Prevalence of Bacteria Causing Urinary Tract Infections and its Antibiotic Resistance at Public Hospital Establishment of Mila, Algeria: a retrospective study

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Abstract

This work aims to study the epidemiological profile of urinary tract infections in public hospital establishment ofMila. This retrospective study (from 2019 to 2022) is carried out on the CBEU of patients at the level of the hospital departments. From this, we were able to collect 13 different bacterial strains, whose main species belong mainly to the group of Enterobacteriaceae. The strains Escherichia coli and Enterobacter cloacae are the most noticed bacteria in the PHE. Statistics ofurinary tract infections in women (62%) is higher than in men. Thus, the age groups most affected are between 15 to 50 years old. In addition, it was reported that the urinary tract infections dominate the Women'sInternal Medicine department (32%), and men's IM. (20%).The multiresistance of selected germs was studied. Among these isolated bacteria we could note the different type strains; ESBL-producing Enterobacteriaceae and 3GC-R Enterobacteriaceae (mainly E.coli (46%)), Enterobacter cloacae (23%), imipenem-resistant A. baumanii (20%) , and MRSA (methicillin-resistant S. aureus) (13%).

Key words:Prevalence, bacterial species, Public Hospital Establishement, Urinary Tract Infections,CBEU, antibiotic multi-resistance.

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Introduction

Nosocomial infections (NIs) represent a real public health problem with considerable consequences. NIs also referred to as healthcare-associated infections (HAI), are infection(s) acquired during the process of receiving health care that was not present during the time of admission. They may occur in different areas of healthcare delivery, such as in hospitals[1].

Nosocomial urinary tract infections (UTIs)are dominated by infections occurring after probing nowadays with an overall annual incidence of around 250 million cases [2]. It includes various infections as, simple acute cystitis, acute pyelonephritis, prostatitis or renal abscess; and they may sometimes require hospitalization [3].

According to the World Health Organization (WHO), 190 million people are hospitalized each year in the world and 9 million of them contract an infection on this occasion [4].

The bacteria most often implicated are, in descending order: Escherichia coli, Enterococcus spp, other enterobacteria, Pseudomonas aeruginosa and Staphylococcus. E. coli remain the most dominant bacterial species [5].

The diagnosis of these microorganisms is based on cytobacteriological examination of urine (CBEU). It consists of carrying out a cytological examination followed by bacteriological isolation and the study of the resistance profile of the bacterium in question [6].

The increasing resistance of bacteria to anti-infectives is a serious worldwide problem. In recent years, the increasing exposure of bacteria to anti-infectives could favor the selection of bacterial strains resistant to anti-infective agents sometimes leading to therapeutic blockade [7].

The emergence of multi-resistant bacteria (MRB) involved in UTIs limits the choice of antibiotics, hence the importance of adequate bacteriological documentation and appropriate antibiotic therapy [8].

This study is considered a first at the area of Mila in the context of monitoring the evolution of UTIs. The objective of this work is to determine the frequency of urinary tract infections and the prevalence of responsible bacteria in the region; In addition, to determine the antibiotic multiresistance profile of selected bacteria.

Methodology

Type and period of study

This study was carried out at public hospital establishment (PHE) of Mila. It is retrospective study of all urine cytobacteriological examinations (CBEU) and carried out in a period of more than 3 years from January 01/ 2019 to February 12/ 2022.

Inclusion criteria

The inclusion criteria are: urine cytobacteriological examinations (CBEU) of the various departments of the PHEand also of outpatients, treated at the microbiology laboratory of the PHE hospital, Mila.

Exclusion criteria

Redundant samples are excluded from the study.

Data collection

The data was collected from the registers of CBEU samples at the bacteriology laboratory of the PHE.

Data analysis

Data obtained from PHE urinary tract infection registers were organized into a statistical matrix. The parameters taken into consideration are: the number of positive/negative tests, the sex of the patients, the age of the patient, the responsible germs, the departments concerned and Bacterial multi-resistance.

We have also described the relationship between the germs responsible for urinary tract infections and the department of origin.

The age groups chosen for this study are: 1-15 years old, 15-30 years old, 30-50 years old and over 65 years old.

Results and discussion

1. Distribution of CBEU carried out during the period of study

From the results processed (1480 cases); 298 bacteriological samples were positive (presence of signs of infection), 1080 bacteriological samples were negative (absence of signs of infection), and 102 samples were contaminated (table 01).

Table 01: Distribution of CBEU during the study period (January 2019- February 2022).

