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Time-of-Day and Appendicitis: Impact on Management and Outcomes

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Abstract

Background—Observational research has shown that delayed presentation is associated with perforation in appendicitis. Many factors that impact the ability to present for evaluation are influenced by time-of-day; for example, child care, work, transportation, and primary care office hours. Our objective was to evaluate for an association between care processes or clinical outcomes and presentation time.

Methods—Prospective cohort of 7,548 adults undergoing appendectomy at 56 hospitals across Washington State. Relative to presentation time, patient characteristics, time to surgery, imaging use, negative appendectomy (NA), and perforation were compared using univariate and multivariate methodologies.

Results—Overall, 63% of patients presented between noon and midnight. More men presented in the morning; however, race, insurance status, co-morbid conditions, and WBC count did not differ by presentation time. Daytime presenters (6AM-6PM) were less likely to undergo imaging (94%

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vs. 98% $p<0.05$) and had a nearly 50% decrease in median pre-operative time (6.0h vs. 8.7h $p<0.001$). Perforation significantly differed by time-of-day. Patients who presented during the workday (9AM-3PM) had a 30% increase in odds of perforation compared to early morning/late night presenters (adjusted OR 1.29, 95% CI 1.05–1.59). NA did not vary by time-of-day.

Conclusions—Most patients with appendicitis presented in afternoon/evening. Socioeconomic characteristics did not vary with time-of-presentation. Patients who presented during the workday more often had perforated appendicitis compared to those who presented early morning or late night. Processes of care differed (both time-to-surgery and imaging use). Time-of-day is associated with patient outcomes, process of care, and decisions to present for evaluation; this has implications for surgical workforce planning and quality improvement efforts.

Keywords

appendicitis; perforation; acute care surgery; patient decision-making; time-of-day

INTRODUCTION

Observational research has suggested that time prior to presentation for patients with acute appendicitis is a risk factor for perforation.^{1–4} This suggests that patient decision-making prior to presentation may influence clinical outcomes. Among several considerations, including symptom severity, health awareness, and insurance coverage, time-of-day may be a factor that influences the decision to present for evaluation. Patients with severe symptoms may be motivated to present late at night, whereas those with mild or early symptoms may wait until morning. Availability of child care, employment, school, transportation, or access to primary care are all influenced by time-of-day, and all may impact when patients are able to be evaluated for acute appendicitis. Time-of-day may also impact care processes used in the evaluation and treatment of patients with appendicitis. Finally, the epidemiology of presentation patterns may generate data pertinent to surgical staffing and optimizing benefits of the Acute Care Surgery (ACS) model that is becoming more prevalent in the care of acute surgical conditions.

The Washington State Surgical Care and Outcomes Assessment Program (SCOAP), a physician-led quality surveillance program initiated in 2006, provides several benefits to evaluating the relationship between time and processes of care and clinical outcomes: a large number of diverse institutions, large numbers of patients, individualized chart review by trained abstractors, specific data on hospital arrival time and operating room (OR) start time, as well as direct review of pathology reports (i.e., diagnoses are not based on data such as ICD-9 codes).

This study was designed to investigate 4 questions. [1] When do patients with appendicitis present to the hospital for evaluation? [2] Are there differences in clinical, demographic, or socioeconomic characteristics among those who present at different times? [3] Do processes of care vary by time-of-day, in particular, use of imaging or length of time from presentation to the OR? [4] Finally, are outcomes different for patients who present at different times? Specifically, are there differences in frequency of perforation or negative appendectomy

(NA)? We hypothesized that a higher percentage of patients with advanced disease present at night and that care processes would be influenced by time-of-day.

METHODS

Study Population and Setting

This study is based on data prospectively collected on consecutive adult patients (18+ years) who underwent non-elective appendectomy in one of 56 SCOAP hospitals in Washington State between January 1, 2010 and December 31, 2011. Estimates based on the Washington Department of Health chart abstraction program suggest that SCOAP captures greater than 85% of the state's non-elective appendectomies.⁵ The SCOAP data collection protocol was designed to evolve and has occasionally been modified to answer new quality or research questions. Time of arrival to the hospital was added to the abstracting template in 2010. The University of Washington Human Subjects Division evaluated our study protocol and waived institutional review since the research team has no access to original SCOAP data and all research was conducted on completely anonymous data.

