Non-Operative Management of Acute Uncomplicated Appendicitis

Clinical Pathway

Disclaimer:

This clinical pathway is intended to provide general guidance and should not replace clinical judgment. It is meant to assist licensed practitioners and other health care providers in clinical decision-making by describing a range of generally acceptable approaches to the diagnosis and management of a particular condition. A particular patient's circumstances should always be taken into account when a practitioner is deciding on a course of management.This clinical pathway is current as of the date of publication and will be reviewed periodically to align with any updated best practices or evidence; however, new development may notbe represented in the published version. The treating practitioner assumes all risks associated with care decisions. Phoenix Children's accepts no liability for the content of this clinical pathway or the outcomes a patient might experience where a practitioner consulted the content of this clinical pathway.

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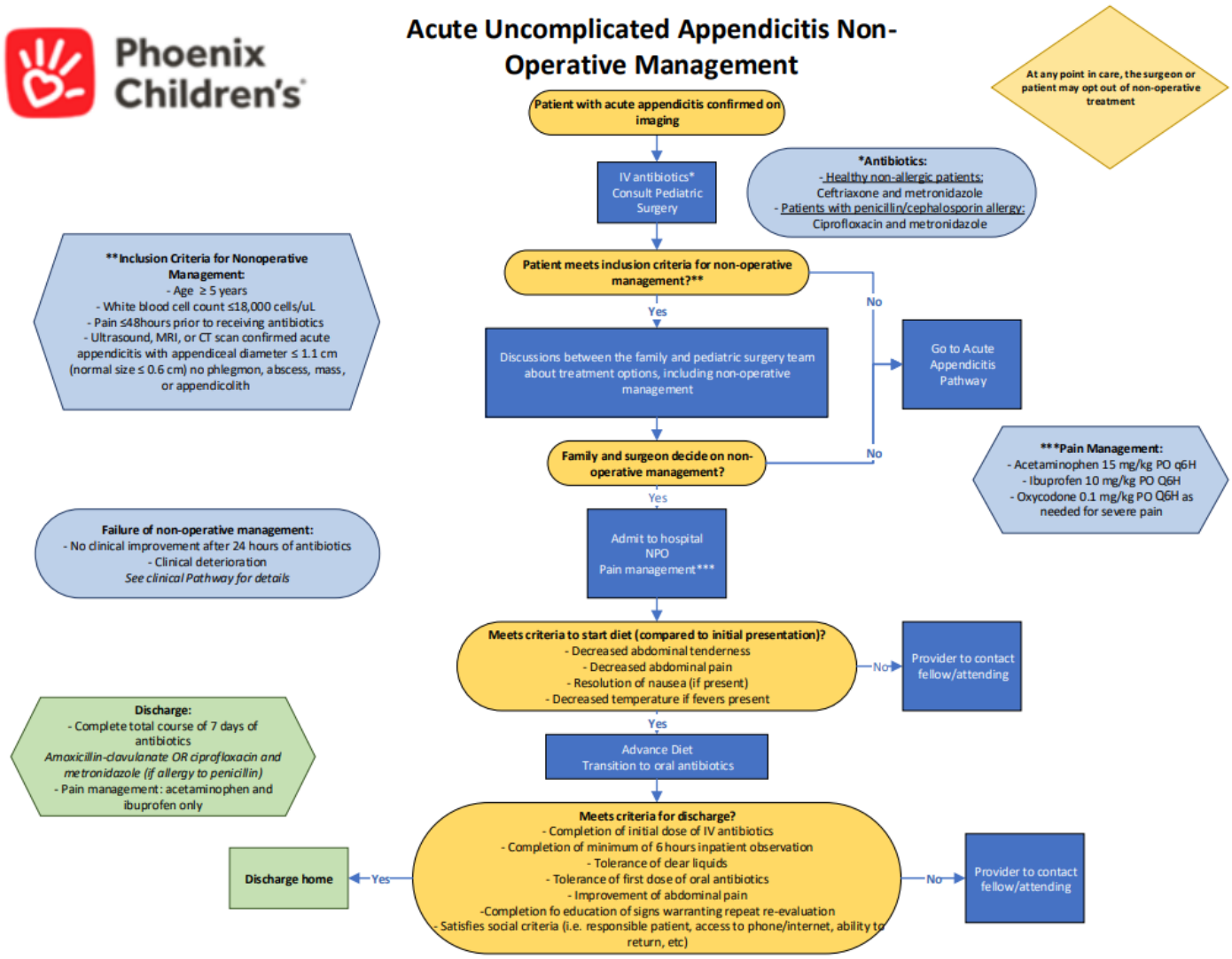
Pathway Flow Diagram/Algorithm



Scope

This clinical pathway is designed to help guide conversations with patients and their families/guardian(s) regarding their treatment options. This pathway addresses what patients meet criteria for nonoperative management of acute uncomplicated appendicitis.

