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A protocol for non-operative management of uncomplicated appendicitis

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Abstract

Background—We developed a protocol to identify candidates for non-operative management (NOM) of uncomplicated appendicitis. Our objective was to evaluate protocol efficacy with the null hypothesis that clinical outcomes, hospital readmission rates, and hospital charges would be unchanged following protocol implementation.

Methods—We performed a single center four-year propensity score matched retrospective cohort analysis of 406 patients with acute uncomplicated appendicitis. The protocol recommended NOM for patients with modified Alvarado score ≤ 6 and no appendicolith. Patients admitted before ($n=203$) and after ($n=203$) protocol implementation were matched by Charlson comorbidity index, duration of symptoms, and modified Alvarado score. Outcomes included operative management, days on antibiotic therapy, length of stay, and hospital charges, as well as readmissions, complications, mortality within 180 days.

Results—Baseline characteristics were similar between groups (age 31 years, ASA class 2.0, Charlson comorbidity index 0.0). Protocol compliance was higher when the protocol recommended appendectomy (97%) rather than NOM (73%, $p<0.001$). The incidence of operative management decreased from 99% to 82% after protocol implementation ($p<0.001$). In the protocol group, there was a lower incidence of open surgery (4% vs. 10%, $p=0.044$) despite a longer interval between admission and surgery (8.6 vs. 7.1 hours, $p<0.001$). Following protocol implementation, 51 patients had NOM: 18 failed NOM during admission, six failed NOM after discharge. Compared to the pre-protocol group, the protocol group had similar length of stay, antibiotic days, and overall complication rates, but more readmissions (6% vs. 1%, $p=0.019$) and lower hospital charges for the index admission (\$5,630 vs. \$6,878, $p<0.001$).

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Conclusions—Implementation of a protocol to identify candidates for NOM of acute uncomplicated appendicitis was associated with lower rates of open surgery, fewer appendectomies, decreased hospital charges, and no difference in overall complications despite high rates of readmission and failure of NOM.

Level of Evidence—Therapeutic study, level IV

Keywords

Appendicitis; appendectomy; non-operative management; antibiotics; recurrent appendicitis

Introduction

Non-operative management (NOM) of acute appendicitis assumes the risk of persistent inflammation, appendiceal perforation, and recurrent appendicitis, but potentially avoids the inherent risks of an invasive procedure. Similarities in the pathophysiology of appendicitis and diverticulitis support the feasibility of treating uncomplicated appendicitis with an initial trial of antibiotics alone, with the understanding that antibiotics alone often fail (1, 2). A meta-analysis of eight studies with 2,551 patients found that 26.5% of all NOM patients required appendectomy within one year, and that adverse events were more common following NOM compared to appendectomy (3). However, patients often desire a trial of NOM (4), NOM may be more cost-effective than surgery (5), and many consider NOM to be safe and effective for adult patients with acute appendicitis (6-8). A recent meta-analysis of five randomized trials concluded that the overall complication rate for NOM is lower than appendectomy, with relative risk 0.61 (0.44-0.83) (9). With advantages and disadvantages for both operative and NOM of acute appendicitis, many clinicians seek clarity in expert opinion. In the recently published Jerusalem guidelines, DiSaverio et al. (10) did not find adequate evidence to recommend routine NOM of appendicitis.

In the absence of widely accepted evidence-based guidelines, we developed a protocol to identify candidates for NOM of acute appendicitis. The purpose of this study was to evaluate the efficacy of this protocol with the null hypothesis that clinical outcomes, hospital readmission rates, and hospital charges would be unchanged following protocol implementation.

Methods

Study design

We performed a propensity score matched retrospective cohort analysis of 406 patients with acute uncomplicated appendicitis managed at our university hospital during a four-year period ending July 1, 2016. Institutional Review Board approval was obtained. We searched our institutional database for all adults (age ≥ 18 years) with acute appendicitis. Pregnant women and patients with complicated appendicitis (i.e. perforation or abscess) or a prior episode of appendicitis were excluded.

