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ORIGINAL ARTICLE

Variation in the documentation of findings in pediatric voiding cystourethrogram

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Abstract
Background Few standards exist for reporting results of voiding cystourethrogram (VCUG).
Objective To assess the variation in reporting of VCUG findings from different facilities using a standardized assessment tool.
Materials and methods VCUG reports were evaluated for demographic, technical, anatomical and functional information. Reports were categorized by age, gender, indication and vesicouretal reflux (VUR) status. Institutions were classified as a free-standing pediatric hospital (n=3), pediatric hospital within a hospital (n=11), or non-pediatric facility (n=24) and reports were classified as having been read by a pediatric radiologist or not. Each category of outside reports (n=152) was randomly matched with a twice-larger group of Hospital A reports from the same category (n=304). Multivariate linear regression was used to analyze the association between the primary outcome (percentage of items described in dictated VCUG report) and the type of radiologist and institution.
Results Of the 456 studies, 66% were in girls, 56% were in those <12 months old, and the indication was urinary tract infection (UTI) in 81%. The mean percentage of items reported was 67±14% (74±7% at free-standing pediatric hospitals, 61±10% at pediatric hospitals within a hospital, and 48±11% at non-pediatric facilities). In multivariate analysis, VCUG reports generated at non-pediatric facilities had 17% fewer items included (95% CI: 14.5–19.7%, P<0.0001), and pediatric hospitals within a hospital had 9% fewer items included (5.9–12.5%, P<0.0001) when compared to free-standing pediatric hospitals. Reports read by a pediatric radiologist had 12% more items included (9.1–15.3%, P<0.0001) compared to those read by a non-pediatric radiologist.
Conclusion More complete VCUG reports were observed when generated at free-standing pediatric hospitals and when interpreted by a pediatric radiologist.

Keywords Vesicoureteral reflux · Radiology · Fluoroscopy · Voiding cystourethrogram · Quality improvement · Pediatrics

Introduction

A voiding cystourethrogram (VCUG) is often part of the imaging evaluation for children with urinary tract infection (UTI) or prenatal hydronephrosis. The VCUG has the potential to provide a tremendous amount of information about the anatomical and functional status of the urinary tract, including identification of vesicoureteral reflux (VUR). One might expect that certain elements of the report would be consistently reported in all cases. However, our clinical experience has been that there is substantial variability both within and among institutions, which suggests that there is little standardization of the information documented in these reports.

Inconsistent reporting of findings is a common problem in radiology — reports are not all created equal. Studies have demonstrated wide variation in reporting standards for procedures as diverse as chest radiography, abdominal CT, mammography and sonography [1–4]. Variations occur in description of the technique, clinical findings, terminology, final interpretations, and recommendations for patient management or further imaging. Itemized reports or templates have been

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proposed to address such inconsistencies [5, 6], including a VCUG report template put forth by the Radiological Society of North America (RSNA) [7]. However the use of such tools regarding the consistency of VCUG reports in clinical practice has not been investigated.

We sought to assess the completeness of VCUG reports arising from one of three types of institutions: free-standing pediatric hospitals, pediatric hospitals within a hospital, and non-pediatric facilities. Every report was assessed against a set of standard demographic, technical, anatomical and functional parameters that should ideally be components of every VCUG report. We hypothesized that there would be significant variation in the completeness of VCUG reports comparing free-standing pediatric hospitals to other institutions.

Materials and methods

Standardized assessment tool

Pediatric radiologists and urologists from Hospital A created a standardized assessment tool used to measure the completeness of VCUG reports. This instrument incorporated 26 variables related to demographics (e.g., age, gender, study indication), technical information (e.g., catheterization technique with or without subsequent urine culture, single or multiple voiding phases), anatomical information (e.g., bladder capacity, International Reflux Study reflux grade, renal collecting system duplication) and functional information (e.g., bladder emptying) (see Appendix). Reports from all facilities were compared to this ideal standard.

