Non-Operative Management of Acute Appendicitis, Part 2

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Nonoperative management (NOM) may be a cost-saving alternative to surgery, but multiple issues surround its use in treating appendicitis, particularly in pediatric patients. The decision to nonoperatively treat the patient is one that must take into consideration the consequences of recurrence and if the better clinical choice is to operate. Before delving further into the subject, a review of the terminology that was presented in "Review of the Appendix and Appendicitis, Part 1," published in March 2026, is appropriate as well as brief reminder of the importance of exploring alternatives to surgery.

The general term that refers to sudden appendicitis is acute appendicitis. It includes the subcategories of complicated appendicitis and uncomplicated appendicitis. A patient diagnosed with complicated appendicitis presents with an abscess, appendiceal rupture, and inflamed mass (phlegmon). Uncomplicated appendicitis, also referred to as acute uncomplicated appendicitis, is characterized by an inflamed appendix without signs of necrosis or rupture. The diagnostic features of these two types of appendicitis must be remembered as they are key to understanding the clinical decision to perform or not to perform surgery.

Appendicitis is the most common surgical diagnosis in children, with an estimated 83 cases per 100,000 children in the US on an annual basis.[1] It is the fifth most common reason for admission to the hospital for children in the US.[2] Children are at a higher risk for perforation as compared to adults, with approximately 30% of pediatric patients admitted to the hospital having experienced perforation.[3]

In 2018, within the age group of 0 – 17, appendectomy was one of the five most costly procedures. The national costs of hospital stays for the procedure in the US were $298 million for men and $194 million for women,

LEARNING OBJECTIVES

- Discuss the factors that must be considered in the decision-making process of nonoperative versus operative management of uncomplicated acute appendicitis
- Review the details of recent studies comparing antibiotic treatment to surgery
- Learn about the advantages of nonoperative treatment versus surgery
- Identify the clinical criteria and contraindications used to determine pediatric patient eligibility for nonoperative management of uncomplicated appendicitis
- Describe the potential risks, recurrence patterns, and long-term outcomes associated with antibiotic-only treatment for uncomplicated appendicitis

KEYWORDS
acute appendicitis, complicated appendicitis, nonoperative management, uncomplicated appendicitis

DEFINITIONS
Appendicolith: A calcified mass that forms inside the appendix. It primarily consists of calcium salts and fecal material. The mass can vary in size. The mass can obstruct the appendix, causing inflammation and resulting appendicitis.

accounting for 23,800 days in the hospital.[4] As evidenced later in the article, controlling costs is one of the motivations for NOM.

RESULTS OF STUDIES

Clinical trials have been conducted for several years to determine the efficacy of NOM, meaning the administration of antibiotics and IV fluid hydration only, in the treatment of uncomplicated appendicitis. A primary issue of this treatment approach has been the recurrence of appendicitis within a short period of time raising the concern if surgery should have been performed in the first place. The following are brief summaries of key studies to highlight the uncertainty within the surgical community regarding balancing what is best for both the patient and contributing towards the control of medical costs.

The results of a study published in 1995 showed that antibiotic treatment in patients with uncomplicated appendicitis was as effective as surgery. Forty patients with abdominal pain of less than 72 hours were divided into two groups of 20.[5] One group underwent surgery, and the second group received antibiotics intravenously (IV) for two days followed by treatment for another eight days.[5] The patients that received antibiotics had a high recurrence rate.

In a study published in 2009, 106 patients were placed in the antibiotics group and 154 underwent an appendectomy.[6] The treatment efficacy for the antibiotic group was 90.8%.[6] Recurrent appendicitis occurred in one-third of the group within ten days and two-thirds between three and 16 months.[6] Major complications, however, were much higher in patients who initially underwent an appendectomy. The conclusion of the research team was that antibiotic treatment "appears to be a safe first-line therapy."[6]

A trial comparing appendectomy to antibiotic therapy in which patients completed a 10-day course of antibiotics was conducted at 25 US centers.[7] The total number of adults included in the study was 1,552 with 414 of those presenting with an appendicolith. The group was evenly divided with 776 that received antibiotics and 776 that underwent an appendectomy. In the antibiotics group, 29% underwent an appendectomy within 90 days.[7] Of that percentage, 41% had an appendicolith and 25% without an appendicolith.[7] Complications were more common in the antibiotic group, but this was attributed to the high percentage of patients with an appendicolith. The researchers concluded, however, that antibiotic treatment was noninferior to appendectomy.[7]