Predictor, Descriptive, and Outcome Variables

The primary predictor of interest was the time at which patients presented to the hospital. Variables were abstracted from each patient's clinical record using standardized definitions. SCOAP abstractors have clear directions in their handbook for recording times as data points. Many patients present to an emergency department (ED) as their first hospital contact, but the dataset is designed to register those patients who present to the hospital via other routes as well (*e.g.*, direct admission via the primary care provider). Time variable definitions are shown in Box 1. WBC was based on last result prior to surgery. SCOAP's co-morbid condition score has previously been described.⁶

One analysis was based on elapsed time from presentation to surgical start ("presentation-to-OR"). There were a small number of clear outliers, many of whom had obviously misclassified data (for instance, time less than zero [118 of 7548 patients]). For this reason, when working with elapsed time, we restricted the analytic cohort to those patients whose presentation-to-OR time was within 63.05 hours (99th percentile of all patients). Outliers were included in all other analyses. Sensitivity analyses suggested that results were not impacted by including or excluding these patients.

Descriptive statistics were generated to characterize patients who present at different times. Additionally, we evaluated processes of care and clinical outcomes and their relationships, if any, with time-of-day. Process outcomes were presentation-to-OR time and use of advanced pre-operative imaging. Clinical outcomes were NA or perforation as determined by the final pathology report.

Statistical Analysis

Patients were ordered by the time at which they presented to the hospital. We then divided the 24-hour day into four 6-hour blocks and performed univariate comparisons based on

clinical (sex, age, WBC count, and comorbid conditions), demographic (race/ethnicity), and socioeconomic (insurance status) characteristics.

Presentation time was further divided into eight 3-hour periods to assess for relationships between time-of-day and care process and outcomes. Of these, presentation-to-OR time was the only continuous variable analyzed. Boxplots of presentation-to-OR time were generated for each of the 8 arrival time intervals. Means were compared using analysis of variance (ANOVA) followed by the Bonferroni adjustment for multiple comparisons. Because time from presentation to OR was not normally distributed (*i.e.*, right-skew), we also conducted a series of Wilcoxon rank-sum tests. 15:00 to 18:00 was chosen as the comparator for all other intervals because it had the shortest median time.

Next, we sought to determine if there was a significant relationship between time of presentation and three categorical (binary) variables: use of pre-operative imaging, frequency of perforation, and frequency of NA. We calculated a percentage for each based on time-of-day of presentation. Statistical comparison was then performed using both univariate and multivariate logistic regression. Using a stepwise regression approach, variables were evaluated for inclusion in the multivariate models using likelihood ratio (LR) tests and were included for LR test $p < 0.05$. Variables were originally considered for inclusion in these parsimonious models if they were known from previous analyses to be associated with imaging use, perforation, or NA. For all logistic regressions, the first time period (midnight to 3 AM) was chosen as the reference category because patients who presented within this time period had the lowest rate of perforation, lowest rate of NA, and the highest use of imaging compared to all other time periods. Using a generalized estimating equation, the final models were adjusted for clustering of patients by institution. Observations with missing data were excluded from multivariate analysis (of 7,548 patients, final pathology was missing for 15, use of imaging for 1, and gender for 2). “Unknown” for race/ethnicity and insurance status was included as a variable, see Table 1.

Finally, because it was clear that time-of-day affected how much time elapsed between hospital arrival and OR start and because risk of perforation is thought by some to have a positive relationship with this presentation-to-OR time, we compared frequency of perforation *between* strata of “wait time” for each block of presentation time: a median wait time was calculated for each 3-hour block of presentation time, and patients within each period were stratified according to whether they went to the OR shorter-than or longer-than the median wait time. Perforation rates were calculated for each strata and compared (Pearson’s chi-square). Significance was set at $\alpha < 0.05$.