Overall case	Positive case	Negative case	Contaminated case
1480	298	1080	102
100%	20%	73%	7%

The epidemiological study of the samples received at the PHE(bacteriology laboratory) shows that: The majority of cases are negative with the percentage (73%), followed by (20 %) of the positive cases (positive culture, presence of germs) and (7%), are contaminated (not pure

culture).

Our results are, on the one hand, superior to those reported by a study carried out by Mola, Fahimatou (2016) at the Mohamed V military hospital in Rabat, from where the rate of positive cases is equal to 10.1 % [9]. On the other hand, they are lower than the results of Hounane, Touiti who found (32%)[10].

2. Characteristics of the studied population

2.1. Study of urinary tract infections by gender

Among the 298 positive cases, 185 cases were of female patients, representing (62%), and 113 cases were of male patients presented by (38%)(Table 02).The sex ratio F/M= 1.63.

Table 02: Distribution of urinary tract infection by sex.

Gender	Case	Percentage
Female	185	62%
Male	113	38%

We notice a female predominance in urinary tract infections, which can generally be mainly due to the anatomy of the female urinary tract, short female urethra compared to male urethra. These results are close to those of Zouhair (2016), who found the following results: (44%) men and (56%) women [181]. Other study such as that carried out by Malmartel in France(2014)found a urine infection (UI)frequency (81%) in female [11].

2.2 Distribution of urinary tract infections by age

The results of the cytobacteriological examination are presented according to the different age groups. The studied age groups are 1-15 years old, 15-30 years old, 30-50 years old, also the age group over 65 years old (figure 01).

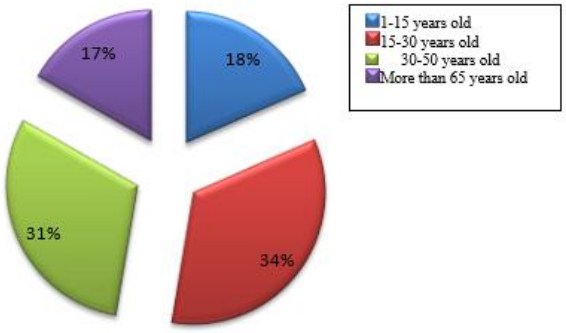

Figure 01: Distribution of urinary tract infections by age.

According to the results of the CBEU, the age groups between 15-30 years old and 30-50 years oldare the most applicants for the test in the PHE. Both age group represents the adult class; with a percentage of (34%), and (31%) respectively.Our results are confirmed by the results obtained by Loumingou1 et al. (2020) at Brazzaville hospital, Congo, who found a dominance of the 25-40 year old class (43.6%) [12].

The 1-15 year old class, which represents the class of children and infants, is the least dominant class (18%); witha class of people over 65 years old(17%).

2.2. Study of the urinary tract infection in relation to the requesting department

The UTIs documented during this period came mainly from internal and external Patients. These statistics concern just the internal patients. The numbers of cases in each department of the PHE are mentioned below (Table 03).The distribution of the results according to the PHE departments shows that: the dominance of UTI is in the following departments; Internal Medicine (IM)woman'sdepartment (32%), IM. men's department (20%), followed by the pediatric department (18%). other services such as resuscitation (12%), emergencies (10%) and operating room (8%), have low percentages

Table 03: Distribution of UTI according to PHE departments.

Departments	Number of cases	Percentages
Men's Internal Medicine (MIM)	58	20%
Women's Internal Medicine (WIM)	94	32%
Emergencies	29	10%
Resuscitation	37	12%
Pediatric	55	18%
Operating room	25	8%

The predominance of germs inWIM.department is confirmed, on the one hand, by the majordistribution of female sex in the hospital, and on the other hand, because IM has a large number of patients who have beenhospitalized .These are allowed for long periods which promote the proliferation of germs especially in lack of hygiene.In other studies, Maleb et al.

(2019) find a high rate in emergency (59.75%), in work carried out in the microbiology laboratory, Mohammed VI University Hospital Center in Oujda, Morocco[13].

In pediatrics department, severe infection in children is caused by lack of preventive and hygienic measures in infants [14]. Pediatrics includes neonatal, infants and male children, who may be uncircumcised [15]. Children with UI, however, typically have various structural abnormalities of the urinary tract that make them more susceptible to UTIs[16]. Our results are close to the values obtained by Cisse (2014), at the General Hospital of Port-Bouët Abidjan,Ivory Coast, where the UI rate was 10.89% [17].

3. Characters of bacteria responsible ofUTI

3.1. Study according to GRAM

Gram negative bacteria dominated the profile of germs responsible for urinary tract infection. They represent (85%) of all cases (figure 02). Gram positive bacteria were also found just in (15%) of cases.The same data are displayed by a study carried out at the Laquintinie hospital in Douala (Cameroon) [18]. Binda et al. (1990), found in a retrospective study that Gram negative germs were the most commonly encountered [19]. Similarly, in another study carried out in Rabat, they found that the predominant bacteria were Enterobacteriaceae [20].

