Evidence-Based Guidelines for Pediatric Imaging: The Example of the Child With Possible Appendicitis

R. Paul Guillerman, MD; Alan S. Brody, MD, FAAP; and Steven J. Kraus, MD

Clinical diagnostic strategies traditionally have been founded largely on anecdotal experience and supplemented by expert opinion or research that lacks rigorous study design. Evaluation of diagnostic procedures, including medical imaging, has focused predominantly on technical performance and simple tests of diagnostic efficacy, with few studies addressing the influence of imaging upon the diagnostic thinking process (the ordering of diagnostic probabilities or need for other tests), therapeutic planning, patient outcome, or costs. Fewer than 10% of imaging studies are supported with respect to specific clinical applications by randomized controlled trials, meta-analyses, or systematic reviews, and nearly 40% of ordered imaging studies are inappropriate or noncontributory.

To maximize benefit and minimize costs and risks, the use of diagnostic imaging should be founded on principles of evidence-based health care. Evidence-based health care is the “conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.” However, there are considerable barriers to achieving evidence-based clinical practice. Not all physicians are truly adept at applying the principles of clinical epidemiology and probabilistic reasoning that are at the core of the evidence-based approach to medical decision making, and it is not feasible for individual physicians to appraise all the available evidence for the myriad conditions that may present in clinical practice.

These barriers may be overcome by the use of clinical practice guidelines that provide explicit, succinct, evidence-based recommendations regarding the appropriate indications for diagnostic imaging in common medical conditions. Such guidelines are an under-appreciated resource for physicians who face diagnostic dilemmas daily and do not have the time or resources to investigate the latest medical research comprehensively at the point of care. The following section details currently available resources for evidence-based guidelines that include recommendations for the imaging of selected pediatric disorders, and also describes the basic process of development and implementation of evidence-based clinical practice guidelines. The subsequent sections illustrate a practical application of this process, using the example of imaging recommendations devised for an evidence-based clinical practice guideline on the care of the child with possible appendicitis.
IMAGING GUIDELINE RESOURCES, DEVELOPMENT, AND IMPLEMENTATION

To promote more rational use of medical resources, many organizations have issued guidelines to assist physicians with decision making. These are available online and are detailed below with the respective Web URLs for reference.

The Cochrane Collaboration is an international organization—comprised of centers in 15 countries and 50 topic-based collaborative review groups—that publishes systematic reviews of the effects of healthcare interventions at the Cochrane Library (http://www.cochranelibrary.net/ Cochrane/default.HTM). The National Guideline Clearinghouse (http://www.guideline.gov/ index.asp) is a comprehensive database of evidence-based clinical practice guidelines and related documents produced by the Agency for Healthcare Research and Quality in partnership with the American Medical Association and the American Association of Health Plans. The reviews and guidelines compiled in the above resources focus predominantly on the treatment of adult disorders.

Resources that address pediatric disorders in which imaging plays a large role in diagnostic evaluation or treatment planning have emerged recently. One particularly valuable resource is the American College of Radiology appropriateness criteria (http://www.acr.org/dyna/?id=appropriateness_criteria). This reference includes recommendations on the most appropriate imaging test for conditions commonly facing the pediatrician, such as the vomiting infant, the limping child, cases of suspected child abuse, developmental dysplasia of the hip, fever without source, acute right lower quadrant and pelvic pain in adolescent girls, hematuria, urinary tract infection, sinusitis, seizures, and headache.


These guidelines address only a small fraction of clinically important pediatric conditions, leaving the opportunity for motivated health care practitioners and organizations to develop additional guidelines as needed. Topics for potential guideline development may be prioritized on the basis of the prevalence and health care burden of a condition, the degree of variation in practice patterns, the potential for guidelines to influence practice, and the availability of evidence to support recommendations. Acute appendicitis is a compelling candidate for evidence-based clinical practice guidelines because it is a common disorder in children with substantial increased morbidity and costs when not diagnosed promptly and treated appropriately. Cincinnati Children's Hospital Medical Center desired to institute a clinical practice guideline for acute appendicitis in children, including recommendations for diagnostic imaging. Despite the voluminous literature on the diagnosis and treatment of appendicitis in children, no satisfactory systematic review or evi-
idence-based guideline on the imaging of pediatric appendicitis could be found, and a project was begun to produce an institutional guideline.

