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Urinary Tract Infections in Patients Hospitalized in a Gastroenterology Department—Study from a Tertiary Regional Hospital in South-East Poland

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Abstract: A retrospective analysis of urine culture results was conducted for adult patients treated between 1 January 2017 and 31 December 2021 at the Department of Gastroenterology in Rzeszow (southern Poland). A total of 102 patients were sampled for microbiological tests during the analyzed period, with microbial growth found in 30 samples. The purpose of our study was to determine the predominant bacterial species present in the urine of patients hospitalized in the Department of Gastroenterology, as well as their drug susceptibility. The data obtained from medical records included, for example, urine culture results and the antibiotic susceptibility of the isolated microorganisms. The material for the study was collected according to the current procedures. During the analyzed period, urine was collected from a total of 102 patients, and 30 positive samples were found. The predominant pathogen was *Escherichia coli* (n = 10 (33.33% of all positive results), $p < 0.001$); the second most common microorganism was *Enterococcus faecalis* (n = 5 (16.67% of all positive results), $p < 0.001$). In vitro susceptibility testing showed *E. coli*, ESBL (ESBL strain with extended-spectrum beta-lactamase) (n = 2 (6.67% of all positive results), $p = 0.055$) and *Klebsiella pneumoniae*, ESBL (n = 3 (10% of all positive results), $p = 0.005$). Urinary tract infection (UTI) was an extremely common problem.

Keywords: urinary tract infections; antibiotic resistance; mechanisms of resistance; gastroenterology

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1. Introduction

Urinary tract infections (UTIs) are common health conditions diagnosed by clinicians across many specialties, including gastroenterologists. Recurrent UTIs can be burdensome and detrimental to a patient's quality of life. For gastroenterologists, they can be challenging to manage, especially in patients whose conditions have been exacerbated by chronic liver failure, acute pancreatitis, or inflammatory bowel disease. It is noteworthy that in such patients, recurrent UTIs impair overall survival and significantly increase the duration and costs of hospitalization [1,2]. Infection is one of the most common events leading to hospital admissions in cirrhotic patients. These patients are prone to infections because of immune dysfunction, bacterial translocation, and an altered gut microbiome during cirrhosis. In fact, bacterial infections can act as triggering factors for the development of hepatic encephalopathy, gastrointestinal bleeding, acute kidney injury, and acute chronic liver failure. Therefore, they represent an important cause of increased mortality. Most of these patients suffer from infections caused by Gram-negative *Enterobacterales*, though Gram-positive bacterial infections are not uncommon in hospitalized patients [1,2]. About one third of patients hospitalized with cirrhosis have at least one infection, and two

thirds of such infections are healthcare-associated or nosocomial in origin. Therefore, first-line antibiotics are often ineffective and may be responsible for the high failure rate and mortality [2].

The pathogenesis of UTIs involves complex interactions between a microbe and the host organism. In general, the vast majority of UTIs can be attributed to facultative anaerobes, the most common of which is *E. coli*, which is responsible for 85% of infections in outpatient settings. *Proteus mirabilis*, *K. pneumoniae*, and *E. faecalis* are the next most frequent strains [3,4]. Most UTIs are a result of retrograde migration of a pathogen from the fecal flora via the urethra to both the lower and upper urinary tract. Hematogenous infection of the kidney by Gram-positive bacteria, such as *Staphylococcus*, is possible, although this is rare in normal individuals [3].

Susceptibility to UTIs depends, among others, on pathogen virulence factors that promote adherence to mucosal surfaces and subsequent invasion as well as host factors such as epithelial cell receptivity that play an important role in the infection process [5]. The adherence of pathogenic organisms is followed by the colonization and eventual invasion of the surface either by a toxin produced by the colonizing organisms or by the bacteria themselves [5].

Urine cultures with sensitivities should be obtained for patients where the diagnosis is not certain; if there is a history of recent antimicrobial therapy; if the symptoms are recurrent or have lasted more than 7 days; and in pregnant, elderly, diabetic, or male patients [3]. Women with uncomplicated UTIs should have follow-up urinalysis 7–10 days after therapy, and all others should have a urinalysis and a culture to document the successful treatment. The rationale for using antibiotics in men is similar, and the duration of treatment should be 7 days [3].

