Original Investigation

2016 ,17 May

Association of Hospital Critical Access Status With Surgical Outcomes and Expenditures Among Medicare Beneficiaries

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JAMA. 2016;315(19):2095-2103. doi:10.1001/jama.2016.5618

Abstract

Importance: Critical access hospitals are a predominant source of care for many rural populations. Previous reports suggest these centers provide lower quality of care for common medical admissions. Little is known about the outcomes and costs of patients admitted for surgical procedures.

Objective: To compare the surgical outcomes and associated Medicare payments at critical access hospitals vs non–critical access hospitals.

Design, Setting, and Participants: Cross-sectional retrospective review of 1 631 904 Medicare beneficiary admissions to critical access hospitals (n = 828) and non–critical access hospitals (n = 3676) for 1 of 4 common types of surgical procedures—appendectomy, 3467 for critical access and 151 867 for non–critical access; cholecystectomy, 10 556 for critical access and 573 435 for non–critical access; colectomy, 10 198 for critical access and 577 680 for non–critical access; hernia repair, 4291 for critical access and 300 410 for non–critical access—between 2009 and 2013. We compared risk-adjusted outcomes using a multivariable logistical regression that adjusted for patient factors (age, sex, race, Elixhauser comorbidities), admission type (elective, urgent, emergency), and type of operation.

Exposures: Undergoing surgical procedures at critical access vs non–critical access hospitals.

Main Outcomes and Measures: Thirty-day mortality, postoperative serious complications (eg, myocardial infarction, pneumonia, or acute renal failure and a length of stay >75th percentile). Hospital costs were assessed using price-standardized Medicare payments during hospitalization.

Results: Patients (mean age, 76.5 years; 56.2% women) undergoing surgery at critical access hospitals were less likely to have chronic medical problems, and they had lower rates of heart failure (7.7% vs 10.7%, P < .0001), diabetes (20.2% vs 21.7%, P < .001), obesity (6.5% vs 10.6%, P < .001), or multiple comorbid diseases (% of patients with ≥2 comorbidities; 60.4% vs 70.2%, P < .001). After adjustment for patient factors, critical access and non–critical access hospitals had no statistically significant differences in 30-day mortality rates (5.4% vs 5.6%; adjusted odds ratio [OR], 0.96; 95% confidence interval [CI], 0.89-1.03; P = .28). However, critical access vs non–critical access hospitals had significantly lower rates of serious complications (6.4% vs 13.9%; OR, 0.35; 95% CI, 0.32-0.39; P < .001). Medicare expenditures adjusted for patient factors and procedure type were lower at critical access hospitals than non–critical access hospitals ($14 450 vs $15 845; difference, −$1395, P < .001).

Conclusions and Relevance: Among Medicare beneficiaries undergoing common surgical procedures, patients admitted to critical access hospitals compared with non–critical access hospitals had no significant difference in 30-day mortality rates, decreased risk-adjusted serious complication rates, and lower-adjusted Medicare expenditures, but were less medically complex.

Introduction

Critical access hospital designation was created to help ensure access to the more than 59 million people living in rural populations. Established in 1997 under the Medicare Rural Hospital Flexibility Program when policy makers were worried these hospitals would close due to financial hardship, the critical access hospital provision entitled hospitals to increased reimbursements if they had fewer than 25 inpatient beds and were located more than 35 miles away from another hospital. More than 1300 hospitals enrolled in this program, but concern about the resultant Medicare budget growing to more than $9 billion annually led government agencies and advisory groups to call for modification and even elimination of the critical access designation. Advocates for critical access hospitals argue that changes would be disruptive to communities that heavily rely on them for their health care.

Debates about the value of critical access hospitals continue with limited evidence about the clinical outcomes and costs to Medicare in these settings. Increased mortality rates and worse process of care measures have been reported for common medical admissions at critical access hospitals; however, far less is known about patients undergoing surgical procedures. To date the largest study of surgical outcomes captures only approximately one-third of critical access hospitals and lacks post discharge follow-up and payment information. Nevertheless, this single study found no difference in postoperative mortality rates suggesting that critical access hospitals may provide comparable surgical care with their acute care counterparts. Whether these findings are representative of surgical care across all critical access hospitals and what the costs are to Medicare remain unknown. The purpose of this study was to evaluate outcomes and costs among Medicare beneficiaries undergoing surgical procedures at critical access and non–critical access hospitals.

