Uropathogens Antimicrobial Sensitivity Pattern in a Common Medical Non-Academic Facility in Romania, a Single Center Retrospective Study

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Key-words: uropathogens, common medical facility, antimicrobial resistance

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Introduction

Urinary Tract Infections (UTIs), caused by a large variety of microorganisms, are a serious public health problem. As some of the most common infections in medical practice, their impact in terms of costs and outcome is significant.

The overuse and misuse of antibiotics have contributed to the growing problem of resistance amongst uropathogenic bacteria, which has become a serious threat to public health[1,2].

In acute care hospitals, 20-50% of prescribed antibiotics are either unnecessary or inappropriate[3,4]. Therefore, antimicrobial stewardship is important to optimize clinical outcomes and ensure cost-effective therapy.

It also aims to minimize consequences of antimicrobial use such as infections with Clostridioides difficile, toxicity, selection of virulent organisms and emergence of resistant bacterial strains[3,5].

Current guidelines recommend adjusting treatment to local data in the management of UTIs, as spectrum and susceptibility patterns of the etiological pathogens should be locally known[3].

The frequently cited AMR Review6 acknowledges that the reported numbers concerning AMR are "broad brush estimates" and emphasizes the need for "more detailed and robust work". This highlights the current lack of comprehensive data on AMR, underscoring the importance of improving infection surveillance[6].

This lack of data is particularly prevalent in nonacademic medical entities, where limited research is conducted despite their significant impact on society's healthcare[6].

Methods

Urine culture results covering one pre-pandemic year, from 01.01.2018 until 31.12.2018, were studied. All urine cultures from Vaslui County Emergency Hospital (including those from ambulatory care) were included.

The methodology used at that time by the central hospital laboratory was standard: isolated colonies were tested for antimicrobial susceptibility using the Agar Disk Diffusion Test, after a standard inoculum from urine samples collected in wide-mouth sterile containers were swabbed on its surface[7].

The inclusion criteria were: positive cultures (defined as more than 100.000 CFU) with one or two germs and available correspondent antibiogram. All negative cultures (meaning less than 1.000 CFU), as well as all cultures with multiple germs (having three or more germs identified, and no antibiogram) were excluded.

Data were analyzed using Microsoft Excel software and the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were calculated and percentages were derived for certain variables.

Results

For one year period, from 01.01.2018 until 31.12.2018, all urine cultures from Vaslui County Emergency Hospital were studied. We identified 1810 positive urine-cultures including 49 with 2 germs (19 females and 30 males), totalizing 1854 strains.

1234 females (68.18%) and 576 males (31.82%) were included, with an age range between 0 and 96 years, and a median age of 68 years. The hospital department distribution is represented in figure 1. The identified species and their distribution are indicated in figure 2.

1. Escherichia coli

Amoxicillin/clavulanic acid (AMC) had 80.29% sensitivity, 15.04% resistance and 4.67% intermediary. This percentages are from 1157 cultures with 929 sensitive and 174 resistant strains.

