bacteria

MDPI

Article

Rising Trends of Urinary Infections Among Pregnant Women: Insights from a Portuguese Hospital (2018–2022)

Francisco Rodrigues [1,*], Patrícia Coelho [1], Sónia Mateus [1], Hatem Eideh [2], Teresa Gonçalves [3,4,5], Armando Caseiro [6,7,8] and Miguel Castelo Branco [9]

1 Sport Physical Activity and Health Research & Innovation Center (Sprint), Polytechnic Institute of Castelo Branco, 6000-084 Castelo Branco, Portugal; patriciacoelho@ipcb.pt (P.C.); soniamateus@ipcb.pt (S.M.)
2 Department of Medical Laboratory Sciences, Al-Quds University, Abu Dis P144, Palestine; heideh@staff.alquds.edu
3 FMUC—Faculty of Medicine, University Coimbra, 3004-504 Coimbra, Portugal; tmfog@ci.uc.pt
4 CNC-UC—Center for Neuroscience and Cell Biology, University Coimbra, 3004-504 Coimbra, Portugal
5 CIBB—Centre for Innovative Biomedicine and Biotechnology, University Coimbra, 3004-504 Coimbra, Portugal
6 School of Health, Polytechnic University of Coimbra, Rua da Misericórdia, Lagar dos Cortiços, S. Martinho do Bispo, 3045-093 Coimbra, Portugal; armandocaseiro@estesc.ipc.pt
7 H&TRC—Health & Technology Research Center, Coimbra Health School, Polytechnic University of Coimbra, Rua 5 de Outubro, 3045-043 Coimbra, Portugal
8 Faculty of Veterinary Medicine, University of Lisbon, CIPER, 1649-004 Cruz Quebrada, Portugal
9 Faculty of Health Sciences, University of Beira Interior, 6201-001 Covilha, Portugal; mcbranco@fcsaude.ubi.pt
* Correspondence: franciscobrodrigues@ipcb.pt; Tel.: +351-966509363

Abstract: This study explores the prevalence and antibiotic resistance of urinary tract infections (UTIs) in pregnant women in central Portugal. A retrospective observational study was conducted on 201 positive urine cultures from pregnant women at a hospital center between January 2018 and December 2022. The data collected included age, hospital admission source, history of antibiotic therapy, catheterization status, identity of bacterial isolates, and their antibiotic profile. The most common bacterial strains were *Escherichia coli* (52.4%) and *Streptococcus agalactiae* (16.9%). In terms of antibiotic resistance, *Escherichia coli* demonstrated complete sensitivity to ertapenem, while *Streptococcus agalactiae* showed sensitivity to four antibiotics, including trimethoprim/sulfamethoxazole. Notably, most infections occurred in the third trimester, underscoring the need for continuous monitoring throughout pregnancy. This study emphasizes the importance of tailored treatment strategies to manage UTIs in pregnancy effectively, reducing the potential maternal and fetal complications. These findings contribute to regional data on UTI management in pregnant populations and aim to support improved healthcare practices. These regional data provide a solid foundation for optimizing healthcare practices in pregnant women, suggesting targeted approaches to combat antibiotic resistance and improve maternal–fetal safety during UTI treatment.

Keywords: urinary tract infections; pregnancy; antibiotic resistance; *Escherichia coli*; *Streptococcus agalactiae*; maternal health

Academic Editor: Bart C. Weimer

Received: 4 December 2024
Revised: 31 January 2025
Accepted: 5 February 2025
Published: 9 February 2025

Citation: Rodrigues, F.; Coelho, P.; Mateus, S.; Eideh, H.; Gonçalves, T.; Caseiro, A.; Castelo Branco, M. Rising Trends of Urinary Infections Among Pregnant Women: Insights from a Portuguese Hospital (2018–2022). *Bacteria* **2025**, *4*, 10. https://doi.org/10.3390/bacteria4010010

1. Introduction

Urinary tract infections (UTIs) are among the most common infections affecting humans. Although often regarded as minor with limited risk of progression, UTIs can occasionally lead to significant complications. These infections may extend beyond the lower urinary tract—the least complex and most frequently involved area—to affect other

organs, such as the kidneys, or even disseminate to other parts of the body, potentially resulting in sepsis [1]. A UTI is defined by the presence of microorganisms within any part of the urinary system, except for the distal urethra, where some microbes may exist without causing infection [1]. The relevance of understanding urinary infections during pregnancy is increasing, considering the potential complications for maternal and fetal health, especially in regions with limited epidemiological data.

