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Effect of time to operation on value of care in acute care surgery

Tyler J. Loftus, MD, Martin D. Rosenthal, MD, Chasen A. Croft, MD, FACS, R. Stephen Smith, MD, FACS, Philip A. Efron, MD, FACS, FCCM, Frederick A. Moore, MD, FACS, MCCM, Alicia M. Mohr, MD, FACS, FCCM, and Scott C. Brakenridge, MD, MSCS, FACS

University of Florida Health, Department of Surgery and Sepsis and Critical Illness Research Center in Gainesville, Florida

Abstract

Background—As reimbursement models evolve, there is increasing emphasis on maximizing value-based care for inpatient conditions. We hypothesized that longer intervals between admission and surgery would be associated with worse outcomes and increased costs for acute care surgery patients, and that these associations would be strongest among patients with high-risk conditions.

Methods—We performed a five-year retrospective analysis of three risk cohorts: appendectomy (low-risk for morbidity and mortality, $n=618$), urgent hernia repair (intermediate-risk, $n=80$), and laparotomy for intra-abdominal sepsis with temporary abdominal closure (sTAC; high-risk, $n=102$). Associations between the interval from admission to surgery and outcomes including infectious complications, mortality, length of stay, and hospital charges were assessed by regression modeling.

Results—Median intervals between admission and surgery for appendectomy, hernia repair, and sTAC were 9.3h, 13.5h, and 8.1h, respectively, and did not significantly impact infectious complications or mortality. For appendectomy, each 1h increase from admission to surgery was associated with increased hospital LOS by 1.1h ($p=0.002$) and increased intensive care unit (ICU) LOS by 0.3h ($p=0.011$). For hernia repair, each 1h increase from admission to surgery was associated with increased antibiotic duration by 1.6h ($p=0.007$), increased hospital LOS by 3.3h ($p=0.002$), increased ICU LOS by 1.5h ($p=0.001$), and increased hospital charges by \$1,918 ($p<0.001$). For sTAC, each 1h increase from admission to surgery was associated with increased antibiotic duration by 5.0h ($p=0.006$), increased hospital LOS by 3.9h ($p=0.046$), increased ICU LOS by 3.5h ($p=0.040$), and increased hospital charges by \$3,919 ($p=0.002$).

Conclusions—Longer intervals from admission to surgery were associated with prolonged antibiotic administration, longer hospital and ICU length of stay, and increased hospital charges, with strongest effects among high-risk patients. To improve value of care for acute care surgery patients, operations should proceed as soon as resuscitation is complete.

Please address correspondence to: Scott C. Brakenridge, MD, MSCS, University of Florida Health, Gainesville, FL, 1600 SW Archer Road Room M-602, Gainesville, FL, 32610-3003, 972-415-2447, Scott.Brakenridge@surgery.ufl.edu.

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Introduction

For several acute diseases, surgical intervention is the most efficient, effective, and definitive treatment. When surgery is offered for these conditions, it seems prudent to operate as soon as possible [1]. This is particularly true when the goal of care is to remove a source of infection or to reduce an acutely incarcerated hernia containing potentially threatened bowel. Intravenous fluid resuscitation is necessary to ensure that anesthesia may be safely induced, especially in the setting of sepsis, and can typically occur within the short period of time necessary to prepare facilities and staff for the operation. There is no apparent advantage of delaying operative management beyond this brief period of initial physiologic resuscitation.

However, the relationship between the interval from admission to surgery and clinical outcomes is unclear. Previous studies have had mixed results for patients with appendicitis [2-12]. Perhaps results have been inconsistent because appendicitis and appendectomy are low-risk entities compared to many other acute surgical diseases and operations. Unfortunately, there is a relative paucity of data about the timing of surgery for higher-risk entities like acutely incarcerated hernias that may contain threatened bowel and intra-abdominal sepsis managed by exploratory laparotomy and temporary abdominal closure (sTAC). In addition, most work regarding the interval from admission to surgery has focused on clinical outcomes rather than value of care, i.e. clinical outcomes in the context of financial costs [13].

The purpose of this study was to investigate the relationships between the interval from admission for acute care surgical conditions to surgery and outcomes including infectious complications, mortality, duration of antibiotic therapy, length of stay, and hospital charges among three distinct patient populations: appendicitis managed by appendectomy, acutely incarcerated ventral and groin hernias managed by open mesh hernia repair, and sTAC. These populations were selected to represent patients at low, intermediate, and high-risk for adverse outcomes, respectively. We hypothesized that longer intervals between admission and surgery would be associated with worse outcomes and increased costs for acute care surgery patients, and that these associations would be strongest among high-risk patients.

