



ISSN: 2230-9926

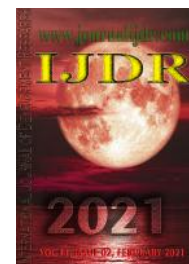
Available online at <http://www.journalijdr.com>

# IJDR

International Journal of Development Research

Vol. 10, Issue, 02, pp.44510-44513, February, 2021

<https://doi.org/10.37118/ijdr.20881.02.2021>



RESEARCH ARTICLE

OPEN ACCESS

## THE ROLE OF ESCHERICHIA COLI IN URINARY TRACT INFECTIONS

\*<sup>1</sup>Silvania Rosa de Souza, <sup>2</sup>Daniela de Sousa Barbalho, <sup>1</sup>Vanderson Ramos Mafra, <sup>3</sup>Cleide Alves Bispo Mafra, <sup>4</sup>Gleiziane Sousa Lima, <sup>1</sup>Natallia Moreira Lopes Leão, <sup>4</sup>Yara Silveira, <sup>4</sup>Christiane Rodrigues de Paula Marques, <sup>5</sup>Jaqueline Cibene Moreira Borgesa, <sup>6</sup>Renata Ferreira Diogo, <sup>7</sup>Maykon Jhuly Martins de Paiva, <sup>8</sup>Patrícia Oliveira Vellano and <sup>1</sup>Vera Lúcia Cavalcante Rodrigues

<sup>1</sup>Master Professor, University of Gurupi - UnirG, Av. Rio de Janeiro, N<sup>o</sup> 1585 - St. Central,, Gurupi, 77403-090, Tocantins, Brazil; <sup>2</sup>Lutheran University Center of Palmas - CEULP / ULBRA, Av. Joaquim Teotônio Segurado, 1501 - Expansion South Master Plan, Palmas, 77019-900, Tocantins, Brazil; <sup>3</sup>University of Gurupi - UnirG, Av. Rio de Janeiro, N<sup>o</sup> 1585 - St. Central,, Gurupi, 77403-090, Tocantins, Brazil; <sup>4</sup>University Professor, University of Gurupi - UnirG, Av. Rio de Janeiro, N<sup>o</sup> 1585 - St. Central, Gurupi, 77403-090, Tocantins, Brazil; <sup>5</sup>Professor Doctor, University of Gurupi - UnirG, Av. Rio de Janeiro, N<sup>o</sup> 1585 - St. Central,, Gurupi, 77403-090, Tocantins, Brazil; <sup>6</sup>Tocantinense University Center Presidente Antônio Carlos - UNITPAC, Av. Filadélfia, 568 - St. Oeste, Araguaína, 77816-540, Tocantins, Brazil; <sup>7</sup>Master Professor, Pharmacy and Aesthetics and Cosmetics at Faculdade de Palmas - FAPAL, 402 South - Set 2 - Lots 7 and, 8, Palmas, 77016-524, Tocantins, Brazil; <sup>8</sup>Master Professor, University of Northern Paraná - UNOPAR, Av. Santos Dumont, 1389, 1389 - Lot. Manoel Gomes da Cunha, Araguaína, 77818-010, Tocantins, Brazil

### ARTICLE INFO

#### Article History:

Received 20<sup>th</sup> December, 2020

Received in revised form

15<sup>th</sup> December, 2020

Accepted 14<sup>th</sup> January, 2021

Published online 24<sup>th</sup> February, 2021

#### Key Words:

Escherichia coli. Infection.  
Urinary tract.

\*Corresponding author: *Silvania Rosa de Souza,*

### ABSTRACT

Despite being considered sterile, urine is one of the biological fluids that suffer the most contamination. Urinary tract infection is a pathology that affects most people, regardless of age or sex. When there is a decrease in the immunological state and an invasion of an aggressive agent by bacteria or fungi, the individual's physiological state is compromised and an inflammation. The present work aims to evaluate the etiological aspects of *Escherichia coli*, addressing its role in urinary tract infections, knowing the virulence factors, outlining the pathophysiological mechanisms and highlighting its incidence in different populations. The methodology of this article consists of a literature review, with bibliographic and descriptive research, through reading scientific articles aimed at urinary tract infection. Thus, an effective diagnosis is of great importance, based on clinical signs and symptoms and laboratory findings, where there is the identification of the causative agent of the infection, which will trace knowledge about uro-pathogens. According to results, *Escherichia coli* is mainly responsible for urinary tract infections.