Several factors contribute to the high incidence of UTIs, including the anatomical proximity between the urethra and anus and direct external exposure through the urethra [1]. Women are particularly susceptible to UTIs due to both anatomical and hormonal factors, with many estimated to experience at least one UTI in their lifetime [2]. Additional risk factors for UTIs include diabetes mellitus, urinary incontinence, anatomical abnormalities in the urinary system, immobility, urinary retention, aging, and immunosuppression [3].

UTIs typically occur through an ascending route, where microorganisms travel up the urethra—a common path—or less frequently via the hematogenous route, particularly in newborns, or the lymphatic route, a rare condition associated with intestinal infections [4]. Enterobacteria are the most prevalent bacteria involved in UTIs, with *Escherichia coli* being the primary causative agent. Although *E. coli* remains the dominant pathogen, its prevalence varies; it is more common in community-acquired infections than in healthcare-associated infections, where a greater diversity of bacterial strains are encountered due to the hospital environment. *Klebsiella pneumoniae* is often the second most prevalent bacterium [5].

Treating bacterial UTIs involves antibiotic therapy based on urine culture results. Urine culture allows for identifying the causative microorganism and performing antibiotic susceptibility testing to determine effective antibiotics. Currently, advanced molecular biology techniques in microbiology aim to reduce the time needed to obtain culture results, typically a 48 h process [6]. While urine culture remains the gold standard, these advances are helping accelerate traditional microbiology's response time, addressing the challenge of reliance on empirical therapy when immediate options are lacking [7].

Pregnancy is characterized by extensive physiological, structural, hormonal, and psychological changes that necessitate close monitoring to safeguard maternal health and ensure the delivery of a healthy infant. Despite being a natural process, pregnancy requires careful management that extends beyond adaptation, representing a comprehensive transformation with broad implications.

Studies highlight the importance of thorough clinical monitoring, ideally starting pre-conception, to create the optimal conditions for pregnancy. This monitoring should be specialized, multidisciplinary, and responsive to the specific needs and potential complications as pregnancy progresses.

Physiologically, pregnancy can increase a woman's susceptibility to UTIs, making them the most common infections among pregnant women and potentially heightening the risks of both maternal and fetal morbidity and mortality [8]. Numerous changes in the woman's body can increase the UTI likelihood. In pregnancy, hormonal and mechanical factors contributing to ureteral dilation, dilation of the renal calyces, and urinary stasis predispose pregnant women to UTIs [9]. These changes promote bacterial colonization in the urinary tract, leading to symptomatic bacteriuria—where symptoms prompt medical attention—or asymptomatic bacteriuria, where bacteria are present without symptoms [10,11]. It is thus essential to screen all pregnant women for bacteriuria and promptly initiate treatment if detected. Asymptomatic bacteriuria, if untreated, can progress to pyelonephritis or other complications [11]. Following treatment, usually a short three-day antibiotic regimen, ongoing monitoring is crucial.

Treating UTIs during pregnancy is particularly important, given the potential risks if left untreated [12,13]. Even asymptomatic bacteriuria poses a risk of progressing to complicated UTIs with adverse outcomes for both mother and fetus.

As in the general population, *Escherichia coli* is the most frequently identified bacteria in UTIs among pregnant women [14]. Experimental studies using animal models suggest a possible association between *E. coli* and preterm labor, although this has not been conclusively demonstrated in humans [14].

This study focuses on UTIs during the unique physiological period of pregnancy, aiming to accomplish the following:

- Characterize UTIs in pregnant women;
- Identify the most prevalent bacterial strains responsible for UTIs during pregnancy;
- Analyze the antibiograms of the most common strains involved in these infections.

2. Materials and Methods

The data for this study were obtained from the hospital's computerized system. A retrospective observational analysis was conducted on all the positive urine cultures from pregnant women at a hospital center in central Portugal between January 2018 and December 2022. This included a total of 201 representative samples from all the admissions during the specified period. A urine culture was considered positive when bacterial growth reached $\geq 10^5$ CFU/mL for a single uropathogen. In cases where two or more species were present, the result was considered contaminated unless one of the species predominated significantly.

The data collection, supported by computerized records, included variables such as age, admission source (emergency, inpatient, or outpatient), history of prior antibiotic use (yes or no), catheterization status (yes or no), bacterial strains isolated, results of antibiotic susceptibility testing (sensitive or resistant), and the management period. Urine samples were processed using standard microbiological procedures. Cultures were performed on chromogenic agar plates and incubated at 37 °C for 24–48 h. Bacterial identification was carried out using matrix-assisted laser desorption/ionization–time of flight mass spectrometry (MALDI-TOF MS) and biochemical tests when necessary. Statistical analyses were conducted using IBM SPSS Statistics software, version 29.0.1, for Mac iOS. Both descriptive and inferential statistical methods were applied, with *t*-tests used for independent samples with normal distributions and Mann–Whitney U tests for non-normally distributed data. A UTI was diagnosed based on the presence of positive urine culture ($\geq 10^5$ CFU/mL) associated with clinical symptoms such as dysuria, increased urinary frequency, urgency, or suprapubic pain. Cases with positive urine cultures without symptoms were classified as asymptomatic bacteriuria and were not included in the analysis. The data were securely stored on a personal computer with restricted access to the research team and were deleted according to the best practice guidelines after this study's completion.

