Adherence to the 2011 American Academy of Pediatrics Urinary Tract Infection Guidelines for Voiding Cystourethrogram Ordering by Clinician Specialty

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OBJECTIVE To evaluate rates of guideline adherence and associations with voiding cystourethrogram result. The American Academy of Pediatrics guidelines recommend voiding cystourethrogram after abnormal renal ultrasound or 2 febrile urinary tract infections. It is unclear whether guideline adherence increases vesicoureteral reflux detection. Additionally, guidelines targeting children 2-24 months are often applied to other ages.

METHODS Children undergoing voiding cystourethrogram from January 2012 to December 2013 at 1 institution were retrospectively reviewed. Children with known genitourinary abnormalities were excluded. The primary outcome was guideline adherence. Univariate and multivariate analyses were performed. Subgroup analysis of children 2-24 months was completed.

RESULTS Voiding cystourethrograms from 365 children were included in the primary analysis, including 187 (51.2%) aged 2-24 months. Overall, 60.3% of voiding cystourethrograms were ordered in accordance with the guidelines. Urologists/nephrologists were more likely to adhere to ordering guidelines than pediatricians/others (76.4% vs 51.7%, odds ratio 3.0 [1.9-4.9], $P < .001$). Subgroup analysis in children 2-24 months revealed similar findings (76.4% vs 51.5%, odds ratio 3.0 [1.5-6.2], $P = .002$). Voiding cystourethrograms were abnormal in 31.8% overall and 26.2% aged 2-24 months. Guideline adherence was associated with increased likelihood of abnormal voiding cystourethrogram among all children ($P = .02$), but not among children 2-24 months ($P = .95$). Older age, white race, and guideline adherence remained significantly associated with abnormal voiding cystourethrogram in a multiple logistic regression model.

CONCLUSIONS Guideline adherence was more likely among urologists/nephrologists than pediatricians/others and was not associated with abnormal voiding cystourethrogram among children 2-24 months. Multicenter evaluation is necessary to determine if ordering recommendations should be revised. UROLOGY 126: 180–186, 2019. © 2019 Elsevier Inc.

The prevalence of urinary tract infection (UTI) in infants and young children between 2 months and 2 years of age with no other source of fever is about 15%.[1] There is a presumed linkage between recurrent UTIs and renal scarring, which can lead to renal insufficiency and hypertension. Abnormal retrograde flow of urine from the urinary bladder to the renal collecting system, known as vesicoureteral reflux, is a risk factor for recurrent febrile UTIs[2,3] and scarring,[4] and can be graded from 1 (mild) to 5 (severe).[5] While the gold standard for diagnosing vesicoureteral reflux is a voiding cystourethrogram (VCUG), concerns about the need for catheterization and radiation exposure have led to an ongoing dialogue regarding judicious utilization.

Historically, renal sonography and VCUG were both performed following a child's first febrile UTI.[6] Renal sonography may reveal hydronephrosis associated with anatomic urinary obstruction, renal or ureteral dilation associated with vesicoureteral reflux, medical renal

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disease, or pyelonephritis among children presenting with UTI. Ultrasound imaging is noninvasive and nonionizing, and renal ultrasound is therefore recommended for all children with a history of pyelonephritis. Controversy exists regarding the usage and timing of VCUG. Proponents of VCUG after 1 febrile UTI note that renal sonography has poor sensitivity for detection of dilating vesicoureteral reflux (grade III-V).[2,7,8] Prompt treatment of febrile UTIs prevents renal scarring,[9,10] and early diagnosis and management of vesicoureteral reflux may improve patient outcomes.

Critics of early VCUG administration argue that procedure morbidity is not justified because early vesicoureteral reflux management may not improve patient outcomes. Hannula et al examined rates of culture-proven vs "false" UTIs and found a similar prevalence of vesicoureteral reflux (37% vs 35%) among both groups of children,[11] suggesting that the association between vesicoureteral reflux and UTI may not be as robust as previously believed. In a prospective analysis of infants with congenital vesicoureteral reflux, Sjostrom et al revealed that spontaneous resolution or downgrading of high-grade vesicoureteral reflux was common in the first year of life.[12] These studies suggest that delayed imaging in a smaller patient cohort may decrease urinary tract manipulation and radiation exposure among young children without influencing patient care outcomes.

