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Epidemiology of Enterobacteriaceae uropathogenic strains and resistant to antibiotics in the clinical laboratory of the regional hospital of Beni Mellal, Morocco

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Abstract
Urinary tract infections were a reel public health problem. Enterobacteriaceae are the most common bacteria involved in the etiology of this type of infection. This study aimed to describe the Epidemiology of Enterobacteriaceae uropathogenic strains isolated from both hospitalized and outpatient's cases, and to determine their resistance antibiograms.
This retrospective descriptive study was carried out in the Clinical Laboratory of the Regional Hospital of Beni Mellal city, over a period of three years from January 2020 to December 2022. Data collection was done using the laboratory register, and statistical analysis was performed using the SphinxPlus2.V5. The prevalence of urinary tract infections was 15.6%. A total of 325 bacterial strains were isolated from 206 women and 119 men. Among the germs identified, 89.84% were Enterobacteriaceae, 84.93% were community strains and 17.07% were nosocomial strains. *Escherichia coli* was the most frequent organism, accounting for 71.63% of cases. The result showed that all isolated strains of Enterobacteriaceae had high levels of resistance to commonly used β-lactam antibiotics, including amoxicillin (60.31%), Ticarcillin (56%), ampicillin (51.38%), amoxicillin-clavulanic acid (48%), cefalotin (42.77%), mecillinam (35.69%) and Cefoxitin (32.66%). Additionally, the strains demonstrated resistance to quinolones such as Ofloxacin (40.31%), ciprofloxacin (36.31%), and nalidixic acid (29.35%), as well as sulfamides such as cotrimoxazole (31.69%). However, there was a low rate of resistance to third-generation cephalosporins (ceftazidime (12.61%) and ceftriaxone (9.85%), phenicoles (chloramphenicol (13.85%), carbapenems (imipenem (2.46%), Aminoglycosidees (gentamicin (7.69%) and Polymyxins (Colistin (09.54%). This study showed a high prevalence of urinary tract infections, mainly caused by Enterobacteriaceae with a high frequency of antibiotic resistance. The results of our study could be useful for taking action to reduce the incidence of urinary tract infections and to mitigate the spread of resistant bacteria.

Keywords: Urinary tract infection, enterobacteriaceae, antibiotic resistance, regional hospital of Beni Mellal

Introduction
Urinary tract infections (UTIs) come in second place after infections respiratory problems as reasons for consultation and antibiotic prescription (Chervet *et al.*, 2018) [1]. Around 150 million cases of UTIs worldwide were recorded annually (Bertholom, 2016) [2]. They are a major public health problem.
Enterobacteriaceae were generally the most bacteria involved in the etiology of UTIs (Randrianirina *et al.*, 2007; Muvunyi Arsalane *et al.*, 2014; Amady *et al.*, 2021) [3-5]. This epidemiological profile were largely dominated by *Escherichia coli* (*E. coli*) and *Klebsiella* (Amady *et al.*, 2021; Dia *et al.*, 2015; Hailaji *et al.*, 2016; Linhares *et al.*, 2012; Rafik *et al.*, 2021; Sekhsokh *et al.*, 2008; Seynabou, 2015) [5-11].
Since the end of the years 1990, the epidemiology of UTIs evolved with the emergence within Enterobacteriaceae of a resistance to antibiotics (Cattoir and Bicêtre, 2008; Elhani, 2008) [12, 13].

The rate of uropathogen resistance to routinely administered antibiotics (Amoxicillin, trimethoprim, sulfamethoxazole) has also been steadily rising, according to various studies conducted in Europe and the United States (Gupta *et al.*, 1999; Kahlmeter and Menday, 2003) [14, 15]. In Africa, strains of Enterobacteriaceae are highly resistant to commonly used β-lactams, quinolones and sulfamides were noticed in Burkina Faso (Ouedraogo *et al.*, 2022) [16]. Studies carried out in Morocco showed that uropathogens Enterobacteriaceae were resistant to β-lactams, quinolones and Aminoglycosidees (Rafik *et al.*, 2021; Nadmi *et al.*, 2010; Nejjari *et al.*, 2022) [9, 17, 18].