Ethical standards were rigorously followed, with approval from the Ethics Committee of the University of Beira Interior, Covilhã, Portugal, as well as from the designated data management authority at the university. Due to the nature of the data and methodology, individual informed consent was waived.

This research is part of the Urinary Tract Infections in the Central Interior of Portugal (UTICIP) project and contributes to a post-doctoral program in biomedicine.

3. Results

The study sample consisted of 201 pregnant women, with an average age of 32.3 years. The majority of pregnant women were in the third trimester of pregnancy (Figure 1).

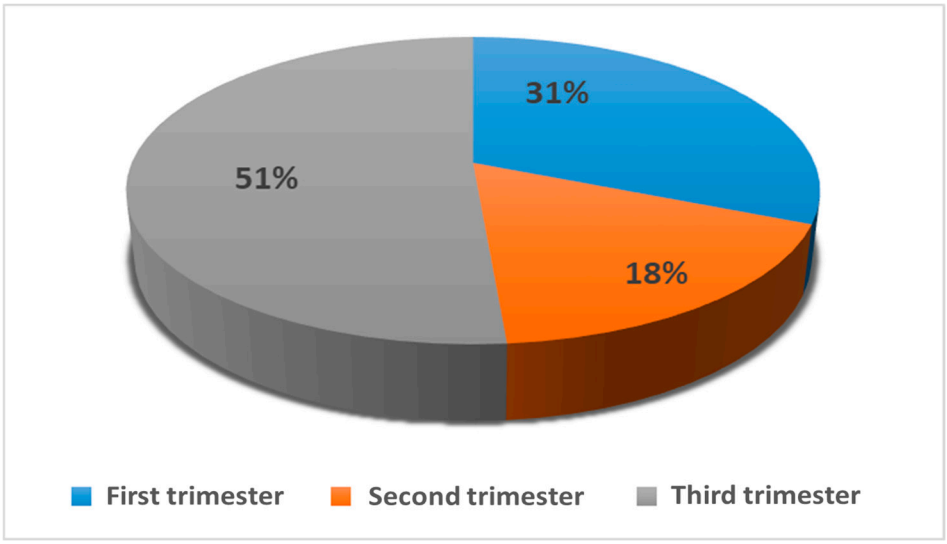

Figure 1. Sample distribution by trimester.

Only one of the women had a urinary catheter (0.49%) and was in the third trimester of pregnancy. Four pregnant women were receiving prior antibiotic therapy at the time of the urine collection for urine culture. Of these, two of them were in the third trimester, one in the second and the last one was in the first trimester.

Moreover, 92.52% of the pregnant women came from the External Consult, 5.98% from the Emergency Department and 1.5% from the Internment Department. A highlight is the fact that no pregnant woman in the first trimester went to the Emergency Department with complaints of urinary infection. Analysis of these data by trimester is presented Figure 2.