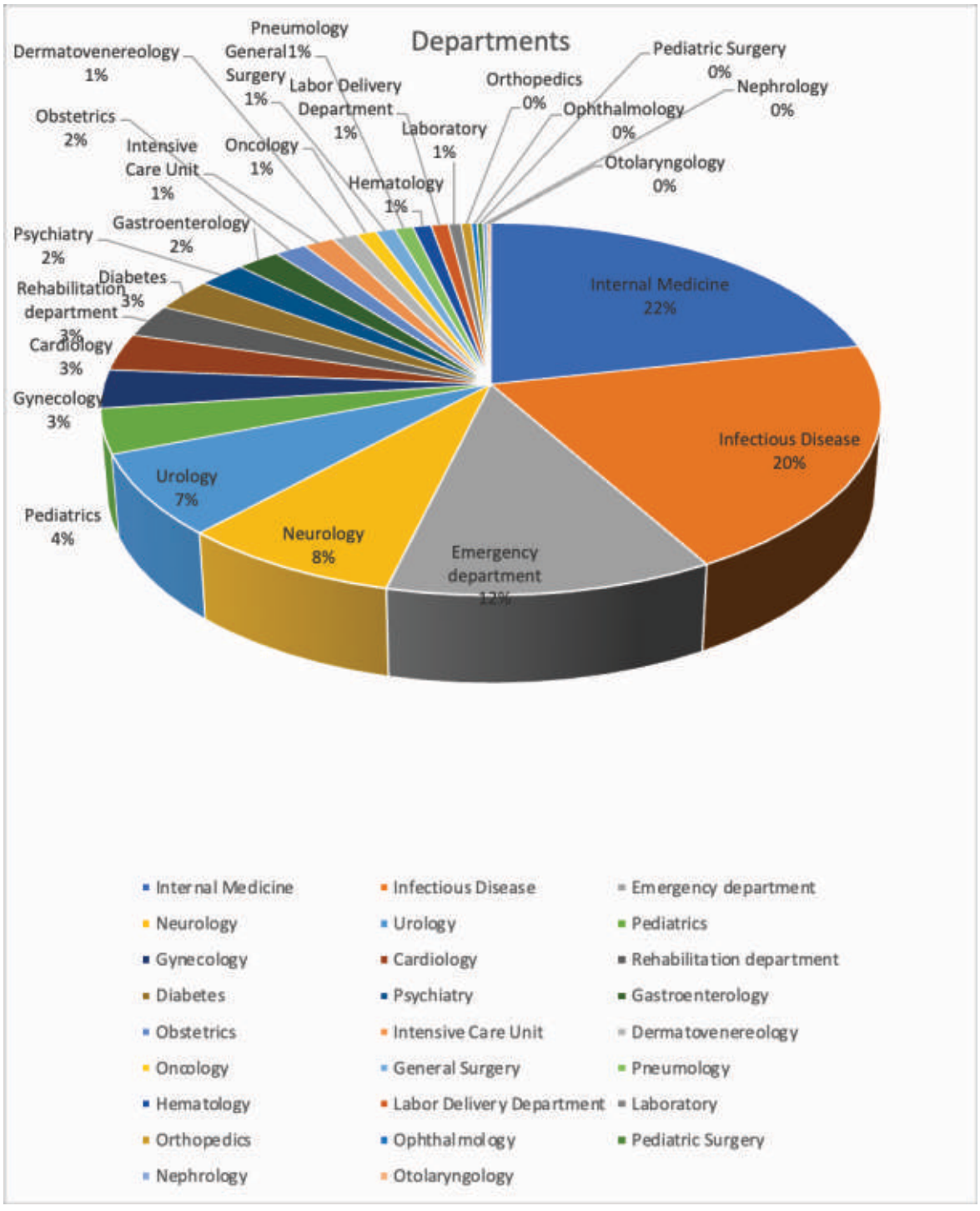


Figure 1. Departments distribution of uropathogens

For fluoroquinolones, aminoglycosides, cephalosporins and carbapenems results are in table 1.

Extended-spectrum beta-lactamases (ESBL) strains were identified in 134 cases out of a total of 1176 bacterial isolates, meaning that 11,39% are resistant to cephalosporins. For non-ESBL E. coli strains, the cephalosporins testing results are illustrated in Table 1, underlying the fact that ESBL secretion is the main process that inactivates cephalosporins activity.

Trimethoprim-sulfamethoxazole (TMP-SMX) was tested in 963 cases, and revealed a high rate of resistance R=21.26% (percentage 25.96%), while 712 was the number of sensitive E. coli, meaning S=60.54% (percentage 73.94%).

From a total of 1144 cases tested, 1105 bacterial isolates were susceptible to nitrofurantoin S=93.96% (percentage 96.59%), 35 were resistant R=2.98% (percentage 3.06%) and 4 intermediate (0.35%), suggesting nitrofurantoin has a very good action profile.

Fosfomycin as well had a very good in vitro effect with 1057 sensitive tests and 17 resistant, S=89.88%, R=1.45% (out of a total of 1144, percentage 98.41%, respectively 1.53%).

2 Klebsiella spp.

AMC had only S=57.4%, and R=34.37% (percentage from 249 tested with 147 - 59.04% sensitivity, 88 - 35.34% resistant and 5.62% intermediary).

For fluoroquinolones, aminoglycosides, cephalosporins and carbapenems results are systematized in table 1.

Out of 256 strains, 50 (19.53%) were found to be ESBL and 71 (27.73%) declared as MDR. What proved different in Klebsiella from E. coli is that apart from ESBL strains, we still identified that part of non-ESBL strains were resistant to cephalosporins (table 1).

Trimethoprim-sulfamethoxazole, tested in 199 cases, revealed a rate of resistance R=23.43% (60 resistant, percentage 30.15%) and sensitivity S=54.30% (139 sensitive, percentage 69.84%).

Nitrofurantoin testing revealed a high resistance with 163 sensitive tests, 80 resistant and 5 intermediary, translated in S=63.67% and R=31.25% (percentages out of a total of 248 65.72%, respectively 32.26% and 2.02%).

Tests were done for Piperacillin-tazobactam, with 52 strains being susceptible (S=2.80%), 17 resistant (R=0.92%) and 4 intermediate (I=0.22%). Percentages from 73 samples are 71.23%, 23.29% and 13.70.

Fosfomycin showed a good effect with 22 susceptible strains and 1 resistant, translated in S=8.59% and R=0.39% (percentages out of a total of 23 are 95.65%, and 4.35%).

