Retrospective Study of the Etiology, Laboratory Findings, and Management of Patients with Urinary Tract Infections and Urosepsis from a Urology Center in Silesia, Southern Poland Between 2017 and 2020

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Background: Recent studies have shown that up to 25% of sepsis cases originate in the urinary tract. Urosepsis can be associated with cystitis, lower urinary tract infections (UTIs), and upper UTIs and is most commonly caused by gram-negative bacteria. This retrospective study from a urology center in southern Poland, was conducted between 2017 and 2020 and aimed to investigate the causes, microbiology laboratory findings, and management in 138 patients with UTIs and urosepsis.

Material/Methods: Records of patients with UTIs with urosepsis admitted to the Urology Department of the hospital in Silesia, Poland, between 2017 and 2020 were analyzed retrospectively, and clinical and laboratory data were evaluated.

Results: The 138 included patients were admitted to the hospital between 2017 and 2020. The median age of patients was 67 (20-94) years, and 59.9% (82/137) were men. The most common reasons for admission to the Urology Department were hydronephrosis due to dysfunction of urinary drainage in 36.5% (50/137) of patients and hydronephrosis due to urolithiasis in 22.6% (31/137) of patients. The main etiological agents responsible for the development of urosepsis were strains of Enterobacteriaceae in 85% of patients, of which 41.4% (48/116) produced extended-spectrum beta-lactamases (ESBL), accounting for 35.0% (48/137) of patients with urosepsis. In 83.3% (80/96) of patients, the pathogen cultured from the urine was identical to that cultured from the blood.

Conclusions: The identification of an increasing prevalence of urosepsis associated with ESBL-producing gram-negative rods from this single-center study highlights the importance of infection monitoring, rapid diagnosis, and multidisciplinary patient management.

Keywords: beta-Lactamases • Sepsis • Urinary Tract Infections

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Background

Urinary tract infections (UTIs) are common in urological Emergency Departments and are considered the most common bacterial healthcare-associated infection [1]. UTIs account for about 40% of outpatient and 10% to 20% of inpatient infections [2] and can include the lower and upper urinary tract and can even lead to sepsis [1-3]. The number of cases increases annually as a result of an aging population, increasing antibiotic resistance, and use immunomodulating therapies, such as chemotherapy, radiotherapy, and immunosuppressants [4,6,7]. The antibiotic resistance of etiological agents usually complicates treatment strategies [8]. The present state of development of antibiotic resistance mechanisms is alarming [9]. The presence of extended-spectrum beta-lactamase (ESBL)-producing gram-negative rods with resistance to frequently used antibiotics is steadily increasing [10]. Bacteria with enzymes that are mainly discovered include *E. coli*, *K. pneumoniae*, and *P. mirabilis* [11]. Among ESBLs, 243 variants of TEM and 228 variants of SHV, 2 main enzyme types, have been identified, with new types being discovered every month [12]. These enzymes are responsible for the resistance to most beta-lactam antibiotics, including expanded-spectrum cephalosporins and monobactams, but not carbapenems [12]. The ESBLs are frequently plasmid encoded; therefore, the prevalence of ESBL-producing bacteria have been gradually increasing, and thus, ESBL-producing microorganisms frequently also possess resistance factors to other classes of antibiotics, such as aminoglycosides and fluoroquinolones, and possibly to piperacillin-tazobactam and cefepime [12]. The impact of ESBL-producing *Enterobacteriaceae* on the choice of empirical and definitive antimicrobial therapy resulted in the increased use of carbapenems in healthcare facilities and may lead to a future increase in carbapenem resistance [13]. The reason for this is the awareness of infections caused by ESBL-producing strains, we included ESBL-producing *Enterobacteriaceae* on the choice of empirical and definitive antimicrobial therapy resulted in the increased use of carbapenems in healthcare facilities and may lead to a future increase in carbapenem resistance [13].

Disturbance of the urine outflow due to urethral diseases, urinary tract obstruction, benign prostate enlargement, urethral stricture, and congenital anomalies are common underlying risk factors of urosepsis development. Interventions and surgery performed on the urinary tract can also lead to urosepsis [15]. Advanced age and comorbidities, such as diabetes mellitus, kidney failure, and immune deficiencies, are considered risk factors of urosepsis [6,16,17].

Sepsis is a systemic host response to an infection that causes acute organ dysfunction, which is mostly related to the source of infection [4,18].

