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Urinary tract infection: diagnosis and management for nurses

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Summary

Urinary tract infection (UTI) is a common health problem, so it is important that nurses in all care settings know how to manage patients with this condition effectively. This article defines UTI, identifying patients who are most at risk and the underlying reasons why. Accurate diagnosis is important in the provision of treatment and the prevention of further complications, some of which can have serious consequences for patients. Inappropriate investigations are expensive, and may result in patients being over-treated. UTI is multifaceted, which makes its management difficult. However, a good understanding of prevention, assessment and management can help nurses to ensure the right treatment is offered.

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Aims and intended learning outcomes

Symptoms of a urinary tract infection (UTI) are a common reason for patients to seek medical advice. However, UTIs can be over-diagnosed and over-treated in primary care. This article identifies a number of issues related to identifying and managing UTI. After reading this article you should be able to:

- Define a UTI and distinguish between an uncomplicated and complicated UTI.
- List the risk factors predisposing patients to UTIs.
- Explain the use of a diagnostic pathway for uncomplicated UTIs.
- Identify when therapeutic intervention is required.
- Describe the role of nurses in the management of UTIs.

Introduction

UTIs are one of the most common infections managed in primary or secondary care. UTIs account for 1-3% of all consultations in primary care (Hill 2006), with the ambulance service conveying a significant number of patients with suspected UTI to accident and emergency departments. It is the most common infection in acute and long-term care patients (Gastmeier 2001), accounting for 23% of all hospital-acquired infections (Emmerson *et al* 1996). This figure may rise from 25% to 40% in non-catheterised patients residing in long-stay units (McMurdo *et al* 1992, Aguirre-Avalos *et al* 1999).

Renal complications, such as chronic renal disease, renal failure and the potential for hypertension can be minimised by correct diagnosis and management strategies (National Institute for Clinical Excellence (NICE) 2005).

Prevalence

UTIs affect all age groups (Table 1). It is one of the most common bacterial infections resulting in pyrexia in children under the age of two years.

Male infants are more likely to have a UTI at neonatal age (Graham and Galloway 2001). Most infections occur in females over six months of age. Many females have recurrent UTIs requiring further investigation and/or health promotion (NICE 2005). Children with UTI require prompt recognition and treatment as they can develop renal complications, which may lead to renal scarring (Wyatt *et al* 2005).

The incidence of UTI appears to be higher in women than in men (Monane *et al* 1995), although this gap closes with age (Lipsky 1989). The incidence in women rises at puberty and can remain high throughout adult life. Several authors suggest that all females will develop a UTI at some point during their lifetime, with the range varying from 20% (Graham and Galloway 2001) to 60% (Foxman *et al* 2000).

An estimated 17-20% of pregnant women present with symptomatic bacteriuria requiring antibiotic treatment (Vazquez and Villar 2000). Asymptomatic UTI in pregnant women is detected during routine antenatal screening and should be treated with antibiotics to reduce the risk of upper UTI, pre-term delivery and low birth weight infants (Smaill 2000).

UTI in young men is rare, unless it is associated with instrumentation, such as catheterisation, or congenital abnormalities, such as those that occur with urethral valves (Goldman 2001). The incidence of UTI in men increases with age and is thought to be attributed to the physiological changes associated with the ageing process (Sinclair and Woodhouse 1995). These changes may be due to prostate enlargement leading to incomplete bladder emptying and reduced levels of testosterone (Bissett 2004).

Definitions

The Health Protection Agency (HPA) (2005) define UTI as: 'the presence and multiplication of bacteria in one or more structures of the urinary tract with associated tissue invasion'. Urine is a poor medium for bacterial growth because of its acidity, but if bacteria adhere to the mucosal lining of the urinary tract, they give rise to an inflammatory response, which causes the symptoms of UTI.

