ARTICLE

Choice of Urine Collection Methods for the Diagnosis of Urinary Tract Infection in Young, Febrile Infants

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Background: The optimal method of urine collection in febrile infants is debatable; catheterization, considered more accurate, is technically difficult and invasive.

Objectives: To determine predictors of urethral catheterization in febrile infants and to compare bag and catheterized urine test performance characteristics.

Design: Prospective analysis of infants enrolled in the Pediatric Research in Office Settings' Febrile Infant Study.

Setting: A total of 219 practices from within the Pediatric Research in Office Settings' network, including 44 states, the District of Columbia, and Puerto Rico.

Patients: A total of 3066 infants aged 0 to 3 months with temperatures of 38°C or higher.

Main Outcome Measures: We calculated adjusted odds ratios for predictors of catheterization. Diagnostic test characteristics were compared between bag and catheterization. Urinary tract infection was defined as pure growth of 100 000 CFU/mL or more (bag) and 20 000 CFU/mL or more (catheterization).

Results: Seventy percent of urine samples were obtained by catheterization. Predictors of catheterization included female sex, practitioner older than 40 years, Medicaid, Hispanic ethnicity, nighttime evaluation, and severe dehydration. For leukocyte esterase levels, bag specimens demonstrated no difference in sensitivity but somewhat lower specificity (84% [bag] vs 94% [catheterization], $P<.001$) and a lower area under the receiver operating characteristic curve for white blood cells (0.71 [bag] vs 0.86 [catheterization], $P=.01$). Infection rates were similar in bag and catheterized specimens (8.5% vs 10.8%). Ambiguous cultures were more common in bag specimens (7.4% vs 2.7%, $P<.001$), but 21 catheterized specimens are needed to avoid each ambiguous bag result.

Conclusions: Most practitioners obtain urine from febrile infants via catheterization, but choice of method is not related to the risk of urinary tract infection. Although both urine cultures and urinalyses are more accurate in catheterized specimens, the magnitude of difference is small but should be factored into clinical decision making.

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URINARY TRACT INFECTIONS (UTIs) are the most common cause of serious bacterial infections in febrile infants younger than 90 days.[1-7] Diagnosis requires collection of urine generally by 1 of 4 methods: sterile urine bag, urethral catheterization (CATH), suprapubic aspiration (SPA), or clean-catch (CC). Both CATH and SPA are thought to yield the most reliable results by minimizing false-positive results, but these methods are invasive and painful. The bag method is a noninvasive and easy alternative but has been criticized as having high false-positive rates,[8-12] prompting the American Academy of Pediatrics (AAP) to discourage its use for urine cultures in infants.[8] Choosing the appropriate urine collection method presents the practitioner with a difficult decision, and little is known about how this decision is made.

Once urine is collected, urinalysis (UA) is often performed as a screen for UTIs. Although substantial data exist on the diagnostic test characteristics of UA,[13] few studies have been performed in the 0- to 3-month-old age group, and we know of no studies that compare the performance of the UA across urine collection methods.

A prior publication[7] from the Pediatric Research in Office Settings' (PROS) Febrile Infant Study reported that urine was tested in only 54% of febrile infants aged 0 to 93 days. Urine testing was more likely in infants with a higher temperature, ill appearance, younger age, and lack of a fever source. This report will address the following questions: (1) Which urine collection techniques do practitioners use to diagnose UTIs in young, febrile infants? (2) What are the infant and practitioner characteristics that predict the choice of urine collection method used? (3) Do the diagnostic test characteristics of UA differ between bag and CATH methods? (4) Do the rates of positive culture results and ambiguous urine culture results differ between methods?