The 2011 American Academy of Pediatrics (AAP) consensus statement on the workup of UTI in children aged 2-24 months limits VCUG acquisition to children with "hydronephrosis, scarring, or other findings that would suggest either high-grade vesicoureteral reflux or obstructive uropathy. . .atypical or complex clinical circumstances. . .or if there is a recurrence of febrile UTI."[13] The AAP Section of Urology disagreed that VCUG should not be routinely performed, noting that "[The guidelines] imply that deferring the VCUG is now the standard of care and may cause many to infer wrongly that choosing to order an initial VCUG is substandard care."[14] It is unclear whether VCUG ordering in accordance with the UTI guidelines increases the detection rate of vesicoureteral reflux. Additionally, it is unclear whether these guidelines lead to improved outcomes. The objectives of this study were to (1) determine rates of clinician adherence with VCUG ordering guidelines by specialty and (2) evaluate the association between guideline adherence and VCUG result.

PATIENTS AND METHODS

The study was a retrospective cohort analysis of children previously identified for evaluation of periprocedural UTIs at an urban, pediatric, and tertiary care center. Study participants were identified by searching the hospital's electronic medical record for the term "cystogram" or "cystourethrogram." All children 18 years of age or younger who underwent a VCUG at the institution for evaluation of UTI between January 2012 and December 2013 were included. Children with known genitourinary abnormality (aside from UTI) or prior diagnosis of vesicoureteral reflux were excluded. A manual chart review was performed to confirm patient eligibility.

Patient characteristics (age, sex, race, ethnicity, and insurance status) and clinical factors (indication for cystogram, prior renal ultrasound findings, ordering clinician specialty, number of prior UTIs, known urologic comorbidities, and VCUG result) were recorded for each study participant. Criteria for guideline adherence were met when VCUGs were ordered after either 2 febrile UTIs or 1 febrile UTI and a prior abnormal renal ultrasound. Ordering practices that did not meet criteria for guideline adherence included VCUG ordering in the setting of: (1) history of nonfebrile UTI only, (2) 1 febrile UTI without a renal ultrasound, or (3) 1 febrile UTI with a normal renal ultrasound. Two study authors independently determined whether VCUGs were ordered in adherence with the guidelines. The primary outcome was adherence to the 2011 AAP guidelines for VCUG ordering in the setting of pediatric UTI. Relationships between clinician specialty (ie, urology vs pediatrics), patient demographics, VCUG outcome, and guideline adherence were evaluated.

Differences in sample characteristics by guideline adherence and VCUG result were evaluated using Wilcoxon rank sum tests for age and chi-squared or Fisher's exact tests (as appropriate) for categorical variables. Pairwise comparisons were conducted to evaluate guideline adherence by specialty (urology, nephrology, pediatrics, or other physicians). Logistic regression models were used to evaluate associations between patient demographics and clinician specialty in predicting guideline adherence and abnormal VCUG result. Since the AAP guidelines specifically target the group of children aged 2-24 months, analyses were repeated on this prespecified subgroup.

Sample characteristics were reported by guideline adherence and VCUG result. Median and interquartile ranges were reported for age, and frequencies were reported for categorical variables. All statistical analyses were performed using SAS, version 9.4 (SAS Institute, Cary NC; 2012). All analyses assumed a 2-sided 5% significance threshold. No corrections were made for multiple hypothesis testing. The study was approved by a local Institutional Review Board prior to initiation.

RESULTS

VCUG reports from 1115 consecutive children were reviewed. A total of 750 children were excluded: 246 for known genitourinary anomalies, 262 for known vesicoureteral reflux, 171 for antenatal hydronephrosis without UTI, and 71 for missing information regarding study indication, fever status, or renal ultrasound result. A total of 365 children (67.1% female, median age 12.4 months [range 0.3-202.6]) were included in the primary analysis (Table 1). Subgroup analysis included 187 children (51.2% of study patients) aged 2-24 months.