Methods

Data Source and Hospital Designation

Data from the Medicare Provider Analysis and Review (MEDPAR) file between 2009 and 2013 were used for this study. This represented 5 years of the most recent data available and also a time period after nearly all (1277 of 1333; 95.7%) of the current critical access hospitals had undergone designation. MEDPAR Hospital provider numbers that included "13" in the third and fourth positions were identified as critical access hospitals. This study was approved by the University of Michigan Investigational Review Board and deemed exempt due to use of secondary data.

Identification of Procedures and Study Cohort

Using procedure codes from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), a subset of general surgery procedures that would be commonly performed at both critical access and non–critical access hospitals were identified. Because larger, complex operations (eg, pancreatic and esophageal resection) are not typically performed at critical access hospitals, the most common operations performed in that setting were chosen; appendectomy (ICD-9-CM codes 47.01, 47.09, 47.11, 47.19), cholecystectomy (ICD-9-CM codes 51.22, 51.23, 51.24), colectomy (ICD-9-CM codes 45.70, 45.71, 45.72, 45.73, 45.74, 45.75, 45.76, 45.79, 17.31 to 17.39, 45.80) and hernia repair (ICD-9-CM codes 53.41, 53.42, 53.43, 53.49, 53.51, 53.59, 53.61, 53.62, 53.63, 53.69). These operations represent the 4 most common inpatient general surgery procedures performed at critical access hospitals. In review of the data, 0.004% of patients were missing information on race, and they were excluded.

Outcome Variables

Outcomes between critical access and non–critical access hospitals were assessed by determining rates of mortality, overall complications, serious complications, reoperations, and readmissions. Mortality in the hospital was determined by vital status at the time of discharge. Additionally, the Medicare beneficiary denominator file was used to ascertain any mortality occurring within 30 days of the index operation. The latter approach identified patients who died after discharge from their index admission or after transfer to another facility.

Complications were identified with ICD-9-CM codes using methods previously described and validated. Overall complications included pulmonary failure, pneumonia, myocardial infarction, deep venous thrombosis, acute renal failure, postoperative hemorrhage, surgical-site infection, and gastrointestinal bleeding. Serious complications were defined as having at least 1 complication and a length of stay higher than the 75th percentile for the specific procedure that was performed previously in the administrative claims databases to improve specificity.

Similarly, reoperation and readmission within 30 days was identified using ICD-9-CM codes in methods that have been previously used for surgical cohorts. Outcomes were reported for all procedures combined as well as for each procedure group. Patients who were transferred during hospitalization were categorized based on the location of their index operation.

Medicare Payments

Medicare payments from MEDPAR were used to explore if location of care—critical access vs non–critical access hospitals—was associated with any difference in expenditures. Because there is wide variation in hospital charges that may not reflect the actual financial expense to Medicare, the analysis herein used Medicare payments. The total episode payment was defined as the sum of diagnosis related group payments, outlier payments, and payments for readmissions within 30 days of discharge.

To compare Medicare expenditures at critical access hospitals with non–critical access hospitals, actual payments (unadjusted) and price-standardized payments were examined. Actual Medicare payments were chosen because they represent the bottom line to Medicare, ie, as the actual amount paid to the hospital. For additional comparison, price-standardized payments were also evaluated.

This analysis was done because payments from Medicare are determined in part by geography (to account for variation in cost of living and the wage index) and the setting in which they provide care (eg, if hospitals care to a disproportionate share of low-income patients or participate in graduate medical education.) By removing these intended adjustments, the comparison of price-standardized amounts provides better insight into differences in resource use between critical access and non–critical access hospitals. For price standardization, this study used methods described initially by the Medicare Payment Advisory Commission and later by the Dartmouth Institute to account for these adjustments, as has been done in multiple previous reports using MEDPAR data to examine payments for surgical procedures. Furthermore, because data were assessed over a 5-year period, payment amounts were adjusted to 2013 dollars to account for inflation.

