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## Research Article

# Sensitivity profile of microorganisms causing urinary tract infection in humans in the city of Lavras, Minas Gerais, Brazil

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**Abstract:** Urinary tract infections (UTIs) have high prevalence and incidence. We evaluate the profile of microorganisms that cause UTIs in patients seenPublic Laboratory of Lavras, Minas Gerais, Brazil, from January, 2011 to May, 2012. Besides, we evaluate possible cyclical variations and tendencies, as well as sensitivity of the microorganisms to different antibiotics. It was used secondary data from the "Sonner" Computer System that's assistsof the Brazilian Public Health System - SUS (DATASUS – SUS "Sistema Único de Saúde"). Two thousand one hundred thirty-five routine urinalysis, followed by urine culture and antibiogram, were analyzed, with 483 positive results. Most of the samples were from women (88%). The majority of patients had 60 years old or older. Gram-negative bacteria found were *Escherichia coli*, *Proteus sp*, *Klebsiella sp*, *Enterobacter sp* and *Pseudomonas sp*, where as gram-positive *Staphylococcus sp* and *Streptococcus sp. E. coli*showed the highest prevalence (77.3%). Antibiotics that showed greater efficacy against gram-negative bacteria were amikacin and ceftriaxone, and these microorganisms were more resistant totrimethoprim/sufametoxazol. Gram-positive bacteria showed sensitivity to chloramphenicol and rifampicin and greater resistance tooxacillin. It could be observed that most of the urine samples submitted to culture were negative for UTIs. The prevalence of microorganisms causing UTIs can vary among different locations, thusit is important to know the local scenario and maybe change empirical treatment according to each region.
**Keywords:** Infections of the urinary system. Bacterialresistance. Escherichia coli. Urine culture. Antibiogram. Cystitis

## INTRODUCTION

Urinary tract infection (UTI) is defined as the presence and growth of microorganisms, mainly bacteria, in the urine, causing lesions. It can be characterized as symptomatic or asymptomatic [1]. When it affects the lower urinary tract it is known as cystitis or urethritis and when it affects the upper urinary tract it is known as pyelonephritis [2].

In cystitis there is the involvement of the urinary bladder, triggering dysuria, pollakiuria, urgency of urination, sharp pain or burning sensation when the urine is released and macroscopic hematuria when it is hemorrhagic [3]. Urethritis is an inflammation of the urethra, causing dysuria and polyuria. Pyelonephritis is considered the most severe form of UTI, affecting kidneys and may be accompanied by cystitis symptoms and fever [4,5].

The most common UTI etiologic agents are *Escherichia coli*, *Klebsiella sp*, *Pseudomonas aeruginosa*, *Enterobacter sp*, *Staphyloccocus* sp [4–7]. Treatment is based basically on the use of antibiotics.

The sensitivity of a bacteria to an antibiotic means that at suitable doses the microorganism is susceptible to the drug, whereas when bacteria is resistant to an antibiotic, efficacy of the treatment is compromised because the microorganism is not inhibited by the drug. When sensitivity is partial, infection could be resolved depending on the administered concentration, but therapy may also be compromised, thus it should not be the first-choice antibiotic [2].

Urinary tract infection (UTI) consists of frequent affection, comprising the majority of cases seen by the Public Health System. Since many cases of UTIs are initially treated empirically based on the frequency of pathogens, antimicrobial resistance rate location and severity of the disease, the use of inappropriate therapy may result in a complicated infection, it could cause of an increase in the mortality

rate and lead to unnecessary use of some antimicrobial drugs, increasing resistance and hence recurrent urinary infection either through relapse or reinfection. Therefore, prior knowledge of the bacteria that cause UTIs in each region, as well as the sensitivity profile of antimicrobial drugs is essential in the selection of empirical therapy.

New research on epidemiology in a specific location can contribute to the prevention of bacterial resistance, which is of great concern in medicine nowadays, and helps reducing costs both for patients and for the public coffers. Tracing an epidemiologic profile also contributes in suiting the list of medicines provided by the Public Health System in each locality.