Overall, 220 (60.3%) of the VCUGs in this study were ordered in compliance with the 2011 AAP UTI guidelines. VCUG ordering patterns were similar among urologists and nephrologists (29 clinicians, ordered 34.8% of VCUGs), and among pediatricians and other specialists (171 clinicians, ordered 65.2% of VCUGs). Thus, these specialties were grouped for analysis. Urologists and nephrologists were more likely to adhere to ordering guidelines than pediatricians and other specialists (97/127 [76.3%] vs 123/238 [51.6%], OR 3.0 [1.9-4.9], P <.0001). Subgroup analysis in children 2-24 months revealed similar findings (42/55 [76.4%] vs 68/132 [51.5%], OR 3.0

Table 1. Patient characteristics by guideline adherence

Variable	Median (IQR)/*N* (%) Total Sample *N* = 365	Nonadherent *N* = 145 (39.7%)	Adherent *N* = 220 (60.3%)	*P* Value*
Age (mo)	12.4 (4.7-48.8)	11.4 (4.2-45.4)	13.5 (5.2-50.7)	.20
Age Category				
Less than 2 mo	42 (11.5%)	18 (12.4%)	24 (10.9%)	.66
2 mo to 2 y	187 (51.2%)	77 (53.1%)	110 (50.0%)	
2 –18 y	136 (37.3%)	50 (34.5%)	86 (39.1%)	
Insurance				
Private	160 (43.8%)	62 (42.8%)	98 (44.6%)	.91
Public	189 (51.8%)	76 (52.4%)	113 (51.4%)	
Other	16 (4.4%)	7 (4.8%)	9 (4.1%)	
Race/ethnicity				
Caucasian	153 (41.9%)	60 (41.4%)	93 (42.3%)	.13
Hispanic	168 (46.0%)	69 (47.6%)	99 (45.0%)	
African-American	17 (4.7%)	10 (6.9%)	7 (3.2%)	
Asian	10 (2.7%)	1 (0.7%)	9 (4.1%)	
Other	17 (4.7%)	5 (3.5%)	12 (5.4%)	
Gender				
Female	245 (67.1%)	102 (70.3%)	143 (65.0%)	.29
Male	120 (32.9%)	43 (29.7%)	77 (35.0%)	
Inpatient status				
Outpatient	320 (87.7%)	131 (90.3%)	189 (85.9%)	.21
Inpatient	45 (12.3%)	14 (9.7%)	31 (14.1%)	
Specialty				
Pediatrics/other	238 (65.2%)	115 (79.3%)	123 (55.9%)	<.001
Urology/nephrology	127 (34.8%)	30 (20.7%)	97 (44.1%)	
VCUG Result				
Normal	249 (68.2%)	109 (75.2%)	140 (63.6%)	.02
Abnormal	116 (31.8%)	36 (24.8%)	80 (36.4%)	

IQR, interquartile range; VCUG, voiding cystourethrogram.
* Wilcoxon rank sum test used to evaluate differences in compliance by age and chi-square or Fisher's exact tests used to evaluate differences for categorical variables.

[1.5-6.2], $P = .002$). Guideline adherence was not associated with age, ethnicity, or sex on bivariate analysis (Tables 1 and 2).

The VCUG result was abnormal in 116/365 children (31.7%) overall and 49/187 (26.2%) children aged 2-24 months. Adherence with the 2011 AAP UTI guidelines was associated with an increased likelihood of abnormal VCUG among all children (36.4% of the adherent studies vs 24.8% of the nonadherent studies were abnormal, $P = .02$), but there was no significant association in children aged 2-24 months (26.4% vs 26.0% among nonadherent studies, $P = 1.0$). Guideline adherence, older age, Caucasian race, female sex, and urology/nephrology specialty were associated with VCUG outcomes on bivariate analysis (Table 3). Following multiple logistic regression analyses, the variables remaining significantly associated with VCUG result were age ($P = .01$), race/ethnicity ($P = .0002$), and guideline adherence ($P = .03$). Clinician specialty was no longer significant in the adjusted model (Table 4). Post hoc multivariate analysis revealed a strong association between guideline adherence and abnormal VCUG result among the 126 children aged 2-18 years, with 44/86 (51.1%) abnormal VCUGs among children with adherent testing vs 13/50 (26.0%) abnormal VCUGs among children with nonadherent testing (OR 3.0 [1.4-6.4], $P = .005$).

