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Review

Evidence-Based Management of Recurrent UTIs: From Diagnosis to Prevention

Shefali Sengar[a], Swati Prakash[a], Shradha Bisht[b], Vishakha Jaiswal[*a]

[a]*Amity Institute of Pharmacy, Amity University Uttar Pradesh, Lucknow Campus, Uttar Pradesh, India-226028.*

[b] *College of Pharmacy, Shivalik Campus, Dehradun, Uttarakhand, India-248197.*

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Corresponding Author: Dr. Vishakha Jaiswal
Email: vishakhajaiswal216@gmail.com
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ABSTRACT

Recurrent urinary tract infections (UTIs) result from a complex interaction between bacterial virulence and host factors, making effective diagnosis and treatment crucial. Cultures are essential for confirming recurrent UTIs, allowing for accurate diagnosis and the monitoring of antibiotic resistance patterns, which benefits both the individual patient and the broader community. Initial therapy for acute infections should follow the guidelines established by the Infectious Diseases Society of America (IDSA), considering regional antimicrobial resistance patterns to ensure effective treatment. Prevention strategies vary based on patient demographics and risk factors. Younger individuals may reduce their risk by avoiding spermicides, which can disrupt the vaginal microbiome, and by taking cranberry supplements, which may prevent bacterial adhesion to the bladder lining.

In older patients, the use of topical oestrogen can help maintain urogenital mucosa integrity, while strategies like ensuring complete bladder emptying and staying well-hydrated are also important in preventing infections. For patients prone to recurrent infections, long-term antibiotic prophylaxis may be considered. This approach can reduce the frequency of UTIs, although it must be carefully tailored to avoid the development of antibiotic resistance. Overall, a combination of tailored acute treatment and preventive measures offers the best approach for managing recurrent UTIs and minimizing their impact on patient health and public health.

Keywords: Bacterial Virulence; Antimicrobial Resistance; Culture Diagnosis; Probiotics; Urogenital Health; Non-antibiotic prophylaxis

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections, and one in four women will develop a recurrence. various risk factors predispose women of different age groups to recurrence. these factors include sexual intercourse, the use of contraception, antimicrobials, estrogen, genetics, and the distance of the urethra from the anus [1]. Recurrent urinary tract infections (UTIs) are 2 episodes of acute bacterial cystitis, associated symptoms within the last 6 months, or 3 episodes within the previous year. Especially in young women, recurrent urinary tract infections (UTIs) are a serious health risk that can result in significant morbidity [2]. To ensure proper treatment, it's important to differentiate between recurring UTIs and relapsing infections, identified by the occurrence of two or more acute UTIs in a month or three in a year. To mitigate future occurrences, primary care physicians and specialists must coordinate care through effective

therapy and preventative strategies such as selected prophylaxis and lifestyle adjustments [3]. Recurrent urinary tract infections (UTIs) are 2 episodes of acute bacterial cystitis, associated symptoms within the last 6 months, or 3 episodes within the previous year [4]. Recurrent urinary tract infections, which manifest as dysuria or irritative voiding, are typically brought on by reinfection with the original bacterial isolate in young, otherwise healthy women who do not have any urinary tract anatomical or functional abnormalities. When a patient presents with recurrent dysuria, the frequency of sexual activity is the best indicator of recurrent UTIs [5]. Eighty percent of UTIs are reinfections, which are primarily caused by strains other from the original one, though occasionally the same strain may still be to blame if it continues to live in the digestive tract. These are primarily seen in sexually active women, those who have gone through menopause, patients with specific urological conditions like cystocele or urine incontinence, patients recovering from gynecological surgery, and patients with neurogenic bladders (diabetics, spinal cord injuries). Relapses happen sooner than reinfections, which can be avoided by using some of the techniques [6].

Table 1: Prevalence rate of UTI among pregnant women

PREVALENCE	CLASS	PERCENTAGE
UTI	42	35%
NON-UTI	78	65%
TOTAL	120	100%

UTIs are more common in women than in men. 81% of UTIs in women occur, peaking between the ages of 16 and 35. Of the women who get a UTI for the first time, about 27% experience another one within six months and 48% within a year. About six days of incapacity are caused by each episode of this infection, and the morbidity is rising in the United States [7]. Approximately 20% of all UTIs occur in men. Relapse or reinfections are also a major concern.