Copyright © 2021, *Silvania Rosa de Souza et al.* This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: *Silvania Rosa de Souza, Daniela de Sousa Barbalho, Vanderson Ramos Mafra, Cleide Alves Bispo Mafra, Gleiziane Sousa Lima, Natallia Moreira Lopes Leão, Yara Silveira, Christiane Rodrigues de Paula Marques, Jaqueline Cibene Moreira Borgesa, Renata Ferreira Diogo, Maykon Jhuly Martins de Paiva, Patrícia Oliveira Vellano and Vera Lúcia Cavalcante Rodrigues, 2021.* "Legitimation through the rankings: case of a Public University in Brazil" *International Journal of Development Research*, 11, (02), 44510-44513

## INTRODUÇÃO

Urinary Tract Infection (UTI) is a microbial invasion of the urinary tract in any segment, from the urethra to the kidneys. It is a common pathology that can affect people of all ages. Urine is considered sterile and may be contaminated by the skin, clothing, and genitalia (SILVEIRA *et al.* 2010 and CAMARGO, *et al.* 2001). With the prevalence variable between 60% and 90% according to study locality and age group, *Escherichia coli* is the main etiological agent of UTI in several national and international series (LO, *et al.* 2013). UTIs have a great socio-economic impact, as they are among the most frequently diagnosed bacterial infectious diseases and are responsible

for high consumption of antimicrobials, it is estimated that there are 150 million cases annually worldwide (SOBRINHO, 2011). Several authors report the stages of involvement of urinary tract infection, which may have onset an inflammation of the urethra (urethritis), which if left untreated, can reach the bladder (cystitis), and reach the ureters. If there is no control the infection can rise and reach the kidneys (Pyelonephritis), which can get complicated and evolve to septicemia and reach death. The virulence of the invading agent, the size of the inoculum, and the host defense mechanisms are contributing factors to the development of UTI severity (CARRARO, 2012). The flow of urine itself contributes to urinary tract sterility. The volume and pressure of sterile urine when passing through the

urinary tract removes possible microorganisms that are colonizing the wall of the same and can eliminate up to 99% of microorganisms present in the bladder (GENNARO, 2014). According to Costa *et al.* (2010), the urinary system is susceptible to opportunistic infections and may affect about 6% of individuals and the most common bacterial infection is characterized. UTI is defined as a condition where the urinary tract is infected by pathogens that determine inflammation. For the development of UTI, it is necessary to trigger factors that collaborate with contamination, such as the nature of the invasive microorganism concerning the conditions of the host that occurs with the use of antimicrobial agents and urinary tract instrumentation (COSTA, *et al.* 2010). Although the urinary tract is resistant to infection, when there is a change in renal structure or obstruction of urinary flow, it becomes more susceptible to contamination. Being more frequent in the renal medulla to the cortex, this is due to the low blood supply, decreased mobilization of leukocytes, and low pH for the performance of inflammatory cells (CHEDID, 2009). Infection can affect a single site, such as the urethra, bladder, or kidneys, although often more than one site is involved. Urine-restricted infection may present as asymptomatic bacteriuria and lead to clinical infection (CAMARGO, 2001). The etiology of UTI varies with gender, age, general patient status, antimicrobial use, and acquisition inside and outside the hospital. Any factor that disrupts normal urinary flow or bladder emptying or facilitates access of the microorganism to the bladder predisposes the individual to infection. These factors include: urethra compromise, fecal contamination, genetic factors, genital infections, among others (COSTA, *et al.* 2010). In women, susceptibility to infection urination is due to mechanical factors, such as the fact that the urethra is shorter and the proximity of the anus to the vagina and urethra. In man, on the other hand, it holds protective actions, because they are advantageous due to greater urethral length, greater urinary flow and bactericidal power of prostatic secretions (COSTA, *et al.* 2010). The major responsibility for UTI is gram-negative enteric bacteria, especially *Escherichia coli*, which is the most frequent, followed by *Klebsiella*, *Enterobacter*, *Acinetobacter*, *Proteus* and *Pseudomonas*. In addition to these, *Staphylococcus saprophyticus* has been pointed out as the second most frequent cause of uncomplicated UTI. In complicated UTI, *Pseudomonas* has a high incidence among Gram-negative ones. *Enterococcus*, on the other, is the main pathogen among Gram-positive (SCHECHTER, 1998). The number of infections by potentially resistant pathogens has been growing progressively and releases the prevalence in the hospital system, either due to the complexity of the patient or by the high consumption of antimicrobials, limiting the therapeutic alternatives. *E. coli* is a bacterium most commonly found in both community and hospital infections, due to the ability of its strains to adhere to the urination mucosa, corresponding to 85% of community infections acquired (SCHECHTER, 1998 and SOBRINHO, 2011).

