

A Comprehensive Review Article on Diagnosis, Management, Prevention in Urinary Tract Infection in Adult.

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I. INTRODUCTION

This article covers the optimization of patient outcomes through prompt diagnosis of, and appropriate antibiotic prescribing for, urinary tract infections.

Urogenital diseases:

18 September 2026. Diagnosis of a urinary tract infection should be based on clinical signs and symptoms, with additional testing, such as urine culture and dipstick, as required

After reading this article, you should be able to:

- Understand the pathophysiology of urinary tract infection (UTI) in adults;
- Understand how to diagnose UTI in different patient groups;
- Understand how to optimize the care of a patient with a UTI;
- Effectively counsel patients and carers about antibiotics, self-care and prevention.

According to a W.H.O systematic analysis, 1,270,000 deaths were attributed to antimicrobial resistance (AMR), making it a leading cause of death globally. Urinary tract infection (UTI) has been identified as one of the disease burdens associated with, and attributable to, AMR.

Health Security Agency Annual Epidemiological report, UTIs remain the most common primary focus of bacteremia accounting for 34.6% of Klebsiella cases, 29.3% of P. aeruginosa cases and 45% of E. coli bacteremia cases. In addition, E. coli bacteremia resistance to multiple antibiotics increased compared

to 2019. In particular, 42.9% and 15.8% of isolates were resistant to co-amoxiclav and third-generation cephalosporins respectively. This has implications on the treatment options available to manage E. coli UTIs. UTIs are major drivers of antibiotic prescribing in primary care and, were responsible for more than 175,000 hospital admissions costing the NHS more than £450m: with a third of those admissions including a hospital stay of more than seven days. The five-year national action plan for antimicrobial resistance 2024 to 2029 outlines ambitions to minimize infection and demonstrate appropriate use of antimicrobials.

The aim of these is to optimize UTI management and clinical outcomes, and reduce Gram-negative bacteremia, supporting the vision for AMR.

1.1 Pathophysiology of urinary tract infection

UTI is a broad term that encompasses different types of infection in the urinary system. If bacteria colonizing the urethra reach the bladder, it can cause a lower urinary tract infection (i.e. cystitis) and if bacteria further ascend into the kidney, this is described as an upper urinary tract infection (i.e. pyelonephritis). If left untreated, UTIs can result in life-threatening infections, such as urosepsis (i.e. organ dysfunction caused by systemic response to UTI) and bacteremia.

UTI is the second most common hospital-acquired infection, accounting for around 17.5% of total infections: with up to 50% of these associated with catheter use. Catheter-associated UTI (CAUTI) is defined as where patients have been catheterized up to 48 hours prior to developing UTI symptoms (see Box 1).

1.2 Risk factors

UTI is more common in women because their urethra is shorter in comparison to men, and their anus and urethra are closer together, resulting in a higher likelihood of exposure to bacteria. Other risk factors of UTI include:

- Sexual intercourse: the urethra comes into contact with bacteria from the genitals and anus;
- History of childhood or maternal family history of UTI in young and pre-menopausal women;
- Previous UTI;
- Urinary catheter;
- Using a diaphragm with spermicide for contraception that may alter vaginal pH;
- Diabetes mellitus (high levels of sugar in urine provide a good environment for bacteria to multiply);
- Inability to empty bladder (e.g. obstruction by diaphragm, bladder stone or enlarged prostate gland; pregnancy, where baby is pressing on the bladder; structural or functional urinary tract abnormalities)
- Menopause: decreases the vaginal pH;
- Immunosuppression: more susceptible to infection.

1.3 Diagnosis

The diagnosis of a UTI should be based on clinical signs and symptoms. with additional testing, such as urine dipstick and culture, as required. However, the reliability of these tests can vary depending on gender and age.

In addition, detailed history-taking that covers the following can help to confirm or exclude UTI diagnosis:

- Family history of urinary tract disease such as polycystic kidney disease;
- Possibility of pregnancy in women of childbearing age: a pregnancy test should be carried out if the patient is unsure;
- Past medical history, including risk factors for recurrent UTI, such as neurological condition, known structural kidney abnormalities, diabetes mellitus, immunosuppression, urolithiasis, and bladder catheterization;
- Sexual history, such as sexual contact within past three months, sexual partner, signs and symptoms

of sexual transmitted disease and method of contraception use;

- Recent courses of antibiotic can inform antibiotic choice

Box 1: Signs and symptoms of urinary tract infection

Men and women aged under 65 years:

- Dysuria: discomfort, pain, burning, tingling or stinging sensation on urination;
- Frequency: passing urine more often than usual;
- Urgency: a strong desire to empty the bladder, which may lead to urinary incontinence;
- Nocturia: passing urine more often than usual at night;
- Hematuria: blood in urine;
- Suprapubic discomfort/tenderness;
- Urine may appear cloudy to the naked eye or change color or odor.