Protocol

A protocol for managing acute uncomplicated appendicitis (Figure 1) was implemented at our institution July 1, 2015. The protocol uses the modified Alvarado score (11-13) and computed tomography (CT) findings to identify candidates for NOM. Patients undergoing NOM were admitted for close observation with serial abdominal exams and antibiotic therapy with ceftriaxone 2g intravenous (IV) every twelve hours plus metronidazole 500 mg IV every eight hours. If a patient undergoing NOM developed worsening pain or increasing leukocytosis, then appendectomy was recommended. If a patient undergoing NOM improved clinically and tolerated nutrition by mouth, then IV antibiotics were transitioned to ciprofloxacin plus metronidazole by mouth or amoxicillin/clavulanate by mouth, to be administered until the patient received seven total days of antibiotic therapy. Patients who underwent successful NOM were instructed to return to clinic in three to four weeks; patients who underwent appendectomy were instructed to return to clinic in two weeks.

Propensity score matching

During the study period, there were 453 patients meeting enrollment criteria prior to protocol implementation, and 209 patients meeting enrollment criteria after protocol implementation. Propensity score matching was performed to equilibrate group size, demographic factors, and baseline characteristics. Logistic regression generated predicted probabilities for group assignment based on three covariates: Charlson comorbidity index, duration of symptoms, and modified Alvarado score. Patients were matched one to one by the greedy nearest-neighbor method with caliper width 0.005 on the propensity score scale. For each patient in the protocol group, the non-protocol group was searched for the patient with the most similar propensity score. If the difference between propensity scores was 0.005, then the patients were set aside into matched cohorts. This process continued until matches were attempted for all 209 patients in the protocol group. In this manner, 203 protocol patients were matched to 203 non-protocol patients.

Data collection

Data regarding patient demographics, comorbidities, clinical presentation, timing of admission, systemic inflammatory response syndrome (SIRS) criteria (14), the modified Alvarado score (11-13), computed tomography (CT) imaging findings (15), procedural management, pathology findings, infectious complications (including superficial, deep, and organ/space surgical site infections and nosocomial infections), non-infectious complications (including technical complications, postoperative hemorrhage, venous thromboembolic disease, transient ischemia attack, cerebrovascular accident, myocardial infarction, and unplanned reintubation), and outcomes within 180 days were obtained from our institutional data repository and review of the electronic medical record. Admissions occurring between 6:00 pm and 6:00 am were considered nighttime admissions. The Alvarado score has been modified since its inception in 1986 (11-13). The modified Alvarado score used in this study considers eight parameters, assigning one or two points to each: pain migrating to the right lower quadrant (+1), anorexia (+1), nausea or vomiting (+1), right lower quadrant tenderness (+2), rebound tenderness (+1), temperature $> 37.5^{\circ}\text{C}$ (+1), white blood cell count $> 10.0 \times 10^9/\text{L}$ (+2), and neutrophil percentage > 75 (+1). Outcome variables included the

performance of appendectomy, laparoscopic vs. open surgery, SIRS criteria on discharge (14), days on antibiotic therapy, hospital length of stay, hospital readmissions, infectious and noninfectious complications, mortality, and hospital charges from an administrative data repository.

Power analysis

Based on results of a randomized trial of adults managed with NOM or urgent appendectomy by Vons et al. (16), our study would require at least 190 patients per group to detect significant differences between groups (17). In our study, there were 203 patients in each group after propensity-score matching was performed, suggesting that the analysis was adequately powered.

Statistical analysis

Statistical analysis was performed in SPSS version 24 (IBM, Armonk, NY). Continuous variables were compared by the Kruskal-Wallis test and reported as median [inter quartile range]. Hospital charges were also compared by one-way analysis of variance and reported as mean (95% confidence interval). Discrete variables were compared by Fisher's Exact test and reported as n (%). Correlations were assessed by Spearman's rho and reported as r values. Significance was set at $\alpha = 0.05$.

