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RESEARCH ARTICLE
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EVOLVING ANTIBIOTIC RESISTANCE IN ELDERLY UTIS: ORIGINAL TRIALS

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Introduction

The maximum frequent infectious disease in elderly patients is urinary tract infection, while Escherichia coli is the maximum established uropathogen among those over 65 who live in communities (Matthews, 2011). With a 20–40% death rate, UTIs can range in severity from a mild, self-limiting disease to severe sepsis. Males are more probable than females to have severe UTIs, and the prevalence of sepsis and the mortality it is related with rises disproportionately with age. When it comes to UTIs, both sexes are equally susceptible in old age. In patients over 70, the female to male ratio is 2:1, while in younger people, the ratio is 50:1. To inspire Clinical Authorizing Groups to lower the use of antibiotics in principal care, for instance, introduced the Quality Premium (Borek, 2020). Between 2013 and 2017, there was a significant decline in antibiotic use in Pakistan entire healthcare system for the first time since these new policies were implemented. According to a recent study, fewer elderly patients receiving primary care saw the prescription of wide-spectrum antibiotics for UTIs. Twenty However rises in the prevalence of gram-negative bloodstream infections have been documented in the meantime, (Folgori, 2014) prompting the UK government to declare a strategy to cut the number of gram-negative circulation infections linked to healthcare in Pakistan by 50% by (Tacconelli, 2014). Assessment of the management and result of urinary tract infections (UTIs) is becoming increasingly important as the use of antibiotics changes in the context of antimicrobial resistance. The incidence of Clostridium pneumoniae difficult in the elderly has also raised concerns about the excessive use of antibiotics in this population. On the other hand, a reduction in the use of antibiotics may be detrimental to older adults who are already susceptible to circulation infections and UTI complications. Further data

regarding the first treatment for UTI in primary care is required. This includes evaluating the clinical outcomes of counselling strategies that include no antibiotics, delayed prescription antibiotics, or direct antibiotics (Little, 2014). A practical technique of assessing the effect of community-based typical care for a generous cohort of elderly individuals with inveterate or supposed UTIs on adverse actions, such as hospital charge, death, and circulation infection, was made likely by our connecting of primary care statistics in Pakistan with hospitalizations and humanity data at the equal of the individual.

METHODS

Data collection and analysis

Surgical Institute in Lahore, Pakistan, received trials (freshly voided midway samples of urine) from June to November 2010 for analysis at the Research laboratory of Clinical Microbiology and Attraction. Residents of 14 different Lombardy assisted living facilities, with bed capacities ranging from 30 to 300, provided samples (Melchiorre, 2021). The informed consent form created by the nursing home's medical staff was approved by study participants or their representatives. The following patients were excluded from consideration: those with spinal cord injuries, who were receiving dialysis, were on antibiotic or anti-infective treatment within the preceding month, were on long-lasting suppressive treatment, or were in position for four weeks; these patients were also considered terminally ill and had an estimated life expectancy of four weeks. Patients with enduring tubes were also immune from the training (Bomans, 2018).

According to (Nejman, 2020) the study contained just samples that had both significant amounts of bacteria (>104.f.u. ml-1) and pyuria (>10 white blood cells Ul-1) from topics who had at minimum one of the succeeding clinical indications: minor fever, increased fiery pain during urination, incidence or urgency, suprapubic pain or sensitivity, novel or falling incontinence, or decline in rational or practical status. The protein esterase activity was measured using a Comber Testing reagent strip for urinalysis (Roche) on leukocytes (Xie, 2021). Light microscopy was used to confirm white blood cell counts (greater than five cells per extremely strong field). A additional sample taken two days following the first showed samples containing three distinct bacterial species. Samples containing more than three kinds of bacterium were deemed tainted. Unless fresh pathogens were isolated from the same individual, the study only took into account a single positive culture per patient.Gram-staining and conventional biochemical methods (API System; bioMe´rieux) were used to identify pathogens (Pinatih, 2022).

