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Diagnosing urinary tract infection in adults: a mapping review

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ABSTRACT

Background

Urine testing for possible infection should be uncontroversial – urinary problems are common, and their assessment and management are widely taught. There are national guidelines that clarify the approach to testing for infection and there are well-articulated adverse outcomes associated with sub-optimal care, including missed diagnoses, harms from unnecessary antibiotics, antimicrobial resistance and increased costs.

Method

We undertook a mapping review of the existing reviews in MEDLINE (2008-2014) and described the themes emerging from the higher quality papers, using a narrative synthesis.

Results

272 review papers were identified but only 3 remained following application of inclusion/exclusion criteria and quality checking. The three retained reviews identified four common areas relevant to the diagnosis and management of possible UTI:

- Defining and diagnosing urinary tract infection
- Urine dip interpretation and the role of urine cultures (including urine collection processes)
- Asymptomatic bacteriuria (especially in care home residents)
- 'Human factors' (the pressure to 'do something')

Discussion

There is general agreement regarding the definition of urinary tract infection and clear guidelines as to the use of urinary dipstick testing, including an acknowledgement of the conundrum of asymptomatic bacteriuria. Variability in practice appears common and is at least in part driven by human factors.

Over-reliance on urinary tests such as urine analyses and urine cultures can lead to unnecessary treatment of asymptomatic bacteriuria as well as adverse drug events, Clostridium difficile infection, and antimicrobial resistance. Consensus guidelines exist to guide clinicians, but appear to be poorly appreciated or understood.

Missing from the literature reviewed was an in-depth understanding of why clinicians do not seem to be aware of or follow existing guidance. We propose further work to explore this in more detail.

Background

Urinary Tract Infection (UTI) is the second most common clinical indication for empirical antimicrobial treatment in primary and secondary care, and urine samples constitute the largest single category of specimens examined in most medical microbiology laboratories [12]. Guidelines describe the approach for diagnosing UTI: detection of pathogen in the urine in the presence of clinical symptoms of dysuria, frequency, suprapubic tenderness, urgency, polyuria, and haematuria [1-3].

There is evidence of variation in the use of diagnostic tests, interpretation of signs or symptoms and initiation of antibiotic treatment [4-7]. The diagnosis of UTI can be particularly difficult in older patients, who are more likely to have asymptomatic bacteriuria [4-9] and confounded by communication barriers, chronic genitourinary symptoms, and comorbidities [10-12].

This is important because potentially unnecessary use of antibiotics leads to increased resistance in common uropathogens, specifically the emergence of multidrug resistant ESBL-producing *E.coli* and *Klebsiella* species¹. Over-use of antibiotics increases the risk of complications, such as Clostridial diarrhoea, as well as unnecessary costs. There is also a potential opportunity cost in terms of missed diagnoses – incorrect interpretation of urine dipstick testing can lead to the true diagnoses being missed and delays in treatment.

In order to gain a deeper understanding of the issues pertaining to the diagnosis of UTI, we undertook a mapping review [13] of the existing literature.

Method

A mapping review is designed to identify and categorise the existing literature to identify gaps which require further review or primary research [13].

A search of MEDLINE was conducted using the following terms: UTI OR urinary tract infection OR urin* infection OR urine dip OR urine AND dipstick OR urinalysis. The search was limited to: English language, humans, adults (19+ years), publication year 2008-2014 and review articles.

Inclusion criteria

- Review articles that covered lower urinary tract infection diagnosis
- Included older adults (>65)

Exclusion criteria

- Primary studies or editorials
- Focussing on complicated UTI (e.g. sepsis, involvement on upper urinary tract), children or pregnant women
- Reviews focussing upon patients with in-dwelling urinary catheters