Results

Patient characteristics

Patient characteristics are listed in Table 1. There were no significant differences between groups. The study population was young (age 31 years) and healthy (ASA class 2.0, Charlson comorbidity index 0.0) with approximately 24 hours of symptoms prior to admission, and about one out of three patients meeting SIRS criteria on admission. Modified Alvarado scores were 7.0 in both groups; 55% of all patients had modified Alvarado scores ≥ 7 in each group. There were more patients with anorexia before the protocol and more patients with rebound tenderness after the protocol, but neither difference was statistically significant. There were no significant differences between pre- and post-protocol groups in nighttime admissions (45% vs. 44%, respectively, $p = 0.920$) or weekend admissions (22% vs. 29%, respectively, $p = 0.139$).

Diagnostic findings and operative management

Computed tomography (CT) scan findings, operative management, and pathology findings are listed in Table 2. There was a non-significant increase in the percentage of CT scans performed with contrast after the protocol was implemented, and the identification of appendiceal mural enhancement was significantly greater in the protocol group (48% vs. 34%, $p = 0.006$). Before protocol implementation, 99% of all patients with acute uncomplicated appendicitis had operative management, compared to 82% after protocol implementation ($p < 0.001$). In the protocol group, there was a lower incidence of open surgery (4% vs. 10%, $p = 0.044$) despite a longer interval between admission and surgery (8.6 vs. 7.1 hours, $p < 0.001$). Calculation of the interval between admission and surgery in the protocol group included eighteen patients who failed NOM and underwent delayed

appendectomy 29.1 [20.6-43.3] hours after admission (Figure 2). Five of these patients (28%) were found to have perforated appendicitis on operative exploration.

Protocol compliance

Among the 203 patients in the protocol group, the protocol recommended appendectomy for 133 patients (Figure 2). Compliance with this recommendation was 97%. There were two patients with an early and robust response to antibiotics that were administered upon arrival to the emergency department. Both of these patients were discharged home on oral antibiotics; one developed recurrent appendicitis managed by laparoscopic appendectomy 101 days later. Two additional patients declined appendectomy and requested NOM. Both were discharged home on oral antibiotics; neither developed any complications.

Protocol compliance was significantly lower when the protocol recommended NOM (73%, $p < 0.001$). Early appendectomy was performed for nineteen out of 70 patients for whom NOM was recommended. Among these nineteen patients, the patient requested appendectomy in nine cases, and diagnostic laparoscopy was performed for one patient with an acute abdomen and an unclear diagnosis with clinical suspicion for appendicitis. Intra operatively, no other pathology was identified; the patient underwent laparoscopic appendectomy, and pathology findings were consistent with acute appendicitis. Reasons for protocol non-compliance were unknown in the other nine cases. Overall protocol compliance was not significantly affected by time of day (nighttime compliance: 87% vs. daytime compliance: 90%, $p = 0.504$) or day of the week (weekend compliance: 88% vs. weekday compliance: 89%, $p > 0.999$).

Outcomes

Outcomes are listed in Table 3 and illustrated in Figure 2. Following protocol implementation, 18 out of 51 patients failed NOM during the initial admission (35%), and 24 out of 51 patients failed NOM during the study period (47%). There were three patients who had successful NOM and underwent interval elective appendectomy. Therefore, 27 out of 51 patients in the protocol NOM group (53%) underwent appendectomy during the study period. SIRS criteria were similar between groups at the time of discharge. Hospital length of stay and antibiotic days were also similar. Clinic follow-up was more frequent before protocol implementation (73% vs. 65%, $p = 0.087$) and occurred earlier (18 [14-22] days vs. 20 [17-24] days, $p = 0.004$). These parameters may have been affected by the lower rates of operative management in the protocol group. When analyzing only the 369 patients who had operative management during the index admission, clinic follow up before and after the protocol was 73% and 68%, respectively, ($p = 0.506$), and the interval between discharge and clinic follow-up was 18 [14-22] days and 20 [17-23] days, respectively ($p = 0.110$).