Antibiotic susceptibility testing

The Health and Scientific Standards Institute's (CLSI, 2009a) disc transmission method was charity to behavior antimicrobial resistance taxing (Hein, 2020). Becton Dickinson provided the antimicrobial agents. A slide gauge was used to quantify inhibition zone sizes to the nearest millimeter (CLSI, 2009a, b). As control stresses, Escherichia coli ATCC 25922, Pseudomonas aeruginosa ATCC 27853, and Staphylococcus aureus ATCC 25923 remained employed. The acceptance of test findings was contingent upon the inhibition zone diameters falling within the performance range. The following antimicrobial drugs were used to test gram-negative bacteria: levofloxacin, ciprofloxacin, amikacin, cefotaxime, and ticarcillin/clavulanic acid. Tests for ceftazidime, the medicine, piperacillin/tazobactam, pipemidic acid, cefepime, meropenem and colistin, were also conducted on gram-negative isolates that tested positive for the oxidative oxidation test (Rao R, 2020).

Assays were conducted using ampicillin, cephalotin, fosfomycin, imipenem, and nitrofurantoin against isolates that were Gram-negative oxidase-negative.Penicillin, this antibiotic, sulfamethoxazole/trimethoprim, ampicillin, cefoxitin, gentamicin, amikacin, linezolid treatment, vancomycin, teicoplanin, and rifampicin were the antibiotics in the panel that were effective against Gram-positive bacteria. The CLSI phenotypic approach is utilized for the discovery of extended-spectrum b-lactamases (ESBL). For all divorces, the disc dispersion method on Mueller-Hinton agar

plates was used to conduct the CLSI ESBL confirmatory test with cefotaxime. In accordance with standards set by the CLSI (2009b), susceptibility test findings were interpreted (Afhami, 2020).

Statistical analysis

The information gathered included clinical presentation, antibiotic spectrum of resistance, urine culture outcomes, and demographics (De Lorenzis, 2020). The position (mean, median, first, and third quartile) as well as the spreading indices and percentages and frequencies (if categorical) were used to define the variables. An evaluation of the impact of age and gender on the type of bacteria identified was conducted using a logistical approach. The Greenacre adjustment was used to account for inertia, and a several communication analysis was utilized to identify qualitative associations in the catching outline of patients. In order to identify the relationship among the pattern of resistance signature and the genus, the bacteria genera that are more commonly Proteus, Enterobacter, Morganella, isolated—Klebsiella, and Providencia—stayed both added as a supplementary point in the multiple communication analysis (Janda, 2021). A regression analysis was carried out to look into any significant connections between the resistance pattern that was found and explanatory variables such as sex, age period, and bacteria. The SAS Institute's v9.1.3 software was used for altogether analyses. P values less than 0.05 were observed as important (Dietz, 2020).

RESULTS

Isolated micro-organisms

Out of the 472 samples that were analyzed between June and November 2010, 328 (69.5%) had positive results, and 59 (17.9%) of those results were polymicrobial. Ninety-three (28.4%) men and 235 (71.6%) women made up the patient population with a diagnosed UTI, whose mean age was 86±8 years (average 86 years). 393 microorganisms in all were inaccessible; Escherichia coli was the maximum common species, followed by Providencia Proteus, mirabilis spp. (Stuartii primarily Providencia), Klebsiella spp., and Pseudomonas aeruginosa; the maximum common Gram-positive bacteria was enterococci (Table 1).

