Hospital Costs by Cost Center of Inpatient Hospitalization for Medicare Patients Undergoing Major Abdominal Surgery

Anne M Stey, MD, MSc, Robert H Brook, MD, ScD, Jack Needleman, PhD, Bruce L Hall, MD, PhD, MBA, FACS, David S Zingmond, MD, PhD, Elise H Lawson, MD, MSHS, Clifford Y Ko, MD, MS, MSHS, FACS

BACKGROUND: This study aims to describe the magnitude of hospital costs among patients undergoing elective colectomy, cholecystectomy, and pancreatectomy, determine whether these costs relate as expected to duration of care, patient case-mix severity and comorbidities, and whether risk-adjusted costs vary significantly by hospital. Correctly estimating the cost of production of surgical care may help decision makers design mechanisms to improve the efficiency of surgical care.

STUDY DESIGN: Patient data from 202 hospitals in the ACS-NSQIP were linked to Medicare inpatient claims. Patient charges were mapped to cost center cost-to-charge ratios in the Medicare cost reports to estimate costs. The association of patient case-mix severity and comorbidities with cost was analyzed using mixed effects multivariate regression. Cost variation among hospitals was quantified by estimating risk-adjusted hospital cost ratios and 95% confidence intervals from the mixed effects multivariate regression.

RESULTS: There were 21,923 patients from 202 hospitals who underwent an elective colectomy (n = 13,945), cholecystectomy (n = 5,569), or pancreatectomy (n = 2,409). Median cost was lowest for cholecystectomy ($15,651) and highest for pancreatectomy ($37,745). Room and board costs accounted for the largest proportion (49%) of costs and were correlated with length of stay, $R = 0.89$, $p < 0.001$. The patient case-mix severity and comorbidity variables most associated with cost were American Society of Anesthesiologists (ASA) class IV (estimate 1.72, 95% CI 1.57 to 1.87) and fully dependent functional status (estimate 1.63, 95% CI 1.53 to 1.74). After risk-adjustment, 66 hospitals had significantly lower costs than the average hospital and 57 hospitals had significantly higher costs.

CONCLUSIONS: The hospital costs estimates appear to be consistent with clinical expectations of hospital resource use and differ significantly among 202 hospitals after risk-adjustment for preoperative patient characteristics and procedure type. (J Am Coll Surg 2015;220:207−217. © 2015 by the American College of Surgeons)

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From the Icahn School of Medicine at Mount Sinai Medical Center, NY, NY (Stey); David Geffen School of Medicine (Stey, Brook, Zingmond, Lawson, Ko) and the Fielding School of Public Health (Needleman), University of California Los Angeles, Los Angeles, CA; RAND Corporation, Santa Monica, CA (Brook); the American College of Surgeons, Chicago, IL (Hall, Ko); and Washington University in Saint Louis Department of Surgery, Olin Business School, and Center for Health Policy; St Louis VA Medical Center; BJC Healthcare Saint Louis, St Louis, MO (Hall).

Correspondence address: Anne M Stey, MD, MSc, 10940 Wilshire Blvd, Suite 710, Los Angeles CA 90024. email: as013j@gmail.com

The amount of money the US spends on health care is typically expressed as charges or costs.[1-4] In some studies, cost is the amount of money a payer, such as Medicare or Blue Cross, pays for health care. In other studies, costs might represent the amount of resources a geographically based population uses on health care, such as how much money is expended on health care in California.