The present study aims to understand the profile of the microorganisms that cause UTIs in patients treated at the Municipal Laboratory of Lavras, Minas Gerais, Brazil, from January 2011 to May 2012 in order to explore possible cyclical variations and trends, and to assess their sensitivity to various antimicrobial therapies.

## METHODOLOGY

### Ethical aspects

This study was submitted to the Ethics in Human Beings Committee of UFLA under number CAAE 04359112.0.0000.5148.Prior to submission and data collection an informed consent, requesting authorization for the use of the data, was signed by the Manager responsible for the Municipal Laboratory of Lavras, Minas Gerais, Brazil.

### Characterization of the study and sample universe

This was a longitudinal, observational descriptive study. The sample universe was composed by 2135 routine urinalysis, followed by urine culture and antibiogram, performed at the Municipal Laboratory of Lavras - Minas Gerais - Brazil, in the period of January 2011 to May 2012. This sample universe represents the total number of tests provided by the database that fits these study inclusion criteria. Positive urine cultures, with a bacterial growth higher than $10^4$UFC/mL, as well as negative urine cultures for comparative purposes, were included in the present research. The final sample contained 483 positive tests. It was used secondary data from the "Sonner" Computer System which feedback of the "Brazilian Public Health System" - SUS (DATASUS – SUS "Sistema Único de Saúde").

### Positive urine cultures evaluation

Following data were analyzed in positive samples: Prevalence between genders; Prevalence between ages; Prevalence of infections over months; Most frequent bacteria; Profile of antibiotic resistance and sensitivity of each bacteria found; Relationship between leukocyte and presence of bacteria obtained from microscopic analysis.

### Tested antibiotics

In positive samples, microorganism sensitivity was tested to several antimicrobial, however, antibiograms were performed using the drugs available in the laboratory routine. We included only the results of antibiotics that were tested in most of the samples. They were: amikacin, cephalexin, ceftriaxone, ciprofloxacin, gentamicin, nitrofurantoin, norfloxacin, trimethoprim/sulfamethoxazole, cefotaxime, imipenem and meropenem (the last three used only for *Pseudomonas sp*being a multidrug resistant bacteria) for the gram-negative bacteria and azithromycin, chloramphenicol, erythromycin, oxacillin, penicillin, rifampin, tetracycline, and vancomycin for gram-positive bacteria.

### Data analysis

The evaluation was carried out in 483 positive urine cultures by descriptive statistics and exploratory data analyses. Data were grouped into tables and graphics containing information such as absolute and relative frequencies of the collected variables.

## RESULTS

All results of urine culture performed at the Municipal Laboratory of Lavras from January 2011 to May 2012 were accessed, corresponding to 2135 patients. Among the samples, 1550 (72.6%) were negative results, 102 (4.8%) were contaminated and 483 (22.6%) were positive for bacteria. Among positive urine cultures, 426 were from women and 57 from men, representing 88% and 12% of positive samples, respectively. The prevalence of UTI was higher after 60 years of age in both men and women (Table 1).

**Table-1:Prevalence of UTIs in the Municipal Laboratory of Lavras, Minas Gerais, Brazil from January 2011 to May 2012, according to gender and age.**

| Age group (years)* | Men n (%) | Women n (%) |
|---|---|---|
| **0 – 10** | 5 (8.8) | 25 (5.9) |
| **11 – 20** | 1 (1.8) | 53 (12.4) |
| **21 – 30** | 4 (7.0) | 64 (15.0) |
| **31 – 40** | 5 (8.8) | 45 (10.6) |
| **41 – 50** | 12 (21) | 36 (8.4) |
| **51 – 60** | 9 (15.8) | 60 (14.1) |
| **>60** | 21 (36.8) | 143 (33.6) |

* Age group according to Neto et al. [7].

All positive urine cultures, but two, showed moderate to intense amount of bacteria in microscopic examination of urine sediment. The two exceptions showed an apparently normal flora. Regarding leukocytes, the results were quite diverse, with 81.8% (395 samples) with more cell per field than is considered pyuria and 23.5% among these samples with white cells completely filling the fields.