This antibiotic resistance has caused growing concern worldwide. Indeed, the World Health Organization (WHO) estimates that in 2050, this resistance will be the first cause of mortality in the world with 10 million cases against 8.2 million for cancer (Berthuin *et al.*, 2018) [19]. To deal with this alarming figure, the WHO created the Global Antimicrobial Resistance Surveillance System (GLASS) in 2015 as a critical component of the global action plan against antimicrobial resistance (WHO, 2017) [20]. By the end of 2018, Morocco joined the GLASS system as a member, and the Ministry of Moroccan Health established the national coordination unit and the technical committee for the surveillance of antimicrobial resistance (Nejjari *et al.*, 2022) [18]. Hitherto, however, the data on resistance to antibiotics of uropathogenic Enterobacteriaceae are very limited and needs further investigations to provide a perspective at a national level (Rafik *et al.*, 2021) [9]. In this context, our study's aim were to describe the epidemiology of Enterobacteriaceae uropathogenic strains isolated from hospitalized and outpatients at the Clinical Laboratory of the Regional Hospital (CLRH) of Beni Mellal and to determine their resistance profile to common antibiotics.

Materials and Methods

Study area and design

This was a retrospective descriptive study, carried out in the CLRH of Beni Mellal in Morocco. It was extended for three years, from January 2020 to December 2022.

Inclusion and exclusion criteria

All positive results of Cyto Bacteriological Examination of Urine (CBEU) and antibiograms of both hospitalized and outpatient individuals, recorded in the laboratory register during the study period were included. However, any duplicate CBEU from the same patient with the same strain, polymicrobial CBEU, CBEU positive for unidentified germs, as well as any intermediate antibiogram results were excluded from the research.

Data collection

The data collected for this investigation was the patient's gender, age, hospitalization department, residence place, and examination results (CBEU and antibiogram). The laboratory register was the source of data collection for the study.

Data analysis

Statistical analysis was carried out using Sphinx Plus2 software. The χ^2 test assessed the links between the different types of data. All significant variables in the χ^2 test analysis ($p<0.05$) were considered.

Ethical considerations

Our study was carried out in accordance with local ethical considerations, and namely obtaining the authorizations of the Ministry of Moroccan Health and Social Protection on March 3th 2020 (Reference Number: 6397-3/3/2020). We rigorously implemented all precautions to respect the anonymity and confidentiality of the patient's information by using a coding system.

Results

Sociodemographic characteristics of patients with a positive CBEU

The results showed that out of 325 positive CBEUs performed, 63.4% were from women and 36.6% were from men, resulting in a sex ratio of 1.73 female per male. The age range of patients was 1 and 94 years old, with a mean age of 49.62±18.9 years. The most impacted age groups in women were those aged of 40 to 49 years and those aged of 60 years and over, whereas, in men, the age range most affected was 60 and over. Regarding the place of residence, 56.8% of patients came from urban areas and 43.2% from rural areas (Table 1 and Table 2).

Table 1: Sociodemographic characteristics (n=325)

Sociodemographic Characteristics	Patients		*P*-Value
	N / Mean ± SD	Percentage	
Gender			
Men	119	36.6	0.0303
Women	206	63.4	
Age			
Mean age (SD)	49.62 (18.97)	-	
< 20	23	7.08	
20-29	15	4.61	
30-39	21	6.46	0.6437
40-49	112	34.46	
50-59	41		
60 and over	113		
Residence place			
Urban	185	56.92	0.7567
Rural	140	43.08	

Table 2: Distribution of UTIs according to age groups and gender

Age (years)	Gender				Total
	Women		Men		
	N	%	N	%	
< 20	18	5.54	5	1.54	23
20-29	12	3.69	3	0.92	15
30-39	17	3.53	4	1.23	21
40-49	78	24	34	10.46	112
50-59	30	9.23	11	3.38	41
60 and over	51	15.69	62	13.08	113
Total	206	63.4	119	36.6	325

Bacterial isolates from UTIs

The overall prevalence of UTIs was 15.6% (325/2083). Table 3 lists the various bacteria that were discovered in the patients' urine. A total of 325 bacteria were identified, with 89.84% of the isolates belonging to the family Enterobacteriaceae. *E. coli* was the most frequent species (71.63%), followed by *Klebsiella* (12.92%), *Proteus mirabilis* (3.86%) and *Enterobacter* (3.43%) of Enterobacteriaceae, 84.93% (248/292) were community strains (Out patients) and 15.07% (44/292) were nosocomial strains (hospitalized patients). The other bacteria isolated accounted for 10.14% including Gram-positive cocci (7.38%) and No fermenting Gram-negative bacilli (2.76%).