The new sepsis definition uses the sequential organ failure assessment (SOFA) scoring system, in which a score higher than 2 points is associated with an in-hospital mortality rate greater than 10% and is considered a sepsis indicator. Quick SOFA (qSOFA) is an easy to perform important clinical score whose criteria include a respiratory rate higher that 22/breaths/min, altered mental state (Glasgow coma scale <15), and systolic blood pressure lower than 100 mm Hg. If a suspected patient demonstrates at least 2 of these criteria, they should be identified as being at risk of developing sepsis [18].

The definition of urosepsis according to Bonkat et al [5] is the life-threatening condition coming from the urinary tract or male genital organs. Urosepsis requires prompt recognition and intervention [5].

Despite the new management of sepsis, multicenter studies in the United States between 1997 and 2000 showed high mortality rates of sepsis, which ranged from 17.9% to 27.8% [7]. The latest data confirm that, among all sepsis cases, an estimated 9% to 31% are urosepsis [8]. Despite the increase in knowledge and the recommendations, urosepsis should still be considered as a serious threat with a high mortality rate. Owing to the small number of recent publications on urosepsis, in particular on cultured etiological factors, and the inconclusive data on the prevalence of ESBL-producing strains, we investigated cases of UTI and urosepsis. Therefore, this retrospective study from a urology center in Silesia in southern Poland was conducted between 2017 and 2020 and aimed to investigate the etiology, laboratory findings, and management of 138 patients with UTIs and urosepsis.

Material and Methods

Ethical Approval

This study was approved by the local Ethics Committee (Medical University of Silesia Bio-Ethics Committee [approval no. PCN/0022/KB1/25/I/20], Bogusław Okopień MD, PhD). We collected research data without any identifiers so that individual participation was anonymous and the data collected could not be linked to the individuals.

Study Participants

A total of 138 patients diagnosed with UTIs with urosepsis between January 2017 and June 2020 were identified. The inclusion criteria for the analysis were a UTI with urosepsis, defined as a positive blood culture in patients with urology comorbidities and the suspicion of sepsis based on a qSOFA score >2 at admission. Patients were initially identified by screening the electronic health records for positive blood cultures obtained on admission by testing with a VITEK 2 system (bioMérieux, Marcy L’Etoile, France). The exclusion criteria were a qSOFA score >2.
score ≤2 at admission, lack of medical documentation not allowing the patient to be included in the statistical analysis, and a negative blood culture.

### Study Design

Our study was a retrospective chart review of electronic records conducted at an 86-bed specialized urology center in Katowice (Silesian region, southern Poland). The study was conducted between January 2017 and June 2020 and included charts of adult patients admitted to the Urology Department who were suspected of having urosepsis. Patient characteristics, including age and sex, were also collected for further statistical analysis. Clinical data were evaluated, including presence of urologic comorbidities, length of hospitalization, duration of treatment with antibiotics, time of appropriate antibiotic therapy, and continuation of antibiotic therapy after discharge. Appropriate antimicrobial therapy was defined as using agents (oral or intravenous) according to the results of antibiotic susceptibility testing. The time to appropriate antimicrobial therapy was defined as the time interval starting from obtaining blood cultures to receiving the first dose of appropriate antimicrobial therapy.

During the study, we collected information on urological comorbidities and the etiological factors of urosepsis. We also obtained patient demographic data and laboratory test results at admission as well as data about clinical outcomes. We compared the patients after separating them into 2 groups: patients with infection caused by ESBL-producing strains and patients with sepsis caused by non-ESBL-producing strains.

### Statistical Analysis

The results were analyzed using Microsoft Excel and TIBCO Statistica version 13 (data analysis software system, [http://statistica.io](http://statistica.io)). Measures of location and data dispersion were defined. The characteristics of the distribution of the examined features were estimated with the Shapiro-Wilk test and the hypotheses were tested with the Mann-Whitney U test and χ² test. A significance level of P<0.05 was considered statistically significant.