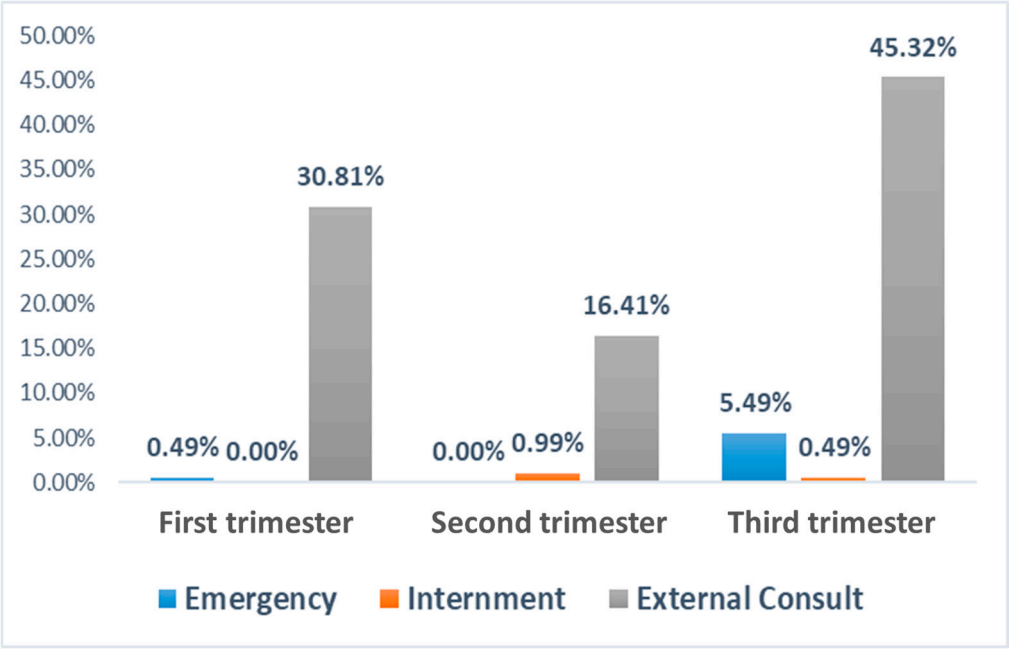

Figure 2. Distribution of the sample by trimester of pregnancy and service of origin.

Regarding the strains identified, we found that 52.4% of the urine cultures showed *Escherichia coli*, 16.9% *S. agalactiae*, 13.9% *E. faecalis*, 9.5% *K. pneumoniae*, 3.9% *P. mirabilis*, 1.9% *S. saprophyticus* and 1.5% *S. aureus*. When analyzing by trimester, we can see what is shown in Figure 3.

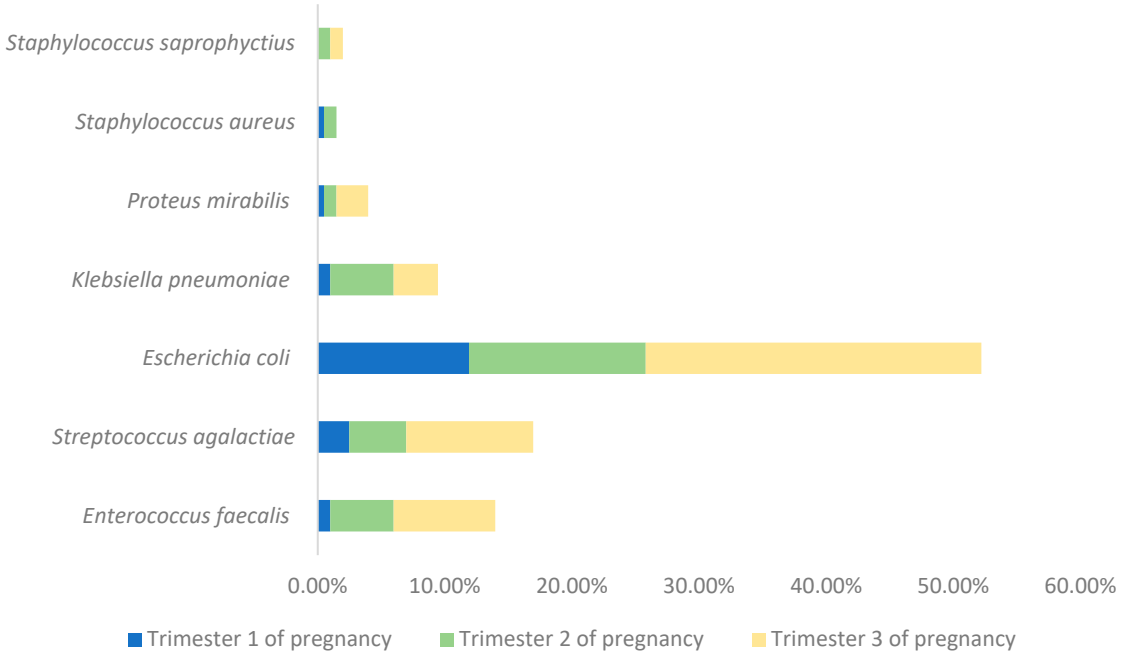

Figure 3. Distribution of the sample by identified bacteria and trimester of pregnancy.

We chose to carry out a detailed analysis of the interaction of the two most commonly isolated bacteria in our sample (*E. coli* and *S. agalactiae*) in relation to the antibiotics tested in the last year analyzed (2022). In Table 1, we check the percentage of strains resistant to antibiotics.

Table 1. Resistance of *E. coli* and *S. agalactiae* to antibiotics in 2022.

