



Impact of Race and Insurance on Door-to-Appendectomy Time among Pediatric Patients

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Impact of Race and Insurance on Door-to-Appendectomy Time among Pediatric Patients

Abstract

Racial and ethnic disparities in the rate of appendiceal rupture have been widely reported among the pediatric population. The main reasons for this remain largely unknown given that previous explanations pointing to signs of poor health care access have recently been shown to account for only a small percentage of the difference in perforation rates between white and minority children. Because the risk of perforation increases with time, racial disparities in time delay from emergency department presentation to OR appendectomy may help account for the higher appendiceal perforation rates observed among minority children. This is the first study dedicated to analyzing racial differences in door-to-appendectomy time. Insurance status and language barriers were also considered as variables of interest.

Retrospective, observational study using admission and treatment data of 607 consecutive children less than or equal to 18 years of age with surgical confirmation of appendicitis. Patients were admitted from February 2, 2013 (start of electronic medical record use) to April 27, 2017.

A significant association was found between race and perforation rate ($p < 0.05$ for all). Door-to-appendectomy times were also not significantly longer for Medicaid/uninsured patients (613 minutes) compared to private insurance patients (597 minutes) ($p = 0.60$), nor for patients with language barriers (545 minutes) compared to patients without (612 minutes) ($p = 0.23$).

While there was a higher appendiceal perforation rate among minority children, it was not due to differences in door-to-appendectomy time. Insurance status and language barriers also did not lead to differential treatment among pediatric patients.

Keywords

Racial Disparities; Appendectomy time



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ABSTRACT

Racial and ethnic disparities in the rate of appendiceal rupture have been widely reported among the pediatric population. The main reasons for this remain largely unknown given that previous explanations pointing to signs of poor health care access have recently been shown to account for only a small percentage of the difference in perforation rates between white and minority children. Because the risk of perforation increases with time, racial disparities in time delay from emergency department presentation to OR appendectomy may help account for the higher appendiceal perforation rates observed among minority children. This is the first study dedicated to analyzing racial differences in door-to-appendectomy time. Insurance status and language barriers were also considered as variables of interest. Retrospective, observational study using admission and treatment data of 607 consecutive children less than or equal to 18 years of age with surgical confirmation of appendicitis. Patients were admitted from February 2, 2013 (start of electronic medical record use) to April 27, 2017. A significant association was found between race and perforation rate ($p < 0.05$ for all). Door-to-appendectomy times were also not significantly longer for Medicaid/uninsured patients (613 minutes) compared to private insurance patients (597 minutes) ($p = 0.60$), nor for patients with language barriers (545 minutes) compared to patients without (612 minutes) ($p = 0.23$). While there was a higher appendiceal perforation rate among minority children, it was not due to differences in door-to-appendectomy time. Insurance status and language barriers also did not lead to differential treatment among pediatric patients.

Keywords: Racial Disparities; Appendectomy time

INTRODUCTION

Higher rates of appendiceal rupture have been widely reported among non-white, publicly insured children compared to white, privately insured children. (1) Compared to white children, the odds of rupture are elevated by as much as 45% for Hispanic children, 47% for African

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American children, and 116% for Asian American children. (2) Children with no insurance or public insurance also have increased perforation rates when compared to children with private insurance. (1, 3)

The main reason for this is subject to debate given that previous explanations pointing to socioeconomic condition have recently been shown to account for only a small percentage of the difference in perforation rates between white and minority pediatric patients.(4) While some studies suggest that pre-hospitalization factors such as access to care, quality of care, and patient education are to blame, other studies indicate that race and insurance status alter in-hospital management, potentially accounting for the greater likelihood of adverse outcomes among minority patients and those without commercial insurance. (1, 5)

One analysis of national data found that white children were more likely to undergo laparoscopic appendectomy than African American children, even after adjusting for severity of disease and underlying chronic illness. The odds of children with private insurance undergoing laparoscopic appendectomy were also found to be significantly higher than those with public insurance at some hospitals. (6) Yet another marker that race may be adversely impacting in-hospital management of children was elucidated in a recent study demonstrating that African American children hospitalized with acute appendicitis were less likely to receive appropriate pain management for moderate and severe pain than white children.(5) Furthermore, disparities in healthcare may start as soon as patients arrive at the hospital as shown by one study which revealed that black and Hispanic children have longer wait times than white children. (7) Door-to-appendectomy time is another in-hospital factor that should be considered as a potential contributor to poorer outcomes among minority children with acute appendicitis.