DISCUSSION

The use of antenatal ultrasound imaging has led to early diagnosis and intervention for children with genitourinary abnormalities. This has, in turn, decreased the overall utilization of radiographic imaging after UTI.[15] Historically, clinicians were advised to obtain both a renal ultrasound and a VCUG after the first instance of febrile UTI.[6] The 2011 AAP UTI guidelines recommended obtaining a renal ultrasound after the initial febrile UTI and reserving VCUG for children with either an abnormal renal ultrasound or the second febrile UTI.[13] Adherence with the updated AAP UTI guidelines is not well documented. Sargent et al analyzed VCUG ordering among Canadian clinicians in 1995 and demonstrated that the overall rate of vesicoureteral reflux detection (30%) was similar in children referred for VCUG by generalists vs subspecialists,[16] however updated studies are lacking.

In the present study, clinician guideline adherence by specialty and associations with VCUG results were analyzed. Overall, 60.3% of VCUGs were ordered in accordance with the 2011 AAP UTI guidelines, suggesting moderate adoption by ordering clinicians. Urologists and nephrologists were significantly more likely to adhere to ordering guidelines than pediatricians and providers in other specialists, and subgroup analysis in children 2-24 months revealed similar findings. Study results are surprising given the initial AAP Section of Urology response to the UTI guidelines.[14] Increased guideline adherence among urologists and nephrologists may suggest greater

Table 2. Subgroup characteristics by guideline adherence

Variable	Median (IQR)/*N* (%) Total Sample *N* = 187	Nonadherent *N* = 77 (41.2%)	Adherent *N* = 110 (58.8%)	*P* Value*
Age (mo)	7.6 (4.5-12.4)	7.6 (4.3-11.8)	7.8 (4.7-13.1)	.28
Insurance				
Private	92 (49.2%)	39 (50.7%)	53 (48.2%)	.75
Public	85 (45.5%)	33 (42.9%)	52 (47.3%)	
Other	10 (5.4%)	5 (6.5%)	5 (4.6%)	
Race/ethnicity				
Caucasian	80 (42.8%)	34 (44.2%)	46 (41.8%)	.47
Hispanic	82 (43.9%)	35 (45.5%)	47 (42.7%)	
African-American	9 (4.8%)	4 (5.2%)	5 (4.6%)	
Asian	9 (4.8%)	1 (1.3%)	8 (7.3%)	
Other	7 (3.7%)	3 (3.9%)	4 (3.6%)	
Gender				
Female	116 (62.0%)	52 (67.5%)	64 (58.2%)	.19
Male	71 (38.0%)	25 (32.5%)	46 (41.8%)	
Specialty				
Pediatrics/other	132 (70.6%)	64 (83.1%)	68 (61.8%)	.002
Urology/nephrology	55 (29.4%)	13 (16.9%)	42 (38.2%)	
VCUG result				
Normal	138 (73.8%)	57 (74.0%)	81 (73.6%)	.95
Abnormal	49 (26.2%)	20 (26.0%)	29 (26.4%)	

* Wilcoxon rank sum test used to evaluate differences in compliance by age and chi-square or Fisher's exact tests used to evaluate differences for categorical variables.

guideline familiarity given that these specialties deal primarily with genitourinary disorders.

VCUG results were abnormal in 31.8% of children overall and in 26.2% of children in the subcohort aged 2-24 months. These results are similar to previously reported estimates of vesicoureteral reflux prevalence, which range from 22% to 28%.[17-19] Guideline adherence was associated with increased likelihood of abnormal

