Does This Child Have a Urinary Tract Infection?

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RATIONAL CLINICAL EXAMINATION REVIEW SOURCE

This is a rational clinical examination abstract, a regular feature of the *Annals*' Evidence-Based Emergency Medicine (EBEM) series. Each features an abstract of a rational clinical examination review from the *Journal of the American Medical Association* and a commentary by an emergency physician knowledgeable in the subject area.

The source for this rational clinical examination review abstract is: Shaikh N, Morone NE, Lopez J, et al. Does this child have a urinary tract infection? *JAMA*. 2007;298:2985-2904. The *Annals*' EBEM editors assisted in the preparation of the abstract of this rational clinical examination review, as well as selection of the Evidence-Based Medicine Teaching Points.

OBJECTIVE

To systematically review the evidence for the accuracy of the medical history, physical examination, and urinalysis in making a diagnosis of pediatric urinary tract infection.

DATA SOURCES

A systematic search of MEDLINE and EMBASE databases for articles published between January 1966 and October 2007 was performed. Non–English-language articles that met inclusion criteria were translated into English before review. This search was supplemented by a manual review of all included article bibliographies, as well as by the inclusion of data from a previously published systematic review, 3 commonly used clinical skills textbooks, and 2 experts.

STUDY SELECTION

Two authors independently screened the titles and abstracts of the search results. Included articles reported original prospective data on the accuracy or precision of medical history or physical examination findings in diagnosing acute culture-proven urinary tract infection in children through 18 years of age. Studies were excluded if they evaluated only adult populations, enrolled only a narrow spectrum of children with urinary tract infection (asymptomatic bacteriuria, high-risk subgroups such as premature birth, sexual abuse, or genitourinary abnormalities), or included patients according to the presence of symptomatic illnesses other than urinary tract infection and fever. Case-series and case-control studies were excluded, as were those with insufficient data to calculate likelihood ratios (LRs) for signs and symptoms of acute urinary tract infection.

DATA EXTRACTION AND ANALYSIS

Articles were independently reviewed, rated, and abstracted by 2 authors, with methodological quality graded using a preestablished rating system. Study data that met inclusion criteria were used to calculate summary LRs for each variable. Because the LRs for all signs and symptoms were similar across studies of infants aged 0 to 24 months, the LRs were pooled. Studies of verbal children were grouped and analyzed together. When 3 or more studies presented data on a specific finding, a random-effects model was used to generate conservative summary measures.

MAIN RESULTS

Twelve articles involving 8,837 children up to aged 15 years met all the inclusion criteria. For infants, fever was the main inclusion criterion, whereas studies of older children used a comprehensive list of signs and symptoms. The highest prevalence was observed in boys younger than 3 months and girls younger than 12 months (Table 1). Black children seemed to have a lower urinary tract infection prevalence than other ethnic groups. Among the 6 ED-based studies, urinary tract infection prevalence ranged from 5.3% to 13.8%. One study assessed interrater reliability of findings from medical history and examination, with good agreement for duration of fever (κ=0.75) but poor agreement for any

Table 1. Diagnostic accuracy of selected urinary tract infection symptoms and signs—0 to 24 months of age.

Symptoms	Positive LR (95% CI)	Negative LR (95% CI)
History of UTI*	2.3 (0.3-17.4) to 2.9 (1.2-7.1)	0.95 (0.89-1.02) to 0.97 (0.89-1.07)
Temperature >40°C*	3.2 (0.7-15.6) to 3.3 (1.3-8.3)	0.66 (0.35-1.25) to 0.93 (0.80-1.08)
Prolonged fever >24 h[†]	2.0 (1.4-2.9)	0.90 (0.83-0.97)
Suprapubic tenderness	4.4 (1.6-12.4)	0.96 (0.90-1.01)
Uncircumcised male infants[†]	2.8 (1.9-4.3)	0.33 (0.18-0.63)

UTI, Urinary tract infection.
*Range of LR results presented from 2 studies.
[†]LR computed from single studies.