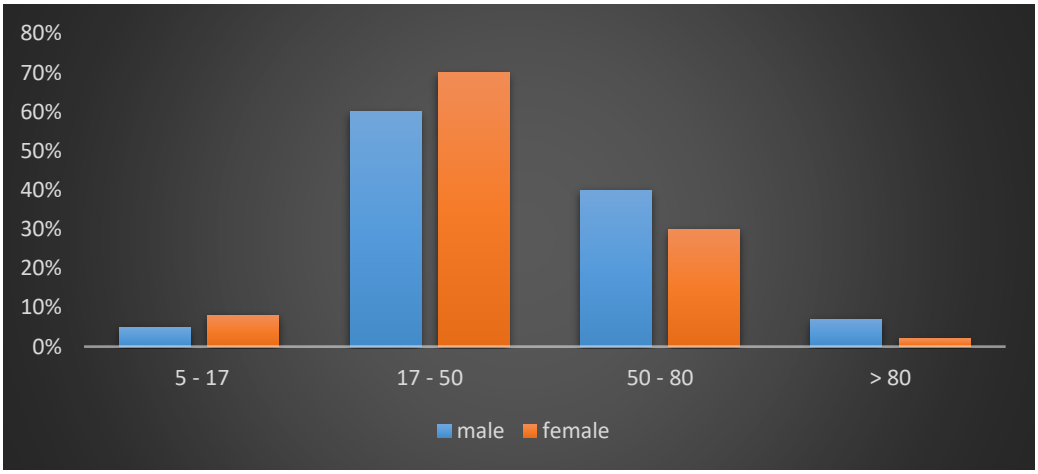

Fig. 1: Prevalence of UTI in male and female age wise

ETIOLOGY

1. Distinctions in Anatomy

• Congenital Defects: Problems with the urinary system's structure, like urethral strictures or abnormally formed bladders, can raise the risk of urinary tract infections [10].

• Obstructive Uropathy: Disorders such as kidney stones or an enlarged prostate can block the flow of urine, increasing the risk of infection and causing urine retention[11].

• Vesicoureteral Reflux (VUR): urine that backflows into the kidneys or ureters from the bladder can encourage the growth of bacteria and result in recurring infections[12].

2. Sexual Activity

• New Partners: Changing partners frequently can introduce new strains of germs, which raises the risk of urinary tract infections [UTIs] [13].

• Poor Hygiene Practices: Using improper hygiene before, during, and after sexual activity can increase the risk of urinary tract infections [14].

3. Hormonal Changes:

• Menopause: Lower estrogen levels during this phase of life might modify the vaginal flora, so reducing the body's natural defenses against pathogenic bacteria [15].

• Pregnancy: Changes in hormone levels and the physical pressure of the expanding uterus might impact the function of the urinary system, increasing the risk of infections [16].

4. Personal Conduct and Hygiene

• Improper Wiping: The risk of infection is increased when wiping from back to front because this transfers bacteria from the anal region to the urethra [17].

• Inadequate Hydration: Drinking too little water can cause a decrease in urine production, which in turn causes the urinary system to flush bacteria less frequently.

5. Immune System Elements

• Immunocompromised State: Illnesses such as diabetes, HIV, or cancer therapy can impair immunity, making it harder to fight infections.

• Autoimmune disorders: The immune system may be impacted by conditions like lupus or rheumatoid arthritis [18].

6. Long-Term Health Issues

• Diabetes mellitus: High blood sugar can impede the immune system's ability to fight off infections and foster the growth of bacteria [19].

• Kidney Disease: Prolonged kidney problems might impair the urinary tract's regular operation, increasing the risk of infections.

7. Drugs and Medical Procedures

• Usage of Antibiotics: Improper or frequent use of antibiotics can upset the balance of healthy bacterial flora, which can result in resistance and recurrent infections.

• Catheterization: Urinary catheter usage has the potential to contaminate the urinary system with bacteria [20].

8. Lifestyle and Genetic Variables

• Genetic Predisposition: Certain individuals may be genetically predisposed to recurrent UTIs due to variations in immunological response or anatomical differences.

