https://doi.org/10.48047/AFJBS.7.1.2025.763-775

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Antibiogram and Bacteriological Profile of Urinary Tract Infections at University Health Centre, Tarnaka and Astra Hospital, Hyderabad

Habib Rahman Hamdard[1] *Waheed Ullah Hafiz[2]

1. Lecturer Paraclinic, Department, Faculty of Medicine, Bayazid Rokhan Institute of Higher Education, Kabul
2. Lecturer Basic Science Department, Faculty of Medicine, Bayazid Rokhan Institute of Higher Education, Kabul

Corresponding Author: Waheed Ullah Hafiz

- Lecturer Basic Science Department, Faculty of Medicine, Bayazid Rokhan Institute of Higher Education, Kabul
- Email: hafizwaheedullah@gmail.com
- Phone: +93781646991

Volume 7, Issue 1, Jan 2025

Received: 15 Nov 2024

Accepted: 25 Dec 2024

Published: 05 Jan 2025

doi:10.48047/AFJBS.7.1.2025.763-775

Abstract

Urinary tract infections (UTIs) are among the most common bacterial infections, often complicated by the rising issue of antibiotic resistance, which limits treatment options and poses significant public health challenges. This study aimed to evaluate the antibiotic resistance and sensitivity profiles of the most common uropathogens in the University Health Centre, Tarnaka and Astra Hospital, Hyderabad, Telangana, South India. A total of 80 urine samples were collected from UTI patients, and the isolates were tested for resistance to five antibiotics: Amoxicillin, Gentamicin, Norfloxacin, Ofloxacin, and Streptomycin, using the Kirby-Bauer disc diffusion method. The antibiotic sensitivity and resistance profile of bacterial pathogens revealed varied responses. *E. coli* showed high sensitivity to Gentamicin, Ofloxacin, and Streptomycin, with 35 isolates sensitive to each, while 12 were resistant to Amoxicillin. *Klebsiella* demonstrated sensitivity primarily to Gentamicin (15) and Ofloxacin (15) but exhibited resistance to Amoxicillin (11). *Proteus* and *Pseudomonas* showed low sensitivity and resistance overall, with Proteus having minimal resistance to Amoxicillin (2) and Pseudomonas exhibiting moderate sensitivity to Gentamicin (8). These findings highlight the potential efficacy of Gentamicin and Ofloxacin against multiple pathogens and underscore the importance of antibiotic susceptibility testing to guide treatment strategies.

Key Words: *Antibiogram, Urinary Tract Infections, Antibiotic Susceptibility, E. coli, UTI Pathogens*

Introduction

Urinary tract infections (UTIs) are one of the most common bacterial infections globally, impacting both men and women across all age groups, though women are particularly vulnerable due to anatomical and physiological differences (1, 2). Women's increased susceptibility is attributed to a shorter urethra and its proximity to the anus, allowing easier access for pathogenic bacteria such as *Escherichia coli* from the perineal and gastrointestinal regions to invade the urinary tract (3). In women, *E. coli* is responsible for approximately 80-85% of UTIs, followed by other uropathogens, including *Klebsiella*, *Proteus*, and *Staphylococcus saprophyticus* (4). UTIs are typically classified based on the infection site: lower UTIs (e.g., cystitis and urethritis) affect the bladder and urethra, while upper UTIs (e.g., pyelonephritis) involve the kidneys and ureters, which can lead to serious complications if untreated (5, 6).

Diagnosis of UTIs in clinical practice often begins with symptom evaluation, especially in young women, for whom symptoms of dysuria, frequency, and urgency strongly indicate a lower UTI (7). While laboratory cultures are the gold standard for definitive diagnosis, urine dipsticks detecting leukocyte esterase and nitrites are commonly used for quick screening (8, 9). In complex or recurrent cases, urinalysis and urine culture are critical for identifying specific pathogens and antibiotic susceptibility, as empirical treatment may contribute to the rise of antibiotic-resistant bacteria, particularly *E. coli* (10).