### Results

#### Patients Characteristics and Comorbidities

A total of 138 UTI patients with urosepsis were enrolled in this study (with clinically confirmed sepsis defined as at least 2 points on the qSOFA scale). One of these patients was excluded from the statistical analysis for formal reasons; therefore, 137 patient charts were analyzed. The median age of the 137 patients was 67.0 (range 20-94) years, and 59.1% (81/137) were men. There was a significant difference in age between men and women. The median age of men was 70.0 (range 22-90) years, which was higher than the median age of women at 66.0 (range 20-94) years, and the difference was statistically significant (P<0.05). The most common causes for admission to the Urology Department were hydrenephrosis due to the dysfunction of urinary drainage catheters (stents, nephrostomy catheter, bladder catheter) in 36.5% (50/137) of patients and hydrenephrosis due to urolithiasis in 22.6% (31/137) of patients. Other reasons for admission included hydrenephrosis of unclear etiology in 16.8% (23/137) of patients, condition after a urological surgery in 8.8% (12/137) of patients, and acute urinary retention in 6.6% (9/137) of patients. In 8.8% (12/137) of patients, it was not possible to find the underlying cause of the condition; therefore, these patients were treated for a UTI with no organic base.

On admission for each patient, biochemical testing was performed, including a full blood count with white blood cell (WBC) count, platelet count (PLT), C-reactive protein (CRP), and creatinine level. Data of all patients with at least 1 deviation in laboratory tests on admission are presented in **Figure 1**. The creatinine level in men was significantly higher (P=0.0463; median 1.68; range 0.77-16.81) than that in women (median 1.47; range 0.59-9.22). No statistically significant difference was observed between values of biochemical parameters (WBC, CRP, PLT levels) between women and men.

On admission, 34.3% (47/137) of patients required minor urological surgery involving the replacement of the nephrostomy/urostomy catheter or a regular bladder catheter. About 28.5% (39/137) of patients required an endoscopic procedure involving the decompression of hydrenephrosis by placing a urethral stent. Most of these procedures (61.5% [24/39]) were in patients with hydrenephrosis caused by ureterolithiasis; 17.5% (24/137) of patients required hydrenephrosis decompression with the percutaneous nephrostomy procedure. These patients were mainly admitted to the hospital because of hydrenephrosis of an undefined etiology, 54.2% (13/24). A total of 10.2% (14/137) of patients required an endoscopic procedure without urethral stenting, such as coagulation of a bleeding mucosa of the bladder, owing to hematuria with life-threatening anemia, 3.6% (5/137) of patients required open surgery, and only 5.8% (8/137) of patients did not require any surgery.

#### Bacterial Isolates

Urine samples obtained from 96 of 137 (70.1%) patients showed significant bacteruria. In 38 of 96 (39.6%) patients, ESBL-producing representatives of *Enterobacteriaceae* were cultured, while non-ESBL-producing strains were found in 43 of 96 (44.8%) patients. In 15 of 96 (15.6%) patients, isolates...
Figure 1. White blood cell count (WBC), platelet count (PLT), C-reactive protein (CRP), and creatinine levels for all patients at admission to the hospital. Creatinine levels in men were higher (median 1.68 mg/dL; range 0.77-16.81 mg/dL) than in women (median 1.47 mg/dL; range 0.59-9.22 mg/dL); this difference was statistically significant ($P=0.0463$). No statistically significant difference was observed between values of biochemical parameters (WBC, CRP, PLT levels) between women and men. Higher creatinine values were observed in patients with blood extended-spectrum beta-lactamase (ESBL)-positive isolates (median 1.75 mg/dL) than in patients with blood ESBL-negative isolates (median 1.44 mg/dL), and this difference was statistically significant ($P=0.02$). The other values for WBC, CRP, and PLT did not differ significantly in patients with sepsis caused by ESBL-positive and other isolates (Enterobacteriaceae ESBL-negative and other strains).
other than *Enterobacteriaceae* were cultured. About 30% of negative urine culture results raise doubts of the occurrence of a UTI. This is due to a number of limitations related to the collection of urine cultures under acute conditions. Patients often pass urine for the culture incorrectly (too little urine, lack of proper preparation for the collection, anuria). Detailed data on the etiologic agents causing UTI (urine cultures) are presented in Table 1.

In all, 137 analyzed patients’ blood cultures demonstrated positive results. In 116 of 137 (84.7%) patients, blood cultures showed *Enterobacteriaceae* growth. Strains of ESBL-producing *Enterobacteriaceae* were shown in 48 of 116 (41.4%) patients, while non-ESBL-producing strains were found in 68 of 116 (58.6%) patients. In 21 of 137 (15.3%) patients, strains other than *Enterobacteriaceae* were found (Table 1).