Table 2. LRs for selected combinations of signs and symptoms—0 to 24 months of age.

Symptom Combination	Positive LR (95% CI)
Temperature >39°C for >48 h with no potential source for fever	4.0 (1.2-13.0)
Temperature >38°C for >48 h with no potential source for fever	3.6 (1.4-8.8)

Table 3. Diagnostic accuracy of selected urinary tract infection symptoms—verbal children.*

Symptoms	Positive LR (95% CI)	Negative LR (95% CI)
Abdominal pain	6.3 (2.5-16.0)	0.80 (0.65-0.99)
Back pain	3.6 (2.1-6.1)	0.84 (0.75-0.95)
Dysuria	2.4 (1.8-3.1)	0.65 (0.51-0.81)
Dysuria/frequency	2.2 (1.1-4.3)	0.71 (0.45-1.13)
Frequency	2.8 (2.0-4.0)	0.72 (0.60-0.86)
New-onset incontinence	4.6 (2.8-7.6)	0.79 (0.69-0.90)

*All LRs computed from single studies.

urinary symptoms (κ=0.31), suprapubic tenderness, or ill appearance (κ=0.38 for both).

Among febrile infants younger than 24 months, no single sign or symptom had a sufficiently low negative LR to exclude the diagnosis of urinary tract infection by their absence. The presence of previous urinary tract infection, temperature greater than 40°C (104°F), suprapubic tenderness, and lack of circumcision were the most useful for identifying infantile urinary tract infection (Table 2). Combinations of signs and symptoms were the most useful when led by temperature greater than 39°C (102.2°F) for more than 48 hours, without an apparent source (Table 3). A temperature less than 39°C (102.2°F) with another fever source was especially useful in black infants (negative LR 0.19).

In verbal children, the authors were unable to identify any literature evaluating the diagnostic accuracy of physical examination signs in older children. Among symptoms elicited by medical history, the most useful were the presence of abdominal pain, back pain, and new-onset incontinence (Table 3). The absence of symptoms was insufficient to exclude urinary tract infection in this population. Unfortunately, none of these symptoms alone is sufficient to establish the diagnosis. For example, in an older child with new-onset incontinence, the posttest probability would increase from 2.1% to 9%.

Microscopic urinalysis of uncentrifuged urine is the most sensitive and specific ancillary test available, but urine dipstick tests alone may be used to guide treatment. A dipstick test negative for both nitrite or leukocyte esterase has a negative LR of 0.20 (95% confidence interval [CI] 0.16 to 0.26), whereas positive findings on both had a positive LR of 28 (95% CI 17 to 46). A positive dipstick test result should be confirmed with a urine culture because the specificity is only 93%.

Because infants younger than 3 months have a higher urinary tract infection prevalence (7.5% in girls; 8.7% in boys) and are more likely than older ages to have associated bacteremia, sepsis, and congenital genitourinary defects, urinalysis and culture should be considered for all febrile infants. For children older than 3 months, the authors recommend risk stratification based on sex and circumcision status. For febrile boys aged 3 to 24 months, circumcised or not circumcised, the absence of any urinary tract infection risk factors (previous urinary tract infection, temperature >39°C (102.2°F), no other source, ill appearance, suprapubic tenderness, nonblack race, and fever duration greater than 24 hours) reduces posttest probability to less than 2%, in which case 24-hour clinical follow-up without urinalysis or culture testing may be appropriate. The presence of any single risk factor, though, suggests a need for urinalysis because a positive dipstick test result for either leukocyte esterase or nitrites will increase urinary tract infection probability to 40% to 90%. The recommended evaluation for girls is similar, although they are stratified by age 12 months with slightly different pre- and post-test probabilities. For verbal children with urinary symptoms or abdominal pain, circumcised boys should be tested only if multiple signs or symptoms of urinary tract infection are present. Girls and noncircumcised boys have similar pretest probabilities and should be tested for urinary tract infection only if they have dysuria, frequency, new incontinence, or back pain.

