Acta Scientific Microbiology (ISSN: 2581-3226)
Volume 7 Issue 7 July 2024

Research Article

Antibiotic Susceptibility Profile of Bacteria Responsible for Urogenital Infections and Epidemiology in Women at the Ignace Deen National Hospital in Conakry (Republic of Guinea)

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DOI: 10.31080/ASMI.2024.07.1394

Received: April 15, 2024

Published: June 24, 2024

Abstract

Introduction: Urinary tract infections are caused by the colonisation of the various organs of the urinary tract by micro-organisms. These infections can affect all parts of the urinary system.

Objective: To determine the prevalence of urogenital infections in women and the antibiotic susceptibility profile of the germs isolated, with a view to improving their management.

Methods: This was a prospective, descriptive longitudinal study conducted over three months, from1 May to 30 August 2023.

Results: Out of 150 urine samples analysed from women, the prevalence of urinary tract infections was 84%. Marital status showed that married women were the most affected by urinary tract infections, with a prevalence of 68%. Housewives were the most represented, at 37%, followed by commercial workers at 17%, administrative workers at 15%, and urinary tract infection patients from the Ratoma commune were the most represented, at 40%. A breakdown of patients by age showed that the 31-40 age group was the most affected (29%), followed by the 21-30 age group (24%) and those aged 61 and over (20%). The age groups least represented were 11-20, 41-50, 51-60 and 0-10 with 10%, 8%, 6% and 3% respectively. With regard to the macroscopic appearance of the urine of the 150 patients examined, 16% of the urine was clear, cloudy urine accounted for 45%, haematic urine for 3% and slightly cloudy urine for 36%. Cloudy urine means that it is potentially infected. Microscopic analysis showed that 15% of the urine was germ-free, while 63% contained gram-negative bacilli and 37% gram-positive cocci. According to cytology, leucocyturia was significant in 86% of infected urine samples. We also noted the presence of epithelial cells in 7%, haematuria in 2%, yeasts in 4% and oxalate crystals in 1%. The distribution of infected urine by germ species shows that E. coli is the most common germ, accounting for 26% of cases, followed by Staphylococcus aureus (14%), Proteus mirailus (9%), K. pneumoniae, Enterococcus spp. and Acidoacter bomani (8% each), Pseudomonas aeruginosae (7%) and other germs (between 1% and 3%). The antibiogram showed that of all the antibiotics used, three were effective against the germs responsible for urinary tract infections. Amikacin was effective in 44% of cases, Gentamycin in 39% and Tobramycin in 24%.

Conclusion: Urinary tract infections are a major health problem because of the bioresistance of germs, mainly in women, and antibiotic susceptibility testing is essential for their management.

Keywords: Urinary Tract Infections; Antibiotic Susceptibility Testing; Epidemiology; Women; CHU Ignace Deen; Conakry

Introduction

Urogenital infections are caused by the colonisation of the various organs of the urinary and genital tracts by micro-organisms. These infections can affect all parts of the urinary system (kidneys, ureter, vagina and bladder) [1]. They are much more common in women than in men, and even young children are not immune to these infections. The most common symptoms are a burning sensation when urinating, lower abdominal pain and leucorrhoea [1]. According to the World Health Organisation (WHO), more than 200 million people are affected by urinary tract infections in tropical environments, particularly in Third World countries where hygiene conditions are precarious. These infections account for 40% of all tropical diseases other than malaria [2]. In the United States, an estimated 20% to 40% of women have already had at least one urinary tract infection. Many women will contract it several times during their lives. Young men, on the other hand, are little affected by this condition [3]. In Canada, more than 65,000 cases were reported by the WHO in 2006. In France, 20-25% of hospital-acquired infections are nosocomial urinary tract infections [4]. In Africa, the prevalence rate among women of childbearing age varies from one country to another. In Guinea Bissau, it is 20% [5]. In Mauritania, 10% according to a 2008 study [6]. In the Republic of Guinea, urological emergencies accounted for 7.70% of medical and surgical emergencies at the Ignace-Deen National Hospital in Conakry in 1996, and 60% of admissions to the department. While the majority of patients came from Lower Guinea (67.9%), Upper Guinea and Forest Guinea were poorly represented, with 7.8% and 2.2% respectively [7]. The aim of this study is to determine the prevalence of urogenital infections in women and the antibiotic susceptibility profile of the germs isolated, with a view to improving their management.

Material and Working Methods

This study was carried out in Conakry (Republic of Guinea). The National Reference Laboratory for Mycobacteria at the CHU-Ignace Deen in Conakry, the Microbiology Laboratory at the Gamal Abdel Nasser University in Conakry, the Medical Biology Laboratory at the Mahatma Gandhi University in Conakry and the Faculty of Health Sciences and Techniques at the Gamal Abdel Nasser University in Conakry were used for the study. Urine and vaginal secretions collected from women constituted our biomaterial. This was a prospective and descriptive longitudinal study lasting 6 months, from 01 May to 30 August 2023. Our study population consisted of all women attending the Ignace Deen University Hospital in Conakry during our survey period. Our sampling was simple random and the sample size (n= 150) was calculated using the average hospital prevalence of urogenital infections in Conakry (18%) by the SCHWARTZ formula. Our study included all women who came to the laboratory with a report or examination booklet requesting a vaginal secretion cytobacteriological examination (VSCE).