Men and women aged over 65 years:

New onset dysuria alone

OR two or more of the following:

- Temperature 1.5°C above patient's normal measured twice in the past 12 hours;
- New frequency or urgency;
- New incontinence;
- New or worsening delirium/debility;
- New suprapubic pain;
- Visible hematuria.

If fever and delirium/debility only: consider other causes before treating for UTI (see 'Differential diagnoses')

1.4 All catheterized adults

Presence of symptoms or signs compatible with a UTI in people with a catheter with no other identified source of infection plus significant levels of bacteria in a catheter specimen taken from the sample port (or a midstream urine specimen when the catheter has been removed within the previous 48 hours).

Cloudy or smelly urine alone without other signs and symptoms does not warrant treatment of UTI especially for patients aged over 65 years. Reasons for change in colored odor of urine include hydration status, food intake and medication, such as vitaminB6.

If patient has a urinary catheter, also check for catheter blockage and consider catheter removal or replacement.

Pyelonephritis symptoms:

- Kidney pain/tenderness in back, under ribs;
- Myalgia, flu-like illness;
- Nausea/vomiting;
- Shaking chills (rigors) OR temperature over 37.9°C (or below 36°C in people aged over 65 years).

II. UROSEPSIS

Information on identification of sepsis can be found here.

2.1 Urine culture and urine dipstick

The urine culture and dipstick tests should be interpreted in the context of clinical signs and symptoms, and should only be requested if there is suspicion of a UTI. When bacteria exist within an environment such as the urinary tract, without causing disease, the host is said to be colonized. If the pathogen invades the host's tissues and multiplies, the host is infected with the pathogen. Colonization of bacteria in the urine or "asymptomatic bacteriuria" is not harmful, even though it causes a positive urine dipstick and urine culture. Asymptomatic bacteriuria does not warrant antibiotic treatment.

The only two exceptions for treating asymptomatic bacteriuria are pregnant women, owing to the risk of pyelonephritis causing preterm birth, and patients who are undergoing urological procedures where mucosal trauma is expected to reduce the risk of post-operative infection. Ideally, urine culture should be taken before starting antibiotics to ensure better microbiological culture yield

2.2 Patients aged over 65 years and patients with a urinary catheter

Urine dipsticks are less reliable with increasing age over 65 years due to increasing levels of asymptomatic bacteriuria in older adults. By 80 years, about half of older adults living in care homes can have bacteria present in the urine without infection and most patients that have had a catheter in situ for more than one month have colonization of bacteria in the urine that has not caused infection.

Treating asymptomatic bacteriuria in patients over 65 years and patients with a urinary catheter is more likely to cause harm, exposing the patient to potential adverse effects secondary to an antibiotic, increased risk of *Clostridioides difficile* and emergence of AMR. Consequently, in patients aged over 65 years or in any patient with a catheter in situ, a diagnosis of a UTI should only be made following a full clinical assessment including vital signs and detailed history-taking. A positive urine dipstick analysis or urine culture alone cannot be used to confirm a diagnosis of UTI.

Men aged under 65 years

Lower UTI is uncommon in men under the age of 65 years; pyelonephritis or other differential diagnoses should be considered. For those with symptoms of a lower UTI, a urine sample should be sent for diagnosis. A urine dipstick may be helpful in some clinical situations to confirm the diagnosis, but it is unreliable to rule out infection entirely.

Women aged under 65 years

For women under the age of 65 years who present with two or more of the key diagnostic symptoms (i.e. dysuria, new nocturia and cloudy urine), no additional testing or sample is required for diagnosis. If there is only one symptom or other urinary symptoms that are severe, such as visible hematuria, frequency, urgency and suprapubic tenderness, urinary dipstick can be used as a diagnostic aid. A urine sample should be sent if there is a possibility of a resistant organism, such as extended-spectrum beta-lactamases *E. coli* or pregnant.

Risk factors for resistance include:

- Antibiotic exposure within previous six months;
- Abnormalities of genitourinary tract;
- Renal impairment;
- Previous UTI that was resistant to antimicrobials;
- Hospital admission lasting over seven days in the past six months;
- Residence in a care home;
- Recent travel and receiving healthcare in a country with increased antimicrobial resistance.