The prevalence and incidence of UTIs vary with age, gender, and other factors such as sexual activity, pregnancy, and underlying anatomical abnormalities. For example, UTIs are common in sexually active young women and in postmenopausal women due to estrogen deficiency, which leads to changes in vaginal flora (11). During pregnancy, UTIs are particularly concerning as

they are linked to adverse maternal and fetal outcomes, such as preterm labor and low birth weight, underscoring the need for proactive screening and treatment (12, 13). Men, although less frequently affected, may develop UTIs due to structural abnormalities or prostate-related issues, particularly as they age (14, 15).

Recurrent UTIs are a significant problem, affecting up to 25% of women after an initial infection. These recurrent infections are often due to reinfection by the same or different bacterial strains, highlighting the importance of accurate diagnosis and long-term management strategies (16, 17). Pathogens responsible for UTIs employ specific virulence factors, such as fimbriae, which enhance their ability to adhere to the urothelial lining and evade the host immune response, allowing persistence and recurrence (18). These mechanisms are especially prominent in uropathogenic *E. coli* (UPEC), which harbors genes that facilitate adherence, invasion, and survival in the urinary tract (19, 20).

UTIs pose a substantial economic burden, accounting for significant healthcare costs annually. In the United States alone, UTI-related healthcare costs are estimated at over $3 billion each year (21). Moreover, due to rising antibiotic resistance, treatment has become increasingly challenging, necessitating research into new diagnostic and therapeutic approaches (22, 23). The high rate of antibiotic prescriptions for UTIs has led to increasing resistance, particularly against commonly used antibiotics like trimethoprim-sulfamethoxazole, prompting recommendations for alternative treatments such as nitrofurantoin and fosfomycin (24, 25).Hence, the present study was undertaken to isolate and identify the causative pathogens of urinary tract infections (UTIs), assess their antibiotic susceptibility patterns among the isolated organisms in the hospital.

METHODOLOGY

This study was conducted at University Health Centre, Tarnaka and Astra Hospital, Hyderabad, Telangana, South India for a time period of 4 months, from April to July 2016. A total of 80 urine samples were collected from patients with UTI as recommended by the general practitioner. We processed all the samples in the lab. As per the standard protocols in the laboratory, isolation and identification of organisms was done. Kirby-Bauer disc diffusion method was used to do antibiotic sensitivity test.

Results

Among 80 samples 60 of females, 10 of Males and 10 of children patients were screened. After checked the bacterial growth of all samples, 40 of Females, 10 of Male and 10 of Children were positive of urinary tract (Figure: 1).

