

**The Latest on Non-operative Appendicitis:
An overview and pathway**

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Disclosures and Collaborators

No financial disclosures

Collaborators:

Surgeons

Hospitalists

Frontline workers

Pediatricians

Primary Care Physicians

Emergency Physicians

Parents

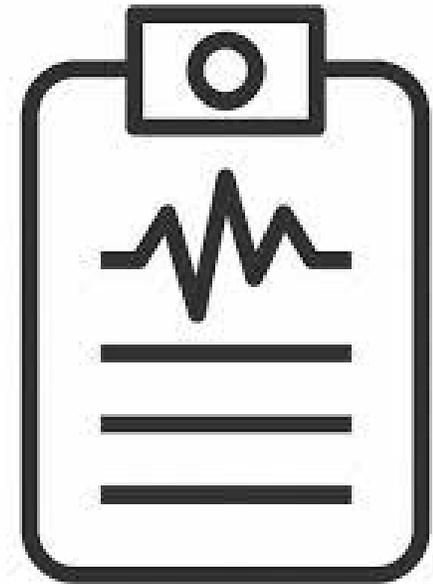


Objectives

Recognize the *clinical presentation of appendicitis* in children and the appropriate work up of symptoms

Adapt to changes in the approach to non-complicated appendicitis, including non-operative treatment

Anticipate needs of patients treated without surgery and *what we can expect* going forward



How common is appendicitis?

Lifetime risk of 8%

Median age 10-11 years old

More males (1.4-1)

11% higher in the Summer



Appendicitis Scoring Models

Pediatric Appendicitis Score

- Clinical and lab values
- May be useful to decide if imaging is needed

Alvarado Score (adolescents and adults)

- Similar scoring
- Again, helps guide imaging and consultation

Most frontline clinicians use *experience*...but this is an area where AI may come to play.

Parameter	Score
Anorexia	1
Nausea/ emesis	1
Fever	1
Migration of pain	1
Tenderness in right lower quadrant	2
Cough/ percussion/ hop tenderness	2
Leucocytosis	1
Neutrophilia	1
Total	10

- Migration of pain: It refers to the migration of pain from the umbilicus to the right lower quadrant.²
- Cough tenderness: Coughing causes increased pain (Dunphy's sign).⁴
- Neutrophilia and Leukocytosis was defined, depending on the age of the child.⁵

All roads lead to imaging

US: first choice

- 85-95% accurate in children
- Only accurate if the appendix is visualized

CT: for equivocal cases (if MRI not used or available)

- 95-98% accurate
- So, if the CT is negative...the patient probably does not have appendicitis

MRI: also highly accurate

- Avoids radiation exposure
- Takes 15 minutes, may require sedation



What is uncomplicated vs complicated?

Is complicated the same as perforated?

Yes!

Complicated cases have:

A longer history of symptoms

Evidence of perforation or severe inflammation

Abscess

Fluid or air around the appendix

Phlegmon

**Bright White spot...an appendicolith...
surrounded by a *phlegmon***



Can we treat complicated/perforated appendicitis without surgery?

Yes, we already do.

Many studies have shown treatment with drainage and antibiotics as a first step is safe.

“Interval appendectomy” is then offered 8 to 12 weeks later

- Can be done as an outpatient
- Can be done laparoscopically
- Some will have ongoing symptoms
 - Another round of antibiotics
 - Earlier interval appendectomy



Why is this even a topic?

Surgery is invasive

- Imaging **got really good**...some findings are very subtle
- Quality of Life measures increasingly being used to assess outcomes
- Patient-reported outcomes and satisfaction now measured
- Healthcare utilization
 - Length of stay
 - Overall cost of care
 - Decrease in appendicitis rates during the pandemic



What are the risks of surgery?

- Infection
 - Surgical site infections
 - Abdominal abscess
- Adhesions
 - Pain
 - Obstruction
- Anesthetic risks
 - Bronchospasm
- Bleeding/hematoma
- Scars from the incisions
- Delayed recovery
- Risk of taking out a normal appendix...the imaging or exam was wrong

Trials of Non-operative Treatment of Appendicitis in Adults and Children

“APPAC Trial” – 73% of adults avoided surgery at one year.

Meta-analysis of multiple studies show recurrence of 20-30% in one year and 35-40% in 3-5 years.

“CODA study” showed 30% of patients treated with antibiotics alone had surgery within 3 months

In *pediatric patients*...a bit more successful (if success is avoiding surgery) – **80% avoid surgery in first year**



When there is another option...

