Does this child have a urinary tract infection?

CRD summary
This review assessed the diagnostic accuracy of signs and symptoms for urinary tract infection (UTI) in children. The authors concluded that individual signs and symptoms are useful but insufficient to diagnose UTI, whereas combinations can be used to identify children with a low likelihood of UTI. The review was generally well conducted, but the data presented were sparse and weak, rendering the authors' conclusions somewhat optimistic.

Authors' objectives
To assess the diagnostic accuracy of signs and symptoms for the diagnosis of urinary tract infection (UTI) in children.

Searching
MEDLINE and EMBASE were searched from inception to October 2007; the search terms were reported. The bibliographies of all included studies, one previous systematic review and a selection of textbooks were handsearched, and field experts were contacted to identify additional studies. No language restrictions were applied.

Study selection
Study designs of evaluations included in the review
Prospective studies of diagnostic accuracy were eligible for inclusion. Case series with fewer than 10 patients and case-control studies were excluded.

Specific interventions included in the review
Studies evaluating one or more components of a clinical history or physical examination for the diagnosis of UTI were eligible for inclusion. The included studies considered a variety of signs and symptoms: ethnicity; history of UTI; temperature or fever; vomiting; diarrhoea; poor feeding; irritability; ill appearance; circumcision status in male infants; suprapubic tenderness; back pain; abdominal pain; dysuria or frequency; new-onset urinary incontinence; urine odour.

Reference standard test against which the new test was compared
Studies were eligible for inclusion if the diagnosis of UTI was made by urine culture. The included studies used various urine sampling methods (bag, clean-catch, catheter or suprapubic aspiration) and a diagnostic threshold for UTI of 50,000 or 10,000 colony-forming units per millilitre.

Participants included in the review
Studies were eligible for inclusion if they were conducted in children aged 18 years or younger; studies of high-risk populations were excluded. The majority of the included studies (8 out of 12) were conducted in children under the age of 2 years; two were in children younger than 5 or 6 years and two were in children aged under 15 years. The prevalence of UTI in the included studies ranged from 3.3 to 13.8%.

Outcomes assessed in the review
The included studies were required to report data on the accuracy or precision of signs and symptoms for the diagnosis of UTI, including sufficient data to calculate likelihood ratios (LRs). Positive and negative LRs, along with 95% confidence intervals (CIs), were reported for each study and sign or symptom.

How were decisions on the relevance of primary studies made?
Two authors independently screened studies for inclusion.

Assessment of study quality
Two authors independently assessed the methodological quality of the included studies. The criteria used addressed the
blinding of those interpreting signs and symptoms to the results of the reference standard test, the application of an appropriate reference standard, and the sample size. The studies were assigned a quality level from 1 (high) to 5.

**Data extraction**
Two authors independently abstracted the data from each included study. For some studies, additional data were obtained from the authors.

**Methods of synthesis**
How were the studies combined?
Where data on a sign or symptom were available for at least 3 studies, a random-effects model was used to generate summary estimates for LRs; otherwise, the studies were combined in a narrative. A diagnostic algorithm for verbal children, older than 24 months and with urinary or abdominal symptoms, was also presented; the post-test probabilities of UTI used in this algorithm were derived from the prevalence of UTI and summary LRs.

How were differences between studies investigated?
Studies were stratified for meta-analyses based on the age of the participants and whether or not they were verbal. Other potential sources of heterogeneity, including urine sampling method and cut-off threshold for a positive urine culture, were discussed in the text.

**Results of the review**
Twelve studies with a total of 8,837 participants were included in the review. All the included studies were of quality level 1 to 4. Two studies classed as level 5 were excluded.

All of the included studies were assigned quality levels between 1 and 4. Half of the included studies were of quality level 1 (independent, blind comparisons of signs and symptoms with urine culture, in 200 or more consecutive participants with suspected UTI).

Precision of signs and symptoms.
One study quantified agreement on clinical history and examination between the examining physician and study nurse: agreement was fair to good (measured by the kappa statistic) between 200 physician/nurse pairs.