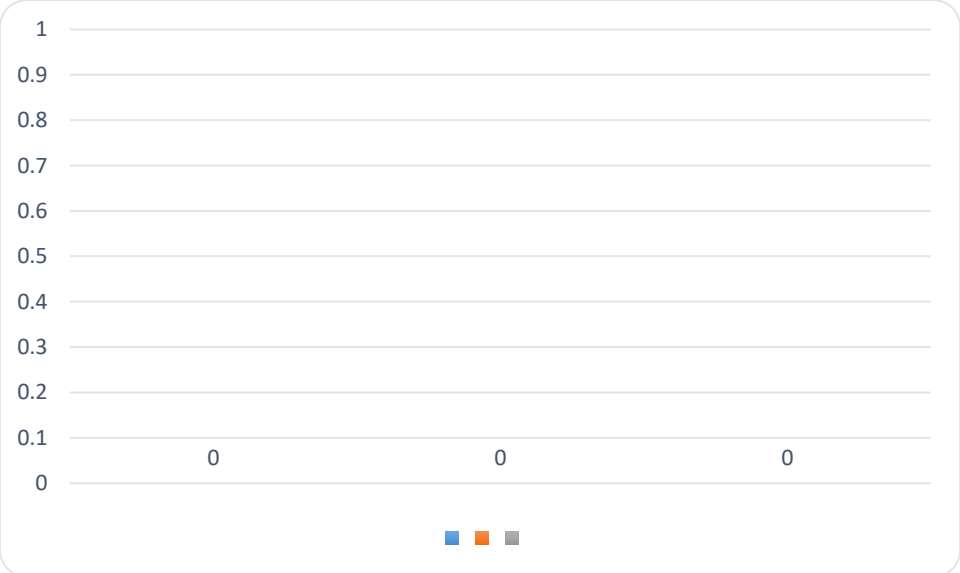

Figure 1 Bacteria isolated from adults and children

As shown in both Table 1 and Figure 2, the distribution of urinary tract infection (UTI) pathogens highlights *Escherichia coli* (*E. coli*) as the most prevalent isolate, identified in 35 samples, which accounts for 58.33% of cases. This high percentage underlines *E. coli*'s well-established role as the primary causative agent of UTIs. *Klebsiella* ranks second, appearing in 15 samples, representing 25% of isolates, indicating it's significant, albeit lesser, association with UTIs. *Pseudomonas* and *Proteus* were detected in 7 and 3 samples, respectively, corresponding to 11.67% and 5% of cases. These lower frequencies suggest a lesser prevalence, yet both pathogens remain clinically relevant, particularly due to *Pseudomonas*'s association with antibiotic resistance in some cases.

Table 1: Frequency Distribution of UTI Pathogens Based on Morphological and Biochemical Tests

Bacteria	***Frequency***	***Gram Stain***	***Percentage***
E. coli	35	Gram Negative	58.33
Klebsiella	15	Gram Negative	25.0
Pseudomonas	7	Gram Negative	11.67
Proteus	3	Gram Negative	5.0

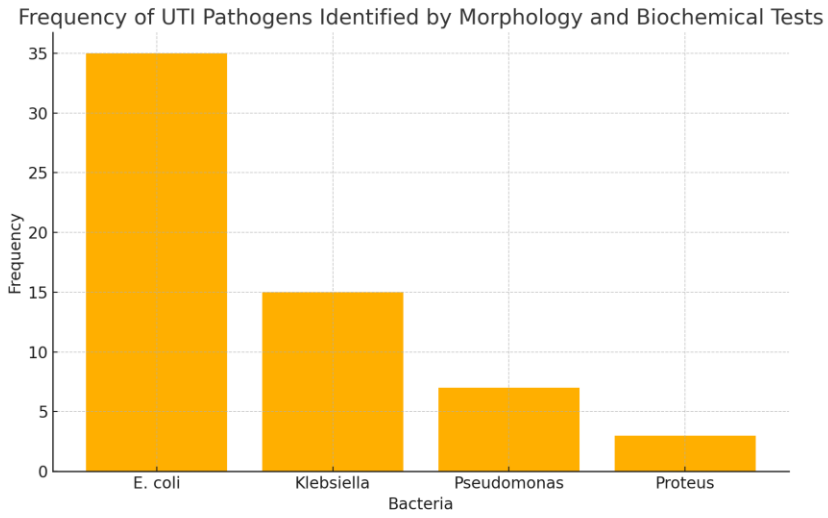

Figure 2: Frequency of UTI Pathogens in Isolated Samples

Table 2 presents the antibiotic resistance and sensitivity profiles of five bacterial pathogens commonly associated with urinary tract infections (UTIs). The table details the resistance (R) and sensitivity (S) of each pathogen to Amoxicillin, Gentamicin, Norfloxacin, Ofloxacin, and Streptomycin, with numbers indicating the frequency of either resistance or sensitivity. Out of 35 samples of **E. coli,** shows resistance to **Amoxicillin** (12) while being sensitive to **Gentamicin** (23), and **Klebsiella** is resistant to **Amoxicillin** (11) but sensitive to **Norfloxacin** (14).

Table 2: Antibiotic Sensitivity and Resistance Profile of Bacterial Pathogens

	Amoxicillin		***Gentamicin***		***Norfloxacin***		***Ofloxacin***		***Streptomycin***	
Bacteria	R	S	R	S	R	S	R	S	R	S
E. coli	12	23	0	35	8	27	0	35	0	35
Klebsiella	11	4	0	15	2	13	0	15	0	15
Proteus	2	1	0	3	2	1	0	3	0	3
Pseudomonas	5	3	0	8	3	5	0	8	0	8

Figure 3 illustrates the resistance profiles of various bacterial pathogens commonly found in urinary tract infections (UTIs) against five antibiotics: Amoxicillin, Gentamicin, Norfloxacin, Ofloxacin, and Streptomycin. Each antibiotic is represented by a unique color, and only resistant frequencies are shown for a focused view on resistance patterns.

