# American College of Radiology
# ACR Appropriateness Criteria®
# Suspected Appendicitis–Child

**Variant 1:** **Child. Suspected acute appendicitis, low clinical risk. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| CT abdomen and pelvis with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT abdomen and pelvis without and with IV contrast | Usually Not Appropriate | ☢☢☢☢☢ |
| CT abdomen and pelvis without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| MRI abdomen and pelvis without and with IV contrast | Usually Not Appropriate | O |
| MRI abdomen and pelvis without IV contrast | Usually Not Appropriate | O |
| US abdomen | Usually Not Appropriate | O |
| US abdomen RLQ | Usually Not Appropriate | O |
| US pelvis | Usually Not Appropriate | O |
| Radiography abdomen | Usually Not Appropriate | ☢☢ |

**Variant 2:** **Child. Suspected acute appendicitis, intermediate clinical risk. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| US abdomen RLQ | Usually Appropriate | O |
| US abdomen | Usually Appropriate | O |
| CT abdomen and pelvis with IV contrast | May Be Appropriate (Disagreement) | ☢☢☢☢ |
| CT abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | ☢☢☢☢ |
| MRI abdomen and pelvis without and with IV contrast | May Be Appropriate (Disagreement) | O |
| MRI abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | O |
| Radiography abdomen | May Be Appropriate (Disagreement) | ☢☢ |
| CT abdomen and pelvis without and with IV contrast | Usually Not Appropriate | ☢☢☢☢☢ |
| US pelvis | Usually Not Appropriate | O |

**Variant 3:** **Child. Suspected acute appendicitis, high clinical risk. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| CT abdomen and pelvis with IV contrast | May Be Appropriate | ☢☢☢☢ |
| MRI abdomen and pelvis without IV contrast | May Be Appropriate | O |
| US abdomen RLQ | May Be Appropriate | O |
| CT abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | ☢☢☢☢ |
| MRI abdomen and pelvis without and with IV contrast | May Be Appropriate (Disagreement) | O |
| US abdomen | May Be Appropriate (Disagreement) | O |
| CT abdomen and pelvis without and with IV contrast | Usually Not Appropriate | ☢☢☢☢☢ |
| US pelvis | Usually Not Appropriate | O |
| Radiography abdomen | Usually Not Appropriate | ☢☢ |

**Variant 4:** **Child. Suspected acute appendicitis, equivocal or nondiagnostic right lower quadrant ultrasound. Next imaging study.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| CT abdomen and pelvis with IV contrast | Usually Appropriate | ☢☢☢☢ |
| MRI abdomen and pelvis without and with IV contrast | Usually Appropriate | O |
| MRI abdomen and pelvis without IV contrast | Usually Appropriate | O |
| CT abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | ☢☢☢☢ |
| US abdomen | May Be Appropriate (Disagreement) | O |
| US abdomen RLQ | May Be Appropriate | O |
| CT abdomen and pelvis without and with IV contrast | Usually Not Appropriate | ☢☢☢☢☢ |
| US pelvis | Usually Not Appropriate | O |
| Radiography abdomen | Usually Not Appropriate | ☢☢ |

**Variant 5:** **Child. Suspected acute appendicitis with clinical suspicion or initial imaging suggestive of complication (eg, abscess, bowel obstruction). Next imaging study.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| CT abdomen and pelvis with IV contrast | Usually Appropriate | ☢☢☢☢ |
| CT abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | ☢☢☢☢ |
| MRI abdomen and pelvis without and with IV contrast | May Be Appropriate (Disagreement) | O |
| MRI abdomen and pelvis without IV contrast | May Be Appropriate (Disagreement) | O |
| CT abdomen and pelvis without and with IV contrast | Usually Not Appropriate | ☢☢☢☢☢ |
| US abdomen | Usually Not Appropriate | O |
| US abdomen RLQ | Usually Not Appropriate | O |
| US pelvis | Usually Not Appropriate | O |
| Radiography abdomen | Usually Not Appropriate | ☢☢ |

## SUSPECTED APPENDICITIS–CHILD

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**Summary of Literature Review**