Selection of cases and controls

The aim of this study was to compare the documentation of VCUG report findings among free-standing pediatric hospitals, pediatric hospitals within a larger general hospital, and non-pediatric facilities using our assessment tool. Our hospital (Hospital A, a free-standing pediatric hospital with a dedicated pediatric genitourinary radiology team) was used as the control group. We determined a priori that the study period would be Jan. 1, 2007, through Dec. 31, 2011. After approval from the institutional review board, we identified reports of VCUGs performed at outside institutions during the study period for patients referred to Hospital A for care; these reports were identified according to the Health Insurance Portability and Accountability Act through a retrospective review of medical records and our VUR and prenatal hydronephrosis databases. We similarly used radiology billing and medical records to identify all VCUG studies performed at Hospital A during the same period. A matched cohort was identified to control for specific patient characteristics and study findings that impact VCUG technique and subsequent reporting, because such factors may differ systematically among institutions. Age (<12 months or ≥12 months) was matched because infants often have cyclic VCUGs [8], which increases the complexity of VCUG reporting. We also matched on gender (because of differences in urethral anatomy), study indication (UTI vs. prenatal hydronephrosis), and presence or absence of VUR (reports from studies with VUR obviously include information that does not appear in studies without VUR, e.g., VUR grade). After categorizing the reports according to these criteria, each group of outside VCUG reports was matched with a twice-larger group of internal (Hospital A) VCUG reports randomly selected from all internal reports with similar values for matching criteria. There were 152 outside VCUG reports and 304 internal (Hospital A) VCUG reports for analysis (total: 456 reports).

Categorization of institutions and radiologists

The Children's Hospital Association (CHA) Web site was used to categorize the hospital where each VCUG originated as a free-standing pediatric hospital (n=3), a pediatric specialty hospital or a pediatric hospital within a larger general hospital (n=11) [9]. If an institution was not present on the CHA Web site it was classified as a non-pediatric facility (n=24). Another potentially significant contributor to the VCUG report quality is whether the report was issued by a pediatric radiologist or non-pediatric radiologist. The Check Board Certification tool within the American Board of Radiology Web site was used to identify whether the attending radiologist had pediatric subspecialty certification [10], in which case he or she was classified as a pediatric radiologist. For those without pediatric subspecialty certification and those not identified by the ABR tool, the Web site of the radiologist's employer was searched to identify whether the radiologist had completed a pediatric radiology fellowship or his or her research and clinical focus was dedicated solely to pediatric radiology. This ensured that radiologists exempted from pediatric subspecialty certification were classified appropriately.

Statistical analysis

Each VCUG report was assessed with the standardized assessment tool. The reports were abstracted by a single reviewer for consistency. For quality control a 10% subset of reports was reviewed by a second reviewer and the results compared; concordance was identified for more than 99% of items. Using the quality measurement tool, one point was assigned for each item on the tool, for a maximum total of 26 points (20 points for reports in children without VUR). Each item was given equal weight. A score was assigned by dividing the number of points achieved for each report by the total number of possible points (20 or 26). This score represented the percentage of variables assessed in each VCUG report and was the primary outcome.

Descriptive statistics were used to display relationships between significant hospital and provider characteristics and the percentage of variables assessed. A multivariate linear regression was developed to analyze the association between the outcome and the type of institution where the report was generated and whether the report was read by a pediatric radiologist. Matching characteristics were controlled for in the model. Generalized estimating equations were used to account for correlations among reports generated within the same institution. The functional form of the outcome was investigated, and diagnostic checks and sensitivity to outliers of the fitted model were performed to verify model assumptions. All statistical tests were two-sided, and $P<0.05$ was considered significant. SAS™ software v. 9.2 (SAS Institute Inc., Cary, NC) was used for the analysis.

Results

Table 1 displays the characteristics of the 152 outside hospital reports and 304 internal (Hospital A) VCUG reports, each categorized according to hospital type.

There was wide variation in specific VCUG report items (Table 2). No report assessed all items. Overall, the mean (SD) percentage of items assessed was 67+/−14%. Demographic characteristics were universally reported, but many other items were reported very infrequently, including clinical factors like collecting system duplication status and whether the VUR occurred during the filling or voiding phases of micturition. Although current protocols emphasize the importance of minimizing radiation exposure [11], less than half of all VCUGs (58% of free-standing pediatric hospitals, 14% of pediatric hospitals within a general hospital, and 2% of non-pediatric facilities) reported the radiation exposure associated with the procedure.

