Clinical management of urinary tract infection in women: a prospective cohort study

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Background. It is unclear how symptoms of urinary tract infection (UTI) influence clinical management in terms of diagnostic testing and treatment with antibiotics.

Objectives. Our aim was to assess how 11 symptoms associated with UTI related to the probability of being tested (near patient test or urine culture) or treated with antibiotics by their GP, and to see if the same 11 symptoms were associated with (i) confirmed infection from urine culture and (ii) re-consultation complaining of the same symptoms within 1 month.

Methods. A prospective cohort study of 160 patients consulting their GP with symptoms of UTI in eight general practices in Avon, UK was carried out. Association between symptoms and the probability of being (i) tested by the near patient test, (ii) tested by urine culture or (iii) treated empirically with antibiotics were examined. The association between symptoms and the probability of being treated empirically or tested (near patient test or mid-stream urine) was examined. Likelihood ratios for symptoms and near patient test results compared with two ‘gold standards’ for diagnosis of UTI were calculated and their impact on post-test probability of UTI determined.

Results. GPs were far more likely to treat empirically patients with symptoms of dysuria and frequency [odds ratio (OR) 6.50, 95% confidence interval (CI) 2.02–20.89] or dysuria alone (OR 5.24, 95% CI 1.62–16.95). They were far less likely to perform diagnostic tests in patients with dysuria and frequency (OR for near patient testing 0.34, 95% CI 0.14–0.83; OR for urine culture 0.15, 95% CI 0.04–0.56). The prior probabilities of UTI were 25% (positive urine culture) and 29% (re-consultation within 1 month), respectively, for each of the ‘gold standards’ used. Individual symptoms and near patient tests did not raise the posterior probability of UTI irrespective of which ‘gold standard’ was used. The most useful symptom was a history of vomiting (likelihood ratio 2.96, 95% CI 0.3–31.2), but this occurred in only three patients.

Conclusions. Current clinical practice results in a large proportion of patients receiving unnecessary antibiotic treatment. Individual symptoms of UTI are an inadequate guide on which to base diagnostic testing and antibiotic treatment decisions in primary care. Either this diagnostic inaccuracy should be acknowledged as an inevitable part of clinical practice or more accurate clinical prediction rules that incorporate symptoms, signs and near patient test results that are applicable in everyday clinical practice are required.

Keywords. Diagnosis, physician’s practice patterns; urinary tract infections.

Introduction

There is uncertainty as to the diagnostic value of symptoms in patients with suspected urinary tract infection (UTI) in primary care. This uncertainty relates to how individual symptoms influence diagnostic testing (near patient test or urine culture) and treatment with antibiotics by GP. Despite the frequency of this condition,2 management strategies in terms of diagnosis, treatment and follow-up are inconsistent in clinical practice.
Algorithms and clinical prediction rules have been developed and tested in primary care settings, but these algorithms are not used commonly by most GPs, who rely on individual symptoms to determine their diagnostic and treatment strategies. Such an approach is now a cause for concern. Antibiotic resistance in urinary pathogens, particularly *Escherichia coli* and *Staphylococcus saprophyticus*, has increased significantly in the last decade, and is directly associated with prescribing of antibiotics by GPs.

As previous studies have relied on self-report, the aim of this study was to examine the actual clinical practice of GPs when managing UTI. In particular, we sought to answer the following questions: how do individuals’ symptoms of UTI influence GPs in their choice of diagnostic testing or empirical treatment with antibiotics; what is the prior probability of UTI in a UK primary care population; and what influence do individual symptoms have on the posterior probability of UTI in a primary care population.

**Methods**

We prospectively evaluated the diagnosis and treatment of patients presenting to eight Bristol practices between July and September 2000 with symptoms suggestive of UTI. Each participating GP agreed to complete a data collection sheet for each included patient (including those who consulted by telephone) that comprised the following categories: demographic details of the patient; symptoms and signs present at consultation (11 symptoms commonly associated with UTI were asked about explicitly); whether or not a near patient diagnostic test was undertaken and its result; whether a mid-stream urine (MSU) sample was taken; self-treatment undertaken by the patient; and treatment recommended by the GP. The practice was visited subsequently by one of us (EW), and patients’ notes were examined to determine the result of urine culture and to see whether the patient had re-consulted with urinary symptoms within 1 month of the initial consultation. Local research ethics committee approval for this study was obtained.

**Analysis**

Descriptive statistics of diagnostic strategies undertaken and treatment recommendations were made. We examined how 11 symptoms of UTI related to the probability of being tested (near patient test or urine culture) or treated with antibiotics. The diagnostic value of the same 11 symptoms was then estimated by calculating positive likelihood ratios (LRs), defined as the sensitivity/specificity, with 95% confidence intervals (CIs) around these estimates. Two ‘gold standards’ against which symptoms were measured were (i) confirmed infection from urine culture and (ii) re-consultation complaining of the same symptoms within 1 month.