Statistical Analysis

The first step of the analysis compared hospital and patient characteristics for critical access and non–critical access hospitals. Hospital characteristics included bed size, teaching status, geography, staffing ratios, surgical volume, and frequency of each procedure type. These were compared using $\chi 2$ and Wilcoxon rank sum tests as appropriate. Similar comparisons of patient characteristics were carried out including age, sex, race, comorbidities, admission type, distance traveled to hospital for care, and destination after discharge (eg, home, transferred, skilled nursing facility.)

The second step of the analysis was to determine whether a difference existed in clinical outcomes or Medicare payments at critical access vs non–critical access hospitals. To evaluate postoperative outcomes, a multivariable logistical regression model was created with each outcome (eg, all complications, mortality, readmission, etc) as a dependent variable. The model was developed using a backward stepwise logistic regression including multiple patient and operation-level variables such as age, sex, race, comorbidities (as outlined previously by Elixhauser et al and Southern et al), admission type (elective, urgent, emergency), and a variable indicating the type of operation. Secular trends were accounted for by including the year of operation as a categorical variable. The model was then used to calculate a risk-adjusted rate for each outcome.

Multiple strategies were used to evaluate the statistical performance of the regression models. First, discrimination was assessed with receiver operating characteristic curves and a C statistic was calculated for each outcome (average C statistic of 0.77; eTable1 in the Supplement). Next, the calibration of each model was evaluated with a goodness-of-fit test that demonstrated a good match between observed and expected outcomes across all deciles of risk. For each independent variable, the variation inflation factor was calculated with no evidence of multicollinearity (all variance inflations factors were <1.3; eTable2 in the Supplement).

To test for possible nesting effects of patients within hospitals, a 2-tier hierarchical model was created using patient factors (level 1) and hospital factors (level 2). There was no difference in these point estimates generated by the hierarchical model compared with the multivariable regression model that used robust standard errors to account for clustering (eTable3 in the Supplement). Finally, the day of admission (weekday vs weekend) was added into the regression model and demonstrated no significant effect on the results (eTable4 in the Supplement).

Medicare payments were then compared between critical access and non–critical access hospitals. After log transformation to account for their nonparametric distribution, payments were compared in 3 different forms: (1) actual Medicare payments before any adjustment; (2) after risk-adjustment for patient characteristics, procedure type, and type of admission; and (3) after additional price standardization. To adjust for clustering within hospitals, robust standard errors were used for all models. All reported P values were 2-sided and a value of <.05 was used as threshold for significance. All statistical analyses were completed with STATA version 14 (STATA Corp).

Results

Significant differences existed between patients treated at critical access vs non–critical access hospitals. Patients undergoing surgical procedures at critical access hospitals were less likely to have common or multiple comorbid conditions (Table 1). They had lower rates of heart failure, diabetes, obesity, or multiple comorbidities (% of patients with ≥2 comorbidities; 60.4% vs 70.2%, $P < .001$). Emergency operations were more common at non–critical access hospitals (44.6% vs 27.4%, $P < .001$). When comparing discharge destination, patients treated at critical access hospitals were less likely to use skilled nursing care (27.1% vs 37.9%, $P < .001$). A higher proportion of patients at critical access hospitals were transferred to another acute care hospital than those treated in non–critical access hospitals (4.7% vs 0.8%, $P < .001$).

Non–critical access hospitals had significant structural differences compared with critical access hospitals. Non–critical access hospitals on average had more operating rooms (8 vs 2), more inpatient beds (>250 beds; 28.6% vs 0.0%) and higher nursing ratios (Table 2). Despite size and resource differences, both types of hospitals performed a similar proportion of the 4 operations examined (eg, colectomy represented approximately 36% of surgical volume for both types of hospitals). Non–critical access hospitals had a higher annual median surgical volume than critical access hospitals (1624 vs 140, $P < .001$). Of the 1277 hospitals with a critical access designation during the study period, 828 (64.8%) performed at least 1 of the 4 operations examined.