In univariate analyses, we observed a substantial difference in VCUG report quality among institutions; free-standing pediatric hospitals assessed 74+/−7% of items compared to pediatric hospitals within a general hospital, which assessed 61+/−10% of items ($P<0.0001$), and non-pediatric facilities, which assessed 48+/−11% of items ($P<0.0001$). The average number of variables assessed by a pediatric radiologist was 72+/−9% compared to 46+/−10% when the report was read by a non-pediatric radiologist, $P=0.02$ (Table 3). After controlling for the type of radiologist reading the report, gender, study indication, age at time of VCUG, and whether the report was positive or negative for VUR, a report generated at a non-pediatric facility compared to one generated at a free-standing pediatric hospital had on average 17% (95% CI: 14.5–19.7%) fewer variables assessed, $P<0.0001$ (Table 4). Similarly, a report generated at a pediatric hospital within a hospital compared to one generated at a free-standing pediatric hospital had on average 9% (95% CI: 6–12.5%) fewer variables assessed, $P<0.0001$. Finally, a report that was read by a pediatric radiologist compared to one read by a non-pediatric radiologist had on average 12.1% (95% CI: 9.1–15.3%) more variables assessed, $P<0.0001$.

Discussion

We observed great variation among facilities in the completeness of VCUG reports, with a higher proportion of complete

Table 1 Characteristics of VCUG studies

	Source of VCUG report			
Matching characteristic	All studies (*n*=456) No. (%)	FSPH (*n*=306) No. (%)	PHWH (*n*=51) No. (%)	NPF (*n*=99) No. (%)
Indication for VCUG				
Hydronephrosis	87 (19)	58 (19)	17 (33)	12 (12)
UTI	369 (81)	248 (81)	34 (67)	87 (88)
VUR status				
Present	354 (78)	238 (78)	42 (82)	74 (75)
Absent	102 (22)	68 (22)	9 (18)	25 (25)
Gender of patient				
Male	153 (34)	102 (33)	19 (37)	32 (32)
Female	303 (66)	204 (67)	32 (63)	67 (68)
Age of patient				
< 1 year	255 (56)	171 (56)	34 (67)	50 (51)
≥ 1 year	201 (44)	135 (44)	17 (33)	49 (49)

FSPH free-standing pediatric hospital, *PHWH* pediatric hospital within a larger general hospital, *NPF* non-pediatric facility, *UTI* urinary tract infection, *VCUG* voiding cystourethrogram, *VUR* vesicoureteral reflux

Table 2 How frequently was each element of the VCUG assessed and reported?