The guidelines for the treatment of uncomplicated UTIs recommend various drugs, including the well-recognized nitrofurantoin monohydrate, trimethoprim-sulfamethoxazole, fosfomycin trometamol, pivmecillinam, and beta-lactams [6,7]. There are also increasing numbers of immunocompromised patients, and increasing emphasis is being placed on providing not only effective but also low-cost treatments [3]. Therefore, continuous monitoring and control of the situation is essential for optimizing empirical therapy [6,8]. In recent years, epidemiologists have shown alarming drug resistance patterns in uropathogens across the globe. In addition, recent studies have shown that extended-spectrum beta-lactamase (ESBL)-producing pathogens are resistant to beta-lactam antibiotics and sometimes even resistant to carbapenems. As a result of the massive and widespread use of antibiotics, the number of ESBL pathogens in the population is constantly increasing [8]. Since UTIs are among the most common infectious diseases affecting humans and represent an important public health problem with a significant economic burden, choosing the appropriate antibiotic to treat these infections requires knowledge of both their general microbiology and the epidemiology of drug-resistant organisms [1,8]. When choosing an empiric therapy, one must consider if the infection is complicated or uncomplicated, the spectrum of activity of the drug against the likely pathogen, the potential negative effects of the drug, patient compliance, cost, and the sex of the patient [3]. A history of recent hospitalization or previous antibiotic therapy and the origin of the infection (community/hospital) are also extremely important when choosing an antibiotic therapy, especially in patients with multiple cases of UTIs. Complicated UTIs occur in patients with any anatomic structural or functional abnormality that compromises therapy [3]. A urine culture is the test that confirms or excludes a UTI. The presence of $\geq 10^5$ bacteria per milliliter (colony-forming units per milliliter—cfu/mL) confirms infection, and an antibiogram allows for the verification of whether the applied therapy can be effective [9]. Treatment with antibiotics should be administered for the shortest possible period, and the dosage and duration of therapy depend on the type of infection [9].

Patient-related factors (the body's defense system), the pathogenicity of the microorganism, the medical procedures used, and the healthcare environment contribute to the

occurrence of healthcare-associated infections. A UTI is the result of an imbalance between the patient's defense mechanisms and pathogenic microorganisms [8].

The aim of the presented study was to evaluate the UTIs in patients hospitalized at the Gastroenterology Department and describe the microbiology results of these patients.

2. Results

A total of 102 urine culture results were retrospectively analyzed. The tests were carried out between January 2017 and December 2021. Microbial growth was found in 30 samples (Figure 1).

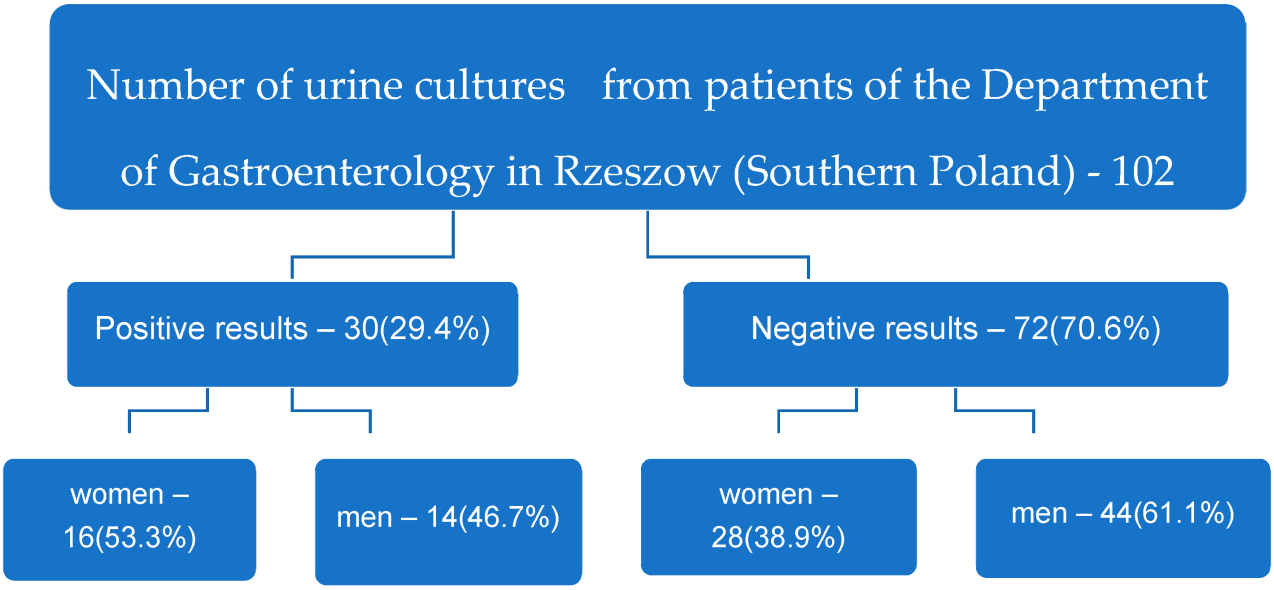

Figure 1. Flowchart of study population.