Table 3. Overall and subgroup patient characteristics by VCUG result

Variable	Overall Median (IQR)/*N* (%) Normal *N* = 249 (68.2%)	Abnormal *N* = 116 (31.8%)	*P* Value*	Age 2-24 Month Subgroup Median (IQR)/N (%) Normal *N* = 138 (73.8%)	Abnormal *N* = 49 (26.2%)	*P* Value*
Age (mo)	11.3 (4.0-40.8)	23.0 (7.3-60.9)	<.001	7.3 (4.4-12.4)	9.3 (6.2-13.1)	.14
Age Category						
< 2 mo	32 (12.9%)	10 (8.6%)	.006			
2 mo-2 y	138 (55.4%)	49 (42.2%)				
2-18 y	79 (31.7%)	57 (49.1%)				
Insurance						
Private	105 (42.2%)	55 (47.4%)	.40	65 (47.1%)	27 (55.1%)	.55
Public	131 (52.6%)	58 (50.0%)		66 (47.8%)	19 (38.8%)	
Other	13 (5.2%)	3 (2.6%)		7 (5.1%)	3 (6.1%)	
Race/ethnicity						
Caucasian	84 (33.7%)	69 (59.5%)	<.001	47 (34.1%)	33 (67.4%)	<.001
Hispanic	131 (52.6%)	37 (31.9%)		69 (50.0%)	13 (26.5%)	
African-American	14 (6.7%)	3 (2.6%)		8 (5.8%)	1 (2.0%)	
Asian	9 (3.6%)	1 (0.9%)		9 (6.5%)	0 (0.0%)	
Other	11 (4.2%)	6 (5.2%)		5 (3.5%)	2 (4.1%)	
Gender						
Female	154 (61.9%)	91 (78.5%)	.002	78 (56.5%)	38 (77.6%)	.009
Male	95 (38.2%)	25 (22.6%)		60 (43.5%)	11 (22.5%)	
Inpatient status						
Outpatient	213 (85.6%)	107 (92.2%)	.07	121 (87.7%)	47 (95.9%)	.10
Inpatient	36 (14.5%)	9 (7.8%)		17 (12.3%)	2 (4.1%)	
Specialty						
Pediatrics/other	174 (69.9%)	64 (55.2%)	.006	99 (71.7%)	33 (67.4%)	.56
Urology/nephrology	75 (30.1%)	52 (44.8%)		39 (28.3%)	16 (32.7%)	

* Wilcoxon rank sum test used to evaluate differences in compliance by age and chi-square or Fisher's exact tests used to evaluate differences for categorical variables.

Table 4. Logistic regression: Association between guideline adherence and VCUG result

Outcome	Predictor	Comparison	OR (95% CI)	*P* Value
All Patients				
Adherence	Specialty	Pediatrics/Other vs Urology/Nephrology	3.0 (1.9-4.9)	<.001
Abnormal VCUG	Age	1-year Increase	1.0 (1.0-1.0)	.01
	Race			<.001
		Asian vs Caucasian	0.1 (0.02-1.1)	.06
		African-American vs Caucasian	0.3 (0.08-1.0)	.06
		Hispanic vs Caucasian	0.3 (0.2-0.6)	<.001
		Other vs Caucasian	0.7 (0.2-2.0)	.48
	Guideline Adherence	Nonadherent vs Adherent	0.6 (0.4-1.0)	.03
Patients 2-24 Months				
Adherence	Specialty	Pediatrics/Other vs Urology/Nephrology	3.0 (1.5-6.2)	.002
Abnormal VCUG	Race			.009
		Asian vs Caucasian	N/A	.98
		African-American vs Caucasian	0.2 (0.02-1.5)	.11
		Hispanic vs Caucasian	0.3 (0.1-0.6)	<.001
		Other vs Caucasian	0.6 (0.1-3.1)	.52

VCUG among all children, but there was no association in children aged 2-24 months. While few prior studies have directly examined the associations between AAP UTI guideline adherence and abnormal VCUG result, other research groups have reached similar conclusions in support of guideline adherence. Lee et al examined 618 children with a history of febrile UTI and determined that if a renal ultrasound or dimercaptosuccinic acid scan is normal after the first febrile UTI then VCUG is not necessary unless a child has recurrent UTIs.[20] Studies by Fuente et al[21] and Berry et al[22] came to a similar conclusion. In a study specifically aimed at guideline adherence, Pennesi et al found that only 0.5% of 406 children treated according to the AAP guidelines had vesicoureteral reflux in the setting of a normal renal ultrasound and recommended guideline adherence.[23]

Several studies recommend against guideline adherence. Friedman et al did not find a significant association between recurrent UTIs and abnormal VCUG findings, and recommended against VCUG acquisition altogether.[19] Studies by Kimata et al and Logvineko et al determined that renal ultrasound is 18%-46% sensitive for predicting vesicoureteral reflux, and therefore a poor screening test.[8,24] While the authors acknowledge that renal ultrasound is insensitive for the prediction of vesicoureteral reflux, these results suggest that there is little benefit to delayed VCUG acquisition.

