

MANAGEMENT OF

Appendicitis

This care process model (CPM) was developed by **Intermountain Healthcare's Surgical Services Clinical Program**. It outlines the components of Intermountain Healthcare's process for management of appendicitis in patients of all ages. The authors used current trends in the peer-reviewed literature as well as the knowledge and opinion of multiple experts across Intermountain Healthcare to create this CPM.



KEY POINTS

This CPM outlines a multi-disciplinary approach to treatment once appendicitis has been diagnosed. It focuses on the operative pathways for the management of ruptured and non-ruptured appendicitis. It also includes options for both the non-operative management of non-ruptured appendicitis and interventional radiology abscess drainage for ruptured appendicitis. In addition, this CPM provides a framework for:

- Pre-surgery treatment and care management
- Discharge criteria and care management
- Post-surgery treatment and care management
- Post-discharge follow-up in clinic

This CPM does not focus on diagnostic pathways nor how to perform an appendectomy.

► Why Focus ON APPENDICITIS?

- **It's common.** Appendicitis is a high-volume disease process, accounting for approximately 3,500 operations at Intermountain facilities in 2014 alone. 
- **It's costly.** In 2014, treatment costs for appendicitis at Intermountain facilities exceeded \$24 million. Cost variations per case can be reduced by using a standardized approach. 
- **Care varies widely.** There is a need to reduce variance in appendicitis care delivered in the Intermountain system.

► GOALS

- Clinical continuity
- Improved outcomes
- Litigation protection for physicians
- Opportunity to study problems where limited information is available

Measurement and Evaluation

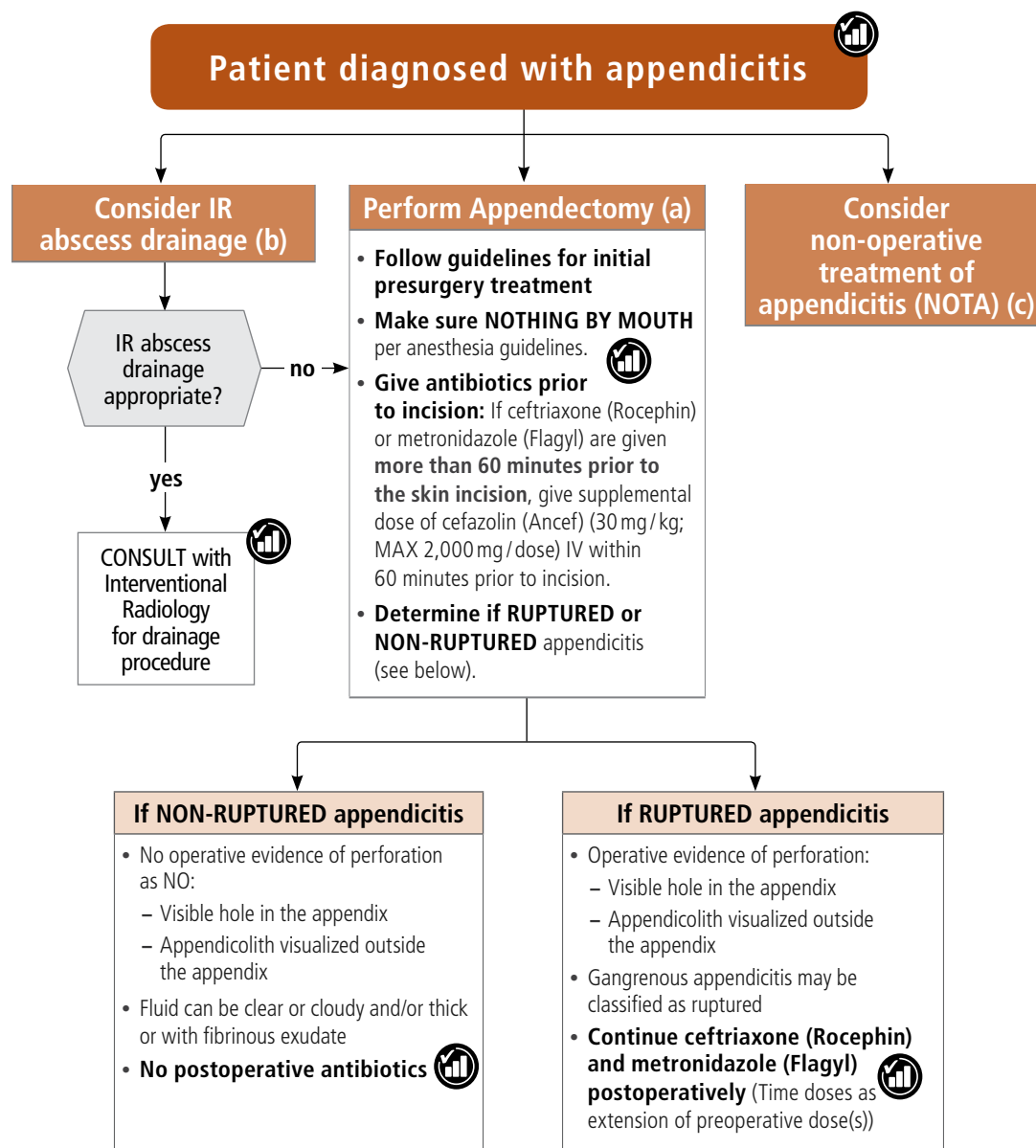
Intermountain is making a deliberate effort in CPM development to recommend and report on measurable outcomes that can be tied to process variations. These will provide a learning feedback loop by which process variations, outcomes results, and new research findings can be used for continuous improvement of the model. Specific outcomes measures in this CPM include:

- Volume
- Length of stay
- Cost
- Readmission within 30 days
- Return to ED within 30 days
- Antibiotic use (none, any, pre-op, post-op within 30 days)
- Use of imaging
- IR procedure within 30 days
- Reoperation within 30 days
- *C. difficile* stool infection rates within 30 days



Indicates an Intermountain measure

► **ALGORITHM: DISPOSITION AND PERIOPERATIVE MANAGEMENT**



ALGORITHM NOTES

(a) Appendectomy: Initial presurgery treatment

- If admitted between 10:00 PM and 6:00 AM, treatment with IV fluids and IV antibiotics, with delay of appendectomy until early the next day is reasonable.
- IV maintenance fluids
 - 3 months to 14 years: D5 0.45% NaCl at maintenance rate
 - 15 years and older: 0.9 NaCl at maintenance rate
- IV bolus fluids (moderate dehydration)
 - Give 0.9% NaCl 20 mL/kg (MAX 500 mL) IV bolus over 20 minutes upon admission.
- IV bolus fluids (severe dehydration)
 - Give 0.9% NaCl 20 mL/kg (MAX 500 mL) IV bolus over 20 minutes upon admission, AND
 - For patients weighing 0 to 30 kg: If urine output is < 1 mL/kg/hr 4 hours after first bolus, give second NS 20 mL/kg (MAX 500 mL) IV bolus over 20 minutes. (Call surgeon if urine output is < 1 mL/kg/hr 4 hours after second bolus completion.)
 - For patients weighing > 30 kg: If urine output is < 30 mL/hr 4 hours after first bolus, give second NS 20 mL/kg (MAX 500 mL) IV bolus over 20 minutes. (Call surgeon if urine output is < 30 mL/hr 4 hours after second bolus completion.)
- Morphine dosing
 - < 40 kg: Give 0.05-0.1 mg/kg IV every 2 hours, as needed (4 mg/dose MAX)
 - ≥ 40 kg: Give 2 to 4 mg IV every 2 hours, as needed (4 mg/dose MAX)
- Antibiotics

The recommendation is to give ceftriaxone (Rocephin) 75 mg/kg IV (max 2,000 mg/dose) once every 24 hours, AND metronidazole (Flagyl) 30 mg/kg IV (max 1,500 mg/dose) once every 24 hours.