The predominant bacteria in our study were *E. coli* (n = 10, including *E. coli*, ESBL (n = 2)), *E. faecalis* (n = 5), and *Enterococcus faecium* (n = 4). The tests also found, for example, *K. pneumoniae*, an ESBL (n = 3). The incidence of other microorganisms in patients' urine is shown in Table 1.

Out of 30 positive patients, 16 patients (53.3%, $p < 0.001$) were women and 14 (46.7%, $p < 0.001$) were men. The mean ages of the female and male patients were 75.6 ± 17.17 years (range: 33–101) and 61.7 ± 18.3 years (range: 27–93), respectively.

The analysis showed no seasonal variation in the number of positive urine culture results that were found.

The characteristics of the patients are presented in Table 2.

Table 1. Results of urine cultures of patients of the Department of Gastroenterology in Rzeszow (southern Poland) with diagnosed microorganisms and their drug susceptibility (January 2017–December 2021).

The Microorganisms Identified n / **The Number of Sensitive Microorganisms, n (Percentages)**	***E. coli*** **8**	***E. coli*, ESBL** **2**	***E. faecalis*** **5**	***E. faecium*** **4**	***K. pneumoniae*, ESBL** **3**	***P. mirabilis*** **3**	***P. aeruginosa*** **1**	***S. epidermidis*, MRCNS** **1**	***S. capitis*, MRCNS** **1**	***C. albicans*** **1**	***C. tropicalis*** **1**
AK	8 (100%)	1 (50%)			3 (100%)	3 (100%)	1 (100%)		1 (100%)		
AMC	4 (50%)	2 (100%)				2 (66.6%)					
ATM							1 (100%)				
CAZ	8 (100%)					3 (100%)	1 (100%)				
CTX	8 (100%)				1 (33.3%)	3 (100%)					
CXM	8 (100%)				1 (33.3%)	2 (66.6%)					
CIP	6 (75%)				1 (33.3%)	3 (100%)					
CT	8 (100%)				2 (66.6%)						
FEP	8 (100%)				1 (33.3%)	3 (100%)	1 (100%)				
GM	7 (87.5%)	1 (50%)			1 (33.3%)	3 (100%)	1 (100%)				
IPM	8 (100%)	2 (100%)	5 (100%)		3 (100%)	3 (100%)	1 (100%)				
MEM	8 (100%)	2 (100%)			3 (100%)	3 (100%)	1 (100%)				
TZP	8 (100%)	2 (100%)				3 (100%)	1 (100%)				
TGC	8 (100%)	2 (100%)	5 (100%)	4 (100%)				1 (100%)	1 (100%)		
TM	8 (100%)	1 (50%)				3 (100%)	1 (100%)				
TIM					1 (33.3%)		1 (100%)				
SXT	7 (87.5%)	1 (50%)			2 (66.6%)	2 (66.6%)			1 (100%)		
AM			5 (100%)								
LEV			1 (20%)								
LZD			5 (100%)	4 (100%)				1 (100%)	1 (100%)		
F			5 (100%)								
S											
TEC			5 (100%)					1 (100%)	1 (100%)		
VA			5 (100%)	4 (100%)				1 (100%)	1 (100%)		
CM								1 (100%)	1 (100%)		
E								1 (100%)	1 (100%)		
OX											
TE								1 (100%)	1 (100%)		

Table 1. *Cont.*

The Microorganisms Identified n / The Number of Sensitive Microorganisms, n (Percentages)	*E. coli* 8	*E. coli*, ESBL 2	*E. faecalis* 5	*E. faecium* 4	*K. pneumoniae*, ESBL 3	*P. mirabilis* 3	*P. aeruginosa* 1	*S. epidermidis*, MRCNS 1	*S. capitis*, MRCNS 1	*C. albicans* 1	*C. tropicalis* 1
PIP							1 (100%)				
AmB										1 (100%)	1 (100%)
CAS										1 (100%)	1 (100%)
FLU										1 (100%)	1 (100%)
AFY										1 (100%)	
MYC										1 (100%)	1 (100%)
VO										1 (100%)	1 (100%)