### Introduction/Background

Acute abdominal pain is one of the most common presenting complaints to the emergency department for the pediatric population. While the differential diagnosis for acute abdominal pain in children is broad and includes infectious, inflammatory, musculoskeletal, traumatic, gynecologic, and other etiologies, acute appendicitis is an important differential diagnostic consideration because of the potential need for surgical intervention. Acute appendicitis represents the most common abdominal surgical urgency/emergency in children [1,2]. Approximately 70,000 children per year in the United States are diagnosed with acute appendicitis, accounting for close to 30% of the total cost of all pediatric general surgical conditions combined [1]. The incidence of appendicitis peaks during adolescence and is uncommon in infants and preschool children and rare in newborns [3].

In spite of its high incidence, the diagnosis of acute appendicitis often presents a challenge, as the classic presenting symptoms of periumbilical pain, anorexia, nausea, vomiting, guarding, and migration of pain to the right lower quadrant (RLQ) are not always elicited and are only moderately reproducible between clinicians [4]. Furthermore, these symptoms are less reliable in the pediatric population, particularly those <5 years of age, who more frequently present with atypical symptoms [1]. As a result, presentation and diagnosis may be delayed, which may contribute to a higher rate of perforated appendicitis in the youngest children [5]. While perforated appendicitis tends to be more common in children than adults [6], morbidity is similar to or lower in children than in adults.

The most common treatment of appendicitis is appendectomy. In complicated cases of perforated appendicitis with abscess formation, surgery may follow percutaneous abscess drainage and treatment with broad-spectrum antibiotics [2]. Nonoperative treatment of early, uncomplicated appendicitis is increasingly being explored, and imaging plays a role in identifying candidates for nonoperative management [2]. Imaging has been shown to facilitate management and decrease the rate of negative appendectomies in children with suspected acute appendicitis [7-10] and remains a central tool in the diagnosis of pediatric acute appendicitis.

### Special Imaging Considerations

This document aims to provide guidance related to the imaging technique(s) best suited for the diagnosis of acute appendicitis. Importantly, this document does not encompass the appropriate imaging of all potential causes of RLQ quadrant pain. While this guideline emphasizes the role of imaging in the diagnosis of acute appendicitis in children, the initial consideration for imaging is based on clinical assessment. Clinical scoring systems and clinical pathways based upon history, symptoms, physical examination, and laboratory findings have been developed to risk stratify regarding the diagnosis of acute appendicitis and to guide imaging, clinical management, and surgery [11-14]. Two of the more widely used scoring systems are the Alvarado Score and Pediatric Appendicitis Score [13,15]. As primary diagnostic tools, clinical scoring systems have been shown to

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perform variably well depending on the population and often perform less well than imaging or a combination of scoring and imaging [13,15].

The greatest benefit of clinical scoring systems has been to differentiate low-risk patients who do not need surgery and generally do not require imaging from high-risk patients who can be triaged to surgical management, potentially without imaging [16-18]. Imaging should still be considered in cases where clinical judgement is at odds with the high or low risk stratification based on a scoring system. The major role for imaging in the context of clinical scoring systems is in the further evaluation of patients considered to have an intermediate risk of appendicitis [11]. While the specific cut-off values for intermediate risk vary based on the clinical score being used and the desired sensitivity and specificity, the intermediate-risk population is the subgroup that has historical, physical examination, or laboratory findings that do not qualify for either the low- or high-risk groups [13].

**US**

Appendix ultrasound (US) is performed in all potential locations of the appendix with gradual increasing pressure to displace overlying bowel gas and content, which is known as the graded compression technique. Graded compression also serves to bring the appendix closer to the transducer. Appendiceal US can be performed as either a focused examination of the RLQ or as a complete abdominal US. For the purpose of this topic, US abdomen includes dedicated appendiceal study. Accuracy of appendix US varies widely, is operator dependent [19], and may be dependent on patient-specific factors, including obesity [20,21]. The sensitivity and specificity of US for the diagnosis of pediatric acute appendicitis and percentage of equivocal cases varies. US accuracy is optimized in experienced hands and can approach that of CT [22-25]. For this document, it is assumed all procedures are performed and interpreted by an expert. In a large series of 3,799 patients with suspected acute appendicitis, Cundy et al [26] showed 92% visualization of the appendix with 95.5% accuracy, 97% sensitivity, and 95% specificity for the diagnosis of acute appendicitis. As an initial imaging modality for suspected acute appendicitis, US has been shown to have high diagnostic accuracy and to reduce or obviate the need for further imaging without increased complications or unacceptable increases in length of stay [22,26-28].