2.3 Differential diagnoses

While delirium and/or fever can be a symptom of UTI in patients over 65 years of age, in isolation, it is not

enough for a diagnosis of UTI. Other causes of delirium, including pain, different origin of infection, poor nutrition, constipation, dehydration, medication and environment change should be considered.

Older patients who present, following a fall, with asymptomatic bacteremia are often diagnosed with a UTI, which leads to the initiation of antibiotic treatment. Assessment for other causes of a fall, such as visual impairment, muscle weakness or polypharmacy is recommended.

For all sexually active men and women, sexually transmitted infections (STIs) are one of the differential diagnoses, as they can present with dysuria. The BASH Guidelines provide further information on diagnosis and management of STIs.

Women experiencing menopause with vaginal dryness, burning, irritation, pain on sexual intercourse and urinary symptoms of urgency, frequency and dysuria should be examined for genitourinary syndrome of menopause. In men, acute prostatitis may present with the same symptoms of UTI, such as dysuria, high frequency or urgency to urinate, in addition to lower back, suprapubic, perineal pain or tender prostate on rectal examination. In instances where there is scrotal pain and epididymis swelling, in addition to dysuria and other UTI symptoms, epididymitis should be suspected.

2.4 Treatment

The empirical choice of antibiotic is based on the most likely causal organism (70–95% cases are *E. coli*), taking into consideration the penetration of the antibiotic to the site of infection, meaning the choice of antibiotic can vary for upper and lower UTI.

In clinical practice the choice and formulation of antibiotic will vary with local guidance and should consider the following:

- Local formulary;
- Local resistance pattern;
- Individual patient risk factors, including severity of the symptoms, allergy, comorbidities and route of administration;
- Pregnancy;
- Previous culture and sensitivity;
- Previous antibiotics use (could be indicative of resistance pattern)
- Pathophysiology.

More information on how to evaluate the clinical appropriateness of an antimicrobial can be found here.

2.5 Lower UTI

The first-line antibiotics recommended by the National Institute for Health and Care Excellence (NICE) for the treatment of lower UTI are nitrofurantoin or trimethoprim, depending on patient criteria.

Nitrofurantoin:

- Nitrofurantoin modified-release 100mg every 12 hours orally or immediate-release 50mg every 6 hours orally;
- First line for lower UTI, including CAUTI;
- Avoid if estimated glomerular filtration rate less than 45 mL/min;
- Avoid at full term in pregnancy as it may cause neonatal hemolysis;
- May cause urine discoloration to brownish color;
- There is a MHRA Drug Safety Update for nitrofurantoin. Healthcare professionals should be alert to the risks of pulmonary and hepatic adverse drug reactions and advise patients to be vigilant for the signs and symptoms in need of further investigation;
- The summary of product characteristics (SPC) should be consulted for further information on cautions, contraindications and side effects.

Trimethoprim:

- Trimethoprim 200 mg every 12 hours orally;
- First line for:
Non-pregnant women with lower UTI, provided previous urine culture suggests susceptibility and not used within three months;
- CAUTI for non-pregnant women and men, provided previous urine culture suggests susceptibility and not used within three months;
- Male patients with lower UTI.
- Teratogenic risk in first trimester of pregnancy. Manufacturer advises avoidance during pregnancy;
- The SPC should be consulted for further information on cautions, contraindications and side effects.

Second-line antibiotic options for the treatment of lower UTI are shown in Table 1.

Practical information on penicillin hypersensitivity and antibiotic allergy can be found in 'Penicillin allergy: identification and management' and 'Accurately diagnosing antibiotic allergies.

The NICE recommended duration of treatment for lower UTI in non-pregnant women is three days, while the duration for pregnant women, men and those with CAUTI is seven days. Non-pregnant, non-catheterized women with mild symptoms and without signs of pyelonephritis or risk factors for complicated UTI can improve without antibiotic treatment, but can be offered a backup antibiotic prescription.

Nitrofurantoin, pimeclonide and fosfomycin oral are only suitable for lower UTIs as there is insufficient data regarding their efficacy in treating pyelonephritis.

III. PYELONEPHRITIS

NICE guidance on the empirical treatment of pyelonephritis is summarized in Table 2.

For non-pregnant women and men with pyelonephritis or urosepsis who are severely unwell or unable to take oral antibiotics, NICE recommends intravenous co-amoxiclav, cefuroxime, aminoglycoside or ciprofloxacin, depending on susceptibility. For pregnant women, NICE recommends intravenous cefuroxime. Consult local microbiology if these antibiotics cannot be used.