RESULTS

9,048 patients underwent non-elective appendectomy in a SCOAP hospital during the 2-year study period. 7,548 had time of hospital presentation recorded in the database, and results are based on this cohort. Nearly two-thirds (63.1%) of patients presented between noon and midnight (*i.e.*, blocks III and IV), with only a third presenting in the morning (midnight to noon) (Table 1). A higher proportion of those who presented from midnight until noon was male compared to those who presented in the latter half of the day (55.0% vs. 51.1%, $p =$

0.001). Average age was slightly younger for patients who presented in the early morning and later evening as compared to those who presented during business hours. Other than gender and age, groups of patients who presented at different times during the day did not vary by number of comorbid conditions (none vs. 1 or more, $p=0.53$), race (white vs. non-white, $p=0.14$), or insurance status (private insurance vs. other forms or none, $p=0.19$). Mean WBC count was nearly identical regardless of when patients presented (Table 1). Figure 1 shows the proportion of the entire cohort that presented to the hospital by each hour of the 24-hour day. The dark line overlying the histogram shows the percentage of perforation among all patients who arrived during each hour (additional discussion of perforation below).

Process Outcomes: Time-to-Treatment and Imaging Use

Elapsed time from hospital presentation to OR start varied by the time-of-day at which patients presented. Time period 6 (1500 to 1800) had the shortest mean and median presentation-to-OR times, and time period 8 (2100–2400) had the longest (Table 2). By Wilcoxon rank-sum test, median presentation-to-OR time for period 6 differed significantly from all 7 other time periods. By ANOVA, there were no significant differences in mean presentation-to-OR times among patients who presented from 0600 through 1800, but wait times were significantly increased for patients who presented from 1800 until 0600 compared to those who presented during usual business hours (defined as 6AM–6PM). These statistical findings are consistent with the overall character of the data as shown in the Figure 2 boxplots: patients who present from 0600 to 1800 have shorter medians, smaller interquartile ranges (IQR), and narrower adjacent values (“whiskers” on the boxplot) compared to those who present from 1800 to 0600. Based on these granular results, we divided the 24-hour day into “business” hours (6AM to 6PM) and “nighttime” hours (6PM to 6AM). Comparing presentation-to-OR time between these blocks was consistent with the first analysis: median presentation-to-OR time was 6.0 hours for business hours and 8.7 hours for nighttime hours, nearly 50% longer (Wilcoxon $p < 0.001$).

Patients who presented in period 1 (midnight to 3AM) were slightly more likely to receive advanced pre-operative imaging compared to all other time periods. After adjusting for age, sex, and insurance status (compared to period 1), the odds that a patient underwent pre-operative imaging were significantly reduced for presentation periods 3, 4, 5, 6 and 7. Patients who presented in periods 2 and 8 had similar rates of imaging to period 1 (Table 2).

Clinical Outcomes: Negative Appendectomy and Perforation

There were no time-of-day differences seen in rates of NA (Table 2) either in univariate comparison or in a multivariate model adjusted for age, gender, and insurance status. Significant differences were detected in perforation. Patients who presented from midnight to 3AM were least likely to have perforated appendicitis. After adjusting for age, sex, comorbid conditions, and insurance status, two time periods had significantly increased odds of perforation compared to the first periods. Patients presenting in period 4 (9AM to noon) and period 5 (noon to 3PM) had an approximately 30% increase in odds of perforation (Table 2). When risk of perforation was stratified by greater-than or less-than median presentation-to-OR time (Figure 2), perforation did not differ between strata for any of the 8

time periods except for period 2 in which those who went to the OR most quickly had a higher rate of perforation (20.1% vs. 12.2%, $p=0.02$). Notably, patients presenting in time periods 1 and 8 had the longest presentation-to-OR time (Figure 2) and the lowest frequency of perforation (Figure 3).