Given that a delay in diagnosis or treatment is thought to increase the risk of perforation, we conducted a study to investigate the association between race and insurance status on door-to-appendectomy time in children with acute appendicitis. Language barriers were also considered as a variable of interest.

METHODS

This study was a retrospective analysis of data contained within the electronic medical record of a major children's hospital with a well-established referral system. It was designed to assess differences in door-to-appendectomy time according to race and insurance type. The study population included patients between the ages of 2 and 18 years who underwent appendectomies (International Classification of Diseases, Ninth and Tenth Revisions [ICD-9, ICD-10] procedure codes 47.01, 47.09, or K35) between February 2, 2003 and April 27, 2017 at a large urban hospital in the Northeastern part of the United States. This time frame was chosen because it represents the total number of years for which data from the electronic medical record was available. The coding used in this study is consistent with that used in other administrative data-based investigations. (1, 2)^{1,2} The Yale institutional review board approved this study.

The outcome of interest was door-to-appendectomy time. This was defined by the following set of time points: the exact time logged when the patient checked into the front desk of the Emergency Department and the exact time of the primary surgeon's first incision. Independent variables extracted from administrative data included patient age, insurance type (commercial, Medicaid, uninsured, other, or unknown), need for a language interpreter, race (white non-Hispanic, African American, Hispanic, Asian, and other), and appendiceal perforation (ICD-9 or ICD-10 code of 540.0 or K35.0).

Patients were grouped according by race (White vs Minority) and T-tests were used to compare the mean door-to-appendectomy times between these two groups. Statistical significance was assigned at $P < 0.05$. Patients were also grouped according to insurance status (private vs. other) and the presence of language barriers (present vs. absent) to look for differences in average time to surgical intervention. Proportions were compared using the Fisher's exact two-tailed test with the p value set to 0.05.

RESULTS

The study population included 607 patients who underwent appendectomies in the 14-year period. The average age of patients was 11 years; 51% of patients were between the ages of 6 and 12 years. 47% of patients were privately insured and 43% were covered under Medicaid or were uninsured. 59% of patients were white, 31% were Hispanic, 7% were African American, and 2% were Asian.

Table 1 provides a demographic description of the study population.

Table 1 also presents door-to-appendectomy time according to race, insurance status, and need for an interpreter. The overall average time to appendectomy was 10 hours. T-tests showed that door-to-appendectomy times were not significantly longer for patients identified as African American (645 min), Hispanic (568 min), or Asian (591 min), compared to patients identified as white (621 min) ($P > 0.05$ for all). Door-to-appendectomy times were also not significantly longer for Medicaid/uninsured patients (613 min) compared to commercially insured patients (597 min) ($P = 0.6$), or for patients with language barriers (545 minutes) compared to patients without (612 min) ($P = 0.2$).

Overall perforation rates were significantly higher for minority children (32%) compared to white children (21%) ($P = 0.003$, Fisher's Exact test); for children insured by Medicaid (32%) compared to children with commercial insurance (20%) ($P = 0.001$, Fisher's Exact test); and for children whose families required an interpreter (48%) when compared to children whose families did not (23%) ($P = 0.0002$, Fisher's Exact test).

Table 1. Demographic Characteristics of Study Population and Door-to-Appendectomy Time

Characteristic	No.	Proportion (%)	Proportion with Perforation (%)	Door-to-Appendectomy Time in min., (mean ± SD)
Total	607		25.5%	
Age				
2-5 y	45	7.4	25 (4.1%)	626 ± 376
6-12 y	309	50.9	79 (13%)	577 ± 367
13-18 y	253	41.7	51 (8%)	637 ± 359
Race				
White	359	59.1	76 (21.1%)	621 ± 320
Black	45	7.4	10 (22.2%)	645 ± 381
Hispanic	188	31	61 (32.4%)	569 ± 351
Asian	15	2.5	8 (53.3%)	591 ± 388
Insurance				
Private	324	53.4	65 (20.0%)	597 ± 372
Medicaid	278	45.8	88 (31.7%)	615 ± 359
Uninsured	4	0.7	0 (0%)	507 ± 248
Other	3	0.5	2 (67%)	809 ± 226
Need Interpreter				
No	553	91.1	129 (23.3%)	612 ± 364
Yes	54	8.9	26 (48.1%)	545 ± 375