There are several important study limitations. First, the study sample was drawn from patients who had undergone VCUG at the study institution. Patients who presented with febrile UTIs and did not undergo VCUG were not studied, thereby limiting the evaluation of children with inappropriately omitted VCUG and potentially skewing study results. While a direct comparison between these groups would be ideal, we unfortunately could not account for patients who were seen by outside providers and not referred to our institution. Therefore, we were unable to evaluate all potential patients with UTIs.

Second, it is difficult to discern independent variable contributions to abnormal VCUG results due to multicollinearity in a multiple logistic regression model. In this sample, among other associations, age was associated with sex, physician specialty, and inpatient status; sex was further associated with race, physician specialty, and inpatient status. Since this was not a purely randomized sample, it is impossible to rule out any confounding effects and it is difficult to truly establish causality. Due to the nature of the research question and relevant hypotheses, however, a randomized study is not possible. Despite these shortcomings, the association between adherence and specialty remained consistent, and overall, adherence seemed to maintain a relationship with VCUG result even after adjustment for multiple demographic factors.

Third, this was a single-center retrospective cohort review. Study results were obtained at an urban, pediatric, and tertiary referral center with subspecialty services and on-site access to VCUG. Ordering patterns may be different in alternate settings. While chart review data is more granular than data extracted from national databases, limited clinical detail was available for some patients. Children were excluded from the cohort if it was unclear why the study was ordered, if their fever status was unknown, or if results of the renal ultrasound were not available. Additionally, payer mix may vary by specialty, leading to over- or under-representation of patient groups in each specialty. It is possible that specific groups (ie, from a particular ordering clinician) were systematically excluded from the sample, thereby biasing both the sample and the study inferences.

Finally, the AAP guideline recommendations are aimed at children between 2 months and 2 years of age. Ordering guidelines are often extrapolated to children outside the target age range because there are no guidelines for VCUG acquisition in younger or older children. While children 2 months to 2 years of age were examined as a subpopulation, the patient cohort was also examined as a whole to account for guideline usage outside of the target age range. Guideline adherence was associated with abnormal VCUG result among all children, but not among children aged 2-24 months. Instead, post hoc analysis revealed a strong association between guideline adherence and abnormal VCUG result among the older patient cohort. Further multicenter evaluation is necessary to determine if the 2011 AAP VCUG ordering recommendations should be revised.

CONCLUSION

At this urban, pediatric, and tertiary care referral center, 2011 AAP UTI guideline adherence for VCUG ordering was more likely among urologists and nephrologists than pediatricians or other specialists. Guideline adherence increased the diagnostic yield of VCUG studies in the full patient cohort, but there was no association in children aged 2-24 months. Further multicenter evaluation is necessary to determine whether VCUG ordering recommendations should be revised.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2018.12.044.