Methods

We performed a retrospective analysis of three cohorts of acute care surgery patients with three different risk profiles for morbidity and mortality: appendicitis managed by appendectomy (low-risk, n =618), acutely incarcerated ventral and groin hernias managed by emergent open hernia repair (intermediate-risk, n=80), and abdominal sepsis managed by exploratory laparotomy and temporary abdominal closure (sTAC; high-risk, n=102). Institutional Review Board approval was obtained. Derivation of the study population is illustrated in Figure 1. Patients were identified by searching our institutional database for all adult (age ≥ 18 years) patients with Current Procedural Terminology (CPT) codes for appendectomy, hernia repair, and relaparotomy during a 5-year period ending July 2016. Patients who survived less than 72 hours were excluded to ensure that all subjects would have complete data for analysis of systemic inflammatory response syndrome (SIRS) criteria [14] and sequential organ failure assessment (SOFA) scores [15] for 72 hours following

admission. In the low-risk appendectomy cohort, patients were excluded if their initial treatment plan was non-operative management with antibiotic therapy alone (as per clinical protocol; Alvarado score ≤ 6 and no appendicolith). In the moderate-risk hernia repair cohort, patients were excluded if they had duration of symptoms >4 days, peritonitis or suspicion of bowel perforation. In the high-risk sTAC cohort, patients who did not have abdominal sepsis present on admission were excluded, as well as those with a primary diagnosis of complicated pancreatitis due to significant differences in the pre and postoperative courses associated with this disease process. Relaparotomy for sTAC patients was performed within 24-48 hours following initial laparotomy. At our institution during the study period, operative management of all three cohorts was performed by an acute care surgery service with 24-hour per day, 7-day per week in-house availability of faculty dedicated to trauma surgery, emergency general surgery, and surgical critical care. Case priority was determined on a case-by-case basis, with preference for operating room availability given to emergencies.

Data regarding demographics, baseline characteristics, management, and outcomes were collected from our institutional database and by retrospective review of the electronic medical record. General medical condition and chronic disease burden were characterized by American Society of Anesthesiologists (ASA) physical status classification and the Charlson comorbidity index. The severity of the acute disease process and initial response to treatment was characterized by SIRS criteria and SOFA scores at the time of admission, as well as 24, 48, and 72 hours after admission. Infectious complications were assessed, including surgical site infections by Centers for Disease Control criteria [16] within 180 days of surgery, and other nosocomial infections (urinary tract infection, pneumonia, bloodstream infection, *Clostridium difficile* stool infection) occurring ≤ 48 hours after admission and within 30 days of discharge. Urinary tract infection was defined as $\geq 10^5$ organisms on culture. Pneumonia was defined as $\geq 10^4$ organisms on quantitative bronchoalveolar lavage or Clinical Pulmonary Infection Score [17] >6 . Blood stream infection was defined as two of four bottles positive for likely contaminants (i.e., *Staphylococcus epidermidis*, *Propionibacterium acnes*, and *Corynebacterium* spp.), or one of four bottles positive for other organisms. *Clostridium difficile* stool infections were identified by the presence of *Clostridium difficile* toxin on polymerase chain reaction. Other outcomes included duration of antibiotic therapy, length of stay in the hospital and in the intensive care unit (ICU), discharge disposition, readmission within 180 days, mortality within 180 days, and hospital charges associated with the initial admission as well as readmissions within 180 days. Hospital charges were obtained from an institutional registry that includes administrative data.

Statistical analysis was performed in SPSS version 24 (IBM, Armonk, NY). Continuous variables were compared by the Kruskal-Wallis test and reported as median [interquartile range]. Discrete variables were compared by Fisher's Exact test and reported as n (%). Significance was set at $\alpha = 0.05$ with application of the Bonferroni correction for comparisons across three cohorts. Changes in the percentage of patients with SIRS over time were assessed by McNemar's test. Changes in SOFA scores over time were assessed by paired t-test. Associations between the interval from admission to surgery and binary variable outcomes were assessed by univariate logistic regression and reported as odds ratios with 95% confidence intervals. Associations between the interval from admission to surgery

and continuous variable outcomes were assessed by univariate linear regression and reported as beta coefficients with 95% confidence intervals.