Different types of UTI need to be identified to determine appropriate treatments. Four definitions can be used to identify the difference between the types of UTI:

1. Asymptomatic bacteriuria is the absence of symptoms, such as dysuria, frequency, urgency, and fever, chills and suprapubic or flank pain. The evidence that bacteria are present is provided by urinalysis. Asymptomatic bacteriuria is common in pregnant women, patients with diabetes and older adults, especially women (Yoshikawa *et al* 1996). It can lead to symptomatic invasive disease, bacteraemia or sepsis unless patients are monitored and treated appropriately (Travis and Lampley-Dallas 1997).
2. Symptomatic bacteriuria is caused by the inflammatory response that occurs when bacteria attach to the urinary mucosa. This response creates the symptoms of urgency, frequency and dysuria (Anderson 1999). Symptoms can be present in patients with uncomplicated and complicated UTI.
3. Uncomplicated UTI is an infection of the bladder or kidney occurring in a normal host without structural or functional abnormality of the urinary tract (Ronald and Pattullo 1991). The HPA (2005) suggests that this occurs in otherwise healthy individuals.
4. Complicated UTI is an infection in the presence of one or more of the following (Warren 1996):
   - Urinary calculi, for example, renal or bladder stones.
   - Cystic renal disease.
   - Urinary obstruction in the kidney, ureter, bladder or prostate.
   - Anatomical abnormalities, for example, vesico-ureteral reflux.
   - Neurogenic bladder dysfunction.
   - A foreign body, for example, a urinary catheter.

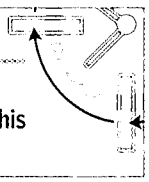
UTI in patients with diabetes, pregnancy, a transplanted kidney or other metabolic or immunologic illness is also considered to be complicated, as are infections that involve the prostate and non-ambulatory, older patients (Ronald and Pattullo 1991).

TABLE 1

Possible signs and symptoms of urinary tract infection experienced in different age groups

Signs and symptoms	Children	Adults	Older people
Dysuria	Possible	Yes	Possible
Frequency	Yes	Yes	Yes
Urgency	Yes	Yes	Yes
Loin pain	Possible	Yes	Yes
Blood	Possible	Yes	Yes
Pyrexia	Yes	Yes	Possible
Abdominal pain	Yes	Yes	Rarely
Offensive smelling urine	Possible	Yes	Yes
Cloudy urine	Yes	Yes	Yes

Time out 1



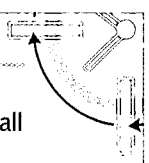
Identify which patient groups are most vulnerable to UTI and why this might be the case.

Natural defence mechanism

The urethra is the body's natural defence mechanism in providing protection from infection to the bladder in a healthy person. The flow and dilution of urine down the urethra help to flush out bacteria in the process of hydrokinetic activity. This flushes out bacteria trapped by mucus that lines the urethra as they attempt to ascend the distal two thirds of the urethra.

The urinary tract is normally sterile with the exception of the distal urethra (Bullock *et al* 1994). Infection may develop if the hydrokinetic properties (voiding or urinary flow) of the urinary system are altered, as in bladder outflow obstruction, reduced frequency of voiding or incomplete emptying. Ensuring complete and regular emptying of the bladder helps to prevent UTI. However, despite complete bladder emptying, certain risk factors may predispose individuals to UTI.

Time out 2



Write down the main risk factors predisposing individuals to UTI in all age groups.

Predisposing risk factors

Women appear to be more susceptible to UTI than men. Apart from the increased risk of urethral contamination from bowel flora, other risk factors include (Anderson 1999):

- Previous history of UTI.
- Sexual activity, especially with a new partner or unusually vigorous intercourse.
- Use of a diaphragm and/or spermicide.
- Delayed postcoital urination.
- Anatomical or structural factors, for example, uterine prolapse or oestrogen deficiency.
- Instrumentation, such as catheterisation.

The reduction of oestrogen associated with menopause also increases women's susceptibility. Increased vaginal pH associated with oestrogen loss leads to the replacement of some of the normal flora (lactobacilli) in the vagina with potential pathogens, such as *Escherichia coli* (*E. coli*). The proximity of the vagina to the urethra increases the likelihood of vaginal organisms gaining access to the urethra and ascending into the urinary bladder (Childs and Egan 1996). Pelvic floor muscle weakness and reduction of bladder capacity are also believed to be risk factors (Bissett 2004).

Multiple factors contribute to the increased incidence of bacteriuria in older people. Apart from physiological and hormonal changes in older people, other factors that may contribute to bacteriuria include (Marchiondo 1998):

- Decreased functional activity and/or ability.
- Cognitive impairment.
- Immobility.
- Faecal incontinence.
- Cerebrovascular disease.
- Incomplete bladder emptying.
- Previous antibiotic therapy.