Does proceeding with surgery become a shared decision with the family and patient?

Argument for "Yes"

- Forces families to think about the possible complications of surgery
- If there is a complication, then the decision was made together

Argument for "No"

- What is the buy-in from the team taking care of the patient?
- Since there is no clear answer yet, should the default be the option that is still safe...surgery?



Audience Response

Which of the following statements is **NOT** supported by recent literature?

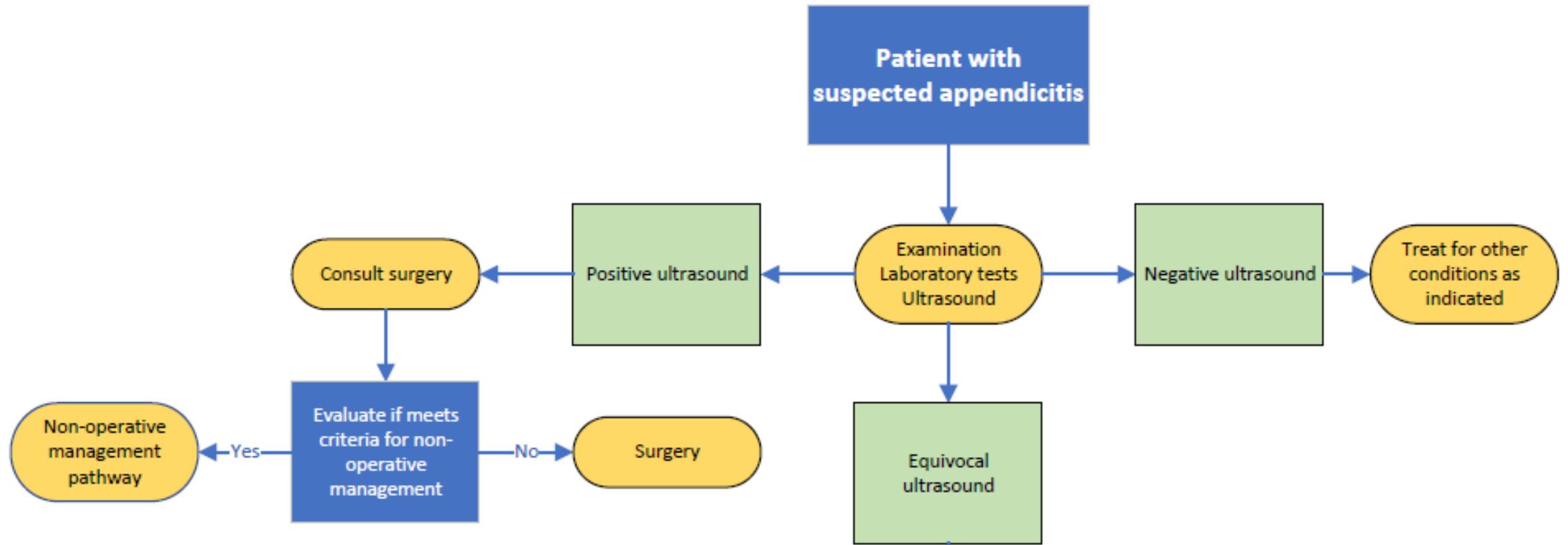
- A. "Treatment of uncomplicated appendicitis with non-operative therapy is considered a failure if the patient has surgery within one year and that happens greater than 50% of the time in children.
- B. "An initial trial of nonoperative management is safe and efficacious, does not increase the risk of complicated appendicitis, and overall is associated with fewer surgical complications, fewer disability days, and lower healthcare costs."
- C. "Small children under the age of 5 years benefit more from surgical treatment of appendicitis since they have a higher rate of perforation, and the trials have not been validated in that age group."



Which of the following statements is NOT supported by recent literature?