Table 1. Micro-organisms isolated from urine samples

Micro-organism	**Males**		**Females**		**Total**	
	n	%	n	%	n	%
Proteus mirabilis	26	25.7	54	18.5	80	20.4
Providencia spp.	8	7.9	27	9.2	35	8.9
Escherichia coli	33	32.7	143	49.0	176	44.8
Klebsiella spp.	7	6.9	18	6.2	25	6.4
Other Enterobacteriaceae	9	8.9	8	2.7	17	4.3
Pseudomonas aeruginosa	2	2	16	5.5	18	4.6
Acinetobacter spp.	1	1	0	0	1	0.3
Staphylococcus aureus	4	3	8	2.7	12	3.1
Enterococcus spp.	11	10.9	18	6.2	29	7.4
Total	101	100	292	100	393	100

Compared to men, females were reported to have contracted an infection with Escherichia coli more often; the odds relation assessment for ladies was 1.87 [95% self-assurance interval 1.143–3.06; P50.0127], and when categorized by mean age (86 years), the OR estimate for older individuals was 1.54 (95% CI 1.02–2.33; P50.0423). Between females and males, there were differences in the isolation charges of Vibrio mirabilis, Escherichia coli, and Gram-positive organisms. Males were more likely than women to isolate Proteus mirabilis (25.7 vs. 18.5%), although Escherichia coli was recovered from 49.0% of urine trials in females and 32.7% in males. Males became more likely than females to get UTIs from gram-positive organisms (14.9 vs. 8.9%, respectively), with

enterococci having notably different isolation rates in males and females (10.9 vs. 6.2%, respectively).

Antimicrobial resistance

Figs. 1–3 summarize the isolates' rates of antibiotic resistance. Figure 1 shows that nearly completely Enterobacteriaceae were sensitive to carbapenems (.97%) and amikacin (93.3%), while ampicillin and fluoroquinolones had only sporadic effects. Three Proteus mirabilis isolates from two dissimilar treatment facilities and unique Klebsiella oxytoca isolate showed imipenem resistance. 42.1% of isolates of Klebsiella spp., Proteus mirabilis, and Escherichia coli had ESBLs found in them. Related to ESBL non-producer parts, these bacteria exhibited greater resistance to aminoglycosides, co-trimoxazole, and fluoroquinolones, with weakness rates of 86.5, 35.3, and 14.3% versus 60.9, 98.7, and 63.8% for amikacin, ciprofloxacin, and co-trimoxazole, individually. ESBL-positive in general, the bacteria Escherichia coli exhibited greater resistance to fosfomycin and the drug (weakness rates of 82.6 and 69.6 %) than ESBL-negative insulates (susceptibility rates of 92.4 and 94.3 %).

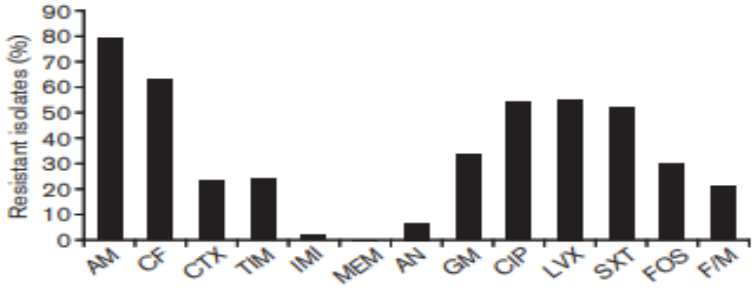

Fig. 1 Enterobacteriaceae has antibiotic resistance that has been observed. IMI, imipenem; AN, amikacin; TIM, ticarcillin/clavulanic acid; MEM, meropenem; GM, gentamicin; CIP, cisplatin; LVX, levofloxacin; SXT, FOS, fosfomycin; trimethoprim/sulfamethoxazole; and F/M, nitrofuran toin (simply Escherichia coli).