The metabolism of medicines can be altered in older people due to the reduction of liver mass, blood flow, renal function and increased body fat (Drake *et al* 1998). These changes can lead to metabolites not being excreted and give rise to irritative symptoms, which may mimic the symptoms of UTI.

Coexisting chronic disease can compound the risk of UTI. Those with Alzheimer's, Parkinson's or cardiovascular disease often have bladder dysfunction (Nicolle 1994). Decreased mobility seems to be associated with increasing infection rates among older people (Abrutyn *et al* 1991). This may be due to problems with personal hygiene, increased incidence of incontinence and fluid imbalance (Travis and Lampley-Dallas 1997).

Patients with diabetes in any age group have a higher risk of UTI (Haus 1998). The prevalence of asymptomatic bacteriuria is three times higher among women with diabetes than non-diabetic women (Zhanel *et al* 1991). In women with diabetes who develop UTI, the site of infection is often localised to the upper urinary tract rather than the bladder (Nicolle *et al* 1987, Zhanel *et al* 1991).

Diagnosis

Diagnosis should not be based solely on the results of clinical signs and symptoms, microscopy, culture or dipstick urinalysis (PRODIGY Guidance 2006). Neither dipstick urinalysis nor urine culture should be used to confirm or disprove diagnosis, as they rarely have important implications for management in symptomatic UTI.

The initial diagnosis of UTI should be based on sound clinical assessment and identification of any presenting urinary symptoms (Box 1) (Scottish Intercollegiate Guidelines Network (SIGN) 2006). However, the diagnostic accuracy of clinical assessment for UTI remains unclear (Bent *et al* 2002), as this may depend on the experience and expertise of the practitioner assessing the patient.

Older patients may present with atypical symptoms including falls, confusion, delirium, apathy and nocturia. Deterioration in continence may also occur (McCue 1993). In men there may be obstructive complaints such as hesitancy, poor flow of urine and dribbling (Lipsky 1989).

Young women with recurrent uncomplicated UTI are often referred to urologists and gynaecologists, but there is inconsistency in the referral pathway. There does not appear to be any evidence-based guidance to recommend when referral is appropriate. Figure 1 outlines steps to be taken in the management of symptomatic uncomplicated lower UTI in non-pregnant women.

Dipstick urinalysis Near patient dipstick urinalysis is a rapid, practical and inexpensive aid to diagnosis and monitoring of a patient's condition. Urine dipstick analysis is valuable in the diagnosis of UTI (Wells 1997). Others suggest that dipstick urinalysis should be regarded as a rough screen, which indicates that a urine sample should be cultured (Anderson 1999, Nazarko 2005).

Dipstick urinalysis is often performed on a perfunctory basis. The clinician observes for signs of UTI, frequently paying little attention to information that can be obtained from the other reagent pad results, such as pH and specific gravity. These are often not recorded in the patient's notes and may be important in the diagnostic pathway, as raised pH can indicate the presence of calculi and specific gravity can indicate dehydration.

Women with uncomplicated UTI, presenting with three or more symptoms and signs, do not require urinalysis, as this is best treated with empirical antibiotics (SIGN 2006). In this instance it is more important to treat the patient's symptoms than conduct further tests. Patients presenting with limited signs and symptoms of UTI (no more than two symptoms) should provide a sample for near patient dipstick urinalysis. Management of positive and negative results is outlined in Box 2.

Urine culture Urine culture has been cited as the gold standard for diagnosing UTI. However, the contamination of midstream urine (MSU) samples is estimated to be as high as 30% (Lifshitz and Kramer 2000), which suggests that its cost effectiveness is questionable.

National clinical guidelines suggest that the gold standard method of obtaining a contamination-free sample is by suprapubic needle aspiration of the bladder (SIGN 2006). This is inappropriate for the majority of patients, as it is an invasive and painful procedure. Routine urine culture costs approximately 90% more than dipstick urinalysis.

Cost effectiveness is an important factor for nurses to consider. The following five presentations should be used to guide nurses' practice in the appropriateness of sending urine samples for culture. One of the following presentations may be sufficient to warrant sending samples for culture analysis (SIGN 2006):

- Recurrent UTI and prolonged duration of symptoms.