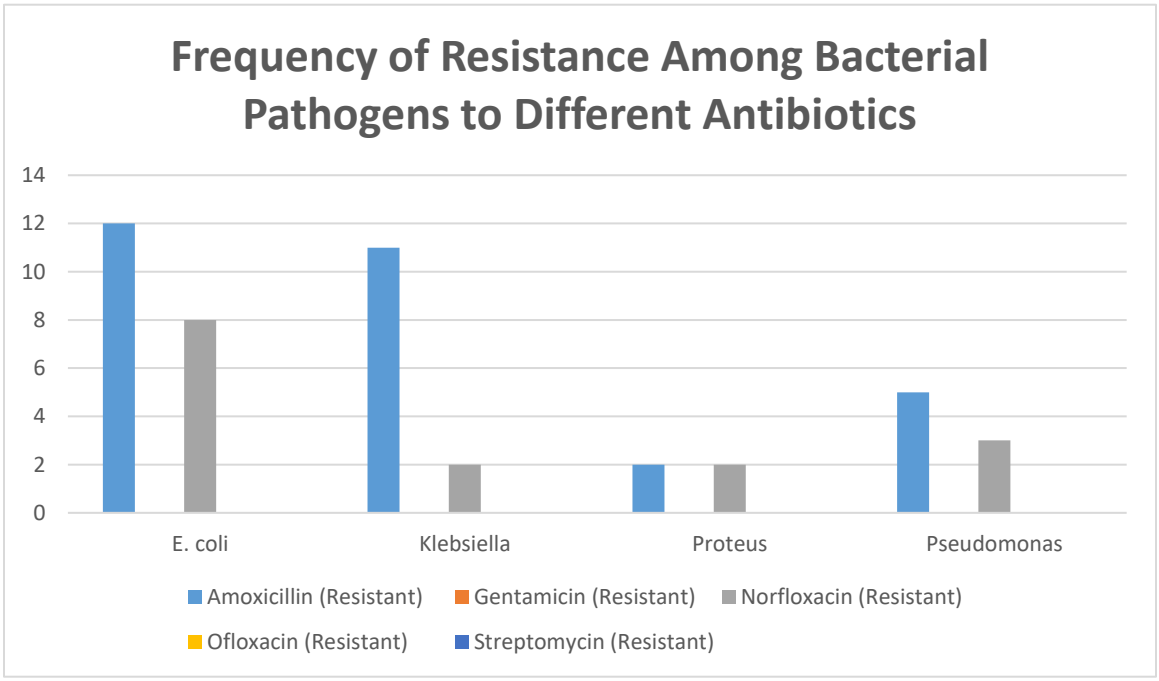

Figure 3 Frequency of Resistance among Bacterial Pathogens to Different Antibiotic

Discussion

The prevalence of urinary tract infections (UTIs) among different demographic groups at the University Health Centre, Tarnaka, OU, reflects patterns observed globally. In this study, 40% of female samples tested positive for UTI symptoms, in contrast to 10% in males, with no positive cases in children aged 3–13 years. This gender-based discrepancy is consistent with previous research indicating that adult women have a higher susceptibility to UTIs due to physiological, lifestyle, and hygiene-related factors, including sexual activity (1).

Comparative studies worldwide show prevalence rates similar to ours, though regional differences exist based on environmental and social factors. For instance, prevalence rates of 11.6% were reported in Addis Ababa, Ethiopia (26), 16.4% in Northern Tanzania 14.6% in Mwanza, Tanzania (27), and 14.0% at Khartoum North Hospital, Sudan (Hassan et al. 2011). The higher prevalence rate observed in our study, 66.7% among symptomatic female patients, may stem from the selection of women presenting with lower abdominal pain, a typical UTI symptom (28).

This study also highlights that Gram-negative bacteria, predominantly *Escherichia coli*, were the primary pathogens isolated, consistent with other UTI studies. *E. coli* is a common causative agent due to its location near the vaginal and rectal areas; anatomical and functional aspects make women especially vulnerable to UTIs from this pathogen (29). Notably, we did not isolate Gram-positive bacteria, although some studies report *Staphylococcus aureus* in UTIs, albeit at lower frequencies (30). Such variation may result from differences in study settings, patient populations, and hygiene practices, underscoring the importance of understanding local microbial profiles for effective UTI management.