All investigated antibiotics, excluding carbapenems, proved to be ineffective against the single strain of Acinetobacter spp. Colistin proved to be the most effective antibiotic versus Pseudomonas aeruginosa, with cefepime, amikacin, piperacillin/tazobactam, and meropenem following closely after (Fig. 2). Only 10% of staphylococci and 50% of enterococci were responsive to levofloxacin, but all gram-positive isolates were liable to glycopeptides and linezolid, and 90% were disposed to nitrofurantoin (Fig. 3). Thirty-one percent of staphylococci were resistant to meticillin, and sixty percent of them produced b-lactamase. Based on the genus of bacteria that were recovered and the examination of point aggregation and supplemental points, four primary patterns of antibiotic resistance were identified. The isolates resistant to an antibiotic called gent, a combination of trim, ampicillin, levofloxacin, fosfomycin, and ciprofloxacin, were grouped into pattern A; isolates resistant to chloramphenicol, fosfomycin, and the medication were grouped into pattern B; and separates resistant to cefotaxime, amikacin, and ticarcillin/clavulanic acid were grouped into outline D.

Patients who were female and between the ages of 86 and 95 exhibited a higher frequency of Pattern A. Regarding age groups and kinds of bacteria, we did not invention significant changes in the prevalence of resistance in cluster B; nevertheless, it was additional common in females (CI 1.05–3.09 OR 1.8, 95%) than in men.

With no gender difference, Cluster C was more common in patients 75–65 years old (CI 1.29–8.49 OR 3.306, 95%) and in infectious species further than Escherichia coli. While resistance cluster D did not exhibit a difference in distribution across age groups, it was more common in females and linked to bacterial species other than Escherichia coli.

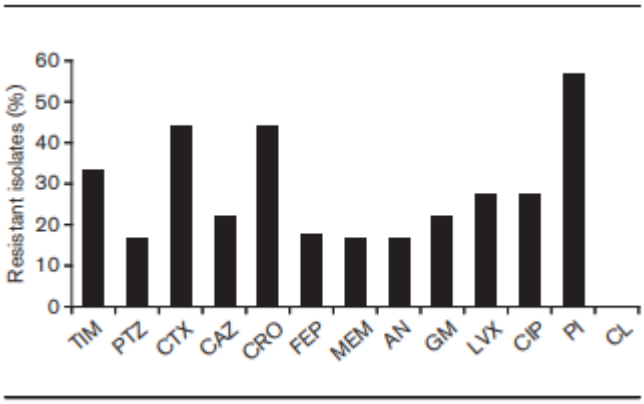

Fig. 2. The organism demonstrated resistance to the examined drugs. Piperacillin/tazobactam (PTZ); cefepime (FEP); ceftriaxone (CRO); ceftazidime (CAZ); colistin (CL). and pipemidic acid (PI); See **Fig. 1** for other abbreviations.

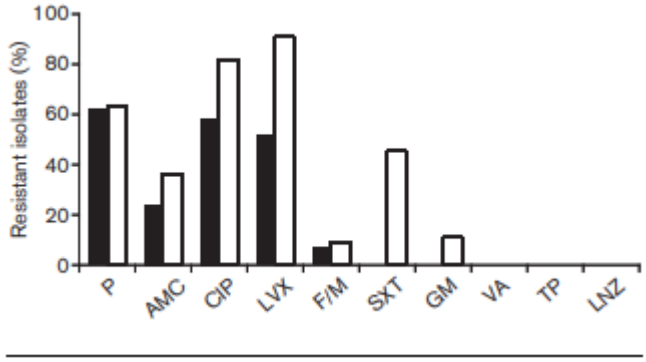

Fig. 3. Resistance of Gram-positive cocci to the tested antibiotics.Filled bars, Enterococcus spp.;open bars, S. aureus. P, Penicillin; AMC, amoxicillin/clavulanic acid; SXT, trimethoprim/sulfamethoxazole; VA, vancomycin; TP, teicoplanin; LNZ, linezolid. See **Fig. 1** for other abbreviations.