DISCUSSION

For surgeons, acute appendicitis is inextricably linked to time. Although there is a substantial body of literature on time elapsed from presentation to surgery, there is surprisingly little information on the time-of-day at which patients present for care and the impact—if any—this has on processes of care or outcomes. Clearly, presentation time-of-day is a separate issue from the time interval between presentation and surgery, but the two are certainly linked, particularly considering how much influence time-of-day has on the factors that impact when patients present after their symptoms begin.

In this large cohort of over 7500 patients, more patients with appendicitis presented for care in the afternoon through late at night compared to early through late morning. More men presented in the morning, and patients who presented late at night and early in the morning were slightly younger. Otherwise, patients presenting at different times were similar in terms of co-morbid conditions, race, and insurance status. Perforation peaked in the middle of the day, but there was no significant difference in NA based on time of presentation. Time from presentation to OR was significantly shorter during business hours; patients who presented late at night or very early in the morning waited longer, with a nearly 3-hour (50%) difference in median presentation-to-OR time compared to those who presented during business-hours. Advanced pre-operative imaging is emphasized in SCOAP hospitals.⁵ Still, a significant temporal difference was detectable: those who presented later at night (or early in the morning, such as 12–3 AM) were more likely to undergo imaging compared to patients who presented at midday. One intuitive explanation for this may be that ED providers are reluctant to call surgeons late at night unless an imaging study has confirmed appendicitis.

Recent scholarship on appendicitis has focused on factors that delay patients from presenting for care and how these may confer increased risk for perforation. Race/ethnicity and insurance status have figured prominently in this work.^{1–4} That time-of-day might also influence patient decision-making in terms of when to present for care has not been considered as thoroughly. A single institution study in 2006, found that 54% of patients presented during daytime hours (7AM to 7PM) and 46% presented during nighttime hours.⁷ Given that patient decision-making may be implicated in outcomes, the time at which patients come to the hospital seems an important factor to investigate, particularly since time-of-day is closely linked to availability of child care, work obligations, school, transportation, and access to primary care. Although our study is not the only one to evaluate time-of-day and appendicitis, with 7500 patients, it is by far the largest and one of the few to evaluate how time-of-day is associated with outcomes and processes of care.

Traditional surgical lore suggests that those who present late at night tend to be sicker patients. If this pattern were true, one would expect to see increased WBC counts and increased frequency of perforation among patients presenting during that time period. On the

contrary, we found no differences in WBC count, and perforation was actually more common among patients who presented in the middle of the day. Patients with less advanced illness were just as likely to come late at night as during the day. Moreover, regardless of when patients presented for care, there was no association between waiting longer for surgery and risk of perforation. In fact, among patients who presented during period 2 (which would be just before scheduled cases start in many hospitals), those with perforated appendicitis appear to have been taken to surgery more expeditiously compared to those without perforation. It makes sense that sicker patients would have their operations prioritized though our data cannot explain why some patients went to the OR faster than others.

It is challenging to explain why perforation should be more common among patients who present during midday. One explanation may be that these patients are more likely to decide to leave work or school. Or, having stayed home in the morning because they did not feel well, are more easily able to come in for evaluation than those with less severe symptoms. Previous studies have shown a relationship between pre-hospital time and risk of perforation,^{8,9} and it is tempting to view the pattern of perforation we see as consistent with the idea that patients who come in earlier in the course of their illness (say, after work on day one of symptoms) present with perforation less frequently compared to those who try to go home and “wait it out” for a night before presenting the next day with advanced disease. Ultimately, a study that directly evaluates patient decision-making is needed to determine how time-of-day impacts the pre-hospital interval.