This pathway is also designed to standardize the approach to nonoperative management of acute uncomplicated appendicitis in patients presenting to Phoenix Children's affiliated Emergency Departments who meet criteria

This pathway does not address the management of complicated appendicitis or acute uncomplicated appendicitis that does not meet the criteria below.

Inclusion Criteria:

1) Patients ≥ 5 years old at time of presentation
2) Patients presenting with imaging confirmed acute uncomplicated appendicitis
    a. Imaging (ultrasound, computed tomography (CT) or magnetic resonance imaging) noting an appendix with a diameter ≤ 1.1 cm (normal size ≤ 0.6 cm), no appendiceal mass, appendicolith, phlegmon or abscess
3) White blood cell counts ≤ 18,000 /μL
4) Abdominal pain for ≤ 48 hours prior to the start of antibiotics
5) The treating surgeon physician/surgical service's discretion

Exclusion Criteria:

1) Patients younger than 5 years of age
2) White blood cell counts > 18,000 /μL
3) Imaging (ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI)) noting an appendix with a diameter > 1.1 cm
4) Imaging (ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) noting an appendiceal mass, fecalith, phlegmon or abscess present
5) Positive pregnancy test
6) Diffuse peritonitis on clinical exam
7) History of chronic intermittent abdominal pain
8) Planned open appendectomy
9) Patients with communication difficulties (e.g. severe developmental delay)
10) Compliance concerns for clinical follow-up needed as part of non-operative management

Pathway Goals

- To guide conversations with patients and their families/guardian(s) regarding their treatment options
- To standardize the approach to non-operative management of acute uncomplicated appendicitis in patients presenting to Phoenix Children's affiliated Emergency Departments who meet criteria

Key Clinical Recommendations with Evidence Based Supporting Material

Background:

Research has demonstrated that nonoperative management can be a safe and effective treatment option for select patients with acute uncomplicated appendicitis. This has been shown to be true in both adult and pediatric literature (1-4,6,8-11). Patients who receive nonoperative treatment report higher short-term quality of life scores, require less analgesia and return to normal activities more quickly than those who undergo surgery (7). Furthermore, the

incidence of complicated appendicitis does not significantly differ between those who have an appendectomy and those treated nonoperatively with antibiotics (1). The success rate of nonoperative management, defined as avoidance of surgery within 1 year, ranges from approximately 65% to 80% (1-3,9).

While nonoperative approaches have shown favorable outcomes, specific criteria must be met for eligibility. Prior research has shown that higher pain levels at the time of initial presentation can increase the risk of non-operative treatment failure during hospitalization (5). Other factors that contribute to an increased risk of non-operative treatment failure include the presence of a fecalith, elevated C-reactive protein (CRP) levels, and a maximal appendix diameter greater than 15 mm (12,13). Additionally, incidence of perforated appendicitis has been shown to increase in frequency as the age of patient decreases and duration of symptoms lengthens, as shown in a study specifically evaluating appendicitis in children 5 years of age or less (14).

In summary, nonoperative management of acute uncomplicated appendicitis presents a safe treatment option for pediatric patients who meet specific eligibility criteria.

Pathway

- Once acute **uncomplicated** appendicitis is confirmed on diagnostic imaging (or at the direction of the surgical service) antibiotics are indicated:
    - Healthy non-allergic patients
        - Ceftriaxone and metronidazole
    - Patients with penicillin/cephalosporin allergy
        - Ciprofloxacin and metronidazole
- Discussions with patients and their families/guardian(s) surrounding potential treatment options should include mention of potential non-operative management with antibiotics (if meets above criteria).
    ****A particular patient's circumstances will need to be considered when the surgical team is deciding on an appropriate course of management. Patients and their families/guardian(s) should not be promised one treatment option versus the other. The patient will require evaluation by the pediatric surgery team to further guide discussions and decision-making regarding the appropriate treatment option for that particular patient.*
- Patients will be admitted for observation if decide to pursue non-operative management
- Patients will receive a minimum of 1 dose of IV antibiotics and then transitioned to oral antibiotics (see below) for subsequent antibiotic doses
    - Healthy non-allergic patients
        - Amoxicillin-clavulanate
    - Patients with a penicillin or cephalosporin allergy
        - Ciprofloxacin and Metronidazole
- Diet advanced after clinical improvement is recognized
    - Clinical improvement: decreased abdominal tenderness, decreased abdominal pain, resolution of nausea (if present), decreased temperature if fevers present
- At least 1 dose of PO antibiotics is administered in the hospital to ensure tolerance prior to discharge
- Criteria for discharge include:
    - Completion of initial IV antibiotic dose
    - Completion of a minimum of 6 hours (after IV antibiotic administration) inpatient observation
    - Tolerance of clear liquid diet
    - Tolerance of first dose of oral antibiotics
    - Improvement of abdominal pain
    - Completion of education of signs warranting repeat evaluation
    - Satisfy social criteria (responsible parents, access to phone/internet, ability to return, etc.)