Rarely discussed is how much it costs for a hospital to provide care for an individual patient with a specific problem, such as a patient undergoing a cholecystectomy—what herein will be referred to as hospital costs. Hospital costs are the sum of the hospital's expenditures in caring for the patient. This can be derived in at least 2 ways. One is directly through the hospital's accounting database.[5,6]

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Abbreviations and Acronyms
ASA = American Society of Anesthesiologists
CBSA = core-based statistical area
IQR = interquartile range

This is done by calculating individual patient costs based on the itemized clinical care activity recorded for each patient in the database. In addition, costs for hospital infrastructure such as administration, billing, and electricity are included. However, because access to these data is usually available only to personnel within the hospital organization, studies based on accounting databases have typically been limited to single hospitals or hospital systems. A second way to estimate hospital costs is to convert patient charges reported in publicly available Medicare claims data to costs using hospital cost-to-charge ratios.[7-12] This method has the substantial advantage that it can be used to determine the hospital costs for patients cared for in diverse hospitals. These individual patient costs can be disaggregated into cost centers.[9]

There were 3 aims for this work. The first was to describe the distribution and magnitude of costs a hospital incurs to care for patients with 1 of 3 common surgical conditions, in aggregate and by cost center. The second was to examine whether costs varied with length of stay, operating room time, patient case-mix severity, and other patient comorbidities (measured using ACS-NSQIP data), as was anticipated from clinical experience. The third was to assess the extent to which there was significant residual variation in hospital cost after risk adjusting for patient case-mix severity, comorbidities, and procedure type.

METHODS

Data sources and measures

Three data sources were used: a clinical data source, an administrative data source, and Medicare cost reports. The clinical data source was the American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP). The ACS-NSQIP is a voluntary clinical registry that uses dedicated full-time trained surgical clinical reviewers who use strict data definitions to collect preoperative demographic and comorbidity patient variables, procedural, and postoperative 30-day patient outcomes data. Regular audits of a sample of hospitals are performed to ensure accuracy of data collection. This clinical dataset was merged with an administrative dataset, the Medicare Provider Analysis and Review File (Medpar), from 2005 to 2008, using indirect patient identifiers and a deterministic linkage algorithm, previously described.[13] The data elements in this file included demographics (sex, race or ethnicity, and age), dates of admission and discharge, ICD-9 diagnosis codes, ICD-9 procedure codes, and disaggregated cost-center charges. The third data source was the Medicare cost reports that are an annual compilation of all hospitals' reported costs and charges by cost centers. These data can be used to generate a cost-to-charge ratio for each cost center for each hospital for each fiscal year. These hospital, fiscal year, cost center-specific cost-to-charge ratios were merged with the Medicare claims data and used to estimate hospital costs from patient disaggregated cost-center charges in the Medicare inpatient claims file.

Primary outcome

The primary outcome was the estimated cost of the inpatient surgical hospitalization from the hospital's perspective. The claims data in the Medicare inpatient claims data file contain the disaggregated patient charges in 32 cost centers. Hospitals annually report all of their costs and charges by 44 cost centers to Medicare. These publicly available cost and charge data (by 44 cost centers) were aggregated into 12 discrete cost centers, as has been done in previous work (Appendix 1, online only), and were used to generate cost-to-charge ratios for each cost center for each hospital for each fiscal year. Extreme, unfeasible outliers in the cost-to-charge ratios were observed, as have been previously reported.[9] Cost-to-charge ratios within each of the 12 cost centers were therefore pulled in (winsorized) to the 2.5 and 96 percentiles, as previously done with these data.[9] These hospital, fiscal year, cost center-specific cost-to-charge ratios were merged with the Medicare claims data and used to estimate hospital costs from disaggregated patient charges in the Medicare inpatient claims file. All costs were inflated to 2013 dollars using the Medicare Market Basket Index. Regional differences in wage rates were adjusted for using the regional wage index. Finally, all patient costs at the cost center level were winsorized to the 0.25 percentile and the 99.75 percentile cost, to minimize the influence of extreme cost outliers.

Hospital cost allocation to cost centers was then examined by calculating the proportion of total annual hospital costs allocated to 5 of 12 of the largest cost centers: intensive care, operating room, supply, pharmacy, and laboratory. Although the variation in proportion of total annual hospital costs depended on the cost center, the interquartile ranges (IQR) were fairly narrow. A median of 5% of total hospital annual costs were attributed to intensive care, with a narrow IQR of 4% to 6%. A median of 10% of total hospital annual costs were attributed to operating room, with an IQR of 8% to 14%. A median of 8%