	E. coli	***S. agalactiae***
Amoxicillin/clavulanic acid	32.6%	
Cefuroxime axetil	18.2%	
Ceftazidime/avibactam	7.2%	
Nitrofurantoin	24.4%	
Trimethoprim/sulfamethoxazole	26.7%	0.0%
Ertapenem	0.0%	0.0%
Benzylpenicillin		0.0%
Methicillin		6.9%
Clotrimazole		0.0%
Vancomycin		67.4%
Imipenem		41.1%

4. Discussion

The data presented in this study offer potential insights into the prevalence and antimicrobial resistance patterns of urinary tract infections (UTIs) among pregnant women in a hospital in central Portugal. While these findings are region-specific, they reflect broader global issues related to UTI management during pregnancy, especially in the context of rising antimicrobial resistance and evolving demographic and clinical patterns.

4.1. Global Relevance of UTIs in Pregnant Women

UTIs are among the most common infectious complications during pregnancy, with significant implications for maternal and fetal health. Globally, the prevalence of UTIs ranges from 2% to 15%, depending on factors such as screening practices, public health conditions, and access to healthcare services [15]. A large study conducted across 10 U.S. sites found that one in six pregnant women reported experiencing a UTI during pregnancy [16]. The rate observed in this study (approximately 4% of pregnancies in the region) aligns with the literature for populations in developed countries, where screening and prenatal care access are widespread. However, in low- and middle-income countries, UTIs during pregnancy are often underdiagnosed, contributing to high rates of complications such as preterm birth, low birth weight, and neonatal mortality [17–19].

While the hormonal and anatomical changes during pregnancy universally increase the UTI risk, susceptibility is influenced by regional factors such as variations in microbiota, genetic predispositions, and healthcare practices [20–22]. The identification of *Escherichia coli* as the primary causative agent in this study aligns with global findings, although the positioning of other pathogens, such as *K. pneumoniae* and *E. faecalis*, demonstrates local variations that emphasize the need for regional studies [18].

4.2. Antimicrobial Resistance: An Emerging Challenge

One of the most critical findings of this study is the antimicrobial resistance among UTI pathogens, particularly *E. coli* and *S. agalactiae*. The resistance to amoxicillin/clavulanic acid in over 30% of cases is consistent with global trends of increasing resistance to widely used antibiotics [23–25]. For instance, studies in Latin America and Southeast Asia report similar rates, prompting restrictions on the use of amoxicillin in pregnant women and encouraging alternatives such as nitrofurantoin or second-generation cephalosporins, where available [26].

The high sensitivity of *E. coli* to ertapenem identified in this study indicates its efficacy as a last-resort treatment but also highlights the importance of judicious use to prevent development of resistance. This phenomenon has been documented in countries like India and South Africa, where inappropriate carbapenem use has led to alarming resistance rates [27,28]. These findings suggest the need for global policies that promote rational antibiotic use, particularly in vulnerable populations such as pregnant women.

The high resistance of *S. agalactiae* to vancomycin observed in this study (67%) is unusual compared to global rates, which generally remain below 20% [29]. This discrepancy may reflect regional peculiarities or specific prescribing practices that warrant further investigation. It could also be due to a cluster of related strains of *S. agalactiae*. This high resistance to vancomycin raises questions about the need for alternative therapies, such as beta-lactams and new antibiotic combinations, which could expand the arsenal of safe treatment options for pregnant women.

4.3. International Perspective: Monitoring and Preventive Interventions

Monitoring and early screening are widely recommended as key strategies to reduce the risks associated with UTIs in pregnancy. However, the implementation of such programs varies significantly between countries. In high-income countries, such as the United States and members of the European Union, guidelines frequently include universal screening for asymptomatic bacteriuria early in pregnancy, with a proven impact on reducing severe complications [19,29]. In contrast, low-income countries often face challenges in implementing systematic screening, resulting in high rates of complications and perinatal mortality [30,31].

The increase in UTIs during the third trimester, as identified in this study, reflects a globally observed trend, where urinary stasis due to uterine compression contributes to a heightened risk. A study from Nigeria reported peaks in infections during the third trimester [32], while another study from India showed that the highest rate was in the second trimester, followed by the third trimester [33], suggesting that targeted interventions, such as additional screenings and enhanced prophylaxis, could be particularly beneficial during these critical periods.

4.4. Impact on Healthcare and Clinical Guidelines

The findings of this study highlight the potential importance of clinical guidelines that balance antimicrobial efficacy with maternal–fetal safety. The use of antibiotics such as nitrofurantoin and fosfomycin, widely recommended in European and American guidelines, remains supported by their continued effectiveness against *E. coli*, even in the context of increasing resistance [34]. However, the use of alternatives in cases of resistance or contraindications, such as carbapenems or specific beta-lactam combinations, must be carefully evaluated due to safety and cost limitations.

Additionally, innovative approaches such as the use of probiotics to restore the vaginal and urinary microbiota have gained attention as complementary strategies to prevent recurrent UTIs during pregnancy. Clinical trials in Europe and Australia suggest that specific *Lactobacillus* strains can significantly reduce pathogen colonization, although more research is needed to validate their efficacy in pregnant populations [35].

