Acute Appendicitis Non-Operative Inpatient

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Patient with Acute Appendicitis on Ultrasound or CT

Alert

At any point in care, the surgeon or parent may opt-out of non-operative treatment and proceed to surgery

[IV Ceftriaxone and Flagyl](#)
Admit to Pediatric Surgery

***Inclusion Criteria for Nonoperative Management:**
- Abdominal pain ≤ 48 hours
- Absence of peritonitis on exam
- WBC <18000 and >5000
- Ultrasound or CT results
  - Diameter ≤1.1 cm
  - No appendicolith
  - No evidence of perforation, abscess or phlegmon

Patient meets inclusion criteria* for non-operative management?

No → Go to [Acute Appendicitis-Operative Pathway](#)

Yes

Provider presents non-operative treatment option to family for shared decision-making

Family and surgeon decide for non-operative management?

No → Go to [Acute Appendicitis-Operative Pathway](#)

Yes

- NPO
- Pain Management*

***Pain Management:**
- Acetaminophen 15 mg/kg PO Q6H
- Ibuprofen 10 mg/kg PO Q6H
- Oxycodone 0.1 mg/kg PO Q6H prn severe pain

Re-evaluation at 6 hours after antibiotic administration

Criteria for Failure:
- Increasing abdominal pain (2 points higher on pain scale)
- More diffuse abdominal pain (Spreading of pain to at least one additional quadrant)
- Increased temperature (≥1 F)
- Increased heart rate (≥20 bpm)
- Development of sepsis (Hypotension, altered mental status)

Meets criteria:
- Decreased tenderness
- Decreased pain
- Resolution of nausea
- Resolution of fever

No → Provider to contact fellow/attending

Yes

- Diet: Clears, advance as tolerated
- Monitor for 12 hours after ATBs minimum

No ← Decision for OR?

Yes

Transition to oral Amoxicillin/ Clavulanate

Discharge:
- Complete total course of 7 days of antibiotics
- Pain Management:
  - Acetaminophen 15 mg/kg PO Q6H prn
  - Ibuprofen 10 mg/kg PO Q6H prn
- Educate caregiver on signs warranting return for evaluation
- No activity restrictions
- Phone follow-up in 1-2 weeks

Meets criteria:
- Tolerates diet and oral antibiotics
- No findings of clinical failure

No →
- Make NPO
- Go to [Acute Appendicitis-Operative Pathway](#)

Yes

Discharge to home

Acute Appendicitis Operative Inpatient

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Inclusion Criteria:
- >3 months of age
- No signs of complex appendicitis
- Failed non-operative criteria

Exclusion Criteria:
- Patient eligible for non-operative pathway and decision for non-operative treatment is made

Patient with Acute Appendicitis on Ultrasound or CT scan

- IV Ceftriaxone and Metronidazole
- Maintenance IV fluids
- NPO
- Admit to Pediatric Surgery

Appendectomy with Operative diagnosis of simple appendicitis?

No → Go to **Complex Appendicitis- Operative Pathway**

Yes

- Consider discharge from PACU
- Clear liquid, Advance diet as tolerated
- Pain management
- No post-op antibiotics

Discharge to home once tolerating clears and pain controlled with oral medications

***Inpatient Pain Management:**
- Acetaminophen 15 mg/kg PO Q6H
- Ibuprofen 10 mg/kg PO Q6H
- Oxycodone 0.1 mg/kg PO Q6H prn severe pain
- IV pain medications for breakthrough pain or if not tolerating diet

Discharge Plan:
- No heavy lifting, gym or contacts sports for 2 weeks
- Pain Management:
  - Acetaminophen 15 mg/kg PO Q6H prn
  - Ibuprofen 10 mg/kg PO Q6H prn
  - Oxycodone 0.1 mg/kg PO Q6H prn ONLY if required inpatient
- Phone follow-up in 1-2 weeks

Complex Appendicitis

Operative

Inpatient

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Signs & Symptoms of Sepsis
- Fever
- Tachycardia
- Hypotension
- Oliguric/Anuric
- Severe pain
- Confusion

Diagnosed with complex appendicitis via Ultrasound/CT

- Start IV antibiotic as soon as diagnosis confirmed (Ceftriaxone/Metronidazole)
- Admit to Pediatric Surgery

OR Findings of Complex Appendicitis:
- Hole in appendix
- Diffuse pus
- Abscess
- Fecalith outside the appendix

Meets complex non-operative criteria?