Table 3: Bacterial isolates from urinary tract infections

Bacteria strains (N=325)	Isolated bacteria	No. of isolates		Total
		Nosocomial strains	Community strains	
		N (%)	N (%)	N (%)
Enterobacteriaceae (N =292)	*E. coli*	33 (14.16)	200 (85.84)	233 (71.63)
	Klebsiella	8 (19.05)	34 (80.95)	42 (12.92)
	Proteus mirabilis	1 (11.11)	8 (88.89)	9 (2.76)
	Enterobacter cloacae	2 (25)	6 (75)	8 (2.46)
Gram-positive cocci (N =24)	*Staphylococci*	7 (2.15)	9 (2.77)	16 (4.92)
	Enterococci	1 (031)	3 (0.92)	4 (1.23)
	Streptococcus	0 (0)	4 (1.23)	4 (1.23)
Non-fermentation Gram-negative bacilli (N=9)	*Pseudomonas*	3 (0.92)	4 (1.23)	7 (2.15)
	Acinetobacter baumannii	0 (0)	2 (0.61)	2 (0.61)
Total		55 (16.92)	270 (83.08)	325

N: Number, %: Parentage

Regarding positive CBEUs in hospitalized patients, 51.85% came from Surgery departments followed by Medicine departments (20.37%), Maternity (16.67%) and Pediatric (11.11%) (Table 4).

Table 4: Distribution of positive CBEUs according to inpatient services

Inpatient services	Positive CBEU	
	N	%
Surgery	28	51.85
Medicine	11	20.37
Maternity	9	16.67
Pediatric	6	11.11
Total	54	100

The isolated Enterobacteriaceae resistance profile

In the light of the results in table 5, we noted that all identified Enterobacteriaceae strains were highly resistant to commonly used β-lactam antibiotics, such as amoxicillin (60.31%), Ticarcillin (56%), ampicillin (51.38%), amoxicillin-clavulanic acid (48%), cefalotin (42.77%), mécillinam (35.69%) and Cefoxitin (32.66%). Additionally, the strains showed resistance to quinolones, including Ofloxacin (40.31%), ciprofloxacin (36.31%), nalidixic acid (29.35%), as well as sulfamides such as cotrimoxazole (31.69%). On the other hand, we observed a low rate of resistance to third-generation cephalosporins (C3G) such as ceftazidime (12.61%) and ceftriaxone (9.85%), phenicoles like chloramphenicol (13.85%), carbapenems such as imipenem (2.46%), Aminoglycosidees such as gentamicin (7.69%) and Polymyxins like colistin (09.54%).

E. coli

Among the 233 isolates of *E. coli*, amoxicillin (66.09%), Ticarcillin (59.23%), ampicillin (53.65%), amoxicillin-clavulanic acid (51.07%), cefalotin (50.64%), and cefotaxime (38.63%) showed the greatest levels of resistance to β -lactams. Regarding quinolones, we noticed that 52.79 were resistant to ofloxacin, 40.77% to cipr Ofloxacin and 33.48% to nalidixic acid. For sulfamides, the resistance rate of *E. coli* strains was 33.05% for cotrimoxazole. However, these bacteria were less resistant to ceftazidime (15.45%), ceftriaxone **(**13.73%), chloramphenicol (12.02%), colistin (9.44%), gentamicin (8.58%), and imipenem (2.14%).