For those patients with documented cephalosporin allergy (anaphylactic β-lactam allergies), give ertapenem (INVanz) per the instructions below:

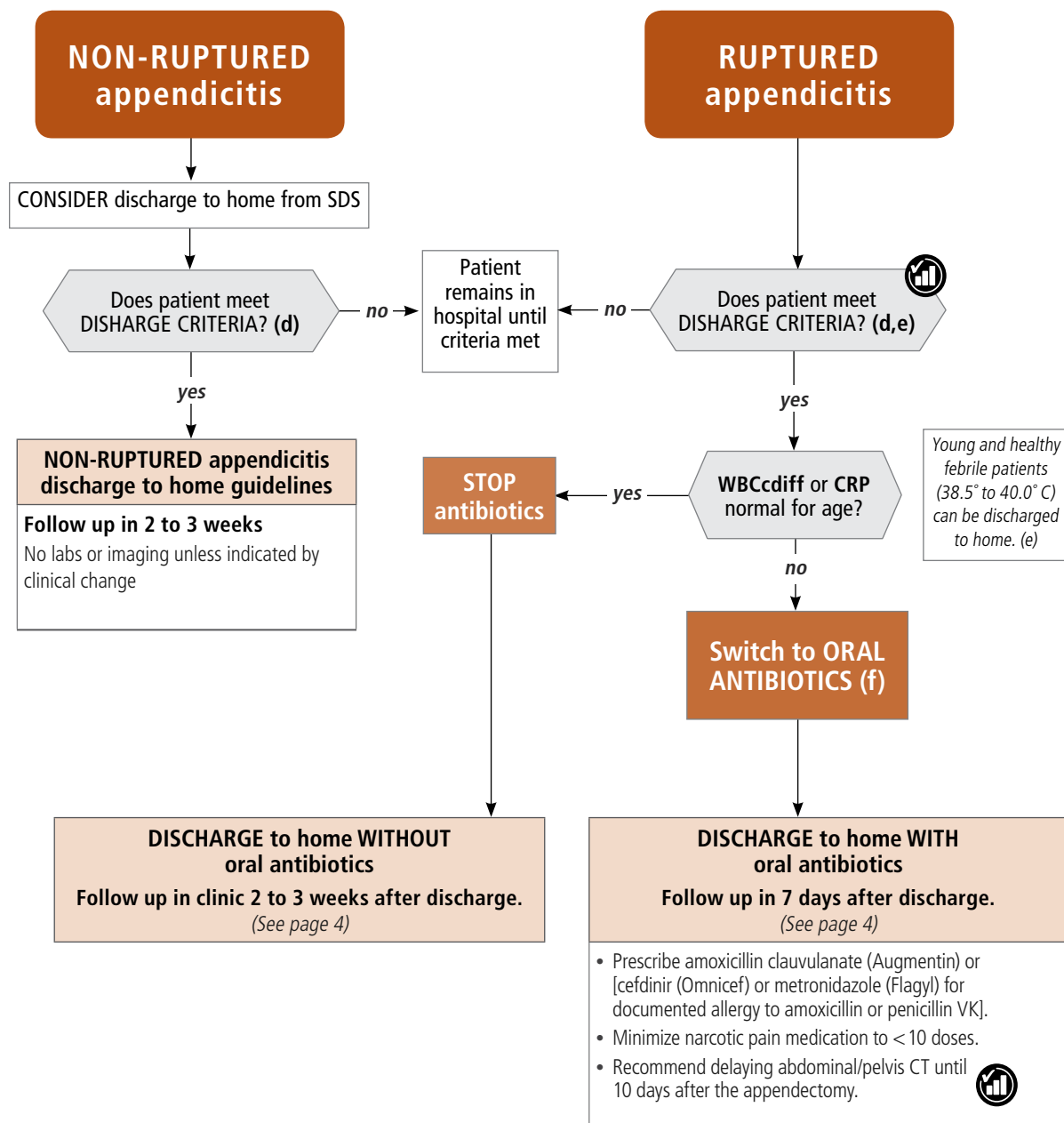
 - 3 months to 12 years: 15 mg/kg IV once every 12 hours (500 mg/dose MAX)
 - ≥ 13 years and older: 30 mg/kg IV once every 24 hours (1 g/dose MAX)
- Tylenol
 - ≥ 40 kg 650 mg PO every 6 hours, as needed for pain
 - < 40 kg: 15 mg/kg every 6 hours, as needed for pain

(b) When to consider IR drainage for patients with > 5 days abdominal pain

- IR abscess drainage, rather than immediate operative management, is appropriate when:
 - The patient is clinically stable.
 - The patient has localized peritonitis.
 - Interventional Radiology feels the abscess(s) is drainable.
 - Patient has ruptured appendicitis with an abscess.
- Consider interval appendectomy > 6 weeks after IR abscess drainage.
- Recommend interval appendectomy in presence of an appendicolith or concern for malignancy.
- Consider use of oral antibiotics at discharge in patients with clinically appropriate response.