The process of developing an evidence-based clinical practice guideline takes several months from inception to implementation and requires a large time commitment from the participants, reinforcing the concept that topic selection should be focused on conditions that have considerable clinical relevance. After topic selection, a multidisciplinary working group is convened to pool clinical expertise and limit bias. The evidence is compiled by a systematic search of databases such as MEDLINE and EMBASE. The evidence is appraised for relevance and quality including study design (eg, randomized or comparison trial, meta-analysis, case-control or cohort study, expert opinion). Recommendations are then derived from the evidence. This is the most subjective phase of the process, and great care must be taken to ensure as much objectivity as possible, because expert opinion and value judgment must be relied on where gaps in the evidence exist. A guideline is drafted with the recommendations and submitted for external review and comments from expert physicians and pertinent departments such as medical records, pharmacy, and legal services. A final draft is prepared and the guideline is implemented with educational sessions aimed at anticipated end users. After implementation, monitoring of compliance and outcomes is performed to evaluate impact of the guidelines. Periodic review and revision is also scheduled to update recommendations on the basis of new evidence and to identify new areas for study.7

To ensure that the process of development and content of a guideline is sound, various organizations have proposed methods of guideline appraisal. In the United States, the Agency for Healthcare Policy and Research has adopted the set of desirable attributes for guidelines developed by the Institute of Medicine. These attributes are: validity (scientific evidence and the method of evaluation of the evidence); reliability/reproducibility (expectation of comparable guidelines if other experts used the same evidence and methodology); clinical applicability (pertinent patient population); clinical flexibility (possible exceptions); clarity (explicit, rational); multidisciplinary process (representation of affected practitioners); scheduled review (revision with new evidence); and documentation (participants, process, evidence, methods of evaluation). In Europe, an instrument for appraisal of clinical practice guidelines has been developed in a collaborative effort, Appraisal of Guidelines, Research and Evaluation in Europe (AGREE) (http://www.agreecollaboration.org/).8

Even a methodologically sound guideline becomes little more than an academic exercise if not implemented in a manner that can be adopted readily by a busy physician. Journal publications or other print media and traditional continuing medical education courses have, at best, only a modest effect on physician behavior. Use of guidelines may be improved by incorporation into Web-based or personal data assistant-based programs. An even more promising method to ensure that physicians consider guidelines is integration of such guidelines into health information technology systems at the point-of-care.9,10 For example, the imaging test performance characteristics and recommendations for a given clinical setting could be displayed on electronic clinical order entry systems. Structured radiology reports could display the probability of a given diagnosis based on the ordering physician's pretest assessment of diagnostic likelihoods and the diagnostic efficacy of the imaging test.

REVIEW AND APPRAISAL OF THE EVIDENCE FOR IMAGING THE CHILD WITH POSSIBLE APPENDICITIS

This section reviews the literature used to formulate imaging recommendations for an evidence-based clinical practice guideline for the care of the child with possible appendicitis at Cincinnati Children's Hospital Medical Center. The process of appraisal of the evidence is also described. The extensive bibliography is provided to demonstrate the breadth of literature review necessary to support recommendations.

The evidence on imaging of pediatric appendicitis was reviewed and appraised according to the 6-level hierarchical model of efficacy advocated by Fryback and Thornbury.11 In this model, level 1 is technical quality, level 2 is diagnostic test performance, level 3 is impact on diagnostic thinking, level 4 is effect on management deci-
sions, level 5 is effect on patient outcome, and level 6 is societal impact (cost-effectiveness). The model is hierarchical with satisfaction of the lower levels necessary but not sufficient for efficacy at the higher levels, and with the levels progressively addressing the impact of imaging on the radiologist, physician, patient, and society. After appraising the evidence by this model, recommendations for diagnostic imaging were created to address the questions on imaging most often posed by practicing clinicians faced with the diagnostic dilemma of possible appendicitis in a child, including which patients to image, what imaging test to order, and what the results of the imaging test imply for further diagnostic or treatment options.

Appendicitis is a frequent diagnostic concern encountered by the pediatrician, accounting for approximately one third of children admitted for acute abdominal pain and 2% of children presenting with abdominal pain in the pediatric outpatient setting. Prompt diagnosis is paramount because delay in treatment increases the risk of perforation and its complications, including abscess, peritonitis, sepsis, bowel obstruction, tubal sterility in girls, and death. The desire to avoid perforation led to the traditional surgical acceptance of a negative laparotomy rate of 10% to 20% as an appropriate index of surgical management of appendicitis. However, a negative laparotomy is not without risk and accurate diagnostic strategies are desirable to reduce negative laparotomy rates while not increasing perforation rates. Diagnostic imaging tests are a means to improve the accuracy of diagnosis of appendicitis in pediatric patients.