CONCLUSIONS

Although certain signs and symptoms increase the probability of pediatric urinary tract infection, none in isolation has a sufficiently high LR to definitively rule in or rule out a diagnosis. The presence of temperature exceeding

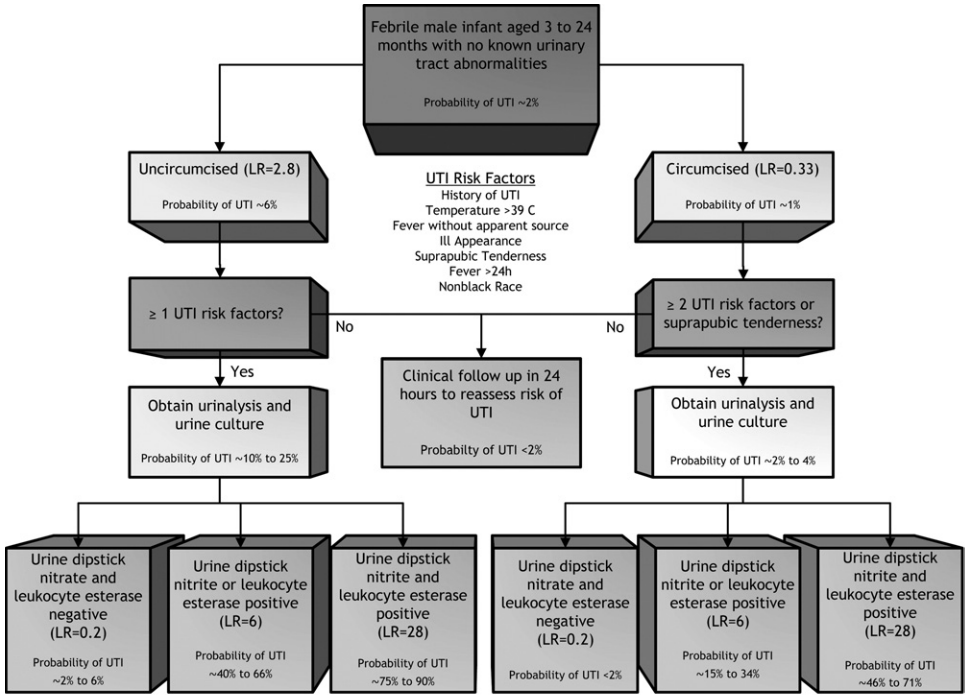

Figure 1. Diagnostic approach for febrile male infants aged 3 to 4 months suspected of having a urinary tract infection. *UTI*, Urinary tract infection; *LR*, likelihood ratio.