3. Streptococcus spp.

Streptococcus showed 100 % sensitivity for gentamycin, penicillin, ampicillin, AMC, vancomycin, teicoplanin, linezolid and nitrofurantoin, and the same to a number of cephalosporins (cefepime, cefotaxime and ceftriaxone).

For fluoroquinolones it was not the same situation, results are available in table 2.

Tetracycline was tested and 47 times was resistant, while 7 times was susceptible (R=51.65%, S=7.69%) (percentages of 54 tests 87.04% and 12.96%).

4. Enterococcus spp.

The 88 Enterococcus cultures were tested according to natural susceptibility, and results are shown in table 2.

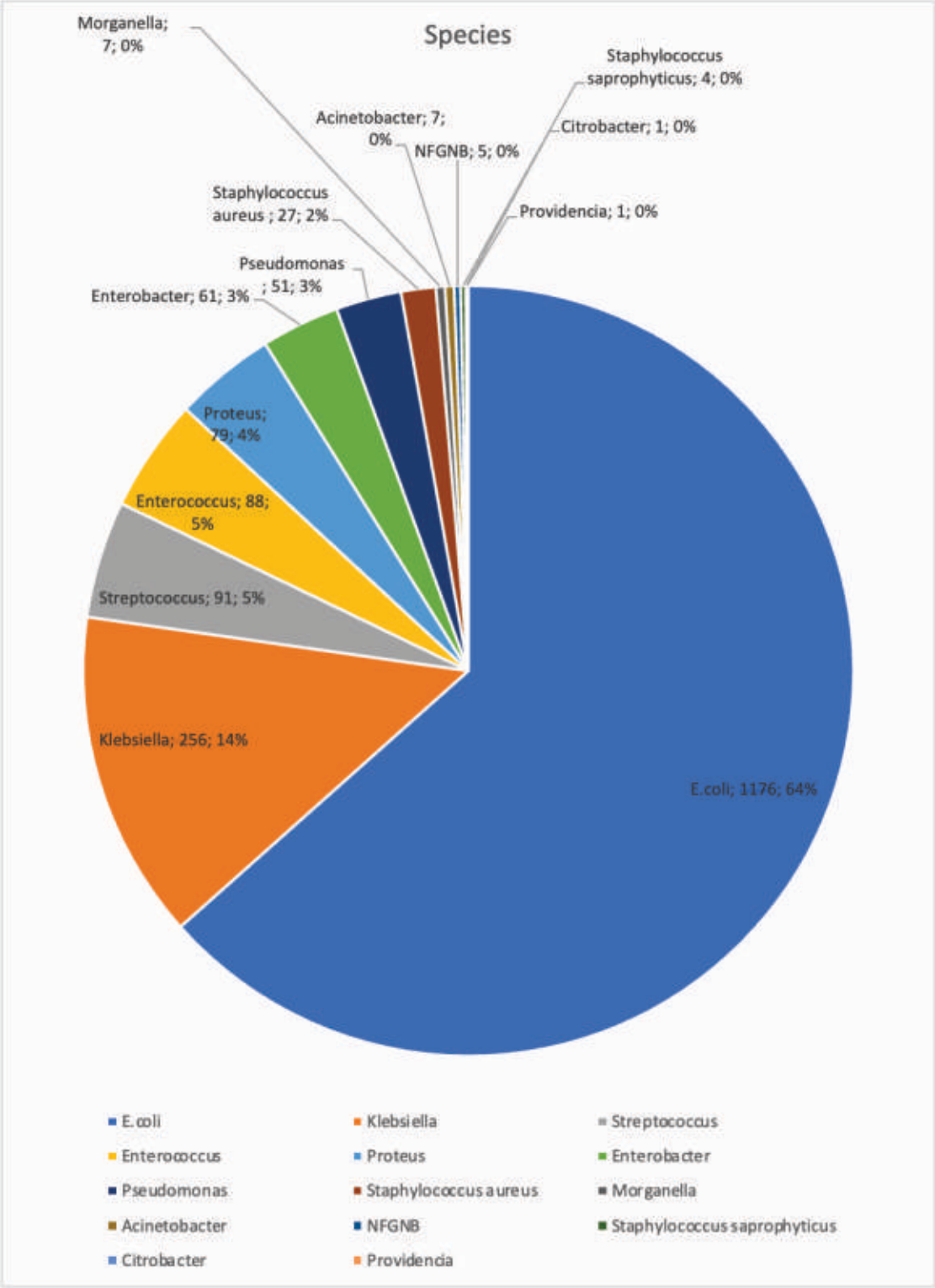


Figure 2. Identified species

8 isolates met criteria for MDR, representing 9.09%.