An important limitation of US is its low sensitivity in the diagnosis of perforated appendicitis [2]. This should be taken in consideration if nonoperative management is considered.

**CT**

CT has high sensitivity (~94%) and specificity (~95%) for the diagnosis of acute appendicitis [29]. If the appendix is not visualized, the negative predictive value is similar to a CT with normal visualized appendix [51]. Studies in both children and adults have allowed optimization of CT technique for the diagnosis of acute appendicitis. There is debate about the usefulness of oral contrast because some studies showed no significant increased accuracy, longer time to examination completion, and increased rates of patient emesis [30-32]. Rectal contrast does not increase accuracy compared to CT with intravenous (IV) contrast only [33].

Most CT examinations for appendicitis are performed with standard technique and coverage for imaging the abdomen and pelvis. Some centers have had success decreasing CT exposure parameters without compromising diagnostic performance [34,35] for acute appendicitis. Other retrospective studies in both adult and pediatric populations have shown that a focused CT from L2 or L3 or based on height-adjusted distance from the umbilicus through the pubis symphysis is sufficient to diagnose acute appendicitis and identify most alternative diagnoses [36,37].

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis. A limited number of retrospective studies of pediatric cohorts imaged without IV contrast have shown rates of visualization of the appendix similar to CT performed with IV contrast as well as high sensitivity and specificity for the diagnosis of appendicitis [1,2]. Potential limitations of unenhanced CT include decreased sensitivity and incomplete characterization of complicated appendicitis (eg, perforation and abscess formation) and possibly lower sensitivity for alternative diagnoses [38,39].

There are no data to suggest that CT with and without IV contrast has better diagnostic performance for acute appendicitis or alternative diagnoses than a single phase (CT with or CT without IV contrast) examination. Furthermore, CT with and without IV contrast approximately doubles radiation exposure to the patient.

**MRI**
MRI without, or without and with IV contrast, has been shown to have high sensitivity and specificity for acute appendicitis that is similar to CT and similar to or better than US [40-45]. Specifically, recent data describe a sensitivity of 86% and specificity of 94% for unenhanced MRI and a sensitivity of 94% and specificity of 94% for MRI with IV contrast [46]. The approach to optimize imaging the appendix with MRI is evolving as it is not clear how the addition of specific sequences (eg, diffusion-weighted imaging, postcontrast imaging) improve accuracy [47].

**Discussion of Procedures by Variant**

**Variant 1: Child. Suspected acute appendicitis, low clinical risk. Initial imaging.**

Risk stratification for acute appendicitis can be achieved based on clinical gestalt and/or laboratory data or based on published scoring systems. Most studies have shown that in patients stratified as "low risk" (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50].

**Radiography Abdomen**
Most studies have shown that in patients stratified as low risk (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50]. Radiographs may identify alternative causes of pain, such as constipation or lower lobe pneumonia [51].

**US Abdomen RLQ**
Most studies have shown that in patients stratified as low risk (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50].

**US Abdomen**
Most studies have shown that in patients stratified as low risk (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50].

**US Pelvis**
Most studies have shown that in patients stratified as low risk (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50]. Pelvic US may identify other causes of pain in girls but there are no data regarding its performance as a first-line imaging modality for acute appendicitis [52].

**CT Abdomen and Pelvis**
In a retrospective study of children who underwent CT of the abdomen and pelvis for suspected acute appendicitis, Kim et al [50] found that no patient categorized as low risk by the Pediatric Appendicitis Score had a positive CT. Similarly, based on retrospective study of a mixed population of children and adults who underwent CT, McKay and Shepard [53] showed that the Alvarado score could rule out appendicitis in low-risk patients with 96% sensitivity. Alternative causes of abdominopelvic pain, which have been described to occur at rates between 7% and 25%, may be identified by CT [54,55].

