The American Journal of Surgery (2016) 212, 857-862

The American Journal of Surgery®

Clinical Science

Hospital variation in outcomes following appendectomy in a regional quality improvement program

Peter C. Jenkins, M.D., M.Sc.[a,*], Mary K. Oerline, M.S.[b], Andrew J. Mullard, M.S.[b], Michael J. Englesbe, M.D., F.A.C.S.[b], Darrell A. Campbell, Jr, M.D., F.A.C.S.[b], Mark R. Hemmila, M.D., F.A.C.S.[b]

[a]Department of Surgery, Indiana University, North Capitol Avenue, Suite B250, Indianapolis, IN 46202, USA; [b]Department of Surgery, Center for Healthcare Outcomes and Policy, University of Michigan, Ann Arbor, MI, USA

KEYWORDS:
Outcomes;
Emergency general surgery;
Regional quality improvement;
Appendectomy

Abstract

BACKGROUND: The aim of this study was to determine hospital variation in clinical outcomes after appendectomy for acute appendicitis.

METHODS: Using data from the Michigan Surgical Quality Collaborative, we selected patients with procedure codes for open or laparoscopic appendectomy with a diagnosis of acute appendicitis (2006 to 2011). We used multivariate regression models for risk adjustment of patient-level factors and reliability adjustment for sample size differences between hospitals. Adjusted rates of outcomes for each hospital were generated by multiplying ratios of observed to expected events by overall mean event rates.

RESULTS: During the study period, 12,410 patients underwent appendectomies in 49 participating Michigan Surgical Quality Collaborative hospitals. Neither the mortality rate nor the rate of superficial or deep surgical site infection demonstrated significant variation. However, significant variation was observed for all other clinical outcomes, including a 14-fold difference of the rate of postoperative sepsis and septic shock.

CONCLUSIONS: We found significant hospital variation in outcomes after appendectomy and identified missing variables that could help to explain the observed variation. These findings have been used to enhance ongoing quality improvement efforts across the state of Michigan.

Regional collaborations among hospitals and physicians have been associated with improved clinical outcomes and decreased costs for surgical patients.[1–5] These quality improvement efforts have been based on collection and analysis of comprehensive data involving patient risk, processes of care, and clinical outcomes.[6] Participating hospitals and physicians receive regular feedback on their performance with regard to quality measures, such as risk-adjusted

The authors declare no conflicts of interest.

* Corresponding author. Tel.: +1-317-962-5317; fax: +1-317-962-2082.

E-mail address: pjenkins1@iuhealth.org

Manuscript received November 4, 2015; revised manuscript February 4, 2016

0002-9610/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2016.02.011

mortality and morbidity rates, after a given surgery. Hospitals and physicians interpret the data, identify best practices, and adopt them throughout the region.[7] Beginning with the Northern New England Cardiovascular Disease Study Group, several groups have used this model to improve the delivery of care in a range of surgical fields including bariatric, cardiac, general, and vascular surgery.[8–10]

To date, regional consortia have not yet addressed targeted quality improvement for some of the most commonly performed procedures. Appendectomy, for example, is the most commonly performed emergent or "unplanned "general surgery operation, and variation in the treatment of appendicitis has been widely studied.[11–13] However, the underlying reasons for variation in processes of care and clinical outcomes among hospitals remain poorly understood. Although cardiac and bariatric procedures may be concentrated within a few hospitals, appendectomies are performed across a broad range of hospitals. Therefore, quality improvement efforts focused on a commonly performed procedure may benefit a broader range of patients and generate greater improvements in quality care.

In this study, we evaluated clinical outcomes after appendectomy in hospitals across Michigan. We sought to determine whether variation exists in clinical outcomes after appendectomy to provide the consortium with retrospective information to evaluate processes of care relevant to the specific outcomes of interest. Although this approach to quality improvement has been adopted by many surgical subspecialties, to our knowledge, this study represents the first attempt to examine hospital variation in clinical outcomes after an emergent general surgery procedure.

Statistical Methods

Data source and study population

This study is based on data from the Michigan Surgical Quality Collaborative (MSQC). As described in greater detail elsewhere, MSQC is a consortium of 49 hospitals and surgeons across the state (Table 1).[9] Of the 174 "health care facilities" identified in Michigan by the 2012 American Hospital Association survey, MSCQ includes all large- (>500 beds) and medium-sized (300 to 499 beds) facilities and many small facilities.[14] Participation in MSQC is voluntary, and the goals of the collaborative are to improve patient outcomes and decrease cost through the dissemination of best, evidence-based practices at quarterly meetings.

In the MSQC, data are collected prospectively through medical record review for each patient at the end of the 30-day perioperative period. Information collected includes demographic variables, preoperative clinical conditions, perioperative processes of care, and outcomes. Centrally trained nurse data abstractors collect data using a standardized and validated instrument. Each participating hospital undergoes regular audits ensure the accuracy and completeness of the data for the registry. Medical record abstraction was based on documentation by abstraction, and data validation required complete data to close the record, so the data included no missing values. For this study, we included all patients diagnosed with acute appendicitis who underwent appendectomy (open and laparoscopic) between January 1, 2006, and September 21, 2011 (Table 2).

Table 1 Hospital characteristics (n = 49)

	%
Hospital type	
Academic/teaching hospital	65.3
Community hospital (not for profit)	32.7
Other	2.0
Bed size	
100–299	14.3
300–499	63.3
≥500	20.4
Other	2.0
Trauma verification level	
Level 1	18.4
Level 2	26.5
Nonverified	55.1

Outcome measures

The primary outcome of interest was inpatient mortality. Secondary outcomes included hospital length of stay (LOS), minor complications, major complications, return to operating room, any complication, superficial or deep surgical site

Table 2 Patient characteristics (N = 12,410)

Age, mean (SD), y	40.1 (16.9)
Female (%)	48.7
Nonwhite race (%)	25.9
ASA classification (%)	
0 (not assigned)	.2
1–2	86.7
3–5	13.0
Evidence of rupture (CPT code 44,960 or *ICD-9-CM* codes 540.0 and 540.1 (%)	18.4
Selected comorbid risk factors (%)	
No diabetes	94.9
Current smoker	27.9
Ethanol use	2.3
No dyspnea	97.4
Do not resuscitate	.2
Independent functional status	98.6
History of severe COPD	1.5
Ascites within 30 d	.7
History of myocardial infarction	.2
Hypertension	19.9
Acute renal failure	.1
Currently undergoing dialysis	.2
Pregnancy (%)	1.1
Open surgical technique (%)	27.9

ASA = American Society of Anesthesiologists; COPD = class Chronic Obstructive Pulmonary Disease; *ICD-9-CM* = *International Classification of Diseases, Ninth Revision, Clinical Modification*.