The gram-negative bacteria found were *Escherichia coli*, *Proteus* sp, *Klebsiella* sp, *Enterobacter* sp and *Pseudomonas sp*, whereas gram-positive were *Staphylococcus sp*and *Streptococcus sp*. As shown in figure 1, the predominant etiologic agent in the positive samples were *Escherichia coli*, representing 77.3% (373 samples), followed by *Proteus sp* 7.2% (35 samples), *Staphylococcus sp* 6.4% (31 samples), *Streptococcus sp* 2.9% (14 samples), *Klebsiella sp* 2.7% (13 samples), *Enterobacter sp* 2.7% (13 samples) and *Pseudomonas sp* 0.8% (4 samples ).

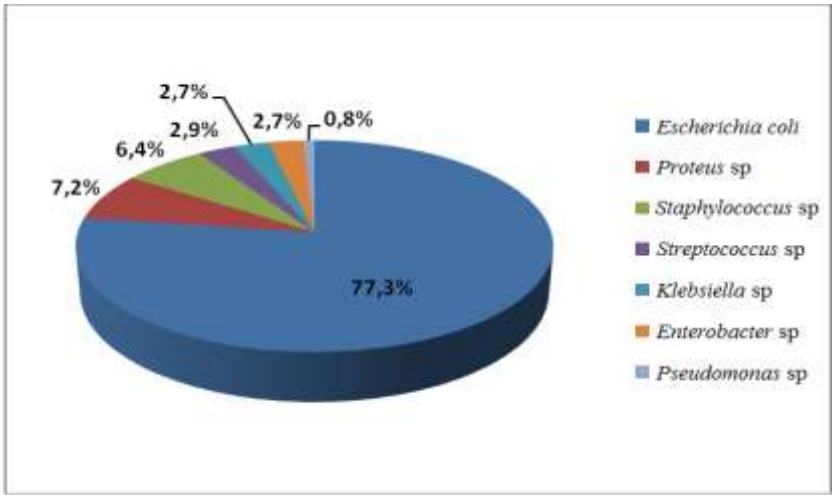


**Fig-1:- Percentage of microorganisms isolated in positive urine cultures**

*E. coli* was more sensitive to ceftriaxone 95.2%, amikacin 91% and showed great resistance to trimethoprim/ sulfamethoxazole 25.7%. *Enterobacter sp* showed 100% sensitivity to amikacin, ceftriaxone, ciprofloxacin and norfloxacin and resistance to trimethoprim/sulfamethoxazole with 37.5%. *Kebsiella* sp show sensitivity to ceftriaxone 90.9% and resistance to trimethoprim/sulfamethoxazole70%. *Proteus sp* was sensitive to ceftriaxone 82.8%, amikacin 72% and resistance to cephalexin 38.1%, followed by nitrofurantoin 35.5% and trimethoprim/ sulfamethoxazole 34.8%. *Pseudomonas sp* was 100% sensitive to ceftriaxone, cefotaxime, ciprofloxacin, imipenem, meropenem and norfloxacin and 100% resistant to cephalexin (Table-2).

*Staphylococcus sp* was sensitive to rifampicin 93.3%, chloramphenicol 93.1% and resistant to oxacilin, 30.8%. *Streptococcus sp* was 100% sensitive to rifampicin, 90.9% tovancomicin and showed 66.7% resistance to oxacilin (Table-3).

Gram-negative bacteria showed greater sensitivity to the antibiotics: ceftriaxon (94.3%) and amikacin (89.4%), whereas to gram-positive were: rifampicin (94.3%) and chloramphenicol (88.2%). On the other hand, gram-negative showed more resistance to trimethoprim/sulfamethoxazole (28.5%), followed by nitrofurantoin and norfloxacin, both 15% and gram-positive to oxacilin (40%) and erythromycin (29,3%)(Tables2 and 3).

The percentage of bacterial sensitivity to each antibiotic was analyzed by Kruskal-Wallis statistical test non-parametric, as shown in Table-4.