Our study demonstrated modest but clear differences in processes of care for patients with appendicitis associated with presentation time, both in terms of imaging use and in speed from presentation-to-OR. These findings are consistent with several other studies that found similar temporal variations in processes of care. A 2005 study demonstrated that patients who had operations earlier in the day had longer post-operative length of stay.¹⁰ Bhangu *et al.*, in a setting much different from SCOAP hospitals, showed that NA, use of laparoscopy, and consultant (*i.e.*, attending) presence in the OR varied substantially by time-of-day in a group of 95 hospitals, mostly in the United Kingdom.¹¹ (Notably, NA was 21% across their entire patient cohort, compared to <5% in Washington State.) Another study in the United States, showed that the ratio of ultrasound to CT scan in the evaluation of abdominal pain in pediatric patients varied considerably by the time-of-day at which the patient was evaluated. During daytime, use of ultrasound was 6 times as often as CT (230 vs. 35), but for those who presented at night, ultrasound was used half as often as CT (50 vs. 110).¹² In the SCOAP patient cohort, imaging use differed by approximately 4% comparing late night to midday. While this difference may not seem clinically meaningful, SCOAP hospitals have made a commitment to use high quality imaging in the workup of suspected acute appendicitis⁵ and in locations/institutions where such a commitment is not as well-established, the temporal differences we see here may be substantially magnified (as demonstrated by the pediatric imaging study above). We know that patient volume, geographic location, and overnight staffing vary considerably among hospitals, and these can all impact the processes of care and outcomes assessed in this study. Our analytic plan was not structured to evaluate in-depth differences between institutions, but we were able to carry out a modest sub-analysis evaluating for associations between perforation rate,

appendectomy volume, and time-to-treatment in SCOAP hospitals. Institutional perforation rate was correlated with appendectomy volume (Spearman $\rho = -0.38$, $P = 0.008$) but time-to-treatment was not ($\rho = 0.20$, $p = 0.12$). For both of the analyses by appendectomy volume, we excluded 6 hospitals that performed less than 10 appendectomies over the 2-year study period. This univariate association between appendectomy volume and perforation could be related to numerous factors (e.g., a more aggressive approach to diagnosis/treatment may result in more appendectomies for mild disease which will drive the perforation rate downward) and our study was not designed to evaluate the nuances of this relationship. Notably, there was no relationship between time-to-treatment and perforation rate at the institutional level (linear regression coefficient -0.42 , 95%CI $-1.4 - 0.55$, $p=0.39$).

The epidemiology of presentation time for appendicitis has implications for surgical staffing and for maximizing the benefits of an increasingly prevalent ACS model. Studies examining the relationship between perforation and elapsed time once patients reach the hospital have yielded divergent results.^{7,9,13–17} One paper that specifically evaluated differences between a traditional home-call model of surgery and an in-house ACS model found that pre-operative time and perforation were both reduced in the ACS model.¹⁸ Those authors extol the virtues of the ACS model, and other recent studies have reached similar conclusions that surgical “hospitalists” improve patient outcomes in acute surgical conditions.^{19–21} Our findings that patients with appendicitis present throughout the day (and most often between noon and 6PM) suggest that one of the benefits of the ACS model is not just avoiding nighttime operations for physicians who would otherwise be on call, but that the ACS model can reduce pre-operative wait times for acute care patients and offload those surgeons whose day of clinic or surgery would otherwise be disrupted by an appendectomy. It is not that these cases are “inconvenient” for the surgeon; they burden an already over-booked, over-extended healthcare system and disrupt care for patients who often wait weeks or months for scheduled clinic and surgery appointments. Whether a few hours in one direction or another change outcomes related to perforation (and data from SCOAP suggests that this is *not* the case¹⁷), patients with appendicitis need surgical care. Waiting for surgery is unpleasant (uncertainty, pain, nausea, fever, etc.), and a model that shortens wait time for the patient and does not disrupt the surgeon’s already overfull day has obvious appeal.