5. Proteus spp.

74 samples were tested for AMC and 38 were sensitive (percentage 51.35%), while 34 were resistant (45.95%) and 2 intermediate (2.70%), results being S=48.10%, I=2.53% and R=43.03%.

Fluoroquinolones, aminoglycosides, cephalosporins and carbapenems are systematized in table 1.

TMP-SMX was tested with R=48.10% and S=25.32% (38 resistant and 20 sensitive, percentage 65.51% and 34.48%).

In most cultures (77) nitrofurantoin was evaluated and 70 were resistant (90.91%), while only 7 were sensitive (9.09%), meaning R=88.61% and S=8.86%. 70 isolates were resistant to nitrofurantoin (percentage 90.91%), while only 7 were susceptible (9.09%) (out of 77 strains R=88.61% and S=8.86%). 16 strains were found to be ESBL (20.25%) and 30 were found to be MDR (37.97%).

A number of 28 tests for piperacillin/tazobactam were done showing 27 sensitive strains (S=34.18%) and 1 resistant (R=1.27%) (percentages 96.43% and 3.57%).

6. Enterobacter spp.

TMP-SMX was tested in 51 out of 61 cases, 39 being sensitive S=63.93% (percentage 76.47%) while 12 being resistant R=19.67% (percentage 23.53%). Fluoroquinolones, aminoglycosides, cephalosporins and carbapenems are in table 1.

Nitrofurantoin was tested in all 61 cases, 31 being sensitive (S=50.82%), while 29 being resistant (R=47.54%) and 1 intermediary (I=1.64%).

A number of 13 strains were ESBL positive (21.31%) and 19 strains were MDR (31.14%).

7 Pseudomonas aeruginosa

Fluoroquinolones, aminoglycosides, cephalosporins and carbapenems results are available in table 1.

Colistin was evaluated in 15 samples and in 14 was sensitive, while in one was intermediate.

We identified 35 piperacillin/tazobactam susceptible strains (S=68.63%), 5 resistant strains (R=9.80%) and 6 intermediate strains (I=11.76%). Percentages are 76.09% vs. 10.87% vs. 13.04%.
27 strains were MDR (52.94%).

8. Staphylococcus aureus

The 27 strains underwent various testing (table 2). The following antibiotics have a 100% efficiency rate, tested number been mentioned for everyone: TMP-SMX (19), vancomycin (1), linezolid (12), nitrofurantoin (18), cefoxitin (2).

We identified 16 MRSA strains (59.26%), being considered a type of MDR.

Overall antibiotic sensibility - We tested the overall susceptibility of all bacterial strains that are considered uropathogens, without taking into consideration the species, as it happens when administrating empiric antimicrobial therapy.

I. Fluoroquinolones. Ciprofloxacin (1208 tested) proved in 96 situations resistant (R=5.18%), in 1109 sensitive (S=59.82%) and in 3 intermediary. Percentiles are 7.947% and 91.805%. A number of 651 samples were not tested.

1641 bacterial isolates were tested for their resistance against norfloxacin and we identified 418 resistant strains (R=22.55%), 1221 susceptible strains (S=65.86%) and 2 intermediate strains (I=0.11%). Percentages are 25.472%, 74.405% and 0,12%, excluding the 217 not-tested ones.

Ofloxacin, 1062 samples tested, proved in 2 resistant R=0.11%, in 1060 sensitive S=57.17 (percentage 99.81%, without the 797 not-tested), and none intermediary.

1472 isolates were tested for levofloxacin resistance, and we identified 123 resistant strains (R=6.63%),

1346 susceptible strains (S=72.60%), 3 intermediate strains. Percentages without the 387 not tested ones are 8.356% vs. 91.44%.

II. Aminoglycosides.

Gentamycin, 1531 tests, appeared to be in 237 situations resistant (R=12.78%), in 1284 sensitive (S=69.26%) and in 10 intermediary (I=0.54%). Percentages are 15.48% resistant, 83.87% sensitive and 0.65% intermediary.

Amikacin, 915 times tested, appeared to be in 44 resistant (R=2.37%), in 865 sensible (S=46.66%) and in 6 intermediary (I=0.32%). Percentages are 4.81% resistant, 94.54% sensitive and 0.66% intermediary.
Tobramycin was the least tested aminoglycoside, 71 times, with 52 resistant (R=2.80%) and 19 sensible (S=1.02%) germs. Percentages are 73.24% resistant and 26.76% sensitive.

III. Beta-lactam antibiotics

IIIa. Penicillins. AMC acid was 1561 times tested, with 345 resistant (R=18.61%), 1144 sensitive (S=61.70%), 72 intermediary (I=3.88%). Percentages are 22.1%, 73.3% respectively 4.6%.

