Testing for urinary tract infection in non-catheterised patients

Maurice Madeo, Paula Johnson

Urinary tract infections (UTIs) are one of the commonest infections seen in primary and secondary care and consequently are often treated with antibiotics. However, recently there has been an increasing amount of evidence highlighting the problem of bacterial resistance to antibiotics commonly used to treat UTI. This makes diagnosis and treatment even more critical. Diagnosis of a UTI can be difficult, especially in elderly patients, and poses many challenges for nurses, including those working in the community, particularly in nursing and residential homes. This article examines the adoption of a chemical indicator dipstick test. This demonstrated good correlation with urine culture results and was seen as a useful additional tool to assist in the diagnosis of UTI, especially in those patients where urine samples may be more difficult to capture.

KEYWORDS:
Contiuence ■ Urinary tract infection ■ Laboratory testing

Urinary tract infections (UTIs) are the second largest single group of healthcare-associated infections (HCAIs) in the UK, accounting for 19% of all HCAIs (Health Protection Agency [HPA], 2011). UTIs are also the second most common clinical indication for empirical antimicrobial treatment (where treatment is started before a diagnosis is confirmed) in primary and secondary care, and urine samples constitute the largest single category of specimens examined in most medical microbiology laboratories.

The diagnosis and management of patients with suspected or confirmed UTI varies greatly across organisations, often resulting in the inappropriate use of antimicrobials and increasing the risk of drug resistance and further complications (Department of Health [DH], 2013). Diagnosing UTI is particularly difficult in elderly patients — they are more likely to have asymptomatic bacteriuria (presence of bacteria in the urine) as they get older and may present with non-classical signs and symptoms, such as acute confusion and falls (Little et al, 2009; Scottish Intercollegiate Guidelines Network [SIGN], 2012).

The collection of urine culture is also fraught with difficulties as poorly taken samples are likely to be contaminated, which can influence treatment and management.

The Scottish Intercollegiate Guidelines Network (SIGN) review in 2012 examined the management of suspected bacterial urinary tract infections and concluded that the evidence around near-patient testing

(also known as point-of-care testing) using dipsticks was variable.

SIGN supports the principle that the presenting clinical signs and symptoms, such as fever, dysuria (pain on urination), or increased
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frequency, form an important role in the correct diagnosis of a UTI, and as such must be taken into consideration.

URINE DIPSTICK TESTING

A urine dipstick test is a simple diagnostic tool used to determine pathological changes in a patient’s urine sample. Often, substances such as protein or glucose will begin to appear in the urine before patients are aware that they may have a problem.

The presence of the leukocyte esterase (an enzyme released by white blood cells), together with the presence of chemical units called nitrates not found in normal urine, would strongly indicate a UTI — nitrates are produced by the reduction of nitrates by Gram-negative bacteria such as *Escherichia coli*, therefore their presence in urine indicates infection.

Urine dipstick testing should not be undertaken in patients with a long-standing urinary catheter in place as these patients will have asymptomatic bacteriuria, which will show a reaction to esterase and nitrite that does not necessarily equate to an infection. Similarly, urine dipstick testing is not actually necessary when diagnosing UTIs, as this can be achieved using clinical signs.

However, in practice it is often performed and the presence or absence of esterase and nitrates can provide additional information. For example, a urine dipstick that has tested positive for esterase may indicate pyuria (elevated numbers of white cells in urine, often referred to as ‘pus’ in the urine). Urinary tract infections including cystitis and urethritis are common causes of pyuria, as are sexually transmitted infections such as chlamydia. Pyuria is also frequently associated with haematuria (blood in the urine), as both are symptoms of inflammation.

The presence of esterase may also be due to non-infectious renal diseases, such as glomerulonephritis (damage to the filters inside the kidneys). Contamination of samples by vaginal secretions may cause a false-positive result (SIGN, 2012).

The detection of bacteria in urine by nitrite-positive dipstick testing is also affected by the presence of nitrates from the patient’s diet (vegetables) and sufficient bladder incubation time.

There are, however, certain Gram-positive bacteria such as *Staphylococcus saprophyticus* and *Enterococcus* that do not produce a nitrate reductase enzyme. Therefore, when infection is due to these bacteria, the dipstick will be negative for nitrite (Little et al, 2009).