Yes → Go to Complex Non-operative pathway

Non-Operative Criteria:
- >5 days illness
- No signs of bowel obstruction
- No signs of sepsis

No

- OR for Appendectomy
- Continue antibiotics
- Offer diet based on clinical exam

Clinical Improvement by POD #7?

Yes → Repeat CBC prior to discharge once discharge criteria met

No → Obtain Imaging: US

Obtain Imaging: US

Abscess >20 cm^2 and ammenable to drainage?

No → **Off Pathway** 48 hour trial of antibiotics

Yes → IR consult for drainage

- Continue IV antibiotics
- Send abscess culture
- Tailor antibiotics to culture sensitivities

Drain Removal Criteria:
- Afebrile < 100.4F
- Non-purulent drainage
- Non-feculent drainage
- Drain output < 10ml/8h

WBC ≥12000

No →
- Discharge without antibiotics
- Phone follow up in 2-3 weeks

Yes → Prescribe antibiotics (Amoxicillin/Clavulanate or appropriate antibiotic) to complete 7 day course from date of OR

- Discharge
- Phone follow up in 1-2 weeks

Clinical Improvement by Post Procedure Day #7 and meets Drain Removal Criteria?

No → Continue IV antibiotics → Consider repeat imaging → **Off Pathway** Consider ID consult

Yes → Drain removal

- Discharge to home
- *If clinically improved prior to PPD #7 then D/C with antibiotic (Amoxicillin/ Clavulanate) to complete 7 day course from source control
- Follow-up in 2-3 weeks

Complex Appendicitis
Non-Operative
Inpatient

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Diagnosed with complex appendicitis via Ultrasound/CT

- Start IV antibiotics (Ceftriaxone and Metronidazole) as soon as diagnosis confirmed
- Admit to Pediatric Surgery

***Non-Operative Criteria:**
>5 days illness
No signs of SBO
No signs of sepsis

Signs & Symptoms of Sepsis
- Fever
- Tachycardia
- Hypotension
- Oliguric/Anuric
- Severe pain
- Confusion

Discharge Criteria

Drain Removal Criteria:
- Afebrile < 100.4F
- Non purulent
- Non feculent
- Drain output < 10ml/shift

Meets non-operative* criteria?

No → **Go to Complex Operative pathway**

Yes

Abscess >20 cm^2 AND amenable to drainage?

No →
- Continue antibiotics
- Fluid resuscitation
- Monitor for clinical improvement

Clinical improvement by hospital day 7?

No → Reimage with US → **Off Pathway**

Yes → D/C to complete 10 day course of antibiotics from start of antibiotics (Amoxicillin/Clavulanate for home)

Outpatient follow up in 6 weeks to determine need for interval appendectomy.

Yes →
- IR consult for drainage/aspiration
- Obtain body fluid cultures
- Continue antibiotics, tailor to culture results

Clinical improvement and meets drain removal criteria?

No → Consider repeat imaging if no improvement by PPD #7 **and** Continue antibiotics → **Off Pathway**

Yes → Remove drain → D/C to home to complete 7 days of Amoxicillin/Clavulanate or appropriate antibiotics

Differential Diagnoses

- Constipation
- Gastroenteritis
- Inflammatory Bowel Disease
- Meckel's Diverticulitis
- Omental infarction
- Pyelonephritis
- Pelvic Inflammatory Disease
- Tubal Ovarian Abscess
- Ectopic Pregnancy
- Typhlitis
- Ovarian Torsion
- Ruptured ovarian cyst
- Intussusception
- Testicular Torsion
- Mesenteric Adenitis
- Kidney Stones
- Spontaneous bacterial peritonitis
- Pneumonia
- Small bowel Obstruction

Return to Acute Non-Operative Algorithm	Return to Acute Operative Algorithm	Return to Complex Operative Algorithm	Return to Complex Non-Operative Algorithm

Definition & Diagnosis

Topic/condition definition: Appendicitis is defined as inflammation of the appendix (small tubular organ attached to the large intestine), that causes pain in the right lower quadrant of the abdomen. Pain can also be accompanied by nausea, vomiting, anorexia and low grade fevers.