IIIb. Cephalosporins were tested, except those strains declared ESBL. The second generation cephalosporins tested were Cefuroxime (32 tests, detailed in table) and Cefoxitin (3 times tested, all 3 sensitive). Out of third generation cephalosporins Cefotaxime, Ceftibuten, Ceftriaxone, Ceftazidime and Cefixime were evaluated, all results detailed in table 3. Fourth generation was represented only by Cefepime as seen in table 3.
Out of all germs tested 215 were BLSE positive (11.597%).

IIIc. Carbapenems.

Imipenem (264 tested): 40 resistant (R=2.16%), 222 sensitive (S=11.97%), 2 intermediary (I=0.11%). Percentages are 15.15%, 84.09%, 0.76% respectively.

Meropenem (594 tested): 47 resistant (R=2.54%), 544 sensitive (S=29.34%), 3 intermediary (I=0.16%). Percentages are 7.91%, 91.58%, 0.51 respectively.
Ertapenem (6 tested): 3 resistant (R=0.16%), 3 sensitive (S=0.16%). Identical susceptibility pattern as meropenem.

Out of all 1854, 47 were carbapenem-resistant strains (2.54%). Carbapenem resistant strains were still sensitive to Gentamycin, Amikacin, Ceftazidime, Piperacillin/tazobactam, Fosfomycin, Colistin, Ampicillin/sulbactam, with the exception of 8 strains.

Table 1. Gram-negative AMR

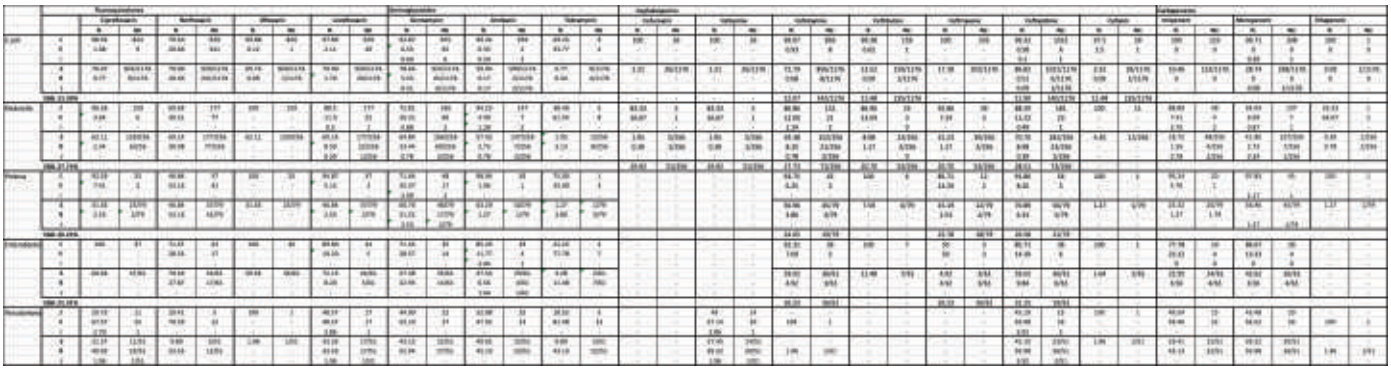


Table 2. Gram-positive AMR

		Fluoroquinolones								Other antibiotics									
		Ciprofloxacin		Norfloxacin		Ofloxacin		Levofloxacin		TMP-SMX		Gentamycin		Nitrofurantoin		Vancomycin		Linezolid	
		%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No
Streptococcus	*S*	82.35	14	100	3	100	7	92.94	79	0	0	100	6	100	22	100	72	100	74
	R	17.65	3	-	-	-	-	7.06	6	100	2	0	0	0	0	0	0	0	0
	I	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0
	S	15.38	14/91	3.30	3/91	7.69	7/91	86.81	79/91	0	0	6.59	6/91	24.18	22/91	79.12	72/91	81.31	74/91
	R	3.30	3/91	-	-	-	-	6.59	6/91	2.19	2/91	0	0	0	0	0	0	0	0
	I	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0
Enterococcus	*S*	17.54	10	21.74	5	100	1	36.11	26	-	-	55.29	47	92.40	73	97.53	79	98.63	72
	R	78.95	45	73.91	17	0	0	62.50	45	-	-	44.71	38	6.33	5	2.47	2	1.37	1
	I	3.51	2	4.35	1	0	0	1.39	1	-	-	0	0	1.27	1	0	0	0	0
	S	11.36	10/88	5.68	5/88	1.14	1/88	29.55	26/88	-	-	53.41	47/88	82.95	73/88	89.77	79/88	81.81	72/88
	R	51.14	45/88	19.32	17/88	0	0	51.14	45/88	-	-	43.18	38/88	5.68	5/88	2.27	2/88	1.14	1/88
	I	2.27	2/88	1.14	1/88	0	0	1.14	1/88	-	-	0	0/88	1.14	1/88	0	0/88	0	0/88
Staphylococcus	*S*	90.00	18	92.31	12	100	5	92.31	24	100	19	96.00	24	100	18	100	1	100	12
	R	10.00	2	7.69	1	-	-	7.69	2	0	0	4.00	1	0	0	0	0	0	0
	I	-	-	-	-	-	-	-	-	0	0	-	-	0	0	0	0	0	0
	S	66.67	18/27	44.44	12/27	18.52	5/27	88.89	24/27	70.37	19/27	88.89	24/27	66.67	18/27	3.70	1/27	44.44	12/27
	R	7.41	2/27	3.70	1/27	-	-	7.41	2/27	0	0/27	3.70	1/27	0	0/27	0	0/27	0	0/27
	I	-	-	-	-	-	-	-	-	0	0/27	-	-	0	0/27	0	0/27	0	0/27