Study variables

Biological variables

- ECBU
- VTEC
- Antibiogram

Epidemiological variables

- Age;
- Occupation;
- Marital status;
- Residence.

Culture media

To culture bacteria for identification, we used Gram staining kits and culture media: Mannitol medium, Kligler-Hajna medium (Lactose-glucose-H2S), Kligler medium, Simmons Citrate medium, Cled medium and Mueller Hinton medium (agar). Macroscopic and microscopic examinations were carried out on each sample taken. The antibiogram was performed using the Vitek 2 Compact identification and antibiogram device.

Antibiotic families used

Aminosides, Quinolones, Nitrofurans, Trimethoprimes/sulfamethoxazoles, Lincosamides, Macrolides, Linezoides, Glycopeptides and β-lactam antibiotics.

Data collection equipment : We used

- Pre-prepared survey forms
- Patient consultation diaries
- Laboratory register

Ethical considerations

Before carrying out the study, we obtained the agreement and consent of the patients, confidentiality was respected throughout the data collection procedure and the results were used strictly for therapeutic and scientific purposes. Our study complied with the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects of 1975, amended in 2008.

Computer analysis of the data

The data collected were entered manually, processed and analysed using Word and Excel under Windows 2010 and SPSS version 21.

Limitations and difficulties

Our limitations and difficulties were the lack of cooperation from some patients, the relatively small sample size and the non-use of PCR for molecular diagnosis.

Results

The application of the research methodology led to the following results, presented in tabular form, interpreted, commented on and discussed in the light of the available literature.

Table 1: Distribution of samples by macroscopic appearance.

N°	Appearance	Number	Percentage
1	Clear	24	16
2	Cloudy	67	45
3	Slightly cloudy	54	36
4	Haematic	5	3
Total		150	100

This table shows that of the 150 patients seen in the laboratory, 67 patients (45%) had cloudy urine due to the presence of cellular and acellular elements and microorganisms in suspension, 24 patients (16%) had clear urine, 54 patients (36%) had slightly cloudy urine and 5 patients (3%) had haematic urine. Cloudy urine is indicative of bacterial infections.

Table 2: Distribution of samples by cytology.

N°	Cytology results	Number	Percentage
1	Leukocytes	129	86
2	Haematuria	3	2
3	Epithelial cells	10	7
4	Yeasts	6	4
5	Oxalate crystals	2	1
	Total	150	100

In this table, we note that out of 150 patients complaining of urinary tract infections, 129 patients had urine containing leukocytes, i.e. 86%. However, 1% of patients had urine containing oxalate crystals, 2% haematuria, 7% epithelial cells and 4% yeast. Leukocyturia is the tell-tale sign of urinary tract infections, particularly by bacteria.

Table 3: Overall prevalence of urogenital infections in women.

N°	Test results	Number	Percentage
1	Positif	126	84
2	Négatif	24	16
	Total	150	100

In this table, we see that out of 150 patients received at the laboratory, the majority suffer from a urinary infection, with 126 positive cases, i.e. a prevalence of 84%, compared with 24 negative cases, i.e. 16%. This very high prevalence can be explained by the multiplicity of sexual partners.

Table 4: Distribution of germs isolated by Gram stain.

N°	Microbial agents	Number	Percentage
1	Gram- bacilli	81	64
2	Gram-positive bacilli	11	9
3	Gram+ cocci	34	27
	Total	126	100

Analysis of this table shows that out of 126 women with urinary tract infections, Gram-negative Bacilli are the most common, with 81 cases (64%), followed by Gram-positive Cocci with 34 cases (27%).

Table 5: Distribution of women with urogenital infections according to the bacterial species involved.

N°	Germes	Number	Percentage
1	*Staphylococcus aureus*	18	14
2	Staphylococcus haemolyticus	12	10
3	*Enterococcus.spp*	10	8
4	*Enterococcus aerogene*	3	2
5	*Enterococcus. cloacae*	4	3
6	*Enterococcus faecalis*	2	2
7	*Escherichia coli*	33	26
8	Klebsiella pneumoniae	10	8
9	*Pseudomonas aeruginosae*	9	7
10	*Proteus mirailus*	11	9
11	*Acidoacter bomani*	10	8
12	*Serratia fonticola*	1	1
13	*Morganella* morganii	1	1
14	*Streptococcus agalactiae*	2	2
	Total	126	100

Analysis of this table shows that urinary tract infections are caused by 14 different bacteria. However, of the 126 women with UTIs, *Escherichia coli* led the way with 33 cases, or 26%, followed by *Staphylococcus aureus* with 18 cases, or 14%, Staphylococcus haemolyticus with 12 cases, or 10%, Proteus mirailus with 11 cases, or 9%, *Enterococcus.* spp and *Acidoacter bomani* with 10 cases each, or 8%, and *Pseudomonas aeruginosae* with 9 cases, or 7%. Other species were poorly represented in this study.

Table 6: Germ susceptibility to aminoglycosides.