Table 1. Urinalysis and Urine Culture Collection Methods for Day of Presentation

Urinalysis Collection Method	Urine Culture Collection Method, No. (%)						
	Bag	CATH	SPA	CC	Not Specified	Test Not Done	Total
Bag	361	33	0	3	0	107	**504** (16)
CATH	11	976	0	0	0	43	**1030** (34)
SPA	0	2	50	0	0	3	**55** (2)
CC	0	2	0	20	0	4	**26** (1)
Not specified	0	0	0	0	24	0	**24** (1)
Test not done	18	87	4	6	8	1304	**1427** (47)
Total	**390** (13)	**1100** (36)	**54** (2)	**29** (1)	**32** (1)	**1461** (48)	**3066** (100)

Abbreviations: CATH, urethral catheterization; CC, clean-catch; SPA, suprapubic aspiration.

METHODS

Data are presented from infants prospectively enrolled in the PROS Febrile Infant Study. The methods of the PROS Febrile Infant Study have been previously described[7,14] and are summarized briefly herein.

PROS FEBRILE INFANT STUDY

The PROS is the practice-based research network of the AAP. The Febrile Infant Study involved 573 practitioners from 219 practices from within the PROS network. Practitioners represented 44 states, the District of Columbia, and Puerto Rico.

SUBJECTS

Inclusion criteria for this study were (1) age of 93 days or younger; (2) axillary, rectal, or tympanic temperature of 38°C or higher in the office or in the previous 24 hours at home; and (3) initial examination by a PROS practitioner. A total of 3066 eligible patients were enrolled in the study between February 28, 1995, and April 25, 1998. However, not all of these patients underwent UAs and urine cultures, and the sample size varies for each analysis and is specified in the results. To analyze predictors of CATH, we included all patients who underwent UA and/or urine culture. To analyze the test performance characteristics of the UA, we included patients who underwent both a UA and urine culture. To analyze urine culture results, we included all patients who had urine cultures. Although some infants had more than 1 urine culture, we limited all of our analyses to tests performed on the day of initial presentation. Furthermore, because so few patients had urine collected by CC or SPA, we chose to focus the analyses on those patients who had specimens obtained by bag or CATH.

Because tests and treatments were ordered at the discretion of the individual practitioners according to their customary clinical care, informed consent was not required. The Committee on Human Research from the University of California, San Francisco, approved the study.

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Multiple aspects of the infants' clinical histories and physical examination findings were recorded, predominantly by checking boxes on the study form. The temperature variable reflected the higher of the temperatures taken in the office or at home. For axillary temperatures, 0.5°C was added to the reported temperature. Categorical variables such as hydration status were assumed to be normal if abnormalities were not documented. Infant and practitioner demographic characteristics were documented. The study protocol required that the practitioner's diagnostic impression and assessment of severity of illness be recorded before laboratory test results were available.

LABORATORY DATA

All practices were supplied with urine dipsticks (Ames-Multistix; Miles Inc, Elkhart, Ind) in an attempt to facilitate comparisons of results. All other laboratory testing, including urine microscopy and culture, was performed in the laboratories normally used by the practitioners. All laboratory tests were ordered in accordance with the practitioners' judgment.

For UAs, practitioners recorded the method of collection, urine dipstick results (leukocyte esterase [LE], nitrite, and blood levels), and urine microscopy results (white blood cell count, red blood cell count, and whether bacteria were seen). The choice of urine collection method was at the practitioners' discretion. A UA was considered to be complete if one of the following was recorded: LE level, nitrite level, blood level, urine white blood cell count, urine red blood cell count, or bacterial presence. For urine cultures, practitioners recorded the date that the culture was performed, whether it was positive or negative, the method of collection, and the types and levels of organism(s).

The diagnosis of UTI was based on urine culture results, independent of UA results, and was defined a priori. The definition of a positive urine culture required (1) classification of the organism as pathogenic or sometimes pathogenic by a pediatric infectious disease consultant who was blinded to data on individual subjects and (2) a minimum number of colony-forming units per milliliter, depending on the urine collection method. For SPA specimens, at least 100 CFU/mL of 1 or more pathogenic organisms was required. For CATH specimens, 20 000 CFU/mL of a single pathogenic organism was required. For bag and CC specimens, at least 100 000 CFU/mL of a single pathogenic organism was required. Results were occasionally reported as greater than or less than, predominantly in the form of "greater than 100 000 CFU/mL" or "less than 10 000 CFU/mL." To facilitate tabulations and statistical analysis, if the culture result was reported as less than a certain value, the value was divided in half. If the culture was reported as greater than a certain value, the value was doubled.

