

# Pediatric Suspected Appendicitis Clinical Pathway

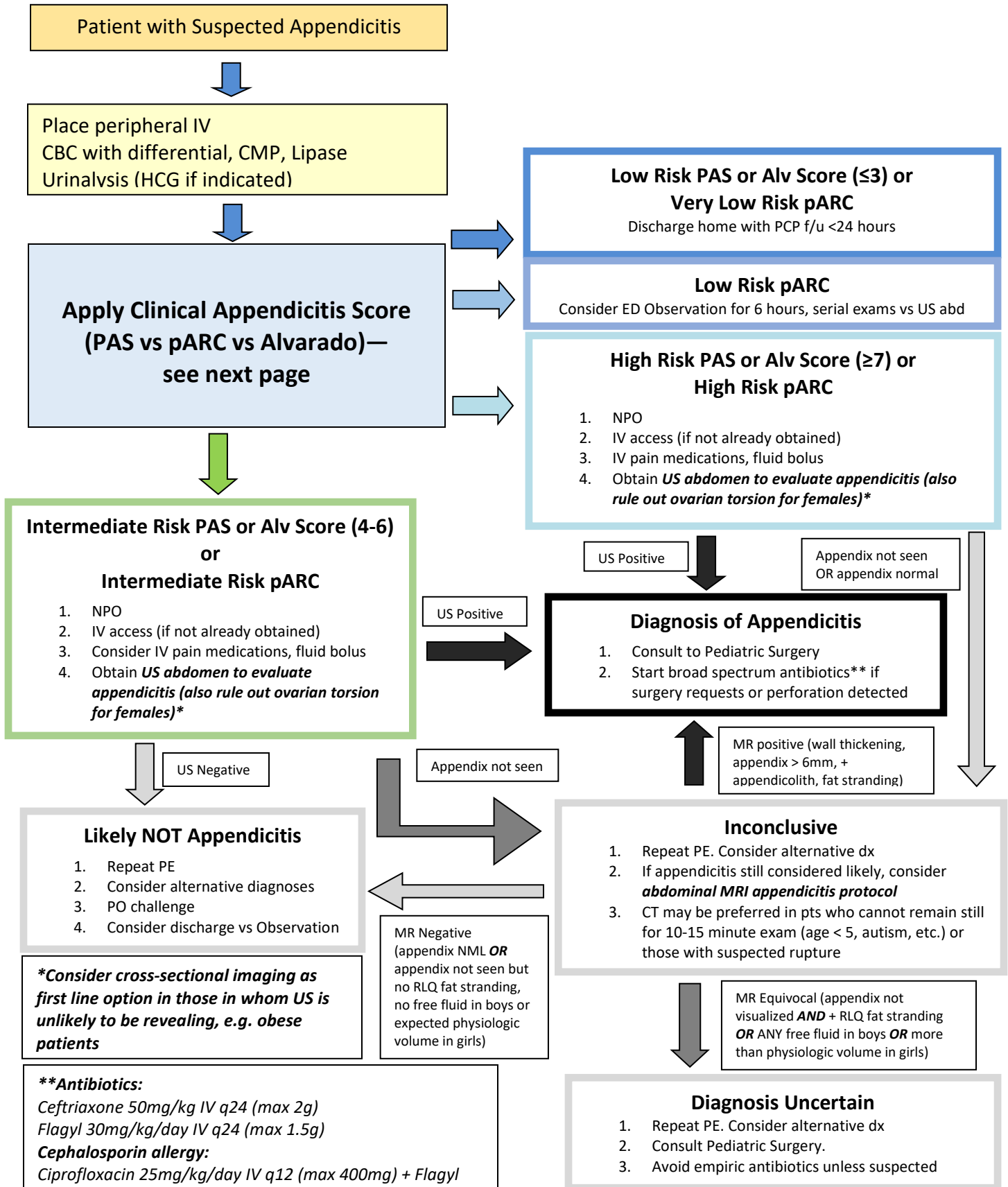
Jan 2022

<b>Inclusion criteria</b>	Patients aged 3-18 years who present with right lower quadrant abdominal pain and/or suspected appendicitis						
<b>Exclusion criteria</b>	Patient with known inflammatory GI disease (e.g. IBD); children aged < 3 years as they present atypically						
<b>Outcomes/Goals</b>	<ol style="list-style-type: none"> <li>1. Create an efficient, team-oriented, and standardized approach for the evaluation and treatment of children with suspected appendicitis</li> <li>2. Minimize radiation exposure where possible during diagnostic evaluation</li> </ol>						
<b>NURSE documentation</b>	Chief complaint. Onset and duration of pain/nausea/vomiting/diarrhea. Abdominal exam including ambulatory status, last po intake, last bowel movement, fever history						
<b>INTERVENTIONS</b> Initiate on arrival	ESI Triage level III Full set of vitals Administer ondansetron ODT 0.1-0.2mg (maximum dose 8mg/dose) for nausea Place topical Lidocaine (LMX) in anticipation of peripheral IV start Place on monitor if toxic appearance or suspected peritonitis UA Urine hCG (if indicated) CMP Lipase CBC with differential Initiate crystalloid bolus 20 ml/kg if clinically indicated						
<b>DIAGNOSTICS</b>	Labs (CBC with diff, CMP, lipase, UA, urine hCG as above) Ultrasound for intermediate or high-risk patients Consider MR/CT for non-diagnostic US results or first-line for obese patients						
<b>PHYSICIAN (LIP)</b> Scoring Criteria	Score patient using a clinical appendicitis scoring tool. Low and very low risk (pARC) patients often may be observed or discharge, while intermediate and high risk patients should undergo imaging.						
IV Fluids (if indicated)	Crystalloid bolus 20 ml/kg Maintenance fluid if appendicitis confirmed						
