Academia Open
Vol 9 No 1 (2024): June
DOI: 10.21070/acopen.9.2024.8928 . Article type: (Medicine)

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ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

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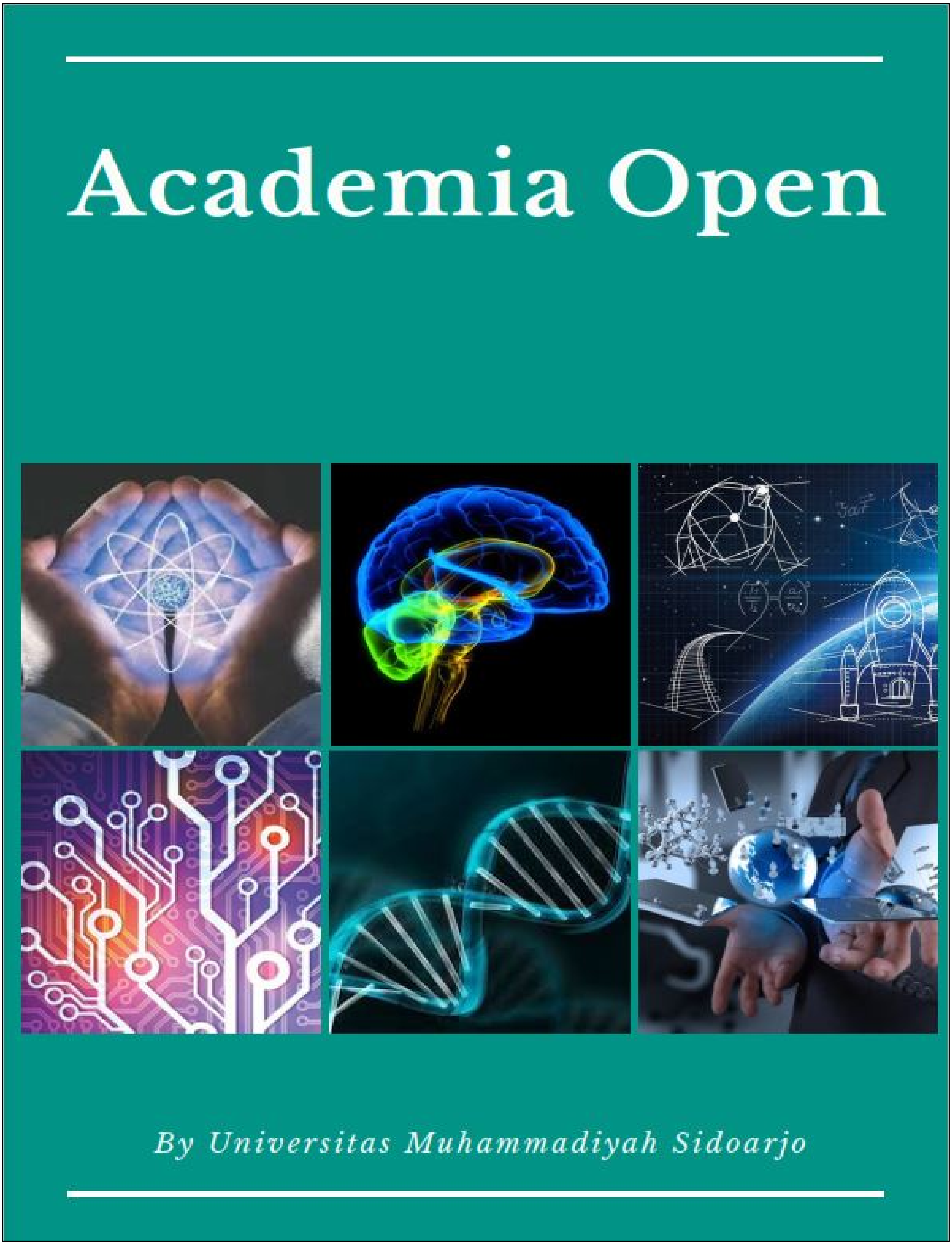

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ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

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Vol 9 No 1 (2024): June
DOI: 10.21070/acopen.9.2024.8928 . Article type: (Medicine)

Update About The Changes In Bacterial Resistance For Multiple Antibiotic In Patients With Urinary Tract Infection In Kerbala

Pembaruan Tentang Perubahan Resistensi Bakteri Untuk Beberapa Antibiotik Pada Pasien Infeksi Saluran Kemih Di Kerbala

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Abstract

Urinary tract infections (UTIs) caused by Escherichia coli (E. coli) are common and recurrent, particularly among females. Treatment often involves various antimicrobial agents, but rising resistance poses challenges. We conducted a study in Al-Hussein Medical City, Kerbala, enrolling 520 UTI patients from April 2022 to February 2023. Urine samples were tested for antimicrobial susceptibility. Results showed high resistance to most agents, except meropenem and levofloxacin. Our findings emphasize the urgent need for strategies to combat antimicrobial resistance in UTIs.