We defined ambiguous cultures as having either (1) the minimum number of colonies to qualify as a UTI for one organism but also having a second organism present or (2) having 20% to 99% of the minimum number of colonies of pure growth. Examples of ambiguous cultures include a CATH urine culture that had 20 000 CFU/mL of *Escherichia coli* but also contained a second organism or a bag urine culture that contained 50 000 CFU/mL of *E coli* (pure growth).

Table 2. Unadjusted Associations Between Infant or Practitioner Characteristics and CATH in Patients Who Had Urinalyses and/or Urine Cultures Obtained by Either Bag or CATH on the Day of Presentation

Variable	Total No. (%) of Infants (n = 1646)	No. (%) With CATH	*P* Value*
Infant characteristics			
Female sex	803 (49)	620 (77)	
Male sex	843 (51)	537 (64)	<.001
Circumcised boy	597 (71)	374 (63)	
Uncircumcised boy	199 (24)	137 (69)	
Circumcision status not documented	47 (6)	26 (55)	.14
Age, d			
0-30	504 (31)	368 (73)	
31-60	711 (43)	504 (71)	
61-93	431 (26)	285 (66)	.02
Race			
White	1299 (79)	905 (70)	
African American	135 (8)	102 (76)	
Asian/Pacific Islander	42 (3)	32 (76)	
Other or missing	170 (10)	118 (69)	.42
Hispanic, any race			
Yes	245 (15)	187 (76)	
No	1401 (85)	970 (69)	.03
Medicaid			
Yes	611 (37)	469 (77)	
No	1035 (63)	688 (66)	<.001
Seen 8 PM to 8 AM			
Yes	221 (13)	169 (76)	
No	1425 (87)	988 (69)	.03
Maximum temperature, °C			
38-38.4	597 (36)	425 (71)	
38.5-38.9	607 (37)	411 (68)	
≥39	442 (27)	321 (73)	.79
Initial appearance			
Minimally ill	1074 (65)	741 (69)	
Moderately ill	535 (33)	389 (73)	
Very ill	37 (2)	27 (73)	.12
Hydration			
Normal	1515 (92)	1063 (70)	
Mild	114 (7)	79 (69)	
Severe	17 (1)	15 (88)	.67
Practitioner characteristics			
Age, y			
<40	541 (33)	442 (82)	
40-49	687 (42)	456 (66)	
>49	404 (3)	250 (62)	
Not documented	14 (1)	9 (64)	<.001
Sex			
Male	1002 (61)	718 (72)	
Female	635 (39)	433 (68)	
Not indicated	9 (1)	6 (67)	.32

Abbreviation: CATH, urethral catheterization.
*P values are derived from χ^2 values for dichotomous and nonordered categorical variables. The Wilcoxon rank sum test was used for ordinal categorical variables (age, appearance, hydration, and temperature).

STATISTICAL ANALYSIS

To analyze predictors of urine collection methods (**Table 1**), we used a multivariate logistic regression model (Stata version 7; Stata Corp, College Station, Tex) to calculate adjusted odds ratios for CATH, adjusting for clustering by physician. For this model, we identified 11 clinically and biologically plausible predictor variables (**Table 2**), then used a backward stepwise elimination model with a P to remove of <.06. An infant was considered catheterized if either the UA or urine culture was obtained by CATH. The catheterization variable was designated as missing if urine was obtained by CC or SPA or if the method was not documented. Goodness of fit of the multivariate model was assessed using the Hosmer-Lemeshow method with 10 groups.[15] Discrimination was assessed using the c-statistic, equal to the area under the receiver operating characteristic curve.[15]

To compute characteristics of the UA as a diagnostic test for UTI, the gold standard was the urine culture result, where ambiguous cultures were considered negative. We included cases where the UA method was different from the urine culture method. If a method was noted for one test but absent for the other, we assumed that the same method was used for both.