In 83.3% (80/96) of the patients, the pathogens cultured from urine were identical to that cultured in the blood and were most frequently *E. coli* (26), *K. pneumoniae* ESBL-positive (21), and *E. coli* ESBL-positive (10). Detailed data on identical strains cultured in the blood and urine simultaneously are presented in Table 2. In urine, ESBL-positive strains were cultured in 38 patients; in most of these patients, 86.8% (33/38), ESBL-positive strains were also cultured from the blood. Interestingly, 5 of these patients demonstrated positive urine cultures with ESBL (+) and ESBL (-) *Enterobacteriacae*.

**Table 1.** Comparison of urine and blood cultures isolates in patients with urosepsis.

|                     | ESBL (+) Entero | ESBL (-) Entero | Other bacterial strains | Overall |
|---------------------|-----------------|-----------------|-------------------------|---------|
|                     | *n*             | *n*             | *n*                     | *n*     |
| Number of patients  | 38              | 48              | 43                      | 68      | 15          | 21          | 96          | 137          |
| *K. pneumoniae* ESBL(+) | 26              | 30              |                         |         |             |             |             |             |
| *E. coli* ESBL(+)   | 10              | 15              |                         |         |             |             |             |             |
| *E. cloacae* ESBL(+) | 3               | 5               |                         |         |             |             |             |             |
| *E. faecalis* HLAR(+) |                |                 | 3                       | 4       | 3           | 4           |             |             |
| *E. faecium* HLAR(+) |                |                 | 3                       | 1       |             |             |             |             |
| MRSE                |                 |                 | 1                       | 2       | 1           | 2           |             |             |
| MRCNS – *S. hominis* |                 |                 | 1                       | 3       | 1           | 3           |             |             |
| *K. pneumoniae*     | 9               | 13              |                         | 35      | 43          |             |             |             |
| *E. coli*           | 29              | 46              |                         | 39      | 61          |             |             |             |
| *E. cloacae*        | 3               | 3               |                         | 4       | 8           |             |             |             |
| *E. faecalis*       | 6               | 5               |                         | 6       | 5           |             |             |             |
| *E. faecium*        | 1               |                 |                         | 1       |             |             |             |             |
| Other Gram negative bacteria | 5 | 11 | 3 | 3 | 8 | 14 |
| MSSA                |                 |                 |                         | 4       | 1           | 4           |             |             |
| MSSE                | 1               |                 |                         |         | 1           |             |             |             |
| *S. hominis*        |                 |                 |                         |         | 1           |             |             |             |
| *B. fragilis*       |                 |                 |                         |         | 1           |             |             |             |
| Dietzia cinnamia    |                 |                 |                         |         | 1           |             |             |             |
| Number of strains (n) | 39              | 50              | 46                      | 73      | 18          | 24          | 103         | 147          |

ESBL – extended-spectrum beta-lactamases; HLAR – high-level aminoglycoside resistance; MRSE – methicillin-resistant *Staphylococcus epidermidis*; MRCNS – methicillin-resistant coagulase-negative *Staphylococcus*; MSSA – methicillin-sensitive *Staphylococcus aureus*; MSSE – methicillin-sensitive *Staphylococcus epidermidis*.
ESBL-positive *Enterobacteriaceae* strains, and this resistance mechanism was not observed in blood isolates. In the urine of 43 patients, ESBL-negative strains were cultured, and in 90.7% (39/43) of these patients ESBL-negative strains were also cultured from the blood. In 1 of 43 patients with positive urine cultures that were ESBL-negative, the blood sample was cultured as an ESBL-positive gram-negative rod.

### Outcomes

After initial data collection, treatment effects for over the 3.5-year study period were compared between patients with sepsis caused by ESBL-positive (35%, 48/137) and ESBL-negative (49.6%, 68/137) gram-negative rods. Significantly higher creatinine values (P=0.02) were observed in patients with blood infected by ESBL-positive strains (median 1.75) than in patients with blood infected with ESBL-negative strains (median 1.44). The other values (WBC, CRP, PLT) did not differ significantly in patients with sepsis caused by ESBL-positive and other bacterial strains.