Results

Characteristics of the study population

Appendectomy, emergent hernia repair, and sTAC cohorts each had unique baseline characteristics (Table 1). Appendectomy patients were significantly younger than hernia repair and sTAC patients (30 vs. 57 vs. 64 years, respectively) and had less acute and chronic disease burden (ASA class 2.0 vs. 3.0 vs. 4.0, respectively; Charlson comorbidity index 0.0 vs. 1.0 vs. 1.0, respectively). There were non-significant differences in the interval between admission and surgery for appendectomy, hernia repair, and sTAC (9.3 vs. 13.5 vs. 8.1 hours, respectively). In the appendectomy cohort, 97/618 (16%) were noted to be perforated on operative exploration. In the hernia repair cohort, 35/80 (44%) had evidence of inflammation or bowel wall compromise on preoperative CT scan, and 7/80 (9%) required bowel resection. In the sTAC cohort, the reason for laparotomy was bowel ischemia in 57/102 (56%), hollow viscus perforation in 34/102 (33%), and an inflammatory or infectious process in 11/102 (11%).

Physiologic response to surgery

Trends in systemic inflammation and organ dysfunction over time are illustrated in Figure 2. In addition to baseline differences in demographics and illness severity at the time of admission, the physiologic response to surgery was also unique in each group. Appendectomy and sTAC patients had a significant decrease in the incidence of SIRS from admission to 24 hours after admission; hernia repair patients did not have a significant decrease in the incidence of SIRS until 72 hours after admission. Appendectomy and hernia repair patients had stepwise decreases in the incidence of SIRS over time. This did not occur in sTAC patients, who are subjected to planned relaparotomy. Among appendectomy and hernia repair patients, SOFA scores decreased significantly from admission to 24 hours following admission, and continued to decrease over time. Among sTAC patients, SOFA scores remained elevated for 72 hours following admission.

Outcomes

Observed outcomes validated the selection of appendectomy, hernia repair, and sTAC cohorts to represent patients with low, intermediate, and high-risk for morbidity and mortality. Mortality within 180 days was highest among sTAC patients (27%), followed by hernia repair (6%) and appendectomy (0%). Surgical site infections were more common following hernia repair than sTAC (28% vs. 14%), and both groups had higher surgical site infection rates than appendectomy (4%) (Table 2). Other nosocomial infections were more common following sTAC than hernia repair (20% vs. 5%), and both groups had higher nosocomial infection rates than appendectomy (0.6%). Duration of antibiotic therapy, hospital length of stay, and intensive care unit length of stay each correlated with nosocomial infection rates.

Interval from admission to surgery: Impact on outcomes

Associations between interval from admission to surgery and outcomes were assessed by univariate logistic and linear regression (Table 3). In all three cohorts, the interval between admission and surgery was not predictive of any measured outcomes, including unplanned reoperation, surgical site infection, nosocomial infection, readmission, or mortality. Total duration of antibiotic therapy was not significantly affected by the interval from admission to surgery in the appendectomy cohort. However, each one hour increase in the interval from admission to surgery was associated with a 1.6 hour increase in antibiotic duration among hernia repair patients ($p = 0.007$) and a 5.0 hour increase in antibiotic duration among sTAC patients ($p = 0.006$). Among hernia patients, for whom antibiotics are usually not administered until the perioperative period, the association between time to surgery and antibiotic duration may have been related to concern for bowel wall compromise, bacterial translocation across compromised bowel, and the possibility of bowel perforation or strangulation. This supposition is supported by the observation that longer intervals from admission to surgery were associated with increased likelihood of performing a bowel resection at the time of hernia repair (OR 1.03, 95% CI 1.00-1.05, $p=0.026$).

Each one hour increase in the interval from admission to surgery was associated with longer hospital length of stay in each group (appendectomy: 1.1 hour increase [21.8:24 hr] ($p=0.002$), hernia repair: 3.3 hour increase [7.3:24 hr] ($p=0.002$), sTAC: 3.9 hour increase [6.2:24 hr] ($p=0.046$). Similar patterns were observed for ICU length of stay (appendectomy: 0.3 hour increase ($p=0.011$), hernia repair: 1.5 hour increase ($p=0.001$), sTAC: 3.5 hour increase ($p=0.040$).

Longer intervals between admission and surgery were also associated with increased hospital charges among intermediate-risk and high-risk groups. Each one hour increase in the interval from admission to surgery was associated with a \$1,918 increase ($p<0.001$) in hospital charges for the index admission among hernia repair patients, and was associated with a \$3,919 increase ($p=0.002$) in hospital charges for sTAC patients. The interval between admission and surgery did not significantly impact charges for appendectomy patients.