Hospital readmissions attributable to appendicitis and its management were more frequent in the protocol group (6% vs. 1%, $p = 0.019$). There were seven patients in the protocol group who were readmitted with appendicitis. Six of these patients presented with recurrent uncomplicated appendicitis and underwent laparoscopic appendectomy. One patient presented with a right lower quadrant phlegmon; appendectomy was recommended but declined by the patient. There were also three patients who underwent interval elective

laparoscopic appendectomy, two of whom stayed overnight in the hospital, one of whom was found to have a malignant appendiceal tumor requiring reoperation for right hemicolectomy. The incidence of infectious and non-infectious complications was similar between groups. There were no mortalities. There were no significant correlations between nighttime admission or weekend admission and interval between admission and surgery, days of antibiotic therapy, hospital length of stay, SIRS at the time of discharge, or hospital charges during the index admission. There were no significant correlations between nighttime admission and complications, but there was a significant correlation between weekend admission and infectious complications ($r = 0.137$, $p = 0.006$). Infectious complications occurred in 9.6% of all patients admitted on a weekend and 3.0% of all patients admitted during a weekday ($p = 0.012$). Compared to weekday admissions, weekend admissions did not have significant differences in demographic factors, chronic disease burden, acute illness severity, duration of symptoms, or interval between admission and operative management. Hospital charges were significantly lower in the protocol group for the index admission (median: \$5,630 vs. \$6,878, $p < 0.001$; mean: \$5,538 vs. \$8,450, $p < 0.001$) and for all admissions during the study period (median: \$5,689 vs. \$6,916, $p < 0.001$; mean: \$6,929 vs. \$8,764, $p = 0.005$). Following protocol implementation, patients who failed NOM had significantly longer hospital length of stay compared to all other patients (2.2 [1.5-3.2] vs. 1.3 [0.9-1.5] days, $p < 0.001$) and significantly higher hospital charges compared to all other patients (median: \$5,897 vs. \$5,645, $p = 0.048$; mean: \$13,528 vs. \$5,975, $p = 0.009$).

Discussion

Our findings suggest that implementation of protocol to identify candidates for NOM of acute appendicitis was safe and effective. The propensity matched groups had similar baseline characteristics, outcomes during the index admission, and complications within 180 days, but the protocol group underwent fewer appendectomies and had lower hospital charges. Protocol implementation was also associated with significantly more readmissions for appendicitis. However, the slight increase in hospital charges for readmissions were offset by significantly lower charges for the initial admission, such that total hospital charges for all admissions related to appendicitis and its management were significantly lower after protocol implementation. These observations underscore the expensive nature of emergency general surgery (18), and the potential value of NOM. Also, the expensive nature of failed NOM underscores the importance of proper patient selection for NOM and the potential value of models to accurately identify patients who are likely to fail NOM and would be better served with early appendectomy. At the administrative level, evolving Centers for Medicare & Medicaid policies regarding hospital readmissions may favor the performance of early appendectomy to avoid penalties associated with readmission for failed NOM of uncomplicated appendicitis.

Appendiceal mural enhancement was identified with greater frequency after protocol implementation. This may be partially explained by the more frequent administration of IV contrast after protocol implementation. However, the reasons for more frequent administration of IV contrast are also unclear, as baseline serum creatinine levels were nearly identical between groups. We also observed a lower incidence of open surgery after

protocol implementation. Because patients with evidence of perforation or abscess formation on CT were excluded from this study, it seems plausible that patients with hostile abdomens (e.g. history of multiple previous laparotomies, an abdominal inflammatory process, or radiation therapy) may have been preferentially allocated to NOM after protocol implementation. Unfortunately, the identification of a patient with a hostile abdomen was not consistently and reliably documented in the electronic medical record, and was not included in this analysis. Such patients may represent the population for whom NOM is of greatest benefit. The decreased incidence of open surgery in the protocol group occurred despite a significantly longer interval from admission to surgery in the protocol group. The longer interval from admission to surgery may be attributable to the subgroup of 18 patients who were initially allocated to NOM, but failed to improve clinically and underwent delayed appendectomy during the index admission. Given the stability of practice patterns among acute care surgeons at our institution during the study period, it seems unlikely that the rate of open surgery was influenced by evolving preferences of the operating surgeons. Notably, 28% of all patients who failed NOM during admission had a perforation sometime between CT scan and operative exploration, underscoring one of the inherent risks of NOM. Although nighttime admission was not associated with adverse events, there was an association between weekend admission and infectious complications, which may have been influenced by the presence of fewer personnel on weekends and changes in processes of care, as described by Drake et al (19). However, nighttime and weekend admission did not appear to influence protocol compliance.

