



Reducing Pediatric CT Usage through Web-Based Education

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EXECUTIVE SUMMARY

- A grant from the AHRA and Toshiba Putting Patients First program enabled Fairview Health System in Minneapolis, MN to launch an interactive education website which provides best practice information for CT usage in head trauma and appendicitis cases.
- The website, PEMguidelines.org contains educational sections geared toward both clinicians and patients and families. The site provides evidenced based guidelines for the management of head trauma and appendicitis.
- PEMguidelines.org was rolled out in 2012 as part of a three pronged intervention strategy. A link to the website was included in new clinical order-sets within the Fairview electronic health system. Clinical decision support aids were also embedded in the medical record system. Fairview held provider education sessions for ED physicians and staff to introduce and promote the new approach.
- Results from a six month period after the initial roll out indicate a decrease of 15% in abdominal CT scans for suspected appendicitis cases, while the numbers of missed cases did not increase. This initial evidence supports the effectiveness of this multilevel strategy in improving the safety and cost-effectiveness of pediatric CT use in diagnosis of appendicitis.

Computed tomography (CT) is a commonly used diagnostic tool for many emergent pediatric conditions, including head trauma and appendicitis. Over the past decade CT utilization has increased dramatically and there has been concern that CT scans may be over utilized in emergency departments (EDs) across the United States.^{1,2} This is a disturbing medical trend both because of potential health risks of exposure to radiation and healthcare costs associated with these scans.^{3,4} Given the large numbers of patients presenting to EDs with head trauma and appendicitis, researchers have focused on these conditions with the goal to reduce utilization and costs. The estimated cost savings of ultrasound versus CT in the diagnostic work-up of appendicitis has been reported at approximately \$450 per patient.⁵ This work has led to the development of validated clinical decision rules and best practice guidelines for both appendicitis and head trauma.

Clinical decision rules use information from the patient's medical history and presenting symptoms to help instruct clinicians on the most appropriate treatment based on patient risk for a serious outcome. Implementing clinical decision rules can standardize care and reduce variability, while maintaining

safe, cost-effective patient care. While clinical decision rules have been developed for both conditions, educating stakeholders on the approach and ensuring adoption remains a challenge. Fairview Health System in Minnesota has chosen a multi-step, web based approach to educate providers and patient families to reduce unnecessary CT scans using existing clinical decision rules for appendicitis and head trauma.

Fairview Health System is comprised of eight hospitals throughout the Minneapolis and St. Paul metropolitan area. For the initial phase of this CT reduction initiative, Fairview chose to focus on one pediatric ED and one community ED. These two EDs collectively see the highest volume of pediatric emergency patients within the Fairview hospital system. For the purpose of this project, pediatric patients were those under 18 years of age. System wide adaptation of this initiative will be implemented after the initial results from these two hospitals have been explored.

Clinical Decision Rules and Best Practice Guidelines

In addition to the high use of diagnostic CT in both conditions, appendicitis and

head trauma were selected as the initial focus of this initiative because of the existing body of work on clinical decision rules for both conditions. The rules selected for inclusion in this program were previously developed in individual EDs and then tested and refined across multiple diverse locations.^{6–8} These clinical decision rules were then incorporated into best practice guidelines for both conditions. These best practice guidelines were utilized by the research team for both the electronic health record order-sets and the public website components of this CT reduction initiative.

Appendicitis Best Practice Guideline

Using two previously developed clinical decision rules and incorporating input from a multi-disciplinary team, the research team developed an appendicitis best practice guideline. The guidelines risk stratified patients into high, medium, or low risk for appendicitis based on the following elements:

- High risk patients: History of pain less than 36 hours, history of focal right lower quadrant pain (RLQ), history of migration of pain, pain with walking, jumping or coughing; focal tenderness in RLQ (McBurney's point).
- Medium risk patients: Elevated white blood cell count or absolute neutrophil along with pain in the RLQ, post-pubertal females with RLQ pain, and persistent pain in RLQ.
- Low risk patients: No history of patient nausea, no maximal pain in the RLQ and a neutrophil count less than $6.75 \times 10^3/L$.