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis [38,39].

**MRI Abdomen and Pelvis**
Most studies have shown that in patients stratified as low risk (which varies per study and is based on the system used), imaging for acute appendicitis is not required, and other causes of abdominopelvic pain should be sought [13,16,17,48-50]. Alternative causes of abdominopelvic pain, which occurred at a rate of 20% in a study of MRI as the primary imaging modality for suspected acute appendicitis, may be identified by MRI [55].

**Variant 2: Child. Suspected acute appendicitis, intermediate clinical risk. Initial imaging.**

Risk stratification for acute appendicitis can be achieved based on clinical gestalt and laboratory data or based on published scoring systems. Most studies have shown that imaging provides diagnostic benefit in patients stratified as "intermediate risk" [48,49] (definition varies per study). In a retrospective study of a mixed population of children and adults, McKay and Shepherd [53] showed that an equivocal Alvarado score (equal to 4–6) was only

36% sensitive and 94% specific for acute appendicitis and that CT imaging had >90% sensitivity and specificity in this subpopulation. Similarly, in their retrospective study, Athans et al [15] found an intermediate-risk Alvarado score to be 92% to 94% sensitive and 47% to 61% specific, depending on the cut-off used. An intermediate-risk Pediatric Appendicitis Score was 61% sensitive and 93% specific [15]. In a prospective study that used the Pediatric Appendicitis Score for initial risk stratification followed by imaging targeted at patients considered intermediate risk, Saucier et al [13] showed that 61% of patients fell in the intermediate risk group based on clinical scoring but that appendicitis was present in only 29% of these patients. The combination of imaging with clinical scoring in that study was 94% accurate with a sensitivity of 92% and a specificity of 95% for the diagnosis of acute appendicitis [13].

**Radiography Abdomen**
Radiographs are neither sensitive nor specific for the diagnosis of acute appendicitis but may identify alternative causes of pain [51].

**US Abdomen RLQ**
US provides diagnostic benefit in patients with an intermediate clinical risk for acute appendicitis and is often the initial imaging modality in staged clinical pathways that incorporate risk stratification. Saucier et al [13] in their study of a staged clinical pathway using stratification per the Pediatric Appendicitis Score with US used in patients with an equivocal score (equal to 4–7) showed US to have 93% accuracy with 86% sensitivity and 97% specificity.

**US Abdomen**
There are no specific data regarding the relative performance of a focused RLQ US versus a complete abdominal US in intermediate-risk patients.

**US Pelvis**
There are no data specific to the use of pelvic US only in children with intermediate clinical risk for acute appendicitis. Pelvic US may be part of a complete evaluation for abdominopelvic pain in peri- or postmenarchal girls [52].

**CT Abdomen and Pelvis**
CT of the abdomen and pelvis has been shown to provide diagnostic benefit in a mixed population of children and adults with intermediate clinical risk for acute appendicitis where the examination had 90% sensitivity and 95% specificity for acute appendicitis [53]. Because CT covers more anatomic territory than a limited RLQ US, it may identify alternative causes of abdominopelvic pain [54,55].

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis [38,39].

**MRI Abdomen and Pelvis**
Given its high sensitivity and specificity for acute appendicitis, MRI may be indicated in children with an intermediate clinical risk for acute appendicitis [40,41,43]. Similar to CT, the greater anatomic coverage of MRI (versus US) may identify alternative causes of abdominopelvic pain [54,55].

### Variant 3: Child. Suspected acute appendicitis, high clinical risk. Initial imaging.

Risk stratification for acute appendicitis can be achieved based on overall subjective assessment or use of published scoring systems. The patient-specific likelihood of acute appendicitis among patients classified as high risk varies across the range of high-risk scores and varies between published studies [56]. Approaches to high-risk patients vary in the literature, with some studies using imaging to confirm the diagnosis of appendicitis [49] and other studies advocating surgical intervention without imaging based on a demonstrated high accuracy of the scoring system in their practice [13,17,18,48,57].