- Patients are discharged home with a prescription for oral antibiotics to complete a total course of 7 days (inclusive of IV antibiotics and PO antibiotics received while inpatient)
- Patients are discharged home with ibuprofen and acetaminophen as needed for pain control
- Should the patient show no clinical improvement after 24 hours of IV antibiotics or show clinical deterioration at any time, continuation of non-operative management versus surgical intervention is deferred to the treating physician/surgical team

Failure of non-operative management:

- No clinical improvement after 24 hours of IV antibiotics
    a. Persistent abdominal pain, abdominal tenderness, nausea or vomiting
    b. Intolerance to diet advancement
    c. Other symptoms/clinical findings deemed lack of clinical improvement by the treating physician/surgical service
- Clinical deterioration
    a. Worsening abdominal pain, abdominal tenderness, nausea or vomiting, increasing tachycardia, hypotension, persistent fever, decreased mental status
    b. Other symptoms/clinical findings deemed clinical deterioration by the treating physician/surgical service

Medication Recommendations

Ceftriaxone

- Recommended pediatric dosing: 50 mg/kg/dose IV every 24 hours
    - Max dosing: 2,000 mg/day
- Do not use if severe or anaphylaxis reaction to penicillin

Metronidazole

- Recommended pediatric IV/PO dosing: 30 mg/kg/dose every 24 hours
    - Max dosing: 1500 mg/dose

Amoxicillin-clavulanate (Augmentin):

- Recommended pediatric PO (suspension) dosing for patient <30 kg: 10-15 mg/kg/dose every 8 hours
    - Make sure to prescribe the suspension with 400 mg of amoxicillin and 57 mg/5mL of clavulanate
    - Max dosing: 500 mg/dose
- Recommended pediatric PO (tablet) dosing for patient >30 kg: 875 mg BID
    - Max dosing: 875 mg/dose
- Side effect: diarrhea

Ciprofloxacin (in combination with metronidazole)

- Use if patient is allergic to penicillin
- Recommended pediatric IV dosing: 10 mg/kg/dose every 12 hours
    - Max dose: 400 mg/dose
- Recommended pediatric PO dosing: 15 mg/kg/dose every 12 hours
    - Max dosing: 500 mg/dose
- Review drug interactions before prescribing if patient on multiple medications

Acetaminophen

- Recommended pediatric dosing: 15 mg/kg/dose every 6 hours
    - Max dosing: 1,000 mg/dose

Ibuprofen

- Recommended pediatric dosing: 10 mg/kg/dose every 6 hours
    - Max dosing: 600 mg/dose

Oxycodone

- Recommended pediatric dosing: 0.05-0.15 mg/kg/dose every 6 hours as needed
    - Max dosing: 5 mg/dose

Admission Criteria

Patients should be admitted to the hospital for observation if they meet the above inclusion criteria.

Discharge Criteria

Criteria for discharge include:

- Completion of initial IV antibiotic dose
- Completion of a minimum of 6 hours inpatient observation
- Tolerance of clear liquid diet
- Tolerance of first dose of oral antibiotics
- Improvement of abdominal pain
- Outpatient pain management with ibuprofen and acetaminophen only
- Completion of education of signs warranting repeat evaluation
- Satisfy social criteria (responsible parents, access to phone/internet, ability to return, etc.)