AmB—Amphotericin B, CAS—Caspofungin, FLU—Fluconazole, AFY—Flucytosine, MYC—Micafungin, VO—Voriconazole, AK—Amikacin, AM—Ampicillin, AMC—Amoxicillin/Clavulanic Acid, ATM—Aztreonam, FEP—Cefepime, CTX—Cefotaxime, CAZ—Ceftazidime, CM—Clindamycin, CXM—Cefuroxime, CIP—Ciprofloxacin, CT—Colistin, E—Erythromycin, F—Nitrofurantoin, GM—Gentamicin, IPM—Imipenem, LEV—Levofloxacin, LZD—Linezolid, MEM—Meropenem, OX—Oxacillin, PIP—Piperacillin, S—Streptomycin, TEC—Teicoplanin, TE—Tetracycline, TIM—Ticarcillin/clavulanic acid, TM—Tobramycin, TZP—Piperacillin /Tazobactam, TGC—Tigecycline, SXT—Trimethoprim/Sulfamethoxazole, VA—Vancomycin. MRCNS—methicillin-resistant coagulase-negative staphylococci (strain resistant to all beta-lactam antibiotics: penicillins, penicillins with B-lactamase inhibitors, cephalosporins, and carbapenems). ESBL—strain with extended-spectrum beta-lactamase.

Table 2. Clinical characteristics of study population.

Characteristics of the Patients	Positive Urine Culture Results (n = 30)		Negative Urine Culture Results (n = 72)	
	Women (n = 16)	**Men (n = 14)**	**Women (n = 28)**	**Men (n = 44)**
Age of patients, years	33–101	27–93	30–87	26–99
Age of patients—arithmetic mean, years (standard deviation)	75.6 (17.17)	61.7 (18.3)	66.1 (18.7)	63.2 (17.2)
Duration of hospitalization, days	2–35			
Duration of hospitalization—arithmetic mean, days (standard deviation)	11.6 (7.1)			
The diagnoses with which the patients reported to the hospital (concerns all 102 examined patients), n	IBD, 4	Liver cirrhosis, 35	Pancreatitis, 14	Gastrointestinal bleeding, 18	Diverticulosis of the large intestine, 2	Other, 29 **
Urine culture result/quantity (%) *	−/4 +/0	−/23 +/12 (34.3)	−/13 +/1 (7.1)	−/13 +/5 (27.8)	−/0 +/2 (100)	−/19 +/10 (34.5)
Origin of the infection	community-acquired		hospital-acquired			
	n = 20		n = 10			
	Women—11	Men—9	Women—5	Men—5		
Diagnoses with which the patients reported to the hospital (applies to the 30 patients with positive urine cultures), n	Liver cirrhosis, 14	Pancreatitis, 8	Diverticulosis of the large intestine, 2	Cholecystitis, 2	Duodenitis, 2	Duodenalulcer, 2
Treatment effect	Improvement—21		Death—9			
Patients with a positive urine culture and a urinary catheter, n	26					
	Women—13		Men—13			
Taking samples for testing	All samples were taken during hospitalization.					

* Negative (−) or positive (+) urine culture result/quantity (percentage of positive results for a given diagnosis). ** Cholecystitis, gastritis, bile duct disease, bile duct stones, liver failure, esophagitis, duodenitis, esophageal varices, and duodenal ulcers.

3. Discussion

Infections are a serious problem and contribute significantly to increased mortality and morbidity. Due to the ongoing global crisis of antibiotic resistance, it is becoming increasingly difficult to treat infections quickly and appropriately. Although the problem is global, the spectrum of infecting organisms and the pattern of antibiotic susceptibility shows considerable variability, depending on the geographic location, prevailing antibiotic policy, and antibiotic use patterns. The prompt implementation of an appropriate antibiotic therapy significantly improves treatment outcomes. Local guidelines based on local data should therefore be formulated [2].

UTIs are common in both community and hospital settings. Most UTIs are caused by the retrograde passage of bacteria from the fecal flora through the urethra into the bladder and kidneys [9]. An initial appropriate empirical treatment requires good knowledge of epidemiological data. Reliable information on the spectrum of local, regional, and national pathogens and their susceptibility is essential to determine appropriate empiric antibiotic treatments for urinary tract infections. This can be achieved through well-structured surveillance programs [7,8].