**Radiography Abdomen**
Radiographs are neither sensitive nor specific for a diagnosis of acute appendicitis but may aid in terms of excluding complications of acute appendicitis, such as bowel obstruction or gross perforation [51].

**US Abdomen RLQ**
There is no evidence to support routine US in all patients considered high risk for acute appendicitis. However, US could be used to confirm the diagnosis of acute appendicitis in this population and to exclude other processes

that clinically mimic appendicitis. False-negative US results are more common in patients with a high clinical risk of acute appendicitis [58].

**US Abdomen**

US may be performed in selected high-risk patients to confirm the diagnosis of appendicitis, but US is likely not needed in all high-risk patients, and false-negative results are more common in this population [58].

**US Pelvis**

There are no data regarding the performance of pelvic US as a first-line imaging modality for acute appendicitis. In peri- or postmenarchal girls, a pelvic US may identify alternative causes of pelvic pain [52].

**CT Abdomen and Pelvis**

There is no evidence to support routine use of CT of the abdomen and pelvis or of focused CT in high-risk patients. Based on high sensitivity and specificity, CT could be used to confirm the diagnosis of acute appendicitis in these patients and to exclude other processes that clinically mimic appendicitis. Tan et al [14] showed that in a population of adult and adolescent patients, the positive likelihood ratio for CT was no different from clinical scoring in patients with a high-risk clinical score, suggesting no diagnostic benefit of CT in this context.

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis [38,39].

**MRI Abdomen and Pelvis**

There is no evidence to support routine use of MRI in high-risk patients. Based on high sensitivity and specificity that is similar to CT, MRI could be used to confirm the diagnosis of acute appendicitis in high-risk patients and to exclude other processes that clinically mimic appendicitis. However, the diagnostic benefit of MRI in this context has not been demonstrated.

**Variant 4: Child. Suspected acute appendicitis, equivocal or nondiagnostic right lower quadrant ultrasound. Next imaging study.**

The definition of an equivocal or nondiagnostic US for acute appendicitis varies widely in the literature, and careful definition of this category has major implications on imaging utilization [22,59,60]. Some consider nonvisualization of the appendix as an equivocal result [40,61]. However, in several retrospective studies, an appendiceal US in which the appendix is not visualized and no inflammatory findings are present in the RLQ has high negative predictive value [3,62-64]. In this context, further imaging is unlikely to be contributory unless there is discordance between the clinical picture and the negative US result [65]. Further imaging, however, is contributory after equivocal US examinations in which the appendix is either visualized or not visualized, and there are findings that could reflect appendicitis. In one study, appendicitis was present in 26% of patients who met this criteria [3].

While there is good evidence regarding secondary imaging modalities following an equivocal US, there is also evidence of the benefit of repeat clinical assessment in these cases, which can obviate further imaging at the expense of delay in diagnosis and the risk associated with extending the hospital visit [10,66]. Schuh et al [67] in a prospective study found that of 123 patients with an initially equivocal US, acute appendicitis could be correctly ruled out clinically in 59% based on reassessment without further imaging.

**Radiography Abdomen**

Given the limited sensitivity and specificity, a radiograph is unlikely to diagnose acute appendicitis in patients with an initial equivocal or nondiagnostic appendiceal US [51]. Radiographs may identify an alternative cause of pain.

**US Abdomen RLQ**

Repeating a US examination after an initially equivocal result increases sensitivity for acute appendicitis. Schuh et al [67] showed that repeat US could make a diagnosis in 55% of cases with persistent clinical concern for acute appendicitis after an initially equivocal US. This final diagnosis rate, however, is lower than what has been reported with both CT and MRI.

**US Abdomen**

There are no specific data related to whether a repeat focused RLQ US or a completed abdominal US is more effective in the setting of an initial equivocal US.

**US Pelvis**

There are no data regarding the performance of pelvic US as a follow-up examination for acute appendicitis after a nondiagnostic RLQ US. In peri- or postmenarchal girls, a pelvic US following an equivocal appendix US may identify alternative causes of pelvic pain or potentially identify an appendix located in the pelvis [52].