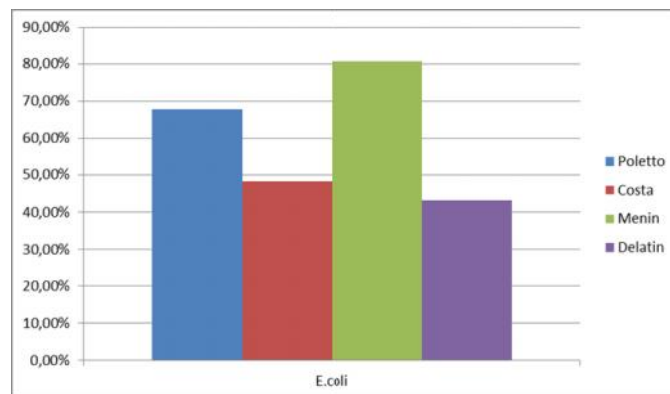
## MATERIALS AND METHODIC

The methodology of this article consists of a literature review, with bibliographic and descriptive research, through the reading of scientific articles directed to urinary tract infections, in order to evaluate the etiological profile of *Escherichia coli* found in urinary tract infections, addressing the characteristics of virulence in the various populations.

## RESULTS

We analyzed 4 studies, each from a locality, representing the regions of Brazil, with its surprising diversity, which was represented by the center-west, northeast, south and southeast, comprising the period from 2002 to 2009, making it possible to observe the etiological agents involved in these studies. In a study conducted in a laboratory of Clinical Health Analyses of the Catholic University of Goiás in Goiânia, corresponding to the period of June 2002 August 2003, 442 urine samples from women were analyzed. Of these, there were 78 (17.6%) positive results for urinary tract infection, and in 67 (85.9%)

samples the agent causing UTI were Gram-negative bacteria and in 11 (14.1%) Gram-positive. *Escherichia coli* was the prevalent microorganism, corresponding (67.9%) cause of this infection (MENIN, 2010).



**Figure 1. Frequency of *Escherichia coli* in the different studies analyzed. The results are presented in percentage (%) cases**

In a study that analyzed 1957 urocultures in the Laboratory of Clinical Analysis-HEMOCLIN from January 2006 to June 2008 in Campina Grande-PB, showed an incidence of 48.2% of *Escherichia coli*, followed by *Proteus mirabilis* with 11%. It was also observed the occurrence of microorganisms that were little incident, including *Proteus Vulgaris*, *Enterococcus Faecallis*, among others (COSTA, *et al.* 2010 AND CEZAR, 2013). Already a study conducted by Menin *et al.* (2010), at the University Laboratory of URI-Campus de Erechim-RS, where 195 urine cultures were evaluated from October 2006 to October 2007, it was found that 36 (18.46%) samples obtained positive results for UTI. Among the urocultures with a count of more than 100,000 CFU/ml, *Escherichia coli* 29/36 (80.55%), *Klebsiella Pneumoniae* 2/36 (5.55%), *Klebsiella oxytaca* 1/36 (2.77%), *Enterobacter agglomerans* 1/36 (2.77%) and *Serratia marcescens* 1/36 (2.77%). In the study by Delatim *et al.* 2012, in a Clinical Analysis Laboratory of a municipality in the Northwest of São Paulo from January to December 2009, in which it analyzed 233 urocultures, among them 50 (21.46%) were positive and 183 (78.54%) Negative. *Escherichia coli* was the most prevalent (43.2%), followed by *Proteus sp\** (38%). The other enterobacteria *Klebsiella sp.*, *Enterobacter sp.*, *Citrobacter sp.* and *Morganella sp.* They have 2.7% each. Although urinary infections caused by Gram-positive were less frequent, it was possible to observe in this study a rate of 10% caused by *Staphylococcus saprophyticus*(SCHECHTER, 1998). As the graph shows, *Escherichia coli* is the main responsible for urinary tract infections.