DISCUSSION

Healthcare home-acquired infections are frequently treated empirically, using information pertaining to historical microbiology and exposure patterns of infections acquired in the community. This approach ignores the possibility that treatment home-acquired impurities differ significantly from those that are developed in the community. Guidelines for the identification and treatment of UTIs are necessary because numerous studies have demonstrated the improper use of antibiotics in hospitals, particularly when treating UTIs (Kang, 2018).

For this purpose, we examined facts from 14 northern Pakistani treatment homes to determine the most prevalent etiological agents and how susceptible they were to antibiotics. The wide variety of Gram-negative viruses that were isolated from the senior population suffering from UTIs was corroborated by our data, which is consistent with the findings of earlier investigations. However, Escherichia coli is the main reason of (UTIs) in older adults living in institutions, affecting both genders. In the sample we studied, the isolation rate of Escherichia coli, but slightly lower than that described in a recent study by (Zelelie, 2023) in participants 65 years of age and older. This discrepancy may result from the fact that, contrary to what reported, the data in our analysis came from residents of long-term facilities rather than community-acquired diseases. Similarly, Pseudomonas aeruginosa isolation rates were similar to those reported by additional writers in participants of a similar age, but they were lower than may be predicted in these kinds of subjects (Anand, 2023).

Only around 10% of UTIs were caused by gram-positive bacteria, with bacteria and enterococci—particularly enteric bacteria faecalis—being the most common kind. In the current investigation,

enterococci were primarily identified as the sole pathogen in symptomatic patients, despite the fact that they are frequently thought of as colonizing agents rather than pathogens in the elderly (Fülöp, 2020). Patients in nursing homes may be a significant source of multidrug-resistant ESBL-producing bacteria and Escherichia coli. Our study revealed that multiple antibiotic resistances were rather prevalent, and the proliferation of isolates that produced ESBL was really alarming. This study's observation of a rather high fluoroquinolone resistance rate, especially in Enterobacteriaceae, raises questions regarding the efficacy of using these drugs as an empirical treatment for UTIs. Previous studies have shown that underlying urinary tract illnesses predispose individuals to repeated urinary tract infections and, in turn, to revelation to antibiotics such as fluoroquinolones. Resistance to fluoroquinolones has been associated with previous administration of antibiotics, particularly fluoridation (Majalekar, 2020).

Furthermore, the significant difference in resistance found between isolates that produced ESBL and those that did not (63.8 vs. 14.3%) suggested that the high prevalence of resistance to fluoroquinolones was linked to the formation of ESBL. In ESBL-positive isolates, the observed decrease in sensitivity to fosfomycin was frequently linked to medication resistance. Fosfomycin has been used for a very long time, especially to treat UTIs brought on by the bacteria Enterococcus faecalis and Escherichia coli. It is commonly well tolerated and has a low rate of side effects. These factors have led to a resurgence of interest in fosfomycin as a treatment for infections of the lower urinary tract and even the entire body brought on by gram-negative bacteria resistant to conventionally prescribed medications. In a similar vein, nitrofurantoin compares favorably to fluoroquinolones and co-trimoxazole when used as an practical treatment for nosocomial, uncomplicated UTIs, including Escherichia coli and microorganisms (Yan, 2022).

Although there is several disagreement between the elevated incidence of mutational struggle to the antibiotic fosfomycin in vitro and the inferior level of this occurrence in experimental studies, our figures raise some worries about the efficacy of both nitrofurantoin and fosfomycin in empirical therapy against ESBL-producing bacteria. Additionally, patients with weakened renal function, which is mutual in the elderly, may not respond well to either drug (Kolben, 2022).

CONCLUSION

Finally, we discovered that microbial resistance to antibiotics was relatively common among elderly patients in nursing homes, where some of the medications that have been frequently used to treat UTIs in the past have shown minimal benefit when administered empirically. From this vantage point, the growing resistance to antibiotics implies that the empirical antibiotic prescription for UTIs acquired in nursing homes might need to be adjusted in light of local data. This emphasizes the value of targeted therapy when appropriate and urine cultures when necessary.

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