Fluoroquinolones should only be prescribed if the benefits outweigh the risk, such as when another option is not available for the patient (e.g. owing to resistance or allergy). There have been several MHRA Drug Safety Updates for fluoroquinolones relating to rare reports of disabling and potentially long-lasting, irreversible side effects affecting the musculoskeletal and nervous systems, such as tendon pain and depression, suicidal thoughts and behaviour, the small risk of heart valve regurgitation and aortic aneurysm and dissection.

Pharmacy professionals should be aware of these alerts and counsel patients about the possible side effects of fluoroquinolones, using the MHRA patient information leaflet to support discussions. The manufacturers advise against use in pregnancy. Fluoroquinolones can prolong the QT interval and can reduce seizure threshold (caution in patient with epilepsy). See SPC for further information on cautions, contraindications and side effects. Ciprofloxacin has an oral bioavailability of 70–80%

and should not be used intravenously unless patient is nil by mouth or has absorption problems.

IV. RECURRENT UTI

Recurrent UTI in adults is defined as repeated lower or upper UTI with a frequency of two or more UTIs in the past 6 months or three or more UTIs in the past 12 months. Personal hygiene measures, such as hydration, avoidance of tight underwear, post sexual intercourse urination and wiping from front to back after going to the toilet, and self-care should be considered before initiation of prophylactic antibiotics. Consider vaginal estrogen for women or trans men or non-binary people with a female urinary system, who are experiencing perimenopause or menopause and personal hygiene measures alone are not effective or not appropriate.

Some people (mainly women) may be able to identify triggers (e.g. sexual intercourse) for UTI. These triggers may vary for different people and, where possible, should be recognized and managed. A single dose of antibiotic when exposed to a trigger may be indicated if personal hygiene measures, self-care and vaginal estrogen are not effective or appropriate.

Consider methenamine Hippurate 1g twice daily as an alternative to daily antibiotic prophylaxis for recurrent UTI in women, and trans men and non-binary people with a female urinary system, if: They are not pregnant; Any current UTI has been adequately treated; and They have recurrent UTI that has not been adequately improved by behavioural and personal hygiene measures, vaginal estrogen or single-dose antibiotic prophylaxis (if any of these have been appropriate and are applicable).

Review use of methenamine Hippurate within 6 months and then every 12-month or sooner if agreed with the patient.

Consider a trial of prophylactic daily antibiotics if there has been no improvement with vaginal estrogen or single-dose antibiotics or methenamine Hippurate. The choice of prophylactic antibiotic should depend on the individual patient's urine culture and sensitivity. The prophylaxis antibiotic of choice should be reviewed at least every six months. See Target Antibiotics Toolkit hub for resources on how to undertake a structured clinical review with patients aged 16 and over who experience recurrent UTI [38]. NICE empirical guidance is summarized in Table 3.

V. SELF-CARE ADVICE AND PREVENTION

Patients should be counselled to drink plenty of fluids (aim for six to eight glasses per day) and to avoid drinking alcohol, fizzy drinks or caffeine as these may irritate the bladder. Additionally, if suffering symptoms of pain, they can take paracetamol or ibuprofen regularly, if there are no contraindications. There are several practices, often used in tandem, to reduce UTIs in both community and healthcare settings.

Steps for UTI prevention include:

- Ensuring an empty bladder when passing urine, including as soon as possible after sexual intercourse;
- Keeping the genital area clean and dry: including changing incontinence pads or nappies quickly if soiled;
- Avoid potentially irritating products in the genital area: including scented soaps, deodorants, powders or douches;
- Using an alternative contraception to spermicides as they eradicate the protective bacteria in the vagina, allowing for overgrowth of uropathies, leading to infections;
- Keeping well hydrated and regularly passing urine.

VI. HYDRATION

Inadequate fluid intake can lead to dehydration, resulting in falls or confusion, or affect electrolyte management, renal and cardiac function. In older adults, there is often decline in thirst, and they may self-limit fluid intake owing to the concern of incontinence or fear of falling when going to the toilet. More than 50% of nursing home residents have problems swallowing certain food or fluids, which can also lead to decreased fluid intake. Vomiting, diarrhea, unconsciousness, exhaustion, personal neglect and frailty all prevent normal oral intake of fluids, and the risk of dehydration should be considered when caring for these patients.

Good hydration (or water diuresis) serves to flush the urinary tract of infected urine and frequent voiding reduces bacterial proliferation. However, there is little evidence to suggest that, once infection is established, hydration improves UTI outcomes. Adult patients

(without fluid restriction) should aim for 1.5–2.5L of water throughout the day to stay well hydrated.