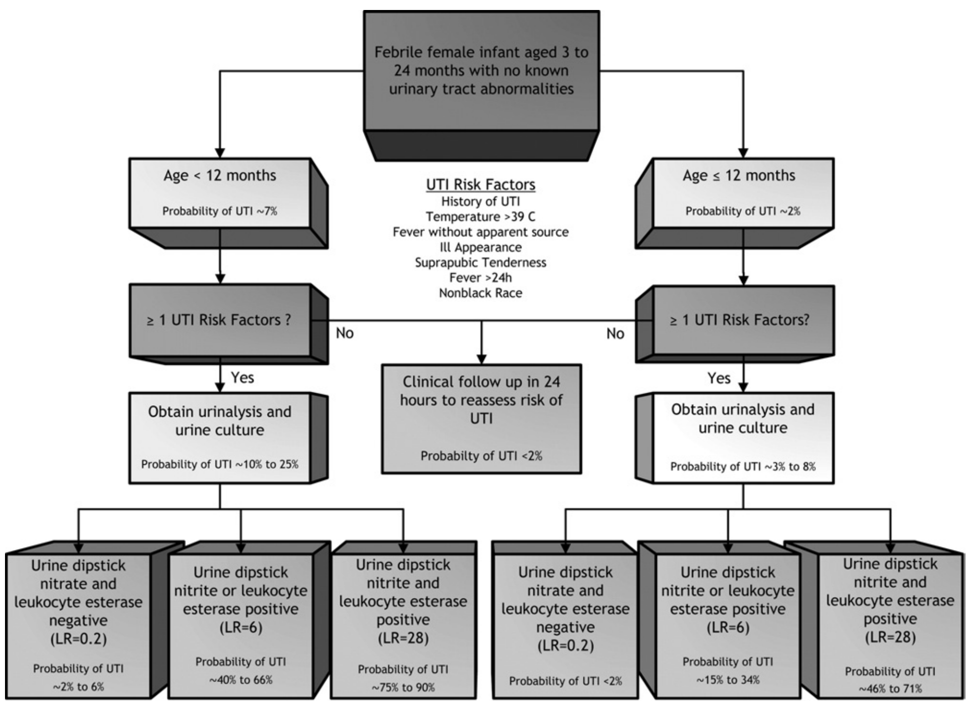

Figure 2. Diagnostic approach for febrile female infants aged 3 to 24 months suspected of having a urinary tract infection.

40° C (104°F), previous urinary tract infection, noncircumcised status, abdominal or back pain, dysuria, frequency, new-onset incontinence, and suprapubic tenderness all increase the likelihood of urinary tract infection by 2- to 6-fold. The absence of a few key signs and symptoms in combination can identify a low-risk pediatric subset suitable for 24-hour outpatient follow-up evaluation for urinary tract infection without further testing.

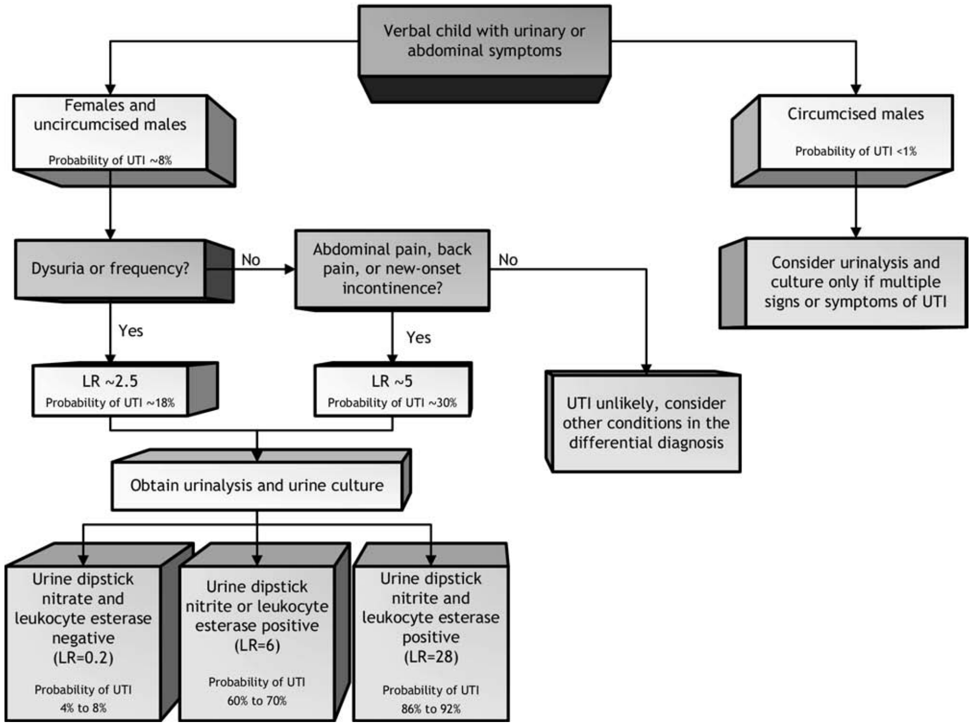

Figure 3. Diagnostic algorithm for verbal children older than 24 months of age with urinary or abdominal symptoms.