Discussion

As expected, patients who underwent appendectomy, urgent hernia repair, and laparotomy with TAC for abdominal sepsis (sTAC) were distinct populations with different baseline characteristics, treatment response, and long-term outcomes, representing cohorts with low, intermediate, and high-risk conditions. In all three groups, there were no significant associations between the interval from admission to surgery and clinical outcomes, such as infectious complications or mortality. However, longer intervals between admission and surgery were associated with longer stays in the hospital and in the ICU in all three groups, and were also associated with increased hospital charges during the index admission for intermediate and high-risk patients undergoing hernia repair and sTAC.

Previous studies investigating relationship between the timing of surgery and clinical outcomes have had inconsistent results. Among patients with acute appendicitis, several authors have found no associations between the timing of surgery and adverse outcomes

[4-8]. However, several authors have reported increased rates of perforation and postoperative complications when the intervals between symptom onset, admission, and surgery are prolonged [2, 3, 9, 10]. In our study, increases in length of stay following appendectomy were directly proportional to the interval between admission and surgery (1.0 hour increase in time to surgery was associated with 1.1 hour increase in length of stay) without any difference in outcomes, suggesting that systems and logistics issues influenced time to surgery, rather than disease severity and the need for resuscitation.

For patients undergoing urgent hernia repair, several authors have reported that longer duration of symptoms and delay in consultation with a surgeon may be associated with increased morbidity and mortality [18-20]. Less data exists regarding the timing of emergency laparotomy and TAC for abdominal infection. In our study, although hernia repair and sTAC patients had a greater degree of organ dysfunction present on admission than appendectomy patients, initial illness severity and the need for resuscitation do not seem to justify the observed intervals from admission to surgery for hernia repair and sTAC patients (13.5 hours and 8.1 hours, respectively). The 13.5 hour median time to surgery among hernia repair patients suggests that these cases may have been lower priority than other urgent and emergent cases.

Although there were no significant associations between the interval from admission to surgery and patient morbidity and mortality, longer intervals were associated with longer length of stay and increased hospital charges. Therefore, cases with longer intervals between admission and surgery likely decreased the value of care provided by increasing medical costs and sequestering potentially productive members of society within the hospital, without providing any clinical benefit. Our findings suggest that this is especially true for low-risk appendectomy patients. Lee et al. [13] recently described how implementation of a value-driven outcomes tool was associated with decreased costs and improved quality for patients undergoing hip and knee surgery, patients with sepsis, and utilization of hospital laboratory services. Ultimately, the desire to relieve patients' suffering and illness in a timely manner and the desire to provide high-value care should drive healthcare workers and healthcare systems to identify and eliminate sources of delays in providing care. Patient-centered outcomes are also germane to this discussion. The authors echo the words of Dr. Carr [21]: "from a patient perspective, timely care is optimal and any delay only keeps them sicker for longer."

This study was limited by including a small sample of patients from a single institution and by selection bias inherent to retrospective analysis. Although the single-institution nature of this study limits its generalizability to other practice settings, it also limits variability in practice patterns and operating room workflow processes, which may vary across institutions. Selection bias was limited as much as possible by including all consecutive patients meeting inclusion and exclusion criteria. In addition, it is difficult to assess the relative importance of different factors which may affect the length of the interval from admission to surgery, including organizational inefficiencies, staff availability, and complex ethical decisions requiring family meetings and discussions. Unfortunately, quantifying these factors is beyond the reach of this analysis. Future research should seek to assess the relative importance of these factors in affecting the interval from admission to surgery,

especially in complex, high-risk patients. Finally, hospital charges do not necessarily reflect true costs. Calculating overall healthcare system costs requires analysis of complex relationships among the hospital, patient, and payer, and requires derivation of a cost-calculating tool that must be specific to the setting in which it is used [13]. Future research should seek to derive and validate such tools and use them to assess the impact of the timing of surgery on value of care on a larger scale.

Conclusions

Among acute care surgery patients at low, intermediate, and high-risk for postoperative morbidity and mortality, there were no significant associations between time to surgery and observed morbidity and mortality. However, longer intervals between admission and surgery were associated with longer length of stay and increased hospital charges. In high-risk conditions, this is likely due to severity of illness and the need for initial physiologic resuscitation prior to operation. However, in low and medium-risk conditions, system logistics-associated delays to operation are likely responsible. To optimize and provide high-value care, acute care surgery operations should proceed as soon as possible after physiologic resuscitation is complete.

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Figure 1.