The main risk factors are old age; female sex; pregnancy; a history of UTIs; sexual activity; a high body mass index, especially when greater than 30; a history of urolithiasis; and diabetes [10–12]. Urinary catheters are considered one of the most important factors in the development of healthcare-associated urinary tract infections [13]. Other identified risk factors include prolonged hospital stays, limited mobility prior to admission, bone fracture, and comorbidities [8].

Resistant GN bacteria are becoming more prevalent and are causing an increasing percentage of UTIs among hospitalized patients [1,7]. The most common pathogen is *E. coli* (75−95%), with other occasional *Enterobacterales* species such as *P. mirabilis* and *K. pneumoniae* as well as GP *E. faecalis* and *S. saprophyticus*. Other Gram-negative and Gram-positive bacteria are rarely isolated, and the rates of resistance to common antibiotics largely depend on the geographic location [7,8,14]. The most frequently diagnosed pathogen in the microbiological urinalysis of the five-year cohort of patients treated between January 2017 and December 2021 at the Department of Gastroenterology in Rzeszow (southern Poland) was *E. coli*, which was found in 10 samples (n = 10 (33.33% of all positive results), $p < 0.001$).

The *E. coli* bacterium was first described in 1885 by Austrian pediatrician Theodor Escherichia, who tested infant feces [15]. It belongs to the order *Enterobacterales*, family *Enterobacteriaceae,* and genus *Escherichia*. The bacterium has the ability to exchange genetic material, not only within the genus *Escherichia* but also with other species such as *Salmonella* spp. and *Shigella* spp. [14,16]. *E. coli* is a Gram-negative motile bacterium that does not produce spores. It is a facultative anaerobe with the ability to metabolize oxygen and carry out fermentation, which is why it is considered the first organism to colonize the digestive tract of infants. The optimal growth temperature for *E. coli* is around 37 °C, but there are also strains that can multiply at temperatures above 49 °C. The bacterium is capable of divisions every 30 min [17]. The natural habitat of *E. coli* is the digestive tracts of humans and animals. There are also pathogenic strains of *E. coli*, which have been divided into two groups based on the infection site. The first one causes infections and syndromes in the gastrointestinal tract—IPEC (intestinal pathogenic *E. coli*). The second group includes organisms that cause diseases in systems other than the gastrointestinal tract; these are called extraintestinal strains. Most pathogenic strains are transmitted via the fecal–oral route from food materials, water, animals, and the environment. Depending on the pathotype, *E. coli* can cause watery, mucous, or bloody diarrhea; abdominal cramps; urinary tract infections; and, in the most severe cases, meningitis [18].

ESBL bacteria, which show resistance to most antibiotics except for the carbapenem group, are steadily increasing in the population [8]. The ESBL mechanism occurs in bacteria that synthesize β-lactamases with an extended substrate spectrum, making them resistant to β-lactam antibiotics [14,19,20]. The presence of a β-lactam ring is a typical feature of all β-lactam antibiotics. β-lactamases are capable of inactivating this group of antibiotics by hydrolyzing the specific site of the β-lactam ring, causing it to open. The antibiotic then cannot bind to its target PBP protein. The ESBL mechanism is most common among Gram-negative bacteria, making them resistant to β-lactam antibiotics. The first β-lactamase that was characterized was from *E. coli* [20–22].

In a prospective study conducted in India over a 24-month period from June 2013 to June 2015, the diagnostics of urinary tract infections found an increase in *E. coli* in 47.72% of all positive urine culture results, and 20.45% were ESBL strains [2].

An Indian study identified 6.82% of all *K. pneumoniae* isolates as being ESBL producers [2]. A higher rate of *Klebsiella* spp. in UTIs was observed in a multicenter hospital prevalence study in the United States [23].

K. pneumoniae is a major cause of hospital-acquired infections worldwide, causing pneumonia, bloodstream infections, urinary tract infections, surgical site or wound infections, and meningitis. It is one of the most common multi-resistant bacteria causing healthcare-associated infections and has significant epidemic potential. It is often responsible for serious infections [7,8,14]. *K. pneumoniae* ESBL was first identified in Germany in early 1980. By the end of the 1990s, ESBL-producing *K. pneumonia* was detected only in hospital settings. These strains have become common among infected outpatients since 2000 [7,20]. The prevalence of ESBL-positive strains of *E. coli* and *K. pneumoniae* is increasing everywhere, especially in Asia, Latin America, and the Middle East [7].