Item	Source of VCUG report			
	All Hospitals (*n*=456) No. (%)	FSPH (*n*= 306) No. (%)	PHWH (*n*=51) No. (%)	NPF (*n*= 99) No. (%)
Date of study	456 (100)	306 (100)	51 (100)	99 (100)
Indication for procedure	456 (100)	306 (100)	51 (100)	99 (100)
Patient age	454 (99.6)	305 (99.7)	51 (100)	98 (99)
Patient gender	422 (93)	303 (99)	48 (94)	71 (72)
Urethral catheter size	72 (16)	8 (3)	26 (51)	38 (38)
Residual urine (volume) in bladder at time of catheter placement	312 (68)	295 (96)	13 (25)	4 (4)
Urine culture/urinalysis sent	305 (67)	275 (90)	19 (37)	11 (11)
Contrast type/% instilled	362 (79)	252 (82)	42 (82)	68 (69)
Voiding phase observed	427 (94)	294 (96)	47 (92)	86 (87)
Cyclic study performed	161 (35)	136 (44)	11 (22)	14 (14)
Fluoroscopy time	226 (50)	178 (58)	20 (39)	28 (28)
Radiation exposure	186 (41)	177 (58)	7 (14)	2 (2)
Scout film – bony structures	321 (70)	253 (83)	36 (71)	32 (32)
Scout film – abdominal structures	337 (74)	274 (90)	37 (73)	26 (26)
Bladder emptying completely during voiding (e.g., no residual)	127 (28)	38 (12)	34 (67)	55 (56)
Observed bladder capacity	380 (83)	304 (99.3)	39 (76)	37 (37)
Predicted bladder capacity	297 (65)	281 (92)	12 (24)	4 (4)
Bladder appearance characterized (e.g. smooth-walled, normal)	416 (91)	299 (98)	46 (90)	71 (72)
Urethra characterized[a]	396 (92)	282 (95)	45 (90)	69 (78)
VUR status reported	456 (100)	306 (100)	51 (100)	99 (100)
VUR graded using IRS scale[b]	333 (95)	232 (98)	37 (88)	64 (86)
Bladder volume at onset of VUR[b]	12 (3)	2 (0.01)	3 (7)	7 (9)
Onset of VUR during filling phase vs. voiding phase[b]	63 (18)	9 (4)	14 (33)	40 (54)
Location of insertion of ureters reported[b]	235 (67)	203 (86)	13 (31)	19 (26)
Duplication of collecting system reported[b]	18 (5)	10 (4)	5 (12)	3 (4)
Drainage of upper tracts or assessment of evidence of obstruction of upper tract & delayed images[b]	224 (64)	197 (83)	11 (26)	16 (22)

FSPH free-standing pediatric hospital, *PHWH* pediatric hospital within a larger general hospital, *NPF* non-pediatric facility, *VCUG* voiding cystourethrogram, *VUR* vesicoureteral reflux

[a] Voiding phase was not observed in 10 FSPH, 1 PHWH and 10 NPF reports

[b] These items were only assessed among the 352 reports (236 FSPH, 42 PHWH and 74 NPF) with vesicoureteral reflux

reports being observed at pediatric specialty centers. If the primary aim of the VCUG is to simply assess for the presence or absence of VUR, all centers performed exceedingly well, with 100% reporting of this parameter. However, the VCUG is a study that is able to assess much more than the presence or absence of VUR. If assessed and subsequently reported in the VCUG, a Christmas tree-shape bladder with bladder diverticula, a low bladder capacity, and a funneled urethra could indicate a neurogenic bladder. Similarly a dilated prostatic urethra could suggest posterior urethral valves as the reason for secondary vesicoureteral reflux. In cases where VUR is identified, important information such as the reflux grade, the bladder volume at the onset of reflux, whether the reflux occurred during the filling or voiding phases of the study, and an assessment of the presence or absence of periureteral diverticula provide important prognostic information to guide the clinician's counseling and management plan [12–15]. Here we show that a significant number of all VCUG reports lack these important anatomical and functional assessments but that reports generated at free-standing pediatric hospitals or pediatric hospitals within a general hospital had more complete reports than those generated at non-pediatric institutions, as did those read by a pediatric radiologist.

Several reasons could explain the large variation in VCUG reporting. Multidisciplinary conferences at pediatric tertiary centers may facilitate communication and collaboration between pediatric radiologists and pediatric urologists, thus helping radiologists understand the type of information of greatest importance to other clinicians.

Table 3 Univariate associations between percentage of items assessed in VCUG reports and the type of hospital and report characteristics

Characteristic	Mean percentage (SD) of items assessed	Difference in percentage of variables assessed in VCUG report (95% CI)	*P*-value
Overall study sample	67±4	–	–
Institution where study performed			
Non-pediatric facility	48±1	−25.9 (−29.0, −22.7)	<0.0001
Pediatric hospital within a hospital	61±0	−13.3 (−18.4, −8.15)	<0.0001
Free-standing pediatric hospital	74±7	Referent	–
Report signed by pediatric radiologist			
Yes	72±9	11.7 (2.1, 21.4)	0.02
No	46±10	Referent	–
Study indication			
Hydronephrosis	72±12	4.3 (3.2, 5.3)	<0.0001
UTI	66±14	Referent	–
Age at time of study			
> 1 year	65±13	−1.7 (−2.7, −0.1)	0.003
≤ 1 year	68±14	Referent	–
Patient gender			
Male	69±13	1.8 (0.1, 3.1)	0.004
Female	66±14	Referent	–
Vesicoureteral reflux present			
Yes	65±13	−9.0 (−10.0, −8.0)	<0.0001
No	74±14	Referent	–