The number of urinalysis as well as positive results throughout 2011did not undergo large variations. In May, 2011 were conducted the largest number of tests, but in August the same year the prevalence of UTIs was higher. In the year 2012, the number of urinalysis was progressive over months and higher prevalence of infection was seen in April. Overall, the greater prevalence of UTIs was seen in August, 2011 (Figure 2). Comparing the results from January 2011 to May 2012, the prevalence was virtually the same.

**Table-2: Sensitivity and resistance to antibiotics tested for gram-negative bacteria in the Municipal Laboratory of Lavras, Minas Gerais, Brazil, from January 2011 to May 2012**

| Antibiotic | Bacteria (total of samples tested) | Sensitivity n (%) | Resistance n (%) | Partialresistance n (%) |
|---|---|---|---|---|
| **Amikacin** | EC (298) | 271 (91) | 4 (1.3) | 23 (7.7) |
| | EN (12) | 12 (100) | 0 (0) | 0(0) |
| | K (12) | 10 (83,4) | 1 (8.3) | 1 (8.3) |
| | P (25) | 18 (72) | 1 (4) | 6 (24) |
| | PS (2) | 1 (50) | 1 (50) | 0 (0) |
| **Total** | (349)* | 312 (89.4) | 7 (2) | 30 (8.6) |
| **Cefalexin** | EC (261) | 183 (70.1) | 28 (10.7) | 50 (19.2) |
| | EN (13) | 9 (69.2) | 1 (7.7) | 3 (23.1) |
| | K (8) | 4 (50) | 1 (12.5) | 3 (37.5) |
| | P (21) | 8 (38.1) | 8 (38.1) | 5 (23.8) |
| | PS (2) | 0 (0) | 2 (100) | 0 (0) |
| **Total** | (305)* | 204 (66.9) | 40 (13.1) | 61 (20) |
| **Ceftriaxone** | EC (313) | 298 (95.2) | 6 (1.9) | 9 (2.9) |
| | EN (11) | 11 (100) | 0 (0) | 0 (0) |
| | K (11) | 10 (90.9) | 0 (0) | 1 (9.1) |
| | P (29) | 24 (82.8) | 4 (13.8) | 1 (3.4) |
| | PS (3) | 3 (100) | 0 (0) | 0 (0) |
| **Total** | (367)* | 346 (94.3) | 10 (2.7) | 11 (3) |
| **Ciprofloxacin** | EC (283) | 237 (83.8) | 36 (12.7) | 10 (3.5) |
| | EN (10) | 10 (100) | 0 (0) | 0 (0) |
| | K (11) | 5 (45.4) | 4 (36.4) | 2 (18.2) |
| | P (31) | 21 (67.8) | 5 (16.1) | 5 (16.1) |
| | PS (3) | 3 (100) | 0 (0) | 0 (0) |
| **Total** | (338)* | 276 (81.7) | 45 (13.3) | 17 (5) |
| **Gentamicin** | EC (264) | 227 (86) | 19 (7.2) | 18 (6.8) |
| | EN (12) | 11 (91.7) | 0 (0) | 1 (8.4) |
| | K (9) | 5 (55.6) | 2 (22.2) | 2 (22.2) |
| | P (28) | 19 (67.9) | 6 (21.4) | 3 (10.8) |
| | PS (3) | 2 (66.7) | 0 (0) | 1 (33.3) |
| **Total** | (316)* | 264 (83.6) | 27 (8.5) | 25 (7.9) |
| **Nitrofurantoin** | EC (273) | 174(63.7) | 36 (13.2) | 63 (23.1) |
| | EN (10) | 5 (50) | 1 (10) | 4 (40) |
| | K (11) | 8 (72.7) | 0 (0) | 3 (27.3) |
| | P (31) | 11 (35.5) | 11(35.5) | 9 (29) |
| | PS (2) | 1 (50) | 1 (50) | 0 (0) |
| **Total** | (327)* | 199 (60.8) | 49 (15) | 79 (24.2) |
| **Antibiotic** | **Bacteria (total of samples tested)** | **Sensitivity n (%)** | **Resistance n (%)** | **Partialresistance n (%)** |
| **Norfloxacin** | EC (311) | 257 (82.6) | 42 (13.5) | 12 (3.9) |
| | EN (11) | 11 (100) | 0 (0) | 0 (0) |
| | K (12) | 7 (58.3) | 3 (25) | 2 (16.7) |
| | P (30) | 19 (63.3) | 4 (13.3) | 7 (23.4) |
| | PS (3) | 3 (100) | 0 (0) | 0 (0) |
| **Total** | (327)* | 199 (60.8) | 49 (15) | 79 (24.2) |
| **Trimethoprim/ Sulfamethoxazole** | EC (269) | 186 (69.1) | 69 (25.7) | 14 (5.3) |
| | EN (8) | 5 (62.5) | 3 (37.5) | 0 (0) |
| | K (10) | 3 (30) | 7 (70) | 0 (0) |
| | P (23) | 13 (56.5) | 8 (34.8) | 2 (8.7) |
| | PS (3) | 2 (66.7) | 0 (0) | 1 (33.3) |
| **Total** | (313)* | 207 (66.1) | 89 (28.5) | 17 (5.4) |
| **Meropenem/ Imipenem** | PS (2) | 2 (100) | 0 (0) | 0 (0) |
| **Total** | (2)* | 2 (100) | 0 (0) | 0 (0) |
| **Cefotaxime** | PS (3) | 3 (100) | 0 (0) | 0 (0) |
| **Total** | (3)* | 3 (100) | 0 (0) | 0 (0) |

