

Clinical Pathway

Suspected Acute Appendicitis (ages 3-17 years)

December 2012

Outcomes/Goals	<ol style="list-style-type: none"> 1. Create an efficient, timely, team oriented, standardized approach for the evaluation and work up of children with suspected Appendicitis 2. Decrease radiation exposure during diagnostic workup.
NURSE documentation	Chief complaint. Onset and duration of pain/nausea/vomiting/diarrhea. Abdominal exam including ambulatory status, last po intake, last bowel movement, fever history
INTERVENTIONS Initiate on arrival	ESI Triage level III Full set of vitals Ondansetron ODT 0.15mg (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 UHCG (if indicated) CBC with differential Initiate NS bolus 20 ml/kg if clinically indicated
DIAGNOSTICS	Labs (CBC with diff, UA, UHCG) Physician/NP scores patient using Low Risk and High Risk Criteria Consider Ultrasound for patients who meet Equivocal Scoring
PHYSICIAN (LIP) Scoring Criteria	Score patients on both scales independently. If combined score is >5 points using the Low Risk Criteria it does not automatically make them high risk and vice versa. Scores that do not fall on either category will be considered equivocal.
IV Fluids (if indicated)	NS bolus 20 ml/kg Maintenance fluid
Medication Pain Medication Anti-emetics	Tylenol 15 mg/kg po/pr Q4 hours for fever/mild pain Fentanyl 1mcg/kg IV maximum 50mcg q 10 minutes prn or Morphine 0.1mg/kg IV maximum 8 mg q 10 minutes prn 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 IV dose 6 months–18 years of age: 0.15mg/kg/dose (maximum dose 4mg)
ADMISSION	Admit to PED Obs or peds surgery service Call primary care physician Prepare family/infant for admission
Special Considerations	Clinical presentation differs depending on age. Infants: vomiting (85-90%), pain (35-77%), diarrhea (18-46%), fever (40-60%), irritability (35-40%), grunting respirations, cough/rhinitis, R hip complaint (3-23%) PreSchool: abdominal pain (89-100%), vomiting (66-100%), fever (80-87%), anorexia (53-60%) School Age: pain with movement (41-75%), pain with cough (95%), pain with jumping (93%), vomiting (68-95%, nausea (36-90%, anorexia (47-75%)

Clinical Pathway Decision Making Process

Suspected Acute Appendicitis (3-18 years)

September 27, 2010

Place IV
CBC with differential
Urinalysis (HCG if indicated)
Score patient separately on Low Risk and High Risk Criteria

Low Risk Clinical Criteria

Low risk of appendicitis (≤ 5 points)

	Points
ANC > 6750	6
Rebound pain/pain with percussion	2
Unable to walk/walks with limp	1
Nausea	2
Migration of pain to RLQ	1
History of focal RLQ pain	2
Total Points	

Low Risk

1. Admit ED Observation / discharge home
2. PCP f/u <24 hours when discharged

High Risk Clinical Criteria (Alvarado)

High Risk of appendicitis (≥ 7 points)

	Points
History of migration of pain to RLQ	1
Anorexia	1
Nausea/Emesis	1
Tender RLQ	2
Rebound tenderness RLQ	1
Temperature ≥ 37.5	1
CBC >75% Neutrophils	1
WBC >10,000	2
Total Points	

High Risk

1. NPO
2. IV access (if not already obtained)
3. Request ED obs bed or peds surgery bed/call resident
4. As ED volume/acuity allows patient should be kept in ED until called for OR. If needing inpatient admit, patient cannot go to Ward until accepted by peds surgery
5. IV pain medications
6. Consider IV antibiotics per surgery

Scores >5 on Low Risk Scale and <7 on High Risk Scale

Equivocal Clinical Findings

1. NPO
2. IV Access
3. Consult Pediatric Surgery
4. Consider Ultrasound as first diagnostic modality
5. IV pain medication
6. Consider observation

Pediatric Suspected Acute Appendicitis

Goals of Clinical Pathway

1. Create an efficient, timely, team oriented, standardized approach for the evaluation and work up of children with suspected Appendicitis
2. Decrease radiation exposure during diagnostic workup.