For common surgical procedures, patients at critical access hospitals had either no significantly different or lower risk-adjusted clinical outcomes compared with non–critical access hospitals. Critical access hospitals had lower rates of in-hospital mortality (2.9% vs 3.9%; adjusted odds ratio [OR], 0.69; 95% CI, 0.62-0.77; $P < .001$) and no difference in 30-day mortality (5.4% vs 5.6%; OR, 0.96; 95% CI, 0.89-1.03; $P = .28$). Critical access hospitals also had lower rates of serious complications (6.4% vs 13.9%; OR, 0.35; 95% CI, 0.32-0.39; $P < .001$) and overall complications (17.5% vs 25.4%; OR, 0.55; 95% CI, 0.52-0.58; $P < .001$). In contrast, critical access hospitals had higher rates of readmission within 30 days than non–critical access hospitals (14.7% vs 13.3%; OR, 1.13; 95% CI, 1.08-1.18; $P < .001$). Repeat subgroup analysis for each individual procedure (appendectomy, cholecystectomy, colectomy, hernia repair) demonstrated similar findings (Table 3). Unadjusted rates of clinical outcomes are reported in eTable 5 in the Supplement.

Critical access hospitals had lower Medicare payments for common surgical procedures than non–critical access hospitals. When examining all procedures combined, actual Medicare payments at critical access hospitals were $5980 lower than non–critical access hospitals ($15 094 vs $21 074, $P < .001$). After both risk-adjustment and price-standardization, payments to critical access hospitals remained lower than non–critical access hospitals ($14 450 vs $15 845; difference −$1395, $P < .001$). Similar differences were found between payments across each of the procedures examined individually (Table 4).

Discussion

This study had 2 principal findings regarding how surgical care is delivered at critical access hospitals. First, the study found that performance of 4 common surgical procedures at critical access hospitals was associated with no difference in 30-day mortality and lower complication rates compared with non–critical access hospitals. Second, despite the reimbursement structure for critical access hospitals established in the Medicare Rural Hospital Flexibility Program, there was no evidence of higher expenditures for common surgical procedures. Both of these findings contrast previously published literature about nonsurgical admissions in these same settings and inform legislators about the valuable role critical access hospitals provide in the US health care system.

Previous studies examining outcomes at critical access hospitals have raised concern about the quality of care provided. A recent study of Medicare beneficiaries admitted for acute myocardial infarction, heart failure, or pneumonia to critical access hospitals reported worse mortality rates and lower adherence to process measures of care.9 A follow-up study for the same medical conditions from 2002 to 2010 found that mortality rates at critical access hospitals actually increased, despite additional funding for quality improvement efforts.10 However, these differences in mortality between critical access vs non–critical access hospitals have not been observed for surgical procedures. For example, work done by Gadzinski and colleagues[11] evaluated patients in the National Inpatient Sample, a 20% stratified sampled of nonfederal hospitals in the United States, and found no difference in in-hospital mortality for multiple surgical procedures.

The present study goes beyond these findings by assessing a wider range of surgical outcomes and evaluating all critical access hospitals in the United States performing common surgical procedures in Medicare beneficiaries.

Although the data from this study cannot identify a clear mechanism for the contrast between medical and surgical outcomes, the findings do suggest several possible explanations. First, with surgery, critical access hospitals have the opportunity to select appropriate candidates before deciding whether to operate. In this study, critical access hospitals generally operated on fewer complex patients (vs non–critical access hospitals) and demonstrated relatively low postoperative transfer rates (4.8% in this study compared with ≤29% reported for medical admissions[9,10]). These findings are consistent with the dual role rural surgeons perform in providing safe local care on appropriately selected patients but also in triaging higher-risk patients to larger centers before an operation. For medical conditions, which are less elective than the surgical procedures that we studied, it is often not possible to make decisions before hospitalization occurs.

Second, this study only includes a subset of relatively well-resourced critical access hospitals; ie, those with the capabilities to perform inpatient general surgery. These hospitals likely have more staff and resources than do the larger population of critical access hospitals that offer medical care.

