

Appendicitis

I. Background & Significance:

Appendicitis is one of the most common acquired surgical conditions of childhood. Diagnosis of appendicitis remains difficult. Much work has been done on validation of clinical scores to reduce the number of unnecessary surgeries and radiographic tests while maintaining a high sensitivity for disease. However, no score performs well enough in practice to reduce these risks (Kulik et al., 2013). It is also known that appendicitis has a familial predominance, but little is known about the genetic factors that may increase a certain child's risk for the condition (Oldmeadow et al., 2009). While clearly environmental factors explain much of acquired appendicitis, the delineation of biological factors may explain why certain patients exhibit disease, and give much more insight into the biological foundations of this illness. Unfortunately, most children presenting with appendicitis have not been referred for genetic testing unless other signs of a genetic disorder such as developmental delay or dysmorphic features are present. As a result, biologic causes of childhood appendicitis often go unrecognized, although some early work has shown that at least some biological markers exist (Muenzer et al., 2010). The addition of genetic testing results either for pre-test probability or biologic cause driven by a known genetic locus to a well standardized clinical score may make the diagnosis of appendicitis much more sensitive for the front line clinicians, therefore reducing risk for patients without the condition, and streamlining medical care for those who do.

II. Algorithm Definitions

a. Overview

- Case 1 : pathology report positive for appendicitis
- Case 2 : no pathology report, treatment is either interventional radiology or systemic antibiotics
- Case 3 : Reported history of appendicitis/appendectomy, without history of incidental appendectomy

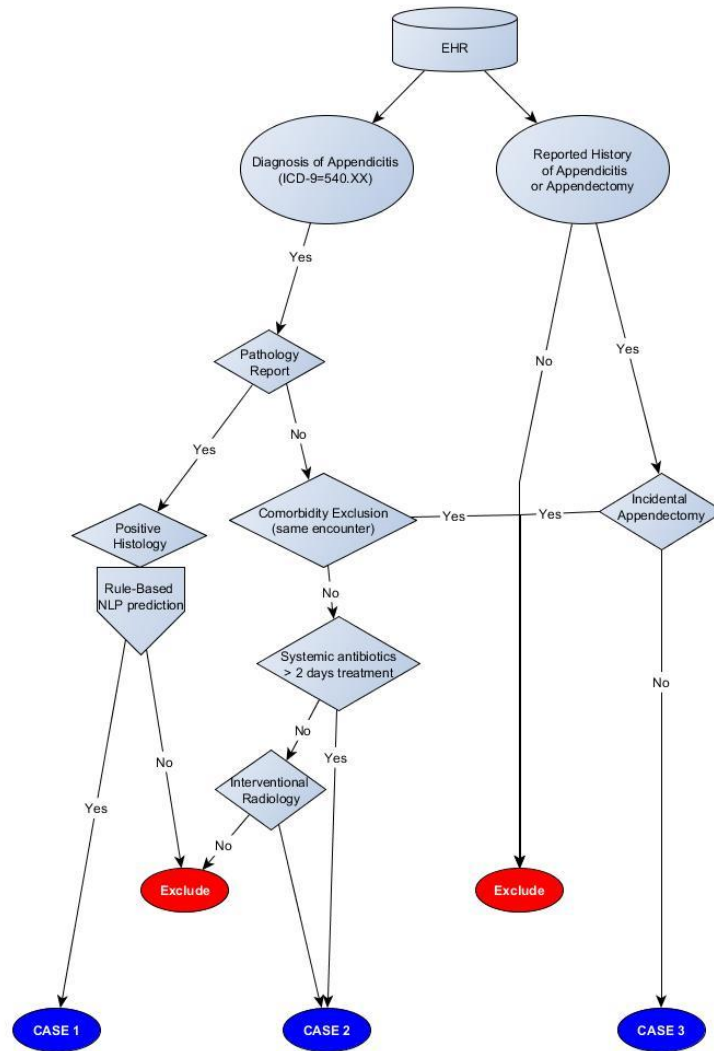


Figure 1: Algorithm Flowchart

1. CASE

1. Diagnoses of appendicitis (ICD-9=540.XX)
YES->2, NO->7
2. Presence of a Pathology Report
YES->4, NO->3
3. Presence of a Comorbidity in same encounter (see Table 1)
YES->EXCLUDE, NO->5
4. Positive result of post-surgical biopsy report (SNOMED-CT CUI rules, see Figure 2, Table 4)
YES->CASE, NO->EXCLUDE
5. Systemic antibiotics (>2days treatment, starting on encounter of diagnosis(step 1), see Table 3)
YES->CASE, NO->6