Diagnostic Criteria: Postoperative Diagnosis of Appendicitis or Confirmed Abscess on Imaging

- Preadmit Findings for admission
  - Confirmed CT or US diagnosis of appendicitis (enlarged appendix over 7 mm diameter, wall thickening over 2 mm, peri-appendiceal fat stranding, fluid-filled appendix, or free fluid).
  - Right lower quadrant abdominal pain
  - WBC elevated
  - Confirmation by surgical team (physical exam)

- **Consider other alternate clinical problem or/or diagnosis when:** Signs/Symptoms of sepsis, Bloody stools, Oliguria, Positive Pregnancy Test, Respiratory Distress
- **Differential Diagnosis**

Return to Acute Non-Operative Algorithm	Return to Acute Operative Algorithm	Return to Complex Operative Algorithm	Return to Complex Non-Operative Algorithm

Signs & Symptoms

- Periumbilical pain that migrates to right lower quadrant
- Pain typically precedes other symptoms
- Nausea
- Vomiting
- Fever
- Diarrhea
- Low grade fever
- Rebound tenderness and/or guarding
- Rovsing's sign (right sided pain from left lower abdominal palpation)
- Obturator sign (pain with flexion and internal rotation of right hip)
- Psoas sign (pain with left side down and right hip flexion)
- Markle sign (pain with heel drop)
- Usually affects ages 10-19 years
- Children younger than 3 years have high suspicion for perforation

Types of Appendicitis

- Simple Appendicitis
  - Symptoms less than 48 hours
  - Appendix is not ruptured
  - No abscess noted
  - No fecalith
- Complex Appendicitis
  - Usually symptoms are > 48 hours
  - National Surgical Quality Improvement Program (NSQIP) definition
    - Hole in appendix
    - Diffuse pus
    - Fecalith (calcified stool ball outside of appendix)
    - Abscess

Return to Acute Non-Operative Algorithm | Return to Acute Operative Algorithm | Return to Complex Operative Algorithm | Return to Complex Non-Operative Algorithm

Inclusion & Exclusion Criteria

Inclusion Criteria:

- CT or US confirmed diagnosis of appendicitis
- > 3 months of age

Exclusion Criteria:

- < 3 months of age
- Patient with unconfirmed diagnosis of appendicitis

Admission Criteria:

- All patients with appendicitis will be admitted to Pediatric Surgery

Return to Acute Non-Operative Algorithm	Return to Acute Operative Algorithm	Return to Complex Operative Algorithm	Return to Complex Non-Operative Algorithm

Diagnostic Testing

- Limited Abdominal Ultrasound
- CT of abdomen and pelvis
- MRI may be considered for imaging in place of CT but appendicoliths may not be visualized.

Pre-Op Imaging

- The first choice of imaging for suspected appendicitis should be a limited abdominal ultrasound.
- Ultrasounds are reported out as one of four categories:
  - Appendix is visualized and is negative for appendicitis – CONSIDERED NEGATIVE
  - Appendix not seen in its entirety but no secondary signs to indicate appendicitis – CONSIDERED NEGATIVE
  - Appendix is not seen in its entirety but secondary signs indicate appendicitis – CONSIDERED POSITIVE
  - Appendix is seen and positive for appendicitis – CONSIDERED POSITIVE
- All radiographic findings should be correlated with the history, physical exam and blood work as appropriate.
- A CT scan should be ordered only in cases where the Ultrasound and history/physical/ blood work do not match.
- A CT scan can also be used to determine whether a drainable abscess is present; however, Radiology may drain an abscess based on Ultrasound or MRI findings alone

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Appendicitis Pre-Op Protocol

Pre-Op Antibiotics

- Antibiotics should be started promptly in the ED (Including LCED) after imaging confirms the diagnosis
- Pediatric Surgery will decide if a patient meets non-operative criteria. If the patient does meet criteria, the patient will be given Ceftriaxone/Metronidazole. If the patient is allergic to Cephalosporin or has had difficulty breathing or anaphylaxis to Penicillin, give Ciprofloxacin/Metronidazole.
  - Ceftriaxone and Metronidazole must be given 0-24 hours prior to incision
  - Ciprofloxacin and Piperacillin-Tazobactam must be given 0-6 hours prior to incision
- If a patient goes to the OR without being given antibiotics and there is not enough time for Metronidazole to infuse, the patient will be given Piperacillin-Tazobactam in the OR to expedite surgery. If the patient is found to have complex appendicitis, the patient will be given Ceftriaxone/Metronidazole after surgery.