Another important finding from this study was that critical access hospitals were less likely to refer patients to rehabilitation or skilled nursing facilities after discharge. Although this finding may simply represent a healthier patient population or less complex surgical procedures at critical access hospitals, it could also reflect limited access to postdischarge care that has been previously described in rural settings.[28] Specifically, patients were much less likely to be discharged to postacute care facilities (27.1% vs 37.9%) from critical access than from non–critical access hospitals. This lower use of postdischarge care at critical access hospitals could in turn account for the higher rate of readmission observed in this study.

This study should be interpreted within the context of certain limitations. First, administrative data have well-known limitations for assessing comorbid conditions and ascertaining complications of care factors.[29,30] To minimize any potential coding bias, this study used selected codes from the Complication Screening Project that significantly increase the specificity of detecting complications in claims data.[14,15] In addition, an extended length-of-stay criteria was applied to increase the specificity of the complication measures. This approach has been demonstrated to more accurately capture complicated hospital courses.[31] Moreover, other sources of data (eg, clinical registries) with more detailed clinical and payer information do not include the majority of rural and critical access hospitals.

Second, because non–critical access hospitals are reimbursed based on disease severity and have more resources, they may be more thoroughly documenting diagnoses codes. As a result, this study could potentially overestimate complication rates and comorbidities of patients treated at non–critical access hospitals. However, the comparisons between critical access vs non–critical access hospitals were consistent in measures that were not sensitive to this type of coding bias (eg, mortality rates, reoperations, expenditures) making the differences found in this study unlikely to be due to documentation alone.

Finally, by using Medicare data, this study population did not include many younger patients who also seek care at critical access hospitals. Although this group of younger patients is important to evaluate, the Medicare Rural Affordability Program in the Balanced Budget Act of 1997 was specifically designed for Medicare beneficiaries and as such, evaluation in Medicare data are most relevant to policy makers.

This study may have important policy implications for payers and policy makers responding to mandates in the Affordable Care Act to evaluate health care services for rural Americans. First, patients in rural settings are sometimes reluctant to travel for surgical care, even when told it would lead to a better outcome.34 These same patients may often prefer follow-up locally, independent of where their initial operation occurred. Recent evidence suggests that, among patients requiring rehospitalization, admission to the same hospital where they had surgery improved survival.35 Maintaining payment policies that secure safe, local surgical care allows rural clinicians to accommodate strong patient preferences without putting them at increased risk of undergoing common operations. Second, although currently exempt from Hospital-Value Based Purchasing, and many other payment reforms, these findings suggest that critical access hospitals may benefit from participating in these reforms. By providing comparable outcomes at a lower cost for common surgical procedures, critical access hospitals may find it profitable to enroll in bundled payment programs.

Third, although only a minority of critical access hospitals (≈5%) are currently participating in Medicare accountable care organizations (ACOs), they may find that creating a network relationship with larger facilities located in the nearest metropolitan area could facilitate the important role they are already playing in triaging and transferring patients to higher levels of care when needed. Nevertheless, critical access hospitals and rural surgical practices may have difficulty meeting the reporting and regulatory requirements of these new payment models.

Conclusions

Among Medicare beneficiaries undergoing common surgical procedures, patients admitted to critical access hospitals compared with non–critical access hospitals had no significant difference in 30-day mortality rates, decreased risk-adjusted serious complication rates, and lower-adjusted Medicare expenditures, but were less medically complex.

Article Information

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Obtained funding: Dimick.

Administrative, technical, or material support: Dimick.

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Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE

Form for Disclosure of Potential Conflicts of Interest. Dr Dimick is a cofounder and has a financial interest in ArborMetrix Inc, which had no role in the analysis herein, and has received grant support from the Agency for Healthcare Research and Quality, personal fees from the National Institutes of Health, and honoraria from Stanford and Emory universities and the University of Texas. No other disclosures were reported.

Funding/Support: Dr Ibrahim receives funding from the Robert Wood Johnson Foundation and the US Department of Veterans Affairs supporting his role as a Robert Wood Johnson Clinical Scholar. Dr Dimick has received grant R01AG039434-04 from

the National Institute on Aging.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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