References

1. Bonadio W, Maida G. Urinary tract infection in outpatient febrile infants younger than 30 days of age: a 10-year evaluation. *Pediatr Infect Dis J*. 2014;33:342–344.
2. Hwang HH, Cho MH, Ko CW. The necessity of voiding cystourethrography in children with prenatally diagnosed hydronephrosis. *J. Int. Med. Res*. 2011;39:603–608.
3. Keren R, Shaikh N, Pohl H, et al. Risk factors for recurrent urinary tract infection and renal scarring. *Pediatrics*. 2015;136:e13–e21.
4. Mattoo TK, Chesney RW, Greenfield SP, et al. Renal scarring in the Randomized Intervention for Children with Vesicoureteral Reflux (RIVUR) Trial. *Clin J Am Soc Nephrol*. 2016;11:54–61.
5. Bridge RA, Roe CW. The grading of vesicoureteral reflux: a guide to therapy. *J Urol*. 1969;101:821–823.
6. Practice parameter: the diagnosis, treatment, and evaluation of the initial urinary tract infection in febrile infants and young children. American Academy of Pediatrics. Committee on Quality Improvement. Subcommittee on Urinary Tract Infection. *Pediatrics*. 1999; 103:843–852.
7. Massanyi EZ, Preece J, Gupta A, Lin SM, Wang M-H. Utility of screening ultrasound after first febrile UTI among patients with clinically significant vesicoureteral reflux. *Urology*. 2013;82:905–909.
8. Logvinenko T, Chow JS, Nelson CP. Predictive value of specific ultrasound findings when used as a screening test for abnormalities on VCUG. *J Pediatr Urol*. 2015;11:176. e171-177.
9. Coulthard MG, Verber I, Jani JC, et al. Can prompt treatment of childhood UTI prevent kidney scarring? *Pediatr. Nephrol*. 2009;24:2059–2063.
10. Oh MM, Cheon J, Kang SH, Park HS, Lee JG, Moon DG. Predictive factors for acute renal cortical scintigraphic lesion and ultimate scar formation in children with first febrile urinary tract infection. *J. Urol*. 2010;183:1146–1150.
11. Hannula A, Venhola M, Renko M, Pokka T, Huttunen N-P, Uhari M. Vesicoureteral reflux in children with suspected and proven urinary tract infection. *Pediatr. Nephrol*. 2010;25:1463–1469.
12. Sjöström S, Sillén U, Jodal U, Sameby L, Sixt R, Stokland E. Predictive factors for resolution of congenital high grade vesicoureteral reflux in infants: results of univariate and multivariate analyses. *J. Urol*. 2010;183:1177–1184.
13. Subcommittee on Urinary Tract Infection SCoQI, ManagementRoberts KB. 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;128:595–610.
14. Wan J, Skoog SJ, Hulbert WC, et al. Section on Urology response to new Guidelines for the diagnosis and management of UTI. *Pediatrics*. 2012;129:e1051–e1053.
15. Gelfand MJ, Barr LL, Abunku O. The initial renal ultrasound examination in children with urinary tract infection: the prevalence of dilated uropathy has decreased. *Pediatr Radiol*. 2000;30:665–670.
16. Sargent MA, Stringer DA. Voiding cystourethrography in children with urinary tract infection: the frequency of vesicoureteric reflux is independent of the specialty of the physician requesting the study. *AJR Am J Roentgenol*. 1995;164:1237–1241.
17. Mahant S, To T, Friedman J. Timing of voiding cystourethrogram in the investigation of urinary tract infections in children. *J. Pediatr*. 2001;139:568–571.
18. Mahyar A, Ayazi P, Tarlan S, Moshiri A, Hamidfar M, Barikani A. When is the best time for voiding cystourethrogram in urinary tract infection of children? *Acta Med Iran*. 2012;50:468–472.
19. Friedman AA, Wolfe-Christensen C, Toffoli A, Hochsztein DE, Elder JS, Lakshmanan Y. History of recurrent urinary tract infection is not predictive of abnormality on voiding cystourethrogram. *Pediatr. Surg. Int*. 2013;29:639–643.
20. Lee JH, Kim MK, Park SE. Is a routine voiding cystourethrogram necessary in children after the first febrile urinary tract infection? *Acta Paediatr*. 2012;101:e105–e109.
21. Fuente MÁ, Costa TS, García BS, Serrano MA, Alonso MS, Luján EA. Practical approach to screen vesicoureteral reflux after a first urinary tract infection. *Indian J Urol*. 2014;30:383–386.
22. Berry CSJ, Vander Brink BA, Koff SA, Alpert SA, Jayanthi VR. Is VCUG still indicated following the first episode of urinary tract infection in boys? *Urology*. 2012;80:1351–1355.
23. Pennesi M, L'Erario I, Travan L, Ventura A. Managing children under 36 months of age with febrile urinary tract infection: a new approach. *Pediatr. Nephrol*. 2012;27:611–615.
24. Kimata T, Kitao T, Yamanouchi S, Tsuji S, Kino M, Kaneko K. Voiding cystourethrography is mandatory in infants with febrile urinary tract infection. *Tohoku J. Exp. Med*. 2013;231:251–255.

EDITORIAL COMMENT

The American Academy of Pediatrics (AAP) guidelines for investigating infants with an initial febrile urinary tract infection (UTI) were designed in the hopes of minimizing unnecessary testing and treatment. Presumably the detection rates of reflux would be higher by raising the bar for ordering a voiding cystourethrogram (VCUG), namely by requiring either an abnormal renal sonogram or the second febrile UTI before performing the VCUG.

The authors of this paper chose to test the AAP's hypothesis. This paper shows that in fact there was no difference in reflux rates in children aged 2-24 months if the guidelines were adhered to or not. Reflux was detected in 26% of these children regardless of guideline adherence. Interestingly, reflux differences were seen in guideline adherence vs nonadherence for those children older than 2 years (51% vs 26% respectively).

