

Risk Factors Affecting Delayed Diagnosis of Adult Acute Appendicitis

Nicholas Prewitt¹, Brett R. Todd, M.D.²

¹B.S., Oakland University William Beaumont School of Medicine

²Department of Emergency Medicine, Beaumont Health

Introduction

- 11 in 10,000 people in the United States require an appendectomy each year¹
- Up to 24% of appendectomies are complicated^{1,2}
 - ~85,000 cases
- 14% of these cases result in morbidities³
 - ~12,000 cases
 - Most commonly perforation, gangrene, and abscess formation
- Almost all appendectomy cases pass through and are diagnosed in the emergency department (ED)

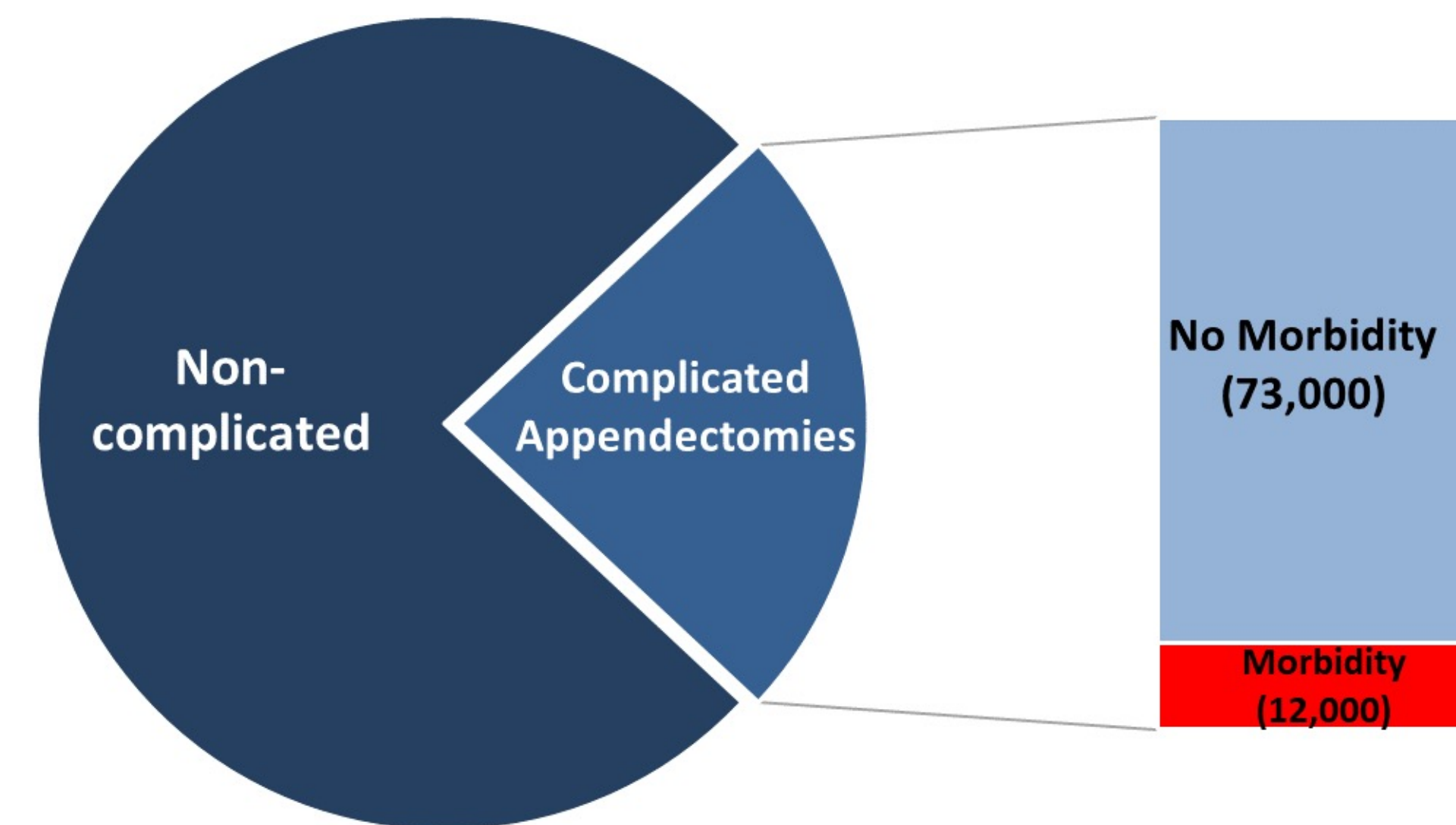


Figure 1. Breakdown of the ~354,000 yearly cases of appendicitis in the United States requiring an appendectomy. ~12,000 of these cases a year result in morbidity.