Imaging for appendicitis is most useful in clinically equivocal cases, which account for up to 35% of cases in young children and up to 45% of cases in adolescent girls. No single clinical finding is able to rule in or rule out the diagnosis of appendicitis reliably. Fever is often a late finding and unreliable, and a normal leukocyte count and C-reactive protein level do not effectively exclude appendicitis in children. Multiple clinical scoring systems have been proposed, incorporating elements of the history, physical examination, and routine laboratory tests, but none have been shown consistently to have adequate diagnostic efficacy in children to be used alone or to outperform modern imaging tests or the judgment of an experienced physician. Imaging improves the accuracy of diagnosis of appendicitis in clinically equivocal cases leading to beneficial changes in management plan, reduction of negative laparotomy rates, and reduction of costs.

In patients who present clinically with a very high likelihood of acute appendicitis, imaging is generally not indicated simply to confirm the diagnosis. The marginal improvement in diagnostic efficacy and the impact on patient management in this setting is slight, and routine imaging would strain radiology resources, increase costs, and delay needed surgeries. In addition, the negative predictive value of a negative test result is reduced by the influence of a high pretest probability of appendicitis in this setting, raising the risk of false negative examinations and missed appendicitis. In clinical presentations with a very low likelihood of appendicitis, imaging is more helpful to establish an alternative diagnosis than in eliminating appendicitis. In this setting, the positive predictive value of an imaging test interpreted as positive for appendicitis is reduced by the influence of a low pretest probability, raising the risk of a false positive examination and negative laparotomy.

While medical observation of equivocal cases traditionally has been considered safe for most patients, the perforation rate increases with delay in time to operation, with 80% of perforations occurring within 48 hours and the incidence of perforation increasing with professional delays greater than 24 hours. A period of observation culminating in perforation is an adverse outcome and potentially avoidable by early imaging. Imaging early in the course of evaluation potentially reduces the perforation rate and eliminates the need for admission for observation in clinically equivocal cases. The caveat of this approach is the theoretical risk of false negative imaging examinations in early appendicitis related to the low degree of inflammation that is below the threshold of imaging detection. Therefore, patients with a short history of symptoms and signs of appendicitis and a negative imaging study should be re-evaluated if symptoms persist.
Selection of a specific imaging test for abdominal pain that is possibly due to appendicitis is a frequent source of confusion for the referring physician. Imaging modalities to consider for possible appendicitis include conventional radiographs, barium enema, ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), and nuclear medicine scintigraphy. Computed tomography and ultrasound are the most extensively evaluated and most commonly used modalities in current practice. They are somewhat complementary, each offering varying advantages and disadvantages relative to diagnostic performance, availability, cost, and risk. The diagnostic performance of the various imaging modalities for clinically equivocal appendicitis in children is detailed in the Table (data compiled as part of a systematic review by the primary author for the Cincinnati Children’s Hospital Medical Center Health Policy and Clinical Effectiveness Program Clinical Practice Guideline for Appendicitis).

Ultrasound

Ultrasound is almost uniformly reported to have a high specificity for appendicitis, with all but a few studies reporting specificities in excess of 90%. Thus, a positive ultrasound examination greatly helps rule in the diagnosis of appendicitis. Ultrasound is noninvasive and offers the advantages of low cost, no ionizing radiation exposure, and minimal patient preparation. It also allows dynamic real-time assessment of peristalsis, bowel compressibility, and blood flow. In addition, ultrasound excels at diagnosing acute gynecologic disease, a common mimic of appendicitis. Disadvantages of ultrasound include high operator and patient dependence. While many investigators report high sensitivity of ultrasound for appendicitis, other investigators have not been able to replicate this achievement. Ultrasound by an inexperienced sonographer is particularly insensitive for appendicitis. A negative ultrasound examination does not exclude appendicitis strictly unless an experienced sonographer confidently visualizes a normal appendix. The rate of visualization of the normal appendix by ultrasound is low, reportedly ranging from 2.4% to 56%. The standard technique of graded compression sonography for appendicitis is limited by the presence of abdominal rigidity, guarding, or obesity, and the appendix may be difficult to visualize if aberrant or atypical in location (eg, bowel malrotation), obscured by air-filled bowel (eg, ileus or small bowel obstruction, retrocecal appendix), or collapsed due to perforation.