To determine whether the urine culture method was an independent predictor of a positive culture, a multivariate logistic regression model was used, with UTI as an outcome and bag

Table 3. Multivariate Model for Predictors of CATH

Variable	OR (95% CI) for CATH	*P* Value
Female sex	2.1 (1.6-2.7)	<.001
Practitioner age <40 y	2.7 (1.7-4.2)	<.001
Medicaid	1.7 (1.2-2.3)	.002
Hispanic	1.5 (1.0-2.4)	.04
Seen 8 PM to 8 AM	1.6 (1.0-2.7)	.04
Severe dehydration	4.1 (1.0-16.8)	.05

Abbreviations: CATH, urethral catheterization; CI, confidence interval; OR, odds ratio.

vs CATH as a predictor. Variables determined from our previous study to increase or decrease the risk of UTI (sex, circumcision, maximum temperature, ill family members, fever duration, inconsolability, Hispanic ethnicity, and respiratory distress)[7] were included as covariates.

RESULTS

URINE COLLECTION METHODS

At the initial visit, a UA was performed on 1639 (53%) of the 3066 infants, and a urine culture was obtained from 1605 (52%) of the infants (Table 1). A total of 1763 patients had either a UA or urine culture, whereas 1482 patients had both a UA and urine culture at presentation. Most urine specimens were obtained by CATH (63% of UAs and 69% of urine cultures). Bag specimens composed 31% of UAs and 24% of urine cultures.

PREDICTORS OF CATHETERIZATION

A total of 1646 patients had urine specimens obtained on the day of presentation by either bag or CATH; 70% were catheterized either for UA or urine culture, and 30% had bag urine testing only. The highest frequencies of catheterization were found in the following subgroups (Table 2): patients with severe dehydration (88%), patients who were seen by younger (<40 years) practitioners (82%), female infants (77%), Medicaid patients (77%), and patients who were seen after hours (76%). Circumcision, height of fever, and general appearance did not predict catheterization. The final multivariate logistic model for predictors of catheterization (**Table 3**) demonstrated good fit (Hosmer-Lemeshow χ^2_9=3.8; *P*=.70). Discrimination of the model was fair (C=0.69).

UA TEST CHARACTERISTICS

Of the 1482 patients who had both UAs and urine cultures, 1384 had the samples obtained by bag or CATH. Overall, LE had higher sensitivity, whereas nitrites demonstrated better specificity (**Table 4**). Sensitivity and specificity were higher in CATH specimens compared with bag specimens for both LE and nitrites, but the only statistically significant difference was the comparison of specificity of LE (84% [bag] vs 94% [CATH], *P*<.001). These calculations changed very little (differences of <2%) if the UTI threshold colony count for CATH specimens was reduced to 10 000 CFU/mL or if the threshold for bag specimens was reduced to 50 000 CFU/mL.

Table 4. Sensitivity and Specificity of Leukocyte Esterase and Nitrites as Diagnostic Tests for Urinary Tract Infections Stratified by Method of Collection

	Leukocyte Esterase, %		Nitrites, %	
Collection Method	Sensitivity	Specificity	Sensitivity	Specificity
Total	84	91	39	99
Bag	76	84	25	98
CATH	86	94	43	99
P value*	.19	<.001	.07	.59

Abbreviation: CATH, urethral catheterization.
**P* values derived from χ^2 values for comparisons of bag and CATH results.

