Follow-up Urine Cultures and Fever in Children With Urinary Tract Infection

Melissa L. Currie, MD; Lindsay Mitz, BA; Carolyn S. Raasch, RN, BSN; Larry A. Greenbaum, MD, PhD

Background: The American Academy of Pediatrics practice parameter for urinary tract infection suggests a repeat urine culture if the expected clinical response is not achieved within the first 48 hours of therapy. The utility of repeat urine cultures and clinical significance of fever at 48 hours is unclear.

Objectives: To determine the frequency of positive repeat urine cultures in children admitted to the hospital with urinary tract infection, and to describe the fever curves of children admitted to the hospital with urinary tract infection.

Design and Methods: We reviewed all cases of urinary tract infection in children 18 years and younger who were admitted during a 5-year period to Children's Hospital of Wisconsin (Milwaukee). We recorded temperatures from hospital admission to discharge, age, sex, initial and follow-up culture results, antibiotics received, imaging performed, and medical history.

Results: Urinary tract infection was identified in 364 patients, and 291 (79.9%) had follow-up urine cultures. None were positive. Follow-up cultures produced $21,388.50 in patient charges. Fever lasted beyond 48 hours in 32% of patients. Older children were more likely to have fever beyond 48 hours.

Conclusions: Follow-up urine cultures were of no utility in children hospitalized for urinary tract infection, including those with fever lasting beyond 48 hours or those with an underlying urologic disease. Fever beyond 48 hours is common and should not be used as a criterion for obtaining a repeat urine culture. These conclusions are valid for children with vesicoureteral reflux. Such an approach would result in significant cost savings.


Urine tract infection (UTI) is a common reason for hospital admission for children.1,2 The American Academy of Pediatrics (AAP) practice parameter for children aged 2 months to 2 years with first-time febrile UTI suggests a repeat urine culture if the expected clinical response (usually defined as fever) is not achieved within the first 48 hours of therapy.4

For editorial comment see page 1157

Many articles on UTI in children recommend routine repeat cultures to ensure sterility of urine at some point after beginning treatment.2,3,5,10 The AAP practice parameter assumes that a repeat urine culture will provide useful information that will change clinical management. However, there is no evidence to support this recommendation when there is an identified organism with antibiotic sensitivities from the initial culture. In addition, the AAP practice parameter implies that fever beyond 48 hours is abnormal and should prompt investigation. A previous study indicated that 11% of children 2 years and younger hospitalized for UTI were still febrile at 48 hours.11

There are no previous studies defining the utility of follow-up urine cultures and the fever curves of all patients younger than 19 years hospitalized for UTI. The objectives of this study are to determine the frequency of positive repeat urine cultures in children with UTI and to describe the fever curves of children admitted to the hospital with UTI.

METHODS

The Children's Hospital of Wisconsin (Milwaukee) institutional review board approved this study. We retrospectively reviewed hospital records for all patients 18 years and younger who were discharged from Children's Hospital of Wisconsin with a principal diagnosis of UTI or pyelonephritis (using International Classification of Diseases, Ninth Re-
A UTI was defined as 10,000 pure colony-forming units (CFUs) per milliliter on a catheterized specimen or a body temperature of 38.0°C for rectal or oral temperatures.\(^\text{11-13}\) Since temperatures were not recorded continuously in the hospital, time to defervescence was divided into 12 categories, each representing an 8-hour time block. Some patients were discharged at less than 88 hours while still febrile; they were categorized separately, as were patients who were never febrile. We also recorded the organism and sensitivities with number of CFUs on initial culture, antibiotic(s) given in the hospital, organism and sensitivities with number of CFUs on any repeat culture, presence or absence of urine leukocyte esterase or nitrite on any repeat urine dipstick, and any imaging performed and its result. Categorical data were analyzed using the \(\chi^2\) test.