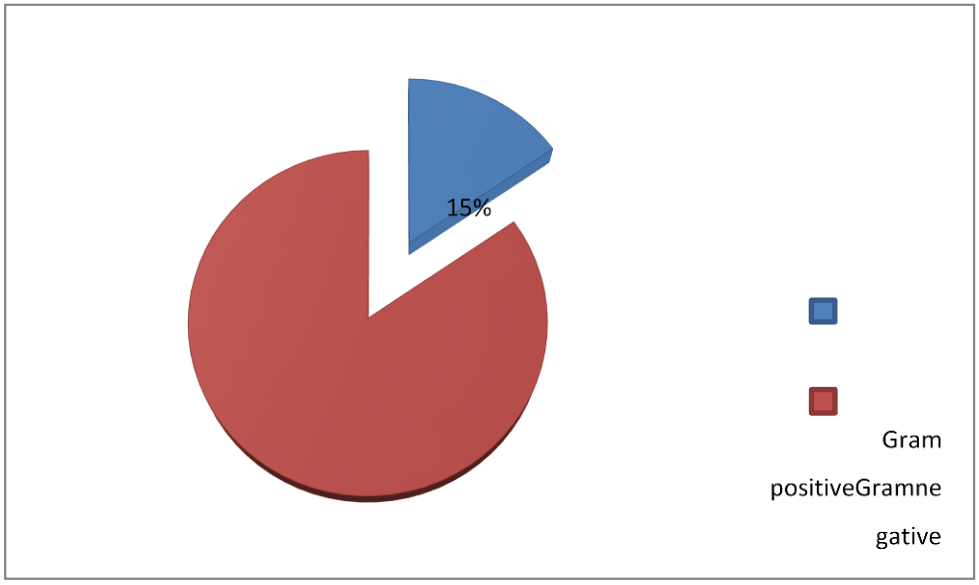

Figure 02: Distribution of bacterial species responsible for UTI according to Gram.

3.2. Study according to bacterial species

In ourseries, several bacterial species have been implicated in UTI. In all of the positive cultures, 298 strains were isolated and identified in the patients tested. The results are presented in figure 03.

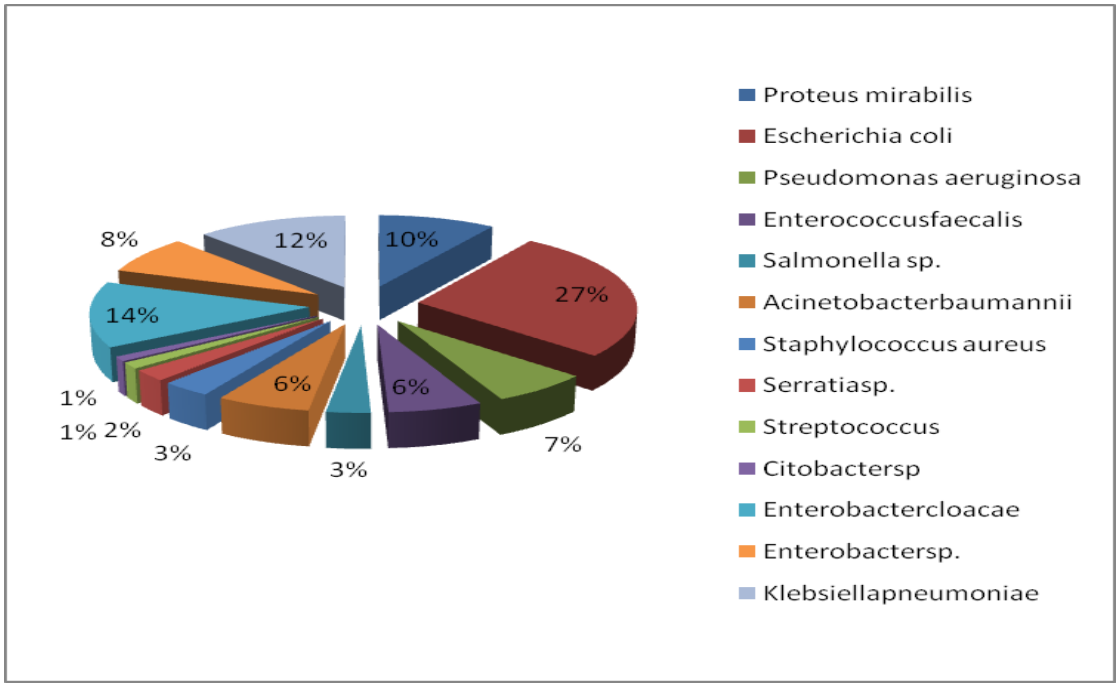

Figure 03: Distribution of UTI according to bacterial species.