Table 5: Resistance profile of the Enterobacteriaceae strains

Antibiotic tested	*E. coli* (N=233)	*Klebsiella* (N=42)	*Proteus mirabilis* (N=9)	*Enterobacter cloacae* (N=8)	Total (N=325)
	RN (%)	RN (%)	RN (%)	R N (%)	RN (%)
INN	92 (39.48)	24 (57.14)	0 (0)	0 (0)	116 (35.69)
AML	154 (66.09)	42 (100)	5 (55.56)	3 (37.5)	196 (60.31)
AUG	119 (51,07)	31 (73.81)	4 (44.44)	2 (25)	156 (48)
TCC	138 (59.23)	38 (90.48)	2 (22)	4 (50)	182 (56)
CF	118 (50.64)	16 (38.10)	0 (0)	5 (62.5)	139 (42.77)
FOX	90 (38.63)	11 (26.12)	0 (0)	5 (62.5)	106 (32.66)
AM	125 (53.65)	42 (100)	0 (0)	0 (0)	167 (51.38)
CTR	32 (13.73)	0 (0)	0 (0)	0 (0)	32 (9.85)
CAZ	36 (15.45)	4 (9.52)	0 (0)	1 (12.5)	41(12.61)
IMP	5 (2.15)	3 (7.14)	0 (0)	0 (0)	8 (2.46)
NA	78 (3.48)	13 (30.95)	3 (33.33)	3 (37.5)	97 (29.85)
CIP	95 (40.77)	19 (45.24)	2 (22)	2 (25)	118(36.31)
OFX	123 (52.79)	0 (0)	0 (0)	0 (0)	131 (40.31)
SXT	77 (33.05)	20 (47.62)	6 (66.67)	0 (0)	103 (31.69)
C	28 (12.02)	15 (35.71)	2 (22)	0 (0)	45 (13.85)
GN	20 (8.58)	4 (9.52)	0 (0)	1 (12.5)	25 (7.69)
CS	22 (9.44)	0 (0)	9 (100)	0 (0)	31 (9.54)

N: Number; %: Percentage; R: Resistance, INN: Mecillinam, AML: Amoxicillin, AUG: Amoxicillin + clavulanic acid, TCC: Ticarcillin + clavulanic acid, CF: Cefalotin, FOX: Cefoxitin, AM: Ampicillin, CTR: Ceftriaxone, CAZ: Ceftazidim, IMP: Imipenem, NA: Nalidixic Acid, CIP: Ciprofloxacin, OFX: Ofloxacin, SXT: Cotrimoxazole, C: Chloramphenicol, GN: Gentamicin, CS: Colistin Sulfate.

***Klebsiella*:** The results of this study showed a high degree of resistance of *Klebsiella* strains to frequently employed β-lactam antibiotics (ampicillin (100%), amoxicillin (100%), Ticarcillin (90.48%), amoxicillin-clavulanic acid (73.81%),

mecillinam (57.14%), quinolones (ciprofloxacin and nalidixic acid, respectively, 45.23% and 30.95%), sulfonamides (cotrimoxazole 47.62%), and phenicoles (chloramphenicol (35.71%)). While the lowest level of resistance was obtained with gentamicin (9.52%), ceftazidime (9.52%) and imipenem (7.14%).

Proteus mirabilis

Proteus Mirabilis strains showed 66.67% resistance to cotrimazole, 55.55% to amoxicillin and 44.44% to amoxicillin-clavulanic acid, 33.33% to nalidixic acid and 22.22% to Ticarcillin, ciprofloxacin and chloramphenicol.

Enterobacter cloacae

In general, high rates of resistance in *Enterobacter cloacae* were observed with β-lactams (cefalotin and Cefoxitin (62.5%), Ticarcillin (50%), amoxicillin (37.5%), and amoxicillin-clavulanic acid (25%)), quinolones (nalidixic acid 37.5%) and ciprofloxacin (25%)). However, these bacteria showed less resistant to Aminoglycosidees (gentamicin (12.5%)).

Discussion

Through our study, we were able to describe the epidemiology of Enterobacteriaceae uropathogenic strains isolated in the CLRH of Beni Mellal city. Additionally, we determined their resistance profile to common antibiotics.

Our study showed that of the 2083 patients' CBEUs, the prevalence of UTIs was 16.6%. This prevalence is similar to rates observed in other countries such as Chad (17.4%), Mauritania (18.4%) and Senegal (18.5%) (Hailaji *et al.*, 2016; Yandai, *et al.*, 2019; Seydou *et al.*, 2021) [7, 21, 22]. Furthermore, 15.07% of UTIs were of nosocomial origin and 84.93% were of community origin. This finding is consistent with studies conducted by Hailaji *et al.* (2016) [7] and Amady *et al.* (2021) [5], which reported that 82.2% and 74.9%, respectively, were UTIs of community origin. This situation can be explained by the fact that UTIs are one of the most common bacterial infections in the community (Hailaji *et al.*, 2016; Yandai *et al.*, 2021; Seydou, 2021; SPILF, 2015) [7, 21, 22, 23].