EC- *Escherichia coli*; EN- *Enterobacter sp*; K- *Klebsiella sp*; P- *Proteus sp*; PS- *Pseudomonas sp*.

* Number of no tested samples for each antibiotic: amikacin (89), cephalexin (133), ceftriaxone (71), ciprofloxacin (100), gentamicin (122), nitrofurantoin (111), norfloxacin (71), trimethoprim/sulfamethoxazole (125), meropenem (2), imipenem (2) and cefotaxime (1).

**Table-3: Sensitivity and resistance to antibiotics tested for gram-positive bacteria in the Municipal Laboratory of Lavras, Minas Gerais, Brazil, from January 2011 to May 2012**

| Antibiotic | Bacteria (total of samples tested) | Sensitivity n (%) | Resistance n (%) | Partialresistance n (%) |
|---|---|---|---|---|
| **Azitromicin** | SL (28) | 17 (60.7) | 5 (17.9) | 6 (21.5) |
| | ST (7) | 4 (57.1) | 0 (0) | 3(42.9) |
| **Total** | (35) | 21 (60) | 5 (14.3) | 9 (25.7) |
| **Chloramphenicol** | SL (29) | 27 (93.1) | 0 (0) | 2 (6.9) |
| | ST (5) | 3 (60) | 0 (0) | 2 (40) |
| **Total** | (34) | 30 (88.2) | 0 (0) | 4 (11.8) |
| **Erythromycin** | SL (28) | 13 (46.4) | 6 (21.4) | 9 (32.2) |
| | ST (13) | 3 (23.1) | 6 (46.1) | 4 (30.8) |
| **Total** | (41) | 16 (39) | 12 (29.3) | 13 (31.7) |
| **Oxacilin** | SL (26) | 13 (50) | 8 (30.8) | 5 (19.2) |
| | ST (9) | 2 (22.2) | 6 (66.7) | 1 (11.1) |
| **Total** | (35) | 15 (42.9) | 14 (40) | 6 (17.1) |
| **Penicilin** | SL (19) | 14 (73.7) | 3 (15.8) | 2 (10.5) |
| | ST (7) | 5 (71.4) | 2 (28.6) | 0 (0) |
| **Total** | (26) | 19 (73.1) | 5 (19.2) | 2 (7.7) |
| **Rifampicin** | SL (30) | 28 (93.3) | 0 (0) | 2 (6.7) |
| | ST (5) | 5 (100) | 0 (0) | 0 (0) |
| **Total** | (35) | 33 (94.3) | 0 (0) | 2 (5.7) |
| **Tetracycline** | SL (30) | 25 (83.3) | 2 (6.7) | 3 (10) |
| | ST (12) | 5 (41.7) | 4 (33.3) | 3 (25) |
| **Total** | (42) | 30 (71.4) | 6 (14.3) | 6 (14.3) |
| **Vancomicin** | SL (26) | 21 (80.8) | 2 (7.7) | 3 (11.5) |
| | ST (11) | 10 (90.9) | 1 (9.1) | 0 (0) |
| **Total** | (37) | 31 (83.8) | 3 (8.1) | 3 (8.1) |

SL- *Staphylococcus sp*; ST – *Streptococcus sp*. *Number of no tested samples for each antibiotic:azitromicin (10), chloramphenicol (11), erythromycin (4), oxacilin (10), penicilin (19), rifampicin (10), tetracycline (3) and vancomicin (8).