Sensibility	Amikacine		Gentamycin		Tobramicin	
	Number	%	Number	%	Number	%
Sensitive	56	44	49	39	30	24
Intermediate	1	1	-	-	-	-
Resistant	8	7	56	44	38	30
Not determined	61	48	21	17	58	46
Total	126	100	126	100	126	100

From this table, we can see that Amikacin was more effective on germs, with 44%, followed by Gentamycin with 39% and 24% for Trobramicin. This sensitivity of germs to aminoglycosides may be due to the fact that aminoglycosides have a broad spectrum of activity and a significant bactericidal effect, which are major advantages. Unspecified sensitivity represented 61 cases, or 48% for Amikacin, 21 cases, or 17% for Gentamycin and 58 cases, or 46% for Tobramicin.

Table 7: Sensitivity of isolated germs to Quinolones.

Sensibility	Nalidixic acid		Ciprofloxacin		Ofloxacin	
	Number	%	Number	%	Number	%
Sensitive	15	12	47	37	12	10
Intermediate	0	-	-	-	1	1
Resistant	21	17	51	40	23	18
Not determined	90	71	28	22	90	71
Total	126	100	126	100	126	100

This table shows that the sensitivity of germs to quinolones is very low. Nalidixic acid 12%, Ciprofloxacin 37% and Ofloxacin 10%. Remarkably, we also found a high level of resistance to quinolones. Unspecified sensitivity represented 90 cases, or 71% for nalidixic acid, 28 cases, or 22% for ciprofloxacin and 90 cases, or 71% for ofloxacin. This resistance is thought to be due to chromosomal and plasmid mechanisms.

Table 8: Sensitivity of isolated germs to Nitrofurans.

Sensibility	Nitrofurantoin	
	Number	Percentage
Sensitive	58	46
Intermediate	5	4
Resistant	24	19
Not determined	39	31
Total	126	100

The Nitrofuran class is represented by a single antibiotic, Nitrofurantoin. Of the 126 patients, Nitrofurantoin was sensitive in 58 cases (46%) and resistant in 24 cases (19%). Sensitivity not determined represented 39 cases, or 31%. It can be said that NIT reacts very well with germs.

Table 9: Sensitivity of germs isolated to trimethoprim/sulfamethoxazole.

Sensibility	Trimethoprim-Sulfamethoxazole	
	Number	Percentage
Sensitive	30	24
Intermediate	-	-
Resistant	43	34
Not determined	51	41
Total	126	100

Timethoprim/sulfamethoxazole was not effective against the germs in the 126 patients. TMP-SMX was resistant in 43 patients, or 34%. Sensitivity not determined represented 51 cases, or 41%.

Table 10: Sensitivity of germs isolated to Lincosamide.

Sensibility	Clindamycin	
	Number	Perrcentage
Sensitive	14	11
Intermediate	-	-
Resistant	21	17
Not determined	91	72
Total	126	100

The table shows that Clindamycin was not effective against the germs in 21 cases, i.e. 17%; 14 cases were sensitive, i.e. 11%, and undetermined sensitivity represented 91 cases, i.e. 72%.

Table 11: Sensitivity of isolated germs to Macrolides.

Sensibility	Erythromycin		Quinupristin	
	Number	Perrcentage	Number	Perrcentage
Sensitive	9	7	15	12
Intermediate	-	-	-	-
Resistant	18	14	5	4
Not determined	99	79	106	84
Total	126	100	126	100

In this table, we note that the Macrolides were not effective on the germs isolated from the 126 patients with urinary tract infections and they represent (not determined) 99 cases for Erythromycin, i.e. 79% and 106 cases for Quinupristin, i.e. 84%. Only 9 cases identified were sensitive to Erythromycin, i.e. 7%, and 5 cases to Quinupristin, i.e. 4%.

Table 12: Sensitivity of isolated germs to Linezoids.

Sensibility	Linezoide	
	Number	Perrcentage
Sensitive	30	24
Intermediate	-	-
Resistant	16	13
Not determined	80	63
Total	126	100

The table shows that Linezoides were effective against the germs: of the germs isolated, 30 cases were sensitive, i.e. 24%, and 16 cases were resistant, i.e. 13%. Unspecified sensitivity represented 80 cases, or 63%.

Table 13: Sensitivity of isolated germs to glycopeptides.

Sensibility	Vancomycines	
	Number	Perrcentage
Sensitive	17	13
Intermediate	-	-
Resistant	24	19
Not determined	85	68
Total	126	100

The Glycopeptide family is represented by a single antibiotic, Vancomycin. Of the germs isolated from 126 patients, Vancomycin was not effective in the vast majority, i.e. 85% of undetermined susceptibility. However, sensitivity was observed in 17 cases (13%).

On the other hand, resistance to several antibiotics in this family was observed: 26% to Ampicillin, 36% to Ticarcillin and 16% to Ceftazidime. Non-determined susceptibility was very high. This

Table 14: Sensitivity of isolated germs to β-lactam antibiotics.

Sensibility	AMP		TIC		TZP		CXT		CTX		CAZ		ERT		IMI	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Sensitive	11	9	6	5	2	2	21	17	19	15	37	29	30	24	62	50
Intermediate	0	0	0	0	1	1	1	1	I	1	3	2	0	0	1	1
Resistant	33	26	45	36	3	2	20	16	20	16	34	27	10	8	5	4
Not determined	82	65	75	59	120	95	84	67	86	68	52	41	84	67	56	44
Total	126	100	126	100	126	100	126	100	126	100	126	100	126	100	126	100

Legend: AMP: Ampicillin; TIC: Ticarcillin; TZP: Piperacillin/Tazobactam; CXT: Cefoxitin; CTX: Cefotaxime; CAZ: Ceftazidime; ERT: Ertapenem and IMI: Imipenem.These results showed high sensitivity to Imipenem (50%), Cefoxitin (17%) and Ertapenem (24%).

resistance could be due to the increasingly marked bio-resistance of *Escherichia coli* and other germs involved in urinary tract infections to antibiotics in this family.

