%	03	33.33%

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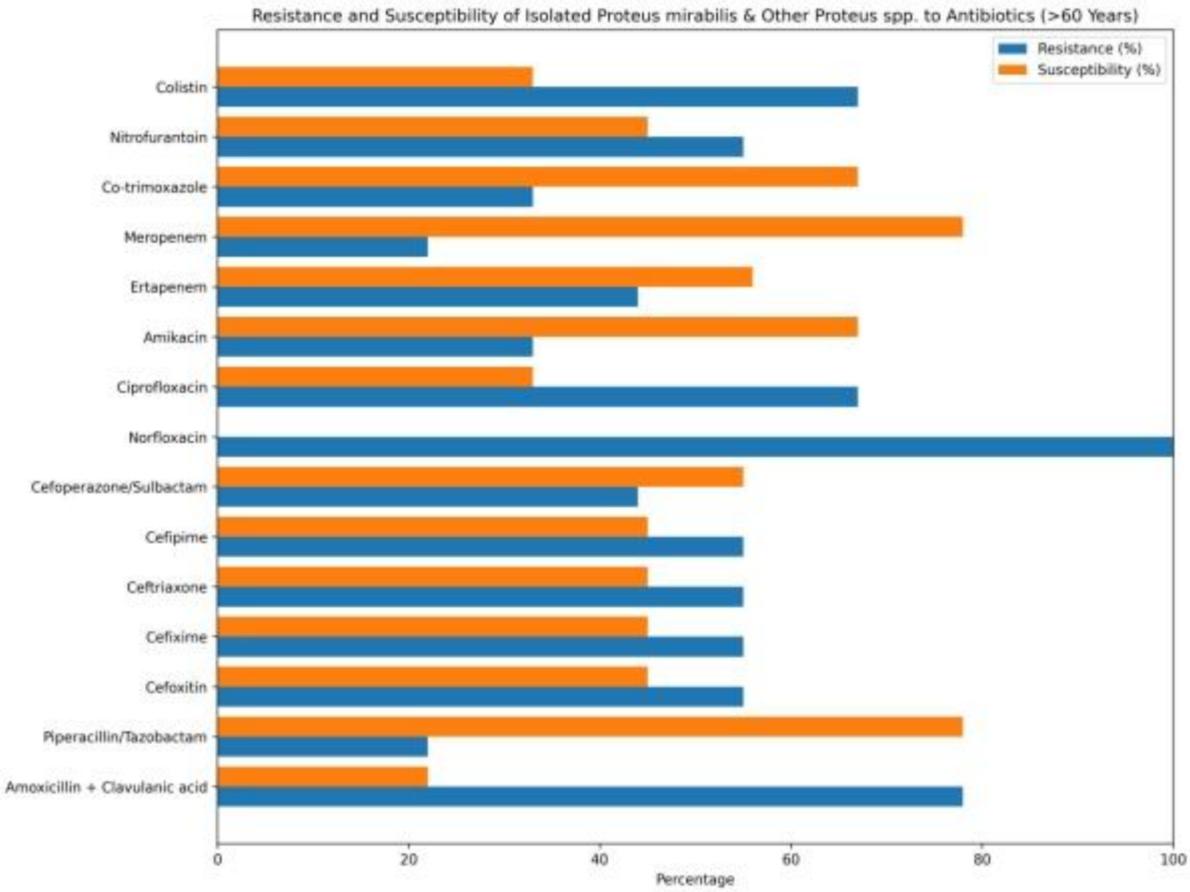

Fig: 6. Pattern of *Proteus mirabilis* & Others *Proteus Spp.* Resistant & Sensitive [>60 Years]

IV. Discussion

Urinary tract infections are some of the most common bacterial infections and is prevalent worldwide. The treatment of UTIs relies heavily on antimicrobial therapy. However, the overuse of antimicrobial therapy has led to the development of drug-resistant microorganisms. Since microorganisms frequently change their susceptibility patterns, it is essential to continuously monitor antimicrobial susceptibility patterns.

Enterobacterales, primarily *Eschericchia coli* and *Klebsiella pneumoniae*, are leading causes of UTIs in patients >50 years, with high resistance rates driven by excessive empirical antibiotic use (e.g., fluoroquinolones, cephalosporins). High prevalence of Extended-Spectrum Beta-Lactamase (ESBL) production and, in some cases, carbapenem resistance, often necessitates tailored therapy based on regional resistance patterns, as resistance increases with age.

In our study positive culture growth shows in enterobacteriaceae group 66 (19.88%) from 332 total samples of age group > 50 to 59 years and 215 (31.25%) from 688 total samples of age group >60 years.

In this study all enterobacteriaceae bacteria shows increasing resistance rate of antibiotics in both age groups are Amxycillin/ clavulanic acid, Cephalosporis group, Quinolones [Fluoroquinolones] group and Colistin.