Our protocol depends heavily on the Alvarado score, which has been criticized for having less sensitivity than clinical assessment and less sensitivity and specificity than CT for adult patients (20, 21). The recently published Jerusalem guidelines state that an Alvarado score less than five is sufficient to exclude the diagnosis of acute appendicitis, but that a high Alvarado score is insufficient to diagnose acute appendicitis (10). Both of these statements are grade A recommendations based on Level I evidence (10). Although the modified Alvarado score is useful as a screening tool to assess the likelihood of appendicitis, its accuracy as a diagnostic tool is modest, and it was not designed to stratify risk for failing NOM. Therefore, there may be a more effective approach to identifying candidates for NOM. In the NOTA study, Di Saverio et al. (6) reported that NOM failed within one week for approximately 12% of all patients (6). The comparatively high frequency of early NOM failures in our study (33% overall) supports the conclusion that our criteria for identifying candidates for NOM were suboptimal. Conversely, it is possible that our threshold for diagnosing failure of NOM was too low. Some of the patients who were deemed to have failed NOM may have improved if the antibiotics were allowed more time to take effect. However, the high rate of perforation among patients who were deemed to have failed NOM (28%) indicates that a substantial proportion of these patients had truly failed NOM. Finally, successful NOM does not exclude the presence of an underlying malignancy. Patients at increased risk for the presence of an appendiceal tumor may be better served by early appendectomy. Studies with long-term follow up of patients subjected to NOM of appendicitis are needed to accurately quantify the risk of missing an underlying malignancy and the associated impact on quality of life and survival.

The major limitations of this study are the small sample size, selection bias inherent to retrospective studies, potential inaccuracies in the reporting of history and physical exam findings and CT scan findings, analysis of hospital charges rather than true costs (22), and the potential for a Hawthorne effect in which the actions of individuals caring for patients with appendicitis may have been influenced by the knowledge that protocol compliance would be discussed among attending staff. We sought to limit selection bias by performing propensity score matching to generate similar study populations. Although history and physical exam findings may have been reported inaccurately in the electronic medical record, it seems unlikely that such inaccuracies would be more frequent or consequential in either study group, and therefore unlikely that it would skew the comparison between groups. Unfortunately, the infrastructure necessary to accurately measure healthcare costs, described by Lee et al. (22), was not available during the study period. Finally, the presence of a Hawthorne effect must occasionally be accepted when instituting quality improvement measures and we acknowledge that our findings must be interpreted in the context of this limitation.

Conclusions

Implementation of a protocol to identify candidates for NOM of acute uncomplicated appendicitis was associated with lower rates of open surgery, fewer appendectomies, lower hospital charges, and no difference in overall complications despite high rates of readmission and failure of NOM. Failed NOM was associated with high rates of appendiceal perforation, prolonged hospitalization, and significantly increased hospital charges. Future research should seek to identify conditions present on admission that are associated with increased risk for failing NOM and assess the long-term effects of NOM.

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Figure 1.

Management protocol for uncomplicated acute appendicitis. ^aCeftriaxone 2g intravenous (IV) every 12 hours plus metronidazole 500 mg IV every eight hours, ^bciprofloxacin plus metronidazole or amoxicillin/clavulanate, to be administered until the patient had received seven total days of antibiotic therapy. PO: *per os*/by mouth, WBC: white blood cell count.

Figure 2.

Protocol recommendations, management strategies, and outcomes for patients with acute uncomplicated appendicitis. NOM: non-operative management.