The strains of Escherichia coli and Enterobacter cloacae represent the most dominant bacteria responsible for UTIs with percentage (27%) and (14%) respectively. Our value is close to the result obtained by Ramilitiana et al. (2014) (Escherichia coli:44.8%) [21]. According to the literature, the dominance of uropathogenic Escherichia coli is very common. It infects the urinary tract through a series of mechanisms such as specialized adhesins, capable of bacterium binding to the urinary epithelium and preventing its elimination through bladder emptying, biofilm, and host aversion[22]. Moreover, it is interesting to note that this strain is the most dominant of the intestinal flora, and therefore poor cleaning of the intimate part can easily cause the entry of the bacteria into the bladder[7].

In addition, in our results, Klebsiella pneumoniae, and Proteus mirabilis represent a dominance of (12%), and (10%) respectively; followed by, Enterobacter sp. (8%) and Pseudomonasaeruginosa (7%), while strains of Enterobacter faecalis and Acinetobacter baumanni (6%), Staphylococcus aureus and Salmonella sp. (3%), and Serratiasp. (2%). Isolates asCitobactersp. and Streptococcus represent the lowest percentages (1%). So, from these results, we can conclude that most of the identified bacterial species in the PHE belong to the Enterobacteriaceae group.

- **Study according to sex and bacterial species**

The results of the distribution of cases of urinary tract infections according to the bacterial species according the sex in the hospital departments are presented in Figure 04.

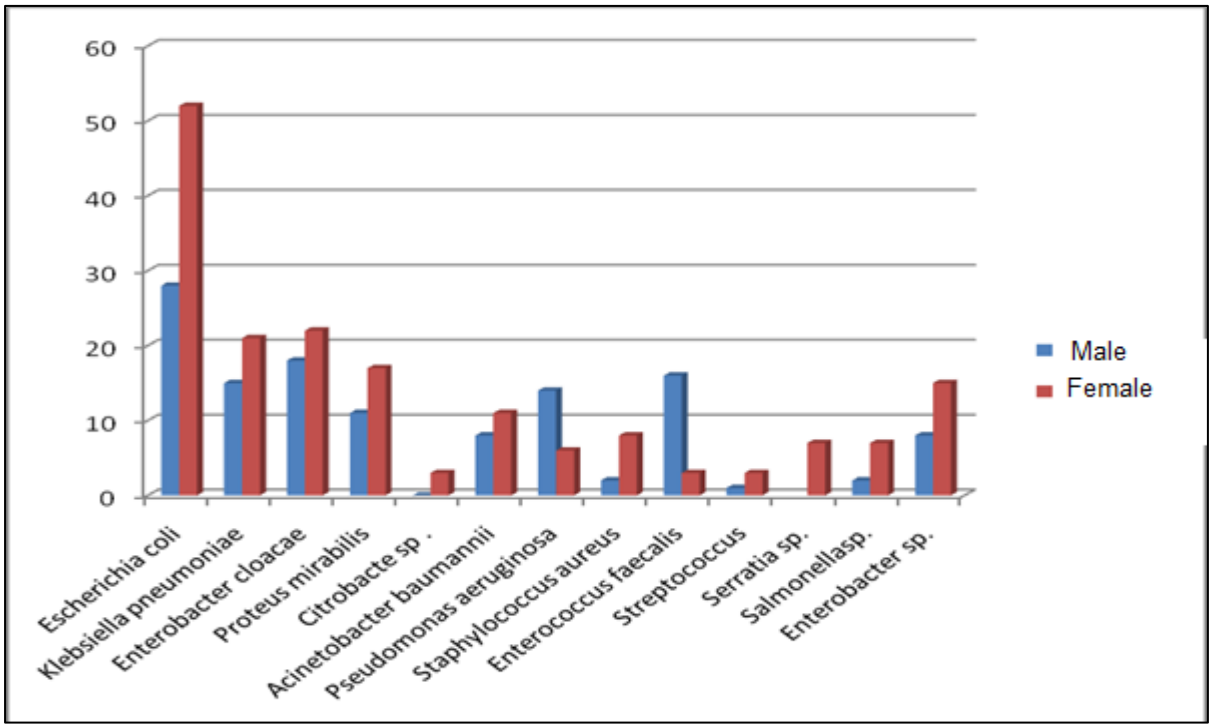

Figure 04: Distribution of germs responsible for UTI according to sex.