Table 15: Distribution of women with urogenital infections by epidemiological parameters.

N°		Number	Percentage
Age groups			
1	0 -10 years	4	3
2	11-20 years	12	10
3	21- 30 years	30	24
4	31- 40 years	37	29
5	41- 50 years	10	8
6	51- 60 years	8	6
7	61 years and over	25	20
Marital status			
1	Married	86	68
2	Single	40	32
Socio-professional categories			
1	Seamstresses	8	7
2	Cooker	4	3
3	Pupils/Students	12	10
4	Housewives	47	37
5	Woman farmer	1	1
6	Health Officers	14	11
7	Administrative staff	19	15
8	Commercial Agents	21	17
Residence			
1	Matoto	27	21
2	Ratoma	50	40
3	Dixinn	11	9
4	Kaloum	12	10
5	Matam	3	2
6	Hors Conakry	23	18
	Total	126	100

The table shows that urinary tract infections affect all age groups. Out of 126 patients with urinary tract infections, the majority of sufferers were in the 31 to 40 age group with 37 cases, or 29%, followed by the 21 to 30 age group with 30 cases, or 24%, and those aged 61 and over, or 20%. The 41-50 and 50-60 age groups accounted for 8% and 6% respectively. Children were the least represented, with 4 cases (3%). The high prevalence among the elderly and adults is certainly due to the high frequency of sexual activity or reduced immunity.

In terms of marital status, married women are the most represented in our population with 86 cases, representing a prevalence of 68%, compared with only 40 cases among single women (32%). The high prevalence among married women could be explained by their frequent sexual relations and polygamy.

In terms of socio-professional categories, the table shows that all socio-professional strata are affected by urinary tract infections. Housewives are the most represented, with 47 cases (37%), followed by commercial workers (17%), administrative workers (12%), pupils/students and seamstresses/cooks (10% each). Women farmers are the least represented at 1%. The high prevalence among housewives indicates a lack of personal hygiene and ignorance of how urinary tract infections are transmitted.

In terms of patients place of residence, patients from the Commune of Ratoma are the most represented with 50 cases, i.e. 40%, followed by those from Matoto, i.e. 21%, and those from elsewhere (outside Conakry), i.e. 18%. Patients with urinary tract infections from the Commune of Kaloum accounted for 10% and those from the Commune of Dixinn for 11%. Patients from the commune of Matam were the least represented, with 3 cases (2%). The high prevalence in the Ratoma and Matoto communes is certainly due to the fact that these are the two largest communes in the capital.

Discussion

In our study of the antibiotic susceptibility profile of urinary tract infections and epidemiology in women seen at CHU-Ignace Deen in Conakry, we saw 150 women with urinary tract infection problems.

Socio-demographic characteristics

In our study, we found that urinary tract infections affect all age groups. Out of 126 patients with urinary tract infections, the majority were aged between 31 and 40, with 37 cases (29%), followed by those aged between 21 and 30, with 30 cases (24%), and those aged 61 and over (20%). Those aged between 41 and 50 and between 50 and 60 accounted for 8% and 6% respectively. Children were the least represented, with 4 cases (3%). The high prevalence among the elderly and adults is certainly due to the high frequency of sexual activity or reduced immunity (table 15).

Our results differ from those of some authors. Camara TD., *et al*. in 2023, reported that the 51 and over age group was the most affected (53.40%), followed by the 25-50 age group (28.40%). The age group least represented was the 0-10 age group, with 1%. This could be explained by the fact that the frequency of urogenital infections increases with age [8].

In relation to marital status, in our study, married women are the most represented in our population with 86 cases, i.e. a prevalence of 68%, compared with only 40 cases in unmarried women (32%). The high prevalence among married women could be explained by their frequent sexual relations and polygamy (table 15).

Camara TD., *et al*. in 2023, showed that married couples were the most affected by urinary tract infections (78.40%). The married/single ratio was 3.63. This could be due to the frequency of intercourse and pregnancy, which encourage germs to take hold [8].

In terms of socio-professional categories, all socio-professional strata are affected by urogenital infections. Housewives were the most common, with 47 cases (37%), followed by commercial workers (17%), administrative workers (12%), pupils/students and seamstresses/cooks (10% each). Women farmers are the least represented at 1%. The high prevalence among housewives indicates a lack of personal hygiene and ignorance of how urinary tract infections are transmitted (table 15).

Camara TD., *et al*. in 2023, found that urogenital infections were observed in all socio-professional groups. However, housewives were the most represented with 29.54% (26/88) followed by administrative employees with 19.31% (17/88) and pupils/students with 17.04% (15/88) [8].

Makanera M., *et al*. in 2022, indicated that the high prevalence of *E. coli* in urogenital infections could be explained by the fact that this bacterial species represents the majority of microbiota in the digestive tract. However, the anal tract and genital tract are closer together in women, which would explain the migration of these bacteria towards the genital orifice. Lack of hygiene in women's intimate areas may also be a factor in urinary tract infection [5].