4.5. The Role of Regional Studies in a Global Context

Although this study focuses on a specific region, it contributes to the global understanding of UTIs during pregnancy. Regional studies like this one might be important to inform locally relevant clinical practices while supporting global public health initiatives. Integrating regional data into international databases can help identify emerging trends of antimicrobial resistance and develop more effective global strategies.

In conclusion, the findings of this study highlight the need for continuous surveillance, adherence to evidence-based guidelines, and investment in future research to address the challenges of UTIs during pregnancy. A collaborative approach, combining regional and global efforts, is essential to improving maternal and neonatal outcomes and mitigating the impact of antimicrobial resistance.

5. Conclusions

This study highlights the prevalence and clinical significance of urinary tract infections (UTIs) among pregnant women in central Portugal, with *E. coli* identified as the primary pathogen, followed by *S. agalactiae*. The high levels of antibiotic resistance in this study, particularly in the third trimester, underscore the need for regular screening and antibiotic susceptibility testing as essential components of prenatal care to reduce maternal and fetal risks such as preeclampsia and preterm labor.

Regional data are crucial for shaping empiric antibiotic protocols and improving pregnancy outcomes. The geographic variability in bacterial prevalence and resistance patterns highlights the importance of localized healthcare approaches and regular region-specific data collection to inform evidence-based decisions and combat antibiotic resistance.

Finally, this study recommends continuous monitoring of resistance patterns throughout pregnancy and revising clinical protocols, including routine bacterial susceptibility testing and quarterly screening, during pregnancy to detect and treat asymptomatic bacteriuria early. Future research should examine risk factors like coexisting health conditions

(e.g., diabetes, obesity) and lifestyle factors (e.g., hydration, hygiene) to identify high-risk groups and tailor prevention and treatment strategies.

Author Contributions: Conceptualization, F.R. and M.C.B.; methodology, F.R.; software, P.C. and F.R.; validation, F.R., P.C., M.C.B. and S.M.; formal analysis, M.C.B., T.G. and H.E.; investigation, F.R. and A.C.; data curation, P.C. and S.M.; writing—preparation of the original draft, F.R. and P.C.; writing—review and editing, M.C.B., T.G. and S.M.; visualization, P.C., A.C. and H.E.; supervision, M.C.B.; project coordination, F.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This work was approved by the Ethics Committee and the Data Protection Officer of the University of Beira Interior, and all ethical precepts were scrupulously respected by the researchers. Informed consent was waived, given the retrospective nature and the fact that no user-identifying data were used.

Informed Consent Statement: Not applicable, as this was a data review.