Highlights:

1. High resistance in UTI treatment observed.
2. Urgent need for antimicrobial resistance strategies.
3. Study reveals E. coli resistance patterns in Kerbala's medical setting.

Keywords: Urinary tract infections, Escherichia coli, Antimicrobial resistance, Al-Hussein Medical City, Kerbala

Published date: 2024-05-13 00:00:00

Introduction

Adult's urinary tract infections (UTIs) are among the most prevalent bacterial illnesses in human being (Oliveira and Mak 2020) . During the first year of life, both sexes are equally prevalent, but after that, they are more prevalent in females (A‘t Hoen, Bogaert et al. 2021). It is helpful to categorize UTIs into three groups: febrile upper UTI (acute pyelonephritis), lower UTI (cystitis), and asymptomatic bacteriuria. This is because it makes it easier to understand the pathophysiology of the illness (Flores-Mireles, Hreha et al. 2019). Depending on the population being investigated and whether the data being analyzed are from surveillance studies, registry data, or interventional research, where particular inclusion and exclusion criteria are employed for patient selection, antibiotic resistance rates might vary significantly. For instance, patients with uro-sepsis had greater rates of antibiotic resistance than those with less serious diseases (Yuan, Huang et al. 2021). Accordingly, depending on the patient group analyzed, the UTI entities included, and the study's primary objective, treatment results vary significantly between studies, ranging from 50% to practically 100% clearance of infection (Ganesh, Shrestha et al. 2019). Pyelonephritis and cUTIs have become popular infection models for the testing of novel antibiotics, and in-depth research of novel compounds active against Gram-ive bacteria has also become common (Atkins, Sallis et al. 2020).

Recently, UTI was shown to be more common in females than in males, with 62.2% and 37.8%, respectively, and 42.2% at age 30-49 years (Belete and Saravanan 2020). Escherichia coli (42.2%) was the most common microbe found in this investigation, followed by Enterobacter (8.9%), Pseudomonas and Klebsiella (6.7% each), Proteus spp and Serratia spp (4.4% each), and mixed culture (E. coli + Proteus and E. coli + Pseudomonas with 2.2% each) (Lewis and Gilbert 2020).

The use of quinolones for bacterial infection prevention resulted in an increase in infections caused by gram-positive bacteria (Larramendy, Deglaire et al. 2020). Second, the widespread use of third-generation cephalosporins resulted in a rise in enterococci infections. The most significant shift was a rise in the prevalence of MDR bacteria and XDR bacteria, which demonstrated that the prevalence of MDR organisms in their center was less than 10% at the end of the 1990s and climbed to 23% in 2012 (Shaikh, Lee et al. 2022). More recently, a big European multicenter investigation found that the prevalence of MDR microbes increased from 29% to 38% between 2011 and 2017-2018. A multicenter global investigation of over 1,300 patients with hepatic disorders revealed a 34% incidence of MDR microorganisms (Yazdi, Bouzari et al. 2020).

High percentages of isolates were resistant to amoxicillin-clavulanate (83%), ceftibuten (86%), nitrofurantoin (92%), and fosfomycin (90%), according to one investigation. However, 74% of the population was sensitive to levofloxacin, 78% to ciprofloxacin, and 66% to co-trimoxazole. Additionally, isolates showed a strong resistance to given antibiotics (a minimum of 67% for gentamicin). Similar results were obtained when just data from female participants were used, however there were not enough male participants to provide a comparable judgment (Albaramki, Abdelghani et al. 2019).

Method

The study was carried out in April 2022 lasting until March 2023, data were obtained from specialized laboratory in Al-Imam Al-Hussein Medical City in Kerbala. In this study, 520 female aged between 30-35 years old were enrolled randomly who were diagnosed to have UTI caused by E.coli intruders by utilizing general urinalysis and urine culture and sensitivity test. The patients have no history of taking antimicrobial or other agents interfere with results like diuretics of alkalinizing agent agent at least in the last 3 weeks, non-diabetics. The number of sensitive and resistant cases was calculated and analyzed statistically.