## DISCUSSION

It is observed a wide range of infections diagnosed in several regions of Brazil, the frequency of cases in the mentioned regions, is presented by the colonization of *E. coli*. The performance of research in several regions of Brazil is extremely important because it traces the knowledge about uro-pathogens that include people in various locations, bringing information that will serve as conduct before the medical community before choosing the appropriate treatment for their patients, in addition to addressing the profile of bacteria, contributing to the choice of therapeutic alternatives. For infection to occur, bacteria must have access to the bladder, fix and colonizing the urinary tract, thus avoiding being expelled by urination and defense mechanisms, only through this escape, bacteria can adhere to the mucosa and initiate inflammation. The adhesion capacity of *E. coli*, is what determines its colonization and subsequent infection. It has about 170 different types of cell wall antigens, about 80 capsular antigens, 50 flagella antigens and various types of fimbria and adhesines (SOBRINHO, 2011). Glycoproteins that serve as receptors are found in Tamm-Horsfall protein and glycosaminoglycans where they act as defense mechanisms against persistence and multiplication

of bacteria in the urinary tract. The destruction of this protective layer of glycoproteins favors penetration into the epithelium and then an inflammatory reaction (POLETTI, 2005). *E. coli* has fimbriae or pili (hair), which are filamentous appendages shorter than the flagella and attach to the wall of the urinary tract preventing them from being dragged by the urinary flow. Fimbriae are responsible for the binding of the bacterium or uroepithelium and the transmission of genetic information to other bacteria through the DNA of plasmids. Other virulence factors that influence the degree of infection are: K antigens or capsules (capsulated polysaccharides involving the cell wall) and the production of bacterial endotoxins. These mechanisms are properties that bacteria possess, thus establishing the infection more easily (DELATIM, *et al.* 2012). They also present with flagella or "H" antigens, responsible for the motility of bacteria and "O" antigens always present in the external membrane of the bacterium, which is antigenic determinants to specific antibodies that are used in serological typing (150 antigens "O" defined) (RIELLA, 2003). Another uro-virulence factor is present, hemolysin, which is made available for iron and can destroy phagocytic and epithelial cells. The characteristic biochemical profile in the identification of *E. coli* is: Indole (+), Lysine (+), Glucose (+), and Citrate (-) COSTA, 2011 and HEILBERG, 2003).

They are Gram-negative bacilli, originating from the intestinal flora. It is not necessary to point out that *E. coli* in the intestinal flora does not cause damage, as it is part of the intestinal microbiota (HEILBERG, 2003). This microorganism outside the intestine can contaminate, colonize and consequently cause infections, making it one of the main etiological agents of septicemias, meningitis, and urinary tract infections (COSTA, 2010). *Escherichia coli* uropathogenic (ECUP) is estimated to be responsible for 85% to 90% of CASES of UTI, where women are the most affected due to anatomical behavior. ECUPs have specified virulence factors (adhesins) capable of adhering to urethra cells and reaching the kidneys. Signaling pathways in bacterial cells and the host facilitate the release of proteins into tissues and ultimately promote pathogen invasion (ESPARIS, *et al.* 2014).