**CT Abdomen and Pelvis**

CT of the abdomen and pelvis has been shown to be highly accurate as a diagnostic modality for acute appendicitis following equivocal or nondiagnostic US [68]. The performance of CT in this context is similar to the performance of CT as a primary imaging modality [61,69] with 91% sensitivity and 98% specificity reported by Santillanes et al [18]. In a retrospective review of their clinical experience, Srinivasan et al [65] showed that CT provides the greatest diagnostic benefit in patients in whom US is equivocal and the Alvarado score was ≥6. Krishnamoorthi et al [70] demonstrated 99% sensitivity and 91% specificity for acute appendicitis of a staged algorithm with US as the initial imaging modality followed by CT in equivocal cases. Similarly, Thirumoorthi et al [69] showed 94% sensitivity and 98% specificity for a staged US followed by CT algorithm.

Regarding focused CT, a retrospective study by O'Malley et al [37] showed that in adults with suspected appendicitis and an equivocal US, focused CT would have been sufficient to diagnose or exclude appendicitis in all cases and to make all alternative diagnoses. Similar results have since been shown in pediatric populations.

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis [38,39].

**MRI Abdomen and Pelvis**

MRI performed following equivocal or nondiagnostic appendix US has similar sensitivity and specificity to CT with 100% sensitivity and 96% specificity demonstrated by Herliczek et al [41,71]. In a clinical pathway with US as the initial modality and MRI for problem solving, Epifanio et al [48] demonstrated MRI to add diagnostic benefit in the small subset of cases that remained indeterminate after US. The overall sensitivity and specificity of the described pathway were 96% and 100%, respectively. Importantly, Aspelund et al [72] showed no difference in clinical outcomes following a shift from CT as the primary imaging modality for acute appendicitis to US with MRI for equivocal cases.

Regarding perforated appendicitis, Dillman et al [40] showed subsequent MRI to have similar sensitivity and specificity to CT for diagnosis of perforation in patients with an initially equivocal or nondiagnostic RLQ US. It should be noted, however, that the total number of cases of perforation in this study was small (10 in the MR group and 4 in the CT group).

**Variant 5: Child. Suspected acute appendicitis with clinical suspicion or initial imaging suggestive of complication (eg, abscess, bowel obstruction). Next imaging study.**

Complicated appendicitis, generally a result of perforation, occurs at a frequency of approximately 30% in the pediatric population and has implications for clinical care [73]. There is debate in the literature regarding optimal care for patients with perforated appendicitis, which can range from antibiotic therapy with delayed appendectomy to interventional drainage to surgical intervention.

**Radiography Abdomen**

Radiographs may identify possible complications of acute appendicitis by identifying bowel obstruction or gross perforation. Radiographs, however, have limited sensitivity and specificity for the diagnosis of acute appendicitis as a cause of the complication [51].

**US Abdomen RLQ**

In general, US has been shown to have limited accuracy in the distinction of perforated from nonperforated acute appendicitis [2]. While US can identify RLQ fluid collections/abscesses and dilated bowel loops, the limited field of view may be inadequate to fully assess complications of appendiceal perforation and thereby guide clinical management.

**US Abdomen**

The greater anatomic coverage of a full abdominal US (versus an RLQ US) may identify additional findings of complicated acute appendicitis outside of the RLQ, but the small image field of view is still limiting in terms of overall assessment of complications.

**US Pelvis**
Focused US of the pelvis is limited in terms of overall assessment of complicated acute appendicitis secondary to its small scope of imaging and field of view.

**CT Abdomen and Pelvis**
CT of the abdomen and pelvis with IV contrast, with or without oral contrast, provides a broad field of view for assessment of complications of acute appendicitis, including perforation, abscess, and bowel obstruction. Focused CT will likely be sufficient to characterize complicated appendicitis in the lower abdomen and pelvis; however, the limited coverage may not permit characterization of complications if they extend into the upper abdomen (eg, perisplenic or perihepatic collections). However, this has not been specifically studied.

There are no studies that compare unenhanced and contrast-enhanced CT for diagnosis of acute appendicitis. Unenhanced CT may be limited in its ability to characterize complicated appendicitis (eg, perforation and abscess formation) [38,39].