• Lifestyle Factors: Excessive stress, insufficient sleep, and unhealthful eating patterns might compromise immune system performance and raise the risk of infection [21].

9. Bacterial Factors

• Antibiotic-Resistant Strains: The rise of antibiotic-resistant bacteria can make Infections are more difficult to treat and increase the likelihood of recurrence.

• Persistent or Recurrent Bacterial Strains: Certain bacterial strains can persist in the urinary tract despite treatment, leading to ongoing infections [22].

10. Underlying Health Issues

• Interstitial Cystitis: A chronic bladder condition that mimics UTI symptoms can complicate diagnosis and treatment.

• Chronic Prostatitis: Inflammation of the prostate can cause UTI-like symptoms and frequent infections [23].

PATHOPHYSIOLOGY

Usually, fresh infections with distinct bacterial species cause recurrent urinary tract infections. Infections that recur after therapy could have an untreated cause, like prostatitis, urinary stones, or abscesses. These recurrent infections have the same cause as any simple case of cystitis. The urethra and periurethral region are typically contaminated by the rectal bacterial flora. Bacteria can travel fast upward and enter the bladder. The link between the microbiomes of the intestines, vagina, and urinary system is complicated and little understood, according to research. Escherichia coli is the cause of 75% of recurrent urinary tract infections. *Enterococcus faecalis, Klebsiella, Proteus mirabilis, and Staphylococcus are other frequently occurring species.* It is

crucial to distinguish between a relapse (the same organism not fully treated) and quick reinfection (a different organism). A recurrence within two weeks of finishing therapy with the same organism is another definition of a relapse. If a new infection from the same organism is discovered more than two weeks following therapy, it is referred to as reinfection. A thorough urological evaluation or imaging is not necessary for the majority of recurrent UTIs that are often seen in clinics and medical offices because they are reinfections.

Imaging may be indicated in cases of recurrent infections, chronic hematuria, a history of kidney stones, and persistent Proteus (which is frequently linked to urolithiasis). There are less protective vaginal lactobacilli after menopause and atrophic vaginitis. Less vigorous bladder contractions result in larger post-void residual volumes, which increase the risk of recurring UTIs [24].

Table 2: Pathogenic Microbes

TYPE OF UTI	PATHOGEN	PERCENTAGE/REMARK
UNCOMPLICATED UTI	*E. coli*	64%
	Enterobacteriaceae	16%
	Enterococcus	20%
	Pseudomonas	<1%
	S. aureus	<1%
SPECIAL CASES	*S. epidermidis*	-
	S. saprophyticus	-
	Yeasts	Catheter-related result
	Viruses	(Adeno, Varicella)
	Chlamydia trachomatis	-
COMPLICATED UTI	*E. coli*	-
	Enterobacteriaceae	% is not possible to judge
	Pseudomonas	Often multi-resistant strains
	Acinetobacter	Often multi-resistant strains

(25)

RISK FACTORS ASSOCIATED WITH THE RECURRENT UTI

Risk factors in premenopausal women:

There are genetic factors that lead to increased bacterial adherence to vaginal and uroepithelial cells and may explain the familial propensity for UTIs [26]. Furthermore, it has been observed that in uroepithelial cells of patients non-secreting for serum AB antigens, the uropathogenic adhesion is increased [27]. On the other hand, there are behavioral factors. Chief among them is sexual activity. Women with daily sexual activity have a 9 times higher risk of developing UTIs [28]. Other factors related to recurrences are the initiation of sexual activity before the age of 15, spermicidal creams (nonoxynol-9 is toxic to vaginal lactobacilli), and the recent change of partner (which is usually associated with increased sexual activity) [29]. Although there are no studies evaluating its role, unprotected anal sex, followed by vaginal sex, is a risk factor for UTIs, therefore, its identification during history-taking (anamnesis) can help to solve the recurrences with hygienic measures.

Risk factors in postmenopausal women:

After menopause, UTIs are rather prevalent, and 15% to 20% of women will recur; this rate is higher in patients who are hospitalized [30]. Urinary incontinence, cystocele, urine residual, UTIs before menopause, non-secretory status for AB blood antigens, and recent gynecological surgery were the main risk factors for recurrence [31]. UTIs following urinary incontinence surgery should raise suspicions of blockage and urine residue in the patient population. There is less research on the function of sexual activity after menopause.