Table 1

Patient characteristics on admission for propensity matched groups presenting with uncomplicated acute appendicitis before and after protocol implementation.

Patient characteristics	Before protocol n = 203	After protocol n = 203	p
Age	30 [23-46]	31 [22-46]	0.907
Female	99 (49%)	109 (54%)	0.372
ASA physical status class	2.0 [1.0-2.0]	2.0 [1.0-2.0]	0.642
Charlson comorbidity index	0.0 [0.0-0.0]	0.0 [0.0-1.0]	0.618
Crohns disease	1 (0.5%)	2 (1%)	>0.999
Diabetes	14 (7%)	14 (7%)	-
Without complications	11 (5%)	12 (6%)	>0.999
With complications	3 (1%)	2 (1%)	>0.999
Body mass index	25.9 [22.8-29.5]	26.3 [23.1-31.2]	0.221
Former smoker	37 (18%)	35 (17%)	0.897
Current smoker	36 (18%)	38 (19%)	0.898
COPD	21 (10%)	22 (11%)	>0.999
Outpatient steroids	2 (1%)	5 (2%)	0.449
Outpatient immunosuppressants	3 (1%)	1 (0.5%)	0.623
Duration of symptoms (h)			
Prior to admission	23.9 [12.1-47.5]	24.6 [12.0-46.6]	0.664
From admission to CT	2.1 [1.1-3.3]	1.9 [1.3-3.0]	0.726
T _{max} within 6 hours (°C)	37.0 [36.8-37.3]	37.0 [36.8-37.3]	0.129
T _{min} within 6 hours (°C)	36.7 [36.5-36.9]	36.7 [36.5-36.9]	0.893
Heart rate	85 [74-96]	87 [75-98]	0.403
Respiratory rate	16 [16-18]	16 [16-18]	0.425
C-reactive protein (mg/L)	18.6 [7.7-62.1]	15.1 [4.5-54.1]	0.528
Creatinine (mg/dL)	0.8 [0.7-1.0]	0.8 [0.7-0.9]	0.801
White blood cell count ($\times 10^9/L$)	14.0 [11.2-17.0]	13.5 [10.5-16.3]	0.221
% neutrophils	82.1 [75.7-87.7]	81.9 [73.4-86.6]	0.293
SIRS	66 (33%)	61 (30%)	0.669
Alvarado score	7.0 [6.0-7.0]	7.0 [5.0-7.0]	0.421
Alvarado score 7	111 (55%)	111 (55%)	-
Migratory RLQ pain	125 (62%)	127 (63%)	0.919
Anorexia	193 (95%)	183 (90%)	0.086
Nausea or vomiting	160 (79%)	152 (75%)	0.410
RLQ tenderness	201 (99%)	198 (98%)	0.449
Rebound tenderness	69 (34%)	88 (43%)	0.066

ASA: American Society of Anesthesiologists, COPD: chronic obstructive pulmonary disease, SIRS: systemic inflammatory response syndrome, RLQ: right lower quadrant. Data are presented as median [interquartile range] or n (%).

Table 2

Computed tomography (CT) scan findings, operative management, and pathology findings.

Diagnostic findings	Before protocol n = 203	After protocol n = 203	p
CT scan findings			
Had a CT	201 (99%)	202 (99%)	>0.999
CT performed at OSH [†]	22 (11%)	16 (8%)	0.395
CT with intravenous contrast	166 (93%)	181 (97%)	0.053
Right lower quadrant fluid	51 (29%)	47 (25%)	0.555
Appendicolith	61 (34%)	49 (26%)	0.112
Appendix diameter (mm)	10.0 [9.0-13.0]	10.0 [9.0-13.0]	0.326
Wall thickening	27 (15%)	39 (21%)	0.174
Mural enhancement	61 (34%)	90 (48%)	0.006
Fat stranding	140 (78%)	146 (78%)	>0.999
Phlegmon/abscess/perforation	0 (0%)	0 (0%)	-
Operative management	202 (99%)	167 (82%)	<0.001
Hours from admission to OR	7.1 [5.2-10.2]	8.6 [6.5-12.4]	<0.001
Perforation noted in OR	25 (12%)	21 (13%)	>0.999
Appendectomy	198 (98%)	163 (98%)	>0.999
Ileocectomy	2 (1%)	2 (1%)	>0.999
Right hemicolectomy	2 (1%)	2 (1%)	>0.999
Laparoscopic	173 (86%)	154 (92%)	0.050
Open	20 (10%)	7 (4%)	0.044
Converted to open	9 (4%)	6 (4%)	0.794
Pathology findings			
Appendicitis	196 (97%)	163 (98%)	>0.999
Suppuration	21 (10%)	28 (17%)	0.090
Necrosis or gangrene	32 (16%)	32 (19%)	0.411
Premalignant tumor	0 (0%)	1 (0.6%)	0.453
Malignant tumor	2 (1%)	4 (2%)	0.416