Data Considerations	Interventions	Rationale
Diagnosis	Appendicitis is the most common surgical emergency in children. ^{1,2} Symptoms overlap many childhood illnesses making this a challenge to diagnosis. Delayed diagnosis and rupture is associated with increased morbidity, mortality and prolonged hospital stays. Initial misdiagnosis rates range from 28-57% for children age 12 years or younger to 100% to those 2 years or younger ^{2,3,6}	
	CT Scan	Although advances in computed tomography have led to modest improvements in both the negative appendectomy rate and the diagnosis of appendicitis, the risks of increased radiation exposure and potential long term effects from this have resulted in a more discriminating use of this diagnostic tool.
	Ultrasound	While ultrasound eliminates radiation exposure risks, the sensitivity is inferior to that of a CT scan. A study by Sivit at Cleveland's Rainbow Babies and Children's Hospital found "Helical CT had a significantly higher sensitivity (95% versus 78%, $p = 0.009$) and accuracy (94% versus 89%, $p = 0.05$) than graded compression sonography for the diagnosis of appendicitis in children, adolescents, and young adults. The specificity of both techniques was 93%.
	Clinical Assessment	In a large study where patients were randomly divided into clinical assessment (CA) only vs clinical evaluation and CT the results showed "the age and gender distributions were similar in both groups. Accuracy was 90% in the CA group and 92% for CT. Sensitivity was 100% for the CA group and 91% for the CT group. Specificity was 73% for CA and 93% for CT." John J. Hong, Stephen M. Cohn, A. Peter Ekeh, Martin Newman, Moises Salama, Suzanne D. Leblang. Surgical Infections. September 2003, 4(3): 231-239.

The low risk criteria given here are based on a prospective cohort study of 601 children ages 3-18 evaluated for appendicitis in an academic emergency department, of whom 35% had appendicitis. Patients with a score of ≤ 5 based on the rules above had a sensitivity of 96.3% (95% CI: 87.5-99) and negative predictive value of 95.6% (95% CI: 90.8-99). The negative LR was 0.102 (95% CI: 0.026-0.405). Based on these findings, observation or discharge with close follow up without immediate imaging are reasonable strategies. [Kharbanda AB, Taylor GA, Fishman SJ, Bachur RG. A Clinical Decision Rule to Identify Children at Low Risk for Appendicitis. Pediatrics, 2005;116:709-716.]

The Alvarado score is a clinical scoring system used in the diagnosis of appendicitis. The score has six clinical items and two laboratory measurements with a total ten points. The modified Alvarado Score omits the WBC differential for a total of nine points. A validation study of the modified Alvarado score in 118 children of whom 32% had operatively confirmed appendicitis found that a score ≥ 7 had a sensitivity of 76% and specificity of 79%. The score performed better in males than females, with a sensitivity of 80% versus 72% and specificity of 82% versus 76%. Assuming a pre-test probability equivalent to the prevalence in that study (32%), the post test probability of score ≥ 7 would be 63%. While this post-test probability is too low to warrant surgery on its own, it is sufficiently high to warrant further evaluation on an inpatient service. Another validation study using the full Alvarado score of 588 children with a 34% rate of appendicitis reported similar sensitivity, specificity, and positive predictive value of a score ≥ 7 (72%, 81%, and 65%). [Macklin CP, Radcliffe GS, Mere JM, Stringer MD. A Prospective Evaluation Of The Modified Alvarado Score For Acute Appendicitis In Children. Annals of the Royal College of Surgeons of England, 1997; 79: 203-205. Schneider C, Kharbanda AB, Bachur A. Evaluating Appendicitis Scoring Systems using a prospective pediatric cohort. Annals of Emergency Medicine, 2007; 49(6): 778-84.