The paper also found that 60% of the VCUGs were ordered as prescribed by the AAP guidelines. These guidelines seem to be shifting clinical practices and fewer VCUGs ordered may be a factor in the trend toward fewer ureteral reimplantations being done in the United States.[1]

Our charge as physicians is to remove our patients from the greatest danger facing them and for children with febrile UTIs, that danger is not reflux, but rather high grades of reflux. I hope the future of data analysis will follow the direction of those nomograms that allow for greater accuracy in predicting clinical outcomes in reflux such as the reflux resolution calculator.[2] Adding more patient characteristics (such as age, ethnicity, family history, degree of fever, etc.) along with more specific sonogram findings (such as ureteral dilation, duplication, and dysmorphia[3]) to a reflux incidence nomogram will increase our likelihood of knowing not only who has reflux but also who has which grade of reflux. In an age when companies armed with data can predict every consumer's exact preferences, we should be able to accurately predict which degree of reflux children have and, armed with that information, be better able to achieve the goals of the AAP guidelines of minimizing unnecessary testing and treatment.

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References

1. Kurtz MP, Leow JJ, Varda BK, et al. The decline of the open ureteral reimplant in the United States: National Data From 2003 to 2013. *Urology*. 2017;100:193–197.
2. Estrada Jr CR, Passerotti CC, Graham DA, et al. Nomograms for predicting annual resolution rate of primary vesicoureteral reflux: results from 2,462 children. *J Urol*. 2009;182:1535–1541.
3. Lee NG, Rushton HG, Peters CA, Groves DS, Pohl HG. Evaluation of prenatal hydronephrosis: novel criteria for predicting vesicoureteral reflux on ultrasonography. *J Urol*. 2014;192:914–918.

https://doi.org/10.1016/j.urology.2018.12.045
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AUTHOR REPLY

We appreciate the thoughtful response to our study findings and agree that the medical community should re-evaluate the American Academy of Pediatrics guidelines for febrile urinary tract infections. While the guidelines rely on the use of renal and bladder ultrasound findings to determine the need for VCUGs, several previous investigations have shown that ultrasound findings are a poorly predictive of VCUG abnormalities. Hoberman et al determined that identification of urinary tract dilation on renal ultrasound following the first febrile urinary tract infection had only a 10% sensitivity and 40% positive predictive value for detection of vesicoureteral reflux on VCUG among 302 children.[1] These results were corroborated by Juliano et al, who reported evidence of dilating vesicoureteral reflux among 23/84 children with a normal renal ultrasound.[2] A larger study by Logvinenko et al revealed that renal ultrasound had a sensitivity of only 32% for detecting grade 3-5 vesicoureteral reflux among nearly 4000 patients. The group concluded that ultrasound was a poor screening tool for diagnosis of high-grade vesicoureteral reflux.[3] The use of renal ultrasound findings to guide VCUG administration, therefore, should be called into question. It is perhaps for this reason that guideline adherence did not improve vesicoureteral reflux detection among children aged 2-24 months in our patient cohort.

Furthermore, while our study demonstrated an association between guideline adherence and vesicoureteral reflux detection among older patients, the current American Academy of Pediatrics guidelines were not intended to target this patient population. The lack of guidelines for a broader range of patients may lead to application among a patient cohort for whom the guidelines were not intended. We support the development of a predictive nomogram to tailor VCUG recommendations for the current age range of patients, and also for older children and very young infants.

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References

1. Hoberman A, Charron M, Hickey RW, Baskin M, Kearney DH, Wald ER. Imaging studies after a first febrile urinary tract infection in young children. *N. Engl. J. Med.* 2003;348:195–202.
2. Juliano TM, Stephany HA, Clayton DB, et al. Incidence of abnormal imaging and recurrent pyelonephritis after first febrile urinary tract infection in children 2 to 24 months old. *J. Urol.* 2013;190:1505–1510.
3. Logvinenko T, Chow JS, Nelson CP. Predictive value of specific ultrasound findings when used as a screening test for abnormalities on VCUG. *J Pediatr Urol*. 2015;11:176. e171-177.

https://doi.org/10.1016/j.urology.2018.12.046
UROLOGY 126: 186, 2019.