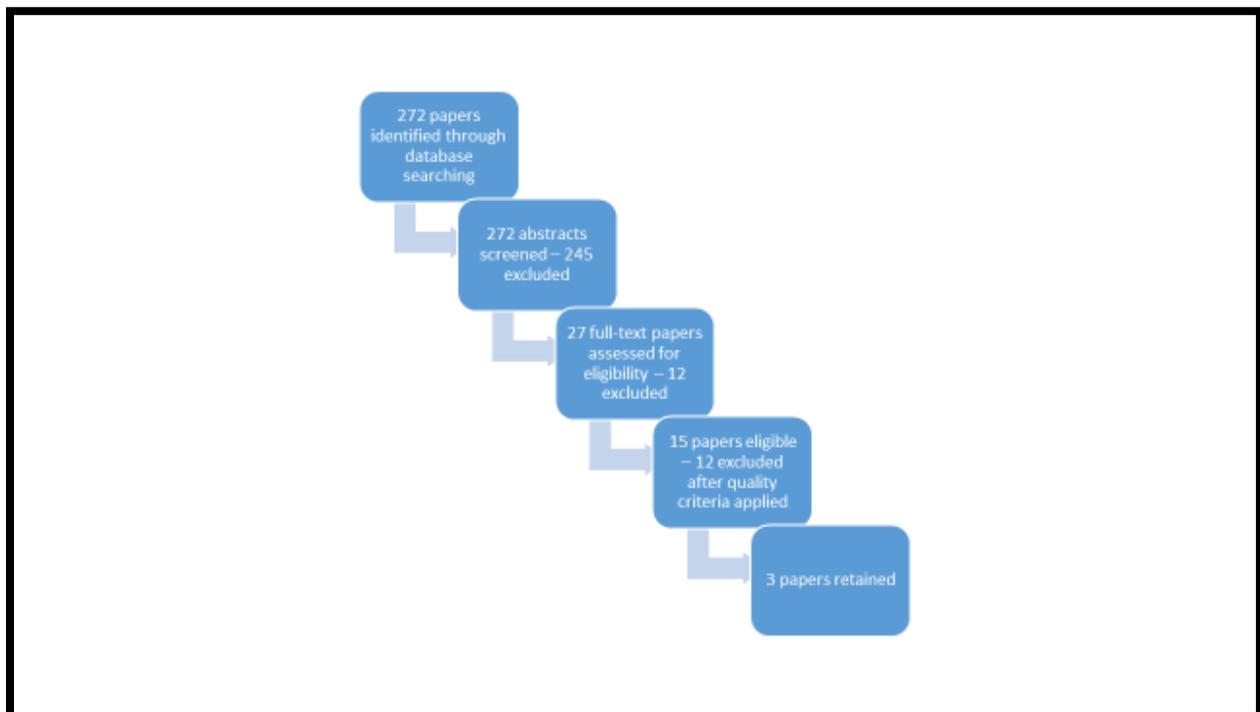
- Reviews focussing purely on treatment

Titles and abstracts were reviewed by two reviewers and consensus was reached on studies to exclude; full text articles were sought when abstracts were unclear or absent. Finally, quality assessment of retained papers was undertaken using the Critical Appraisal Skills Programme (CASP) Checklist for Review Articles [14]. The CASP tool for systematic reviews consists of 10 questions, of which seven or eight (depending on whether or not there was a meta-analysis) can be scored 0/1/2, giving a maximum score per paper of 14-16 marks. We assigned a percentage rating to each paper to allow for differences in the scoring system, and papers scoring above 50% that met the selection criteria were included in the scoping exercise.

Results

Initially, 272 articles were identified; after review of the title and abstract by the two reviewers, 27 were retained (*Figure 1*). The same paired reviewers applied the inclusion/exclusion criteria to the twenty-seven full-text articles and were in agreement on 12 papers for exclusion. Fifteen articles were identified as potentially eligible, but only three met the quality criteria, and were retained.

Figure 1 Paper selection process



Of the three retained articles (Mody 2014 [15], Grigoryan 2014 [16], Schmiemann 2010 [17], two focussed on women (one in women with diabetes), and all three looked at diagnostic accuracy and treatment options. The overall quality of the reviews (CASP scores 50%, 56% & 80%) and the primary papers they cited and rated was low. Four key themes emerged: defining and diagnosing UTI, urine dip testing and urine culture, asymptomatic bacteriuria and 'human factors', discussed in more detail below. Two of the reviews also discussed treatment options (i.e. which antibiotics to use), but we do not report upon that issue here.

Figure 2 Summary information from retained papers

Paper	Aim	CASP rating	Databases used and search criteria	Studies included	Summary of results
Mody 2014 [15]	To review management of asymptomatic bacteriuria an symptomatic UTI and review prevention of recurrent UTIs in older community-dwelling women	50%	Ovid English-language Human studies Adults aged 65 and over Published in peer-review journals from 1946-2013 Clear search terms detailed	3 case control & 6 cohort studies looking at risk factors and 13 mixed studies (combination of observational, cohort, case-control and RCTs) looking at treatment regimes	New onset dysuria is one of the best indicators of a potential symptomatic UTI In older patients, urinary studies should only be performed if a patient’s symptoms worsen acutely and there is no other identifiable cause Non-specific symptoms should not be the only reason for obtaining urinary studies Suggested approach to the evaluation and treatment of older women with a suspected UTI devised
Grigoryan 2014 [16]	To define the optimal approach for treating acute cystitis in young healthy women and in women with diabetes and men and to define the optimal approach for diagnosing acute cystitis in the outpatient setting	80%	PubMed and the Cochrane database English language Up to July 2014	27 RCTs, 6 systematic reviews, 11 observational studies 33 studies made the final review	Uncomplicated cystitis is a common condition that can often be successfully diagnosed and treated without urine culture Increasing resistance rates among uropathogens have complicated treatment of acute cystitis
Schmiemann 2010 [17]	To review diagnostic accuracy of UTI in order to guide specific use of antibiotic therapy.	56%	Medline, EMBASE, CCMed and Cochrane databases German and English From 1999 to 2009 Clear search terms Contacted authors for missing data	16 articles included, mainly observational studies	Diagnosing UTI on purely clinical symptoms is often wrong Asymptomatic bacteriuria only requires treatment in exceptional cases Diagnostic precision can be increased by using urine dip sticks and clinical algorithms