CI confidence interval, *SD* standard deviation, *UTI* urinary tract infection, *VCUG* voiding cystourethrogram

Table 4 Multivariate analysis of the association between the percentage of items assessed in VCUG reports and the type of hospital and report characteristics

Characteristic	Difference in percentage of variables assessed in VCUG report (95% CI)	*P*-value
Institution where study performed		
Non-pediatric facility	−17.2 (−19.8, −14.5)	<0.0001
Pediatric hospital within a hospital	−9.2 (−12.5, −5.9)	<0.0001
Free-standing pediatric hospital	Referent	–
Report signed by pediatric radiologist		
Yes	12.1 (9.1, 15.3)	<0.0001
No	Referent	–
Study indication		
Hydronephrosis	1.2 (0, 2.7)	0.12
UTI	Referent	–
Age at time of study		
> 1 year	−0.1 (−2.4, 0.1)	0.24
≤ 1 year	Referent	–
Patient gender		
Male	−0.1 (−3.1, 1.7)	0.59
Female	Referent	–
Vesicoureteral reflux present		
Yes	−9.4 (−11.0, −7.8)	<0.0001
No	Referent	–

UTI urinary tract infection, *VCUG* voiding cystourethrogram

Moreover, these hospitals likely have a higher volume of these procedures, which increases the radiologists' familiarity with the technique and the important non-reflux-related anatomical and functional components of the VCUG report.

The frequency of omissions in key components of the VCUG at all three types of institutions in this study demonstrates that there is room for improvement at all institutions. Items consistently omitted from reports included whether a cyclic study was performed, which can improve the diagnostic accuracy of a VCUG [8], and whether the VUR occurred during the filling or voiding phase, which can help prognostication [14]. Another potential goal for improved reporting at all institutions is the description of the collecting system as single or duplicated (among patients with VUR). Should definitive management be necessary, knowing whether the collecting system is duplicated has implications for the pediatric urologist's surgical approach. Even in cases where a cyclic study *was* performed or the phase at which VUR first occurred *was* noted or the duplication status *was* assessed, failure to include these details explicitly in the report forces the clinician to guess as to whether the omission means that the finding was not present or was not assessed. This is a clear opportunity for quality improvement.

These findings are relevant within the broader context of the health care system because payers such as insurance companies increasingly treat radiology as a commodity. This is based on the premise that for a particular diagnostic study comparable reports can be generated at any facility. Payers therefore incentivize patients to undergo diagnostic imaging at lower-cost general radiology facilities instead of specialized tertiary-care centers [16, 17]. The current findings suggest that, given the wide variation in reporting, the decline in quality associated with such a strategy is measureable and may be substantial. The completeness of VCUG reports as measured by content was significantly higher at pediatric hospitals and when pediatric radiologists generated the reports. Thus the adoption and promulgation of standardized reporting templates, in addition to advancing knowledge in the nuances of pediatric radiology techniques at non-pediatric facilities, could improve the quality of VCUG reports and possibly the quality of the study itself. Until these measures are undertaken, pediatric patients may benefit from having studies performed at high-volume specialized pediatric centers.

The low rate of reporting of radiation exposure is concerning for a number of reasons. Medical radiation exposure among children is increasingly recognized as a significant public health issue [18, 19]. There is evidence that simply reporting exposure levels during diagnostic imaging procedures can result in lowering of subsequent exposure levels [20], perhaps related to a so-called Hawthorne effect, wherein the act of measuring the parameter leads to changes in behavior among the observed [21]. Although in this study we measured only the reporting of radiation exposure, and not the levels themselves, other investigators have found that imaging equipment at general adult and even some pediatric facilities may not be routinely adjusted for pediatric patients or different pediatric age groups, resulting in higher-than-necessary exposure levels [18, 19, 22, 23].