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▶ ALGORITHM: POSTOPERATIVE MANAGEMENT AND FOLLOW UP



NOTES

(c) When to Consider NOTA

Consider NOTA in the reliable **NON-PREGNANT** patient with early non-ruptured appendicitis. Inclusion criteria include:

- Symptoms less than 48 hours
- No generalized peritonitis or suspicion of perforation based on imaging or clinical findings
- WBC <18,000, or if ordered, CRP less than 40
- Imaging (ultrasound or CT) shows simple appendicitis:
 - No appendicolith
 - No abscess or free air
 - Appendix diameter <1.5cm
 - No mass or findings suspicious for tumor
- No history of chronic or recurrent abdominal pain

NOTA management must include admission to surgery.

If there is no clinical improvement within 24 hours of starting NOTA, strongly recommend to proceed with appendectomy.

(d) Non-ruptured discharge criteria:

- Normal vital signs for age
- Tolerating oral fluids at greater than the IV maintenance rate
- Tolerating home medications well (including new home pain medication)
- Pain controlled with oral medications

(e) Ruptured discharge criteria: Same as for non-ruptured appendicitis PLUS no fever (< 38.5° C) for 24 hours

Guidelines:

- NO abdominal or pelvic CT until 10 days after the appendectomy as abscess development would not be visible before then.
- NO PICC for antibiotics. Consider PICC for total parenteral nutrition no sooner than 5 days after the appendectomy.
- NO labs until discharge unless mandated by a clinical change.
- NO change in antibiotics without a culture demonstrating resistance or ID consult.

Young and healthy febrile patients 38.5° to 40.0° C who otherwise respond well to treatment are eligible for discharge. These patients do not need a WBC or CRP check to determine need for antibiotics. They can be discharged to home on oral antibiotics.

Clinic follow up is per the guidelines for ruptured appendicitis discharge to home on oral antibiotics.

(f) Switch to oral antibiotics:

Patients must demonstrate ability to tolerate oral antibiotics prior to discharge:

amoxicillin clauvulanate (Augmentin):

- 25 mg/kg PO twice a day (875 mg per dose MAX)
- Prescribe enough to cover until first clinic visit

For patients with severe documented allergies to a penicillin, use:

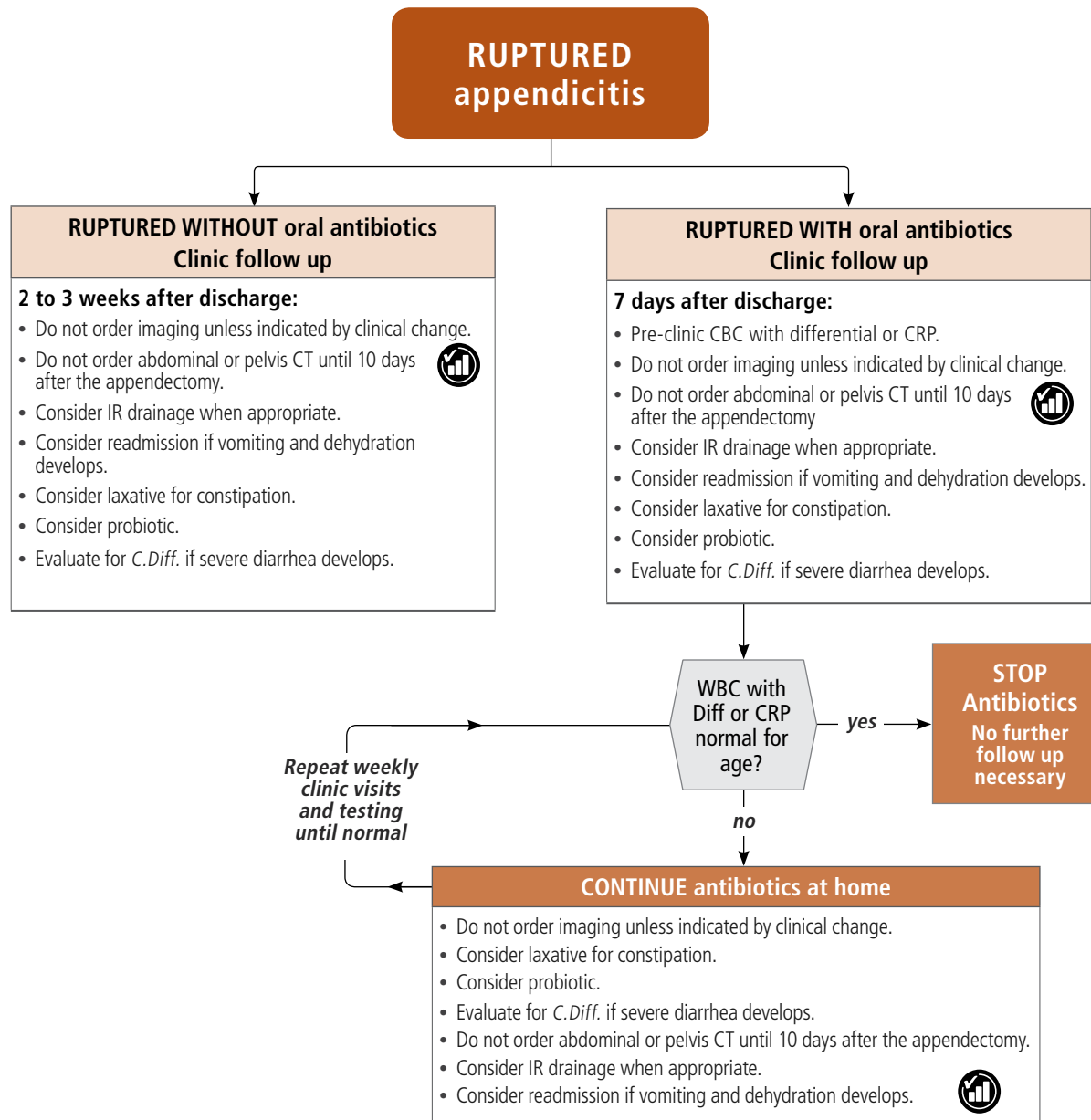
cefdinir (Omnicef):

- 3 months to 12 years: 7 mg/kg PO 2 times a day
- ≥ 13 years: 14 mg/kg PO Daily (MAX 600 mg/day)

metronidazole (Flagyl):

- 3 months to 12 years: 7.5 mg/kg by 4 times a day
- ≥ 13 years: 10 mg/kg PO 3 times a day (MAX 500 mg/dose)

▶ ALGORITHM: POST-DISCHARGE FOLLOW-UP



BIBLIOGRAPHY

The following are the primary references used in the creation of this CPM:

- Chen CY, Chen YC, Pu HN, et al. Bacteriology of acute appendicitis and its implication for the use of prophylactic antibiotics. *Surg Infect.* 2012;13(6):383-390.
- Sallinen V, Akl EA, You JJ, et al. Meta-analysis of antibiotics versus appendectomy for non-perforated acute appendicitis. *Br J Surg.* 2016. doi: 10.1002/bjs. 10147.
- Skarda DE, Schall K, Rollins M, et al. Response-based therapy for ruptured appendicitis reduces resource utilization. *J Pediatr Surg.* 2014;49(12):1726-1729.

A complete bibliography can be found on the Surgical Services document page on intermountain.net/clinicalprograms.

Resources

Additional information concerning antibiotic recommendations for acute appendicitis and order sets can be found in the [Antibiotics for Appendicitis](#) clinical guideline.

CPM Development Team

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This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to David E. Skarda, MD, Medical Director, Surgical Services Clinical Program, Intermountain Healthcare. David.Skarda@imail2.org.