This study aimed to assess the prevalence and antibiotic resistance patterns of urinary tract infections (UTIs) in above 50 years patients a 3- month period. The findings underscore the significant burden of UTIs in the elderly, with *Escherichia coli* identified as the predominant pathogen, consistent with existing literature (Mareș et al,[17] 2023; Nguyen et al,[18] 2019). However, the high levels of antibiotic resistance observed in *Escherichia coli* and other pathogens raise serious concerns about the effectiveness of commonly used empirical treatments (Alhomayani et al,[19] 2022).

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Prevalence of Pathogens The dominance of *Escherichia coli* (56%) as the leading causative agent aligns with global trends, where it is recognized as the primary pathogen in UTIs across all age groups (Paul,[20] 2018). The presence of other pathogens such as *Klebsiella pneumonia* and *Proteus mirabilis* reflects the diverse microbial landscape associated with UTIs in elderly patients. These pathogens, while less prevalent, exhibited substantial resistance to multiple antibiotics, complicating treatment options (Ho et al,[21] 2019). In our study findings are consistent with reports from other regions, indicating that resistance to these antibiotics is widespread (Khan et al,[22] 2023).

This study highlights the high prevalence of *Escherichia coli* as the primary uropathogen in elderly patients, with significant resistance to commonly used antibiotics. The presence of multidrug-resistant strains, particularly in *Klebsiella pneumoniae* further complicates treatment. These findings necessitate a reassessment of current empirical treatment protocols, favouring the use of antibiotics with lower resistance rates. Continuous surveillance of antibiotic resistance patterns is crucial to improving clinical outcomes and managing the increasing threat of multidrug-resistant UTIs in this vulnerable population.

Antibiotic resistance has emerged as a significant public health issue, resulting in restricted treatment alternatives, elevated healthcare expenses, and extended hospitalization. It is crucial to continually monitor and investigate the shifting trends in bacterial drug susceptibility pattern, especially in relation to urinary tract infections. This enables treating physicians to remain up to date on the most effective initial treatments for UTIs. Instead of depending on standardized guidelines, the selection of antibiotics for UTI therapy should be determined by periodically understanding the prevalence of particular microorganisms responsible for the infection and assessing their susceptibility to antibiotics in the local region.

V. Conclusion

In summary, rising antibiotic resistance among urinary pathogens, and especially the emergence of multi-drug resistant clonal groups, has provided urgency to the development of novel preventative and therapeutic strategies. Some older antibiotics may prove to be very useful in treating antimicrobial-refractory UTIs, especially those due to ESBL-producers. Newer Antibiotic, such as the recently approved doripenem, have proven highly effective in the clinic to treat complicated UTIs.

Research into novel anti-virulence therapies, such as inhibiting the production of, or adherence by, urinary pathogenic *Escherichia coli* (UPEC) fimbriae is still an early stage but holds promise for future development. The use of probiotics to prevent vaginal urinary pathogenic *Escherichia coli* (UPEC) colonization and the use of an immuno-stimulatory urinary pathogen extract (SolcoUrovac) are currently in clinical trials to determine efficacy in preventing recurrent UTIs. Another preventative strategy is vaccination, and experimental vaccines have been developed that are effective in preventing UTIs in primates.

It is important that each country should have its own epidemiological data, and physicians should know antimicrobial resistance rates in their regions so as to arrange treatment, and prophylaxis accordingly. Antimicrobial resistance rates are increasing steadily against antibiotics expected to exert clinical efficacy in the treatment of UTI as a result of their widespread, and erroneous use. We think that at certain intervals canters should identify urinary pathogens prevalent in their regions, and aware of antimicrobial susceptibilities of these pathogens which are very important for the economy of the country, and appropriate treatment.

Antimicrobial resistance is a globally ever increasing problem. The emergence and spread of antimicrobial resistance are complex and driven by numerous interconnected factors. The principle causes of microbial resistance are inappropriate, irrational, high consumption, and profligate use of antibiotics. The use of antimicrobials must be restricted and monitored in order to decline the resistance. The present results in increasing antibiotic resistance trends in UTI patients indicate that it is imperative to rationalize the use of antimicrobials and to use these conservatively. Considering the relatively increase rates of UTI and drug resistance observed in this study, continued local, regional, and national surveillance is warranted. Antibiotics should only be issued when prescribed by physicians.

Regular monitoring is required to establish reliable information about resistance pattern of urinary pathogens for optimal empirical therapy of patients with UTIs. A combination of traditional and innovative prevention and treatment strategies is being deployed to combat the threat of emerging antibiotic resistance among urinary pathogens. Finally, we suggest that empirical antibiotic selection should be based on the knowledge of local prevalence of bacterial organisms and antibiotic sensitivities rather than on universal guidelines.

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The prevalence of Enterobacterales causing UTIs is high in patients over 50, with alarming rates of antibiotic resistance and ESBL production, necessitating tailored, evidence-based, and often broader-spectrum empirical therapy to avoid treatment failure.

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