**MRI Abdomen and Pelvis**
MRI has not been specifically compared to CT as a modality for assessment of suspected complications of acute appendicitis and the role of IV gadolinium in this setting has not been specifically assessed. Data from a small number (n = 10) of patients with an initially equivocal or nondiagnostic RLQ US suggest MRI performs similarly to CT for the detection of perforated appendicitis [40], but patients with known or suspected perforation were not included in that study, and the ability of MRI to accurately characterize the perforation or other complications has not been studied. The broad field of view provided by MRI of the abdomen and pelvis should allow for assessment of complications of acute appendicitis.

**Summary of Recommendations**

- **Variant 1:** Imaging is not generally recommended for suspected acute appendicitis in a child with low clinical risk.
- **Variant 2:** US abdomen RLQ or US abdomen is usually appropriate for the initial imaging of suspected acute appendicitis in a child with intermediate clinical risk. These procedures are equivalent alternatives. The panel did not agree on recommending radiographs of the abdomen, CT abdomen and pelvis with IV contrast, CT abdomen and pelvis without IV contrast, MRI abdomen and pelvis without IV contrast, or MRI abdomen and pelvis with and without IV contrast for these patients. There is insufficient literature to support the use of these procedures in this clinical scenario.
- **Variant 3:** Approaches to children with high clinical risk for acute appendicitis vary in the literature with some studies using imaging to confirm the diagnosis and other studies advocating surgical intervention without imaging based on a demonstrated high accuracy of clinical scoring system(s) in their practice. When imaging is performed, CT abdomen and pelvis with IV contrast, MRI abdomen and pelvis without IV contrast, or US abdomen RLQ may be appropriate. The panel did not agree on recommending CT abdomen and pelvis without IV contrast, MRI abdomen and pelvis without and with IV contrast, or US abdomen for these patients. The general opinion of the panel was that CT of the abdomen and pelvis for suspected acute appendicitis is optimally performed with IV contrast and that IV contrast may not be required for MRI of the abdomen and pelvis for suspected acute appendicitis.
- **Variant 4:** CT abdomen and pelvis with IV contrast, MRI abdomen and pelvis without IV contrast, or MRI abdomen and pelvis without and with IV contrast is usually appropriate as the next imaging study of a child with suspected acute appendicitis and equivocal or nondiagnostic RLQ US. These procedures are equivalent alternatives. The panel did not agree on recommending CT abdomen and pelvis without IV contrast or US abdomen. There is insufficient literature to support the use of these procedures in this clinical scenario.
- **Variant 5:** CT abdomen and pelvis with IV contrast is usually appropriate as the next imaging study for a child with suspected acute appendicitis with clinical suspicion or initial imaging suggestive of complication (eg, abscess, bowel obstruction). The panel did not agree on recommending CT abdomen and pelvis without IV contrast, MRI abdomen and pelvis without IV contrast, or MRI abdomen and pelvis without and with IV contrast for these patients. There is insufficient literature to support the use of these procedures in this clinical scenario.

### Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

### Appropriateness Category Names and Definitions

| Appropriateness Category Name | Appropriateness Rating | Appropriateness Category Definition |
|---|---|---|
| Usually Appropriate | 7, 8, or 9 | The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients. |
| May Be Appropriate | 4, 5, or 6 | The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal. |
| May Be Appropriate (Disagreement) | 5 | The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned. |
| Usually Not Appropriate | 1, 2, or 3 | The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable. |

### Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document [74].

| Relative Radiation Level Designations | | |
|---|---|---|
| **Relative Radiation Level*** | **Adult Effective Dose Estimate Range** | **Pediatric Effective Dose Estimate Range** |
| O | 0 mSv | 0 mSv |
| ☢ | <0.1 mSv | <0.03 mSv |
| ☢☢ | 0.1-1 mSv | 0.03-0.3 mSv |
| ☢☢☢ | 1-10 mSv | 0.3-3 mSv |
| ☢☢☢☢ | 10-30 mSv | 3-10 mSv |
| ☢☢☢☢☢ | 30-100 mSv | 10-30 mSv |
| *RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies". | | |

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