- Morbidities increase with time without appendectomy⁴
- Important to learn what factors affect time to diagnosis of appendicitis in the ED
- Previous research has only looked at the variable of race⁵

Aims and Objectives

- This study aimed to determine if demographic, environmental, or provider-related factors result in delays in the diagnosis of adult acute appendicitis in the ED
- Demographic factors: patient age, race, sex, and primary language
- Environmental factors: time of day, day of week, time of year, mode of arrival, referral to ED, and return ED visit
- Provider-related factors: provider experience

Methods

- We conducted a retrospective cohort study to evaluate the causes of variability in diagnosis times in acute appendicitis utilizing chart review methodology. A data manager used the electronic medical record to pull charts for all patients diagnosed with acute appendicitis, 18 years and older, and from a large, suburban, tertiary care center ED in Southeast Michigan (Beaumont, Royal Oak) in the time period of 2016 to 2018. Charts were manually reviewed by one of the study investigators (NP) and entered into a secure data base. Any discrepancies were reviewed by the second investigator (BT).
- Time to diagnosis was defined as the time from ED arrival to diagnosis of appendicitis by radiologist read
- Age was analyzed using a two-sample t-test. The remaining variables were analyzed using a univariate generalized linear model

Table 1. Definitions of variables studied.

Variable	Definition
Age	<65 or ≥65
Race	White or non-White
Sex	Male or female
Primary Language	English or non-English
Time of day	Morning, swing, or night shift
Day of week	Weekday or weekend
Time of year	Season
Mode of arrival	Ambulance or non-ambulance
Referral to ED	Referred to ED by non-emergency medicine healthcare provider
Return ED visit	Return to ED for same complaint within one week
Provider experience	Attending, resident, Physician Assistant, or Nurse Practitioner

Table 2. Inclusion and exclusion criteria.

	Inclusion Criteria	Exclusion Criteria
	≥ 18	< 18
	Acute appendicitis	Not acute appendicitis
	Diagnosed in ED	Diagnosed outside ED
	Beaumont, Royal Oak	Outside hospital
	Admitted in 2016 to 2018	Admitted prior to 2015 or after 2019

Results

- 907 charts met the inclusion criteria
- Time to diagnosis of acute appendicitis
 - Mean = 4.04 hours
 - Median = 3.75 hours

Table 3. Mean time to diagnosis of studied variables and if the difference was significant.

Variable	Time to Diagnosis	Significance?
Age	<65 = 4.05 hours ≥65 = 3.97 hours	No; p = 0.58
Race	White = 3.96 hours Non-White = 4.30 hours	Yes; p = 0.005
Sex	Male = 3.74 hours Female = 4.32 hours	Yes; p < 0.001
Primary Language	English = 4.03 hours Non-English = 4.34 hours	No; p = 0.24
Time of day	Morning = 4.03 hours Swing = 4.00 hours Night shift = 4.12 hours	No; p = 0.68
Day of week	Weekday = 4.00 hours Weekend = 4.16 hours	No; p = 0.20
Time of year	Spring = 3.96 hours Summer = 4.01 hours Winter = 4.02 hours Fall = 4.17 hours	No; p = 0.53
Mode of arrival	Ambulance = 4.15 hours Non-ambulance = 4.03 hours	No; p = 0.67
Referral to ED	Referral = 3.92 hours No referral = 4.07 hours	No; p = 0.23
Return ED visit	Bounce back = 4.43 hours No bounce back = 4.03 hours	No; p = 0.22
Provider experience	Attending = 3.96 hours Resident = 4.05 hours PA = 4.12 hours NP = 4.26 hours	No; p = 0.68

Conclusions

- Female patients experience a prolonged time to diagnosis of acute appendicitis than male patients.
- 4.32 hours in female patients compared to 3.74 hours in male patients
- Female patients receive CT scans later than male patients when presenting with abdominal pain⁶
- The differential diagnosis for a female with symptoms of appendicitis is greater due to considerations of pelvic pathology
- Pregnancy is a concern before exposing the patient to radiation from a CT scan

- Non-White patients experience a prolonged time to diagnosis of acute appendicitis than White patients.
- 4.30 hours in non-White patients compared to 3.96 hours in White patients
- Previous research has shown that non-White patients have prolonged wait time in EDs^{7,8}
- Proposed reasons have been provider-related and patient-related
 - Provider-related: implicit bias, cultural incompetence, language barriers⁸
 - Patient-related: lack of access to primary healthcare, higher prevalence of other health conditions⁹

- Limitations include the study being retrospective in nature and a single center study

- ED providers should be cognizant of these discrepancies in order to avoid increased morbidity and mortality in these populations of patients with acute appendicitis

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