VII. CATHETERS

Indwelling catheters provide a focus for bacterial biofilm formation; therefore, they should only be utilized when clinically indicated. This does not include management of urinary incontinence (unless all other management methods of incontinence have been ineffective). Alternatives to indwelling catheters include condom catheterization in men or intermittent catheterization as an alternative to short- or long-term indwelling catheters. Healthcare professionals should consider the use of a bladder scanner to determine if catheterization is necessary and cause erosion of the bladder neck and urethral mucosa, resulting in stricture formation.

The correct catheter for patients is dependent on multiple factors, including diameter, length, balloon size and material type, and should be fully documented in the medical records. Larger catheters have been shown to be a risk factor for UTIs as they can increase the amount of residual urine.

Good infection prevention and control techniques for catheter placement and care must be maintained to help reduce CAUTIs. Catheterization should be an aseptic or clean procedure, ensuring good hand hygiene before and after catheterization and good ongoing catheter care. Care and observation of the urethral opening should be undertaken during daily hygiene practice, with only unscented soap and water required. Urine output should be regularly assessed throughout the day (including color and concentration) and recorded in the patient record. Drainage bags should be emptied several times per day and positioned to prevent backflow of urine (below the level of the bladder to allow gravity drainage). Drainage bags should not be placed on the floor, and there should be no twists or kinks in the tubing.

Healthcare staff should also keep a fluid balance by recording input and output over a period of time, usually 24 hours. Patient output should be measured via catheter bag (if marking on the collection device) or via measuring jug. This will help avoid dehydration in unwell patients as keeping the urine dilute decreases risk of infections. When caring for a urinary catheter, gloves and aprons must be worn if indicated (i.e. Contact with a mucosal barrier or bodily fluids,

secretions or excretions). Indwelling catheters should be reviewed daily and removed as soon as they are no longer required, with the removal documented in nursing and/ or medical notes.

VIII. ANTIMICROBIAL STEWARDSHIP AND RESOURCES

Appropriate diagnosis and management of UTI is crucial, and a multidisciplinary approach necessary to preserve the effectiveness of antimicrobials and reduce the emergence of AMR. A balance must be reached between adequately treating the infection and not treating for longer than necessary. Pharmacists and pharmacy technicians can aid diagnosis and advise the patient's clinical team on appropriate antibiotic prescribing, optimizing dose and duration while minimizing adverse effects. More information can be found in 'How to evaluate the clinical appropriateness of an antimicrobial'. Box 2 explores this role and outlines best practice in the context of UTI.

The role of pharmacists and pharmacy technicians in antimicrobial stewardship in the context of urinary tract infection

- Discuss and prompt review or stopping of an antibiotic for UTI in patients aged over 65 years or patients with a urinary catheter who were diagnosed based on: Positive urinary dipstick alone without UTI symptoms;
 - Positive urine culture without UTI symptoms;
 - Delirium and/or fever alone without UTI symptoms;
 - Fall without UTI symptoms.
- Support treatment selection by considering:
 - Previous urine culture and sensitivity;
 - The choice of antibiotic as per pathophysiology and local guidance;
 - Individual patient factor and comorbidities, such as allergy, renal function and past medical history.
- Review the choice of antibiotic 48–72 hours after initiation or as soon as urine culture is available, based on patient's response, with documented decision to either stop, switch from intravenous to oral treatment, or change or continue antibiotic;
- Ensure the appropriate duration was prescribed based on biology and pathophysiology;

- Counsel and provide advice on the following for patients with UTI or recurrent UTI:
 - Antibiotic – see 'Antibiotic checklist';
 - The name, dose, frequency and duration of the antibiotic;
 - Whether the antibiotic should be taken with or without food or whether to avoid alcohol;
 - Common side effects and what to do if experiencing side effects.
 - Self-care advice (see previous section);
 - Safety-netting advice, especially for those with prescription delays: Seek medical help if symptoms do not start to improve within 48 hours of taking the antibiotic or worsen at any point;
 - Seek medical help if signs and symptoms of pyelonephritis or urosepsis develop (see Box 1);
 - Patients with a delay prescription should start antibiotics if symptoms do not improve within 48 hours of seeing a healthcare professional or worsen at any time;
 - For non-pregnant, non-catheterized women with mild symptoms not needing antibiotics, the symptoms usually improve in five to seven days.
- For patients with CAUTI, advise catheter change, especially if it has been in place for more than seven days;
- For patients who no longer require urinary catheter, prompt removal.

IX. SUMMARY

Appropriate management of UTIs has a significant impact on patient outcomes and healthcare costs across primary and secondary care settings. It is therefore essential for healthcare professionals to understand the diagnosis, prevention and management of UTIs. Pharmacy professionals should familiarize themselves with their local UTI guidelines and review antibiotic prescriptions in all patients being treated for UTI.

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