Transfer Rates and Use of Post-Acute Care After Surgery At Critical Access vs Non-Critical Access Hospitals

Adam J. Gadzinski, MD, MS; Justin B. Dimick, MD, MPH; Zaojun Ye, MS; John L. Zeller, MD, PhD; David C. Miller, MD, MPH

**IMPORTANCE** There is growing interest in the use of health care resources by critical access hospitals (CAHs), key providers of medical care for many rural populations.

**OBJECTIVE** To evaluate discharge practice patterns and use of post-acute care after surgical admissions at CAHs.

**DESIGN, SETTING, AND PARTICIPANTS** We used data from the Nationwide Inpatient Sample (2005-2009) and American Hospital Association to perform a retrospective cohort study of patients undergoing common inpatient surgical procedures at CAHs or non-CAHs.

**EXposures** The CAH status of the admitting hospital.

**MAIN OUTCOMES AND MEASURES** Hospital transfer, discharge with post-acute care, or routine discharge.

**RESULTS** Among the 1283 CAHs and 3612 non-CAHs included in the American Hospital Association annual survey, 34.8% and 36.4%, respectively, reported data to the Nationwide Inpatient Sample. For each of 6 common inpatient surgical procedures, a greater proportion of patients from CAHs were transferred to another hospital (P < .01); however, patients discharged from CAHs were less likely to receive post-acute care for all but 1 of the procedures examined (P < .01, except transurethral resection of prostate, P = .76). After adjustment for patient and hospital factors, the higher likelihood of transfer by CAHs vs non-CAHs persisted for 3 procedures: hip replacement (odds ratio, 1.90; 95% CI, 1.01-3.57), colorectal cancer resection (3.37; 2.23-5.09), and cholecystectomy (1.67; 1.27-2.19) (P < .05 for each), but differences in the use of post-acute care did not. In subset analyses, Medicare beneficiaries treated in CAHs were less likely to be discharged with post-acute care after hip fracture repair (odds ratio, 0.65; 95% CI, 0.47-0.89) and hip replacement (0.70; 95% CI, 0.51-0.96).

**CONCLUSIONS AND RELEVANCE** Hospital transfers occur more often after surgical admissions at CAHs. However, the proportion of patients at CAHs using post-acute care is equal to or lower than that of patients treated in non-CAHs. These results will affect the ongoing debate concerning CAH payment policy and its implications for health care delivery in rural communities.
The Balanced Budget Act of 1997 created the critical access hospital (CAH) designation to provide financial support to rural hospitals in danger of closing.1,2 The CAH status was initially limited to small hospitals (≤25 beds) located at least 35 miles from another hospital via a primary road or 15 miles via a secondary road.1,3 Because of this legislation, CAHs are exempt from Medicare’s Prospective Payment System (PPS) and instead receive cost-based reimbursement for services rendered to Medicare beneficiaries.3 After this policy shift, the number of CAHs rose precipitously,4 and they now make up approximately 25% of acute care hospitals in the United States.

Given this proliferation of CAHs and the accompanying budgetary implications for the Centers for Medicare & Medicaid Services (CMS), there is now heightened interest in the quality and cost of care provided by these facilities. Recent reports suggest that patients treated at CAHs for common medical conditions have higher mortality rates than their counterparts treated in non-CAHs.5,7 In contrast, prior comparisons for patients undergoing inpatient surgery noted no such mortality differences, although costs associated with surgical episodes were 10% to 30% higher at CAHs.8,9

Consistent with the latter finding, the Medicare Payment Advisory Commission (MedPAC) recently reported that annual Medicare payments to CAHs are $2 billion more than they would be for the same services provided under the PPS.10 Although it is expected that CAHs are reimbursed at higher rates, the MedPAC report noted that nearly half of this differential was due to higher payments for post–acute care (ie, services provided after an inpatient discharge), making this an area of great interest for potential cost savings.10 At present, little is known about the disposition of patients after discharge from CAHs, including hospital transfers and use of nursing, home health, and rehabilitative services. Such data would prove invaluable to policy makers, as well as CMS and other payers, as they deliberate the future impact and sustainability of CAH payment policy. In this context, we used nationally representative data to compare rates of hospital transfer and use of post–acute care among patients undergoing common inpatient surgical procedures at CAHs vs non-CAHs.