Results and Discussions

Result

The study demonstrate that many antimicrobial agents were out of coverage area of efficacy regarding treatment of UTI. Of these, vancomycin, trimethoprime, cephalosporins, and gentamicin were lacking the efficacy to treat E.coli infection of urinary system. Nitrofurantoin, amikacin, and ciprofluxaacin showed moderate significance (*p<0.05*) of efficacy while meropenem and levofuxacin have highest (*p<0.0001*) significant effectiveness to treat UTIs as shown in the tables below.

Results						
Vancomycin	Trimethoprim	Meropenem	Nitrofurantion	Ciprofloxacin	Row Totals	
Responding	153 (278.40)[56.48]	221 (278.40)[11.83]	413 (278.40)[65.08] ***	347 (278.40)[16.90]*	258 (278.40)[1.49]*	1392

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Non-responding	367 (241.60)[65.09]	299 (241.60)[13.64]	107 (241.60)[74.99]	173 (241.60)[19.48]	262 (241.60)[1.72]	1208
Column Totals	520	520	520	520	520	2600 (Grand Total)

Table 1. *show the statistical significance of efficacy for proposed drugs used for UTIs culture and sensitivity test.*

Results						
Levofloxacin	Gentamycin	Amikacin	cefuroxime	Cefotaxime	Row Totals	
Responding	401 (246.60)[96.67]***	154 (246.60)[34.77]	307 (246.60)[14.79]*	112 (246.60)[73.47]	259 (246.60)[0.62]	1233
Non-responding	119 (273.40)[87.20]	366 (273.40)[31.36]	213 (273.40)[13.34]	408 (273.40)[66.27]	261 (273.40)[0.56]	1367
Column Totals	520	520	520	520	520	2600 (Grand Total)

Table 2. *show the statistical significance of efficacy for proposed drugs used for UTIs culture and sensitivity test.*

**= significant*

****= highly significant*

Discussion

the prevalence rate of UTI in women was several times larger than males (women,65.37% and men, 34.63%) as it was calculated by various research (Folliero, Caputo et al. 2020). Enterobacteriaceae family bacteria are the most prevalent causes of UTIs; owing to the presence of these bacteria in the digestive system, a probable UTI may arise.. coli prevalence recorded 50%–80% in Asia (58% in Saudi Arabia, 70% in India, 75.3% in Turkey, 65.9% in South Korea, 74.8% in Bangladesh,, 60.29% in Africa, 90%–-60% in Europe (64.5% in Portugal and 85.9% in Russia90%–75% in the USA, and 76.6% in Brazil. E. coli in the present and mentioned research is the most prevalent pathogen causing UTIs (Gebremariam, Legese et al. 2019). In certain research, it was reported that high prescription rates for amikacin and penicillins (± β-lactamase inhibitors) and extended i.v. treatments were seen (Pachori, Gothalwal et al. 2019). Escherichia coli was extremely resistant to ampicillin, but third-generation cephalosporins displayed better in vitro effectiveness (Gajdács, Bátori et al. 2020). Establishment of antimicrobial stewardship schemes and frequent monitoring of antibiotic resistance might assist to prevent improper prescription for UTIs (Yelin, Snitser et al. 2019). On the other hand, other Some studies revealed that uropathogenic bacteria that cause urinary tract infections are highly resistant to antibiotics (Leitner, Ujmajuridze et al. 2021). The majority of these strains showed some resistance to amoxicillin (67%), co-trimoxazole (61%), nalidixic acid (81%), trimethoprim/sulfamethoxazole (83%), cephalexin (43%), gentamicin (49%), and ciprofloxacin (46%) (Samarasinghe, Reid et al. 2019). Finding new antibiotics may aid in the fight against MDR and XDR in bacteria; but, in cases where resistance is mediated by modifications in cell wall permeability, finding new antibiotics may not be enough to counteract widespread resistance (Uruén, Chopo-Escuin et al. 2020). There are several processes attributed to the emergence of antibiotic-resistant microorganisms. In terms of the virulence factors, it was noted in a global study that both those secreted and exported to the site of action and those linked to the surface cell of E. coli were present (Bunduki, Heinz et al. 2021). When virulence factors were categorized based on their modes of action, immune suppressors accounted for 54.1% (874/1615) of the total, followed by adhesins (2316/5048), siderophore systems (647/1549), and toxins (19.9% (529/2664) (Dong, Abbas et al. 2019). When considered separately, the most common virulence factors from the adhesins group were: the capsular polysaccharide K antigen (kpsMTII) in 60.6% (120/198, 95% CI: 0.54–0.67), the cell surface hydrophobicity (CSH) in 80% (120/150, 95% CI: 0.73–0.86), the fimbrial and afimbrial adhesins: fimH/MSHA in 75.3% (881/1170, 95% CI: 0.73–0.78), fimP/MRHA in 35.6% (219/616, 95% CI: 0.32–0.39), the serum resistance coded by the gene traT in 75.1% (266/354, 95% CI: 0.70–0.79), and pap in 30.2% (350/1158, 95% CI: 0.28–0.33). In 92.1% (209/227, 95% CI: 0.88–0.95) of the immune suppressors, sisA was found in 72.2% (164/227, 95% CI: 0.66–0.78), sisB in 24.7% (56/227, 95% CI: 0.19–0.31), and PAI in 55.2% (265/480, 95% CI: 0.51–0.60) of the immune suppressors (Katongole, Nalubega et al. 2020). Toxins and siderophore molecules served as examples of the secreted virulence factors that were transported to the infection site (Elshamy and Aboshanab 2020). Haemolysin (hlyA) accounted for 22.1% (334/1511, 95% CI: 0.20–0.24) of the detected toxins, followed by secreted autotransporter toxin (sat) at 26.2% (28/107, 95% CI: 0.19–0.35) and cytotoxic necrotizing factor-1 (cnf-1) at 13.3% (91/682, 95% CI: 0.11–0.16). The aerobactin system, which included the outer membrane proteins genes iucD in 65.7% (95% CI: 0.59–0.72), iutA in 61.8% (0.55–0.68), the aerobactin (aer) in 52.4% (130/198, 95% CI: 0.48–0.57), and the heme receptor genes (chuA) in 20.3% (46/227, 95% CI: 0.16–0.26), was the most commonly observed system for siderophores (Laxminarayan, Van Boeckel et al. 2020).