According to the results obtained, for female it was noticed a predominance of Escherichiacoli presented by (52 cases), and of Enterobactercloacae (22 cases), also Klebsiellapneumoniae (21 cases). These results are explained by the distribution of the majority of strains that belong to the Gram negative and to the Enterobacteriaceae group. The dominance of these strains in women is confirmed by the study by Kahindo Kangitsi et el. (2019) in Congo which finds the prevalence of Gram-negative bacteria (80.7%) and Enterobacteriaceae (80.7%) [23].

For the other strains in note that Proteus mirabilis presented by (17cas), Enterobacter sp. (15cas) and Acinetobacter baumannii (11cas), the isolates of Staphylococcus aureus represents (8cas), also (7cas) for both Serratia sp. and Salmonella sp., (6 cases) for Pseudomonas aeruginosa, and finally (3 cases) for Enterococcus faecalis, Streptococcus, and Citrobacte sp.

For male, the results obtained still show the predominance of Escherichia coli (28 cases), followed also by Enterobacter cloacae (18 cases), Enterococcus faecalis (16 cases), (15 cases) and (14 cases) for Klebsiella pneumoniae and Pseudomonas aeruginosa, respectively. Isolates of Proteus mirabilis represents (11cas), Acinetobacter baumannii is noticed by (8cas), and (2cas) for Salmonella sp.

A single case for Streptococcus, and absence of any strain such as Citrobacte sp, and Serratia sp.

- **Study according to the department and the bacterial species**

The results of the distribution of cases of urinary tract infection according to the departments of origin of the hospital and the bacterial species are presented below (Figure 05).

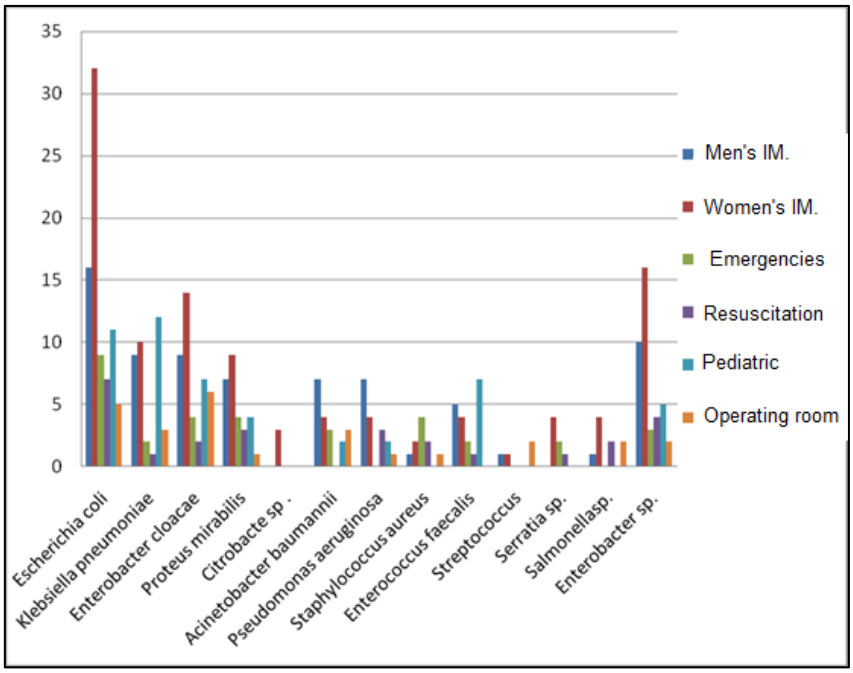

Figure05: The repair of bacterial strains according to the PHE departments.

According to this figure, it has been noticed that all the isolated strains (of PHE) are presented in the majority of the departments mentioned above. A predominance (high percentages) of strains such as Escherichia coli was noted in some departments, namely, the departments of women's internal medicine (32 cases) and men'sinternal medicine (16 cases).

We find that female in IM patients are the most confronted with urinary tract infections. The strains that affect this department are in order of dominance: Enterobacter sp (16 cases), Enterobacter cloacae (14 cases), Klebsiella pneumoniae (10 cases).

Patients in the MIM department are also affected by Escherichia coli (16 cases), and Enterobactersp (10 cases), K. pneumoniae and Enterobacter cloacae (9 cases).

4. Multi-resistant bacteria (MRB)

Multi-resistant bacteria are detected by several methods in the laboratory for the purpose todetermineand choose the appropriate antibiotic therapy. The types of MRB cited in this study are Extended-spectrum beta-lactamases (ESBL) -producing bacteria, 3rd generation cephalosporin (C3G)-resistant Enterobacteriaceae, Methicillin-resistant Staphylococcus aureus (MRSA), and imipenem-resistant bacteria (Pseudomans aeroginosa, Acinetobecter baumannii).