Defining and diagnosing urinary tract infection

There was agreement about the criteria necessary to diagnose UTI: the presence of new urinary tract symptoms such as frequency, urgency, dysuria, new incontinence, or costovertebral or suprapubic tenderness and a urine culture that grew 10 [3-5] colony forming units (CFU)/mL of an uropathogenic organism.

For acute uncomplicated cystitis, it was generally agreed that treatment could be based upon signs and symptoms only – without a urine culture – but with longer treatment courses for men.

In older people, including care home residents and those with barriers to communication such as stroke or dementia, signs and symptoms can be far less clear, with clinicians attributing factors such as fever, functional decline, increased confusion, and non-specific signs and symptoms such as back pain or constipation to urinary tract infections and starting treatment on this basis.

In summary, the literature consistently indicates that in the absence of clear symptoms and signs localising to the urinary tract, older patients and those with communication barriers should be comprehensively and systematically assessed in order to arrive at a differential diagnosis.

Urine dip interpretation and urine culture

Urine collection

All three papers emphasised the existing evidence that describes a 'clean catch' mid-stream specimen of urine – and frequently acknowledged that this may be hard to achieve in clinical practice, especially for older people with functional and/or cognitive impairment.

Urine dip testing

The diagnosis of UTI should be based on systemic or localised symptoms in conjunction with a positive urine culture, however a urine culture is typically not available to guide diagnosis or therapy at the time therapeutic decisions need to be made. There was agreement across all three reviews that there was little to be gained by adding urine dip testing in the presence of at least two new lower urinary tract symptoms. Mody *et al* [15] advocated that urine dipstick analysis should be used primarily to rule out and not to establish a diagnosis of UTI.

Urine culture

Studies comparing urine specimens in women with cystitis have shown that traditional criterion for a positive culture of urine (10 [5] colony-forming units per millilitre) is insensitive for bladder infection and 30-50% of women with cystitis have colony counts of 10 [2] to 10 [4] colony-forming units per millilitre in voided urine. Laboratories have different criterion for a positive urine culture and since most clinical laboratories do not quantify bacteria below a threshold of 10,000 colony-forming units per millilitre in voided urine specimens, a culture report of 'no growth' in a woman with urinary symptoms does

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not necessarily mean that UTI is not present. This supports the view that patients presenting with classical UTI features can be diagnosed and treated without the need for dipstick testing or urine culture.

Asymptomatic bacteriuria

All reviews recognised the conundrum of asymptomatic bacteriuria (present if a patient does not exhibit the clinical features of UTI and the upper limit of ≥ 10 [5] CFU/mL is exceeded on culture). Asymptomatic bacteriuria reaches 50% in some populations (namely older people in long term care), and is commonly associated with positive urine dip tests. All the reviews emphasised the importance of new symptoms to guide decisions about treatment, and avoiding the pressure to treat given the limited evidence of benefit.

In the bacteriuric care home resident, any alteration in clinical status without localised findings might be misinterpreted as urinary tract infection. Given the high prevalence of positive urine cultures, this can lead to substantial over-diagnosis. Changes in the character of the urine such as odour, colour, or turbidity may be due to incontinence or dehydration should not be the sole basis of a diagnosis of urinary tract infection [15].

Human factors

Although not explicitly stated as such, all three papers made reference to clinician and/or patient pressures to 'do something'. If there is diagnostic uncertainty, for example in care home residents, the options available to the clinician are to commence antimicrobial therapy or to observe and monitor, seeking alternative explanations for the change in condition. Clinicians frequently opt for antimicrobial therapy citing concerns over missing an infection, delaying treatment, or not meeting a resident's or family's expectations. In doing so, clinicians overvalue the benefits of immediate antimicrobial therapy to the patient and undervalue the strong likelihood of negative outcomes.