In our retrospective study on *Enterobacterales* isolates, 31.25% of all diagnosed microorganisms were ESBL strains. These results were lower than the results of a prospective study conducted in India in which 35.9% of *Enterobacterales* isolates produced ESBL [2].

The second most common microorganisms in the analyzed urine culture results of a five-year cohort of patients treated at the Department of Gastroenterology in Rzeszow (southern Poland) were bacteria of the genus Enterococcus. *E. faecalis* was found *in* five samples (n = 5 (16.67% of all positive results), $p < 0.001$), and *E. faecium* was found in four samples (n = 4 (13.33% of all positive results), $p < 0.001$). A prospective Indian study found *E. faecalis in* 6.82% of all positive urine cultures [2].

Other microorganisms diagnosed in our study included *P. mirabilis* (three isolates); *S. epidermidis* MRCNS (one isolate); *S. capitis*, MRCNS (one isolate); *Candida albicans* (one isolate); *Candida tropicalis* (one isolate); and *Pseudomonas aeruginosa* (one isolate).

In the retrospective study presented here, urinary tract infections occurred in 53.3% of the women and 46.7% of the men that were studied. According to our study and data in the literature, the male sex is a protective factor against UTIs [10,12,14,20].

In women, there is a trend of decreasing UTI prevalence in middle age (35–65 years), with a later increase after 65 years of age. It was found that after the age of 65, in non-institutionalized people, the prevalence of UTIs was 10.9% for men and 14% for women [8].

A study of postmenopausal women up to the age of 75 found that a lifetime number of UTIs greater than five was the strongest predictor of another UTI [8].

Host factors, such as epithelial cell susceptibility, are important in the infection process [3,5]. In women, the receptivity of vaginal cells varies depending on the hormonal status. In the peri- and postmenopausal periods, estrogen deficiencies can promote urinary incontinence and urinary tract infections [9]. It has been proven that bacterial adherence is higher after menopause compared to before menopause or after menopause while taking estrogen replacement therapy [3]. When studying the prevention of UTIs in postmenopausal women, it has been shown that topical estrogen replacement restores the vaginal pH to premenopausal levels, promotes re-colonization by *Lactobacillus* bacteria, reduces colonization by *E. coli*, and consequently leads to fewer urinary tract infections [3,24]. In vitro studies have also proven that cranberry juice reduces the adhesion of *E. coli* bacteria to the epithelium lining the urinary tract and vagina [9]. Urinary tract infections in postmenopausal women may be associated with typical symptoms (urinary urgency, increased frequency of urination, dysuria, urinary incontinence, and malodor) or fever [24].

The prevalence of healthcare-associated UTIs is 12.9, 19.6, and 24% in the United States, Europe, and developing countries, respectively [8].

Due to the massive empirical use of antibiotics in the treatment of UTIs, the resistance of *Enterobacterales* bacteria, particularly the major uropathogens *E. coli* and *K. pneumoniae*, has increased significantly worldwide [7,14,20,22].

Multidrug-resistant bacterial infections are becoming common on all continents: Korea—29% ESBL; Italy—8% ESBL; Spain—6% ESBL, 2% *Pseudomonas*, and 2% *Acinetobacter*; France—8% MRSA (methicillin-resistant *Staphylococcus aureus*) and 4% ESBL; and USA—6.5% ESBL and 5% MRSA [2]. Multidrug-resistant infections have been shown to be responsible for higher initial treatment failure and higher in-hospital mortality and have been identified as independent predictors of mortality at 30 days in some studies [14,20,25,26].

The highest rates of healthcare-associated infections are observed in intensive care units (ICUs) [8]. Urinary catheters in patients in these departments are a major risk factor. An overall 8% increase in catheter-related infections has been reported in the United States [8]. No specific types of risk factors were identified for gastroenterology departments. In terms of the number of UTIs, they do not differ from other hospital departments, apart from the ICU [7].

The proper treatment of urinary tract infections is only possible if urine microbiological tests are performed along with drug susceptibility testing. The initial empirical treatment should be modified based on knowledge of the infecting uropathogen [14,20,22,27].