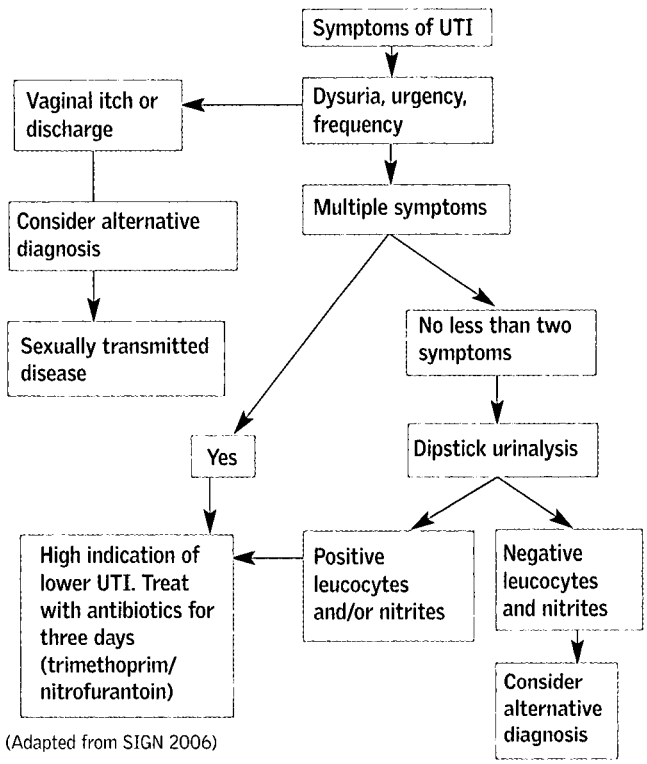
BOX 1

Signs and symptoms of urinary tract infection

- Dysuria.
- Urgency.
- Frequency.
- Haematuria.
- Back pain.
- Flank or loin tenderness.
- No vaginal irritation or discharge.
- Pyrexia.

FIGURE 1

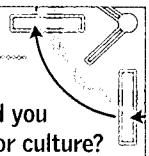
Steps in the management of symptomatic uncomplicated lower urinary tract infection (UTI) in non-pregnant women



(Adapted from SIGN 2006)

- To identify bacteria and their sensitivity to antibiotics, in the absence of a therapy response.
- Signs of upper UTI.
- Complicated UTI.
- Males.

Time out 3



Reflect on the last few urinalysis dipsticks you have carried out. Did you send any of these urine samples for culture? If so, how many were reported as contaminated and how many needed to be repeated? Did any have a definitive diagnosis for type of infection? How many were negative? Identify how you would change your practice as a result of your learning.

Organisms responsible for UTI

The body's bowel flora, as in *E.coli*, is the most common cause of UTI. *E.coli* accounts for between 80-90% of uncomplicated UTI (Johnson and Stamm 1989). *Staphylococcus saprophyticus* accounts for the remaining 10-15% and *Enterobacteriaceae* (*Klebsiella*, *Proteus* and *Enterobacter cloacae*) the last 5%.

E.coli is responsible for only 20% of organisms in complicated UTI. *Enterobacteriaceae*, *Pseudomonas*, *Acinetobacter* and gram positive (*S. aureus*) are more significant (Warren *et al* 1999, Goldman 2001).

Overuse of antibiotic therapy has led to multi-resistant organisms, such as *Enterobacteriaceae*-producing extended-spectrum beta-lactamases (ESBLs). These multi-drug resistant strains do not respond well to oral antibiotics. Treatment should be given with intravenous therapy and may require inpatient stay.

BOX 2

Management of urinary tract infection

Presence of symptoms	Treatment strategy
Symptomatic with three or more symptoms	Treat empirically with antibiotics for three days
Minimally symptomatic with less than two symptoms	Dipstick urinalysis. If positive to bacteriuria (leucocytes ± nitrites) treat with antibiotics for three days
Minimally symptomatic with less than two symptoms	Dipstick urinalysis. If negative to bacteriuria (leucocytes ± nitrites) offer empirical treatment with antibiotics after discussing risks and benefits with patient
Asymptomatic pregnant women (incidental finding)	Treat empirically. Do not treat older patients without symptoms
Recurrent or persistent UTI with symptoms following therapy	Send midstream urine for culture and sensitivity

Therapeutic intervention

The aim of treatment for patients with symptomatic UTI is the relief of symptoms (SIGN 2006). For those with bacteriuria who are asymptomatic, the aim is to prevent symptomatic episodes. Identifying who needs to be treated and who does not is a challenge for healthcare professionals.