These risk categories were created by combining information from both the Pediatric Appendicitis Score and the Low Risk Appendicitis Rule.^{7,8}

The appendicitis best practice guidelines developed recommend patient management for each risk category. The pathway recommends that high risk patients, those with approximate risk of appendicitis greater than 75%, receive a surgical consult prior to any

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diagnostic imaging. Suggested management for patients in the medium risk category, patients with an approximate risk of appendicitis of 30–50%, is abdominal ultrasound and CT only if ultrasound is unavailable or inconclusive. Suggested management for low risk patients, patients with an approximate risk of appendicitis is 5%, is discharge home with close outpatient follow-up (alternatively, observation in the ED or as an inpatient). These appendicitis patient management recommendations served as the basis for both parent and provider focused components of our program.

Head Injury Pathway

Best practice guideline recommendations for obtaining a head CT in patients presenting with blunt head trauma were based on the Pediatric Emergency Care Applied Research Network (PECARN) guidelines.⁶ The PECARN guidelines consider children 0–2 of age and children 2 and older separately, due to differences in accident risk and developmental ability. Based on several factors including the Glasgow Coma Scale, altered mental status, and palpable skull fracture, patients with head trauma are classified into low, moderate, and high risk for traumatic brain injuries (TBIs). High risk (4.4% risk of TBI) patients are recommended for CT, and low risk (<0.05% risk of TBI) patients are recommended for no CT scan and discharge with parental observation. Patients at moderate risk (0.9% risk of TBI) are less clear, physicians are advised to use their best clinical judgment, observation and preference of the patient's family to make the decision of whether or not to obtain a CT. These rules were developed and validated in a large group of diverse hospitals (within PECARN) to safely predict cases in which risk is low and CT scans are not needed to safely diagnose patients.⁶

Education Strategy

A primary focus of the CT reduction strategy was improving adherence to best practice guidelines through provider education. This was approached from two avenues: provider focused materials on the PEMguidelines.org website, and order-sets within the electronic medical system. The public PEMguidelines.org website contains an interactive clinician education section for each condition. Clinical order-sets provide decision support to clinicians while they are in the process of making decisions and ordering tests. This information is provided both through alert windows with best practice reminders and through a hyperlink to PEMguidelines.org. While the clinical order-sets and website were available system wide, educational sessions were only initially held at the two target hospitals to inform providers about the order-sets and encourage their use.

In addition to the clinician focused components, the research team chose to include patient and family education as part of the intervention strategy. These materials aim to explain the underlying reasons for the best practice guidelines and the reasons a reduction in CT scans is needed. Patient and family sections of the website were designed to provide information for families either when the family is making the decision to go to the ED, or after they have been discharged home.

Website Development

Content for the education website PEMguidelines.org was divided into clinician and patient family sections (see Figure 1). Clinician focused sections were based on the best practice guidelines previously described. Both sets of appendicitis guidelines were incorporated into interactive web tools where

providers could enter symptom information and receive a risk category and course of treatment recommendation. Physician recommendations for blunt head trauma were incorporated into a graphic presentation of the risk estimates and course of treatment guidelines (see Figure 2). This information was also embedded into clinical order-sets for both conditions. Both the educational website and the clinical order-sets were considered essential parts of the unnecessary CT reduction strategy.

Engaging patient family stakeholders was an important piece of this CT reduction strategy. Patient and family sections of PEMguidelines.org were developed initially by medical students and then reviewed and refined by physicians in the ED. ED medical students researched existing parent focused information on each condition and drew from existing discharge handouts written by the hospital's patient education department. These materials were used to create several informational sections for each condition including: what is the condition, what does it feel like, CT scans and radiation, and suggested management at home. Discharge handouts were also included in the website and available in English, Spanish, and Somali. Figures 3 and 4 provide examples of patient and family focused web content.

The completed website and clinical order-sets were introduced in early 2012. Educational sessions were held for providers at the two target hospitals to introduce the intervention and encourage use of both strategies. The website was also mentioned to families at the time of discharge from the ED at the two target hospitals to remind them of this post-discharge resource.

Impact

To begin with, trends in appendicitis imaging were examined before and after the launch of the initiative in both the pediatric and community EDs. Pediatric



Figure 1 • Screen capture of PEMGuidelines.org main page.