Table 3 Overall Cephalosporins resistance

Cephalosporins							
	Cefuroxime	**Cefotaxime**	**Ceftibuten**	**Ceftriaxona**	**Ceftazidime**	**Cefixime**	**Cefepime**
S	31	1124	192	336	1328	53	46
R	1	41	5	13	76	1	26
I	0	2	0	0	4	0	1
Total	32	1167	197	349	1408	54	73
S%	96.88	96.32	97.46	96.28	94.32	98.15	63.01
R%	3.12	3.51	2.54	3.72	5.40	1.85	35.62
I%	-	0.17	-	-	0.28	-	1.37
ESBL %	14.72	15.11	14.14	15.32	17	13.45	47.22
S	1.67	60.63	10.36	18.12	71.63	2.86	2.48
R	0.05	2.21	0.27	0.70	4.10	0.05	1.40
I	-	0.11	-	-	0.22	-	0.05
ESBL	11.65	13.81	11.87	12.30	15.70	11.65	13.00

IV. Trimethoprim/sulfamethoxazole

We identified 373 resistant strains against TMP-SMX (R=20.12%), 940 susceptible (S=50.70%) and one intermediate (I=0.05%) out of 1314 tested. Percentages are 28.39%, 71.54%, 0.07%.

V. Glycopeptide.

Vancomycin (156 tested, 179 eligible strains) 2 resistant (R=1.12%), 154 sensitive (S=86.03%). Percentages are 1.28% vs. 98.72%. The 2 resistant bacteria were both Enterococcus, one sensitive to Linezolid and Nitrofurantoin and one only intermediary to nitrofurantoin.
Teicoplanin (62 tested, 179 eligible strains) 2 resistant (R=1.12%), sensitive (S=34.64%). Percentages are 3.23% vs. 96.77%.

VI. Fosfomycin

23 strains were resistant (R=1.24%) and 1197 susceptible (S=64.56%) out of 1120 strains tested. Percentages 2.05% vs. 97.95%.

VII. Nitrofurantoin

1676 strains tested, 241 resistant strains (R=13.00%), 1424 susceptible (S=76.81%) and 11 intermediate (I=0.59%). Percentages 14.38%, 84.96% and 0.66%.

VIII. Other

Linezolid 162 strains tested with 1 resistant (R=0.56%) and 161 (S=89.94%) sensitive.

Piperacillin/tazobactam was tested in 159 cases: 117 susceptible (S=6.31%), 32 resistant (R=1.73%) and 10 intermediate strains (I=0.54%). Percentages 73.58%, 20,13% and 6.29%.

MDR is defined as non-susceptibility to at least one agent in three or more antimicrobial categories8. This includes ESBL producing strains, MRSA, and counted for 313 bacterial isolates (16.882%)8. PDR was defined as resistance to all tested antibiotics. 8 strains with no identified sensitivity were found, but none was tested for their resistance profile to colistin or fosfomycin. Out of 8 strains, 4 were only intermediate to one antimicrobial: amikacin, nitrofurantoin.

Discussion

Uropathogens were detected in all hospital departments. This is in accordance to ECDC data, which emphasizes that Romania lacks robust data on AMR rates, healthcare-associated infections (HAIs) and antimicrobial consumption at the local level.

With regard to AMR, contributing factors include inadequate multidisciplinary collaboration between clinicians, microbiologists and epidemiologists, and limited collaboration between human and veterinary domains[9].

In light of the above-mentioned, inter-disciplinary collaboration should be improved for better results. Gender distribution shows females as being more at risk. Age was increased, as other paper-works showed, as the prevalence of UTIs or ABU increases with age.