Patients with UI were shown to have a higher frequency of sex, diabetes, a history of UI, or urine incontinence in a study involving 899 women without UI and 911 with UI [32].

When vaginal lactobacillary flora disappears and there is insufficient estrogen in postmenopausal women who do not have the previously mentioned conditions, this could lead to recurrences [33]. Reduced glycogen levels result from a vaginal oestrogen deficiency. Lactobacilli use this substrate to form lactic acid, which keeps the vaginal pH acidic, and to produce hydrogen peroxide and bacteriocins, which are antimicrobial peptides that inhibit the growth of uropathogens in the vagina and urethra. However, oestrogens also influence the urethral mucosa and pelvic muscles, which promotes bladder emptying and urine continence. It has been demonstrated that applying vaginal oestrogens improves bladder emptying and continence while lowering the amount of IURs and restoring the lactobacillary flora [34].

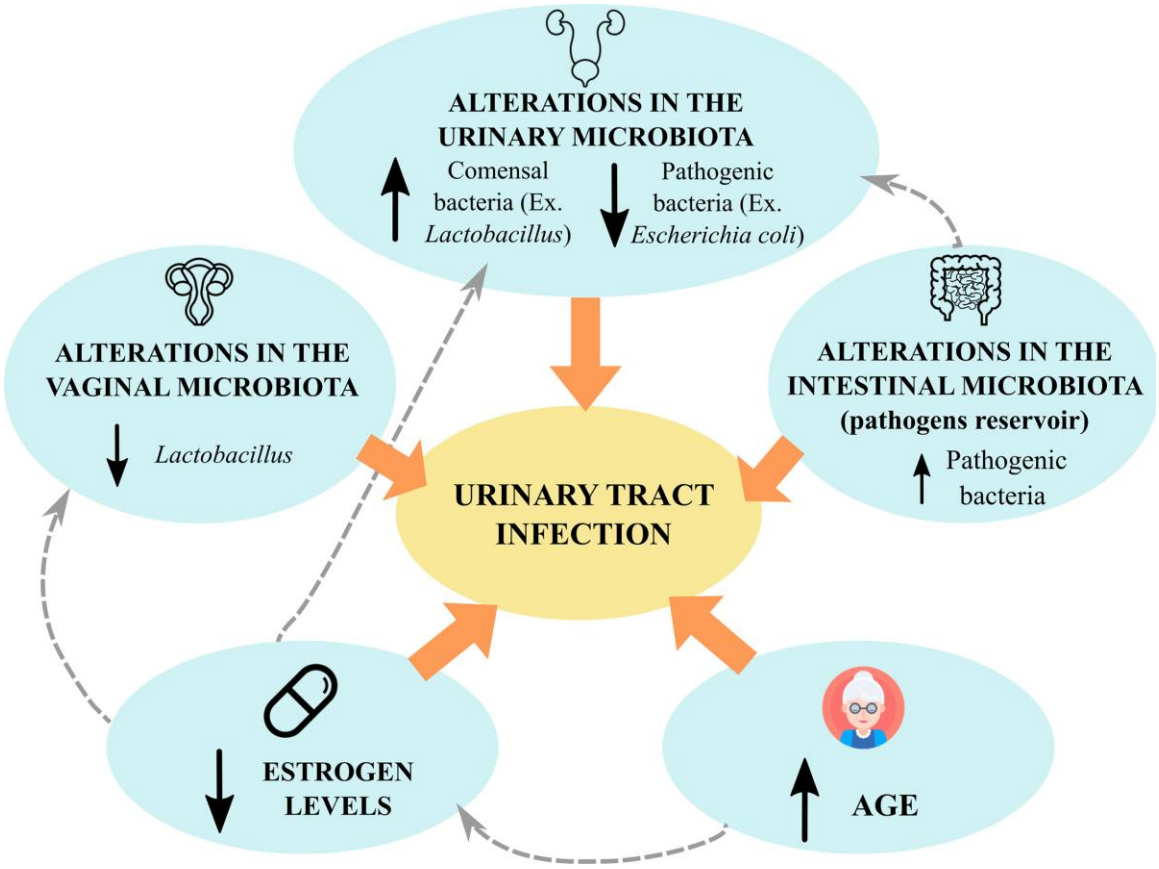

Fig. 2. Possible key risk factors contributing UTI

The presence of glycosuria or an underlying neurogenic bladder increases the chance of recurrence in women with diabetes. The use of renal sodium-glucose cotransporter 2 inhibitors (iSGLT2), which lower plasma glucose by causing glycosuria, has recently been linked to a little rise in the incidence of UTIs and non-serious genital infections (candidiasis). If the cause and effect are clear, the issue can be resolved by simply switching the antidiabetic medication [35]. Twelve One prevalent cause of UTIs in neurological patients is a neurogenic bladder. In addition, higher exposure to antibiotics and urine catheterization are additional factors linked to UTIs in older women living in institutions [36].

Route of infection: Females are more susceptible to infections because to their reproductive system, which can happen through congenital areas including the urethra, vaginal entrance, perineum, and anus, which are known to dwell their unique microbiota. The majority of women do not experience the infection despite one's menstrual cycle, sexual habits, and personal hygiene is undeniable, and enteric bacteria's invasion of the periurethral zone and other intestinal microbes, which causes the infection to start. The main sources of these microorganisms are the bowel movements. to colonize and infiltrate the urinary system, and subsequently

provide the infection. Previous research has demonstrated the presence of a microbial population in the urinary tract in variable densities, and it is evident that these microbes can recover from the rectum, urethra, and cervix of females. Such locations can act as a main entry point for infections. But even so, the population of S. saprophyticus, which is thought to be one of the offenders recovery of these bacteria is still pending confirmation of the infection has been verified from the various urinary tract segments. Urine is the main component that promotes microbial growth since it has all