

The Diagnosis of UTI: Liquid Gold and the Problem of Gold Standards

Kenneth B. Roberts, MD

Why is urine yellow? Because it is liquid gold!
Pediatric nephrologist William Primack*

For >50 years, the gold standard for the diagnosis of urinary tract infections (UTIs) has been a positive culture result without regard for urinalysis findings. Both the definition of “positive” and the role of urinalysis stem from a publication in 1956.¹ Edward Kass applied quantitative culture methods to urine specimens obtained from adults by catheterization to determine a dividing line between contamination and infection. The urine of most, but not all, patients with symptoms of acute pyelonephritis (chills, fever, flank pain, and dysuria) contained >100 000 CFU/mL. Urine specimens from some asymptomatic women also had such high colony counts but most were much lower. Kass concluded: “For survey purposes, a count of 10⁵ bacteria or more per mL of urine has been designated arbitrarily as the dividing line between true bacteriuria and contamination.” He acknowledged that for “individual clinical purposes,” lower colony counts needed to be considered and noted that pyuria did not reliably accompany bacteriuria in the asymptomatic women. During the subsequent decade, screening programs were widely conducted, applying $\geq 10^5$ CFU/mL as the diagnostic criterion without regard for the presence or absence of pyuria. The distinction between “survey” (screening) and “individual clinical purposes” became obscured; the threshold of 10⁵ became established in the minds of clinicians as absolute; and

the significance of pyuria was overlooked.

By the end of the 1970s, asymptomatic bacteriuria (AB) was acknowledged to be a distinct entity involving colonization rather than infection, causing no morbidity except during pregnancy. Antimicrobial treatment was shown to be potentially harmful; bacterial replacement occurred with strains that increased the risk of symptomatic infection.² Screening for AB was subsequently actively discouraged.³

The question, however, is how to distinguish true UTI in an infant during a febrile illness from AB with the fever coming from a source other than the urinary tract, a situation akin to the dilemma with strep carriers who develop fever and have a throat culture performed. The distinction is that subjects with true UTI should have evidence of inflammation in their urine, whereas those with AB do not. By definition, therefore, the sensitivity of pyuria in a true UTI should be 100%. (The word “pyuria” is used here to indicate the presence of white blood cells and/or leukocyte esterase in the urine.) The finding of pyuria is particularly significant, because although bacteria are responsible for the infection, it is the host inflammatory response that damages the kidney.⁴ Other components of the urinalysis, such as nitrite and microscopically visible bacteria, indicate bacteriuria, but pyuria has a unique position of central importance regarding both the diagnosis of true infection and the risk of scarring. For

FREE

University of North Carolina School of Medicine, Chapel Hill, and Cone Health, Greensboro, North Carolina

Opinions expressed in these commentaries are those of the author and not necessarily those of the American Academy of Pediatrics or its Committees.

www.pediatrics.org/cgi/doi/10.1542/peds.2015-0884

DOI: 10.1542/peds.2015-0884

Accepted for publication Mar 19, 2015

Address correspondence to Kenneth B. Roberts, MD, 3005 Bramblewood Dr, Mebane, NC 27302. E-mail: kenrobertsmd@gmail.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2015 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The author has indicated he has no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The author has indicated he has no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found on page 965, and online at www.pediatrics.org/cgi/doi/10.1542/peds.2015-0012.

*W. Primack, MD, personal communication, 2014.

this reason, the American Academy of Pediatrics 2011 UTI guideline requires the presence of pyuria as well as a positive culture result for the diagnosis of UTI.⁵