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Treatment

Operative Treatment

- Laparoscopic Appendectomy
  - Gold standard
- Open Appendectomy

Non-Operative Management

- Antibiotic only treatment for Simple Appendicitis
- Antibiotic treatment with delayed appendectomy
  - May be used for Complex Appendicitis with abscess and/or phlegmon
    - Appendectomy usually 6-8 weeks after treated with drainage and antibiotics
- Interventional Radiology Drainage or Aspiration of Abscess >20 cm^2
  - Consider repeat imaging on POD#7 if patient continues to have abdominal pain, fevers, diarrhea, elevated WBC
    - US should be used primarily
    - CT if recommended by IR or surgical attending

IV Antibiotics

- Ceftriaxone 50 mg/kg q 24 hours (max dose 2000 mg)
- Metronidazole 30 mg/kg q 24 hours (max dose 1000 mg)
- Alternative Dosing for Medication Allergies
- Penicillin Allergy
  - Ciprofloxacin 15 mg/kg/dose q 12 hours (max 400 mg)
  - Metronidazole 30 mg/kg q 24 hours (max dose 1000 mg)
- Metronidazole Allergy
  - Piperacillin-Tazobactam 100 mg/kg/dose q 8 hours (max dose 4000mg)

Oral Antibiotics

- Amoxicillin/ Clavulanate 22.5 mg/kg/dose q 12 hours (max dose 875 mg)
- Alternative Dosing
  - Ciprofloxacin 15 mg/kg/dose q12 hours (max dose 500 mg)
  - Metronidazole 10 mg/kg/dose q 8 hours (max dose 500 mg)

TPN Recommendations

- May order PICC /TPN if pt NPO for > 10 days, not including time pt was NPO preoperatively

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Complications

- Sepsis
- Peritonitis
- Small Bowel Obstruction
- Pleural effusions
- Surgical Site Infection
- Intraabdominal abscess
- Enterocutaneous Fistula
- Clostridium Difficile infection

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Monitoring, Signs of Deterioration & Escalation of Care

Monitoring protocol/process:

- Vitals signs q 4 hours (Temp, HR, RR, BP, and pOx)
- Strict I&Os
- Monitor return of bowel function (+flatus, +stool)
- Monitor diarrhea
- Monitor abdominal distention

Severity Categories/Criteria:

- Red Flags: Sepsis, Respiratory Distress, Bloody stool, Bilious emesis, Postoperative Anemia, Hypotension
- Signs and Symptoms of Sepsis: Fever, Tachycardia, Hypotension, Absent or near absent urine output, Severe pain, and Confusion

Signs of Deterioration:

- Tachycardia
- Increased abdominal pain
- Increased abdominal distention
- Peritonitis
- Anorexia
- Increased WBC (White Blood Cells)
- Increased work of breathing
- Oliguria or Anuric
- Confusion
- Fever

PICU Admission Criteria:

- Hemodynamic instability
- Inability to close abdomen postoperatively
- Respiratory distress or failure
- Sepsis

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Medications

IV antibiotics
- Ceftriaxone 50 mg/kg/day IV every 24 hours (2000 mg max dose)
- Metronidazole 30 mg/kg/day IV every 24 hours (1000 mg max dose)

Alternative Antibiotics if penicillin/cephalosporin allergy
- Ciprofloxacin 10 mg/kg IV every 12 hours (400 mg max)
- Metronidazole 30 mg/kg IV every 24 hours (1000 mg max)

Alternative if Flagyl allergy
- Piperacillin/Tazobactam 100 mg/kg IV every 8 hours (max 4000 mg)