4.1.Distribution of isolated MRB according to PHEdepartments

The prevalence of MRB isolated in the different departments of the PHE hospital is presented in figure 06.

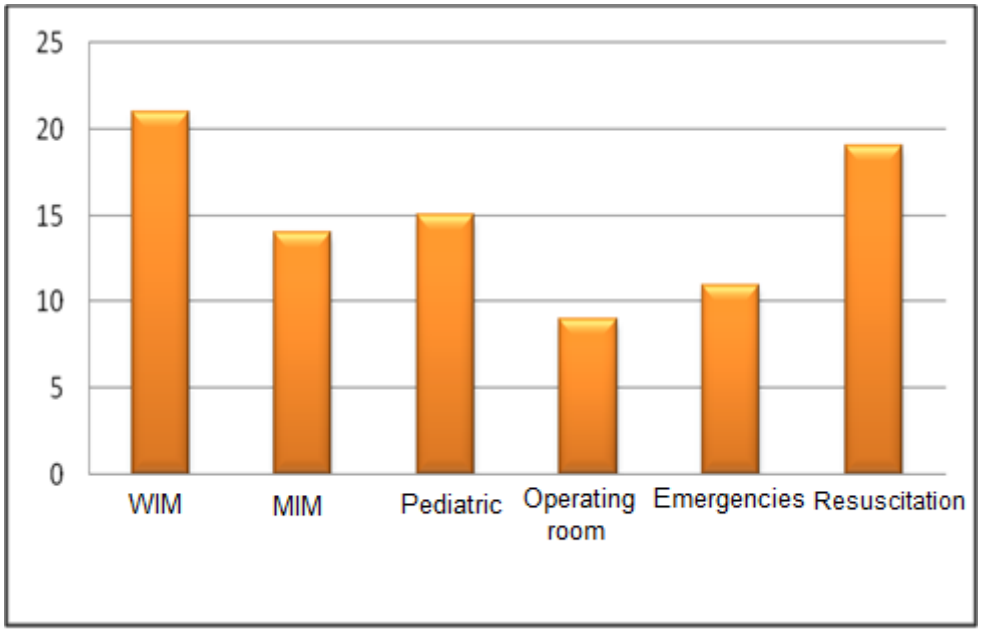

Figure06: Distribution of MRBin hospital departments.

The results of the distribution of MRB according to PHEdepartments show that the highest percentages are found in the women's IM. (24%) followed by the resuscitation (17%), pediatrics (16%), man's IM. (14%), emergencies (12%), and finally, in the operating room (9%).

4.2.Distribution of ESBL-producing bacteria in PHE

According to the results below (Figure 07), the frequency of ESBL-producing bacteria represents 68% of all strains; while bacteria that do not produce ESBL represent only 32%.

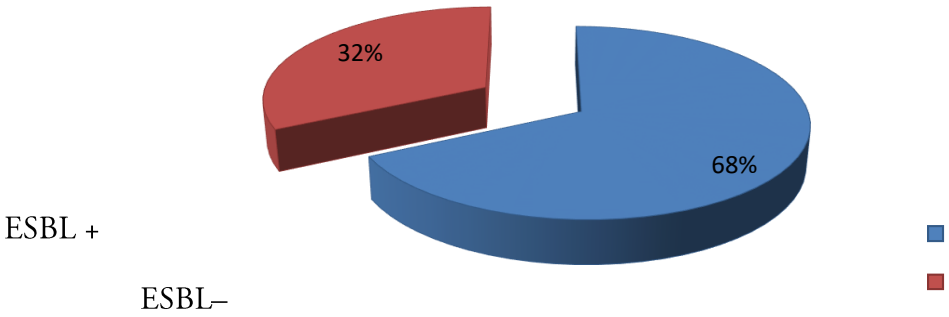

Figure08: Distribution of ESBL-producing bacteria.

4.2.1. Distribution of ESBL-producing Enterobacteriaceae

ESBL-producing Enterobacteriaceae are the most frequently isolated bacteria in the studied departments. They are mainly represented by the following strains (figure 09): Escherichia coli (46%), Proteus mirabilis (23%), Klebsiella pneumoniae (17%), Enterobactercloacae (14%).