In our study, 45% of women had cloudy urine, 16% had clear urine, 36% had slightly cloudy urine and 3% had haematic urine. Cloudy urine is indicative of bacterial infections (Table 1). Another study by Camara TD., *et al*. in 2023, showed that of 175 patients, 132 patients (75%) had cloudy urine due to the presence of cellular and acellular elements and suspended micro-organisms, 26 patients (15%) had clear urine, 12 patients (7%) had slightly cloudy urine and 5 patients (3%) had haemorrhagic urine [9]. The distribution of women's urine according to cytology : in our study, of 150 women with urinary tract infections, 86% had urine containing a high proportion of leukocytes. However, 1% of patients had urine containing oxalate crystals, 2% haematuria, 7% epithelial cells and 4% yeast. Leukocyturia is the tell-tale sign of urinary tract infections, particularly by bacteria (table 2).

Camara TD., *et al*. in 2023, found that out of 175 patients complaining of a urinary infection, 86% of patients had urine containing leucocytes, 2% of patients had urine containing oxalate crystals, 3% had haematuria, 7% had epithelial cells and 4% had yeast. Leukocyturia is the tell-tale sign of urinary tract infections, particularly bacterial infections [9].

With regard to the prevalence of urogenital infections, in our study, of the 150 women seen in the laboratory, the majority suffered from a urinary infection in 84% of cases (Table 3). This very high prevalence can be explained by the large number of sexual partners (Table 2). Our results are comparable with those of Camara TD., *et al*. in 2023, who reported a prevalence of urinary tract infections in 39% of patients (88/228) compared with 61% of patients who had no urinary tract infections (140/228) and those reported by Camara TD., *et al*. in 2023, with the majority of patients suffering from a urinary tract infection with a prevalence of 85% compared with 15% of negative cases. This very high prevalence could be explained by the multiplicity of sexual partners and polygamy [9].

The distribution of infected urine in relation to Gram stain in our study showed that of the 126 women actually suffering from urogenital infections, Gram-negative Bacilli were the most incriminated with 64%, followed by Gram-positive Cocci with 27% (table 4). Our results are similar to those reported by Camara TD., *et al*. in 2023, that of the 88 urines of patients suffering from urinary tract infections, 77.27% contained Gram-negative bacilli (68/88) and 22.72% Gram-positive cocci (20/88) [8] and by Camara TD., *et al*.

in 2023, also reported that Gram-negative bacilli were the most frequently incriminated with 63%, followed by Gram-positive cocci with 37% [9].

Compared with the bacterial species incriminated in urogenital infection in women in our study, 14 bacterial species were involved: *Escherichia coli* in 26% of cases, *Staphylococcus aureus* in 14% of cases, Staphylococcus haemolyticus in 10% of cases, Proteus mirailus in 9% of cases, *Enterococcus.* spp and *Acidoacter bomani* each in 8% of cases, and Pseudomonas aeruginosae in 7% of cases. Other bacterial species were poorly represented in this study (Table 5).

In the study by Camara TD., *et al*. in 2023, the distribution of bacterial germs isolated from infections according to species showed that out of 17 bacterial species incriminated, *E. coli* was in the lead with 52.27% (46/88), followed by Klebsiella pneumoniae with 12.5% (11/88), Enterococcus spp. with 9.09% (8/88), the Enterobacter cloacae complex and *Staphylococcus aureus*, each representing 8%. Other species were poorly represented [8] and Camara TD., *et al*. in 2023, also reported that 17 species of bacteria were responsible for urinary tract infections, with *Escherichia coli* leading the way with 40%, followed by *Staphylococcus aureus* with 32%. Other species were only moderately represented [9]. On the other hand, Makanera A., *et al*. in 2023, reported fifteen (15) different species of Enterobacteriaceae isolated with a majority of Klebsiella pneumonia species with 32.30%, followed by *Escherichia coli* with 27.95% and Enterobacter cloacae (9.94%) [10]. Mohammed S., *et al*. in 2017, reported that *E. coli* accounted for approximately 63% of cases followed by Klebsiella spp. 32.8%. The frequency of ESBL isolation within each species of enterobacteria shows a greater capacity for ESBL production in Klebsiella pneumoniae with 25.8%, followed by Klebsiella oxytoca with 20%, Enterobacter cloacae with 11.4% and *Escherichia coli* with 10.5%, however no ESBL-producing Proteus spp or Citrobacter strains were isolated reported by Mohammed S., *et al*. in 2017 [11].

In terms of patients' place of residence, patients from the Commune of Ratoma are the most represented with 50 cases, i.e. 40%, followed by those from Matoto, i.e. 21%, and those from elsewhere (outside Conakry), i.e. 18%. Patients with urinary tract infections from the Commune of Kaloum accounted for 10% and those from the Commune of Dixinn for 11%. Patients from the commune of Matam were the least represented, with 3 cases (2%). This high prevalence in the communes of Ratoma and Matoto is certainly due to the fact that these are the two largest communes in the capital and that more patients came for consultation during our study (table 15).

Our results differ from those reported by Makanera A., *et al*. in 2023, who reported that the majority of patients (81.37%) were from the city of Conakry, and particularly from the commune of Ratoma (49.69%), which houses the hospital (HASIGUI), followed by Matoto (17.39%). The high rate of attendance by people from these two communes could be explained by the proximity of the hospital to its users [10].