Derivation of the study population. CPT: Current Procedural Terminology, sTAC: emergent laparotomy for intra-abdominal sepsis with temporary abdominal closure.

Figure 2.

Systemic inflammation and organ dysfunction over time for patients undergoing appendectomy, urgent hernia repair, and laparotomy with temporary abdominal closure (TAC) for intra-abdominal sepsis. **A:** Changes in the systemic inflammatory response syndrome (SIRS) over time, presented as percentage of total population, * $p < 0.05$ vs. Admit within each group, * $p < 0.05$ between groups. **B:** Changes in sequential organ failure assessment (SOFA) scores over time, presented as mean with 95% confidence interval, * $p < 0.05$ vs. Admit within each group, * $p < 0.05$ between groups.

Table 1

Baseline characteristics of patients undergoing appendectomy, urgent hernia repair, and laparotomy with temporary abdominal closure (TAC) for abdominal sepsis.

Patient characteristics	Appendectomy ^a n = 618	Hernia repair ^b n = 80	TAC for sepsis ^c n = 102	*Bonferroni corrected <i>p</i>	
				<i>p</i> ^{a,b}	<i>p</i> ^{b,c}
Age (years)	30 [22-45]	57 [51-68]	64 [53-73]	<0.002	<0.002
Female	304 (49%)	35 (44%)	61 (60%)	>0.999	0.162
ASA class	2.0 [1.0-2.0]	3.0 [3.0-3.0]	4.0 [3.0-4.0]	<0.002	<0.002
Charlson comorbidity index	0.0 [0.0-0.0]	1.0 [0.0-2.0]	1.0 [0.0-3.0]	<0.002	<0.002
Body mass index (kg/m ²)	26 [23-30]	31 [26-38]	28 [22-32]	<0.002	0.441
T _{max} within 6h (°C)	37.0 [36.8-37.3]	36.9 [36.6-37.1]	37.0 [36.7-37.6]	<0.002	>0.999
T _{min} within 6h (°C)	36.8 [36.5-36.9]	36.6 [36.4-36.8]	36.5 [36.1-36.8]	0.003	<0.002
Heart rate	85 [74-98]	87 [71-100]	102 [86-113]	>0.999	<0.002
Respiratory rate	17 [16-18]	18 [16-20]	19 [16-24]	0.039	<0.002
Serum Bicarbonate (mEq/L)	24 [23-26]	25 [23-28]	22 [18-25]	0.093	<0.002
Serum Creatinine (mg/dL)	0.8 [0.7-1.0]	0.9 [0.7-1.2]	1.2 [0.8-1.9]	0.108	<0.002
WBC count (× 10 ⁹ /L)	13.9 [11.1-16.9]	9.8 [7.7-12.4]	12.9 [9.2-19.1]	<0.002	>0.999
Neutrophil %	81.9 [75.6-87.6]	76.7 [71.0-85.7]	86.9 [79.5-91.0]	0.009	<0.002
Hours from admission to OR	9.3 [6.9-12.1]	13.5 [2.6-32.8]	8.1 [4.3-24.0]	0.333	>0.999

TAC: temporary abdominal closure, ASA: American Society of Anesthesiologists, WBC: white blood cell, OR: operating room.

* Bonferroni corrected *p* <0.05 was considered significant. Data are presented as median [interquartile range] or n (%).

Outcomes for patients undergoing appendectomy, urgent hernia repair, and laparotomy with temporary abdominal closure (TAC) for abdominal sepsis.