A study by Little et al (2009) used dipstick testing to help gauge treatment for UTI and showed that only nitrite, leukocyte esterase and blood independently predicted a diagnosis of UTI. A rule for using dipsticks based on detecting nitrite, or both leukocytes and blood was moderately sensitive, suggesting that if used appropriately dipsticks may be useful in arriving at correct diagnoses. When individual clinical features alone were considered, cloudy urine or dysuria were predictive of UTI, but nocturia (urination at night) or odorous urine were not.

The British Infection Association primary care guidelines suggest that if the urine is cloudy, there is a high likelihood of a UTI being present (97% PPV) and a urine dipstick should be undertaken (HPA, 2011).

Therefore, it is clear that although urine dipstick testing has its uses, there are some limitations. A positive dipstick test for leucocyte esterase or nitrite is not able to differentiate between asymptomatic bacteriuria and UTI, therefore, signs and symptoms should always be considered before a diagnosis is made. Also, the level of asymptomatic bacteriuria increases with age and is reported to be as high as 40% in women over 80 years, thus, the use of dipstick testing is questionable in this group (SIGN, 2012).

**THE REVIEW**

**Aim**

The aim of this review was to evaluate the performance and functionality of an *in vitro* diagnostic device in a busy admission unit (the TENA U-test).

The U-test is used to detect leukocytes and nitrates and is contained in a fleece adhesive backing that can be used in incontinence pads to detect UTIs. Both urine collection and analysis take place while the device is in the pad. This means that painful catheterisation and unnecessary discomfort are avoided while the dignity of the individual is maintained. The chemical indicators are included in the integrated U-test card, which is automatically sealed once sufficient urine has entered the device. The U-test design avoids incubation of the urine between voiding, therefore, reducing the risk of false positives.

The U-test is designed as an alternative method for testing urine in patients who are unable to provide a ‘clean-catch’ sample of urine, which can be subsequently dipstick tested.

The review’s objectives were to:

- Compare the urine culture results (including identification of species) obtained via pad/culture with the results obtained from the U-test
- Identify whether the U-test met the needs of nursing staff, i.e., whether it helped further inform clinicians whether the patient had an underlying UTI.

### Table 1: Urine culture results

<table>
<thead>
<tr>
<th>Urine culture result</th>
<th>Number of patients</th>
<th>Number of patients on urinary tract infection treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>Heavy mixed growth</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td><em>Pseudomonas</em></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>No bacterial growth</td>
<td>24</td>
<td>4</td>
</tr>
</tbody>
</table>

![CONTINENCE](image-url)
Answer the following questions about this topic, either to test the new knowledge you have gained or to form part of your ongoing practice development portfolio.

1 – What are the common symptoms of UTI?
2 – Can you name some of the main elements that a microbiology sample of urine is tested for?
3 – Can you explain the difference between nitrates and nitrites?
4 – Why might elderly people have more trouble providing a urine sample for culture?
5 – What are some of the causes of UTI?

**Method**

The authors’ admission unit deals with upwards of 40 patients a month who present with a suspected UTI. Patients admitted to the unit with a suspected UTI were assessed to determine their ability to produce a clean-catch urine specimen. Those patients assessed by nursing staff on the admission unit who were considered unable to provide a midstream urine specimen were chosen for the review.

The mean age of the 59 patients included was 72 years, with a range of 17 to 94 years. The review included 32 females (with a mean age of 69 years) and 27 males (with a mean age of 75 years). The data analysis was undertaken independently to reduce bias using Microsoft Excel.

Ethical approval was not required as the product was already in use. The evaluation was seen as a service improvement to help the trust determine whether the U-test would improve the detection of UTIs.

Those patients unable to produce a urine specimen due to urinary incontinence were provided with a urine collection pad and the U-test device, which was fixed on top of the collection pad. This method of fitting ensured that freshly voided urine only reached the U-test device’s collection chamber, therefore reducing the risk of contamination. Placing the U-test on top of the pad ensured the white blood cells were not filtered out, which would skew the diagnosis of infection. It is also important not to have stagnating urine collected in the pad, which can become colonised by the patient’s skin flora or faecal organisms and contaminate the U-test. Placing the pad under the U-test removed this risk.

The urine pad and the U-test device were checked every two hours and changed if the pad was dry and/or visible faecal contamination was present. Although the U-test can remain in place for considerably longer, this regimen was adopted to reduce the risk of urine culture contamination.

Once urine was voided, the U-test was left in place for approximately 15 minutes to allow enough time for the chemicals to be activated and produce a result.

