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Determinants of practice patterns in pediatric UTI management

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Summary

Introduction—Urinary tract infection (UTI) affects 10% of girls and 3% of boys by age 16. Both the American Academy of Pediatrics and National Institute for Health and Clinical Excellence Guidelines recommend urine testing prior to initiation of antibiotic treatment, and the use of local antibiograms to guide empiric antibiotic therapy. Urine culture results not only provide the opportunity to halt empiric therapy if there is no bacterial growth, but also allow for tailoring of broad-spectrum therapy. Additionally, the use of antiobiograms is recommended to improve empiric antibiotic selection based on local resistance patterns. However, execution of guideline recommendations has proven challenging. In order to develop targeted interventions aimed at improving adherence to these guidelines, understanding the barriers that may exist in implementing them is critical.

Objectives—The present study sought to investigate practice patterns and factors that influence urine testing and antibiogram use in the setting of empiric antibiotic treatment of UTI in children, with the aim of ultimately improvinguo A adherence to UTI management guidelines.

Study design—A random, national sample of physicians caring for children was surveyed from the American Medical Association Masterfile. Participants were queried regarding practice type, length of time in practice, factors influencing urine testing, urine specimen collection method, and antibiogram utilization. Logistic regression was used to assess factors associated with use of urine testing, bagged specimens, and antibiograms.

Results—Of respondents who acknowledged contact by surveyors, 47% completed the survey (n=366). Most respondents (84%) obtained urinalysis and culture prior to treatment for UTI. Physicians reported that they would more likely order testing if the specimen were easier to collect (46%) and if results were available immediately (48%). Urine collection by bag was more common in circumcised boys (>30%) compared with girls (20%) and uncircumcised boys (20%) (P=0.02). The most common reasons for collection by bag were parental refusal for (49%) and

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Conflicts of interest statement

The authors have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

difficulty with (42%) catheterization. Of the 70% of respondents reporting antibiogram access (n=256), 50% reported its use the majority of the time with empiric prescription (n=128).

Discussion—While most practitioners reported following guidelines to obtain urine testing prior to antibiotic prescription for UTI, urine collection by bag was common. Additionally, <50% of practitioners adhered to guideline recommendations for empiric antibiotic selection based on local antibiograms. Interventions to improve adherence to UTI management guidelines should focus on: (1) improving catheterization practices; (2) educating parents regarding the value of catheterization; and (3) incorporating local antibiograms into electronic medical records.

Keywords

Urinary tract infections; Microbial sensitivity tests; Pediatrics; Antibiotics; Urine specimen collection

Introduction

Urinary tract infection (UTI) is a common medical condition in children. By 16 years of age, the cumulative incidence is 10% among girls and 3% among boys [1]. Both the American Academy of Pediatrics (AAP) and National Institute for Health and Clinical Excellence (NICE) Guidelines recommend urine testing prior to initiation of antibiotic treatment, and the use of local antibiograms to guide empiric antibiotic therapy until return of urine test results [2–4]. The results of urine culture not only provide the opportunity to halt empiric therapy if there is no bacterial growth, but also allow for tailoring of broad-spectrum therapy. Additionally, the use of antiobiograms is recommended to improve empiric antibiotic selection based on local resistance patterns. However, execution of guideline recommendations has proven challenging with two large studies, which demonstrated that less than one third of children <3 years had urine testing prior to antibiotic treatment [1,5].

In order to develop targeted interventions aimed at improving adherence to these guidelines, understanding the barriers that may exist in implementing them is critical. The present national study surveyed a sample of all physicians caring for children within the USA to investigate factors that influence urine testing, as well as antibiogram use, in the setting of empiric antibiotic treatment of UTI in children.

Materials and methods

Study design

Study participants were physicians practicing in the USA who cared for children. Participants were selected from the American Medical Association (AMA) Physician Masterfile. The AMA Physician Masterfile includes current and historical data for physicians, residents, and medical students in the USA; it is created upon entrance to medical school or post-graduate residency and updated with information collected from board certification and state licensure programs, annual AMA census surveys, and an annual online profile update [6]. This database was accessed through Redi-Data (Fairfield, NJ). Physicians classified by the AMA as pediatricians, internists and family practice physicians with a focus on adolescent medicine, pediatric emergency medicine physicians, pediatric

nephrologists, and pediatric urologists in office based, medical teaching or hospital staff practices were eligible for inclusion in the study. Residents and/or those in administration or research practices were excluded from analysis. A cross-sectional sample of 8834 physicians caring for children was randomly selected from a total population of 151,415, using these criteria. An invitation was electronically mailed (e-mailed) to the sample, asking them to complete a web-based survey (www.surveymonkey.com) on the evaluation and treatment practices of children suspected of having UTI. Nonresponders received a series of three follow-up e-mails after the initial request, again asking for their participation. The participants were offered a $10 gift card from Starbucks® for completion, which was supported by the National Institutes of Health. This incentive was chosen because of evidence supporting small, guaranteed dollar amounts versus larger, lottery-based amounts in optimizing the response rates [7]. The University of California, San Francisco Committee on Human Research, approved this study.