**Table-4: Percentage of sensitivity of gram-positive and gram negative with respect to the antibiotic tested**

| Antibiotic | Bacteria n (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | EC | EM | K | P | PS | SL | ST |
| **Ceftriaxone** | **95.2 a** | 100 | 90.9 | **82.8 a** | 100 | - | - |
| **Amikacin** | **91 a** | 100 | 83.4 | 72 ab | 50 | - | - |
| **Gentamicin** | **86 a** | 91.7 | 55.6 | 67.9 ab | 66.7 | - | - |
| **Ciprofloxacin** | 83.8 ab | 100 | 45.4 | 67.8 ab | 100 | - | - |
| **Norfloxacin** | 82.6 ab | 100 | 58.3 | 63.3 ab | 100 | - | - |
| **Cefalexin** | 70.1 bc | 69.2 | 50 | 38.1 ab | 0 | - | - |
| **Trimethoprim/ Sulfametoxazole** | 69.1 bc | 62.5 | 30 | 56.5 ab | 66.7 | - | - |
| **Nitrofurantoin** | **63.7 c** | 50 | 72.7 | **35.5 b** | 50 | - | - |
| **Rifampicin** | - | - | - | - | - | 93.3 | 100 |
| **Chloramphenicol** | - | - | - | - | - | 93.1 | 60 |
| **Tetracycline** | - | - | - | - | - | 83.3 | 41.7 |
| **Vancomicin** | - | - | - | - | - | 80.8 | 90.9 |
| **Penicilin** | - | - | - | - | - | 73.7 | 71.4 |
| **Azitromicin** | - | - | - | - | - | 60.7 | 57.1 |
| **Erythromycin** | - | - | - | - | - | 46.4 | 23.1 |
| **Oxacilin** | - | - | - | - | - | 50 | 22.2 |

a,b,c: In columns, percentage followed by different letters differ by Kruskal-Wallis test ($p < 0.05$).
EC- *Escherichia coli*; EN- *Enterobacter sp*; K- *Klebsiella sp*; P- *Proteus* sp; PS- *Pseudomonas* sp; SL- *Staphylococcus* sp; ST – *Streptococcus* sp.

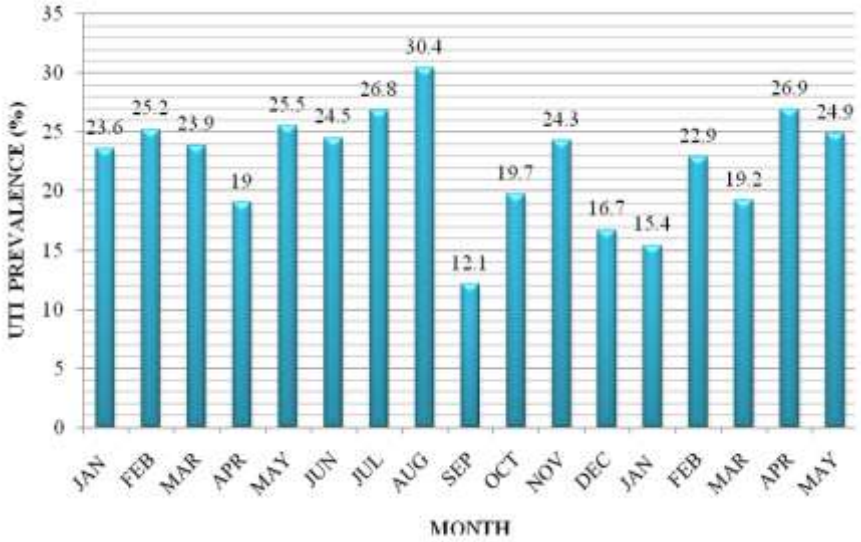


**Fig-2:- Prevalence of urinary tract infection (UTI) in patients seen at the Municipal Laboratory of Lavras, Minas Gerais, Brazil, from January 2011 to May 2012**