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COMMENTARY: CLINICAL IMPLICATION

Urinary tract infections in children account for an estimated 5% to 14% of pediatric emergency department (ED) visits in the United States.[1] The diagnosis can be difficult to secure in light of the nonspecific and variable signs and symptoms at the time of presentation, in addition to the unique challenges of obtaining an accurate medical history and physical examination in a young child. Delays in the diagnosis and appropriate treatment of pediatric urinary tract infection, however, appear to cause renal scarring and may ultimately produce hypertension and end-stage renal disease.[2] Yet the reference standard for diagnosis—the isolation of a specific uropathogen on culture—is typically unavailable when treatment is to be initiated. This systematic review therefore evaluates the existing literature for the test characteristics of common signs and symptoms in the diagnosis of urinary tract infection.

In one urban setting, the prevalence of urinary tract infection in febrile children younger than 2 years and presenting to the ED was 3.3%, whereas noncircumcised boys younger than 1 year had an 8% prevalence.[3] Other ED-based studies reporting prevalence failed to enroll all subjects and reported prevalences of 8.7% to 20.9% among children of various age, sex, and ethnicity.[3,4] Asian, Hispanic, and white infants (22%, 16%, and 16%, respectively) presenting to the ED have demonstrated higher urinary tract infection rates than black infants (4%).[5] Although black infants may have a lower urinary tract infection rate than other ethnic populations, further research is required to confirm and better understand this observation. Pediatric urinary tract infection has been the focus of one clinical decision rule validation in girls younger than 2 years, but the 5-item rule's 3-positive cutoff threshold lacked sufficient diagnostic accuracy to be clinically useful: positive LR 1.25, negative LR 0.41.[6] Pediatric urinary tract infection therefore continues to present a diagnostic challenge.

Suprapubic bladder aspiration in the ED appears to be less successful than urethral catheterization in dehydrated infants[7]; however, in catheterized specimens discarding early stream urine may be helpful to improve predictive value. Studies have reported a decrease in false-positive microscopic pyuria (≥5 WBCs/high pressure field) from 25% to 13% and, among patients aged 2 to 24 months, a decrease in contamination (with culture-positive rates decreasing from 29.7% to 6.8%).[8,9] Gram's stain may also be helpful, with some studies indicating diagnostic or near-diagnostic positive and negative LRs.[10]

The authors of this rational clinical examination suggest potential algorithms for categorizing patients who may be treated for urinary tract infection according to pre- and posttest probabilities (see Figures 1 to 3). Given the relative quality of the data reviewed and Bayesian nature of the pathways suggested, despite a lack of definitive validation, these algorithms seem to be reasonable approaches to children presenting to the ED and in whom the diagnosis of urinary tract infection is being seriously considered.

TAKE-HOME MESSAGE

Although diagnosing urinary tract infection in a pediatric population can be challenging, the presence of risk factors such as fever, history of urinary tract infection, abdominal pain, back pain, dysuria, frequency, new-onset incontinence, and suprapubic tenderness can increase the pretest probability of urinary tract infection. The authors' algorithms appear logical and appropriate; however, future prospective evaluation in pragmatic clinical settings will be necessary before these recommendations can be considered validated.

EBEM TEACHING POINT

Suggested Algorithms Versus Clinical Decision Rule

Derivation and validation. Although these rational clinical examination authors suggest a diagnostic management algorithm that is both intuitively logical and based on what appears to be the best available evidence, readers should understand that such recommendations are not proven adjuncts to patient care. Clinical decision rules should generally follow a strict methodological sequence, including rigorous examination and derivation of all variables. Once this multistep process is completed, if a clinically useful rule can be derived, then attempts to prospectively validate the rule should be undertaken in multiple settings. This will be the only formal method of assessing the rule's ability to detect disease and improve outcomes. Although suggested algorithms are useful in the absence of validated clinical tools, they do not replace formal derivation and validation of clinical decision rules.

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