Computed Tomography

Computed tomography is reported to have both a high sensitivity and specificity for appendicitis, with virtually all studies showing sensitivities and specificities in excess of 90%. This allows appendicitis to be largely excluded with a negative test and confirmed with a positive test. Advantages of CT over ultrasound include less operator dependence, more confident visualization of the appendix, and better delineation of the extent of phlegmon and abscess in complicated appendicitis. Disadvantages of CT compared to ultrasound include higher cost, potential need for sedation, and potential risks of contrast media and ionizing radiation exposure.

Conventional Radiographs

Conventional abdominal radiographs are nonspecific and insensitive for the diagnosis of appendicitis. The identification of a fecalith has a high positive predictive value for appendicitis in a patient with abdominal pain, but a fecalith is detected on radiographs in no more than 5% to 10% of cases. Radiographs were reported to be normal or misleading in 75% of cases of pediatric appendicitis in one study. Another study reported that abnormalities were detected on radiographs by radiologists in only 33% of patients with possible appendicitis, whereas another study found radiographs to be helpful in only 6% of cases. The routine use of conventional radiographs for evaluation of possible appendicitis is not cost-effective, and radiographs are unnecessary if CT is planned. However, conventional radiographs can be helpful in certain settings that may alter the approach to patient management (eg, to assess for suspected small bowel obstruction).

Barium Enema

Prior to the dissemination of CT and ultrasound, the barium enema played a primary role in
## Diagnostic Performance of Imaging Tests for the Child With Possible Appendicitis

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BE = barium enema; US = ultrasound; CT = computed tomography; MRI = magnetic resonance imaging; NM = nuclear medicine

Values reported are as cited by the reference or calculated from 2 x 2 contingency tables derived from data provided in the reference. Blanks exist where the values were not cited in the reference or were not able to be calculated from data provided in the reference.
the imaging evaluation of possible appendicitis. Filling of the appendix to the tip with contrast virtually excludes appendicitis, whereas non-filling of the appendix with mass effect on the cecum suggests appendicitis. However, the appendix does not fill completely in 8% of normal cases and determination of complete filling can be difficult because of the wide variation in the length of normal appendices and variation in the level of obstruction of the appendix in acute appendicitis. Several conditions other than appendicitis can produce mass effect on the cecum, limiting the specificity of barium enema for appendicitis. In addition, the barium enema has very limited use in making alternative diagnoses of extra-colonic diseases that commonly mimic appendicitis. For these reasons, CT and ultrasound have replaced the barium enema as the preferred imaging tests for the evaluation of possible appendicitis.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) offers the advantages of excellent soft tissue contrast, multi-planar imaging capability, and no ionizing radiation exposure. However, study of MRI for the evaluation of possible appendicitis in children has been very limited. In one study, MRI identified all 20 cases of acute appendicitis, signifying a high sensitivity of MRI, but the specificity is uncertain because no cases without appendicitis were studied. Because of the tendency of calcification and air to produce similar signal voids on MRI, fecaliths and intestinal gas may be difficult to distinguish reliably. Magnetic resonance imaging has relatively high cost, frequently requires sedation in young children, and is not always available on an emergent basis. Because of these limitations and the paucity of data on its diagnostic efficacy for appendicitis, MRI cannot currently be advocated over CT or ultrasound for the evaluation of possible appendicitis in children.

Nuclear Medicine

Nuclear medicine scintigraphy for the evaluation of appendicitis is based on the localization of radiolabeled leukocytes, antibodies, or other agents to sites of acute inflammation. In some studies, the diagnostic efficacy of scintigraphy for appendicitis in the pediatric population approaches that of ultrasound and CT, whereas others have reported relatively poor diagnostic performance and poor interobserver agreement. Nuclear medicine scintigraphy is hindered by relatively high cost, lengthy preparation and imaging time, or limited availability when compared to ultrasound and CT. Thus it currently plays an adjunctive role to CT or ultrasound for the evaluation of possible appendicitis in children.

Imaging of Alternative Diagnoses

A major benefit of imaging is its utility in making alternative diagnoses. Computed tomography or ultrasound reveals alternative diagnoses in 18% to 31% of children with suspected appendicitis. The most common alternative diagnoses detected by imaging are mesenteric adenitis, ileocolitis, gynecologic disorders (ovarian cyst, ovarian torsion, tubo-ovarian abscess), urinary tract disorders (pyelonephritis, urolithiasis), segmental omental infarction, and basilar pneumonia.