## DISCUSSION

The high prevalence of UTIs in Lavras (22.6%) was consistent with the findings of Costa et al. [8] who observed 28.9% of positive samples. The high number of women with urinary tract infection observed in this study (88%), corroborates the findings of Soares et al. [6]86.67% and Blatt and Miranda [9], who observed that women are 1.4 times more likely to have this infection than men. This higher susceptibility seen in women are probably duo to anatomical features, since the female smaller length of the urethra facilitates contact with the outside environment and intestinal bacteria in perianal region [2,3,5]. Physiology, intercourse, use of spermicidal, diaphragms and tampons, and history of maternal UTIs or during childhood are risk factors for women obtain UTIs[2,3,6,9,10].

The greater number of urinalysis in women is due to the fact that this exam is part of prenatal checkup. According to Silveira et al. [11], 80.9% of pregnant women carry out prenatal care through Public Health System, and are examined by different doctors during pregnancy which call for a new examination of urinalysis at each visit. This is a period of anatomical and physiological changes in the female body. Dilation of the urethra occurs due to hormonal alterations, specially progesterone, and mechanical alterations, the pregnant uterus; reduction in the peristaltic activity due to progesterone; urine pH becomes more alkaline facilitating the spread of microorganisms and occurs also hyperestrogenism, which facilitates bacterial adhesion to uroepithelial cells, especially *E. coli* strains [1,12,13].

Besides all these factors, it is observed that women in post-menopause are more likely to leave higher residual urine volume, which creates a favorable situation for bacterial growth and can lead to UTIs [4].Diabetes Mellitus, as well gestational diabetes, are diseases that increase the UTIs risk. In most cases occurs asymptomatic bacteriuria in women [14]. Diabetic neuropathy with neurogenic bladder generates residual urine favoring the growth of microorganisms in the urine of these patients, in addition to that, further leukocytes' changes facilitate bacterial adhesion to the bladder epithelium. The presence of glucose in urine also favors microorganism proliferation. Not treating UTIs can lead to serious complications to the mother, increasing the risk of acute pyelonephritis, apreterm labor and newborns with low weight or fetal death in more severe cases.

The age group with the highest prevalence of UTI in women and in men was 60 years old or older, which corresponds respectively to physiological changes in the body that occurs during menopause and to prostate related diseases [7]. Additionally there is a significant increase in incidence of UTIs in women between 21 and 30 years, which suggests a more active sex life.

The presence of contaminated samples (4.8%) in this study, as the findings of Soares et al. [6] corresponding to 20.8% reflects the reality of what happens in Public Health System. Patients often don´t understand the directions given by the laboratory staff on collecting samples. Besides, the bottle in which urine sample should be collected may not be sterile and transportation should be immediate. A confirmation that the patient has understood the procedure is essential for an accurate result.

The high number of negative results (72.6%) corresponds to studies by Soares et al.[6]and Blatt and Miranda [9]. In part, may be due to the routine

assessment of prenatal care, since most pregnant women are asymptomatic [1,13]; to the control post treatment with antimicrobials; to kidney infection or urethral colonization with another microorganisms [4].

The presence of bacteria was noted in almost all sedimentoscopy tests. However this does not state the presence of an UTI, since it can be associated with contamination. On the other hand, it is not correct to say that the lack of bacteria in the urinary sediment exclude the possibility of urinary tract infection, as evidenced by the findings of this study. The presence of bacteria in sediment is just an indication that there may be UTI, but only urine culture can confirm this result. Likewise, the pyuria may be present in both symptomatic and asymptomatic infections, but the finding of leukocytes in urine is not a diagnostic of urinary tract infection. They may be present in renal infections and also in non-infectious causes of urinary tract inflammation. However, symptomatic infections are associated with high number of leukocytes in urine [4].