Survey instrument

The survey was developed and pilot tested using 20 members of the Department of Pediatrics at the University of California, San Francisco, as well as faculty and fellows in the division of Pediatric Urology at the University of California, San Francisco, with the specific goal of eliciting feedback on the survey design. After revising the questionnaire, based on the feedback received from the pilot study, the survey request was e-mailed to the aforementioned national sample of pediatricians.

The survey took <5 minutes to complete and consisted of 18–24 multiple choice questions, depending on whether the respondent: always performed urine testing when empirically prescribing antibiotics for a UTI; altered their practices based on patient gender and circumcision status; and had access to a local antibiogram (Appendix A Survey). The survey was administered electronically in 2014, and the answers were collected using a commercial Internet company: Survey Monkey (Palo Alto, CA).

The respondents provided their state, and years since finishing residency training, specialty and practice type, and how often they read academic journals. The primary outcome measure was whether the provider ordered a dipstick urinalysis or a microscopic urinalysis and a urine culture when empirically prescribing antibiotics for a UTI. The frequency of ordering urine testing was determined using an ordinal scale (never, rarely, sometimes, most of the time, or always). Those who did not always obtain urine testing were asked to select the factor(s) that influenced their decision to order testing, and the role(s) that testing has/have in the evaluation of a UTI. Participants were also asked to report the influence of patient factors on their decision to obtain testing, including: patient race, age, sex, and medical history (recent treatment for UTI, recurrent UTI, recent antibiotic exposure, recent hospitalization, urologic anomalies, and non-urologic comorbidities) using an ordinal scale (strongly disagree, disagree, neutral, agree, strongly agree). Additional questions solicited the factor(s) that influenced respondents' decision to obtain urine via catheterization, suprapubic aspiration, or urine collection bag among non-toilet-trained children aged 2–24 months, as well as the factor(s) that might increase the likelihood of obtaining urine for testing. Lastly, access to local antibiograms was assessed.

Statistical analyses

The responses were reported as the proportion of total respondents. Participant demographics were compared with one-way ANOVA for continuous variables and Chisquare test for categorical variables. Multivariate logistic regression analysis was performed with the following *a priori* predictor variables: age of physician, practice type, frequency of reading academic journals, and specialty. Results were considered significant if the *P*-value <0.05. Statistical analysis was performed using STATA (Stata Corp, College Station, TX).

Results

A total of 8834 invitations were sent out by e-mail. Of these, 127 e-mails were undeliverable and 7930 subjects did not open the e-mail; therefore, delivery could not be confirmed. These 8057 subjects were excluded from the analysis, as they did not view the invitation to participate in the survey, nor its content. According to convention, it was considered that the 777 subjects who opened at least one e-mail had received an invitation to participate in the study [8]. Of those who opened the e-mail, 366 subjects completed the survey in its entirety (47% response rate). The categories were determined according to preset American Medical Association Masterfile categories derived Redi-Data electronic data tracking. This tracking assessed the number of e-mail invitations that were opened and the number of survey links clicked. Clicked links were considered responses by the data tracking system.

The modal age category of participants was 40–49 years (32%), having completed residency 18 years previously. Most were pediatricians (87%) working in private, group practices (45%) reporting that they read academic journals weekly or more frequently (40%) (Table 1).

Most respondents (84%) stated that they obtained urinalysis and culture prior to treatment for UTI. Neither physician age (P=0.56) nor practice type (P=0.16) was associated with always ordering urine testing. Emergency physicians, pediatricians, and urologists were more likely to order testing compared with all other specialists (family practitioners, internists, adolescent specialists, and nephrologists), P<0.001 (Table 2). Physicians who did not always obtain urine testing reported that they would be more likely to order testing if the specimen was easier to collect (46%) and if the results were immediately available (48%) by point-of-care testing (Fig. 1).