Medication	<table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top; padding-right: 10px;">Pain Medication</td> <td>Tylenol 15 mg/kg po/pr (maximum 650mg) Q4 hours for fever/mild pain Fentanyl 1 mcg/kg IV (maximum 50mcg) q 10 minutes prn or Morphine 0.1mg/kg IV (maximum 8 mg) q 10 minutes prn</td> </tr> <tr> <td style="vertical-align: top; padding-right: 10px;">Anti-emetics</td> <td>Ondansetron Oral dose 2-4 years of age: 2-4 mgs (0.15mg/kg) 4-11 years of age: 4 mgs &gt;11 years of age: 4-8 mgs</td> </tr> <tr> <td style="vertical-align: top; padding-right: 10px;">Antibiotics</td> <td>IV dose 6 months–18 years of age: 0.15mg/kg/dose (maximum dose 4mg) Ceftriaxone 50mg/kg IV (max 2g) q24hrs Metronidazole 30mg/kg/day IV (max 1.5g) q24hrs Severe cephalosporin allergy: Ciprofloxacin 25mg/kg/day IV (max 400mg) q12hrs</td> </tr> </table>	Pain Medication	Tylenol 15 mg/kg po/pr (maximum 650mg) Q4 hours for fever/mild pain Fentanyl 1 mcg/kg IV (maximum 50mcg) q 10 minutes prn or Morphine 0.1mg/kg IV (maximum 8 mg) q 10 minutes prn	Anti-emetics	Ondansetron Oral dose 2-4 years of age: 2-4 mgs (0.15mg/kg) 4-11 years of age: 4 mgs >11 years of age: 4-8 mgs	Antibiotics	IV dose 6 months–18 years of age: 0.15mg/kg/dose (maximum dose 4mg) Ceftriaxone 50mg/kg IV (max 2g) q24hrs Metronidazole 30mg/kg/day IV (max 1.5g) q24hrs Severe cephalosporin allergy: Ciprofloxacin 25mg/kg/day IV (max 400mg) q12hrs
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<b>DISPOSITION</b>	If confirmed appendicitis, consult pediatric surgery						
<b>Special Considerations</b>	Clinical presentation differs in younger children. <u><b>Infants:</b></u> vomiting (85-90%), pain (35-77%), diarrhea (18-46%), fever (40-60%), irritability (35-40%), grunting respirations, cough/rhinitis, R hip complaint (3-23%) <u><b>Preschool:</b></u> abdominal pain (89-100%), vomiting (66-100%), fever (80-87%), anorexia (53-60%)						