Conclusion

In conclusion, this study highlights the significant prevalence of urinary tract infections (UTIs) caused by Escherichia coli (E. coli) and the alarming rates of antimicrobial resistance observed in this context, particularly

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

against commonly used antibiotics such as ampicillin, co-trimoxazole, and ciprofloxacin. The study underscores the urgent need for antimicrobial stewardship initiatives to guide appropriate antibiotic prescribing practices and curb the emergence of multidrug-resistant strains. Additionally, it emphasizes the importance of continued surveillance of resistance patterns and the development of novel therapeutic strategies to combat the growing threat of antibiotic resistance in UTIs. Further research is warranted to explore alternative treatment options, including the investigation of new antibiotics and the elucidation of mechanisms underlying bacterial virulence and resistance, to address this pressing public health concern effectively.

References

1. A. ‘t Hoen et al., "Update of the EAU/ESPU guidelines on urinary tract infections in children," J. Pediatr. Urol., vol. 17, no. 2, pp. 200-207, 2021.
2. J. H. Albaramki et al., "Urinary tract infection caused by extended-spectrum β-lactamase-producing bacteria: Risk factors and antibiotic resistance," Pediatrics Int., vol. 61, no. 11, pp. 1127-1132, 2019.
3. L. Atkins et al., "Reducing catheter-associated urinary tract infections: A systematic review of barriers and facilitators and strategic behavioural analysis of interventions," Implementation Sci., vol. 15, pp. 1-22, 2020.
4. M. A. Belete and M. Saravanan, "A systematic review on drug resistant urinary tract infection among pregnant women in developing countries in Africa and Asia; 2005–2016," Infect. Drug Resist., vol. 13, pp. 1465-1477, 2020.
5. G. K. Bunduki et al., "Virulence factors and antimicrobial resistance of uropathogenic Escherichia coli (UPEC) isolated from urinary tract infections: A systematic review and meta-analysis," BMC Infect. Dis., vol. 21, pp. 1-13, 2021.
6. Z. Dong et al., "Biological functions and molecular mechanisms of antibiotic tigecycline in the treatment of cancers," Int. J. Mol. Sci., vol. 20, no. 14, pp. 3577, 2019.
7. A. A. Elshamy and K. M. Aboshanab, "A review on bacterial resistance to carbapenems: Epidemiology, detection and treatment options," Future Sci. OA, vol. 6, no. 3, pp. FSO438, 2020.
8. A. Flores-Mireles et al., "Pathophysiology, treatment, and prevention of catheter-associated urinary tract infection," Top. Spinal Cord Injury Rehabil., vol. 25, no. 3, pp. 228-240, 2019.
9. V. Folliero et al., "Prevalence and antimicrobial susceptibility patterns of bacterial pathogens in urinary tract infections in University Hospital of Campania 'Luigi Vanvitelli' between 2017 and 2018," Antibiotics, vol. 9, no. 5, pp. 215, 2020.
10. M. Gajdács et al., "Characterization of resistance in gram-negative urinary isolates using existing and novel indicators of clinical relevance: A 10-year data analysis," Life, vol. 10, no. 2, pp. 16, 2020.