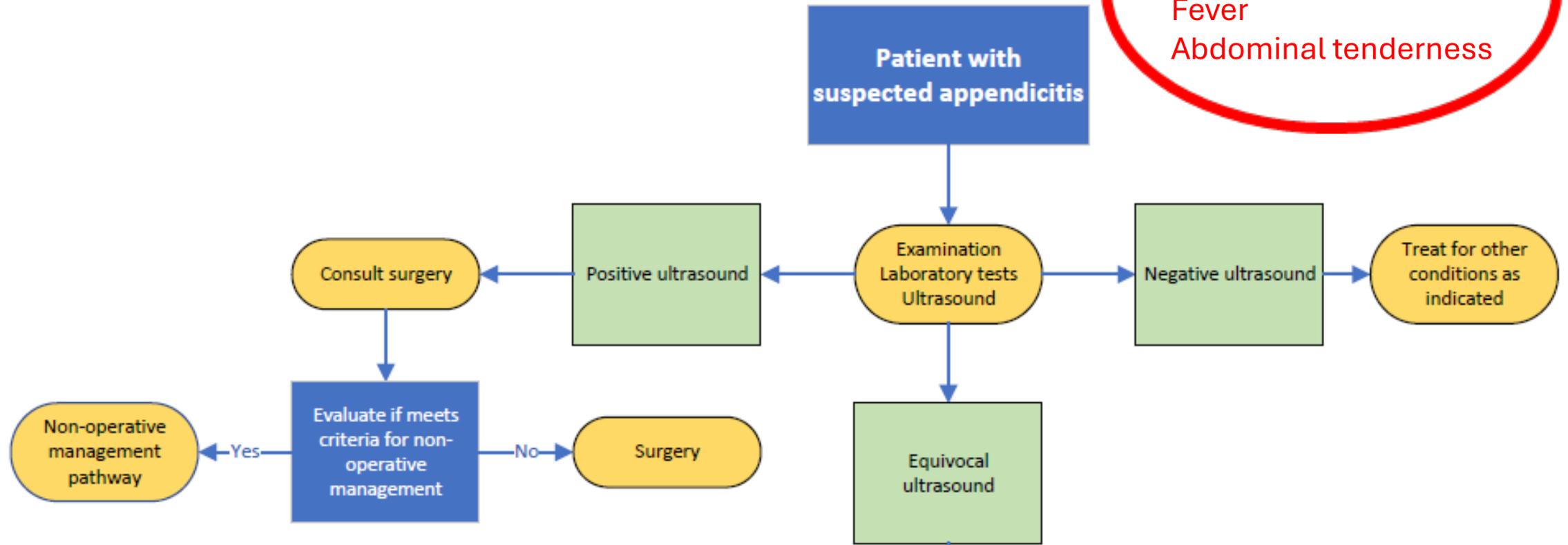
How is non-operative treatment done?

It starts with selection criteria...which patients are good candidates?



How is non-operative treatment done?

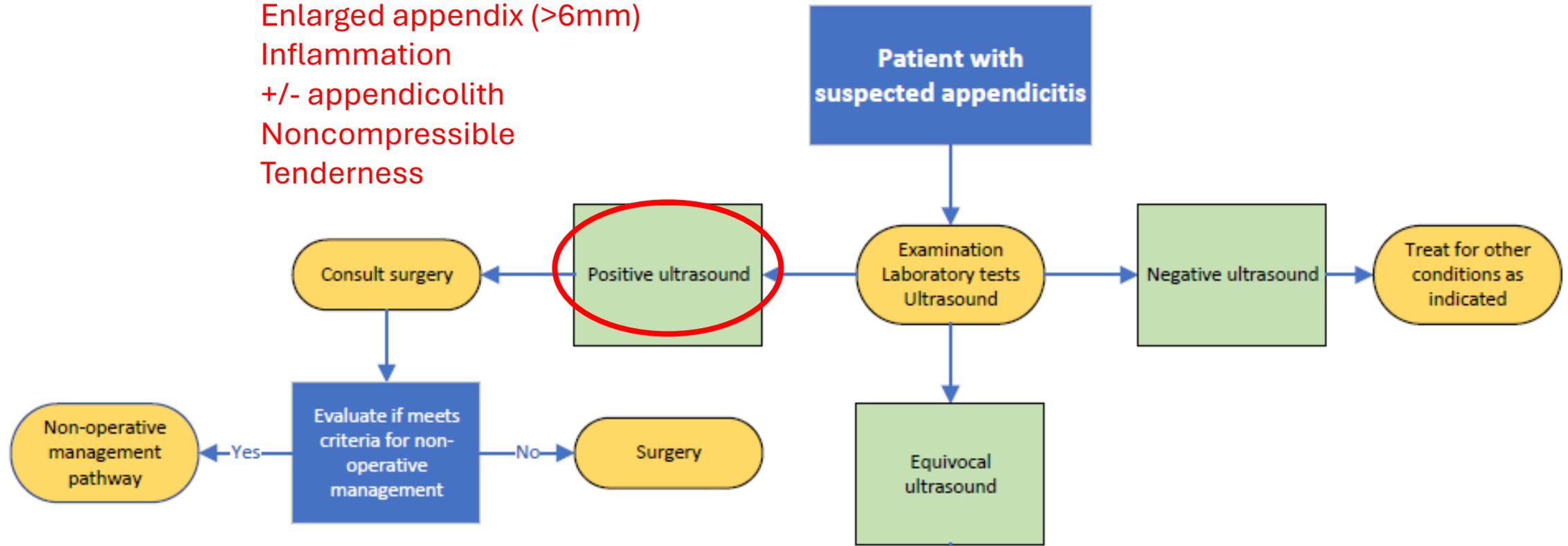
Suspicion of the diagnosis of appendicitis...