To further examine the difference in specificities of LE between methods, we analyzed the 54 patients who had bag UAs with false-positive results for LE. Of the patients who were also tested for nitrites, only 4 (8%) of 51 had positive results. Of the patients who were also tested for urine white blood cell counts, 9 (19%) of 47 had more than 10 white blood cells per high-power field. Ambiguous cultures occurred in 13 (24%) of 54 of these patients. If patients who had specimens with positive LE test results and positive nitrite test results, more than 10 white blood cells per high-power field, or ambiguous culture results are considered to be positive for UTI, the difference between methods in specificity for LE is still significant (89% [bag] vs 95% [CATH], *P*<.001).

The CATH specimens performed better for urine white blood cell counts as well (**Table 5**). When compared with bag specimens, the area under the receiver operating characteristic curve (C statistic) for urine white blood cell counts and UTI (**Figure**) is higher in patients with CATH specimens (0.86 vs 0.71, *P*=.01) Again, areas under the curve did not change significantly (<.01) when thresholds for UTI were changed to 10 000 CFU/mL for CATH specimens and/or 50 000 CFU/mL for bag specimens.

URINE CULTURE RESULTS

Urine cultures were obtained by CATH or bag in 1490 patients. Compared with CATH, bag urine cultures were more likely to have 2 organisms, to have nonpathogenic bacteria, and to have an ambiguous result (**Table 6**). The relative risk of an ambiguous culture for specimens obtained by bag was 2.7 (95% confidence interval [CI], 1.7-4.5); however, the absolute risk was small (7.4% [bag] vs 2.7% [CATH]). Twenty-one cultures (95% CI, 13-53) would have to be obtained by CATH to avoid 1 ambiguous culture obtained by bag. The unadjusted UTI rates were similar between bag and CATH methods (8.5% vs 10.8%, *P*=.19). The adjusted odds ratio for a UTI by bag when compared with CATH was 0.9 (95% CI, 0.6-1.3; *P*=.51).

COMMENT

Most urine specimens in this study were obtained by catheterization. The strongest predictors of CATH were practitioner age and infant sex. Surprisingly, neither height of fever nor ill appearance was associated with increased catheterization. This suggests that practitioners do not base decisions to catheterize on the pretest probability of UTI.

Table 5. Likelihood Ratios for Urine White Blood Cell Counts as a Diagnostic Test for Urinary Tract Infections Stratified by Urine Culture Collection Method

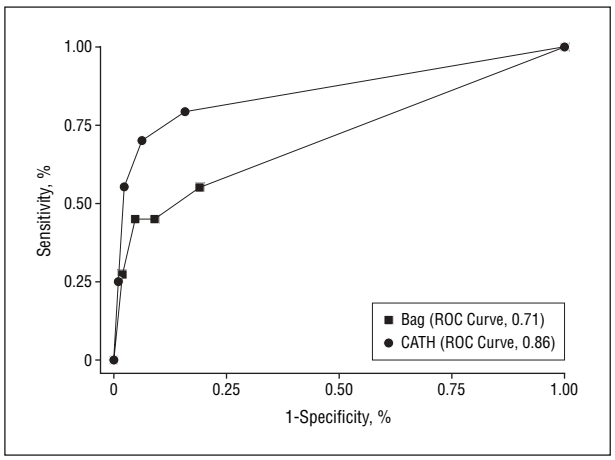
No. of White Blood Cells per High-Power Field	Bag (n = 273)	CATH (n = 716)	Total (n = 1056)
0-2	0.6	0.2	0.3
3-5	1.1	1	1
6-10	0*	3.7	2.8
11-20	7	23.9	18.2
>20	13.5	26.3	19
ROC curve (95% CI)	0.71 (0.61-0.82)	0.86 (0.82-0.91)	0.83 (0.79-0.87)

Abbreviations: CATH, urethral catheterization; CI, confidence interval; ROC, receiver operating characteristic.
*None of the 11 patients with 6 to 10 white blood cells per high-power field in a bag specimen had a urinary tract infection.