Simultaneously, urine from the collection pad was aspirated via syringe and submitted to the laboratory using the urine specimen collection container. Due to the potential of the collection pads to filter white blood cells, the laboratory were informed to culture all of the samples submitted.

In short, with all patients in whom the U-test was used, a urine culture was also submitted to the laboratory for culture and sensitivity.

The hospital’s specialist infection prevention and control nurse team also reviewed each patient’s medical and nursing records for clinical signs and symptoms to identify if a UTI was suspected before the test was performed. They also noted each patient’s current antimicrobial treatment and gathered user feedback on the usability of the U-test.

The traditional definition of a UTI is a positive urine culture with significant microorganisms cultured and at least two or more of the following criteria in patients aged over 65 years; or three or more in those aged under 65 years (HPA, 2011):

- Fever over 38°C
- Suprapubic/flank pain
- Dysuria
- Frequency
- New incontinence
- Physician diagnosis.

For the purposes of this review, which was to help determine the sensitivity of the U-test, the definition of a contaminated urine sample was decided as the presence of more.

**Expert commentary**

**Frank Booth is a freelance continence advisor**

**D**ipstick testing is not a new technique and is often maligned, however, this article suggests that we dismiss it at our peril. The author provides examples of evidence indicating that dipstick testing is significantly more cost-effective than pathology laboratory studies alone, and the outcomes are easily comparable.

With funding difficult to obtain, it is important for trusts to use their infection control specialists to identify best practice and make sure that we do not rely on techniques simply because they have been used historically.

Misuse/overuse of antibiotics is common, especially in relation to UTIs. Therefore, to provide best practice we must be sure that the techniques used are absolutely necessary. Interestingly, the article also identifies that we need to collect clinical data as well as urine testing, as neither is sufficient alone. This is a timely reminder to us all that we must talk to our patients, remembering that not everything that is obvious to us, as clinicians, is a problem for them, especially when they are at living at home. Both evidence and the nurse’s own observations are required.
Results
Overall, 59 tests were completed using the new device. From the patient details and based on clinician diagnosis and symptoms, it was possible to determine that 58 patients had been diagnosed as having a possible UTI before the U-test review took place, with 11 experiencing increased frequency of urination; nine having a temperature; five experiencing new incontinence; and four experiencing suprapubic pain.

There were 30 patients without two or more of the classical symptoms who had been diagnosed as positive for UTI anyway. A number of patients were reported as having acute confusion, general deterioration and infection of unknown source.

The rate of accurate UTI diagnosis based only on clinical judgement, compared with the accuracy of urine culture, was 56%. Where clinicians’ diagnoses were based on the presence of at least two signs or symptoms, the accuracy of predicting a positive urine culture and hence possible UTI, rose to 60%.

There were 24 patients whose culture showed no evidence of bacterial growth, yet four of these had been prescribed antimicrobial treatment for UTI infection. It was also noted that there were 12 patients who presented with ‘heavy mixed growth’ who could have been regarded as being contaminated — five of these were receiving antimicrobial treatment.

In total, there were 35 patients with a positive urine culture — 21 females and 14 males. The positive culture rate was 66% for females compared to 51% for males.

For the purposes of the review, the U-test recordings were considered to be a true positive if the nitrite reading was positive (with or without a positive leucocyte reading) when compared to the urine culture. If the U-test’s nitrite indicator was negative, with or without leucocytes, this was seen as a true negative when compared to the urine culture (this was a decision based on pragmatism, Little et al’s [2009] data and the knowledge that patients may have leucocytes present in their system but not be infected).

The results show the U-test had a positive predictive value (PPV) of 88.5%, and a negative predictive value (NVP) of 63.6%. This means that the U-test was better at detecting UTIs than ruling them out. The test’s overall rate of detection of UTI compared to urine culture was found to be 78% (Table 1).

Nurse feedback
Overall, the feedback from nurses who used the U-test was very positive. From the 10 responses received, there were no major issues described in terms of application and usage. The only negative comments were from two respondents regarding the interpretation of the result (Figure 1), in that it was not easy to determine due to very faint chemical changes.

The nurses who took part in this review were asked how they rated the product in terms of general use; adherence, interpretation of results; and whether it assisted with diagnosis. Overall, the respondents found the device useful in helping them to make clinical decisions (Figure 2). There were no reports of patient discomfort or any adverse skin reactions from the device.