Diagnosis of UTI in older patients is difficult, as they are more likely to develop asymptomatic bacteriuria as a result of ageing and coexisting morbidity, for example, diabetes. In the absence of symptoms, the presence of bacteria in a urine sample can indicate contamination or colonisation.

Treating older patients, particularly those in long-term care, is common and can lead to overuse of antibiotic therapy, with no clear evidence of its benefit (Nicolle 2000, Walker *et al* 2000). It exposes the patient to unnecessary antibiotic side effects and provides the opportunity for resistance to antimicrobial therapy to develop (Bradley 1997, Wise *et al* 1998).

About 50% of patients with proven bacteriuria are asymptomatic within three days with no treatment (MeReC 1995). However, patients presenting with symptomatic UTI should be treated with antibiotics (PRODIGY Guidance 2006). Asymptomatic UTI is not usually treated with antibiotics, as it can increase the incidence of resistant organisms (Haus 1998). All men presenting with UTI should be referred to the local urology department for further investigation of possible urinary tract abnormalities.

Choice of antibiotic for treatment may depend on the individual patient and local policy. Generally, the recommendation for those with an uncomplicated UTI is trimethoprim for three days. Nitrofurantoin would be the second choice for this group of patients, as it is highly concentrated in the urine. It is also the first choice therapy in pregnant women with asymptomatic bacteriuria.

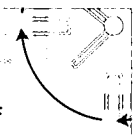
Nitrofurantoin is not recommended for complicated UTI as it does not reach therapeutic levels in the blood or renal tissue (Bint and Hill 1994). Ciprofloxacin for seven days is the drug of choice in complicated UTI (Kahlmeter 2000). The second choice for complicated UTI would be cefradine or co-amoxiclav for ten to 14 days.

Cefradine is recommended for ten to 14 days to treat cases of symptomatic pregnancy and children (Kahlmeter 2000). Antibiotic therapy is prescribed in the absence of contraindications to the drug, but its efficacy, side effect profile and

cost are also considered as part of the prescribing process. Table 2 identifies the recommended antibiotic therapy in each treatment group.

Misdiagnosing UTI or ignoring the symptoms in vulnerable patients can lead to poor patient outcomes – the most serious of these being long-term renal damage or death.

Time out 4



Identify the signs and symptoms of UTI. Consider the implications of treating or not treating patient groups presenting with asymptomatic bacteriuria. Identify why this might be important in management of patients.

Non-medical interventions

Nurses are often the first healthcare professional to detect the possibility that the patient has a UTI through routine urinalysis. This routine screening test can be important in older patients who do not necessarily present in the conventional way (dysuria, fever, frequency), but may experience unexplained confusion, delirium, apathy or incontinence.

Patients who have an indwelling urinary catheter are at high risk of developing UTI because of the invasiveness of this device. The nurse should ensure that infection control measures such as adherence to good hand hygiene, use of gloves, correct perineal cleansing, adequate urinary bag emptying and patient education on catheter care, are undertaken to prevent cross-infection or contamination.

Patients with faecal incontinence, poor fluid intake and reduced mobility are also prone to UTI. Nurses should ensure that faecal incontinence is contained adequately, by thorough continence assessment and management and/or the elimination of associated infection. Inadequate fluid intake should be monitored and appropriate action taken to reduce the risk of UTI. Patients on bed rest are at increased risk of UTI, which is caused by urinary stasis and incomplete bladder emptying.

Nurses have a responsibility to have good working knowledge of non-medical interventions before offering patients advice on their use. Concerns of over-use of antibiotics and antibiotic resistance have prompted research into the viability and usefulness of alternative management strategies for UTI.

Research suggests that cranberry juice assists in the prevention of UTI by limiting the adherence of bacteria to uroepithelial cells. *E. coli* is a common cause of UTI and is known to be susceptible to condensed tannins found in cranberries. The tannins prevent *E. coli* from attaching to the walls of the urinary tract (Lavender 2000, Kontiokari *et al* 2001, Jepson *et al* 2004).