Some attitudes may prevent UTIs, as supplementation of C vitamin that acidifies the urine, the consumption of fermented dairy beverages containing probiotic bacteria such as *Lactobacillus acidophilus* or GG that restore normal flora [10,15], intake of large amounts of liquids, right hygiene in genitalia-anus direction and abandon the habit of keeping a full bladder [6].

*E. coli* accounted for 77.3% of the positive samples. This high percentage corresponds to studies of Duarte et al. [13]80%, Soares et al. [6] 63.64% and most of the research related to UTIs[4,9]. This bacterium is part of the normal flora of the intestinal tract and can be found in the perianal region, which facilitates the infection of the urinary tract[2]. The sequence of other etiologic agents found in the present study does not resemble those found in the literature. Soares et al. [6] obtained a prevalence of 18.18% of *Staphylococcus aureus*, *Enterobacter cloacae* 9.09% and 4.55% of *Pseudomonas aeruginosa*, while Dias Neto et al. [7] found 26% *E. coli*, 15% *Klebsiella sp* and *P. aeruginosa* and 11% *Streptococcus* sp. It is suggested that these findings may have been different due to the different cities in which the surveys were conducted, as well as the time and place at which the samples were collected.

In general, the gram-negative bacteria were found in over 90% of the samples, as shown by Dias Neto et al. [7] with the finding of 80%. The low prevalence of *Pseudomonas sp* can be explained because this agent is more often seen in hospitals. This microorganism is highly resistant to antimicrobial therapy and becomes dominant when the normal flora or other bacteria is eradicated after antibiotic therapy [2,9].

One limitation of this study is related to susceptibility to antimicrobial agents. It was analyzed only those antibiotics that were tested in an increased number of samples, since in the laboratory routine some groups of antibiotics were unavailable. Thus, it was analyzed data of antibiotics that were tested for most samples.

Some bacteria showed substantial sensitivity to antibiotics of this study as the third generation cephalosporin: ceftriaxone and of broad spectrum aminoglycoside: amikacin, for the gram-negative; rifampicin and chloramphenicol for gram-positive. However, the use of the latter two antibiotics to treat urinary tract infection is inappropriate, as rifampicin is indicated for the treatment of leprosy and tuberculosis, and chloramphenicol is extremely toxic to the body and its excretion is biliar and not renal[2]. The fluoroquinolone ciprofloxacin showed significant efficacy in this study and, in clinical practice, it is quite effective against gram-negative bacteria, since it is eliminated in the form of the active metabolite in the urine and has less toxicity compared with amikacin and ceftriaxone. As penicillin and tetracycline are safer drugs with fewer adverse reactions and could be used to treatment against gram-positive bacteria.

The findings of the present study, in comparison with results from other studies, reflect the need to know the profile of local bacterial sensitivity compared to different chemotherapy agents available in the market. In many cases, such as uncomplicated cystitis [2] and in situations where the treatment must be immediate, empiric treatment is often established. Therefore, it is essential to have prior knowledge of the patterns of bacterial resistance, in order to achieve maximum effectiveness of treatment and avoid increasing rates of bacterial resistance, as well as promote the rational use of antimicrobials.

## CONCLUSION

Through the findings of this study it could be seen that most of the samples belonged to females of 60 years old or older. The higher prevalence of UTIs during the period occurred in August 2011. In general, gram-negative bacteria were the most frequent, being found *Escherichia coli* as the predominant etiologic agent in positive samples. Antibiotics that showed sensitivity to gram-negative bacteria were amikacin and ceftriaxone, for gram-positive were rifampicin and chloramphenicol. However, ciprofloxacin, which is largely used in clinical practice against gram-negative, as well as penicillin and tetracycline, effective against gram-positive organisms, are safer, with fewer side effects and should be used in empiric treatment of UTIs.

Thus it is important to know the local circumstances and the prevalence of microorganisms causing UTIs and treatment varies according to each region in order to obtain maximum efficiency and

contribute to the reduction of bacterial resistance to the antibiotic of choice in empirical treatment.

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