The mean age of the patients with UTIs was 49.62 years old. Among women, the age range most impacted were those between 40 to 49 years old and ≥ 60 years old. Among men, the most impacted age group was those ≥ 60 years old. These findings were similar to those of Ouedraogo *et al.* (2022) [16], who found that the age groups most impacted were men and aged 55 and over, and women aged between 30-45 and ≥ 55 years old. The tampons use during menstruation, which would raise the urinary tract infection risk, pregnancy, the use of contraceptives, and other occurrences may all contribute to these findings in women. Additionally, the menopausal phenomenon, which would result in a hormone flow imbalance (Lack of oestrogen) and the loss of *Lactobacillus* in the vaginal flora, would be associated to the high prevalence of UTIs in the age range of 60 years. For males, benign prostatic hypertrophy, or inflammation that stops the bladder from emptying fully, is assumed to be the cause of the increased prevalence of UTIs in the age range of 60 years (Ouedraogo *et al.*, 2022) [16]. In fact, for both sexes, the high prevalence of UTIs in the age range of ≥ 60 years is associated with diminished functional autonomy and a drop in immune system effectiveness (Gaudré *et al.*, 2019) [26].

Among the positive CBEUs in hospitalized patients, the highest rate (51.85%) came from the surgical departments. This is different from the results of Gaudré *et al.* (2019) [26], which showed that 50.2% of positive CBEUs came from the medical departments. This observation can be explained by the presence of the urology service within the surgery department of Regional Hospital of Beni Mellal.

The majority of the bacteria responsible for UTIs (89.84%) were isolates of the family Enterobacteriaceae. This prevalence was similar to those reported in Madagascar (85%), in Rwanda (85.4%) and in Senegal (91.92%) (Randrianirina *et al.*, 2007; Muvunyi Arsalane *et al.*, 2014; Amady *et al.*, 2021) [3-5]. *E. coli* was the predominant isolate of the Enterobacteriaceae (71.63%), followed by *Klebsiella* (12.92%), *Proteus mirabilis* (3.86%), and *Enterobacter* (3.43%). This epidemiological profile largely dominated by these 4 bacteria was reported by several studies that focused on UTIs (Dia *et al.*, 2015; Hailaji *et al.*, 2016; Sekhsokh *et al.*, 2008; Seynabou, 2015) [6, 7, 10, 11]. The high colonization of the perineum by digestive-related bacterial strains and the presence of bacterial adhesins that could attach to the urine epithelium can explain the preponderance of Enterobacteriaceae observed in our study (Ferjani *et al.*, 2011; Larabi *et al.*, 2003) [24, 25].

Our study confirmed that *E. coli* remained the most common uropathogen isolated from both community-acquired and nosocomial UTIs. These findings were in agreement with similar surveillance studies (Amady*et al.*, 2021; Hailaji *et al.*, 2016; Ouedraogo *et al.*, 2021; Gaudré *et al.*, 2019; Muvunyi *et al.*, 2011; Mouanga Ndzime *et al.*, 2021) [5, 7, 16, 26, 27, 28]. The pathophysiological mechanism of UTI, which mostly occurs along the ascending route, may help to explain the high frequency of *E. coli.* Additionally, this bacterium was the most prevalent species in the gut flora and it is simple for it to spread to the urinary tract. Moreover, *E. coli* found among the faecal coliforms, making it easy for the germs to enter the urinary system when the private parts aren't cleaned properly (Ferjani *et al.*, 2011) [24].

Analysis of the susceptibility of Enterobacteriaceae strains to β-lactams showed variable resistance level. Thus, isolated strains were in 56% resistant to ticarcillin, and to ampicillin in 51.38% of cases. Our results were similar to those of Yandai *et al.* (2019) [21] in Tchad and were lower to those obtained by Mouanga Ndzime *et al.* (2021) [28] in Gabon. These high rates of resistance may be the cause of the no longer advised use of carboxypenicillins and aminopenicillins for the probabilistic treatment of UTIs (Benhiba *et al.*, 2015) [29].

The resistance rates of Enterobacteriaceae to amoxicillin-clavulanic acid were 48%. This frequency was more than that reported in France (SPILF; 2015) [23], which ranged between 25 and 35%. But it was compared to that of 50% recorded in Rwanda (Muvunyi Arsalane *et al.*, 2014) [4].

The high prevalence of β-lactams resistance in Enterobacteriaceae strains is mostly a result of the synthesis of β-lactamases, which is a very efficient resistance mechanism. In fact, bacteria that make-lactamases inactivate -lactams by hydrolytic action, making this the most pervasive method of bacterial resistance to antibiotics containing a β-lactam nucleus (Livermore, 1995) [30]. In relation to this, Amady *et al.* (2021) [5] in their study showed that Extended Spectrum Beta-Lactamase (ESBL) production was observed in 28.3% of Enterobacteriaceae strains.