Although female infants are at high risk for UTI, uncircumcised males are at an even higher risk[7,16-19] but were significantly less likely than females to be catheterized. This discrepancy may be due to perceived technical difficulties or other unmeasured factors. The association between young practitioner age and increased catheterization may reflect evolving training practices, the fact that younger practitioners tend to adhere more closely to guidelines than older practitioners,[20,21] or a propensity by younger practitioners to do or order more procedures.

Regarding the test performance characteristics of the UA, our findings for LE and nitrites were consistent with prior studies,[13,22] specifically in regard to the low sensitivity and high specificity of nitrites. The differences in sensitivities between methods for both LE and nitrites were not statistically significant, but the CIs were wide, reflecting the lower sample size of patients with UTIs. The extremely low sensitivity of the nitrite test for both bag and CATH methods (25% vs 43%) demonstrates that practitioners should not rely on this test to rule out UTIs. For LE, the sensitivities were much higher (76% vs 86%, $P = .19$) for bag and CATH specimens. Should future studies document a statistically significant difference in sensitivity between methods of 10%, this could potentially influence management decisions, particularly for those practitioners who use the UA results to guide the decision to obtain a culture, hospitalize, or provide immediate antibiotic treatment while awaiting culture results.

The decreased specificity of LE in bag UAs was statistically significant, indicating that there are increased false-positive LE test results on bag UAs. This finding could be due to inflammatory processes in the perineal or periurethral area unrelated to UTIs that are detected by bag but not CATH specimens. Alternatively, there may have been false-negative bag cultures that led to the appearance of false-positive UA results. Bag cultures are generally thought to be highly sensitive,[8] but sensitivity depends on the definition of UTI. In this study, we used fairly strict criteria for a diagnosis of UTI by bag cultures. Furthermore, perineal cleansing techniques likely varied between practices, and if cleansing materials with antimicrobial properties interfered with the bag urine culture, false-negative cultures may have resulted. However, the difference in specificities between methods persisted even after patients with increased likelihood of a false-negative urine culture (positive nitrites or >10 white blood cells per high-power field on UA or an ambiguous culture result) were considered to have a UTI.



Receiver operating characteristic (ROC) curve for urine white blood cell counts and urinary tract infection stratified by bag and urethral catheterization (CATH).

To our knowledge, this is the first study to find that the performance of the UA varies by method. Further studies that compare urinalyses obtained simultaneously in the same patient by both methods would help to substantiate or refute our findings.

Bag urine cultures were more likely to have more than 1 organism, to yield nonpathogenic bacteria, and to have bacterial growth in insufficient quantity to qualify as a UTI. In prior studies,[10,11] investigators have classified cultures of this sort as false positive and have reported poor specificity of urine bag cultures. Such classification is misleading, however, because it assumes that practitioners will interpret results of this nature as true UTIs. In our analysis, we attempted to define ambiguous cultures (ie, culture results that are most likely to cause diagnostic uncertainty). Although ambiguous culture results were nearly 3 times as likely in bag specimens, the risk in both groups and the absolute difference between the risks were low (7% vs 3%), translating into a high number (n=21) needed to catheterize to avoid 1 ambiguous bag specimen.

The overall rate of UTI for urine cultures obtained on the day of presentation was slightly higher in catheterized infants than in infants who had urine obtained by bag. These findings are not attributable to preferential catheteriza-

Table 6. Urine Culture Results Stratified by Method of Collection

Culture Result	Bag, No. (%) (n = 390)	CATH, No. (%) (n = 1100)	*P* Value
Positive, UTI	33* (8)	119† (11)	.19
Sterile	247 (63)	904 (82)	<.001
Nonpathogen	35 (9)	7 (1)	<.001
>1 Organism	30 (8)	20 (2)	<.001
UTI and bacteremia	4 (1)	12 (1)	.91
>1 Organism, at least 1 organism meets UTI criteria for colony count	**8 (2)**	**12 (1)**	.16
Bacterial pathogen, pure growth, CFU/mL			NA
<4000	5	27	
4000-9999	9	**11**	
10 000-19 999	4	**7**	
20 000-49 999	**12**	11	
50 000-99 999	**9**	13	
≥100 000	32	93	
Ambiguous culture result‡	29 (7)	30 (3)	<.001