Patient and Family Education/Discharge Planning

If the patient meets the above discharge criteria:

- **Discharge home with a prescription of oral antibiotics to complete a total course of 7 days (inclusive of IV antibiotics and PO antibiotics received while inpatient)**
    - Healthy non-allergic patients
        - Amoxicillin-clavulanate
    - Patients with a penicillin or cephalosporin allergy
        - Ciprofloxacin and Metronidazole
- **Discharge home with ibuprofen and acetaminophen to take as needed for pain control**
- **Planned follow-up in Pediatric Surgery Clinic in 2 weeks**
- **Instruct to call the pediatric surgery clinic at 602-933-0016 for fever over 101, vomiting, increasing abdominal pain or any questions**

References

1. Minneci PC, Hade EM, Lawrence AE, et al. Association of Nonoperative Management Using Antibiotic Therapy vs Laparoscopic Appendectomy With Treatment Success and Disability Days in Children With Uncomplicated Appendicitis. *JAMA*. 2020;324(6):581-593. doi:10.1001/jama.2020.10888

2. Svensson JF, Patkova B, Almström M, et al. Nonoperative treatment with antibiotics versus surgery for acute nonperforated appendicitis in children: a pilot randomized controlled trial. *Ann Surg*. 2015;261(1):67-71. doi:10.1097/SLA.0000000000000835
3. Tanaka Y, Uchida H, Kawashima H, et al. Long-term outcomes of operative versus nonoperative treatment for uncomplicated appendicitis. *J Pediatr Surg*. 2015;50(11):1893-1897. doi:10.1016/j.jpedsurg.2015.07.008
4. Talan DA, Saltzman DJ, Mower WR, et al. Antibiotics-First Versus Surgery for Appendicitis: A US Pilot Randomized Controlled Trial Allowing Outpatient Antibiotic Management. *Ann Emerg Med*. 2017;70(1):1-11.e9. doi:10.1016/j.annemergmed.2016.08.446
5. Minneci PC, Hade EM, Gil LA, et al. Demographic and Clinical Characteristics Associated With the Failure of Nonoperative Management of Uncomplicated Appendicitis in Children: Secondary Analysis of a Nonrandomized Clinical Trial. *JAMA Netw Open*. 2022;5(5):e229712. Published 2022 May 2. doi:10.1001/jamanetworkopen.2022.9712
6. Tan APP, Yap TL, Cheong YL, et al. Conservative antibiotic treatment of pediatric acute uncomplicated appendicitis during the COVID-19 pandemic: a prospective comparative cohort study. *Pediatr Surg Int*. 2022;39(1):60. Published 2022 Dec 23. doi:10.1007/s00383-022-05344-3
7. Hall NJ, Sherratt FC, Eaton S, et al. Patient-centred outcomes following non-operative treatment or appendicectomy for uncomplicated acute appendicitis in children. *BMJ Paediatr Open*. 2023;7(1):e001673. doi:10.1136/bmjpo-2022-001673
8. Bethell GS, Rees CM, Sutcliffe J, Hall NJ; CASCADE study collaborators. Outcomes 1 year after non-operative management of uncomplicated appendicitis in children: Children with AppendicitiS during the CoronAvirus panDEmic (CASCADE) study. *BJS Open*. 2023;7(3):zrad055. doi:10.1093/bjsopen/zrad055
9. Decker E, Ndzi A, Kenny S, Harwood R. Systematic Review and Meta-analysis to Compare the Short- and Long-term Outcomes of Non-operative Management With Early Operative Management of Simple Appendicitis in Children After the COVID-19 Pandemic. *J Pediatr Surg*. 2024;59(6):1050-1057. doi:10.1016/j.jpedsurg.2023.12.021
10. Nepomuceno H, Pearson EG. Nonoperative management of appendicitis in children. *Transl Gastroenterol Hepatol*. 2021;6:47. Published 2021 Jul 25. doi:10.21037/tgh-20-191
11. Perez Otero S, Metzger JW, Choi BH, et al. It's time to deconstruct treatment-failure: A randomized controlled trial of nonoperative management of uncomplicated pediatric appendicitis with antibiotics alone. *J Pediatr Surg*. 2022;57(1):56-62. doi:10.1016/j.jpedsurg.2021.09.024
12. Kobayashi T, Hidaka E, Koganezawa I, et al. Prediction Model for Failure of Nonoperative Management of Uncomplicated Appendicitis in Adults. *World J Surg*. 2021;45(10):3041-3047. doi:10.1007/s00268-021-06213-1
13. Shindoh J, Niwa H, Kawai K, et al. Predictive factors for negative outcomes in initial non-operative management of suspected appendicitis. *J Gastrointest Surg*. 2010;14(2):309-314. doi:10.1007/s11605-009-1094-1
14. Nance ML, Adamson WT, Hedrick HL. Appendicitis in the young child: a continuing diagnostic challenge. *Pediatr Emerg Care*. 2000;16(3):160-162. doi:10.1097/00006565-200006000-00005

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