AMR and treatment conclusions

Cystitis treatment. The empiric treatment is one of the most important aspects in this paragraph, since the culture is not mandatory in all cases of cystitis, and this type of UTI is the most frequent.

According to data above and the available susceptibility patterns in Europe, oral treatment with Fosfomycin trometamol 3 g single dose, and nitrofurantoin (e.g. nitrofurantoin monohydrate/macrocrystals 100 mg twice daily for five days), should be considered for first-line treatment10,11. Resistance rates to Fosfomycin are extremely low, and resistance to nitrofurantoin is less than 15% (under the sometimes-designated threshold of 20%).

The next antimicrobials option includes trimethoprim alone or combined with a sulphonamide. Co-trimoxazole (160/800 mg twice daily for three days) or trimethoprim (200 mg twice daily for five days). As they should only be

considered as drugs of first choice in areas with known resistance rates for E. coli of less than 20%, they look inappropriate[12,13].

Ciprofloxacin, ofloxacin and levofloxacin have the required less than 20% resistance, but on March 11, 2019, the European Commission implemented stringent regulatory conditions regarding the use of fluoroquinolones due to their disabling and potentially long-lasting side effects14. This legally binding decision is applicable in all EU countries. National authorities have been urged to enforce this ruling and to take all appropriate measures to promote the correct use of this class of antibiotics. In uncomplicated cystitis a fluoroquinolone should only be used when it is considered inappropriate to use other antibacterial agents that are commonly recommended for the treatment of these infections14. We can underline that these recommendations are applicable in the studied area of Vaslui.

Uncomplicated pyelonephritis treatment.

Fluoroquinolones and cephalosporines are the only antimicrobial agents that can be recommended as oral empirical treatment (until mandatory culture results are available) of uncomplicated pyelonephritis15. Ciprofloxacin, ofloxacin and levofloxacin have the required less than 10% resistance, in fact showing a lower level of resistance compared with other reports, or other countries nearby, like Hungary[16].

In oral empiric treatment should cautiously be used norfloxacin or amoxicillin/clavulanic acid, as resistance rates are high.

Inpatient treatment

Patients with uncomplicated pyelonephritis requiring hospitalization should be treated initially with an intravenous fluoroquinolone, an aminoglycoside (with or without ampicillin), or an extended-spectrum cephalosporin[17].

The fluoroquinolone should be ciprofloxacin or levofloxacin as both are a good option with less than 10% resistance. Ofloxacin is not an option as the intravenous form is not available.

The aminoglycoside should be gentamycin or even amikacin because they have about 15%, respectively less than 5 % resistance.

The elected cephalosporins should be third generation, like ceftriaxone, as they have acceptable resistance rates (about 15, and all of them less than 20%).

Complicated UTIs should follow the same regimens as those with uncomplicated pyelonephritis requiring hospitalization, until the antibiogram is ready to use. The symptomatic catheter-associated-UTI must be treated according to the recommendations for complicated UTI, and the same urosepsis and acute bacterial prostatitis.

Overall, the resistance to carbapenems is seldom encountered, and in most of the time there is an alternative for treatment. The incidence to carbapenems appeared generally to be at same levels throughout the years as later studies showed[18].

Special situations

The absence of first-generation cephalosporin in testing is a special situation, as they are unfortunately not frequently used in Romania. Testing to second-generation cephalosporins is underutilized. Although cefuroxime showed a low rate of resistance, results should be interpreted with caution, as the number of tests is too low compared with other cephalosporins.

Results regarding ofloxacin seem intriguing. Apparently, there is no other major explanation except the fact that the resistance rates are all hidden in the large number of not-tested samples.

Accordingly, many tests were gradually done, so there was no testing to carbapenems if many other options were identified to be available, and they were tested only in case of XDR germs.

The same approach was applied for cefepime (4th generation cephalosporin), piperacillin/tazobactam, colistin. This means that rough numbers need

prudence in interpretation.

Comments regarding species

Escherichia coli is the most frequent cause of UTIs in all previous studies as a recent meta-analysis of 90 studies conducted between 1991 and 2015 has shown - E. coli as the predominant uropathogen, accounting for 62%, followed by Klebsiella spp. with 13% [19]. This study comes up with similar findings in terms of epidemiology, with E. coli as the most frequent bacterial strain (63.43%), followed by Klebsiella (13.81%).

The most incriminated uropathogen involved in UTIs, Escherichia Coli, had somewhat the same profile of sensitivity, with slightly higher resistance rates in some cases, or slightly lower than identified in other studies in Romania, regarding all groups of antibiotics[20]. For comparison, resistance was higher for Fosfomycin, with 1.45% versus 1.28%, or for ceftazidime 11.90% (ESBL adjusted) versus 8.53%, and lower for nitrofurantoin, with 2.98% versus 5.83%, or amoxicillin-clavulanic acid 15.04% versus 18.17% [20].