Urine collection among non-toilet-trained children aged 2–24 months was queried. Urine collection by bag was more commonly performed in circumcised boys (31%) compared with 22% of girls and 24% of uncircumcised boys (P=0.02) (Appendix B). The most common reasons for collection by bag were parental refusal for (49%) and difficulty with (42%) catheterization (Fig. 2).

Finally, 70% of respondents (n=256) reported access to local antibiogram. Of these, 50% (n=128) reported that they use an antibiogram ‘always’ or ‘most of the time’ when prescribing antibiotics empirically for UTI. On multivariate analysis, physician age, practice

type, frequency of reading academic journals, and specialty were not associated with increased antiobiogram use (P=0.84, 0.80, 0.33, and 0.14, respectively).

Discussion

The present cross-sectional study sought to document the practice patterns of practitioners caring for children across the USA. It was found that most practitioners reported that they obtained urinalysis and culture prior to antibiotic prescription for UTI. This demonstrated adherence to the AAP guidelines for UTI management, which recommends obtaining a urine specimen for both urinalysis and culture if a clinician empirically treats a febrile infant for presumed UTI [2]. Similarly, the NICE guidelines recommend that infants and children with symptoms and signs suggestive of UTI should have a urine sample tested for infection [3].

Although practitioners reported that they obtained urine testing prior to empiric treatment of UTI with antibiotics, this was contrary to the findings of two large studies using claims data, which demonstrated that less than one third of children <3 years had urine testing prior to antibiotic treatment [1,5]. This discrepancy between practitioners' intentions to obtain urine testing, which was documented in the present study, and the limited rates of urine testing truly obtained, as assessed by Copp et al. and Platt et al., suggests that the lack of urine testing seen in practice may not be due to a failure of guideline dissemination or comprehension. Instead, it may suggest that while providers intend to comply with guidelines and obtain urine testing, barriers may prevent this from being instituted in practice.

In the present study, physicians reported that parental refusal for catheterization and difficulty with catheterization were common barriers to urine testing. Difficulty with catheterization would have a larger impact on children who are not toilet trained and therefore required catheterization to obtain a specimen. In fact, Platt et al. found that compliance with urine testing was significantly poorer among children aged <3 years vs those aged 3–16 years (28% vs 68%, respectively). Notably, urine collection by bag was performed in up to one third of circumcised boys, although a positive culture result for a specimen collected in a bag should not be used to document a UTI [2]. In conjunction, these data suggest that improving adherence to UTI management guidelines may be best accomplished by implementing educational programs directed at both improving the practice of catheterization and providing education to parents regarding the importance of catheterization during the evaluation of their child. Creating and implementing such an educational program and assessing its impact on adherence to guidelines would be of great interest to follow-up the present study.

Urine testing is critical, as urine culture results not only provide the opportunity to halt empiric therapy if there is no bacterial growth, but also allows for tailoring of broad-spectrum therapy. Data from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey suggest that 32% of children with UTI are treated with a broad-spectrum antibiotics, despite the fact that national UTI resistance patterns demonstrate that most uropathogens are sensitive to narrow-spectrum alternatives, with consistently low resistance rates [9]. Importantly, ineffective empiric antibiotic therapy

may contribute to increased morbidity and increased costs due to prolonged antibiotic treatment, recurrent office or emergency room visits, and hospital admissions [10,11]. The Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases recommend that antibiotics should not be used empirically if local resistance rates of uropathogens exceed >20% [12]. However, some 50% of children were prescribed trimethoprim/sulfamethoxazole for UTI, despite the fact that most regions in the USA have resistance rates >20% [13].

Empiric prescribing patterns may be improved through the use of local antibiograms, which are published by 98% of USA hospitals [14]. In the present study, it was found that while most practitioners reported access to an antibiogram, only half of them utilized this tool to base empiric antibiotic selection. In 2014, the Centers for Disease Control and Prevention (CDC) recommended that all acute care hospitals implement Antibiotic Stewardship Programs (ASPs) to improve antibiotic use [15]. According to the CDC, these programs help clinicians to improve the quality of patient care and patient safety through increased infection cure rates, reduced treatment failures, and increased frequency of correct prescribing patterns [16]. With the increased adoption of electronic medical records (EMRs), assimilating antibiotic stewardship programs into EMRs may ultimately improve antibiotic prescribing patterns [17]. Specifically, incorporation of local antibiograms into EMRs may help practitioners to choose appropriate empiric antibiotics when treating UTI in children.