This study has some limitations. Though our multivariate models adjust for age, sex, comorbid conditions and demographic/socioeconomic characteristics, any observational dataset is vulnerable to confounding from unmeasured variables. We do not know, also, at which point in the overall course of evaluation/treatment patients are recorded as having presented to the hospital. Some patients present to other providers before coming to the hospital, and our data collection methods are not able to capture these times, although SCOAP does capture imaging studies performed outside of the hospital at which surgery is performed. This dataset is also unable to capture ED waiting room times (which are known to fluctuate throughout the day), which could have impacted our results. That said, some of the “busyness factor” that would impact ED waiting room times is likely to be reflected in the time-to-treatment data we studied, as a busy ED may have longer workup times prior to surgical consultation and thus longer presentation-to-OR time. This is a surgical cohort, so patients treated non-operatively are not captured by this dataset; however, antibiotics-first

approach to acute appendicitis was exceedingly uncommon at the time this data was collected (2010–2011). A more relevant limitation, however, may be that patients with abscess are frequently taken for percutaneous drainage and patients with phlegmon are often treated with antibiotics; neither of these scenarios would be captured by our dataset unless these interventions failed and the patient required an operation. If these particular patients present at variable times during the day, this could skew some of the overall findings. If they present uniformly throughout the day, or in a pattern similar to patients with perforation included in the surgical cohort, their exclusion would not alter our findings. Finally, those patients who had time-to-treatment longer than 24–36 hours may represent a different subset of patients than those who were taken to surgery closer to the median wait time of 6.7 hours. There are several possible reasons for wait times longer than 24–36 hours: those who had substantial diagnostic uncertainty early on in the ED or those who failed initial non-operative management. 77 patients had presentation-to-OR times longer than 36 hours, approximately 1% of our patient cohort. Despite these limitations, to our knowledge, this is the largest series evaluating presentation time for appendicitis using data carefully abstracted directly from patient charts.

CONCLUSIONS

Contrary to our hypothesis, we did not find that sicker patients presented to the hospital late at night. We also found that patients were relatively similar in terms of demographics and socioeconomic status regardless of when they presented, with the exception of a slight predominance of men among patients who presented in the morning. Although SCOAP hospitals emphasize advanced imaging in the work-up of appendicitis, significant differences were detectable in the use of imaging between night and day, differences that might be amplified in hospitals where imaging is not used as routinely. Imaging use is clearly associated with rates of NA,^{5,22} and institutions with more variation in this care process may see more NAs at different times of the day. We found that patients who presented at midday had higher risk of perforation although they waited a shorter time to be taken to the operating room. These data are consistent with the hypothesis that system and care processes do not substantially contribute to the risk of perforation. Further research is needed to clarify how time-of-day influences patient decision-making and whether this contributes to clinical outcomes such as perforation.

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Box 1**Time Variable Definitions for SCOAP Abstractors**

- “**Admit Date:** date patient was admitted to the hospital. Admission to the hospital is considered the date and time of first hospital encounter including observation, admission, or ER admission.”
- “**Admit Time:** use a 24-hour clock to indicate the time patient was admitted to the hospital. Admission to the hospital is considered the date and time of first hospital encounter including observation admission or ER admission.”
- “**Time of First Incision:** use a 24-hour clock to indicate the time of the first incision.”

Figure 1. Patient Volume (as a Percentage of the Cohort) & Percent Perforation by Hour

The histogram depicts the percentage of the entire cohort that presented within each hour of the day (right sided Y-axis). The dark line overlying the histogram indicates the perforation rate by hour of presentation (left sided Y axis).

Figure 2. Boxplot: Time from Hospital Arrival to OR, by Time-of-Presentation

Figure 3. Percent Perforation by Time-of-Presentation

Time-of-Presentation is divided into three-hour periods. Patients presenting within each period were also stratified by whether the time elapsed from their presentation to their OR start was greater or less than the median; a perforation rate was calculated for each strata, which are represented by the dotted lines.