the necessary elements for microbial enhancement and is said to be the finest natural growth medium. and the microbes' establishment. Instruments used for urine catheters, for example, are among the channels via which infections spread, and in not having any medical gadgets microorganisms infiltrate the urine pathway via the urine stream. Microorganisms conform to the penetrate the urothelial linings and urothelial cells, resulting in the sickness. Moreover, the urine stream and bowel movements which gives microorganisms access to the urinary system, there are specific bacteria have the ability to move because they have flagella, which allow them to invade the different parts of the urinary tract. As the common route of infection begins, the germs often invade the various sections of the urinary tract in an ascending pattern. from the urethra, which enters the bladder by the lower urinary tract It then moves up to the ureter and other upper urinary tract sections kidney.

COMPLICATIONS

1. Chronic Kidney Disease (CKD):

Mechanism: Recurrent UTIs can cause persistent inflammation and infection in the urinary tract, potentially ascending to the kidneys (pyelonephritis). Repeated episodes of pyelonephritis can damage renal tissue, leading to chronic kidney disease over time.

Impact: Chronic kidney disease can progress to end-stage renal disease (ESRD), requiring dialysis or kidney transplantation. Symptoms of CKD include fatigue, fluid retention, and changes in urine output. A study by Schaeffer and Schaeffer (2000) highlights the risk of renal damage from repeated UTIs, particularly in individuals with pre-existing kidney conditions [37].

2. Renal Scarring:

Mechanism: Kidney tissue may be scarred as a result of pyelonephritis. This frequently happens as a result of recurring or chronic infections that inflame and fibrose the renal parenchyma.

Impact: Renal scarring raises the risk of chronic kidney disease (CKD), proteinuria, hypertension, and impaired kidney function. Long-term research has demonstrated that children with recurrent UTIs are more vulnerable to renal scarring, which can impair kidney function well into adulthood [38].

3. Antibiotic Resistance:

Mechanism: Using antibiotics frequently to treat recurrent UTIs can cause bacteria to become resistant to certain antibiotic strains. This happens when bacteria adapt to withstand exposure to drugs that would usually cause their death.

Impact: The treatment of subsequent infections becomes more difficult due to antibiotic resistance, necessitating the use of stronger antibiotics or different therapeutic approaches. This may raise the possibility of long-term sickness and treatment failure. The management of recurrent UTIs is becoming increasingly concerned with antibiotic resistance [39].

4. Effect on Quality of Life:

Mechanism: Prolonged pain, frequent urination, and discomfort are all possible side effects of recurrent UTIs. The condition's enduring nature may also have an impact on one's mental and emotional health.