How is non-operative treatment done?

Imaging is the next step...

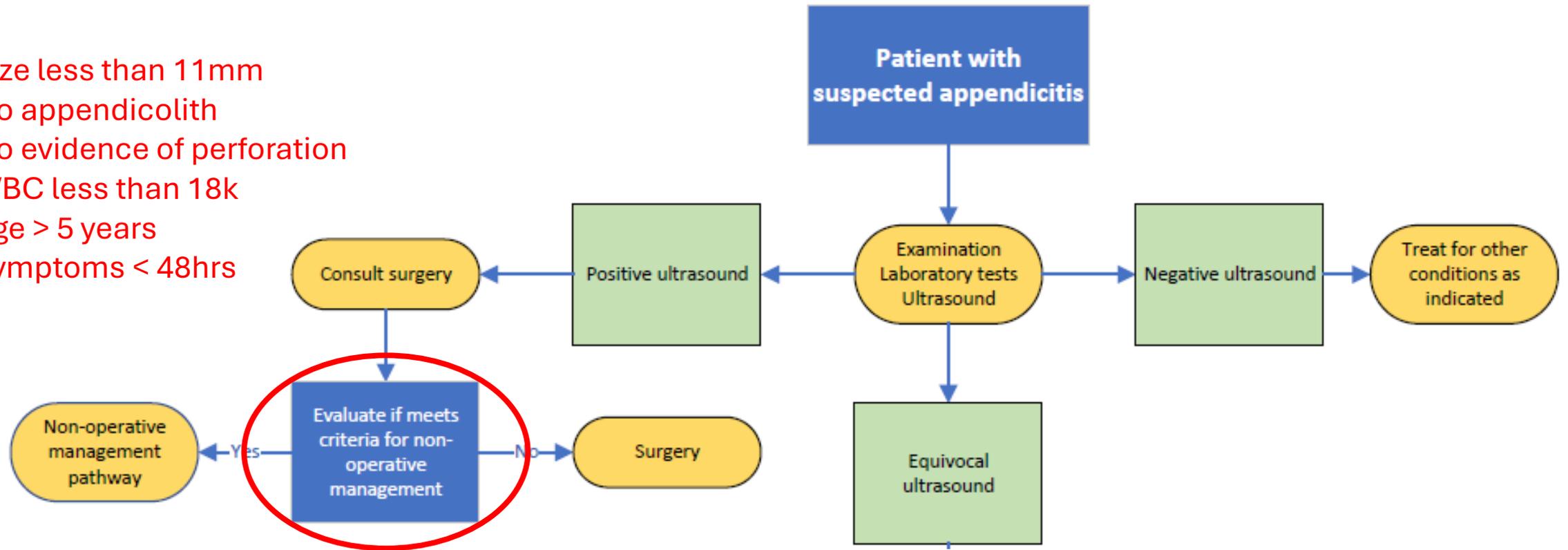
Enlarged appendix (>6mm)
Inflammation
+/- appendicolith
Noncompressible
Tenderness



How is non-operative treatment done?

Non-operative criteria...as of now...

- Size less than 11mm
- No appendicolith
- No evidence of perforation
- WBC less than 18k
- Age > 5 years
- Symptoms < 48hrs



Audience Response

You are called by a parent whose four children are well established in your practice. They were travelling when their 16 y/o daughter developed periumbilical pain that migrated to the RLQ, so they went to the local children's hospital ED. CT revealed appendicitis with an 8mm mildly-inflamed appendix and no evidence of perforation.

The first ED physician said she would undergo surgery. The second ED physician said antibiotics alone was an option. They were admitted and the hospitalist said that both options were possible.

Then a surgeon saw them the next morning and recommended surgery. They tell you they don't know who to trust, so they want your opinion since you diagnosed appendicitis in your office on their oldest child and everything came out well. **What would be the best way to counsel them?**

- A) If she looks great and is hungry, it is ok to choose the antibiotics and see if she improves. Then they can continue their vacation and follow up with you in the office when they return.
- B) Surgery may be a better option since they are out of town.
- C) Surgery is the best option since she will end up getting her appendix out anyway due to a high recurrence rate in children.