Among the 48 patients with urosepsis due to ESBL-producing microorganisms, the median length of hospital stay was 11 days, compared with 9 days for patients with non-ESBL-producing *Enterobacteriaceae*, and the difference was statistically significant (P<0.0005). Significantly longer treatment duration with antimicrobials was found in patients with urosepsis due to ESBL-producing microorganisms than in patients diagnosed with urosepsis caused by non-ESBL-producing *Enterobacteriaceae* (11 days vs 9 days; P<0.0005). Similarly, there was a significant difference between the hospitalization time of patients with urosepsis caused by ESBL-positive rods and the hospitalization time of patients with urosepsis caused by other ESBL-negative strains (P<0.0005). On the other hand, a similar and nonsignificant (P=0.9) difference in hospitalization time was observed between patients with urosepsis caused by ESBL-negative rods and patients with urosepsis caused by other microorganisms. In patients with urosepsis caused by ESBL-positive strains, 20.8% (10/48) received empirical antibiotic therapy, which also turned out to be a targeted antibiotic therapy, while in patients with urosepsis caused by other bacterial strains (ESBL-negative and others), empirical antibiotic therapy was targeted in 73.5% (60/89) of patients (P<0.0005).

### Discussion

In the analysis of 137 patients with a history of urosepsis, demographic data were described and blood and urine isolates were detailed in laboratory test results on admission. In addition, the most common urological comorbidities were described. We also compared groups of patients with urosepsis caused by ESBL-positive and ESBL-negative strains.

We agree with Singer et al who stated that rapid management of sepsis, including intravenous administration of an appropriate antibiotic, is vital for optimal outcomes. Inadequate antibiotic coverage is identified as an outstanding problem in urosepsis [22]. Usually, initiatory antibiotic therapy should be empiric with a broad antimicrobial spectrum to cover all likely causative bacteria, and should be altered on the basis of obtained culture results [5]. At present, ESBL-positive *Enterobacteriaceae* (including *E. coli*) pose a serious threat to patients. Such multidrug-resistant bacteria can account for up to 45% of all *Enterobacteriaceae* [19]. In these cases, initial empiric therapy is often inappropriate. It is therefore crucial to rapidly identify the microbial pathogen because an adequate treatment decreases the mortality in cases of ESBL-positive infection [20]. In our single-center study, ESBL-producing pathogens were identified from blood cultures in 35.0% (48/137) of patients. These results demonstrated higher rates than those reported in the literature [22,23]. In a single-center study in

| Pathogens cultured from urine and blood culture of the same patients (n=80) | Number of strains |
|---|---|
| MSSA | 1 |
| MRSE S. epidermidis | 1 |
| E. faecalis HLAR(-)/E. faecalis HLRAR(+) | 3/2 |
| Other Gram negative bacteria | 7 |
| E. coli | 2/1 |
| K. pneumoniae ESBL(+)/K. pneumoniae ESBL(-) | 21/6 |
| E. cloacae ESBL (+)/E. cloacae ESBL (-) | 2/1 |
| E. coli ESBL (+)/E. coli ESBL (-) | 26/10 |

**Table 2.** Identical bacterial etiological agents of infections cultured from blood and urine of the same patient.
Canada, the results were significantly lower, although a similar methodology was used [24]. A recent study from China confirmed an even more frequent occurrence of the above strains, at the level of 42% [25]. Interestingly, the percentage of E. coli was much lower than in a similar study from India (44% vs 94%), but this is most likely due to the different identification methods used [26]. Although studies have shown steady increases in the proportion of ESBL-producing rods in blood isolates, from 1.8% in 2008 to 10.3% in 2015 [22], we are concerned about the obtained results. It is easier for pathogens to acquire ESBL-resistance mechanisms, which are most often transmitted via plasmid transfer [27]. Previous hospitalizations and long-term stays in nursing homes, admission to the intensive care unit, traveling to endemic regions, recurrent UTIs, and previous exposure to antibiotics (particularly beta-lactams) have been described as risk factors for colonization and infection by ESBL-producing Enterobacteriaceae [24].