Abbreviations: CATH, urethral catheterization; CFU, colony-forming units; NA, not applicable; UTI, urinary tract infection.
*Includes an infant who had *Escherichia coli* bacteremia and bacteriuria but the colony count was missing.
†Includes an infant who had a positive urinalysis result and a renal abscess but the urine culture was missing, and an infant who had *E coli* bacteremia and bacteriuria but the colony count was missing.
‡Ambiguous cultures (defined in the "Methods" section) equals the sum of the numbers in bold.

tion of high-risk infants and challenge the notion that false-positive results are more common in bag urine cultures. If bag cultures yield high rates of false-positive results, then the method of collection should be an independent predictor of UTI after adjustment for other UTI risk factors. Our analysis demonstrates that this was not the case. Theoretically, however, false-positive bag cultures may have been balanced by false-negative bag cultures.

Limited data exist addressing the comparison between bag and CATH cultures. The AAP's practice parameter on UTI[8] cites 3 references to support the high false-positive rate of bag urine cultures[23-25] and recommends obtaining urine by CATH or SPA. However, none of the studies cited analyzes urine cultures obtained by CATH. The study by Sorensen et al[25] is on incontinence and school-aged girls and has no mention of specific urine collection methods. In the studies by Shannon et al[23] and Leong and Tan,[24] SPA specimens were obtained on infants and children after prior bag urine cultures yielded bacterial growth. In both studies, SPA yielded a significant number of sterile cultures, indicating that a proportion of the bag cultures were false positive. However, it is likely that many UTIs resolve spontaneously,[7] which may explain part of this discrepancy. Furthermore, the study by Leong and Tan has no mention of perineal cleansing before bag placement and states specifically that the "child's external genitalia is not swabbed,"[24(p43)] which is not the standard of practice today.

The consequences of false-positive urine cultures are not benign because they may lead to unnecessary antibiotics, hospitalization, and diagnostic imaging.[9] On the other hand, CATH specimens are painful, technically difficult, and a common source of parental anxiety.[26,27] Parents have been shown to differ from physicians in placing greater emphasis on the pain and discomfort of tests and when given scenarios ranked CATH as substantially more undesirable than bag urine and closer in value to lumbar puncture and venipuncture.[28] In addition, CATH may risk introducing bacteria into the urinary tract[29] and has been shown to be a risk factor for septicemia in neonates.[30] Although catheterized specimens appear to perform better than bag specimens, the magnitude of the difference is small, and the technique undoubtedly has limitations.

This study is limited in that all infants were enrolled by PROS practitioners who performed the initial clinical examination. Infants initially seen by emergency department physicians were not included in the study, and the performance of urine testing might differ in these infants. Furthermore, positive, negative, and ambiguous urine cultures were defined by the study investigators. Although these definitions were meant to reflect standards available in the literature, they may not represent standards followed by all practitioners. Finally, not all of the 3066 infants in this study underwent urine testing. Although the issue of which infants did or did not get tested was addressed in a prior publication,[7] this selective testing may limit the generalizability of our findings. In other words, if urine testing was mandatory as opposed to discretionary, the predictors of catheterization and the UA test characteristics may have differed.

We believe that if bag urine cultures are performed appropriately and interpreted cautiously, errors can be minimized. The poorer specificity of bag specimens is of greater concern for practitioners who manage UTIs aggressively (ie, routine hospitalization and imaging). Ultimately, the choice of urine collection method should incorporate a number of factors, including patient age, parental preference, need for immediate diagnosis and/or antibiotic treatment, and plans for future imaging. The diagnosis of UTI should be made only after careful consideration of pretest probability, UA results, method of collection, and urine culture results.

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Disclaimer: Dr Pantell had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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