Among the medical records reviewed, 364 patients met all inclusion criteria. Their ages ranged from 1 week to 18 years, with a median age of 7 months and a mean age of 31 months. Two hundred twenty-two patients (61%) were younger than 1 year, 103 (28%) were aged 1 to 8 years, and 39 (11%) were aged 9 to 18 years. Seventy-six percent were girls. This varied from 72% in children younger than 1 year, 86% in children aged 1 to 8 years, and 74% in children aged 9 to 18 years. Preexisting diagnoses in the study population included 84 patients with VUR (36 of those had grades III, IV, or V), 54 with previous UTI, 16 with sickle cell disease, 6 with a history of renal transplantation, and 2 with posterior urethral valves. The most common organism was \textit{E coli} (87%), followed by \textit{Klebsiella pneumonia} (3.5%), \textit{Pseudomonas aeruginosa} (1.92%), and \textit{Enterococcus species} (1.6%).

Of the 364 patients identified, 291 (79.9%) had follow-up urine cultures done within 72 hours of hospital admission. None met positive culture criteria, and there were no resultant changes in management. Of the patients who were afebrile at 48 hours (79%) had follow-up urine cultures done within 72 hours of hospital admission. None met positive culture criteria, and therefore none resulted in a change in management.

The Figure shows the fever characteristics for the total population. Thirty-two percent of patients had fever beyond 48 hours. The median time for fever resolution was 40 hours, with 75% of patients afebrile by 64 hours (2½ days). Table 1 compares the fever characteristics of patients based on the presence or absence of VUR or a history of UTI. There was no significant difference in the percentage of patients afebrile at 48 hours between patients with and without VUR (\(P=.28\)). Fever after 48 hours occurred in 42% of the children with a history of UTI and in 30% of those without a history of UTI (\(P=.13\)).

Table 2 compares fever characteristics by age. A fever beyond 48 hours was present in 27% of the children younger than 1 year and in 39% of the children older than 1 year (\(P=.03\)).

Of the 291 patients with follow-up cultures, 256 (88%) had follow-up urine dipsticks. Two were positive for nitrites, and 172 (59%) were positive for leukocyte esterase.

The percentage of children who had repeat urine cultures during each year of the study is presented in Table 3. Repeat urine cultures were performed in 86% of the patients who were febrile beyond 48 hours and 79% who were afebrile at 48 hours (\(P=.14\)).

At our institution, the charge for a urine culture is $73.50. The total charges for repeat urine cultures in these patients were $21,388.50.

### Table 1. Effect of Vesicoureteral Reflux and History of Urinary Tract Infection on Fever Duration

<table>
<thead>
<tr>
<th>Patient Age</th>
<th>VUR</th>
<th>History of UTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 mo</td>
<td>27</td>
<td>41</td>
</tr>
<tr>
<td>1-8 y</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>9-18 y</td>
<td>34</td>
<td>40</td>
</tr>
</tbody>
</table>

Abbreviations: UTI, urinary tract infection; VUR, vesicoureteral reflux.

### Table 2. Effect of Age on Fever Duration*

<table>
<thead>
<tr>
<th>Patient Age</th>
<th>0-12 mo</th>
<th>1-8 y</th>
<th>9-18 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had fever beyond 48 h, %</td>
<td>27</td>
<td>41</td>
<td>34</td>
</tr>
<tr>
<td>Median time to fever resolution, h</td>
<td>32</td>
<td>48</td>
<td>40</td>
</tr>
</tbody>
</table>

* \(P=.02\) for 0 to 12 months vs 1 to 8 years; \(P=.47\) for 0 to 12 months vs 9 to 18 years; \(P=.59\) for 1 to 8 years vs 9 to 18 years.

### Table 3. Repeat Urine Cultures During Each Year of the Study

<table>
<thead>
<tr>
<th>Year</th>
<th>Repeat Urine Cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>20%</td>
</tr>
<tr>
<td>1998</td>
<td>25%</td>
</tr>
<tr>
<td>1999</td>
<td>30%</td>
</tr>
<tr>
<td>2000</td>
<td>35%</td>
</tr>
<tr>
<td>2001</td>
<td>40%</td>
</tr>
</tbody>
</table>

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The AAP practice parameter for the diagnosis, treatment, and evaluation of the initial UTI in febrile infants and young children recommends repeat urine culture when the child does not achieve the expected clinical response in the first 2 days of antimicrobial therapy. While the strength of evidence is classified as “good,” there is little published data supporting this recommendation. Although “expected clinical response” is not explicitly defined in the AAP parameter, it is generally accepted in the medical community to represent the resolution of fever. One can raise 2 questions from this statement. First, what is the typical length of fever for children admitted to the hospital with UTI? In other words, is it reasonable to expect resolution of fever within 48 hours of therapy? Second, what additional information does a repeat culture add, given that organism and sensitivities are available from the initial culture? The study by Bachur provided us with some of these answers. He showed that of 288 children 2 years and younger, 11% were still febrile beyond 48 hours of therapy. Among the 93% of his patients that had repeat urine cultures, all were negative.