Antibiotic susceptibility of isolated uropathogenic bacteria

In our study showed that of the 126 women with urinary infections, Amikacin was more effective on germs, i.e. 44% followed by Gentamycin with 39% and 24% for Trobramicin. This sensitivity of germs to aminoglycosides would be due to the fact that aminoglycosides have a broad spectrum of activities and a significant bactericidal effect which constitute major advantages. Undetermined sensitivity represented 61 cases, or 48% for Amikacin, 21 cases, or 17% for Gentamycin and 58 cases, or 46% for Tobramicin (table 6).

In our study, we found that out of 126 women with urinary tract infections, the sensitivity of germs to Quinolones was very low. Nalidixic acid 12%, Ciprofloxacin 37% and Ofloxacin 10%. Remarkably, we also found a high level of resistance to quinolones. Undetermined sensitivity represented 71% for Ac nalidixic, 22% for Ciprofloxacin and 71% for Ofloxacin. This resistance is thought to be due to chromosomal and plasmid mechanisms (table 7).

Our study showed that Nitrofurantoin was sensitive on 46% and resistance represented 19%. Undetermined sensitivity represented 31%. NIT reacts very well with germs (table 8). Timethoprime/sulfamethoxazole was not effective against germs because TMP-SMX was resistant in 34% of cases and undetermined sensitivity represented 41% (table 9). Also, in our study, Clindamycin was not effective on the germs in 17%; 11% sensitivity and undetermined sensitivity represented 72% (table 10).

Our study showed that Macrolides were not effective on germs isolated with undetermined susceptibility, with 79% for Erythromycin and 84% for Quinupristin (table 11). Linezoids were effective with 24% sensitivity, 13% resistance, and undetermined sensitivity represented 63% (table 12). The glycopeptide family (Vancomycin) was ineffective in the vast majority of germs, with 85% undetermined sensitivity (table 13). In contrast, 50% sensitivity to Imipenem, 17% to Cefoxitin and 24% to Ertapenem was recorded. On the other hand, in our study, resistance to several antibiotics in this family was observed: 26% to Ampicillin, 36% to Ticarcillin and 16% to Ceftazidime. Non-determined susceptibility was very high. This resistance could be due to the increasingly marked bio-resistance of *Escherichia coli* and other germs involved in urinary tract infections to antibiotics in this family (table 14).

Our results are comparable to those of several authors. Makanera A., *et al*. in 2023, reported that several strains of Enterobacteriaceae isolated in their studies showed high levels of resistance to tetracycline, Trimethoprim/Sulfamethoxazole and cephalosporins. However, several strains of Enterobacteriaceae showed high levels of resistance to tetracycline, trimethoprim/sulfamethoxazole and cephalosporins [10]. These results are partly similar to those of Mohamed., *et al*. in 2023, Niger, who found in their 2023 study that up to 75% of Enterobacteriacee isolates were highly resistant to ampicillin, amoxicillin-clavulanic acid, ticarillin, piperacillin-tazobactam, cefoxitin, cefixime, ceftazidime, ceftriaxone, cotrimoxazole, nalidixic acid and ofloxacin [12]. Most of these species were susceptible to meropenem, imipenem and amikacin. These results differ from those of Funkè F., *et al*. in 2023, in Benin, who observed variable rates of resistance depending on the families of antibiotics and the species isolated. High resistance rates (≥80%) were obtained with molecules from the macrolide, cephalosporin and penicillin families [13]. Resistance rates of over 50% have been recorded with compounds from the fluoroquinolone, aminoglycoside and tetracycline families.

However, our results are superior to those found in Senegal by Sabor H. in Dakar, in 2017 [15] and close to those obtained in Algeria by Djahida S., *et al*. in 2011 [16]. According to Huemer M., in 2020, antibiotic resistance and the rapid spread of aminoglycosides and β-lactam antibiotics such as cephalosporins and fluoroquinolones against uropathogenic bacteria compromise the clinical management of infection and lead to a poor prognosis [17]. According to Haque M., *et al*. in 2018, Shafiq M., *et al*. in 2022 and Bilal H., *et al*. in 2021, multidrug resistance (MDR) of pathogenic bacteria may be associated with severe morbidity in urinary tract infections, which is a major global health problem [18-20].

The results of Camara TD., *et al*. in 2023, showed a bacterial sensitivity of 61% to amikacin and 35% to gentamicin. This sensitivity of germs to certain aminoglycosides could be explained by the fact that aminoglycosides are broad-spectrum antibiotics [8]. The sensitivity of the bacterial strains studied to quinolones was generally low, with 31% for ciprofloxacin, 13% for ofloxacin and 12% for nalidixic acid. The nitrofuran class is represented by a single antibiotic, nitrofurantoin, to which 56% of strains are sensitive, while 34% of these strains are resistant to this molecule [8].

Camara TD., *et al*. in 2023, showed that the resistance of the strains studied to the trimethoprim/sulfamethoxazole combination and to clindamycin was high, with 71% for trimethoprim/sulfamethoxazole and 78% for clindamycin respectively. Similarly, resistance to macrolides and quinupristin/dalfopristin was even higher, at 88% and 86% respectively. Very few germs are sensitive to lineazoid antibiotics (Table 3). The glycopeptide family is represented by a single antibiotic, vancomycin. Thus, 10% of strains were sensitive to this molecule [8]. High sensitivity to imipenem (75%), cefoxitin (65%) and ertapenem (64%). However, resistance to ampicillin (72%), ticarcillin (71%) and ceftazidime (54%) [8].