While there is no empirical evidence to support the effectiveness of cranberry products in treating symptomatic UTI (Jepson *et al* 2004), the SIGN (2006) guidance suggests that there is evidence of the effectiveness of cranberry products in preventing symptomatic UTI in women with a history of recurrent UTI (Jepson *et al* 2004).

Patients are advised not to rely on the use of cranberry juice alone, but to seek medical advice if their symptoms persist (Lavender 2000). Not all patients would benefit from cranberry juice. Patients with diabetes need a sugar-free variety and acid juices should be avoided in patients with rheumatoid arthritis as these may exacerbate pain.

Patients who are on warfarin should avoid cranberry juice, as several cases have been reported where there has been an increase in the time that it takes blood to clot (as measured using the prothrombin time test) (Committee on Safety of Medicines 2004).

Nurses commonly advise patients to increase fluid intake during an episode of UTI to 'flush bacteria' from the urinary system (Black *et al* 2001). Research on intrinsic defence mechanisms in the urinary tract fails to support this rationale (Schaeffer 1998). Studies examining the influence

TABLE 2

Recommendations for antibiotic therapy based on susceptibility of Escherichia coli

Treatment group	First choice	Second choice
Uncomplicated urinary tract infection (UTI)	Trimethoprim (three days)	Nitrofurantoin (three days)
Complicated UTI	Ciprofloxacin (seven days)	Cefradine or co-amoxiclav (ten to 14 days)
Asymptomatic bacteriuria in pregnant women	Trimethoprim, nitrofurantoin, amoxicillin or cefalexin (seven days for all)	If there is no response to first choice, then culture urine sample and prescribe accordingly
Symptomatic bacteriuria in pregnant women	Cefradine (ten to 14 days)	Amoxicillin (seven days)
Children	Cefradine (ten to 14 days)	Co-amoxiclav (ten to 14 days)

(Kahlmeter 2000)

of urine osmolality and uromucoids (glycoprotein in the urine that reduces bacterial adherence) suggest that excessive dilution of the urine may impair prevention of the adherence of antibiotics (Pak *et al* 2001). Properties of urine such as pH, osmolality, glucose, amino acids and urea, can promote or inhibit the growth of bacteria (Kunin 1997).

Gray and Krissovich (2003) suggest that there is reluctance among experts to provide guidelines about specific amounts of fluid intake, although many authors propose between 1.5 litres and 2 litres in a 24-hour period (Nazarko 2000). Gray and Krissovich (2003) make clinical recommendations that patients should drink sufficient fluid to meet daily requirements. Any verbal advice given regarding fluid intake should be supported with written literature to avoid confusion (Morrison 2000).

Nurses have been known to offer advice to patients on possible lifestyle and behavioural changes. While such changes may contribute to reducing episodes of UTI (Leiner 1995), there is little robust evidence to demonstrate effectiveness. Some of the advice given includes:

- Urinate frequently enough to empty the bladder (three to four hourly is considered normal).
- Personal hygiene after urination or defecation. Wipe from front to back and wash hands.
- Both partners should wash hands and genitalia before sexual intercourse.

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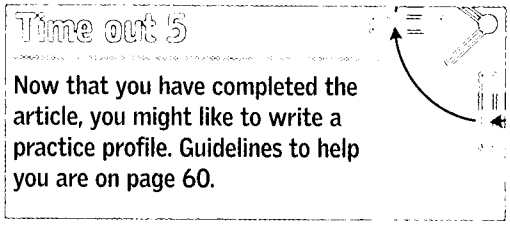
- Pass urine after sexual intercourse, ideally within ten to 15 minutes.
- Use a water-based lubricant during sexual intercourse to reduce urethral irritation.
- Avoid caffeine drinks as they can cause bladder irritation.

Other advice given, which is not based on evidence but seems to make common sense, is avoid prolonged soaking in bubble baths and avoid wearing wet or tight clothing, and nylon underwear.

Conclusion

The causes of UTI are multifaceted, which makes its management difficult. Identifying whether a UTI is uncomplicated or complicated will determine patient care. As nurses it is important to understand the manifestation of UTI. Knowledge of the prevention and management of UTI is important for improving patients' quality of life. Identifying risk factors for UTI, understanding which groups are more vulnerable and the diagnostic pathway and management will help to ensure that patients receive effective treatment **NS**



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