**What would be the best way to
counsel them?**

What next???

Talk to the surgeon and the family

If nonoperative treatment is chosen...

- Give Ceftriaxone and Metronidazole (24 hr dosing)
- Start clear liquids and advance diet
- Watch for 6 hours
- If stable or improved...change to Augmentin PO
- Discharge home on 7-day course
- Instruct to return for worsening symptoms
- Follow up with surgeon in 2 weeks



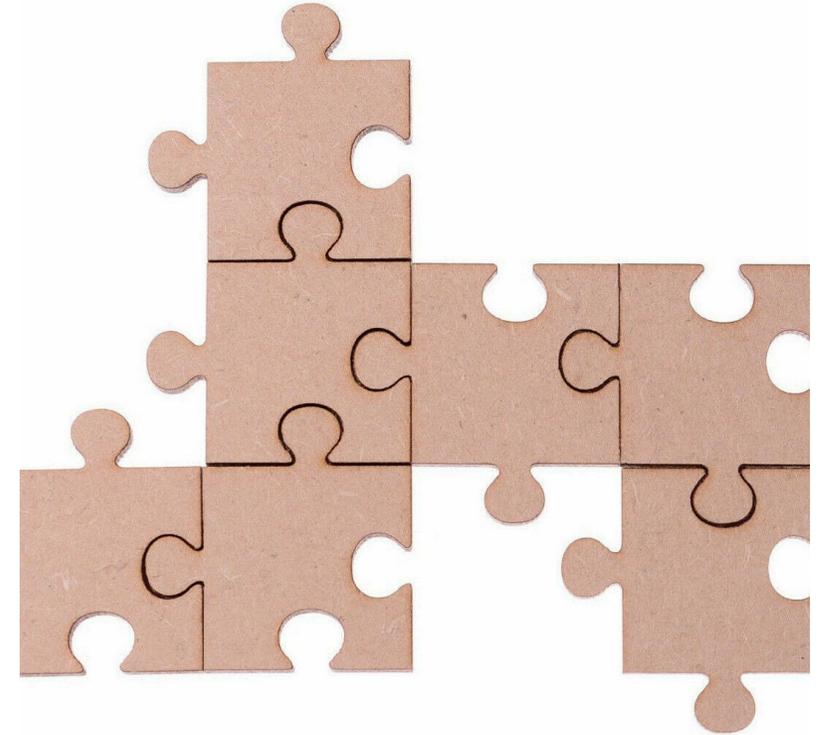
Who is not a candidate?

- Course of symptoms longer than 48 hrs
 - Signs of perforation
 - Appendicolith
 - High WBC
 - Age less than 5 years
-
- Where does the family live?
 - Is the child vomiting?
 - How severe is the pain?



What does it take to provide this care?

- Infrastructure!
- Patient access to advice and 24/7 care
- Proximity to healthcare facility
- Quality imaging
- Ability to perform serial examinations
- OR availability if initial antibiotic treatment not working
- Follow up that is convenient
- Education materials
- Healthcare literacy



How can we tell it's working?

- The patient gets better!
- They can eat!
- The pain improves!

- Did they really have appendicitis?



If it is NOT working, what do we do?

- Is that a treatment failure?
- Not if surgery is part of the rescue treatment when the patient is not improving
- Operating Room should be available, and a plan should be made to proceed after the antibiotic approach is not successful
- Sometimes, families change their minds
 - Crowdsourcing



Audience Response

A 10-year-old child was diagnosed with uncomplicated appendicitis and initially managed non-operatively. The family brings him in two weeks later after he has finished his initial course of antibiotics to see you and ask what you think the next step should be.

SELECT ALL TRUE ANSWERS

- A) Review the course of his diagnosis and treatment and instruct the family to bring him to you to be seen if he develops recurrent symptoms.
- B) Encourage the family to follow up with the surgeon to discuss the pros and cons of elective interval appendectomy.
- C) Instruct the family that if the child develops recurrent symptoms that are severe on a weekend or holiday when your office is not open, they should go back to the original hospital and request repeat workup and surgical therapy if appendicitis is diagnosed a second time.



