Learning from Our Missed Opportunities: Initial Experience Using Sonographer Report Cards to Improve the Diagnostic Accuracy of Pediatric Appendix Ultrasound and Decrease CT Utilization

Karyn A. Ledbetter, MD; Andrew K. Moriarity, MD; Safwan Halabi, MD
Henry Ford Hospital, 2799 W. Grand Blvd, Detroit, MI, 48202

Disclosures

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BACKGROUND

- Acute appendicitis is a leading cause of emergency department visits and emergency abdominal surgery in children [1-3]
- Children more often present to a community setting than a dedicated pediatric hospital [2,4] and accurate diagnosis is difficult due to early non-specific symptoms [1-3,5]
- Imaging plays a central role in diagnosis because both delayed diagnosis and removal of a normal appendix can cause significant morbidity [6]
- Many national guidelines recommend initial ultrasound (US) for suspected pediatric appendicitis [7–10]
- However, actual rates of US only imaging are unknown and felt to be inappropriately low in many situations and institutions
- Children who present to community hospitals have been found to undergo higher rates of CT imaging for diagnosis, resulting in undesirable exposure to ionizing radiation [4]

BACKGROUND

- Our institution is a large, academic-clinic model community health system with 24-hour emergency services across multiple sites
- US is performed by dedicated, but not pediatric trained, sonographers and interpreted by fellowship trained radiologists
- Throughout our institution, US is the recommended first line modality to evaluate for suspected pediatric appendicitis
- As a result, US utilization has increased substantially across the last decade, with over 250 pediatric appendix ultrasound examinations in 2013 and only 100 examinations performed in 2006.

BACKGROUND

- Despite increased utilization, both the sensitivity and specificity of pediatric appendix US have remained low
- Baseline data collected over a five-month interval found:
  - Visualization of the appendix in less than 20% of studies
  - Examination confidently reported as positive for acute appendicitis in less than 6% of cases and negative in less than 1% of cases
  - Radiologist reports were equivocal for acute appendicitis in 7.1% of cases
  - 30% of patients who had ultrasound appendix US subsequently had a CT
  - 9.8% of patients were transferred to a children's hospital for further workup after nondiagnostic ultrasound

PURPOSE

- Given the opportunity to improve the rate of diagnostic pediatric appendix US in our institution, we implemented a quality improvement initiative using individual sonographer report cards with the goal of:
  - Increasing visualization of the appendix
  - Decreasing the number of cases reported as equivocal, and in particular, improving the number of cases confidently reported as negative
  - Decreasing CT utilization
  - Decreasing patient transfers due to incomplete workup

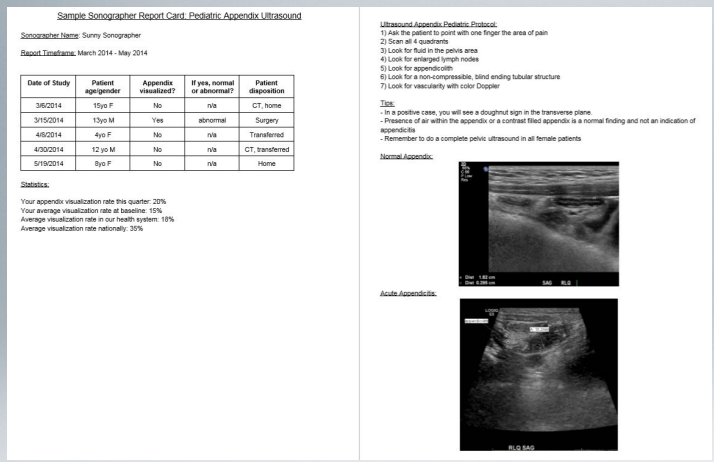
MATERIALS & METHODS

- Under IRB approval, a database search was done to find all appendix ultrasound (US) exams performed for patients <18 years-old in the health system emergency department and urgent care centers between October 2013 and February 2014
- During this 5 month period, 112 pediatric patients received dedicated right lower quadrant US for evaluation of suspected acute appendicitis
- The following information was recorded for each case to establish the pre-intervention diagnostic accuracy of US appendix:
  - Patient age
  - Patient gender
  - Sonographer name
  - Appendix visualization
  - Radiologist
  - Radiologist impression (positive/negative/equivocal)
  - Radiologist recommendation (CT yes/no)
  - Subsequent patient care (CT performed, patient admitted, surgery performed or patient transferred)

MATERIALS & METHODS

- A review committee was then established, which consisted of a radiology resident, a pediatric radiologist, the lead department sonographer and the ultrasound department supervisor
- The committee collaborated to develop a sonographer report card, which includes:
  - For each case performed:
    - Imaging results, including whether the appendix was visualized and the radiologist's impression
    - Patient outcomes, including subsequent CT (with results, if applicable) and patient disposition
  - The sonographer's appendix visualization rate with comparative values from:
    - The sonographer's visualization of the appendix at baseline
    - Average appendix visualization within our health system
    - Average appendix visualization at a dedicated children's hospital
  - Review of the US appendix protocol at our institution
  - Sonographic images of the normal and abnormal appendix