The fimbria that prevails among the ECUP samples are fimbrial type 1, that is, those fimbriae of adhesins whose receptor is the mannose of the glycoproteins, and this type of fimbria is involved with bacterial adhesion to the lower urinary tract, that is, acute bacterial cystitis and can be inhibited by mannose. They are present in the *Enterobacteriaceae* family, manifested in more than 90% of *E. coli* samples (SPINDOLA, 2006). The ECUPs adhere to the epithelium through type 1 and P fimbriae which recognize their receptors. After invading and multiplying intracellularly, it can go through the ureters and reach the kidneys and adhere through the fimbria P. After the seizure, the production of toxins that injures the glomeruli occurs. In some situations, ECUPs can cross the epithelium and invade the blood system (ESPARIS, *et al.* 2014). The indiscriminate use of antimicrobials and self-medication favors the appearance of resistant bacterial strains. Its choice is due to clinical efficacy because of the prevalence of resistance, costs and the class of bacteria allowing the application of adequate treatment both hospital and community (COSTA, *et al.* 2010). In Brazil and in several countries, access to antimicrobials is facilitated, which leverages increased bacterial resistance. Another triggering factor is antimicrobial resistance achieved by a microbiological evaluation of the etiological agent and its resistance pattern (MOURA, 2010).

Use Arial font 12, with spacing 1.5. Discussion is the most important part of scientific work. For, it is in the discussion that the results of the study are interpreted, the results are analyzed according to the theoretical foundation of other studies and the inferences about the results and theories are established. The interpretation of the results is performed to try to respond to the study problem and, concomitantly, provides direction to accept or refute the study hypotheses. To assist in the organization of the writing of the discussion, try to use the same order performed in the presentation of the results. The discussion should present the explanation for the results verified in its study. This should be done based on established assumptions.

## Final Considerations

The UTI plays a significant role in public health, as it is among the main diseases of the community. In several studies analyzed, *Escherichia coli* is the main pathogen related to urinary tract infections. The etiology varies with gender, age, gender, patient status, antimicrobial use and acquisition inside and outside the hospital. With the decrease in immunological activity and predisposing factors such as pH and temperature ideas of the host, they favor and facilitate the development of pathogens. *Escherichia coli* are enteric Gram-negative bacteria of the *enterobacteriaceae* family. It is of great relevance to researching various locations in Brazil, because it traces the knowledge of uropathogens, and presents information about the profile of the bacterium, thus contributing to the choice of alternative therapies and more effective and safe treatment for the patient. The bacterial virulence of *E. coli* is multifactorial, has mechanisms to overcome the obstacles imposed by the immunological and physiological barriers of the individual, behaves with several types of fimbria and adhesins, has around 170 different types of cell wall antigens, about 80 capsular antigens and 50 flagellar antigens. These properties they possess help establish the infection more easily. The request for laboratory tests is due to the clinical signs and symptoms of the patient, and through microscopic analysis, culture and biochemical tests it is possible to identify and isolate the agent of infection. Given the importance of the incidence of *E. coli* in numerous populations, it is necessary to know the bacterium, emphasizing its virulence factors and tracing its pathophysiological mechanisms, so that through these data contribute to epidemiological knowledge and the diagnosis of UTIs. Because the appropriate diagnosis and treatment are essential factors to avoid errors in antimicrobial therapy, thus avoiding the appearance of resistant strains, which, when untreated, can spread *E. coli* into the bloodstream and cause septic shocks and even lead to death. Thus, it had directed the therapeutic medical management, besides preventing the spread of resistant pathogens, favoring a better prognosis for the patient.

## REFERENCES

- BRAOIOS, Alexandre. *et al.* Infecções do trato urinário em pacientes não hospitalizados: etiologia e padrão de resistência aos antimicrobianos. *Jornal Brasileiro de Patologia AND Medicina Laboratorial*, Rio de Janeiro, 4 dez. 2009. Folha Saúde, Caderno 6, p.8.
- CAMARGO, Ilana L. Baratella da C. *et al.* Diagnóstico bacteriológico das infecções do trato urinário. *Rev. Técnica Medicina*. Ribeirão Preto, p.70-78, jan. 2001.
- CARRARO, José Carlos Eduardo; GAVA, Isabela Ambrosio. O uso de vacinas na profilaxia das infecções do trato urinário. *Jornal Brasileiro de Nefrologia*, São Paulo, 2 abr. 2012. Folha Saúde, Caderno 8, p.2
- CEZAR, Guilherme de Oliveira; SANTOS, Vanessa Danesi dos; FUNCHAL, Cláudia. Análise bibliográfica dos microrganismos encontrados com maior frequência em infecções do trato urinário. *Revista Newslab*. n.116, fev. 2013.
- CHEDID, Elias. Infecção Urinária. Publicação do Núcleo Avançado de Urologia do Hospital Sírio-Libanês. 9 ed. Jul. 2009.
- COSTA, Larissa Chaves. *et al.* Infecções urinárias em pacientes ambulatoriais: prevalência e perfil de resistência aos antimicrobianos. *Rev. Bras. de Análises Clínicas*. v.42(3), p.175-180, 2010.
- COSTA, Naiara Barreira. Estudo dos agentes infecciosos AND da resistência bacteriana em infecções do trato urinário. 2011, 87f. Monografia (Graduação em Biologia) - Consórcio Setentrional de Educação a Distância Universidade de Brasília e Universidade de Goiás, Brasília, 2011.
- DELATIM, *et al.* Avaliação do perfil de suscetibilidade aos antimicrobianos de uropatógenos. *Revista Laes e Haes*., v.5, n.199, out. 2012.