Impact: Because of their physical symptoms and the stress of having to manage a chronic illness, patients with recurrent UTIs frequently have a lower quality of life. show that disruptions in employment, social activities, and general well-being are among the effects on day-to-day living [40].

5. Mechanism of Pregnancy:

Complications: Preterm labor and low birth weight are two risks that are increased when a pregnant woman has recurrent UTIs. Pregnancy-related physiological changes to the urinary system may potentially increase the frequency of infections.

Impact: Perinatal infections, intrauterine growth restriction, and premature birth are among the possible complications. To prevent negative consequences for the mother and the unborn child, recurrent UTIs in pregnant women need to be carefully managed [41].

6. Impact on the Mind:

Mechanism: Managing recurring UTIs, numerous medical visits, and chronic pain can all lead to psychological discomfort.

Impact: Because the infections are chronic, patients may suffer from anxiety, depression, and a lower quality of life. Studies conducted by Kiecolt-Glaser et al. (1999) have demonstrated a strong correlation between the occurrence of chronic illnesses, such as recurring UTIs, and stress and mental health problems [42].

7. Mechanism for Increased Risk of Other Infections:

Prolonged UTIs might impair immunity and make people more vulnerable to other infections.

Impact: People who have persistent urinary tract infections (UTIs) may be more susceptible to other bacterial illnesses, such as skin and respiratory diseases. This heightened susceptibility may result from a higher total health burden and more frequent medical interventions [43].

DIAGNOSIS

- **Atrophic vaginitis:** Thickening, desiccating, and inflaming of the vaginal tissues, often resulting in symptoms related to urination because of estrogen depletion [42].
- **bladder hyperactivity:** Urgency and frequency without any indication of an infection [44].
- **Syndrome of painful bladder:** (Diagnosis of exclusion.) Dysuria without any signs of illness, but frequent and urgent [45].
- **Pelvic inflammatory disease:** fever, cervical discharge, soreness in the cervical motion, and lower abdominal or pelvic pain [46].
- **Prostatitis:** May manifest as a painful prostate on digital rectal examination and pain during ejaculation [47].
- **Urethritis:** Pyuria, not bacteria, is shown in urinalysis for urethritis (this is prevalent in sexually active women.) [48]
- **Urolithiasis:** Nephrolithiasis may be an infected focus in urolithiasis, which can have symptoms similar to those of bladder or distal ureteral calculi [49].
- **Vaginitis:** Vaginal discharge, odor, pruritus, and dyspareunia (without frequency or urgency) are indicative of vaginitis [50].

Ninety percent of women who report with classical symptoms have a urine infection, which can be treated empirically without the use of a urine dipstick. In one study, female participants with dysuria and frequency but negative urine dipstick results for nitrites and despite receiving antibiotics, 75% of leucocytes showed a quicker symptomatic relief. If medication is stopped until urine culture results are accessible, and every instance of UTI is connected to symptoms for an average of 6.1 days, 2.4 days of limited activity, 0.4 days spent in bed and 1.2 days without going to work or school rest[24].

Urine tests are available for symptoms that are less common. Urine from the middle of the void should be collected cleanly to prevent urethral and peri-urethral flora contamination. Urine collection does not require cleaning of the vulva or penis beforehand. The dipstick will show a positive result for either leukocytes or nitrites. raises the likelihood of a UTI to almost 80%, however a dipstick negative for leukocytes and nitrites decreases the likelihood of UTI to roughly 20%.UTI to roughly 20%.

The causal pathogen and local resistance trends are identified by urine culture. A 104 colony forming units (cfu) threshold Since ml is typically recognized as a sign of a UTI, samples with It is possible to report "no significant growth" with less CFU. But still and women who exhibit symptoms with 102 cfu/ml and additionally, 103 probably have a UTI. The most frequent accountable Up to 85% of cases involve

Escherichia coli, and most of these cases involve uropathogenic (UPEC) E. coli[40]. Here is a collection of strains of E. coli that are different from the commensal bacteria found in the feces digestive system, together with extra virulence factors and genes included inside their genomes that aid in the host's infection urinary system. Men, women who are pregnant, women who have recurring UTIs, and women whose symptoms return quickly after taking antibiotics should all have their urine cultured. Additionally, it is required in complex cases and when pyelonephritis or prostatitis is suspected [22].