Diagnostic accuracy of signs and symptoms in febrile infants under 2 years.
The findings considered most useful for identifying infants with a UTI were previous history of UTI (positive LR 2.3 and 2.9; 2 studies), temperature higher than 40 degrees C (positive LR 3.2 and 3.3; 2 studies), supra-public tenderness (positive LR 4.4, 95% confidence interval, CI: 1.6, 12.4; 1 study) and lack of circumcision in male infants (positive LR 2.8, 95% CI: 1.9, 4.3; 6 studies). Presence of circumcision in male infants was the only finding with a negative LR below 0.5 (summary negative LR 0.33, 95% CI: 0.18, 0.63; 6 studies). Combinations of findings were considered more useful than individual signs and symptoms for identifying individuals with UTI: for a temperature above 39 degrees C for more than 48 hours and the absence of another potential source of fever, the positive LR for all other signs and symptoms present was 4.0 (95% CI: 1.2, 13.0), whereas for a temperature below 39 degrees C and the presence of another source of fever, the positive LR was 0.37 (95% CI: 0.16, 0.85); these observations were based on data from 2 separate individual studies and no definition of ‘all other signs and symptoms’ was provided.

Diagnostic accuracy of signs and symptoms in verbal children.
Abdominal pain (positive LR 6.3, 95% CI: 2.5, 16.0; 1 study), back pain (positive LR 3.6, 95% CI: 2.1, 6.1; 1 study), dysuria and/or frequency (positive LR range: 2.2 to 2.8; 3 studies) and new-onset urinary incontinence (positive LR 4.6, 95% CI: 2.8, 7.6; 1 study) increased the likelihood of UTI.

A diagnostic algorithm, in the form of a flow chart, was presented for verbal children older than 24 months with urinary or abdominal symptoms.
Authors' conclusions
Individual signs and symptoms can be helpful but are not sufficiently accurate to diagnose UTI. Combinations of findings can be used to identify infants with a low likelihood of UTI.

CRD commentary
The review addressed a clearly stated research question, which was defined by appropriate inclusion criteria. The literature search was adequate to ensure a reasonable rate of retrieval of the available data and no language restrictions were applied. Appropriate measures to reduce the potential for error and bias in the review process were reported. Sufficient details of the included studies were reported to facilitate interpretation and application of the results provided. Some limited aspects of methodological quality, relevant to studies of diagnostic accuracy, were assessed. However, the results of the quality assessment were presented only as a summary grade and 2 studies were excluded on the basis of quality score (not specified in the stated inclusion and exclusion criteria).

The majority of the results presented by the authors were based on observations from one or two individual studies. Meta-analyses, where presented, were weakened by the small numbers of studies involved and the potential for between-study heterogeneity (not formally assessed). In general, the authors’ conclusions appear optimistic since the positive LRss presented (even for combinations of signs and symptoms) only reached levels generally considered to indicate a small increase in the likelihood of disease. The combination data on identifying infants with low likelihood of UTI were presented as a positive LR; assuming this to be an error and the data to represent a negative LR, it is again at the level generally considered to represent only a small decrease in the likelihood of disease.

Implications of the review for practice and research
Practice: The authors presented their work as a tool to estimate the pre-test (dipstick or culture) probability of UTI in children. They recommended that urinalysis and culture should be considered for all febrile infants younger than 3 months; catheterisation (for urine sampling) should be considered in uncircumcised males aged 3 to 24 months when risk factors for UTI are present and in circumcised males aged 3 to 24 months when two or more signs or symptoms are present; further testing should be considered in febrile female infants aged 3 to 24 months with any risk factor for UTI; verbal children with signs or symptoms of UTI should have a urine sample collected for diagnostic testing. Research: The authors stated the need for more research into the relationship between race and UTI.

Bibliographic details

PubMedID
18159059

DOI
10.1001/jama.298.24.2895

Original Paper URL
http://jama.ama-assn.org/

Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Algorithms; Child; Child, Preschool; Diagnosis, Differential; Female; Fever; Humans; Infant; Male; Urinalysis; Urinary Tract Infections /diagnosis /epidemiology

AccessionNumber
Record Status

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