11. R. Ganesh et al., "Epidemiology of urinary tract infection and antimicrobial resistance in a pediatric hospital in Nepal," BMC Infect. Dis., vol. 19, no. 1, pp. 1-5, 2019.
12. G. Gebremariam et al., "Bacteriological profile, risk factors and antimicrobial susceptibility patterns of symptomatic urinary tract infection among students of Mekelle University, northern Ethiopia," BMC Infect. Dis., vol. 19, pp. 1-11, 2019.
13. P. Katongole et al., "Biofilm formation, antimicrobial susceptibility and virulence genes of Uropathogenic Escherichia coli isolated from clinical isolates in Uganda," BMC Infect. Dis., vol. 20, no. 1, pp. 1-6, 2020.
14. S. Larramendy et al., "Risk factors of extended-spectrum beta-lactamases-producing Escherichia coli community acquired urinary tract infections: A systematic review," Infect. Drug Resist., vol. 12, pp. 3945-3955, 2020.
15. R. Laxminarayan et al., "The Lancet Infectious Diseases Commission on antimicrobial resistance: 6 years later," Lancet Infect. Dis., vol. 20, no. 4, pp. e51-e60, 2020.
16. L. Leitner et al., "Intravesical bacteriophages for treating urinary tract infections in patients undergoing transurethral resection of the prostate: A randomised, placebo-controlled, double-blind clinical trial," Lancet Infect. Dis., vol. 21, no. 3, pp. 427-436, 2021.
17. A. L. Lewis and N. M. Gilbert, "Roles of the vagina and the vaginal microbiota in urinary tract infection: Evidence from clinical correlations and experimental models," GMS Infect. Dis., vol. 8, pp. 1-8, 2020.
18. E. A. Oliveira and R. H. Mak, "Urinary tract infection in pediatrics: An overview," Jorn. Pediatr., vol. 96, pp. 65-79, 2020.
19. P. Pachori et al., "Emergence of antibiotic resistance Pseudomonas aeruginosa in intensive care unit; a critical review," Genes Dis., vol. 6, no. 2, pp. 109-119, 2019.
20. S. Samarasinghe et al., "The anti-virulence effect of cranberry active compound proanthocyanins (PACs) on expression of genes in the third-generation cephalosporin-resistant Escherichia coli CTX-M-15 associated with urinary tract infection," Antimicrob. Resist. Infect. Control, vol. 8, no. 1, pp. 1-9, 2019.
21. N. Shaikh et al., "Reassessment of the role of race in calculating the risk for urinary tract infection: A systematic review and meta-analysis," JAMA Pediatr., vol. 176, no. 6, pp. 569-575, 2022.
22. C. Uruén et al., "Biofilms as promoters of bacterial antibiotic resistance and tolerance," Antibiotics, vol. 10, no. 1, pp. 3, 2021.
23. M. Yazdi et al., "Isolation, characterization and genomic analysis of a novel bacteriophage VB_EcoS-Golestan infecting multidrug-resistant Escherichia coli isolated from urinary tract infection," Sci. Rep., vol. 10, no. 1, pp. 7690, 2020.
24. I. Yelin et al., "Personal clinical history predicts antibiotic resistance of urinary tract infections," Nat. Med., vol. 25, no. 7, pp. 1143-1152, 2019.

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25. F. Yuan et al., "Pathogenesis of Proteus mirabilis in catheter-associated urinary tract infections," Urol. Int., vol. 105, no. 5-6, pp. 354- , 2021.