Furthermore, studies showed that *Klebsiella* was the bacterium most responsible for ESBL-producing. Thus, Hailaji *et al.* (2016) [7] and Amandy *et al.* (2021) [5] in their studies reported that among the ESBL-producing Enterobacteriaceae, *Klebsiella* accounted for 41.8% and 40.7%, respectively. This funding could explain the high resistance rates of *Klebsiella* strains to β-lactams: Amoxicillin and ampicillin (100%), ticarcillin (90.48%), and amoxicillin-clavulanic acid (73.81%) in our study.

The resistance of Enterobacteriaceae strains to C3G ranged from 8.85 to 32.66%. Our results were compared to those of Mouanga Ndzime *et al.* (2021) [28] that ranged from 30 to 33% and 29.11% noted by Muvunyi *et al.* (2011) [27]. This resistance acquired to C3G can be related to the ability of Enterobacteriaceae strains to produce high degree of cephalosporinase (Amady *et al.*, 2021; Gaudré *et al.*, 2019) [5, 26].

Enterobacteriaceae were found to be resistant to cotrimoxazole in 31.69%. This prevalence was similar to these ranging between 20% and 30% noted in France (Lemort *et al.*, 2006) [31] and were lower than 75.67% observed in Burkina Faso (Ouedraogo *et al.*, 2022) [16]. Sulfamides' usage in the treatment plan for HIV patients' opportunistic infections would be the cause of this resistance to them. Thus, this can result in the abuse of antibiotics.

In our study, we found that 29.85% and 36.31% of the Enterobacteriaceae strains examined were resistant to nalidixic acid and ciprofloxacin, respectively. These rates were in line with those of 28.6% and 40.6%, respectively, observed by Hailaji *et al.* (2016) [7]. The appearance of this quinolone resistance may be explained by the first-line usage of fluoroquinolones as a probabilistic therapy of UTIs in our country.

In our study, imipenem was the antibiotic that was most effective against 97.14% Enterobacteriaceae strains. These results were similar to those of Ouedraogo *et al.* (2022) [16] who noted in their study that 91.25% of Enterobacteriaceae strains were susceptible to imipenem. To explain these lower resistance rates, Amandy *et al.* (2021) [5] reported in their study that only 3.2% of Enterobacteriaceae strains produced the carbapenemase.

Aminoglycoside activity was conserved across all Enterobacteriaceae. Therefore, 7.69% of strains were resistant to gentamicin (8.58% for *E. coli*, 9.52% for *Klebsiella*, 12.5% for *Enterobacter cloacae* and 0% for *Proteus mirabilis*). The resistance to Aminoglycoside observed in our study was compared to these of 14% reported in Mauritania (Hailaji *et al.*, 2016) [7] and 8-14% reported in Morocco (Muvunyi Arsalane *et al.*, 2014) [4]. The apparently preserved efficacy of Aminoglycoside could be explained by their parental administration limiting use.

Generally, the highest rates of resistance of Enterobacteriaceae strains to antibiotics observed in our study can be explained by the fact that in our country, the CBEU which is the only element of diagnosis of certainty is only rarely requested in case of suspected UTIs. Afterwards, probabilistic treatment of UTIS is an approach adopted in medical practice. Indeed, Beni Mellal Khénifra region is among the poorest regions in Morocco and most people can only afford generic drugs. Moreover, self-medication is also a common practice of our patients. These factors, among others, led to a strong emergence and dissemination of multi-resistant bacteria.

Study Limitations

This study was retrospective and we did not monitor the urine samples or the progress of the microbiological tests (CBEU and antibiograms) However, we limited ourselves to the data reported in the laboratory register. Our results do not apply to the whole population as our study was conducted in a single hospital center in Morocco.

Conclusion

The study found that the most often implicated bacteria types in UTIs, Enterobacteriaceae, continue to exhibit significant levels of resistance to β-lactam, quinolone, and sulfamide. Our study's findings may help policymakers take steps to curb the spread of resistant bacteria and lower the frequency of urinary tract infections. The best approaches to preventing this phenomenon are antibiotic susceptibility testing before treating patients, compliance with antibiotic prescriptions, and promoting public awareness to discourage self-medication at health center level.

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