Despite the importance of pyuria as noted here, its usefulness in the diagnosis of UTI was disregarded because of its apparent low sensitivity in various studies in adults,¹ children,⁶ and young infants⁷ compared with culture as the gold standard. In this issue of *Pediatrics*, Schroeder et al⁸ raise the question of faulty gold standards, proposing that the observed sensitivity of pyuria compared with culture is reduced because, although some of the subjects studied had a true UTI, others likely had AB, and some may have had contaminated specimens. The authors compared the reported rate of AB in infants with the rate of bacteriuria in febrile infants and calculated that AB could account for the apparent low sensitivity of pyuria versus culture. They tested the validity of this proposition by studying a group of young infants with true UTI, as determined by the presence of the same organism in urine and blood. In these infants, the sensitivity of pyuria ranged from 96% to 99.5% (depending on the quantitative definition of pyuria), thus confirming its usefulness for diagnosis. Because pyuria can be detected at point of care, there is also

great practical value to pyuria as a diagnostic criterion. By itself, pyuria is nonspecific and requires the addition of bacteriuria to establish the diagnosis of UTI, but the absence of pyuria should create great doubt about the presence of a UTI.

Schroeder et al⁸ also remind us that colony counts <100 000 CFU/mL may represent true UTIs, echoing the observation noted by Kass.¹ Twenty years ago, Hoberman et al⁹ proposed 50 000 CFU/mL as a more appropriate threshold in children, adopted in the 2011 American Academy of Pediatrics guideline.⁵ Colony counts between 10 000 and 50 000 may also represent true UTIs, however, as recognized previously and now demonstrated by Schroeder et al when pyuria is associated with the same uropathogenic organism in urine and blood.

The article by Schroeder et al⁸ clarifies that, for “individual clinical purposes,” establishing an accurate diagnosis of infection in specimens of “liquid gold” mandates a thoughtful reconsideration of what have traditionally been considered gold standards regarding pyuria and colony counts.

REFERENCES

1. Kass EH. Asymptomatic infections of the urinary tract. *Trans Assoc Am Physicians*. 1956;69:56–64
2. Lindberg U. Asymptomatic bacteriuria in school girls. V. The clinical course and response to treatment. *Acta Paediatr Scand*. 1975;64(5):718–724
3. Kemper KJ, Avner ED. The case against screening urinalyses for asymptomatic bacteriuria in children. *Am J Dis Child*. 1992;146(3):343–346
4. Glauser MP, Meylan P, Bille J. The inflammatory response and tissue damage. The example of renal scars following acute renal infection. *Pediatr Nephrol*. 1987;1(4):615–622
5. Roberts KB; Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. *Pediatrics*. 2011;128(3):595–610
6. Pryles CV, Eliot CR. Pyuria and bacteriuria in infants and children. The value of pyuria as a diagnostic criterion of urinary tract infections. *Am J Dis Child*. 1965; 110(6):628–635
7. Crain EF, Gershel JC. Urinary tract infections in febrile infants younger than 8 weeks of age. *Pediatrics*. 1990;86(3):363–367
8. Schroeder AR, Chang PW, Shen MW, Biondi EA, Greenhow TL. Diagnostic accuracy of the urinalysis for urinary tract infection in infants <3 months of age. *Pediatrics*. 2015;135(6):965–971
9. Hoberman A, Wald ER, Reynolds EA, Penchansky L, Charron M. Pyuria and bacteriuria in urine specimens obtained by catheter from young children with fever. *J Pediatr*. 1994;124(4):513–519

The Diagnosis of UTI: Liquid Gold and the Problem of Gold Standards

Kenneth B. Roberts

Pediatrics 2015;135;1126

DOI: 10.1542/peds.2015-0884 originally published online May 25, 2015;

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/135/6/1126>

References

This article cites 9 articles, 3 of which you can access for free at:
<http://pediatrics.aappublications.org/content/135/6/1126#BIBL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):
Evidence-Based Medicine
http://www.aappublications.org/cgi/collection/evidence-based_medicine_sub
Nephrology
http://www.aappublications.org/cgi/collection/nephrology_sub

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

The Diagnosis of UTI: Liquid Gold and the Problem of Gold Standards

Kenneth B. Roberts

Pediatrics 2015;135;1126

DOI: 10.1542/peds.2015-0884 originally published online May 25, 2015;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/135/6/1126>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2015 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