We were then able to estimate the prior probability of UTI according to these two different ‘gold standards’ and assess the impact of individual symptoms on the post-test probability of having the target disorder by multiplying the pre-test odds by the LR. Estimation of post-test probability requires that the initial pre-test probability be converted to a pre-test odds (pre-test odds = pre-test probability/(1−pre-test probability)). The pre-test odds are then multiplied by the LR, and the post-test odds is then converted back to a post-test probability (post-test probability = post-test odds/post-test odds +1). A nomogram proposed by Fagan allows practitioners to go from pre-test to post-test probability without doing calculations of odds on each occasion. All calculations were made in Stata version 7.0.

**Sample size calculation**

GPs were asked to record data from every consultation in which the patient presented with symptoms suggestive of UTI during a 4-month period available for data collection. The study was designed principally to detect a difference in the proportion of patients with and without the specific symptoms of dysuria and frequency receiving empirical treatment from their GP. Previous work indicates that ~80–90% of patients with symptoms suggestive of UTI are treated empirically and that 75% of patients with suspected UTI have symptoms of dysuria and frequency. In order to detect a difference of 22 percentage points between these two groups in the proportion treated, with 80% power and 5% two-sided alpha, a total sample size of 145 is required, with a ratio of three to one in favour of patients with the symptoms.

**Results**

**Descriptive statistics**

A total of 160 patients consulted 29 (63% of those eligible) GPs in eight practices. The median number of patients recruited per practice was 15 (range 5–43). The median number of patients recruited per GP was four (range 1–20). Three patients moved away, and in seven patients there was incomplete data collection at either initial consultation or follow-up. Thus follow-up details on 150 (94%) patients were obtained. Of these patients, 37 had a confirmed UTI from urine culture, whilst 43 returned to surgery within 1 month, giving a range of pre-test probability of UTI in this population of patients of 25–29%. Over a third of patients, 52 (34%), had symptoms for a day or less prior to consultation (interquartile range 1–5 days). The majority of patients 132 (88%) were treated with an antibiotic, 66 (44%) of whom received a 3-day course, 32 (21%) a 5-day course and 32 (21%) a 7-day course. Trimethoprim was the first line agent used in 90 (60%) patients.

Thirteen men consulted with symptoms of UTI; all were tested by urine culture (six were positive) and 12
Ninety-two percent were given an immediate antibiotic. Two pregnant women consulted with symptoms of UTI, both were tested by urine culture (both subsequently negative) and both received an immediate antibiotic. These 15 individuals were removed from subsequent analyses because the management strategy of testing and treating with antibiotics differs from that of adult non-pregnant women with symptoms of UTI. In the remaining 135 women, 85 (63%) were tested by urine culture, whilst 59 (44%) had a near patient test. A significant minority of patients, 45 (33%), tried self-treatment remedies, usually increasing their fluid intake (39, 29%) or drinking cranberry juice (6, 4%). The majority 118 (87%) were treated with immediate antibiotics by their GP. In those 85 women who had a urine culture performed, 51 (60%) re-consulted within a month, 18 (21%) patients had a negative culture, received an antibiotic and re-consulted, and 27 (32%) had a positive culture, received an antibiotic and re-consulted.

**Relationship between symptoms and testing or treatment**

The combined symptom of dysuria and frequency was associated with an increased probability of being treated with an antibiotic (odds ratio [OR] 6.5) (Table 1). Dysuria and frequency were also significantly associated with a decreased probability of being tested by either near patient test (OR 0.34) or urine culture (OR 0.15) (Table 1). Patients complaining of dysuria were less likely to be tested by urine culture and more likely to be treated with an antibiotic. In patients with symptoms suggestive of higher urinary tract infection, back pain or abdominal pain, near patient testing was significantly more likely to occur, though testing by urine culture was not significantly more likely to occur (Table 1). The probability of having an MSU sample sent off to the laboratory was more likely if a patient had a positive near patient test result (OR 2.18, 95% CI 1.03–4.59).

**Likelihood ratios for symptoms of UTI**

The likelihood ratios for the symptoms of frequency and dysuria, either separately or together, did not change the probability of UTI substantially (Table 2). Figure 1 shows the prior probability (22 and 26% for the respective ‘gold standards’ of positive urine culture or return to surgery within 1 month) and the impact of symptoms on posterior probability for the two ‘gold standards’ in this study. For the common symptom of frequency and dysuria, the posterior probability was reduced to 21 and 24% for each of the ‘gold standards’ used. Other symptoms of frequency and dysuria have a similar impact on posterior probability. The most diagnostically useful symptom was a history of vomiting (LR 2.96), raising the posterior probability to 45.5% when the ‘gold standard’ was positive urine culture, but this symptom was present in only three patients.