Imaging Impact on Management Outcomes and Cost

In addition to improving diagnostic accuracy, imaging frequently influences management planning in children with clinically equivocal appendicitis. Imaging findings may guide whether a patient should be discharged home, undergo further diagnostic evaluation, or be sent to surgery. Ultrasound changes initial treatment plans in 30% to 46% of patients. Computed tomography has even more influence on management decisions, with a beneficial change in management reported in up to 73% of patients. It excels at depicting the extent of phlegmon or abscess in cases of perforated appendicitis. This assists in the decision of whether to treat invasively, with percutaneous or surgical drainage, or medically, with antibiotics followed by interval appendectomy.

By improving diagnostic accuracy and patient management, imaging leads to better patient outcomes. A statistically significant reduction in the negative surgery rate for patients operated on for suspected appendicitis has been reported in those who underwent CT or ultrasound prior to surgery compared to those who did not. A trend for lower perforation rates has been reported with use
of CT or ultrasound. However, not all studies showed improvement in negative surgery rates or perforation rates in patients undergoing imaging. Intuitively, imaging is more likely to impact the negative surgery rate than perforation rate, as the former is dependent on diagnostic accuracy and differentiation of appendicitis from other acute abdominal processes, while the perforation rate correlates with time from symptom onset to treatment. Patient delay in presentation or professional delay in ordering an imaging test limits the ability of imaging to lower perforation rates.

At a time of heightened cost-consciousness, it is notable that the improvement in diagnosis and outcomes provided by imaging can be obtained in a cost-effective manner. Imaging with ultrasound, CT, or a protocol of ultrasound followed by CT if ultrasound is negative, reduces the overall cost of evaluation of appendicitis in children. The costs of imaging are minor compared to the cost of an unnecessary surgery or delayed diagnosis. However, the economic benefit of imaging depends on selective application, because imaging is less cost-effective as the degree of certainty of the presence or absence of appendicitis prior to imaging increases, underscoring the principle that imaging is of primary benefit in cases with equivocal clinical presentations.

IMAGING TEST SELECTION

The goal of imaging is to maximize diagnostic efficacy while minimizing cost and risk to the patient. Currently, no single imaging test is superlative for this goal in all settings. The best imaging test depends on patient profile, test characteristics, institutional resources, and physician expertise. There is evidence to help physicians decide which test is the most appropriate to order in certain settings.

The patient’s gender, body habitus, age, and mode of clinical presentation are important when selecting the most appropriate imaging test. Ultrasound is the preferred initial imaging test in girls because of excellent depiction of the adnexa, the high frequency of gynecologic pathology mimicking acute appendicitis, and the lack of ionizing radiation exposure to the gonads. Ultrasound may also be preferred as the initial imaging test in thin patients with focal, self-local-ized tenderness where sonography can be performed quickly and with high accuracy. Computed tomography should be considered for the initial imaging test in obese or older children. Ultrasound is limited in patients with a large body habitus, with a significant decrease in sensitivity demonstrated beyond a body mass index threshold of 25. Visualization of the appendix on CT is improved in the presence of larger amounts of peritoneal fat. Computed tomography has significantly greater sensitivity than ultrasound in patients older than 10 years. For patients who present with subacute symptoms and perforated appendicitis is a concern, CT is preferred because ultrasound is more likely to miss perforated than nonperforated appendicitis, and perforated appendicitis has the most dramatic findings on CT.

Institutional factors such as available expertise and physician preference also influence selection of the imaging test. The high efficacy of ultrasound reported in some studies may not be generalized to all sonologists or institutions. When not performed by experts, the sensitivity of ultrasound diminishes and is not high enough to rule out appendicitis reliably. A negative ultrasound examination instills less confidence in the radiologic interpretation than a positive ultrasound examination, and a negative ultrasound examination engenders less confidence than a negative CT examination for exclusion of appendicitis.