- ESPARIS, Carmem Macedo. *et al.* Aspectos biológicos e moleculares de amostras uropatogênicas de *Escherichia coli* isoladas na cidade do Rio de Janeiro. *Revista da Sociedade Brasileira de Medicina Tropical*. v.39, n.6, nov. 2006. Disponível em: <<http://www.scielo.br>>. Acesso em: 16 abr. 2014.
- GENNARO, A.R. Remington: a Ciência AND a Prática da Farmácia. 20 ed. Rio de Janeiro: Guanabara Koogan, 2004.
- HEILBERG, Ita Pfeferman; SCHOR, Nestor. Abordagem diagnóstica e terapêutica na infecção do trato urinário-Itu. *Revista da Associação Médica Brasileira*. v.49, n.1, jan. 2003.
- LISBOA, Thiago; NAGEL, Fabiano. Infecção por patógenos multirresistentes na UTI: como escapar?. *Revista Brasileira de Terapia Intensiva*. v.23, p.120, jan. 2011.
- LO, Denise Swei. *et al.* Infecção urinária comunitária: etiologia segundo idade e sexo. *Jornal Brasileiro Nefrologia*, São Paulo. 5 abr. 2013. Folha Saúde, Caderno 35, p.2.
- MENIN, Viviane Tortelli; GRAZZIOTIN, Neiva Aparecida. Infecções do trato urinário diagnosticadas no laboratório universitário da URI-Campus de Erechim/RS. *Revista Brasileira de Análises Clínicas*, v.42(4), p.307, 2010.
- MOURA, Lorena Brandhuber; FERNANDES, Maiára Gomes. A incidência de infecções urinárias causadas por *E.coli*. *Revista Olhar Científico*. v.1, n.2, ago. 2010.
- PALMA, Paulo. Cistite na Mulher. *Revista Brasileira de Medicina*. v.70, n.10, p.350, Out. 2013.
- POLETO, Karine Queiroz; REIS, Cleomenes. Suscetibilidade antimicrobiana de uropatógenos em pacientes ambulatoriais na cidade de Goiânia, GO. *Revista da Sociedade Brasileira de Medicina Tropical*. v.38, n.5, set. 2005.
- RIELLA, Miguel Carlos. Princípios de Nefrologia AND Distúrbios Hidroeletrólíticos. 4 ed. Rio de Janeiro: Guanabara Koogan, 2003.
- SCHECHTER, Mauro; MARNGONI, Denise Vantil. Doenças infecciosas: conduta diagnóstica e terapêutica. Rio de Janeiro: Guanabara Koogan, 1998.
- SILVEIRA, Solange Aparecida. *et al.* Prevalência e suscetibilidade bacteriana em infecções de pacientes atendidos no hospital universitário de Uberaba. *Revista Brasileira de Análises Clínicas*, v.42(3), p.157-160, 2010.
- SOBRINHO, Rosemary Alves dos Santos. Micro-organismos envolvidos em infecções urinárias de mulheres com idade superior a 15 anos atendidas no HC-UFG em 2009 AND os perfis de suscetibilidade aos antimicrobianos. Dissertação (Mestrado) – Universidade Federal do Goiás, Goiânia, 2011.
- SPINDOLA, Sheila. Ocorrência de *Escherichia coli* em culturas de urina no setor de microbiologia do PAM Antônio Ribeiro Netto. Rio de Janeiro, Dez. 2006.

\*\*\*\*\*