Table 1
Clinical, demographic, and socioeconomic characteristics of patients by time-of-presentation

	Block I	Block II	Block III	Block IV
	Midnight to 6 AM	6 AM to Noon	Noon to 6 PM	6 PM to Midnight
Number	1063 (14.1%)	1716 (22.7%)	2509 (33.2%)	2260 (29.9%)
% Male	55.4%	54.7%	50.6%	51.6%
Mean Age (SD)	38.1 (15.9)	41.0 (17.4)	40.3 (16.8)	38.3 (16.1)
Mean WBC (SD)	13.8 (4.1)	13.3 (4.4)	13.3 (4.8)	13.6 (4.2)
Comorbid Conditions Score				
0	86.6%	86.3%	85.3%	86.6%
1	10.5%	10.8%	11.6%	10.9%
2	1.9%	2.1%	2.1%	1.8%
3+	1.0%	0.8%	1.0%	0.7%
Race				
White	68.1%	71.2%	71.8%	71.3%
African American	2.9%	2.7%	2.4%	2.8%
Asian	5.8%	4.6%	5.3%	5.0%
American Indian	1.4%	0.5%	0.7%	0.9%
Native Hawaiian or PI	0.7%	0.4%	0.8%	0.6%
Not Available	21.1%	20.7%	19.0%	19.4%
Insurance				
Private	57.2%	58.3%	60.0%	60.7%
Medicare	6.9%	9.9%	7.8%	7.4%
Medicaid	9.3%	8.3%	9.4%	8.6%
Self-Pay, Uninsured, Unknown	21.5%	19.5%	19.3%	20.3%
Other Gov't Programs	5.1%	4.0%	3.3%	3.1%

White blood cell = WBC.

Table 2
Time of Day, Processes of Care, and Clinically Meaningful Outcomes

Mean and median elapsed time from presentation to start time in the operating room (OR) is compared across the 8 periods of presentation time.

Additionally, use of pre-operative imaging, rates of negative appendectomy (NA), and rates of perforation across the 8 time periods are compared via univariate percentages and multivariate logistic regression (results presented as adjusted odds ratios and 95% confidence intervals). The multivariate models for imaging use and NA are adjusted for age, sex, and insurance status. The multivariate model for perforation is adjusted for age, sex, co-morbid conditions, and insurance status.

Time Period	Time of Day	Time from ED presentation to OR start		Imaging (%)	Imaging, Odds Ratio [95% CI]	Perforation (%)	Perforation Odds Ratio [95% CI]	% NA	NA, Odds Ratio [95% CI]
		Median (H)	Mean (H)						
1	Midnight to 3AM	8.85	9.61	97.9	Ref.	13.0	Ref.	3.6	Ref.
2	3 AM to 6 AM	7.43	8.36	96.4	0.58 [0.30 – 1.14]	15.7	1.18 [0.87 – 1.59]	3.2	0.95 [0.43 – 2.06]
3	6 AM to 9 AM	7.10	8.01	95.2	0.41* [0.22 – 0.78]	14.4	0.98 [0.80 – 1.20]	3.3	1.03 [0.55 – 1.91]
4	9 AM to 12, Noon	6.56	8.07	93.8	0.30* [0.17 – 0.53]	18.0	1.29* [1.05 – 1.59]	3.8	1.15 [0.58 – 2.29]
5	12, Noon to 3 PM	5.87	7.62	94.1	0.32* [0.17 – 0.63]	17.0	1.27* [1.02 – 1.56]	4.1	1.18 [0.62 – 2.23]
6	3 PM to 6 PM	5.35	7.30	93.5	0.28* [0.16 – 0.52]	16.5	1.20 [0.98 – 1.46]	3.8	1.12 [0.61 – 2.06]
7	6 PM to 9 PM	6.21	9.14	95.1	0.41* [0.26 – 0.66]	14.7	1.10 [0.87 – 1.39]	3.4	1.01 [0.57 – 1.78]
8	9 PM to Midnight	10.44	10.6	97.7	0.92 [0.55 – 1.55]	14.2	1.12 [0.84 – 1.49]	3.5	0.97 [0.55 – 1.71]

The asterisk (*) represents $p < 0.05$ when compared to the referent time period (Period 1).

Ref. = reference group. H = hours. 95% CI = 95% Confidence Interval.