The technical performance and interpretation of imaging tests is the responsibility of the radiologist, but the pediatrician should be aware of the limitations of certain techniques. Graded compression evaluation of the right lower quadrant is the standard technique for ultrasound evaluation of appendicitis, but in females the examination should be extended to the pelvis to improve detection of adnexal pathology that may mimic appendicitis. Computed tomographic technique can vary widely, because scans can be performed with or without intravenous, oral, or rectal contrast, and with a field of view that includes the whole abdomen and pelvis or is restricted to just the right lower abdominal quadrant. The differing CT techniques have been shown to have comparable diagnostic efficacy for appendicitis in children. To keep radiation exposure as low as
reasonably achievable, the radiologist may perform a limited CT in which only the lower abdomen and pelvis are scanned. Almost all cases of appendicitis are diagnosable by a limited CT examination and alternative diagnoses are predominantly located in the lower abdomen and pelvis. However, the pediatrician must be cognizant that alternative diagnoses above the lower abdomen, such as pyelonephritis and basilar pneumonia, could be missed on a limited CT examination. Also, if intravenous contrast is used, the sensitivity of CT for detection of urinary tract calculi is reduced. Communication between the radiologist and clinician is vital to prevent errors of omission from lack of understanding of test limitations.

Evidence-based health care principles dictate that guidelines should be based on the best available evidence and are subject to change with the emergence of new research. The process of guideline development often reveals deficiencies in existing evidence and suggests topics for future research. There are many unresolved issues regarding the diagnostic evaluation of appendicitis. It is still uncertain whether predictors based on history, clinical examination, and simple laboratory tests can be identified to stratify patient risk for appendicitis more reliably than physician judgment. Many studies exist on the diagnostic efficacy of various imaging modalities for appendicitis, but studies that directly compare imaging with other diagnostic approaches (eg, diagnostic laparoscopy or serial clinical examinations) are needed so that the role of imaging within the overall diagnostic strategy can be defined better.

**Summary of Imaging Recommendations**

Imaging is strongly recommended in clinically equivocal cases, where imaging has substantial utility in enhancing the efficacy of diagnosis and management, improving patient outcomes, and reducing costs. In the setting of a child with a low likelihood of appendicitis, imaging is more valuable when used to establish an alternative diagnosis than when performed to exclude appendicitis. When indicated, imaging generally should be obtained early in the course of evaluation to avoid increasing the risk of perforation because of diagnostic delay. If there is a clinically unequivocal diagnosis of appendicitis, imaging generally is not indicated simply to confirm the diagnosis, because this adds expense, delays treatment, and poses potential risks of ionizing radiation or sedation for a marginal improvement in diagnostic accuracy. An exception may be the setting of a subacute presentation where perforated appendicitis is a reasonable concern and identification of small bowel obstruction or abscess could alter management approach.

Ultrasound and CT are the imaging modalities most strongly recommended for evaluating the child with possible appendicitis. Both are specific enough to virtually rule in the diagnosis of appendicitis with a positive test, and CT is sensitive enough to virtually rule out the diagnosis with a negative test. Ultrasound is extremely operator dependent, and the diagnosis of appendicitis is ruled out reliably only if an experienced examiner confidently visualizes a normal appendix. Ultrasound should be considered for the initial imaging test in females and thin patients with focal tenderness. Ultrasound also should be considered as the initial test in younger children to avert the possible need for sedation and potentially higher risks of ionizing radiation exposure from CT in this population. Computed tomography is particularly useful when ultrasound is likely to be technically limited or less sensitive (eg, obesity, older child, presence of abdominal guarding, experienced sonographer unavailable) and when perforated appendicitis is suspected. In these settings, CT should be considered as the initial imaging test. It should also be considered if the clinical suspicion of appendicitis persists and ultrasound is negative or inconclusive.

**CONCLUSION**

When applied judiciously, imaging tests are a valuable resource for the physician to improve diagnostic certainty and direct patient management. Evidence-based guidelines are emerging to assist the physician in the medical decision-making process, and references for some of the most useful guideline resources have been provided above. However, the number of guidelines specifically addressing the imaging of pediatric disorders is sparse, and institutions must adapt existing guidelines or generate novel guidelines in
response to local needs. The included review and recommendations on the imaging of the child with possible appendicitis serve as an example of the content and method involved in appraising the efficacy of diagnostic testing as part of the development of an evidence-based clinical practice guideline.

Given the effort required to review the literature comprehensively, to devise recommendations, and to communicate guidelines to practicing physicians, a reasonable question is whether evidence-based clinical practice guidelines improve patient outcomes or reduce overall costs compared to traditional practice. This has been answered affirmatively for an evidence-based clinical pathway for acute appendicitis evaluated at the authors’ institution, although continued monitoring and education are necessary for sustained impact. Other guidelines should undergo similar validation. It must also be emphasized that evidence-based guidelines are not rigid rules, but tools designed to assist clinicians with making decisions based on the best available evidence. Evidence-based guidelines cannot apply to all patients in all settings, and their proper use requires, rather than replaces, clinical judgment.

REFERENCES