A study published in 2021 was conducted at 97 hospitals in the United Kingdom and Republic of Ireland. The aim of the study included 90-day follow-up of patients.[8] A total of 3,420 patients were included in the study with 1,402 (41%) that were treated with antibiotics and 2,018 (59%) that underwent an appendectomy.[8] At the 90-day follow-up mark, 1,116 patients (80%) of the 1,402 were successfully treated with antibiotics.[8] The researchers also noted the antibiotic group had fewer complications and a shorter length of stay in the hospital. The cost of treating patients with antibiotics was lower by $1,387.48 ($1,665.40 in 2026 accounting for inflation) per patient.[8] The researchers concluded that antibiotics is an alternative first-line treatment and can lead to reduced costs.

> "The question, based on the research, obviously becomes to operate or not to operate."

Another study published in 2021 involved 186 patients who were randomly placed into the antibiotic-group only and the surgery group. Based on the results of the clinical trial the researchers commented, "Patients with acute,

uncomplicated appendicitis treated with antibiotics only experience high recurrence rates and an inferior quality of life. Surgery should remain the mainstay of treatment for this commonly encountered acute surgical condition."[9]

One of the most recent studies was published in 2025 in the *Journal of the American College of Surgeons*. The analysis of data involved 1,068 patients, age 7 – 17, with uncomplicated appendicitis. The study population comprised 370 that received antibiotic treatment and 698 that underwent laparoscopic appendectomy. The data showed that the antibiotics-only patients had less pain and fewer days away from school during the first year after the initial hospital visit.[10] In 2023 dollars, the average cost of a laparoscopic procedure was $9,791, and the cost per patient for NOM was $8,044.[10] The researchers concluded the cost analysis shows that NOM of uncomplicated appendicitis is a cost-effective patient management strategy over one year when compared to surgery.[10]

Two other studies showed that medical costs were much higher. One study showed a higher cost of $1,067 per patient when surgically treating uncomplicated appendicitis.[11,12] The landmark Finnish trial, Appendicitis Acuta (APPAC), conducted from 2009 to 2021, showed the costs for performing surgery were 1.6 and 1.4 time higher in patient follow-ups at 1- and 5-years, respectively.[13]

DISCUSSION

The question, based on the research, obviously becomes to operate or not to operate. The number of extensive studies has generated a mix of contradictory results and conclusions as evidenced by the summaries of clinical studies in the previous section. Although there are studies whose results show the option of using antibiotics alone is a feasible treatment option, clinicians should most likely exercise caution when considering NOM.

Regardless of the advancements that have been made in treating uncomplicated appendicitis with antibiotics, appendectomy has been the primary treatment for more than 120 years.[7,14-16] Though large clinical trials have shown that while NOM might have comparable or better results in the short term, as many as 25% to 40% of antibiotics-only patients wind up requiring an appendectomy within a year.[7,14,16] Other studies have also indicated that 46% of patients underwent an appendectomy at 2 years and increased to 49% at 3 and 4 years.[14] Additionally, for those patients who have a poor clinical response to NOM or experience worsening symptoms or recurrence, the only option is surgery.[17] On the positive side, NOM may be an advantageous treatment for patients situated in a remote medical care environment or locations where resources are scarce, such as U.S. Navy personnel assigned to a submarine.[14,18] Evidence has suggested that antibiotics have been effective in resolving or delaying surgery for individuals in that type of situation or similar if the appendicitis is identified prior to late-stage inflammation.[19,20]

NOM may be considered for selected children who meet specific criteria. The inclusion criteria include[21]:

- being older than 7 years of age,
- a white blood cell count between 5,000 and 18,000 (see Part 1 article published in March 2026 for further information regarding normal leukocyte counts),
- symptoms have been occurring for less than 48 hours,
- imaging results confirm nonperforated appendicitis (see Part 1 for further information regarding methods of imaging for diagnosing appendicitis),
- an appendiceal diameter of less than 1.1 centimeter, and
- the absence of abscess, appendicolith, or phlegmon.