Inpatient Pain Management:
- IV pain medications if not tolerating diet or pain uncontrolled with oral medications
  - Ketorolac 0.5 mg/kg IV (max 30mg) every 6 hours for 12 doses initially (max 20 doses)
  - Acetaminophen IV (Ofirmev) - 15 mg/kg (max 1000 mg) every 6 hours
  - Morphine 0.1 mg/kg every 3 hours as needed for pain (max 4mg, if not effective may prescribe Hydromorphone
  - Hydromorphone (Dilaudid) 0.01-0.015 mg/kg every 2-3 hours as needed for pain
- Transition to oral medications as soon as tolerating a diet
- Acetaminophen 15 mg/kg PO (max 1000 mg) every 6 hours for 48 hours then every 6 hours as needed
- Ibuprofen 10 mg/kg PO (max 600 mg) every 6 hours for 48 hours then every 6 hours as needed
  - Oxycodone 0.1 mg/kg (max 10 mg) PO Q4-6 hours as needed for severe pain

Outpatient Pain Management
- Pain Management:
  - Acetaminophen 15 mg/kg PO Q6H for 48 hours then every 4-6 hours prn
  - Ibuprofen 10 mg/kg PO Q6H for 48 hours then every 6-8 hours prn
- Oxycodone 0.1 mg/kg PO Q6H prn ONLY if required inpatient (limit doses)

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Discharge Criteria & Planning

Floor Discharge Criteria:

- Afebrile (temp < 100.4 F) x 24 hours
- Pain controlled with oral medications
- Tolerating regular diet: must consume 3 meals consecutively of 50% or more of typical appetite as described by caregivers. If a meal is skipped or does not take 50%, the count will restart.
- **Simple appendicitis:**
  - 1 dose of IV antibiotics preoperatively and no antibiotics for home
- **Complex appendicitis, operative:**
  - Continue IV antibiotics until improved clinically or transition to oral prior to discharge. Treatment x 7 days total
  - CBC w/diff: if WBC ≥ 12000 then complete 7 days total, discuss with surgeon if 7 days already completed
  - CBC w/diff: if WBC < 12000 then no antibiotics for home
- **Complex appendicitis with abscess drainage:**
  - Continue IV antibiotics until clinically improved then transition to oral antibiotics. Treatment duration 7 days from last IR drain.
- **Complex appendicitis with phlegmon or abscess not amenable to drainage:**
  - Continue with IV antibiotics until clinically well and then transition to oral antibiotics. Treatment duration 10 days total

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Patient & Caregiver Education

- Helping Hands
  - Appendectomy Simple Appendicitis HH-I-75 (Revised 2022)
  - Appendectomy Complex Appendicitis HH-I-76 3/85 (Revised 2018)
- Footsteps to home after Ruptured Appendicitis – checklist for patients and families provided by unit
- Discharge instruction template

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Metrics

Pathway Goal

- Standardize criteria for post-operative management of complicated appendicitis by reducing unnecessary imaging and procedures, and duration of antibiotics.

Quality Measures

Outcome Metrics

- Reduce the number of complex appendicitis patients undergoing CT scan post-operatively.
- Reduce the number of patients undergoing percutaneous drainage of fluid collections <20 cm^3 in size.
- Reduce the average duration of antibiotics for complex appendicitis post-operatively
- Reduce length of stay

Process Metrics

- Clinical Pathway Utilization

Balancing Metrics

- Readmission rates within 7 days
- Delayed percutaneous drainage or prolonged length of stay for post-op complex appendicitis?

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Pathway Team & Process

Pathway Development Team

Leader(s):

Pediatric Surgery:

Tomara Price, MSN, CPNP – AC/PC
Brian Kenney, MD

Members:

Pediatric Surgery:

Dana Noffsinger, CPNP–AC

Abigail Nelson, CPNP- AC

Sara Mansfield, MD

Interventional Radiology:

Mark Hogan, MD

Pharmacy:

Andrew Sager, PharmD

Infectious Disease:

Jeanette Tavares, MD

Clinical Pathways Program:

Medical Director – Clinical Informatics & Emergency Medicine:

Laura Rust, MD, MPH

Medical Director – Surgery:

Dana Noffsinger, CPNP-AC

Business & Development Manager:

Rekha Voruganti, MBOE, LSSBB

Program Coordinators:

Tahje Brown, MBA

Tara Dinh, BS

Clinical Pathway Approved

Medical Director – Associate Chief Quality Officer, Center for Clinical Excellence:

Ryan Bode, MD, MBOE

Advisory Committee Date: *September, 2023*

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Next Revision Date: *October, 2026*

Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

For more information about our pathways and program please contact:
ClinicalPathways@NationwideChildrens.org

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