Patients with rapidly recurring infections with the same organism should be evaluated to identify foci of bacterial persistence, such as teeth tartar or an obstruction of the ureteropelvic junction, which should be removed or corrected to prevent further events [3].

The presented study is limited by a relatively small number of patients. Additional studies with larger sample sizes may be necessary to confirm the results. It would also be interesting to further analyze the data to ascertain the average number of UTIs per capita among gastroenterology department patients. The present study may also be limited by its analysis of a single center. The fact that we were able to isolate microorganisms from only 30 (29.4%) patients from our total population of 102 patients also represents a limitation of the present study.

An important limitation of our study was setting a cut-off value for urine cultures at $\geq 10^5$ cfu/mL. As recommended by the EAU Guidelines on Urological Infections 2022, "Asymptomatic bacteriuria in an individual without urinary tract symptoms is defined by a mid-stream sample of urine showing bacterial growth $\geq 10^5$ cfu/mL in two consecutive samples in women and in one single sample in men. In a single catheterized sample, bacterial growth may be as low as 10^2 cfu/mL to be considered repressing true bacteriuria in both men and women" [28].

4. Materials and Methods

Ethics Statement

The study was approved by the Bioethics Committee of the Regional Medical Chamber (resolution No. 88/B/2020 of 24 September 2020).

Pursuant to Polish law, patient consent was not required due to the retrospective nature of the study.

A retrospective analysis of urine culture results was conducted for adult patients admitted and subsequently treated between 1 January 2017 and 31 December 2021 at the Department of Gastroenterology in Rzeszow (southern Poland). Data for all hospitalized patients used for the analysis were obtained from the hospital's electronic medical records. Material for microbiological tests was obtained before the implementation of antibiotic therapy. In general, urine should be carefully collected in a sterile container to minimize contamination by nonpathogens. A midstream voided specimen is generally adequate, but urethral catheterization or suprapubic aspiration may be necessary in an individual who cannot produce a clean specimen. It is best if the morning urine is collected for testing [9]. The indications for urine culture in hospitalized patients were dysuria symptoms, fever of unclear origin, and suspected urinary sepsis.

Urine collected according to the current procedures was quantitatively seeded onto solid media: 5% sheep blood agar and MacConkey agar. Plates with blood agar and MacConkey medium were incubated for 24 h at 37 °C. In the event of a positive result (microbial growth of $\geq 10^5$ colony-forming units was found in 1 mL of urine), microorganisms were identified using an automated VITEK MS mass spectrometer (bioMérieux, Marcy-l'Étoile, France) using MALDI-TOF technology [9,29–32]. MS enables the rapid and reliable identification of human pathogens as well as zoonotic and environmental microorganisms. This technique, based on matrix-assisted laser desorption ionization time of flight (MALDI-TOF), uses an extensive database of bacteria and fungi [30–33].

The drug resistance profile of the cultured and identified microorganisms was determined using the disc diffusion method or by means of a VITEK2 (bioMérieux, Marcy-l'Étoile, France) automatic system for the identification and determination of susceptibility, according to EUCAST (European Committee on Antimicrobial Susceptibility Testing) [34].

A statistical analysis was performed using PASW Statistics, version 18.0 from IBM (Armonk, New York, NY, USA).

5. Conclusions

UTIs are most often caused by pathogens originating from the end sections of the gastrointestinal tract.

Urinary tract infections are an extremely common problem. Providing cost-effective care while minimizing drug resistance requires proper diagnostics, evaluation, and treatment of urinary tract infections. Progress in understanding both the host and bacterial

factors associated with UTIs leads to therapy optimization. In urinary tract infections, it is important to start an empirical therapy taking into account the local susceptibility patterns of *E. coli* to antibiotics, with the performance of urine cultures before treatment and possible modification to ultimately implement an individual targeted antimicrobial therapy according to the results of the microbiological examination.

In our presented study, no specific types of risk factors were identified for gastroenterology departments. In terms of the number of UTIs, they do not differ from other hospital departments, apart from the ICU.

Maintaining the effectiveness of antimicrobial substances, especially those relevant to public health, is becoming a major challenge. The magnitude of the problem calls for comprehensive measures that include, first and foremost, promoting the prudent use of antibiotics and reducing the excessive use of antimicrobial substances in human medicine, veterinary medicine, and agriculture.

Educating patients about risk factors is also warranted when attempting to eliminate urinary tract infections, which can help them to monitor any urinary symptoms.

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