Our results are also comparable to those of several other authors who have reported high susceptibility of ESBL-producing uropathogenic *E. coli* to carbapenems (imipenem and ertapenem) in ESBL-producing uropathogenic strains [21]. The susceptibility of uropathogenic *E. coli* strains to carbapenems established in this work is comparable to that reported in Mexico by Ramirez-castillo., *et al*. (2018) who established full susceptibility of all uropathogenic *E. coli* strains in their study [3]. Rezaï., *et al*. (2015) reported that most ESBL-producing uropathogenic *E. coli* strains were susceptible to carbapenems [21]. The beta-lactam susceptibility of the majority of *E. coli* studied in the present work was broadly comparable to that reported by some authors [21].

The strains studied in this work were generally resistant to ampicillin, ticarcillin and ceftazidime. This is due, on the one hand, to the fact that these molecules (in particular ampicillin) are abused in Guinea and, on the other hand, to the fact that most of these strains are ESBL producers. Shahbazi., *et al*. in 2018, found that more isolates of ESBL-producing uropathogenic *E. coli* were resistant to aminoglycosides and quinolones compared to strains of non-ESBL-producing uropathogenic *Escherichia coli* [22]. Idil N., *et al*. in 2016, found that carbapenems (imipenem and meropenem) represent the best option for the treatment of UTIs caused by ESBL-producing strains [23]. Bartoletti R., *et al*. 2016, cephalosporins, penicillins and monobactams can be used with β-lactamase inhibitors [24].

The frequency of ESBL-producing *E. coli* isolates varies between regions of the world and sometimes even between hospitals in the same country. In addition to β-lactam resistance, ESBL-producing *E. coli* isolates are also resistant to other antimicrobial agents, such as aminoglycosides, tetracycline and trimethoprim/sulfamethoxazole

[21]. Shahbazi., *et al*. (2018) found that more ESBL-producing UPEC isolates were resistant to aminoglycosides and quinolones compared to non-ESBL-producing UPEC strains [22]. Carbapenems (imipenem and meropenem) are the best option for treating UTIs caused by ESBL-producing strains [23]. Cephalosporins, penicillins and monobactams should be used in combination with β-lactamase inhibitors [24].

High resistance to broad-spectrum antibiotics such as carbapenems, which contrasts with other studies from different countries that reported lower resistance (around 34%) to imipenem and meropenem in India [25], Malaysia [26], Colombia, Saudi Arabia [27] and Iran [25,26]. Although we found carbapenems to be more active against ESBL-producing bacteria, the high rate of resistance compared with other studies remains a major concern [28-30]. Recently, a study in Iran showed 75% susceptibility to carbapenems in pathogenic ESBL-producing bacteria [31]. The main reason for the wide variation in resistance rates between different countries and regions within countries is the intensive use of broad-spectrum antibiotics, particularly third-generation cephalosporins, and the persistence of resistant strains in healthcare institutions. The extensive use of broad-spectrum antibiotics, particularly third-generation cephalosporins, was reported by Salehifar., *et al*. [32]. The rate of antibiotic consumption in our institution was significantly higher than in other centres [32].

Camara TD., *et al*. in 2023, found that aminoglycosides (amikacin, gentamycin and tobramycin) were very active on *E. coli* strains. In fact, these *E. coli* strains were generally sensitive to amikacin (96.96%), gentamicin (69.23%) and tobramycin (60.60%) [8]. Our results differ from those found in India by Shahid., *et al*. (2008) in terms of the frequency of sensitivity to aminoglycoside antibiotics [33]. These authors reported that the *E. coli* strains analysed in their study had a sensitivity of 57.1% to amikacin, followed by tobramycin with 38.5% and gentamicin with 31.9%. This shows that these molecules were more active on the *E. coli* strains in this study than those of the authors. On the other hand, the sensitivity frequencies of *E. coli* strains to aminoglycosides showed that amikacin was more active than gentamicin, and the latter more active than tobramycin. Conversely, the resistance phenotype detected in *E. coli* strains was generally weaker, and the phenotypic resistance detected is mainly as follows: GEN, TOB, NET and AMI resistance [33].

The majority of *E. coli* strains were fairly resistant to quinolones. In fact, the resistance of *E. coli* to quinolones was 82.75% for nalidixic acid and 56.0% for ciprofloxacin and ofloxacin. These results are similar to those of other studies carried out elsewhere in the world. Indeed, Akya., *et al*. (2015) reported the metadata of 53 studies of uropathogenic *E. coli* strains, performed between 2001 and 2011 on quinolones [34]. The compilation of these data showed high resistance of uropathogenic E.coli strains to these molecules. The overall resistance of these strains to nalidixic acid, ciprofloxacin, norfloxacin and ofloxacin was 42.3%, 28.2%, 48.5% and 24.1% respectively [34].

Thus, the resistance observed in uropathogenic *Escherichia coli* strains isolated at the Sino-Guinean Friendship Hospital in Kipé is much higher than the average resistance observed by these authors. This situation is thought to be encouraged by the excessive use of quinolones in Guinea, which are considered to be broad-spectrum antibiotics [10]. They are powerful inhibitors of bacterial DNA gyrase and topoisomerase IV [35]. Resistance to quinolones is increasing in all bacterial species worldwide. The mechanisms of acquired resistance are mainly chromosomal (target modification, impermeability/active efflux), while plasmid resistance is frequently detected in enterobacteria such as *E. coli* [35].