Interestingly, neither a failure of guideline dissemination nor a failure of practitioners to understand these guidelines has limited adherence. Instead, it is the implementation of these guidelines into clinical practice that has presented a challenge. This study suggests that proposing guidelines is not sufficient to improve management; focus needs to be turned towards integrating recommendations into practice. For UTI management, interventions to improve adherence should focus on: (1) improving catheterization practices; (2) educating parents regarding the value of catheterization; and (3) incorporating local antibiograms into EMRs.

Study limitations

This study was limited by the low response rate and associated small sample size, and the limited diversity of specialists responding, with the vast majority of respondents being pediatricians (87%). This may be inherent to e-mailed surveys, as its unknown if the invitation was blocked or simply deleted before being read. While this potentially created a selection and response bias, reliance on the response rate is not recommended as the sole indicator of validity in survey data [18,19]. Instead, it is critical to assess factors known to be associated with response bias, such as age [19]. In the present study, the age of respondents (48 years) was not significantly different than the age of nonrespondents (50 years). A survey limited to local sample, such as within one hospital, may have resulted in a greater response rate. However, utilizing a national mailing source, compared with a local sample, allowed increased generalizability. Lastly, utilizing a simple study design with pretesting minimized common limitations of survey research, including misinterpretation and survey fatigue. Selection bias could be further considered, as respondents who chose to answer the survey may have had more interest in this topic and may, therefore, have been significantly

different in their understanding of the guidelines. As Table 1 describes, respondents were not uniform in practice type, with one fifth of respondents in academic practices and less than one half in group private practices. Moreover, their self-reported frequency of reading academic journals was also variable, with over one third reading weekly or more, nearly one third reading ‘every few weeks’, and the remaining respondents reading between ‘monthly’ and ‘less than once a year’. This suggests that respondents were, in fact, variable in their understanding of the current literature.

Conclusions

While most practitioners reported that they followed guidelines to obtain urinalysis and culture prior to antibiotic prescription for UTI, urine collection by bag specimen was common, especially in circumcised males. Difficulty with catheterization and parental refusal of catheterization were cited as the most common barriers to executing guideline-recommend urine testing. Additionally, <50% of practitioners adhered to guideline recommendations for empiric antibiotic selection based on local antibiograms. This study suggests that interventions to improve adherence to UTI management guidelines should focus on: (1) improving catheterization practices; (2) educating parents regarding the value of catheterization; and (3) incorporating local antibiograms into electronic medical records.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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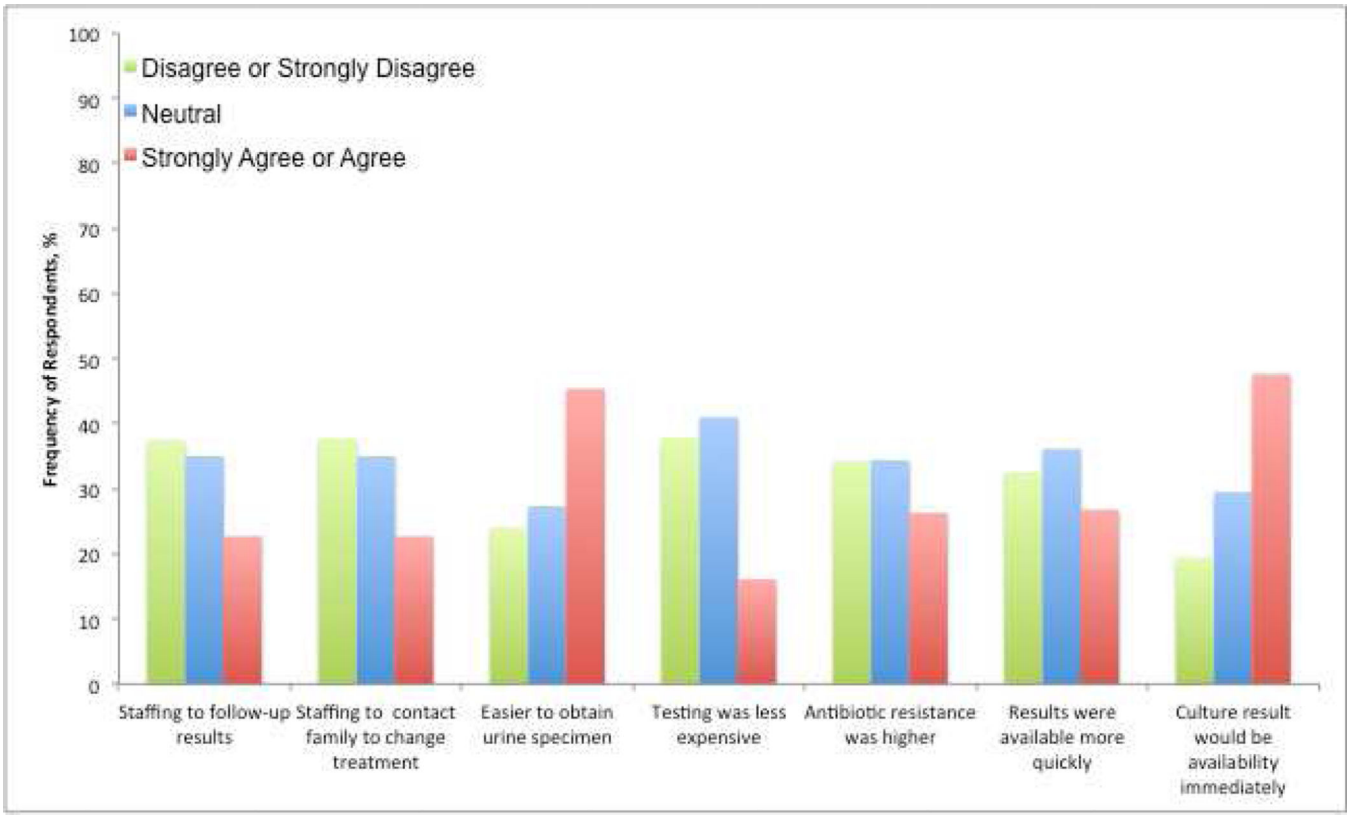