A 10 y/o child was diagnosed with uncomplicated appendicitis and managed non-operatively. The family brings him in 2 weeks later after he has finished his initial course of antibiotics and ask what you think the next step should be. SELECT ALL THAT APPLY:

Audience Response

An 8-year-old child was diagnosed with uncomplicated appendicitis and initially managed non-operatively. The family brings him in several times over the next two months to your office with persistent or recurrent abdominal pain that doesn't fit the typical course, but the family is fixated on the possibility that this is recurrent appendicitis. How would you counsel this family? **SELECT ALL THAT APPLY**

- A) Get more history and pursue a workup for the chronic abdominal pain.
- B) Consult a surgeon to discuss the indications for an interval appendectomy.
- C) Repeat imaging after each visit to determine if the appendix is acutely inflamed.



**8 y/o child was diagnosed with uncomplicated appendicitis and initially managed non-operatively. The family brings him in several times over the next two months with recurrent abdominal pain... How would you counsel this family?
SELECT ALL THAT APPLY**

References

Nepomuceno H, Pearson EG. Nonoperative management of appendicitis in children. *Transl Gastroenterol Hepatol.* 2021 Jul 25;6:47.

Review

Di Saverio S, et al. The NOTA Study (Non Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. *Ann Surg.* 2014 Jul;260(1):109-17.

14% recurrence rate

Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol.* 1990 Nov;132(5):910-25.

Vons C, et al. Amoxicillin plus clavulanic acid versus appendicectomy for treatment of acute uncomplicated appendicitis: an open-label, non-inferiority, randomised controlled trial. *Lancet.* 2011 May 7;377(9777):1573-9.

26% recurrence rate

Salminen P, Tuominen R, Paajanen H, et al. Five-Year Follow-up of Antibiotic Therapy for Uncomplicated Acute Appendicitis in the APPAC Randomized Clinical Trial. *JAMA.* 2018;320(12):1259–1265.

5-year recurrence rate 39%

References

Di Saverio S, et al. The NOTA Study (Non-Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. *Ann Surg.* 2014 Jul;260(1):109-17.

Long term recurrence rate 14%

CODA Collaborative; Flum DR, et al. A Randomized Trial Comparing Antibiotics with Appendectomy for Appendicitis. *N Engl J Med.* 2020 Nov 12;383(20):1907-1919.

Randomized PCORI trial; antibiotics inferior; half of the antibiotics only patients were treated at home

de Almeida Leite RM, Seo DJ, Gomez-Eslava B, et al. Nonoperative vs Operative Management of Uncomplicated Acute Appendicitis: A Systematic Review and Meta-analysis. *JAMA Surg.* 2022;157(9):828–834.

18% recurrence rate leading to surgical appendectomy

O'Leary DP, et al. A Randomized Clinical Trial Evaluating the Efficacy and Quality of Life of Antibiotic-only Treatment of Acute Uncomplicated Appendicitis: Results of the COMMA Trial. *Ann Surg.* 2021 Aug 1;274(2):240-247.

Recommended surgery due to inferior QOL and high recurrence rate

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Minneci PC, et al. Effects of a Patient Activation Tool on Decision Making Between Surgery and Nonoperative Management for Pediatric Appendicitis: A Randomized Clinical Trial. JAMA Netw Open. 2019 Jun 5;2(6)

Minneci PC, et al. Effectiveness of Patient Choice in Nonoperative vs Surgical Management of Pediatric Uncomplicated Acute Appendicitis. JAMA Surg. 2016 May 1;151(5):408-15.

These are the criteria we use at Phoenix Children's
76% success rate at 1 year

Minneci PC, Hade EM, Lawrence AE, Saito JM, Mak GZ, Hirschl RB, Gadepalli S, Helmrath MA, Leys CM, Sato TT, Lal DR, Landman MP, Kabre R, Fallat ME, Fischer BA, Cooper JN, Deans KJ; Midwest Pediatric Surgery Consortium. Multi-institutional trial of non-operative management and surgery for uncomplicated appendicitis in children: Design and rationale. Contemp Clin Trials. 2019 Aug;83:10-17.

Trial is underway

Svensson JF, et al. Nonoperative treatment with antibiotics versus surgery for acute nonperforated appendicitis in children: a pilot randomized controlled trial. Ann Surg. 2015 Jan;261(1):67-71.

62% avoided appendectomy at 1 year; low recurrence rate

Tanaka Y, et al. Long-term outcomes of operative versus nonoperative treatment for uncomplicated appendicitis. J Pediatr Surg. 2015 Nov;50(11):1893-7.

28% recurrence rate

Satisfaction higher in operative group; families were asked to choose

Thank you! – Always available for questions

Kathleen van Leeuwen

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