In our study, 32% of children had fever beyond 48 hours. There are a number of possible explanations for the higher percentage of patients in our study who were still febrile at 48 hours when compared with the study by Bachur (11%). That study only included patients younger than 2 years and excluded patients with a history of UTI. We found that older age was a risk factor for fever beyond 48 hours. In addition, we did not exclude children with other medical problems, including a diagnosis of VUR, sickle cell disease, posterior urethral valves, or a history of renal transplantation. While our definition of fever was the same as that of Bachur, it is possible that there are variations in measuring or recording temperatures between the 2 hospitals.

The majority of our patients were girls and more than 80% of the infections were due to E coli, as has been observed in other studies of children with UTI. In our study, 32% of children had fever beyond 48 hours. There are a number of possible explanations for the higher percentage of patients in our study who were still febrile at 48 hours when compared with the study by Bachur (11%). That study only included patients younger than 2 years and excluded patients with a history of UTI. We found that older age was a risk factor for fever beyond 48 hours. In addition, we did not exclude children with other medical problems, including a diagnosis of VUR, sickle cell disease, posterior urethral valves, or a history of renal transplantation. While our definition of fever was the same as that of Bachur, it is possible that there are variations in measuring or recording temperatures between the 2 hospitals.

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</p><p>Table 3. Percentage of Children With Repeat Urine Culture by Year</p><table><thead><tr><th>Year</th><th>Percentage</th></tr></thead><tbody><tr><td>1997</td><td>83</td></tr><tr><td>1998</td><td>84</td></tr><tr><td>1999</td><td>77</td></tr><tr><td>2000</td><td>81</td></tr><tr><td>2001</td><td>80</td></tr></tbody></table>
hospital. Our study does not deal with why physicians order follow-up urine cultures. Future studies should address this issue and determine what educational interventions can result in wider acceptance of practice parameters. In addition, our study does not address the issue of repeat urine cultures once the patient has completed therapy. While children are at an increased risk for a UTI after finishing therapy, the role of routine follow-up cultures has not been defined. The current AAP guidelines do not advocate routine follow-up cultures.

Limitations of this study include the inability to draw any conclusions about fever curve or expected clinical response among certain subpopulations that were present in small numbers (e.g., renal transplant recipients and patients with posterior urethral valves). Also, in 16 of our patients (4%), true duration of fever could not be determined because they were sent home before becoming afebrile, although it is unlikely that this small population would have changed our results significantly. We excluded these patients when reporting fever duration.

Our study focused on hospitalized patients receiving intravenous antibiotics. It does not address the utility of repeat urine cultures in the outpatient setting. Oral antibiotics may be less effective owing to poor patient compliance or decreased efficacy. Yet, even in the outpatient setting, the frequency of a positive follow-up urine culture was only 1% in a highly compliant patient population.

In our study population, 80% of patients had repeat urine cultures. Along with the direct cost of the urine culture, there are potentially significant hidden costs due to a delay in hospital discharge caused by waiting to obtain the specimen for a repeat culture or waiting for culture results. This is especially important given the evidence that intravenous and oral antibiotics produce equivalent outcomes in children with UTI. In addition, repeat urine cultures in infants and toddlers are often obtained by catheterization. This may produce physical pain and emotional distress. Moreover, there is a small risk of complications with urethral catheterization.

Based on our findings, the routine use of repeat urine culture in hospitalized children younger than 19 years with UTI when an initial positive culture with sensitivities is available is not justified. There is no evidence that the procedure provides any additional useful information (in patients with or without prolonged fever). Fever beyond 48 hours is common and is therefore not an appropriate criterion for justifying either repeat culture or prolonging hospitalization.

Accepted for publication July 14, 2003.

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REFERENCES


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