Our findings on the antibiotic susceptibility patterns in Gram-negative isolates indicated high sensitivity to gentamycin, ofloxacin, and streptomycin, suggesting these as viable treatment options. This observation aligns with global concerns about rising antibiotic resistance, with resistance patterns varying significantly across different regions (31). Ensuring the efficacy of these antibiotics is critical for empiric treatment strategies, given the reliance on antibiotics for UTI management. Regular monitoring of local susceptibility patterns is essential to guide effective treatment (32).

In addition to gender, this study identifies pregnancy and age as critical risk factors for UTIs. Physiological changes during pregnancy, such as hormonal fluctuations, increase the likelihood of bacterial colonization, posing risks to both maternal and fetal health (33). Elderly populations are similarly prone to UTIs, especially those with urinary catheters or other devices. Studies indicate that catheter use, prolonged hospitalization, and conditions like diabetes heighten UTI risk due to immune alterations and bacterial colonization in hyperglycemic conditions (34).

Non-antibiotic interventions, such as cranberry juice and probiotics, are gaining popularity as effective UTI preventive measures. Cranberry juice has compounds that hinder bacterial adherence to the urinary tract, thereby reducing infection risk (35). Probiotics also aid in maintaining healthy microbial flora, offering a natural alternative to antibiotics, which can be particularly useful given the rising concern over antibiotic resistance.

Conclusion

In conclusion, our study confirms a higher prevalence of UTIs among women and highlights the need for tailored prevention and management strategies. These findings highlight the potential efficacy of Gentamicin and Ofloxacin against multiple pathogens and underscore the importance of antibiotic susceptibility testing to guide treatment strategies. Our findings align with international research, emphasizing the importance of demographic considerations, localized susceptibility testing, and alternative treatments to effectively manage UTIs and mitigate antibiotic resistance.

References

1. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. Am J Med. 2002; 113(Suppl 1A):5S-13S.
2. Stamm WE, Norrby SR. Urinary tract infections: disease panorama and challenges. J Infect Dis. 2001;183(Suppl 1)
3. Nicolle LE. Urinary tract infections in special populations: diabetes, renal transplant, HIV infection, and spinal cord injury. Infect Dis Clin North Am. 2014; 28(1):91-104.
4. Kline KA, Lewis AL. Gram-positive uropathogens, polymicrobial urinary tract infection, and the emerging microbiota of the urinary tract. Microbiol Spectr. 2016;4(2)
5. Dielubanza EJ, Schaeffer AJ. Urinary tract infections in women. Med Clin North Am. 2011; 95(1):27-41.
6. Foxman B, Brown P. Epidemiology of urinary tract infections: transmission and risk factors, incidence, and costs. Infect Dis Clin North Am. 2003; 17(2):227-41.

7. Hooton TM. Clinical practice: uncomplicated urinary tract infection. N Engl J Med. 2012; 366(11):1028-37.
8. Simerville JA, Maxted WC, Pahira JJ. Urinalysis: a comprehensive review. Am Fam Physician. 2005; 71(6):1153-62.
9. Nicolle LE. Asymptomatic bacteriuria: when to screen and when to treat. Infect Dis Clin North Am. 2003; 17(2):367-94.
10. Gupta K, Hooton TM, Naber KG, Wullt B, Colgan R, Miller LG, 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(5)
11. Raz R, Stamm WE. A controlled trial of intravaginal estriol in postmenopausal women with recurrent urinary tract infections. N Engl J Med. 1993; 329(11):753-6.
12. Delzell JE Jr, Lefevre ML. Urinary tract infections during pregnancy. Am Fam Physician. 2000; 61(3):713-21.
13. Schieve LA, Handler A, Hershow R, Persky V, Davis F. Urinary tract infection during pregnancy: its association with maternal morbidity and perinatal outcome. Am J Public Health. 1994; 84(3):405-10.
14. Nicolle LE. The chronic indwelling catheter and urinary infection in long-term–care facility residents. Infect Control Hosp Epidemiol. 2001; 22(5):316-21.
15. Dason S, Dason JT, Kapoor A. Guidelines for the diagnosis and management of recurrent urinary tract infection in women. Can Urol Assoc J. 2011; 5(5):316-22.