DISCUSSION

Our study shows that race and payer type does not correlate with door-to-appendectomy time. Black, Hispanic, and Asian children did not receive delayed surgical intervention compared to white children. Consistent with previous studies, overall perforation rates were still higher for minority children and children with Medicaid, compared to white non-Hispanic and privately insured children, respectively. Furthermore, perforation rates were higher for children whose families required the need for an interpreter compared to children without this need. Differences in time to surgical intervention likely do not contribute to observed racial disparities in appendiceal perforation rates among pediatric patients. Additional studies are needed to identify specific contributors to poorer outcomes amongst minority patients.

Of note, our study precisely defined door-to-appendectomy. The time points used in this study were chosen because they are some of the most widely used in the surgical quality improvement literature. We believe in the importance of disclosing and using consistent time point in order to standardize research between healthcare systems.

Pediatric appendicitis perforation rate remains an ideal subject of investigation regarding health care disparities. This is due to acute appendicitis having a consistent, time-dependent natural history, a single definitive treatment (appendectomy), and a distinct negative outcome

(perforation). There is also no known biological predisposition to perforation in any racial group. A delay in diagnosis or treatment is known to increase risk of perforation; therefore, perforation rates may be used as a marker for access to surgical care.

A large body of research exists to suggest that race correlates with delays in time to treatment. In adults, where most studies of this type have been conducted, African American and Hispanic patients are consistently found to experience delays in timely therapy for a number of conditions including myocardial infarction, and adjuvant therapy for breast and prostate cancer. (8-10) Fortunately, more recent studies indicate that some race-based differences in the receipt of timely care have diminished over the years, as a result of several high-profile initiatives to improve national standards of care for all patients. (11) This suggests that in-hospital causes of racial disparities are in fact actionable and can allow for large-scale improvements in outcomes for all patients regardless of race.

Investigating in-hospital factors that contribute to poorer outcomes will remain an important area of research because these elements are largely within the control of individual institutions and providers. As such, identifying concrete points of intervention, such as standardizing door-to-balloon time for all patients regardless of race, can lead to greater more immediate advancements against the persistent racial and ethnic disparities in health and healthcare that have become a major theme in American healthcare policy.

Strengths

The strengths of this study are the large sample size and the ability to answer a specific question regarding the impact of race and insurance status on door-to-appendectomy time at a single institution. A high degree of precision in the calculation of door-to-appendectomy time was possible—down to the very minute—due to access to the entire electronic medical record for each patient. Investigations utilizing data with such high granularity are less feasible to carry out on a larger, multi-institutional scale, but are uniquely suited for single institutional studies such as this.

Limitations

A limitation of this study is that it is comprised of data from a single institution, and therefore may not be representative of other healthcare settings. Moreover, there are factors in door-to-appendectomy that this study could not take into account. These factors include human factors such as the fact that different providers may have different response times, patient load in the Emergency Department and the operating suite, and the time of day at which patient's presents to the Emergency Department. This study could not control for every factor.

Future Directions

Because this is a single-institution study, future efforts can include expanding research to institutions in other areas of the country in order to obtain a more comprehensive understanding on the impact of race and insurance status on door-to-appendectomy time in a variety of healthcare systems. With access to higher volume data, additional avenues of study might include the consideration of variables such as “private” versus “public” institutions, institution-specific patient volumes, size of patient referral base, and even timing of patient presentation, e.g. day versus night, and weekend versus weekday admissions.

CONCLUSION

Our study is the first to demonstrate that previously observed racial disparities in appendiceal perforation rates can occur despite no race-based differences in door-to-appendectomy time. This suggests that the rate of appendiceal rupture is likely more strongly

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associated with pre-hospitalization factors such as access to care, quality of care, and patient education. This is also the first study to demonstrate that language barriers correlate with increased rates of perforation. Additional studies are needed to investigate the impact of race, insurance status, and language barriers on the pre-hospitalization determinants of appendiceal rupture among pediatric patients.

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