Furthermore an incomplete VCUG report can lead to increased radiation exposure by requiring repeat imaging. Unlike CT scans and MRI studies in which all of the imaging data are recorded (and all images can be reexamined or reinterpreted), most radiology departments only store a few representative VCUG images at study completion. The report is therefore the only opportunity for complete documentation of the observed findings, other than the selected saved images themselves. For example, if a VCUG report for an infant boy does not include a statement regarding the urethra, and urethral images were not saved, then a repeat study may be required, thereby exposing the child to unnecessary radiation. Thus strategies to improve the completeness of VCUG reports could not only help the radiographic assessment of the child with VUR but also improve the quality of the report and reduce the harm from diagnostic radiation in these children.

The results of this study should be interpreted in light of its limitations. Most significant among these is the relatively selective nature of the VCUG reports that were available for review. The great majority of pediatric hospital reports came from our own facility, while the outside reports came from a more diverse set of facilities. This raises issues of selection, particularly if the outside studies are more likely to have certain characteristics, such as presence of VUR. We attempted to address this by explicitly matching for several characteristics that appeared to be differentially distributed between outside and internal (Hospital A) reports and by using generalized estimating equations to account for the correlation in reports generated at particular hospitals. Another limitation is that the 26-item quality-assessment tool was devised by our own pediatric radiologists and pediatric urologists, based on technical and clinical factors that we thought important in a VCUG report. The choice of items therefore reflects the clinical biases and preferences of the study authors and their colleagues. While these decisions were somewhat subjective, the included items were not chosen simply because they were routinely reported at our institution; indeed, it turns out that our institution performed poorly for several items, including catheter size, bladder emptying during voiding, the phase of VUR onset and other items. Also, in requiring key items not included in the RSNA template [7], the tool used in this study is more stringent. For example, our tool assessed whether the International Reflux Study VUR grade, the phase of VUR onset (filling or voiding), and upper tract drainage after voiding were reported, among others. Even given these differences in report measurement tools, the discrepancies in reporting between free-standing pediatric hospitals and non-pediatric institutions are of such large magnitude that changes in the quality assessment tool are not likely to substantially change the results. Although inclusion of items queried at our study may lead to a longer VCUG report, it is our opinion that they also produce a report that provides a more complete picture of the anatomical and functional characteristics of the upper and lower urinary tracts. The aim of this study was not to devise an ideal VCUG report template but rather to highlight the variation in VCUG reporting among institutions. Such a task should be left to a consensus decision among key stakeholders from the radiologic, nephrourologic and general pediatric communities. Finally, this study focused on the content of the VCUG report itself, not on the accuracy or reliability of the clinical findings. We cannot state whether the findings of the diagnostic study (e.g., VUR grade) were more or less accurate at certain facilities compared to others. However, clinical accuracy has been studied extensively within the radiology literature, and substantial variation has been observed among institutions in numerous settings [24–27]; there is little reason to expect different results in the VCUG context.

Conclusion

Documentation of VCUG findings varies significantly, with more complete reports observed at pediatric centers. Quality improvement strategies such as template-driven VCUG reports could help to improve the completeness of VCUG reports, regardless of facility. In the absence of such systematic change, our findings suggest that the quality and completeness of VCUG reports is significantly dependent on both the interpreting radiologist and the center at which the study is performed.

Conflicts of interest None

Appendix

Form generated by Hospital A urologists and pediatric radiologists and used to systematically analyze all voiding cystourethrogram (VCUG) reports

Study ID #:___________________________

D1) Hospital Performing VCUG

Boston Children's

Outside Hospital

Name________________________

City/State_____________________

Attending Radiologist _______________________

INCLUSION CRITERIA

D2) Date of Study (mm/dd/yyyy):
_______/________/_______
Is DOS not between 1/1/2007 and 5/1/2012?
If yes → go to D3
If no → STOP HERE

D3) Prior VCUG history
☐No indication of history of prior VCUG[0] → go to D4

☐history of prior VCUG indicated in report [1]
(history of VUR, reference to prior VCUG, etc)
→ STOP HERE