Table 2

Outcomes	Appendectomy ^a n = 618	Hernia repair ^b n = 80	TAC for sepsis ^c n = 102	*Bonferroni corrected p		
				p ^{a,b}	p ^{a,c}	p ^{b,c}
Unplanned reoperation [#]	6 (1%)	7 (9%)	9 (9%)	<0.002	<0.002	>0.999
Surgical site infection [#]	22 (4%)	22 (28%)	14 (14%)	<0.002	<0.002	0.075
Superficial	3 (0.5%)	4 (5%)	1 (1%)	0.012	>0.999	0.513
Deep	5 (0.8%)	0	5 (5%)	>0.999	0.021	0.204
Organ/space	14 (2%)	18 (23%)	8 (8%)	<0.002	0.021	0.018
Other nosocomial infection [†]	4 (0.6%)	4 (5%)	20 (20%)	0.024	<0.002	0.012
Urinary tract infection	2 (0.3%)	4 (5%)	11 (11%)	0.006	<0.002	0.555
Pneumonia	0	0	8 (8%)	-	<0.002	0.030
Bloodstream infection	0	1 (1%)	4 (4%)	0.345	<0.002	>0.999
<i>C. difficile</i> stool infection	2 (0.3%)	0	1 (1%)	>0.999	>0.999	>0.999
Multiple infections	0	1 (1%)	4 (4%)	0.345	<0.002	>0.999
Hospital length of stay (d)	1.2 [0.9-1.8]	4.2 [2.5-7.4]	15.2 [8.9-27.5]	<0.002	<0.002	<0.002
ICU length of stay (d)	0.0 [0.0-0.0]	0.0 [0.0-1.8]	10.0 [5.0-19.0]	<0.002	<0.002	<0.002
Antibiotic days	0.5 [0.2-1.6]	1.9 [0.1-6.9]	15.0 [8.0-24.5]	0.015	<0.002	<0.002
Discharge disposition						
Home	608 (98%)	65 (81%)	29 (28%)	<0.002	<0.002	<0.002
Subacute rehabilitation	8 (1%)	9 (11%)	26 (25%)	<0.002	<0.002	0.066
Long-term acute care	1 (0.2%)	3 (4%)	19 (19%)	0.015	<0.002	0.006
Inpatient rehabilitation	0	1 (1%)	4 (4%)	0.345	<0.002	>0.999
Another hospital	1 (0.2%)	1 (1%)	7 (7%)	0.648	<0.002	0.240
Inpatient mortality	0	0	11 (11%)	-	<0.002	0.009
Hospice	0	1 (1%)	6 (6%)	0.345	<0.002	0.411
Readmission [#]	8 (1%)	28 (35%)	28 (28%)	<0.002	<0.002	0.996
Mortality [†]	0	5 (6%)	27 (27%)	<0.002	<0.002	<0.002
Charges-first admission	6,369 [5,355-7,962]	46,481 [32,727-97,278]	236,242 [129,153-378,070]	<0.002	<0.002	<0.002
Charges-all admissions	6,383 [5,368-8,173]	53,039 [30,686-112,842]	253,312 [143,840-401,201]	<0.002	<0.002	<0.002

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TAC: temporary abdominal closure.

within 180 days,

[†] within 30 days,

* Bonferroni corrected $p < 0.05$ was considered significant. Data are presented as n (%) or median [interquartile range].

Table 3

Associations between interval from admission to surgery and outcomes for patients undergoing appendectomy, urgent hernia repair, and laparotomy with temporary abdominal closure (TAC) for abdominal sepsis.

Binary outcomes	Appendectomy n = 618				Hernia repair n = 80				TAC for sepsis n = 102			
	OR	95% CI	p		OR	95% CI	p		OR	95% CI	p	
Unplanned reoperation [#]	0.99	0.85, 1.16	0.937		1.02	0.99, 1.04	0.183		1.01	0.98, 1.04	0.441	
Surgical site infection [#]	1.00	0.93, 1.08	0.935		1.02	1.00, 1.04	0.094		1.00	0.97, 1.03	0.982	
Nosocomial infection [†]	0.95	0.76, 1.19	0.653		1.02	0.99, 1.05	0.148		1.00	0.97, 1.03	0.934	
Inpatient mortality	-	-	-		-	-	-		1.01	0.98, 1.04	0.409	
Readmission [#]	1.01	0.90, 1.14	0.867		1.01	0.99, 1.02	0.484		0.99	0.97, 1.02	0.476	
Mortality [#]	-	-	-		1.02	0.99, 1.04	0.219		1.00	0.98, 1.02	0.869	
Continuous outcomes	β	95% CI	p		β	95% CI	p		β	95% CI	p	
Total antibiotic hours	0.89	-0.97, 2.69	0.239		1.60	0.01, 3.28	0.007		4.98	1.22, 9.30	0.006	
Hospital length of stay (h)	1.14	0.33, 2.08	0.002		3.31	0.89, 4.85	0.002		3.85	0.32, 7.85	0.046	
ICU length of stay (h)	0.319	0.07, 0.62	0.011		1.49	0.14, 2.48	0.001		3.47	0.33, 6.69	0.040	
Total hospital charges	-56	-164, 75	0.165		1.918	273, 2,549	<0.001		3.919	1,522, 6,645	0.002	

Binary variable outcomes are reported as odds ratios with 95% confidence intervals; continuous variable outcomes are reported as beta coefficients with t-statistics. ICU: intensive care unit.

[#] within 180 days,

[†] within 30 days