TREATMENT:

Following conservative treatments, the following are frequently advised as initial non-antibiotic preventive medicines when they are unable to control recurrent UTIs:

Cranberries products: While advised as first-line preventative measures, their effectiveness is still debatable because a clear advantage has not yet been shown. It is believed that the proanthocyanidins found in cranberries reduce the adhesion of bacteria to the urothelium. Although this makes sense and is a compelling theory, proanthocyanidin levels in commercially available cranberry products are quite low. The American Urological Association Guidelines recommend this course of action, but they also warn patients that there is no guarantee of success and that further therapies might be required [10].

D-mannose: In the event of recurrent cystitis, binding to bacterial surface ligands may assist lessen the adhesion of infected organisms to the urothelial mucosa. There is conflicting evidence of a decrease in recurring infections and conclusive trials have not yet been conducted. The medicine is somewhat expensive, and while 500 mg BID is frequently advised, ideal dosages are still unknown. Randomized trials conducted recently have not demonstrated any therapeutic effect.

Methenamine prophylaxis: The medication causes the urine to become acidic in addition to vitamin C. The bladder transforms methenamine into formaldehyde if the urine pH stays acidic, ideally less than 5.5. Methenamine is an efficient and well-tolerated preventive antibacterial drug that can be used without the need for systemic antibiotics and their possible adverse effects, according to a new systematic review. Methenamine and trimethoprim were compared in a different multi-institutional clinical randomized trial study for the prevention of UTIs, and after a year, the rate of recurrences for both was the same. The majority of studies on methenamine demonstrate efficacy, despite some failing to demonstrate a long-term benefit. This suggests that more research and usage of methenamine are necessary, especially in light of current trends showing an increase in antibiotic resistance. It is contraindicated if the glomerular filtration rate (GFR) is less than 10 mL/min [44].

Changes in conduct and way of life: Research involving 47 patients followed for six months revealed the benefits of cranberry products, D-mannose, and probiotics. In the trial, women had a 76% decrease in UTI rates and a 90% decrease in antibiotic use. Combining antibiotic avoidance with non-antibiotic therapy seems to be a very promising way to treat bacteria while reducing resistance to antibiotics and increasing effectiveness. Nevertheless, additional studies employing diverse components and larger sample numbers are required to validate and ascertain the ideal components and dosages.

Vaccines for preventing recurrent UTIs: The majority of these vaccines are now in the research and development stage, although several seem promise in terms of avoiding recurring UTIs. With minimal side effects and safety information, MV140, an oral vaccination, has demonstrated good efficacy in preventing recurrent UTIs in multiple studies. Recently, early long-term research on MV140 showed efficacy over a period of nine years after the first dosage. Heat-inactivated strains *of Escherichia coli, Klebsiella pneumoniae, Enterococcus faecalis, and Proteus vulgaris* are present in MV140 and alter the bladder's local immune response by inducing the generation of host antibodies. The vaccination is currently accessible in a number of nations across the world, including Australia, Chile, the Dominican Republic, Lithuania, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, and the United Kingdom, while not being authorized for use in the US or Canada[50].

Antibiotic prophylaxis: Prophylaxis effectively prevents recurring UTIs, however, other non-antibiotic measures are typically advised before antibiotic use. This strategy lowers expenses, gets rid of antibiotic-related side effects, and stops microorganisms from becoming resistant. When more cautious approaches

are unsuccessful or there is clear evidence of several quick recurrences, prophylaxis makes sense. However, as this would quickly result in highly resistant organisms, usage is contraindicated in individuals with nephrostomies or permanent catheters[20].

Vaginal estrogen: Reduced vaginal estrogen, elevated vaginal pH, and altered vaginal flora with decreased lactobacillus are all effects of menopause. As numerous studies have shown, topical estrogen in the form of tablets, rings, or creams can help lower vaginal pH, lessen gram-negative bacterial colonization, restore lactobacillus, and minimize the likelihood of UTI recurrence. Nevertheless, systemic estrogen is unable to lessen recurring UTIs. Vaginal estrogen supplementation has been suggested by the EAU guideline 2022 as a means of preventing recurrent UTIs in postmenopausal women (Level of evidence: 1b, strong recommendation). When used in conjunction with other preventive measures, this topical medication lowers the incidence of recurrent urinary tract infections in postmenopausal women[14].