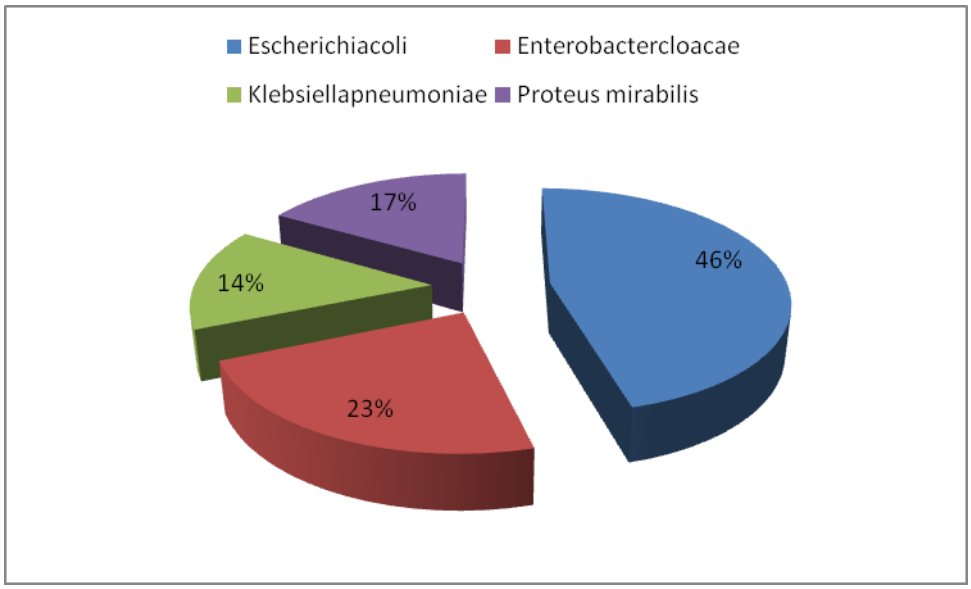

Figure 09: Distribution of ESBL-producing Enterobacteriaceae.

4.3. Rates of other MRB

Among the MRB, it was noticed that (62%) of strains which produce ESBL are thus resistant to cephalosporin 3rd generation (3GC-R Enterobacteriaceae). In addition, it has been noted that several strains are resistant to imipenem by the production of carbapenemase, including A.baumannii (20%) andP. aeroginosa (5%). Also the MRSA (Methicillin-resistant Staphylococcus aureus) was attained (13%) (Table 04).

Table 04: MRB rate according to species.

Bacteria	Numbers	Percentage
3GC-R Enterobacteriaceae	48	62%
P.aeroginosaRI	4	5%
A.baumanniiRI	16	20%
MRSA	10	13%

Among the multi-resistant bacteria isolated from PHE, (62%) ESBL-producing strains are generally resistant to 3rd generation cephalosporin [223]. In addition to this result, strains resistant to imipenem can be detected by the production of carbapenemase, in this case: A.baumannii (20%), MRSA (13%), and P.aeroginosa (5%). Resistance to methicillin leads to resistance to all beta-lactams. It is determined by the presence of a chromosomal gene (mecA) which codes for an additional PLP, PLP 2a. This additional PLP has less affinity for beta-lactams and in particular for methicillin; this is why meti-R strains are also resistant to all beta-lactams [24, 25].

Conclusion

Urinary tract infections remain among the most common problems in the world. They occupy a place of choice in general pathology by their frequency in both sexes and at different ages.

Our study is a retrospective study on the epidemiological profile of urinary tract infections, in the microbiology unit PHE-Mila. It allowed having an idea on the prevalence and rates of resistance to antibiotics, the main bacteria involved in urinary tract infections, in the area.

This study helped us to show that urinary tract infections (by the strains mentioned above) are very common at the establishment, especiallythe strains of E. coliamong women. Currently, we have few means to fight against the development of bacterial resistance to antibiotics, hence the need to reduce unnecessary prescriptions of antibiotics in medicine, reduce the early use of narrow-spectrum antibiotics and identify the causal germ and its sensitivity to one of narrow-spectrumantibiotics, even before starting treatment.

References

1. Sikora, A. and F. Zahra, Nosocomial infections, in StatPearls [Internet]2022, StatPearls Publishing.
2. Younes, A., INFECTION URINAIRE ET PATHOGENES EMERGENTS. 2020.
3. de Lafforest, S., et al., Incidence des infections urinaires hospitalisées en France: une cohorte historique. Infectious Diseases Now, 2021. **51**(5): p. S103-S104.
4. Espinasse, F., B. Page, and B. Cottard-Boulle, Risques infectieux associés aux dispositifs médicaux invasifs.Revue francophone des laboratoires, 2010. **2010**(426): p. 51-63.
5. Javaudin, F., Evaluation of the efficacy of eradication of ESBL-producing Enterobacteriaceae from the murine and human digestive tract by phagotherapy, 2022, Nantes Université.
6. TOMETIN, N.D., PROFIL DE RESISTANCE DES BACTERIES ISOLEES DES INFECTIONS URINAIRES A L'HOPITAL EL-FATEH A PORTO-NOVO, 2018, EPAC/UAC.
7. Sekhsokh, Y., M. Chadli, and S. El Hamzaoui, Fréquence et sensibilité aux antibiotiques des bactéries isolées dans les urines. Médecine et maladies infectieuses, 2008. **38**(6): p. 324-327.
8. Pavese, P., Infections urinaires nosocomiales: définition, diagnostic, physiopathologie,