**Likelihood ratios for near patient testing**

The diagnostic value of near patient test results was limited. A positive nitrite test (LR 2.04) raised the probability of a positive urine culture to 36.5%, whilst a positive near patient test for the presence of blood (LR 1.44) raised the probability of return within 1 month to 33.5% (Table 2).
<table>
<thead>
<tr>
<th>Symptom</th>
<th>‘Gold standard’ 1 Positive urine culture (n = 85)</th>
<th>'Gold standard' 2 Return within 1 month (n = 135)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n with symptom, likelihood ratio (95% CI)</td>
<td>n with symptom, likelihood ratio (95% CI)</td>
</tr>
<tr>
<td>Frequency and dysuria</td>
<td>n = 56, 0.94 (0.7–1.3)</td>
<td>n = 103, 0.88 (0.7–1.1)</td>
</tr>
<tr>
<td>Dysuria</td>
<td>n = 62, 1.02 (0.7–1.5)</td>
<td>n = 110, 0.82 (0.7–1.0)</td>
</tr>
<tr>
<td>Frequency</td>
<td>n = 71, 0.90 (0.7–1.1)</td>
<td>n = 118, 1.04 (0.9–1.2)</td>
</tr>
<tr>
<td>Haematuria</td>
<td>n = 11, 0.49 (0.1–1.7)</td>
<td>n = 22, 0.96 (0.4–2.3)</td>
</tr>
<tr>
<td>Urgency</td>
<td>n = 50, 1.10 (0.8–1.5)</td>
<td>n = 80, 0.70 (0.5–1.0)</td>
</tr>
<tr>
<td>Nocturia</td>
<td>n = 28, 1.30 (0.8–2.2)</td>
<td>n = 40, 0.69 (0.4–1.5)</td>
</tr>
<tr>
<td>Nausea</td>
<td>n = 17, 1.61 (0.7–3.7)</td>
<td>n = 24, 0.87 (0.4–2.0)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>n = 3, 2.96 (0.3–31.2)</td>
<td>n = 3, 0*</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>n = 30, 0.97 (0.6–1.7)</td>
<td>n = 45, 1.29 (0.8–2.1)</td>
</tr>
<tr>
<td>Back pain</td>
<td>n = 23, 1.15 (0.6–2.3)</td>
<td>n = 32, 0.72 (0.3–1.5)</td>
</tr>
<tr>
<td>Vaginal discharge</td>
<td>n = 4, 1.48 (0.2–9.9)</td>
<td>n = 6, 0.54 (0.1–4.5)</td>
</tr>
<tr>
<td>Positive near patient test</td>
<td>n = 45, 0.67 (0.4–1.1)</td>
<td>n = 85, 1.25 (0.8–1.9)</td>
</tr>
<tr>
<td>Positive blood (near patient test)</td>
<td>n = 27, 1.20 (0.8–1.9)</td>
<td>n = 41, 1.44 (0.9–2.2)</td>
</tr>
<tr>
<td>Positive protein (near patient test)</td>
<td>n = 8, 1.56 (0.9–2.6)</td>
<td>n = 41, 1.13 (0.7–1.7)</td>
</tr>
<tr>
<td>Positive leucocyte (near patient test)</td>
<td>n = 7, 1.33 (0.7–2.4)</td>
<td>n = 30, 0.65 (0.3–1.3)</td>
</tr>
<tr>
<td>Positive nitrite (near patient test)</td>
<td>n = 5, 2.04 (0.7–6.3)</td>
<td>n = 20, 0.55 (0.2–2.0)</td>
</tr>
</tbody>
</table>

* None of the three patients with vomiting returned within 1 month.

![Figure 1](image.png)

**Figure 1** Influence of symptoms on posterior probability of UTI according to two different ‘gold standards’
Discussion

This study demonstrates that GPs are more likely to treat patients with antibiotics and less likely to undertake further testing, by either near patient test or urine culture, when certain specific symptoms of UTI are present, most particularly a history of frequency and dysuria or a history of dysuria alone (Table 1). Unfortunately, the same symptoms raise the posterior probability of UTI to no greater than 30% (Table 2). A history of vomiting appears to be the only symptom that has diagnostic value, raising the probability of UTI (judged by positive urine culture) to 46%. However, this symptom was only present in three patients, so is of little practical value in primary care. It seems that GPs are either systematically overestimating the diagnostic value of individual symptoms or accept that for every patient appropriately treated with an antibiotic between one and three more patients will receive unnecessary antibiotic treatment. It should be noted that the strength of this study design is that it is evaluating actual clinical practice and not relying on self-report.