The median age of our patients (67 years) was identical with the Canadian survey; although, in our study, most patients were male [24]. In a 2-center study from China, the age structure of patients was similar to that of our present study, but the number of women affected was higher [25]. It is also interesting that, in contrast to our study in which the most common urological comorbidity disease was hydronephrosis (due to the dysfunction of urinary drainage), in the case of the study from China, it was urolithiasis [25]. A study from Ireland showed a similar average age (70 years) and more female patients (60%) [28]. The urological comorbidity predisposing patients to urosepsis [28] was bladder outlet obstruction secondary to benign prostatic hyperplasia. The study from Ireland confirmed the high frequency of E. coli strains (85.9%) in obtained cultures; however, ESBL-positive strains were detected only in 8.4% of patients [28]. However, the authors gave attention to the increasing antibiotic resistance with mechanisms other than ESBL [28,29]. Another study from China characterized the population of people diagnosed with urosepsis. The average patient age was 59.83 years, similar to that of our patients. Researchers also obtained a high percentage of E. coli strains of 64.6% and ESBL-positive strains of 66.15% [30]. In the present study, the results of laboratory tests, except for creatinine, and the clinical status of patients with ESBL-positive urosepsis did not differ significantly from the remaining patients. Similar to the Canadian survey, the renal insufficiency may thus be a predictor of ESBL-positive urosepsis [24]. We have not noted statistically significant differences between values of biochemical parameters (WBC, CRP), except for creatinine, in patients with sepsis caused by ESBL-positive and ESBL-negative strains. The impact of bacterial infections caused by ESBL-producing strains on mortality remains controversial. Some studies have suggested that ESBL-positive bloodstream infections have been associated with increased morbidity and mortality [32,33]. One meta-analysis found that implications for mortality outcomes may be an effect of a delay in prescribing effective antibiotics for patients infected with ESBL-producing strains, causing bacteremia [34]. Length of stay has been studied in previous matched case-control studies, which have shown no differences between ESBL-producing and non-ESBL-producing bacterial bloodstream infections [34,35]. In the present study, there was a statistically significant (P<0.005) increase in median hospital stay duration of patients with urosepsis caused by ESBL-producing strains, compared with that of patients infected by ESBL-negative strains. These results are in line with studies presented by Huang et al in Canada [24]. Likewise, antibiotic therapy was significantly longer in the ESBL-positive group in the present study and in the Canadian study [24]. Delay to effective antimicrobial therapy for patients with ESBL-producing Enterobacteriaceae bloodstream infections has been consistently documented in the literature [33-36]. In our analysis, patients with ESBL-positive urosepsis received empirical antibiotic therapy, which also turned out to be a targeted antibiotic therapy, significantly less often than did patients with urosepsis caused by other strains (non-ESBLs and others).

The prior colonization with ESBL-producing rods was not analyzed a priori in the present study. Such prior colonization could have affected the selection of antimicrobials in favor of agents that empirically target ESBL-producing microorganisms, which would have shortened the median time to receipt of appropriate antimicrobials in the ESBL-positive urosepsis group. This is because clinicians often tailor empiric antimicrobial selection on the basis of previous microbial colonization [37,38]. Early detection of infections, including bacteremia, caused by ESBL-producing microorganisms appears to be of fundamental importance in the treatment of these patients. Future studies should consider prior colonization as a study variable. In conditions of escalating prevalence of ESBL-producing Enterobacteriaceae strains, the use of modern techniques (molecular methods) in detecting the above-mentioned pathogens should be considered, for example, PCR-microarray-based molecular assays [39]. Clinicians should be able to rely on methods more quickly and reliably in detecting the pathogens responsible for the infection. Despite the initial high costs, we believe that such a procedure will reduce the costs of treatment by reducing hospitalization time, reducing unnecessary antibiotic therapy, and limiting the development of multi-drug-resistant strains.

This study had several limitations. First, it was limited as a single-center analysis and could be improved through subsequent prospective investigations. In addition, our study focused on urological patients in the period of 2017 to 2020; thus, the study group was small and requires confirmation in a wider range of patients during a longer observation time. Given that our study was retrospective, the possibility of incomplete data for patient comorbidities and former medical history, including antibiotic intake history, was relatively high.
Further cohort studies on a larger group of patients should be performed. The prior colonization with ESBL-producing microorganisms was not analyzed a priori in the current study. In future studies, it would be worth considering the above and distinguishing the groups of patients, including prior colonization, to choose appropriate treatment.

Conclusions

This study described a 35% prevalence of ESBL-producing Enterobacteriaceae as an etiological agent of infections, and in 83.3% of cases, the same pathogen was cultured from the urine and blood samples of the patients from the Urology Center in Silesia. Patients infected with ESBL-producing rods significantly less frequently received appropriate empirical antibacterial treatment. The identification of an increasing prevalence of urosepsis associated with ESBL-producing gram-negative rods from this single-center study highlights the requirement of rapid diagnosis, monitoring, and patient management by multidisciplinary team in the case of infection.

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Declaration of Figures’ Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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