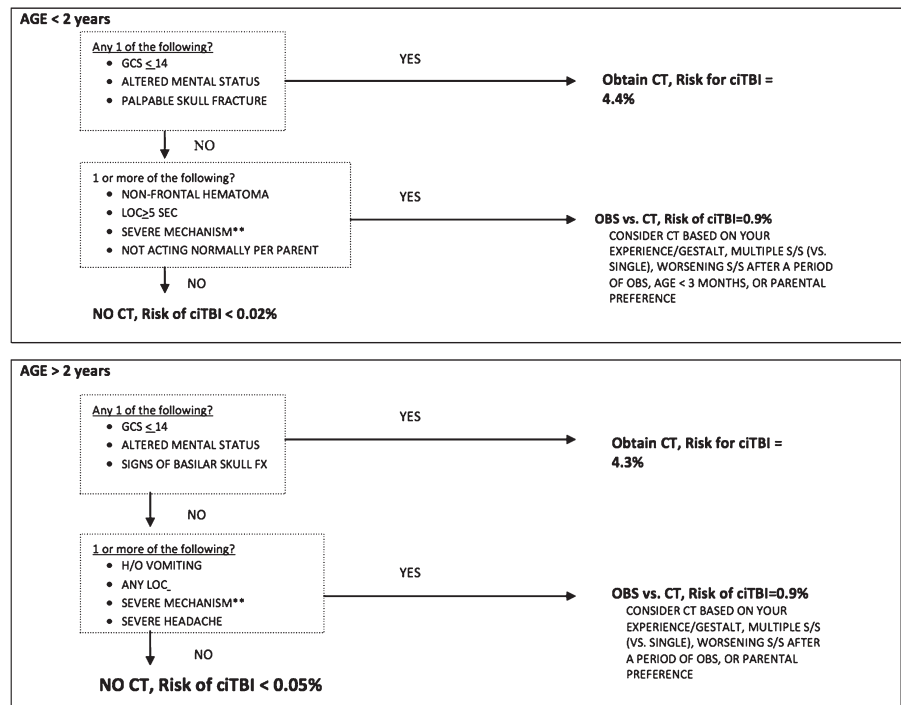


Figure 2 • PECARN head trauma guideline from Kupperman et al, 2009.

patient charts were retroactively reviewed for three months prior to the intervention and six months after. During this period, a total of 327 patients with suspected appendicitis were seen in both EDs; 22% of patients were confirmed appendicitis cases. Change in imaging rates varied across the two sites evaluated. In the pediatric ED, there was no significant change in the rate of ultrasound or CT scans in suspected appendicitis patients (this ED was already using ultrasound at a very high rate). In the community ED, there was a 15% decrease in CT and a 15% increase in ultrasound use in suspected appendicitis cases. There were very few missed appendicitis cases both before and after the intervention (two before the intervention and one after).⁹ Analyses of care trends in head CT are not available for this publication.

These initial results indicate a positive impact of this pediatric imaging reduction initiative. The decreased rate of CT and increased rate of ultrasound at the community ED suggests providers are following the best practice guidelines introduced through this program. The lack of demonstrated change in the pediatric ED during the period studied likely resulted from an already low rate of CT in this ED (13% pre-intervention and 10% post-intervention). Importantly, there is no indication that the initiative has increased the risk of missed appendicitis. The rate of missed appendicitis cases remained very low in both EDs after the initiative was implemented, indicating introduction of best practice guidelines did not reduce patient safety.⁹

Future Directions

Early information indicates the potential for this approach to safely reduce CT use in pediatric patients cared for in the ED. Head injury order-sets will be introduced as part of the next phase of the intervention. Further analysis of imaging rates for head trauma patients is needed to fully understand the impact of this initiative