The criteria that are particularly predictive of NOM failure are prolonged symptoms and presence of abscess or an appendicolith.[21] Children whose symptoms fail to improve including persistent pain, fever, or are incapable of tolerating a normal diet should undergo an urgent appendectomy.

Patients that opt for NOM should be advised as to the potential for the progression of the symptoms of appendicitis despite the treatment with antibiotics, the chance of appendicitis reoccurring, and, in rare instances, missed neoplasms of the appendix (see Part 1 article published in March 2026 for further information regarding neoplasms). Furthermore, NOM is contraindicated in immunocompromised patients, pregnant patients, patients with a hemodynamic instability, patients undergoing chemotherapy, and patients with a history of inflammatory bowel disease.[14,17] Based upon the novel approach of NOM, the importance of shared decision-making between the physician and the patient cannot be overemphasized, including patient-centered decision-making to ensure that the appendicitis is identified as uncomplicated, which occurs in approximately 60% to 70% of cases, versus complicated.[14]

NOM involves extensive fluid hydration and the administration of the proper antibiotic therapy, either orally or IV.[17] The treatment generally includes 1 to 2 days of IV antibiotics, followed by the patient taking oral antibiotics for 7- to 10-days as long as the clinical symptoms improve.[21] When a patient is treated by NOM, the treatment involves a combination of antibiotics to eliminate aerobic and anaerobic bacteria.[22,23] A third-generation cephalosporin, such as cefo-

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taxime, or a beta-lactam, such as ampicillin, provides coverage for aerobic gram-negative bacteria.[22] Clindamycin or metronidazole provide coverage for anaerobic bacteria.[22] The decision, however, on the choice of antibiotics will be based on the patient's circumstances including allergies and experience with previous antibiotic administration.

The discussion of cost is another gray area. As presented in the previous section, some studies have shown that NOM may be less expensive as compared to surgery. Other clinicians, however, argue that appendectomy, in the long run, is least expensive for the following reasons:

- Appendectomy has an evidence-based history of a high level of success and efficacy. In other words, it has a low failure rate. Whereas, NOM, being a novel method of treating uncomplicated appendicitis, does not have documented long-term results.
- Other costs should be taken into consideration when treating a patient with antibiotics only, including clinical personnel and the length of patient follow-up that is required for NOM.[14]
- The combined costs also need to be considered. If a patient immediately undergoes an appendectomy, they are paying only for the surgery. Patients that opt for NOM, however, are paying for the costs of that treatment with the strong possibility of then having to pay for surgery in 1 – 5 years.

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1. **NOM can be effective for patients situated in a remote location who have late-stage inflammation.**
   a. True
   b. False

2. **Which of the following is a contraindication for NOM?**
   a. Patients who underwent previous abdominal surgery
   b. Patients with temperatures above 101 degrees
   c. Dehydrated patient
   d. Pregnant patient

3. **Which of the following medical terms refers to an inflamed mass?**
   a. Appendicolith
   b. Calcinosis
   c. Phlegmon
   d. Ossificans

4. **Which of the following is a false statement regarding NOM inclusion criteria for children?**
   a. WBC of 5,000 – 18,000
   b. < 1.1-centimeter appendiceal diameter
   c. Older than 7 years of age
   d. Symptoms have occurred for less than 72 hours

5. **Which of the following antibiotics are effective against anaerobic bacteria?**
   a. Clindamycin
   b. Ampicillin
   c. Cefotaxime
   d. Aminoglycosides

6. **Multiple studies have shown a significantly lower cost associated in treating patients with antibiotics alone as compared to surgery.**
   a. True
   b. False

7. **How many days will the patient take oral antibiotics after completing the course of IV antibiotics?**
   a. 4 – 7
   b. 5 – 8
   c. 6 – 9
   d. 7 – 10

8. **What is the estimated number of appendicitis cases per 100,000 children per year?**
   a. 83
   b. 73
   c. 63
   d. 53

9. **What percentage of cases are uncomplicated?**
   a. 50% - 60%
   b. 55% - 65%
   c. 60% - 70%
   d. 65% - 75%

10. **What is the estimated percentage of patients that are treated with antibiotics only who undergo an appendectomy within a year?**
    a. 25% - 40%
    b. 30% - 45%
    c. 35% - 50%
    d. 40% - 55%

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