Probiotics: Probiotics are defined as "live microorganisms, which confer a health benefit on the host when administered in adequate amounts." They are easily purchased as liquids, capsules, or yoghurt drinks, and they come in different strains and dosages. living things. They support the urogenital flora's continued health. by stopping the colonization of harmful organisms. It's been determined that the necessary oral dosage for restoring and keep 1 billion live lactobacilli in the vaginal flora. bacteria once every two weeks.8 Probiotic usage generally in the Several studies have assessed the group with recurrent UTIs, utilizing various delivery methods and distinct organisms under different regimes. According to a Cochrane study on the topic, which assessed nine trials with 735 participants, probiotics did not considerably lower the risk of UTI when compared to placebo or antibiotics. It was believed that the lack of sufficient and high-quality data could not exclude advantage as well. Disturbances in the gut flora caused by antibiotics might result in the proliferation of bacteria such as *Clostridium difficile* and antibiotic-associated diarrhea. Probiotic use for a brief period of time appears to have some benefit for immunocompetent people [25].

Immunomodulators: It may be possible to use urine tract pathogen lysate exposure to stimulate the immune system to fight infection without the use of antibiotics.

Because the bacteria that cause UTIs can vary greatly, even within *E. Coli* strains) deciding on a target that the vaccination should attack is challenging and single-target vaccinations would only work for a tiny portion of the bacterial strains[37].

Table 3: Conventional Antibiotics for Recurrent UTI

Table 4: Treatment Regimen

DRUGS	**ACTIVE AGAINST**			
Trimethoprim	Gram positive and gram-negative bacteria			
Cephalexin	Gram positive and gram-negative bacteria. eg- staphylococcus aureus or proteus mirabilis.			
Nitrofurantoin	Most common uropathogens.			
Norfloxacin	Most strains of gram-negative and gram-positive bacteria.			
	Duration	**Treatment option**	**Dose**	**Frequency**
Continuous prophylaxis	3-6 months	Trimethoprim Cephalexin Nitrofurantoin Trimethoprim + sulphamethoxazole	150 mg 250 mg 50 mg 160/800 mg	At night At night At night At night
Self-start therapy	3 days 5 days 3-5 days 5 days	Trimethoprim Cephalexin Nitrofurantoin Amoxycillin + clavulanate	300 mg 500 mg 50 mg 500/125 mg	At night 12 hourly 6 hourly 12 hourly

		Norfloxacin	400 mg	12 hourly
Post intercourse	Single dose	Trimethoprim	150 mg	
	Single dose	Cephalexin	250 mg	
	Single dose	Nitrofurantoin	50 mg	
	Single dose	Trimethoprim + sulphamethoxazole	160/800 mg	

CONCLUSION

Recurrent urinary tract infections (UTIs) pose a significant health challenge, particularly among women, and can result in substantial morbidity if not properly managed. Understanding the interplay between bacterial virulence and host factors is crucial in differentiating between reinfections and relapsing infections. Accurate diagnosis, including the use of cultures, plays a key role in identifying the underlying pathogens and tracking antimicrobial resistance patterns, ultimately benefiting both individual patients and the wider community[42].

Effective management of recurrent UTIs requires a multi-faceted approach that includes adherence to established guidelines, such as those from the Infectious Diseases Society of America (IDSA), and consideration of regional resistance patterns. Prevention strategies are essential and should be tailored to the patient's demographic and risk factors. Younger women may benefit from avoiding spermicides and using cranberry supplements, while older individuals can use estrogen therapy, ensure proper bladder emptying, and maintain adequate hydration to reduce recurrence. For high-risk patients, long-term antibiotic prophylaxis may be necessary, although it should be used cautiously to avoid antibiotic resistance[17].

In conclusion, managing recurrent UTIs requires both acute treatment and preventive measures. A personalized approach, based on individual risk factors and effective use of available therapies, is the most effective strategy for reducing the frequency of infections and their associated health impacts. Coordinated care between primary care physicians and specialists is essential for optimal outcomes and long-term patient well-being.

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