A common finding from the literature was that urine tests drive treatment decisions. If a urine test is ordered, there is a high likelihood the resident will receive antibiotic treatment, regardless of whether a UTI is present or not. One study found that 71% of asymptomatic older adults presenting to the emergency department for reasons unrelated to possible urine infection were treated with antibiotics despite having no symptoms of UTI and negative urine cultures [10]. Despite agreement regarding the signs and symptoms that constitute a diagnosis of urinary tract infection, clinicians continue to commence antimicrobial treatment to cover urinary tract infection in the absence of these criteria.

Mody *et al* [15] noted the frequent resolution of urinary symptoms without antibiotic therapy, advocating a watch and wait policy. However, watchful waiting is not considered to be 'taking action'; yet observation and monitoring of residents in whom the diagnosis of UTI is being considered allows for further data gathering, can provide reassurance to residents and family members, may optimise antimicrobial therapy, and minimises the chance of misdiagnosis.

Discussion

Our mapping review indicated that there is general concordance regarding the definition of urinary tract infection and clear guidelines as to the use of urinary dipstick testing. Similarly, asymptomatic bacteriuria in the older patient or care home resident cohort can be wrongly attributed to UTI due to poor correlation with clinical signs and symptoms. Human factors and behaviours also play a role in the incorrect diagnosis of UTI; possible reasons for this include a need to fulfill patient expectations and fear of adverse outcomes. All three articles raised concerns about increasing resistance rates among uropathogens.

A strength of this mapping exercise was the systematic and inclusive approach used to identify relevant studies. The use of two independent reviewers to appraise abstracts prior to selection ensured that only relevant reviews made the final set. We have included only higher quality articles, which means that many of the papers that offered useful insights but were not of high quality, have been excluded.

Over-reliance on urinary tests such as urine analyses and urine cultures can lead to unnecessary treatment of asymptomatic bacteriuria (which frequently recurs [15]) as well as adverse drug events, Clostridium difficile infection, and antimicrobial resistance. This is particularly true in care home populations where asymptomatic bacteriuria is prevalent (15-50%) and in whom non-specific presentations are common.

There is evidence that treating UTI does little to alter prognosis in people with advanced dementia, yet this is a common scenario [18]. The Loeb criteria (Consensus guidelines from 2005) addressed this diagnostic uncertainty by recommending clinical criteria for initiation of empiric antimicrobial therapy for presumed infection in care home residents [3,10]. Urine testing in this cohort should only be performed when there is a reasonable likelihood that the patient may have a UTI (*Figure 3*), as judged by meeting at least minimal criteria for initiating antibiotics.

Figure 3 2005 Loeb Diagnostic Criteria for Urinary Tract Infection in Long Term Care

Minimum criteria for Ordering a Urine Culture		
Fever >37.9°C and 1 or more of the following, order a urine culture: <ul style="list-style-type: none"> - Dysuria - Urgency - Flank pain - Shaking chills - Urinary incontinence - Frequency - Gross haematuria - Suprapubic pain 	OR If no fever, order urine culture if there is new onset burning on urination, or 2 or more of the following: <ul style="list-style-type: none"> - Urgency - Flank pain - Shaking Chills - Urinary incontinence - Frequency - Gross haematuria - Suprapubic pain 	OR If fever >37.9°C but 2 or more symptoms of non-UTI infection, DO NOT ORDER A URINE

Our findings demonstrate inconsistency between guidelines and practice with regard to urine dipstick testing. Despite the relative paucity of studies addressing this, human factors appear to partly account for the discrepancy between the established knowledge, and its application in clinical practice. By identifying and recognising the behaviours that contribute to incorrectly arriving at a diagnosis of UTI clinicians may then be able to make better and more accurate clinical decisions.

Michie *et al* [19] aimed to simplify psychological theory relevant to behaviour change and identified 12 theoretical domains that should be considered when seeking explanations for failure to implement evidence based practice: knowledge; skills; social/professional role and identity; beliefs about capabilities; beliefs about consequences; motivations and goals; memory, attention and decision processes; environmental context and resources; social influences; emotion; behavioural regulation; and nature of the behaviours.

By using these domains we can explore the behavioural factors impacting upon UTI diagnosis. Questions may include exploring what clinicians feel will happen if they do not diagnose UTI, how much they need to feel they need to make a diagnosis and to what extent emotional factors facilitate or hinder making a diagnosis of UTI. The responses may provide insight into beliefs about consequences, motivation and emotions. By then implementing an intervention that draws on these responses and the theories of human behaviour, a more robust solution to this problem may be devised.

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