Nitrofurantoin was the only antibiotic molecule representing the furan class. This molecule was active on the majority of the *E. coli* strains analysed. In fact, 87.17% of these strains were sensitive to this compound [8].

These results are similar to many others reported around the world. Indeed, in 2019, Kot reported that the resistance of uropathogenic *E. coli* to nitrofurantoin is very low, favouring its use as a first-line antibacterial agent. Studies by Sanchez., *et al*. (2016) showed that in the US, nitrofurantoin retains a high level of antibiotic activity against *E. coli* isolated from urinary tract infections [36]. A comparison of reports between 2003 and 2012 revealed that resistance of *E. coli* isolates from adults to nitrofurantoin increased only slightly (from 0.7% to 0.9%). Kresken., *et al*. (2016) reported that studies in Germany, Belgium and Spain showed that *E. coli* is generally sensitive to nitrofurantoin. Indeed, resistance rates of uropathogenic *E. coli* in these countries during 2013-2014 were less than 1.5% [37].

According to the European Association of Urology guidelines reported by Bonkat G., *et al*. in 2017 [38], nitrofurantoin is recommended for the treatment of uncomplicated cystitis as first-line empiric therapy [38].

In Argentina and Brasilia, uropathogenic *E. coli* isolates are generally susceptible to nitrofurantoin. In fact, a slightly higher percentage of uropathogenic *E. coli* resistant to nitrofurantoin was observed among isolates from elderly patients hospitalised in Argentina (2.3%) [39]. In Brazil, the rate of nitrofurantoin-resistant uropathogenic *E. coli* isolates was 6.6% [36].

The class of sulphonamides was represented by the trimethoprim/sulfamethoxazole combination. This combination of sulphonamides was not very active on most of the *E. coli* strains studied. In fact, 83.60% of these strains were resistant to the sulphonamides tested [8].

This observation has already been made by many other authors. Indeed, in Mexico City, Ramifez-Castillo., *et al*. (2018) reported in their study a high frequency of resistance of *E. coli* strains to the trimethoprim/sulfamethoxazole combination which was 72.7% [3]. In Iran, Rezai., *et al*. (2015) reported a resistance frequency of 65% of uropathogenic *E. coli* strains to the trimethoprim/sulfamethoxazole combination [21]. A similar rate of resistance of uropathogenic *E. coli* isolates to the trimethoprim/sulfamethoxazole combination (50.6%) was observed in Brazil [37]. These frequencies of *E. coli* resistance to the combination of antibiotics are lower than those found in this work. The high frequency of uropathogenic *E. coli* to combined antibiotics (trimethoprim and sulfamethoxazole) is thought to be due to the uncontrolled use of this molecule, often used in Guinea for respiratory infections and diarrhoea [10].

Conclusion

The antibiotic susceptibility profile of urogenital infections in the 150 women received at the Laboratory led to the following conclusion.

Of 150 women seen in the laboratory, 45% had cloudy urine, 16% were clear, 36% were slightly cloudy and 3% were haematic. The vast majority of women suffered from a urinary infection, 84% caused by Gram-negative Bacilli (64%), followed by Gram-positive Cocci (27%). The bacterium *Escherichia coli* took the lead with 26%, followed by *Staphylococcus aureus* with 14%. Antibiotic susceptibility testing showed that Amikacin was effective against 44% of germs, Gentamycin 39%, Nitrofurantoine 46% and Imipenem 50%.

In terms of epidemiological variables, 68% of the women were married, compared with 32% who were single. The age range of the women with the disease was between 31 and 40, with 29%, followed by between 21 and 30, with 24%, and 61 and over, with 20%. Housewives were the most represented with 37%, followed by commercial agents with 17%, administrative agents with 12%, pupils/students and seamstresses/cooks with 10% each. Patients from the Commune of Ratoma were the most represented at 40%, followed by those from Matoto (21%) and elsewhere (outside Conakry) (18%).The sensitivity of uropathogenic bacteria to Amikacin (44%), Gentamycin (39%), Nitrofurantoine (46%) and Imipenem (50%) shows the increasingly significant increase in the resistance of these germs to antibiotics.

Despite the sensitivity of these pathogenic bacteria to Amikacin, Gentamycin (39%), Nitrofurantoine and Imipenem, these antibiotics should only be used as second-line treatment (in line with WHO recommendations) in the management of urogenital infections.

Statement from the institutional review board

The Ethics Committee of the Gamal Abdel Nasser University of Conakry, together with the Ministry of Higher Education, Scientific Research and Innovation, approved this study in June 2022.

Transparency

The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Data Availability Statement

The data is available.

Competing Interests

The authors declare that they have no conflicts of interest.

Authors' Contributions

All the authors have contributed to this work; they have read and pproved the final version of the manuscript.

Acknowledgements

The authors would like to thank the management of the Ignace Deen University Hospital in Conakry, the partner laboratories, the Ministry of Health and Public Hygiene and the Ministry of Higher Education and Scientific Research of the Republic of Guinea for their efforts in the management of the various diseases in the country.

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