D4) What was indication for the study?
☐UTI[0] → go to D5
☐hydronephrosis[1] → go to D5
☐other indication[2] → STOP HERE
☐no indication given[3] → STOP HERE
☐ Unable to assess[99]

Comments

____
____
____

MATCHING CRITERIA

D5) Age at time of study
☐<1 year[0] ☐ 1 year or greater[2]
☐no indication given[2]

D4) Patient Gender
☐male[1] ☐female[0]

D5) Was the VCUG study positive or negative for VUR?
☐VUR positive[1] ☐VUR negative[0]

Study Demographic Data

Q1) Date of Study
☐Reported[1] ☐Not reported[0]

Q2) Indication for procedure
☐Reported[1] ☐Not reported[0]

Q3) Patient age (stated or inferable from DOB)
☐Reported[1] ☐Not reported[0]

Q4) Patient gender
☐Reported[1] ☐Not reported[0]

Study Technique Data

Q5) Urethral catheter size
☐Reported[1] ☐Not reported[0]

Q6) Residual urine (volume) in bladder at time of catheter placement
☐Reported[1] ☐Not reported[0]

Q7) Urine culture/Urinalysis sent
☐Reported[1] ☐Not reported[0]

Q8) Contrast type/% instilled
☐Reported[1] ☐Not reported[0]

Q9) Voiding phase observed
☐Reported[1] ☐Not reported[0]

Q10) Cyclic study performed
☐Reported[1] ☐Not reported[0]

Q11) Fluoroscopy time
☐Reported[1] ☐Not reported[0]

Q12) Radiation exposure
☐Reported[1] ☐Not reported[0]

VCUG anatomic findings

Q13) Scout film – bony structures
☐Reported[1] ☐Not reported[0]

Q14) Scout film – abdominal contents
☐Reported[1] ☐Not reported[0]

Q15) Bladder emptying completely during voiding (e.g. no residual)
☐Reported[1] ☐Not reported[0]

Q16) Observed bladder capacity (Volume)
☐Reported[1] ☐Not reported[0]

Q17) Predicted bladder capacity for patient age
☐Reported[1] ☐Not reported[0]

Q18) Observed capacity vs. predicted capacity - %
☐Reported[1] ☐Not reported[0]

Q19) Bladder appearance characterized (e.g. smooth-walled, normal)
☐Reported[1] ☐Not reported[0]

Q20) Urethra characterized
☐No voiding phase[2] ☐Reported[1] ☐Not reported[0]

Q21) VUR status reported (this is NOT asking if VUR is present)
☐VUR status reported[1] ☐VUR status NOT reported[0]

Parameters specific to VUR

Q22) VUR graded using IRS scale (I-II-III-IV-V)?
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

Q23) Bladder volume at onset of VUR
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

Q24) Onset of VUR during filling phase vs. voiding phase reported
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

Q25) Location of insertion of ureters reported, if VUR present
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

Q26) Duplication of collecting system reported, if VUR present
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

Q27) Drainage of upper tracts or assessment of evidence of obstruction of upper tract & delayed images
☐No VUR[2] ☐Reported[1] ☐Not reported[0]

MISCELLANEOUS

Q30) Note or comment made of incidental findings
☐Yes[2] ☐No[1]

Comments

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References

1. Houssami N, Boyages J, Stuart K et al (2007) Quality of breast imaging reports falls short of recommended standards. Breast 16: 271–279
2. Lee R, Cohen MD, Jennings GS (2006) A new method of evaluating the quality of radiology reports. Acad Radiol 13: 241–248
3. Schwartz LH, Panicek DM, Berk AR et al (2011) Improving communication of diagnostic radiology findings through structured reporting. Radiology 260:174–181