6. Interventional Radiology¹ (CPT code, see Table 2)
YES->CASE, NO->EXCLUDE
7. Reported History of Appendicitis
YES->8, NO->EXCLUDE
8. Incidental Appendectomy (See Table 5)
YES->EXCLUDE, NO->CASE

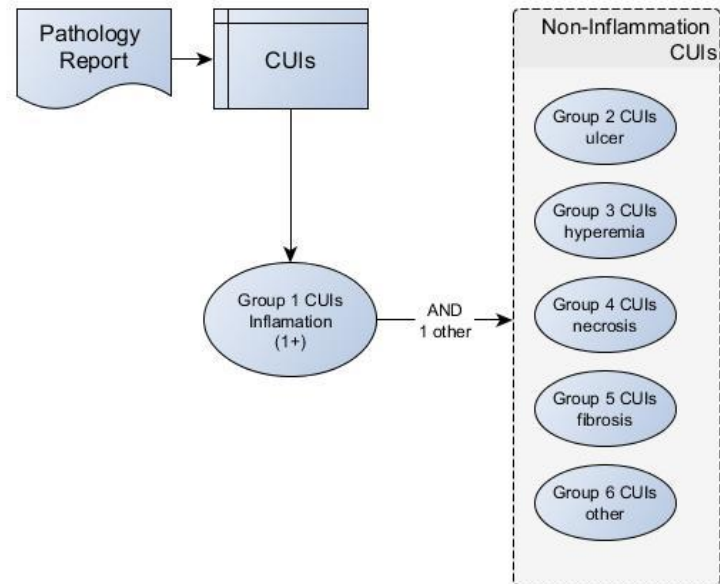


Figure 2: Positive Pathology CUI Rules

For a positive pathology report, note must have 1 CUI from inflammation group (Group 1), AND 1 or more from any of the other groups (Groups 2-6).

2. CONTROL

1. Reported History of Appendicitis
YES->EXCLUDE, NO->2
2. Diagnoses of appendicitis (ICD-9=540.XX)
YES->EXCLUDE, NO->3
3. Exclusion ICD9 codes (see Table 6)
YES->EXCLUDE, NO->CONTROL

¹ Interventional radiology – refers to procedures done under imaging. That can be performance of a needle inserted under ultrasound or fluoroscopy (dynamic X ray). The classic example in the case of acute appendicitis is a scenario where the appendix had already burst or perforated and leaked, and the infection in the abdomen has organized itself into an abscess. The interventional radiologist will aspirate the pus from the abscess with a needle he/she will advance into the abscess, all done under imaging.

3. CASE3 (Adult) CONTROL

1. Reported History of Appendicitis
YES->EXCLUDE, NO->2
2. Diagnoses of appendicitis (ICD-9=540.XX)
YES->EXCLUDE, NO->3
3. Exclusion ICD9 codes (see Table 6)
YES->EXCLUDE, NO->4
4. At least 2 primary care/medical home² visits between ages 20 -40 years (inclusive)
NO->EXCLUDE, YES->CONTROL

² Primary care/medical home definition may vary by site.

Table 1: Comorbidities for Appendicitis (Case Exclusion)

ICD9	Description
575.0	Acute cholecystitis
788.0	Right ureteric colic
633.0	Ectopic pregnancy
486	Pneumonia
533.5	Perforated peptic ulcer (without obstruction)
533.51	Perforated peptic ulcer (with obstruction)
599.0	Urinary tract infection
614.2	Salpingitis/
614.9	pelvic inflammatory disease
558.9	Gastroenteritis
560.9	Intestinal obstruction
590.80	pyelonephritis
590.10	pyelonephritis (acute pyelonephritis)
590.00	pyelonephritis (chronic pyelonephritis)
620.0	Ruptured ovarian follicle
250.1	Diabetic ketoacidosis (type 2 or unspecified)
250.11	Diabetic ketoacidosis (type 1; juvenile)
250.12	Diabetic ketoacidosis (type 2 uncontrolled)
250.13	Diabetic ketoacidosis (type 1 ; juvenile, uncontrolled)
577.0	Pancreatitis
620.2	Torted ovarian cyst
555.0	Terminal ileitis (small intestine)
555.1	Terminal ileitis (large intestine)
555.2	Terminal ileitis (small and large intestine)
560.0	Intussusception
277.1	Porphyria
751.0	Meckel's diverticulitis
780.96	Preherpetic pain (generalized pain)
562.11	Colonic/diverticulitis
543.9	appendicular diverticulitis (diverticula appendicular)
289.2	Mesenteric adenitis
924.9	Rectus sheath haematoma (hematoma) (no code for rectus sheath)