MATERIALS & METHODS



Sample Sonographer Report Card: Pediatric Appendix Ultrasound

Sonographer Name: Sunny Sonographer

Report Timeframe: March 2014 - May 2014

Date of Study	Patient age/gender	Appendix visualized?	If yes, normal or abnormal?	Patient disposition
3/6/2014	15yo F	No	n/a	CT, home
3/15/2014	13yo M	Yes	abnormal	Surgery
4/6/2014	4yo F	No	n/a	Transferred
4/30/2014	12 yo M	No	n/a	CT, transferred
5/19/2014	8yo F	No	n/a	Home

Statistics:

Your appendix visualization rate this quarter: 20%
Your average visualization rate at baseline: 15%
Average visualization rate in our health system: 18%
Average visualization rate nationally: 35%

Ultrasound Appendix Pediatric Protocol:
1) Ask the patient to point with one finger the area of pain
2) Scan all 4 quadrants
3) Look for fluid in the pelvis area
4) Look for enlarged lymph nodes
5) Look for appendicolith
6) Look for a non-compressible, blind ending tubular structure
7) Look for vascularity with color Doppler

Tips:
- In a positive case, you will see a doughnut sign in the transverse plane.
- Presence of air within the appendix or a contrast filled appendix is a normal finding and not an indication of appendicitis
- Remember to do a complete pelvic ultrasound in all female patients

Normal Appendix:

Acute Appendicitis:

- Report cards (example on left) are generated on a quarterly basis for each sonographer who has performed pediatric appendix US
- Prior to distribution, the committee reviews each sonographer's report
- Sonographers receive report cards via email to ensure privacy and allow for easy reference

RESULTS

	Baseline	Post-intervention	% Change
Time Frame	5 months	3 months	
Cases	112	80	
Average monthly cases	21.4	26.7	
Appendix Visualized	15%	22.5%	+7.5%
Reported as Positive	5.6%	7.5%	+1.9%
Reported as Negative	0.8%	6.3%	+5.5%
Reported as Equivocal	7.1%	6.3%	- 0.8%
CT Recommended	32%	21%	- 11%
CT Performed	30%	25%	- 5%
CT Positive	4.9%	3.75%	-1.15%
Patient Transfers*	9.8%	6.3%	- 3.5%

*** Percentage of patients transferred with persistent concern for acute appendicitis despite negative US**

DISCUSSION

- The novel use of individualized sonographer report cards has resulted in clinically significant improvements across all data points tested
- Additionally, there has been positive sonographer feedback, more specifically sonographers have reported:
  - Increased knowledge of department protocol for performing a pediatric right lower quadrant US
  - Greater commitment to finding the appendix when scanning pediatric patients
  - Increased desire to learn about secondary signs of appendicitis
  - Interest in an interactive session with the committee to provide more hands-on experience

NEXT STEPS

- Quarterly sonographer report cards will continue to be generated through 2015 to allow for more precise characterization of each sonographer's performance
  - Individual sonographers with consistently below average (greater than 1 standard deviation below the mean) performance at the one-year mark will be selected for additional education and training
- Overall data will be evaluated by the committee semi-annually to assess for additional possible interventions, such as providing resident/attending feedback and training
- At the sonographers' request, a laminated technique review card will be posted in each ER ultrasound suite to allow for easy reference
- An appendix in-service will be given by the review committee, allowing sonographers to ask questions and have hands-on scanning experience under the supervision of committee members

LIMITATIONS

- Our results reflect a single-institution experience, which limits generalization to other institutions
  - There may be unique characteristics among our patient population
  - Our referring emergency department physicians may have different practice patterns
- Only cases of suspected appendicitis evaluated with ultrasound were retrospectively examined
  - Patients with high suspicion or classic clinical findings for acute appendicitis may have been referred for direct surgical consultation without imaging or may have been transferred to a children's hospital
  - Patients who were initially examined with CT were not included in the study
- At our institution, fellowship trained pediatric radiologists check all US examinations performed between 7am and 5pm prior to completion and may request additional imaging or may scan patients themselves. Outside of these hours, ultrasound examinations are checked by residents and signed off by the emergency radiology division
  - This could result in varying levels of US sensitivity or CT utilization depending on the time of day that the patient presents for evaluation

CONCLUSIONS

- Ultrasound is a proven method for diagnosing appendicitis in the pediatric population, however baseline data revealed suboptimal visualization of the appendix in our institution with a substantial number of CT examinations and/or patient transfers
- Initial results of our quality improvement project demonstrate that providing individual sonographer report cards on a quarterly basis leads to improved diagnostic value of pediatric appendix US, and specifically:
  - Increased rate of appendix visualization
  - Fewer equivocal radiologist reports
  - More examinations reported as negative
  - Decreased number of CTs both recommended and performed
  - Fewer patient transfers to children's hospital for further workup

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