Data Availability Statement: Data may be shared, in case of a duly justified request, considering the necessary protection.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Zhang, L.; Foxman, B. Molecular epidemiology of *Escherichia coli* mediated urinary tract infections. *Front. Biosci. J. Virtual Libr.* **2003**, *8*, e235–e244. [CrossRef] [PubMed]
2. Zare, M.; Vehreschild, M.J.G.T.; Wagenlehner, F. Management of uncomplicated recurrent urinary tract infections. *BJU Int.* **2022**, *129*, 668–678. [CrossRef] [PubMed]
3. Litza, J.A.; Brill, J.R. Urinary tract infections. *Prim. Care* **2010**, *37*, 491–507. [CrossRef] [PubMed]
4. Branco, M.C.; Coelho, P.; Rodrigues, F. Urinary Tract Infections in a Single Hospital in Central Portugal, a 5-Year Analysis. *Microbiol. Res.* **2024**, *15*, 850–863. [CrossRef]
5. Salh, K.K. Antimicrobial Resistance in Bacteria Causing Urinary Tract Infections. *Comb. Chem. High Throughput Screen.* **2022**, *25*, 1219–1229. [CrossRef]
6. Wojno, K.J.; Baunoch, D.; Luke, N.; Opel, M.; Korman, H.; Kelly, C.; Jafri SM, A.; Keating, P.; Hazelton, D.; Hindu, S.; et al. Multiplex PCR Based Urinary Tract Infection (UTI) Analysis Compared to Traditional Urine Culture in Identifying Significant Pathogens in Symptomatic Patients. *Urology* **2020**, *136*, 119–126. [CrossRef] [PubMed]
7. Rodrigues, F.; Barroso, A. Etiologia e sensibilidade bacteriana em infecções do trato urinário. *Rev. Port. Saúde Pública* **2011**, *29*, 123–131. [CrossRef]
8. Kalinderi, K.; Delkos, D.; Kalinderis, M.; Athanasiadis, A.; Kalogiannidis, I. Urinary tract infection during pregnancy: Current concepts on a common multifaceted problem. *J. Obstet. Gynaecol. J. Inst. Obstet. Gynaecol.* **2018**, *38*, 448–453. [CrossRef] [PubMed]
9. Vicar, E.K.; Acquah, S.E.K.; Wallana, W.; Kuugbee, E.D.; Osbutey, E.K.; Aidoo, A.; Acheampong, E.; Mensah, G.I. Urinary Tract Infection and Associated Factors among Pregnant Women Receiving Antenatal Care at a Primary Health Care Facility in the Northern Region of Ghana. *Int. J. Microbiol.* **2023**, *2023*, 3727265. [CrossRef]
10. Schnarr, J.; Smaill, F. Asymptomatic bacteriuria and symptomatic urinary tract infections in pregnancy. *Eur. J. Clin. Investig.* **2008**, *38* (Suppl. S2), 50–57. [CrossRef]
11. Glaser, A.P.; Schaeffer, A.J. Urinary Tract Infection and Bacteriuria in Pregnancy. *Urol. Clin. N. Am.* **2015**, *42*, 547–560. [CrossRef] [PubMed]
12. Macejko, A.M.; Schaeffer, A.J. Asymptomatic bacteriuria and symptomatic urinary tract infections during pregnancy. *Urol. Clin. N. Am.* **2007**, *34*, 35–42. [CrossRef]
13. Corrales, M.; Corrales-Acosta, E.; Corrales-Riveros, J.G. Which Antibiotic for Urinary Tract Infections in Pregnancy? A Literature Review of International Guidelines. *J. Clin. Med.* **2022**, *11*, 7226. [CrossRef] [PubMed]
14. Ovalle, A.; Levancini, M. Urinary tract infections in pregnancy. *Curr. Opin. Urol.* **2001**, *11*, 55–59. [CrossRef]
15. Sujatha, R.; Nawani, M. Prevalence of asymptomatic bacteriuria and its antibacterial susceptibility pattern among pregnant women attending the antenatal clinic at Kanpur, India. *J. Clin. Diagn. Res.* **2014**, *8*, DC01. [CrossRef] [PubMed]
16. Johnson, C.Y.; Rocheleau, C.M.; Howley, M.M.; Chiu, S.K.; Arnold, K.E.; Ailes, E.C. Characteristics of Women with Urinary Tract Infection in Pregnancy. *J. Women's Health* **2021**, *30*, 1556–1564. [CrossRef] [PubMed] [PubMed Central]