Implications of study findings

The implications of these findings are important as urinary symptoms are common and are treated with antibiotics in nearly 90% of cases. It should be emphasized that the GPs in this study are following recommended management strategies for UTI. Cost-effectiveness studies favour empirical treatment over diagnostic testing and subsequent treatment of positive cases,11,12 and randomized trials which have implemented UTI guideline recommendations also encourage empirical treatment with trimethoprim.13 It is interesting to note that whilst antibiotic prescribing between 1993 and 1997 decreased by 19–26% for respiratory conditions, there was a much smaller decline in antibiotic prescribing for UTI (6%).14 It seems likely that in the context of increased antibiotic resistance,5,6,15 a policy of empirical treatment (particularly courses for ≥5 days as occurred in 42% of patients in our study) may not be sustainable in the future.

Context of other studies

The prior probability of infection (confirmed by culture) has been recorded at 36% in an unselected primary care population of women consulting with symptoms of UTI.3 The findings from this study are lower than this estimate, but the misclassification may be due to the fact that 85 (63%) women in this study had an MSU sample taken. The poor diagnostic performance of individual symptoms of UTI and findings from near patient test examination have also been reported previously,3,16–18 and show that the predictive values of individual symptoms or near patient test results are much lower in primary care populations than when assessed in more selective hospital-based populations. For other acute infectious diseases seen by GPs, a similar picture emerges. No individual symptom or finding from the physical examination is accurate enough by itself to rule in a target disorder. This applies to conditions such as group A β-haemolytic streptococcus pharyngitis,19 acute sinusitis20 and pneumonia.21 It seems likely that for most acute infectious illness dealt with by GPs, the antibiotic treatment threshold (the level of probability above which treatment is recommended) is at most 40%.

If the current state of inaccurate diagnostic labelling of UTI is to change, then a new paradigm in the diagnosis of UTI in primary care is needed. Development and testing of a clinical prediction rule that can incorporate the elements of history, examination and near patient test testing, and thus improve diagnostic accuracy for UTI in primary care, is required.22 Two clinical prediction rules have been developed,3,4 but only one of these has been tested in a different primary care population, external to the original study population.4 It is also important that such an approach takes into account the group of women who experience urinary symptoms in whom pyuria and bacterial organisms are absent—the so-called urethral syndrome.23 This form of symptom attribution is still relatively poorly defined in primary care,24 and incorporation of psycho-social factors, including past consultation history with similar symptoms, when taking a history may have a predictive value in ruling out bacterial infection.25

Limitations of the study

There are several shortcomings to this study. The two ‘gold standards’ used to define the target disorder of UTI are not entirely satisfactory. Urine culture was defined in this study as a colony count >10⁶ organisms per ml of urine, presence of pyuria and identifiable organism. It has been shown that colony counts far lower than this value may also be associated with urinary symptoms and that symptoms may relate to one of six clinical conditions (subclinical pyelonephritis, lower urinary tract bacterial infection, chlamydia urethritis, other forms of urethritis, vaginitis or dysuria without any urinary tract or vaginal infection) each of which require different management strategies.25 Establishing whether pyuria is present is probably of greater diagnostic value than obtaining a urine culture,25 but urinalysis is rarely performed in UK primary care. Only 63% of patients were asked to provide an MSU sample, resulting in ‘spectrum’ bias in the investigation of the diagnostic value of urinary symptoms.26 For this reason, we chose a second ‘gold standard’, return to surgery within 1 month. This second ‘gold standard’ has the advantage that it equates more accurately to poor clinical outcome for these patients. Lastly, it is not likely that all consecutive patients were recruited to this study and that the availability of microbiological specimen collection may have influenced GPs’ likelihood of sending off an MSU sample.

There were some important elements of a patients’ history which we did not ask GPs to report, particularly
a history of recent sexual activity or psycho-social symptoms.\textsuperscript{27,28} This was because individual patient consent would have been required and this would have severely limited recruitment of patients within the constraints of funding available for this study. Lastly, the number of individuals undergoing near patient testing is small, possibly leading to a ‘spectrum’ bias when evaluating the diagnostic value of this test.\textsuperscript{26} As this was a pragmatic study which aimed to evaluate current diagnostic strategies and as GPs were using near patient tests selectively, it is most likely that the direction of bias is towards exaggerating the diagnostic utility of this form of near patient testing.

Conclusions

Individual symptoms of UTI are an inadequate guide on which to base antibiotic treatment decisions in primary care. Current practice by GPs suggests that too much weight is given to individual symptoms when deciding on antibiotic treatment and, for a significant minority of patients, duration of therapy is too long. If the volume of antibiotic prescribing is to be reduced and the increasing problem of resistant organisms addressed, alternative diagnostic and treatment strategies in primary care are needed.\textsuperscript{29}

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