DISCUSSION
The diagnosis of UTI can be a challenge, partly due to its diverse clinical presentations, especially in elderly patients. Similarly, UTI remains one of the most common but widely misunderstood and challenging infectious diseases encountered in clinical practice. Antimicrobial resistance is a particular concern, with few oral options available to treat infections caused by Gram-negative resistant organisms. For this reason, efforts should be made not to treat asymptomatic bacteriuria (SIGN, 2012).

Figure 1.
Nursing staff feedback on the test’s ease of use.

Figure 2.
Usefulness of the test according to users, who were asked ‘In your opinion, how useful do you think the product was in assessing UTI?’
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JCN has been around for a while, but read it now 21st century style, via tablets and smartphones, online and in print.
An integrated device that could assist clinical staff to make accurate UTI diagnosis could be a useful tool in certain patients. The U-test featured in this review has been integrated within nappies for use in paediatric patients (Krähenbühl et al, 2012), but so far data in its application within the adult population is sparse.

This review confirms the difficulties in reaching a diagnosis of UTI on signs and symptoms alone, with the accuracy being approximately 60%. It is acknowledged that there are many variables that can affect the accuracy of the urine dipstick test, and because of this all the available clinical signs and symptoms must be taken into consideration before a diagnosis is reached (Devillé et al, 2004).

The presence of nitrites in a sample does not necessarily mean that the patient has a UTI (HPA, 2011). The elderly population has an increased risk of asymptomatic bacteriuria, and, as such, a positive test should be viewed with caution in the absence of clinical signs and symptoms (HPA, 2011). However, if the patient does have symptoms, this can be a useful trigger to begin empiric treatment while the culture result is being processed.

The results from this review show that the U-test can be a useful aid in determining whether to initiate empiric treatment in those patients where urine samples can be difficult to obtain, or where there is likely to be a delay.

The nursing staff involved in the review found the U-test easy to use, and, overall, felt that it was something that could help them arrive at a clinical diagnosis.

The mean age of the patients involved in the review was 71 years and a significant number were confused, meaning that many would not have been able to provide a traditional urine sample for dipstick testing. Similarly, the presence of leucocytes in samples taken from pads are significantly lower because cellular material is partially retained.

However, the use of the U-test in this review overcame these problems as it sits on top of the pad.

LIMITATIONS

There were a number of limitations with this review, such as the small convenience sample size. It was also undertaken in one hospital during a short period of time, therefore, the sample may not have been representative.

Also, the monitoring was not undertaken at weekends or outside of normal office hours, and so some opportunities to recruit and follow-up additional patients and staff may have been missed.

CONCLUSION

Overall, this review suggests that the U-test may be a useful aid for specific patients where a urine sample may be more difficult to capture. Empirc treatment may be started if clinical signs and symptoms are severe enough and supported by a positive nitrite result.

However, the culture results must always be reviewed to determine whether the antibiotic agent is sensitive to any particular organism — this will help to mitigate against antimicrobial resistance. JCN

REFERENCES


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KEY POINTS

- Urinary tract infections (UTIs) are one of the commonest infections seen in primary and secondary care and consequently are often treated with antibiotics.
- Recently there has been an increasing amount of evidence highlighting the problem of bacterial resistance to antibiotics commonly used to treat UTI.
- Diagnosis of a UTI can be difficult, especially in elderly patients, and poses many challenges for nurses, including those working in the community, particularly in nursing and residential homes.
- This article has examined the adoption of a chemical indicator dipstick test.
- This test demonstrated good correlation with urine culture results and was seen as a useful additional tool to assist in the diagnosis of UTI, especially in those patients where urine samples may be more difficult to capture.
- The results from this review show that the U-test can be a useful aid in determining whether to initiate empiric treatment in those patients where urine samples can be difficult to obtain or where there is likely to be a delay.
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1. Krähenbühl et al.: Evaluation of a novel in vitro diagnostic device for the detection of urinary tract infections in diaper wearing children. Swiss Med Wkly. 2012;142:w13560. 2. Case study with 15 nursing home wards. Sponsor: SCA. 3. It takes one nurse one or two minutes to place a TENA U-test in pad during pad change, obtaining a urine sample for a dipstick test by taking the resident to the toilet, manoeuvring in bed, and if unsuccessful, inserting a catheter, can take one or two nurses 15–40 minutes. SCA, Extensive internal studies, 2011–2012

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