Fig. 1.

Factors cited by respondents as barriers to obtaining any urine testing. Respondents were able to select multiple factors that influenced their decisions; therefore, sum of percentages is >100.

Table 1

Demogaphics of survey participants

Participant Response	n	%
Age of physician, category		
21–29	4	1%
30–39	92	25%
40–49	116	32%
50–59	106	29%
60–69	47	13%
70–79	1	0%
Years post residency, mean (SD)	18 (10)	
Practice type		
Academic	78	21%
HMO	26	7%
Private practice/group	163	45%
Private practice/solo	33	9%
Community clinic	22	6%
Hospital-based	44	12%
Frequency of reading academic journals		
Weekly or more frequently	148	40%
Every few weeks	117	32%
Monthly	54	15%
Every other month	21	6%
Once in awhile	24	7%
Less than once a year	2	1%
Specialty		
Emergency physician	19	5%
Pediatrician	317	87%
Urologist	9	2%
Other*	21	6%

*Other includes family medicine, internal medicine, adolescent medicine, and nephrology

Table 2

Factors associated with always performing urine testing

Characteristic	Percentage Obtaining Urine Testing	OR	95% CI	*P* Value
Age of physician				
Less than 50	95%	---		
50 or older	96%	1.35	0.49 – 3.73	0.56
Practice type				
Academic	92%	---		
Nonacademic	96%	0.48	0.17 – 1.33	0.16
Frequency of reading academic journals				
Weekly/every few weeks	96%	---		
Monthly/every other month	96%	1.14	0.31 – 4.14	0.84
Once in a while/less than once a year	92%	0.57	0.12 – 2.69	0.48
Specialty				
Emergency/Pediatrician/Urologist	97%	---		
Other *	77%	0.06	0.02 – 0.18	<0.001

* Other includes family medicine, internal medicine, adolescent medicine, and nephrology

Table 3

Factors cited by respondents as influential in using a urine collection bag.

Factor	Frequency of Responses*
Parents refuse catheterization	49%
Difficulty with catheterization	42%
If collection bag negative, no further testing; If collection bag positive, will catheterize	30%
Never use a collection bag	27%
Prefer collection bag due to trauma of catheterization	12%
Disagree with AAP guidelines	2%
Difficulty obtaining urine; prefer broad spectrum antibiotics	1%

Factors cited by respondents as (A) barriers to botaining any urine testing and (B) influential in using a urine collection bag.

Factor	Frequency of Responses*
(A) Barries to obtaining urine testing	
Culture result would be availability immediately	48%
Easier to obtain urine specimen	45%
(B) Factors reported by respondents in using a urine collection bag	
Parents refuse catheterization	49%
Difficulty with catheterization	42%

*Respondents were able to select multiple factors which influenced their decision; therefore, sum of percentages >100.