16. Hooton TM, Stamm WE. Diagnosis and treatment of uncomplicated urinary tract infection. Infect Dis Clin North Am. 1997; 11(3):551-81.
17. Scholes D, Hooton TM, Roberts PL, Stapleton AE, Gupta K, Stamm WE. Risk factors for recurrent urinary tract infection in young women. J Infect Dis. 2000; 182(4):1177-82.
18. Mulvey MA, Schilling JD, Hultgren SJ. Establishment of a persistent Escherichia coli reservoir during the acute phase of a bladder infection. Infect Immun. 2001; 69(7):4572-9.
19. Donnenberg MS, Welch RA. Virulence determinants of uropathogenic Escherichia coli. In: Mobley HL, Warren JW, editors. Urinary Tract Infections: Molecular Pathogenesis and Clinical Management. ASM Press; 1996. p. 135–74.
20. Wullt B. The role of P fimbriae for persistence of Escherichia coli in the human urinary tract. Int J Antimicrob Agents. 2003; 21(6):605-21.
21. Foxman B, Gillespie B, Koopman J, Zhang L, Palin K, Tallman P, et al. Risk factors for second urinary tract infection among college women. Am J Epidemiol. 2000; 151(12):1194-205.
22. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nat Rev Microbiol. 2015; 13(5):269-84.
23. Stamm WE. Scientific and clinical challenges in the management of urinary tract infections. Am J Med. 2002; 113(Suppl 1A):1S-4S.
24. Kahlmeter G. An international survey of the antimicrobial susceptibility of pathogens from uncomplicated urinary tract infections: the ECO.SENS Project. J Antimicrob Chemother. 2003; 51(1):69-76.

25. Gupta K, Scholes D, Stamm WE. Increasing prevalence of antimicrobial resistance among uropathogens causing acute uncomplicated cystitis in women. JAMA. 1999; 281(8):736-8.

26. Assefa, A., Asrat, D., Woldeamanuel, Y., & Wondemagegnehu, T. (2008). Prevalence of UTI in Addis Ababa, Ethiopia. *Ethiopian Medical Journal*, 46(3), 239-245.
27. Masinde, A., Gumodoka, B., Kilonzo, A., & Mshana, S. E. (2009). Urinary tract infection among pregnant women at Bugando Medical Centre, Mwanza, Tanzania. *Tanzania Journal of Health Research*, 11(3), 154-159.
28. Stamm, W. E., & Hooton, T. M. (1993). Management of urinary tract infections in adults. *New England Journal of Medicine*, 329(18), 1328-1334.
29. Manges AR, Tabor H, Tellis P, Vincent C, Tellier PP. Endemic and epidemic lineages of Escherichia coli that cause urinary tract infections. Emerg Infect Dis. 2008 Oct; 14(10):1575-83. doi: 10.3201/eid1410.080102. PMID: 18826822; PMCID: PMC2609861
30. Ronald, A. (2003). The etiology of urinary tract infection: Traditional and emerging pathogens. *Disease-a-Month*, 49(2), 71-82.
31. Gupta, K., Hooton, T. M., Naber, K. G., Wullt, B., Colgan, R., Miller, L. G., & Soper, D. E. (2011). 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. *Clinical Infectious Diseases*, 52(5), e103-e120.
32. Nicolle, L. E. (2005). Complicated urinary tract infection in adults. *Canadian Journal of Infectious Diseases and Medical Microbiology*, 16(6), 349-360.
33. Gilstrap, L. C., & Ramin, S. M. (2001). Urinary tract infections during pregnancy. *Obstetrics and Gynecology Clinics of North America*, 28(3), 581-591
34. Geerlings, S. E., Stolk, R. P., Camps, M. J. L., Netten, P. M., Collet, T. J., & Hoepelman, A. I. (2001). Risk factors for symptomatic urinary tract infection in women with diabetes. *Diabetes Care*, 24(10), 1731-1737
35. Howell, A. B., Reed, J. D., Krueger, C. G., Winterbottom, R., Cunningham, D. G., & Leahy, M. (2005). A-type cranberry proanthocyanidins and uropathogenic bacterial anti-adhesion activity. *Phytochemistry*, 66(18), 2281-2291.