TABLE 2: CPT Codes for Interventional Radiation

CPT Codes (Case2-CPT)	Description
76003	Fluoroscopic guidance for needle placement
77002	Fluoroscopic guidance for needle placement
77003	Fluoroscopic guidance for needle placement
76360	CT guidance for needle placement
77012	CT guidance for needle placement
76393	MRI Guidance for needle placement
76942	Ultrasonic guidance for needle placement
44901	Incision and drainage of appendiceal abscess; percutaneous

TABLE 3: Systemic Antibiotics

Systemic Antibiotics (Case2-Med)
Ampicillin
Cefepime
Cefotan
Cefotaxime
Cefotetan
Claforan
Clavulanate
Cleocin
Clindamycin
Ertapenem
Flagyl
Garamycin
Gentacidin
Gentamicin
Invanz
Levaquin
Levofloxacin
Maxipime
Mefotoxin
Meropenem
Merrem
Metronidazole
Piperacillin
Sulbactam

Tazobactam
Ticarcillin
Timentin
Unasyn
Zosyn

TABLE 4: SNOMED-CT CUIs for CASE 1 Rules

Added CUIs in red (5-5-2016)

GROUP	Description	CUI
Group 1 (inflammation-related)	inflammation	C0021368
	Organizing inflammation	C0021369
	Acute exudative inflammation	C0021374
	Inflammatory exudate	C0302306
	Acute inflammation	C0333361
	inflammatory cell	C0440752
	purulent	C0439665
	Exudate	C0015388
	serositis	C0036749
	microabscess	C0333373
	Fibrinous adhesion	C0334155
	Suppurative inflammation	C0038862
	Acute suppurative inflammation	C0341352
	Acute suppurative appendicitis	C0333368
	Suppurative appendicitis	C0267623
Ruptured suppurative appendicitis	C0521606	
Group 2 (ulcer-related)	focally ulcerated	C0333299
	Mucosal ulcer	C0236053
Group 3 (hyperemia-related)	Hyperemia	C0020452
	Erythema	C0041834
Group 4 (necrosis-related)	focally necrotic	C0333504
	Necrosis	C0027540
	Necrotising appendicitis	C1737231
	Necrotic	C0027540
Group 5 (fibrosis-related)	submucosal fibrosis	C0334138
	Fibrous obliteration	C0334145
	fibrous adhesions	C0334156
	Fibrosis	C0016059
Group 6 (other)	edematous	C0013604
	Hemorrhage	C0019080

	periappendicitis	C0031034
	fecalith	C0333033
	erosion	C0333307
	Perforation	C0549099
	Congestion	C0700148
	Neutrophil Infiltration	C0751982
	Congested	C1533708
	Hemorrhagic	C0333275

TABLE 5: Procedure Codes for Incidental Appendectomy

ICD9	Description
47.1	Incidental appendectomy
47.11	Laparoscopic incidental appendectomy
47.19	Other incidental appendectomy
CPT	Description
44955	Appendectomy; when done for indicated purpose at time of other major procedure

TABLE 6: CONTROL ICD9 Exclusion

ICD9	Description
540	Acute appendicitis
540.0	Acute appendicitis With generalized peritonitis
540.1	Acute appendicitis With peritoneal abscess
540.9	Acute appendicitis Without mention of peritonitis
567*	Peritonitis

Covariates: Collecting the following information (See Data Dictionary):

- History of Disease (ICD9, CPT)
- Features of Disease (CUIs)
- History of Disease (Medications)

Control Definitions:

Healthy individuals with no history of appendicitis and no history of other acute abdominal conditions (Generalized peritonitis, Palpable right iliac fossa mass)

REF:

- 1) Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann. Emerg. Med.* 1986; 15: 557–64.
- 2). Dingemann J, Ure B. Imaging and the use of scores for the diagnosis of appendicitis in children. *Eur. J. Pediatr. Surg.* 2012; 22: 195–200.
- 3). Senocak R, Menten O. Diagnosing appendicitis at different time points in children with right lower quadrant pain: comparison between pediatric appendicitis score and the Alvarado score. *World J. Surg.* 2012; 36: 216–21.
- 4). Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. *BMC Med.* 2011; 9: 139.