17. Fede, T.; Valente, S.; Bertasi, M. Evaluation of a prospective study on the urinary tract infections in pregnancy. *Clin. Exp. Obstet. Gynecol.* **1983**, *10*, 131–134. [PubMed]
18. Patil, G.; Patil, D.; Patil, A.; Shrikhande, S. Microbiological Profile and Antimicrobial Susceptibility Pattern of Uropathogens Isolated From Pregnant Women Attending a Tertiary Care Hospital in Central India. *Cureus* **2024**, *16*, e70798. [CrossRef] [PubMed] [PubMed Central]
19. Smaill, F.M.; Vazquez, J.C. Antibiotics for asymptomatic bacteriuria in pregnancy. *Cochrane Database Syst. Rev.* **2007**, CD000490. [CrossRef]
20. Kałuziak, P.; Parys, J.; Mikosińska, A.; Kaźmierczak, M.; Jajczak, M.; Mossakowski, M.; Witek, A.; Litwin, M.; Jesionek, S. Review of Urinary Tract Infections in Pregnancy: Risks, Complications and Management. *Qual. Sport* **2025**, *37*, 57277. [CrossRef]
21. Radu, V.D.; Vicoveanu, P.; Cărăuleanu, A.; Adam, A.M.; Melinte-Popescu, A.S.; Adam, G.; Onofrei, P.; Socolov, D.; Vasilache, I.A.; Harabor, A.; et al. Pregnancy Outcomes in Patients with Urosepsis and Uncomplicated Urinary Tract Infections-A Retrospective Study. *Medicina* **2023**, *59*, 2129. [CrossRef] [PubMed]
22. Ngong, I.N.; Fru-Cho, J.; Yung, M.A.; Akoachere, J.K.T. Prevalence, antimicrobial susceptibility pattern and associated risk factors for urinary tract infections in pregnant women attending ANC in some integrated health centers in the Buea Health District. *BMC Pregnancy Childbirth* **2021**, *21*, 673. [CrossRef]
23. McCowan, C.; Bakhshi, A.; McConnachie, A.; Malcolm, W.; Barry, S.J.; Santiago, V.H.; Leanord, A. *E. coli* bacteraemia and antimicrobial resistance following antimicrobial prescribing for urinary tract infection in the community. *BMC Infect. Dis.* **2022**, *22*, 805. [CrossRef] [PubMed]
24. Taghavi-Zahedkalaei, A.; Kazemi, M.; Zolfaghari, P.; Rashidan, M.; Sohrabi, M.B. Association Between Urinary Tract Infection in the First Trimester and Risk of Preeclampsia: A Case-Control Study. *Int. J. Women's Health* **2020**, *12*, 521–526. [CrossRef] [PubMed]
25. Rosana, Y.; Ocviyanti, D.; Halim, M.; Harlinda, F.Y.; Amran, R.; Akbar, W.; Billy, M.; Akhmad, S.R.P. Urinary Tract Infections among Indonesian Pregnant Women and Its Susceptibility Pattern. *Infect. Dis. Obstet. Gynecol.* **2020**, *2020*, 9681632. [CrossRef]
26. Mimica Matanovic, S.; Bergman, U.; Vukovic, D.; Wettermark, B.; Vlahovic-Palcevski, V. Impact of restricted amoxicillin/clavulanic acid use on Escherichia coli resistance--antibiotic DU90% profiles with bacterial resistance rates: A visual presentation. *Int. J. Antimicrob. Agents* **2010**, *36*, 369–373. [CrossRef]
27. Livermore, D.M.; Sefton, A.M.; Scott, G.M. Properties and potential of ertapenem. *J. Antimicrob. Chemother.* **2003**, *52*, 331–344. [CrossRef]
28. Wald-Dickler, N.; Lee, T.C.; Tangpraphaphorn, S.; Butler-Wu, S.M.; Wang, N.; Degener, T.; Kan, C.; Phillips, M.C.; Cho, E.; Canamar, C.; et al. Fosfomycin vs Ertapenem for Outpatient Treatment of Complicated Urinary Tract Infections: A Multicenter, Retrospective Cohort Study. *Open Forum Infect. Dis.* **2021**, *9*, ofab620. [CrossRef]
29. Gizachew, M.; Tiruneh, M.; Moges, F.; Tessema, B. *Streptococcus agalactiae* maternal colonization, antibiotic resistance and serotype profiles in Africa: A meta-analysis. *Ann. Clin. Microbiol. Antimicrob.* **2019**, *18*, 14. [CrossRef] [PubMed]
30. Halboup, A.; Al-Khazzan, A.; Battah, M.; Areqi, A.; Khamaj, F.; Al-Arifi, S. Urinary Tract Infections Management in the Developing Countries. In *Handbook of Medical and Health Sciences in Developing Countries*; Al-Worafi, Y.M., Ed.; Springer: Cham, Switzerland, 2023.
31. Lee, A.C.; Mullany, L.C.; Koffi, A.K.; Rafiqullah, I.; Khanam, R.; Folger, L.V.; Rahman, M.; Mitra, D.K.; Labrique, A.; Christian, P.; et al. Urinary tract infections in pregnancy in a rural population of Bangladesh: Population-based prevalence, risk factors, etiology, and antibiotic resistance. *BMC Pregnancy Childbirth* **2019**, *20*, 1. [CrossRef]
32. Oladeinde, B.H.; Omoregie, R.; Oladeinde, O.B. Asymptomatic urinary tract infection among pregnant women receiving ante-natal care in a traditional birth home in Benin City, Nigeria. *Ethiop. J. Health Sci.* **2015**, *25*, 3–8. [CrossRef] [PubMed]
33. Kerure, R.D.; Biradar, A.V.; Lakshetty, S.; Biradar, S. A study of urinary tract infection in pregnancy and its effect on maternal and perinatal outcome. *Int. J. Reprod. Contracept. Obstet. Gynecol.* **2024**, *13*, 284–289. [CrossRef]
34. Gupta, K.; Hooton, T.M.; Naber, K.G.; Wullt, B.; Colgan, R.; Miller, L.G.; Moran, G.J.; Nicolle, L.E.; Raz, R.; Schaeffer, A.J.; et al. International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 Update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clin. Infect. Dis.* **2011**, *52*, e103–e120. [CrossRef]
35. Barthow, C.; Wickens, K.; Stanley, T.; Mitchell, E.A.; Maude, R.; Abels, P.; Purdie, G.; Murphy, R.; Stone, P.; Kang, J.; et al. The Probiotics in Pregnancy Study (PiP Study): Rationale and design of a double-blind randomised controlled trial to improve maternal health during pregnancy and prevent infant eczema and allergy. *BMC Pregnancy Childbirth* **2016**, *16*, 133. [CrossRef]