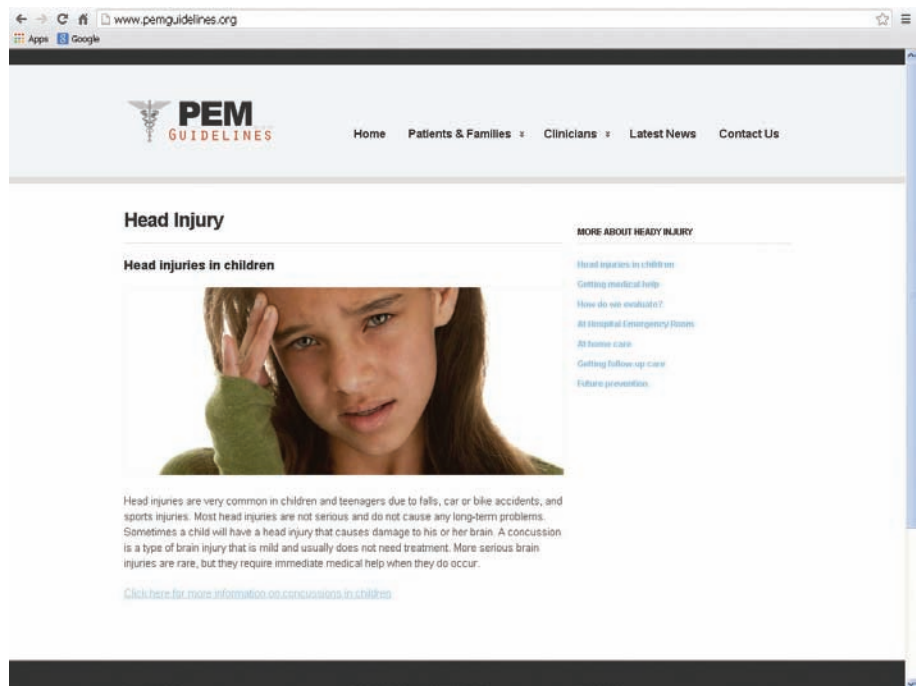


Figure 3 • Screen capture of parent information for head injury.

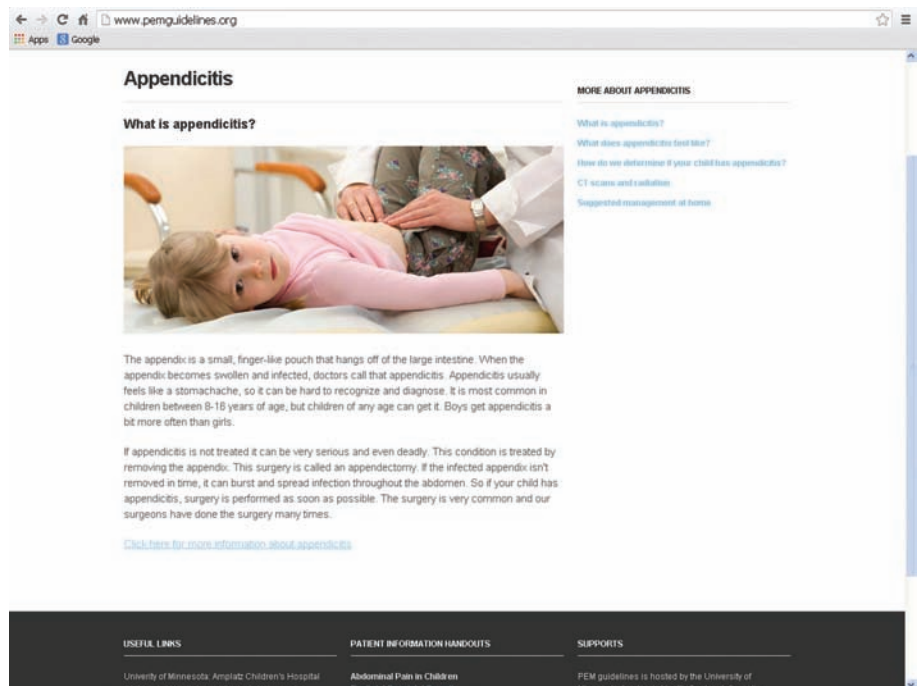


Figure 4 • Screen capture of parent information for appendicitis.

on these EDs. Measuring patient and family use of the PEMguidelines.org website could also provide insight on the impact and effectiveness of this component of the initiative. Gathering qualitative data on clinician reception of the initiative could also aid in measuring the extent to which this program influenced clinician decision making. While the PEMguidelines.org website was created specifically for use by Fairview Health System's physicians and patients, the website is free and open to clinicians and patients and families outside of this system. Other health systems and hospitals can use this multi-step, evidence based approach as a model for addressing pediatric imaging. 🌱

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