Compared to other studies, Klebsiella spp strains proved less resistant, for example amoxicillin-clavulanic acid 34.37% vs 52.06%, levofloxacin 8.59% vs. 34.57%[16]. Other resistance rates: ceftazidime 28.51 % (ESBL adjusted) vs. 29.05%, for amikacin 2.73% vs. 24.53%, meropenem 2.73% vs 9.24%[20]

Enterococcus spp. had lower resistance rates towards penicillin, ampicillin and levofloxacin than similar studies in our country. Also, resistance to linezolid and vancomycin was at very low levels. On the other hand, resistance to vancomycin was identified, unlike other studies in Romania that did not show any21. In Germany, a paper-work published by Remshmidt et al. analyzed data from the German national nosocomial infection surveillance system in which the proportions of VRE (vancomycin resistant Enterococcus) among all nosocomial enterococcal infections were calculated22. Enterococcal infections were analyzed and the proportion of VRE leading nosocomial infections is significantly increasing for UTIs from 2.9 to 9.9% [22].

Streptococcus spp. appeared very frequently in cultures, and must be mentioned, but as this was a study of identified germs, no comments will be made on the pathogeny or clinical implications of this.

Proteus spp. didn't follow the same pattern of lower resistance rates. In fact, as an exception, this species of Enterobacteriaceae showed higher resistant rates to usual oral antibiotics, such as in amoxicillin-clavulanic acid 43.04% vs. 30.12%, trimethoprim/sulfamethoxazole 48.10% vs. 24.35%. In the case of ceftazidime, resistance was higher than in other paperworks 26.58% vs. 15.38%, but not the same for meropenem where no resistance was encountered vs. 1.28%. Levofloxacin instead had lower resistant rates, as all fluoroquinolones proved in this study, having 2.53% vs. 17.94%.[20]

For Enterobacter spp no solid data was found for a good comparison, but we can state that generally was in between Proteus and Pseudomonas.

Unlike all other spp., Pseudomonas is that case where resistance seems significantly higher for the most important antimicrobials, with the frequently encountered exception for levofloxacin.

Pseudomonas aeruginosa results are compared next (Vaslui versus Romania):

- Amikacin 45.10 – 35.83
- Meropenem 50.98 – 29.16
- Imipenem 43.13 – 29.16
- Ceftazidime 50.98 – 38.33
- Levofloxacin 33.33 – 48.33

Staphylococcus, did follow the same pattern of lower resistance rates than other studies in our country. Comparison is made with the same study, considered to be most eloquent20. Resistant rates are greater for penicillin 66.67% vs. 52.23%, but lower for others, like levofloxacin 7.41% vs. 29.85%. TMP-SMX with sensitivity 70.37% vs. 52.23%. Amikacin, linezolid and nitrofurantoin (no resistivity identified in both studies for it) remained with the best sensitivity rates and most promising therapeutic results.

Overall, the resistance rates of germs to antimicrobials appears lower than the national one. A possible explanation is the low-income of the local population leading to a lower addressability towards health-care units, including primary ones, less abuse of antibiotics, and consequently less resistance.

Contrariwise, there is resistance to almost all categories of antibiotics, and according to MDR definition is higher as other centers show. A paper published in 2021 in Antibiotics revealed 4.58% MDR strains in 3 hospital settings in Romania, compared with almost 17% 23. On the other hand, the increased rates of resistance in our study are mostly to first line treatments (penicillin, ampicillin, nitrofurantoin or trimethoprim), but still having alternatives available, and less or basically the same to second line and reserve treatments.

Overall carbapenem resistance is similar with findings of other Romanian researchers being around 2%24,25, but increased and increasing as other Romanian researchers found in the nearby university center of Iași26. PDR seem more rarely encountered compared with high volume centers of health services, but there is lack of robust data for direct comparison.

In common medical hospitals in Romania uropathogens' antimicrobial sensitivity pattern is still approachable, and not as high as in clinical and high-end hospitals, which concentrate the most difficult cases. Medium-sized hospitals are therefore a promising place to improve infection control, adhesion to guide-lines, better multidisciplinary collaboration between clinicians, microbiologists and epidemiologists, antimicrobial stewardship implementation and overall antimicrobial resistance control.

Conclusion

In a common medical facility in Romania uropathogens' antimicrobial sensitivity pattern is still clinically approachable, with overall lower resistance than clinical hospitals, and antimicrobial stewardship must be implemented for keeping resistance rates as low as possible.

Adhesion to general guide-lines and local particularities awareness are of paramount importance.

Conflicts of interest and source of funding statements:
The authors declare no conflict of interest.

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