# Clinical Pathway Decision Making Process

## Suspected Acute Appendicitis (3-18 years)

Jan 2022



## Pediatric Clinical Appendicitis Scoring Tools

Alvarado/Mantrels Score		Pediatric Appendicitis Score		Pediatric Appendicitis Risk Calculator (pARC)		
	Points		Points		Calculate using scoring tool available in EMR or at MDCALC <a href="https://www.mdcalc.com/pediatric-appendicitis-risk-calculator-parc">https://www.mdcalc.com/pediatric-appendicitis-risk-calculator-parc</a>	
Anorexia	1	Anorexia	1	Male sex		
Nausea or vomiting	1	Nausea or vomiting	1	Age and sex		
Migration of pain to RLQ	1	Migration of pain to RLQ	1	Duration of pain		
Fever > 37.3° C (>99.2°F)	1	Fever	1	Presence of pain with walking		
RLQ Rebound tenderness	1	Cough/percussion/hopping tenderness	2	Migration of pain to RLQ		
RLQ tenderness	2	RLQ tenderness	2	Maximal TTP in RLQ		
WBC > 10,000	2	WBC > 10,000	2	Abdominal guarding		
ANC > 7,500	1	ANC > 7,500	1	ANC		
Total Points						
Low Risk	0-3	Low Risk	0-3	Very low risk	<5%	
Intermediate Risk	4-6	Intermediate Risk	4-6	Low risk	5-14%	
High Risk	7+	High Risk	7+	Intermediate risk	15-24%	
					25-49%	
					50-74%	
					75-84%	
				High risk	>85%	

Experienced clinician judgment has been found to be comparable to the Alvarado score and the Pediatric Appendicitis Score. Of the tools listed above, the pARC appears to have the best test characteristics for ruling in and ruling out appendicitis.

# Pediatric Suspected Acute Appendicitis

## Goals of Clinical Pathway

1. Create an efficient, team-oriented, standardized and accurate approach for the evaluation and treatment of children with suspected appendicitis
2. Minimize radiation exposure where possible during diagnostic evaluation

Data Considerations	Interventions	Rationale
<b>Diagnosis</b>		Appendicitis is the most common surgical emergency in children. Symptoms overlap many childhood illnesses making this a challenge to diagnosis. Delayed diagnosis and rupture are associated with increased morbidity, mortality and prolonged hospital stays. Initial misdiagnosis rates range from 28-57% for children age 12 years or younger, and can be much higher in children aged less than 2.
	<b>Clinical Assessment</b>	Several clinical scoring systems have been prospectively studied in children to aid in the diagnosis of appendicitis, including the Pediatric Appendicitis Score, the Alvarado Score, and the Low-Risk Appendicitis Score. The newest of these, the Pediatric Appendicitis Risk Calculator (pARC) appears to have the best test characteristics though requires more sophisticated calculations.
	<b>Ultrasound</b>	Though ultrasound is inferior to CT scan for the diagnosis of appendicitis, both ACEP and ACR recommend US as the initial study to minimize radiation exposure in pediatric patients. A multicenter study at major pediatric centers by Mittal showed ultrasound to have sensitivity of 73% and specificity of 97%. However, utility of US for diagnosis of appendicitis depends on pretest probability. A study combining US and PAS found that in kids with high risk PAS, 19% of US were falsely negative and 45% with equivocal results had appendicitis. For intermediate risk, 13% of equivocal had appendicitis, while 6% with negative US did.
	<b>CT Scan</b>	CT is superior to US and in most studies to MRI. CT with contrast is the preferred study in the diagnosis of appendicitis with rupture. There is not good evidence suggesting oral contrast improves diagnostic accuracy, though IV contrast is useful. At OHSU, sensitivity of CT is ~100% while specificity is 99%.
	<b>Abdominal MRI</b>	Limited abdominal MRI has been studied in children as an alternative to CT. In a 2012 retrospective single center study, MR had sensitivity of 97.6%, specificity of 97.0%, PPV 88.9%, and NPV 99.4% with minimum f/u of 30 days for clinical confirmation. A 2014 study using contrast-enhanced MR showed similar test-characteristics, with sensitivity 96.2%, specificity 95.7%, PPV 92.7%, and NPV 97.8%. Appendix was visualized in 67% of cases in this latter study and was visualized in 36% of true negative cases in the former. This study can be performed at OHSU, and deferring CT scan to obtain a quick abdomen MRI is generally the preferred option to avoid excess radiation.

## References:

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3. Moore MM, Gustas CN, Choudhary AK, et al. MRI for clinically suspected pediatric appendicitis: an implemented program. *Pediatr Radiol* 42 (2012): 1056-63
4. Mushtaq R, Desoky SM, Morello F. First Line Diagnostic Evaluation with MRI for Children Suspected of Having Acute Appendicitis. *Radiology* 29 (2019): 170-7
5. Ebell MH, Shinholser J. What are the most clinically useful cutoffs for the Alvarado and Pediatric Appendicitis Scores? A systematic review. *Ann Emerg Med* 64 (2014): 365-372
6. Kharbanda AB, Vazquez-Benitez G, Ballard DW, et al. Development and Validation of a Novel Pediatric Appendicitis Risk Calculator (pARC). *Pediatrics* 141 (2018)