[†] Findings from outside hospital (OSH) CT scans were not consistently reported and were not included in the analysis. OR: operating room. Data are presented as n (%) or median [interquartile range].

Table 3

Outcomes for propensity matched groups presenting with uncomplicated acute appendicitis before and after protocol implementation.

Outcomes	Before protocol n = 203	After protocol n = 203	p
On discharge			
T _{max} within 6 hours (°C)	36.9 [36.7-37.1]	36.9 [36.8-37.1]	0.091
T _{min} within 6 hours (°C)	36.7 [36.5-36.9]	36.7 [36.6-36.9]	0.522
Heart rate	78 [70-86]	76 [67-88]	0.449
Respiratory rate	17 [16-18]	17 [16-18]	0.131
Creatinine (mg/dL)	0.8 [0.6-0.9]	0.8 [0.6-0.9]	0.306
White blood cells ($\times 10^9/L$)	9.9 [7.9-12.6]	9.3 [7.1-11.8]	0.247
% neutrophils	79.1 [70.3-85.3]	74.8 [66.0-83.7]	0.278
SIRS	9 (4%)	9 (4%)	-
Hospital length of stay (days)	1.2 [0.9-2.2]	1.2 [0.9-1.6]	0.175
Total antibiotic days	0.6 [0.2-2.4]	0.5 [0.2-3.5]	0.682
Inpatient antibiotic days	0.6 [0.2-1.5]	0.5 [0.2-1.2]	0.334
Outpatient antibiotic days	0.0 [0.0-0.0]	0.0 [0.0-2.0]	0.167
Clinic follow-up	148 (73%)	131 (65%)	0.087
Days to clinic follow-up	18 [14-22]	20 [17-24]	0.004
Readmission within 180 days	3 (1%)	13 (6%)	0.019
For surgical site infection	3 (1%)	2 (1%)	>0.999
For appendicitis	0 (0%)	7 (3%)	0.015
For elective appendectomy	0 (0%)	4 (2%)	0.123
Complication within 180 days	23 (11%)	21 (10%)	0.873
Infectious complication	12 (6%)	7 (3%)	0.348
Surgical site infection	10 (5%)	6 (3%)	0.445
Superficial	3 (1%)	1 (0.5%)	0.623
Deep	2 (1%)	4 (2%)	0.685
Organ/space	5 (2%)	1 (0.5%)	0.215
Other nosocomial infection	2 (1%)	1 (0.5%)	>0.999
Noninfectious complication	12 (6%)	14 (7%)	0.840
Mortality within 180 days	0 (0%)	0 (0%)	-
Charges: index admission (median \$)	6,878 [5,669-9,599]	5,630 [4,824-6,301]	<0.001
Charges: index admission (mean \$)	8,450 (7,636-9,264)	5,538 (5,367-5,709)	<0.001
Total charges (median \$)	6,916 [5,690-9,668]	5,689 [4,952-6,457]	<0.001
Total charges (mean \$)	8,764 (7,858-9,670)	6,929 (6,021-7,837)	0.005

SIRS: systemic inflammatory response syndrome. Data are presented as median [interquartile range], n (%), or mean (95% confidence interval).