prévention, traitement. Médecine et maladies infectieuses, 2003. **33**: p. 266-274.
9. Samah-Mola, F., Infections urinaires chez le diabétique à l'hopital militaire d'inscription Mohamed V de Rabat, 2016.
10. HOUNANE, N. and D. TOUITI, Facteurs de risque des infections urinaires nosocomiales Etude prospective randomisée.
11. Dupin, N., et al. Infection à Chlamydia trachomatis. in Annales de dermatologie et de vénéréologie. 2006. Elsevier Masson.
12. Loumingou, R., et al., Les Infections Urinaires de l'Adulte dans le Service de Néphrologie du CHU de Brazzaville: Aspects Cliniques et Évolutifs. Proteus, 2020. **2**: p. 2.10.
13. Maleb, A., et al., Les infections urinaires infantiles au centre hospitalier universitaire Mohammed VI d'Oujda (Maroc). Journal de Pédiatrie et de Puériculture, 2019. **32**(6): p. 322-329.
14. Tourigny, D., L'infection urinaire chez l'enfant de moins de deux ans. Le médecin du Québec, 2003. **38**(2): p. 51-56.
15. Zaiz, S. and L. Ait Sab, Le profil bactériologique de l'infection urinaire chez l'enfant. Service de pédiatrie B CHU Mohammed VI Marrakech, 2008. **95**: p. 1-4.
16. Imane, M.S. and M. Hiba, Contribution à l'étude de l'infection urinaire chez les enfants au service de pédiatrie de l'hôpital EL zahraoui à M'sila, 2020, UNIVERSITE MOHAMED BOUDIAF-M'SILA.
17. Cisse, L., L'infection urinaire de l'enfant au cours d'un accès fébrile à l'hôpital général de Port-Bouët (Abidjan Côte d'Ivoire). Revue Africaine et Malgache de Recherche Scientifique/Sciences de la Santé, 2017. **5**(1).
18. Njall, C., et al., Écologie bactérienne de l'infection nosocomiale au service de réanimation de l'hôpital Laquintinie de Douala, Cameroun. The Pan African Medical Journal, 2013. **14**.
19. TROPICAL, E.M.H., ETUDE CLINIQUE DE L'INFECTION DES VOIES URINAIRES CHEZ L'ENFANT. Médecine d'Afrique Noire, 1990. **37**(1).
20. AIT MILOUD, K., L'infection urinaire: expérience du laboratoire de microbiologie de l'hôpital des spécialités de Rabat, 2011.
21. RANDRIANARISON, A., M. RANDRIA, and W. RANDRIAMAROTIA[1], Prévalence de la résistance des bactéries aux antibiotiques dans les infections urinaires de l'adulte en milieu hospitalier à Antananarivo.Médecine d'Afrique Noire, 2014. **61**(10): p. 515.
22. Lazrak, M.A., et al., Profile of nosocomial urinary tract infection in a nephrology ward.The Pan African Medical Journal, 2014. **19**: p. 59-59.
23. CharleS, K.K., K.M. Richard, and M. Kivunda, PROFIL EPIDEMIOLOGIQUE, CLINIQUE, BACTERIOLOGIQUE ET EVOLUTIF DE L'INFECTION URINAIRE CHEZ LES ENFANTS DE 0 A 5 ANS A L'HOPITAL PROVINCIAL DU NORD-KIVU.Revue de l'Istm-Goma./Rev. Hig. Inst. Med. Techn-Goma Juin, 2019. **1**(1): p. 40-49.
24. Fauchere, J., J. Henlin, and J. Boutin, Combinatorial chemistry: State-of-the-art, analytical

needs and future evolutions.Analusis, 1997. **4**(25): p. 97-101.

25. Ajdakar, S. and L. Arsalane, Les entérobactéries productrices de bêtalactamases à spectre élargi (BLSE): Profil épidémiologique actuel et conséquences thérapeutiques. Marrakech: Université Cadi Ayyad de Marrakech, 2015.