4. Le T, Fayadh RA, Menard C et al (2008) Variations in ultrasound reporting on patients referred for investigation of ovarian masses. J Obstet Gynaecol Can 30:902–906
5. Sistrom CL, Langlotz CP (2005) A framework for improving radiology reporting. J Am Coll Radiol 2:159–167
6. Bosmans JM, Weyler JJ, De Schepper AM et al (2011) The radiology report as seen by radiologists and referring clinicians: results of the COVER and ROVER surveys. Radiology 259:184–195
7. Meyer J (2012) Radiological Society of North America radiology reporting templates. http://www.radreport.org/template/0000110. Accessed 30 Sept 2013
8. Papadopoulou F, Efremidis SC, Oiconomou A et al (2002) Cyclic voiding cystourethrography: is vesicoureteral reflux missed with standard voiding cystourethrography? Eur Radiol 12:666–670
9. Children's Hospital Association (2012) Find a children's hospital link. http://www.childrenshospitals.net. Accessed 1 Oct 2012
10. American Board of Radiology (2014) Check board certification link. http://www.theabr.org. Accessed 30 Jan 2014
11. Frush DP, Donnelly LF, Rosen NS (2003) Computed tomography and radiation risks: what pediatric health care providers should know. Pediatrics 112:951–957
12. Knudson MJ, Austin JC, McMillan ZM et al (2007) Predictive factors of early spontaneous resolution in children with primary vesicoureteral reflux. J Urol 178:1684–1688
13. Barrett DM, Malek RS, Kelalis PP (1976) Observations on vesical diverticulum in childhood. J Urol 116:234–236
14. Arsanjani A, Alagiri M (2007) Identification of filling versus voiding reflux as predictor of clinical outcome. Urology 70:351–354
15. Estrada CR Jr, Passerotti CC, Graham DA et al (2009) Nomograms for predicting annual resolution rate of primary vesicoureteral reflux: results from 2,462 children. J Urol 182:1535–1541
16. Tynan A, Berenson RA, Christianson JB (2008) Health plans target advanced imaging services: cost, quality and safety concerns prompt renewed oversight. Issue Brief Cent Stud Health Syst Change 118:1–4
17. Andrews M (2012) Some Insurers Paying Patients Who Agree To Get Cheaper Care. Kaiser Health News. http://www.kaiserhealthnews.org/Features/Insuring-Your-Health/2012/Cash-Rewards-For-Cheaper-Care-Michelle-Andrews-032712.aspx. Accessed 15 Dec 2012
18. Goske MJ, Applegate KE, Bulas D et al (2011) Image gently: progress and challenges in CT education and advocacy. Pediatr Radiol 41:461–466
19. Sidhu M, Goske MJ, Connolly B et al (2010) Image Gently, Step Lightly: promoting radiation safety in pediatric interventional radiology. AJR Am J Roentgenol 195:299–301
20. Darling S, Sammer M, Chapman T et al (2011) Physician documentation of fluoroscopy time in voiding cystourethrography reports correlates with lower fluoroscopy times: a surrogate marker of patient radiation exposure. AJR Am J Roentgenol 196:777–780
21. Mayo E (1993) The human problems of an industrial civilization, vol 3, 2nd edn. MacMillan, New York
22. Paterson A, Frush DP, Donnelly LF (2001) Helical CT of the body: are settings adjusted for pediatric patients? AJR Am J Roentgenol 176:297–301
23. Hollingsworth C, Frush DP, Cross M et al (2003) Helical CT of the body: a survey of techniques used for pediatric patients. AJR Am J Roentgenol 180:401–406
24. Eakins C, Ellis WD, Pruthi S et al (2012) Second opinion interpretations by specialty radiologists at a pediatric hospital: rate of disagreement and clinical implications. AJR Am J Roentgenol 199:916–920
25. Gollub MJ, Panicek DM, Bach AM et al (1999) Clinical importance of reinterpretation of body CT scans obtained elsewhere in patients referred for care at a tertiary cancer center. Radiology 210:109–112
26. Sung JC, Sodickson A, Ledbetter S (2009) Outside CT imaging among emergency department transfer patients. J Am Coll Radiol 6:626–632
27. Loevner LA, Sonners AI, Schulman BJ et al (2002) Reinterpretation of cross-sectional images in patients with head and neck cancer in the setting of a multidisciplinary cancer center. AJNR Am J Neuroradiol 23:1622–1626