**Methods**

**Data Sources**

We used 2 data sources for this analysis. First, we used the American Hospital Association (AHA) annual survey (2005-2009) to obtain hospital characteristics, including CAH status. To evaluate patient discharge disposition and use of post–acute care services, we used the Nationwide Inpatient Sample (NIS) (2005-2009) from the Healthcare Cost and Utilization Project. The NIS includes all discharge abstracts from a 20% stratified sample of US nonfederal hospitals in 44 states.11 The abstracts contain patient demographics, and admission and discharge information (eg, type of admission, disposition at discharge), along with diagnosis and procedure codes associated with each inpatient stay (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]).

**Identification of Hospitals and Patients**

Using AHA data, we first identified all nonfederal acute care hospitals with and without CAH designation in the United States and Washington, DC. We then used established Rural-Urban Commuting Area codes to classify each hospital as rural or urban.12 Next, we linked data from the NIS and AHA survey by year to identify hospitals reporting to the NIS. Because some states have privacy laws that prohibit release of identifying hospital information to the NIS, we were unable to combine AHA and NIS data for hospitals in 17 states. With this approach, we successfully linked AHA and NIS data in at least 1 year for 34.8% of CAHs and 36.4% of non-CAHs in the United States.

As described elsewhere, surgical admissions were defined as hospitalizations that included a primary ICD-9-CM procedure code meeting NIS criteria for a major surgical procedure.8,13 We then selected admissions for procedures commonly performed in CAHs, including hip and knee replacement, hip fracture repair, colorectal cancer resection, cholecystectomy, and transurethral resection of the prostate (TURP). We excluded from analysis all patients who died during the admission, left against medical advice, or had a missing or unknown discharge destination. This study was deemed exempt by the University of Michigan Institutional Review Board.

**Discharge Disposition and Use of Post–Acute Care**

Our primary outcome was discharge disposition after inpatient surgery. Discharge disposition was defined according to the following 3 categories: (1) routine discharge to home, (2) transfer to another acute care hospital, or (3) discharge with post–acute care. For our subsequent analyses, we then constructed dichotomous variables for (1) hospital transfer and (2) use of post–acute care. When examining hospital transfers, we classified patients discharged with post–acute care or discharged home as not transferred. Likewise, we excluded patients who were transferred to another hospital from our analyses examining the use of post–acute care. In keeping with previous reports,14,16 we classified patients as receiving post–acute care if they were discharged with home health care or to a nursing home, skilled nursing facility, rehabilitation hospital, long-term care facility, or swing bed within the same hospital. Hospitals with swing bed capabilities are permitted to change the level of care provided to a patient without changing the patient’s actual location.17 Thus, after formal hospital discharge, the patient is admitted to a swing bed while still physically occupying the same hospital bed. The level of care provided to swing bed patients is similar to that in a skilled nursing facility.17

**Statistical Analysis**

As a first analytic step, we compared characteristics of CAH and non-CAH facilities using χ2 and Wilcoxon rank sum tests. We compared the same characteristics for CAHs that could or could not be linked to the NIS. We also used χ2 and Wilcoxon rank sum tests to compare characteristics of patients undergoing each of the 6 surgical procedures at CAHs vs non-CAHs.
Next, we used similar univariate statistics to compare the frequency of hospital transfers and use of post-acute care for patients undergoing inpatient surgery at CAHs vs non-CAHs. We fit multivariable regression models to compare procedure-specific discharge patterns between CAHs and non-CAHs, adjusting for patient and hospital characteristics. For both the hospital transfer and post-acute care models, we implemented generalized estimating equations to account for clustering of patients within hospitals, and we adjusted for patient variables that may influence discharge disposition including age, sex, race, comorbid conditions, median household income of patient's home zip code, admission type (elective or nonelective), and the primary payer for admission.

To measure comorbidity, we used the Elixhauser method described elsewhere for analyses based on the NIS. We also adjusted the models for hospital characteristics that may influence discharge disposition, including rural/urban location, intensive care unit capabilities, availability of inpatient rehabilitation, association with a home health care agency, and hospital provision of swing bed services or affiliation with a skilled nursing or intermediate care facility. The post-acute care models were further adjusted for geographic region of the country owing to known regional differences in the use of these services. Because of the small annual case volumes at some CAHs, we did not adjust for year of admission. Finally, we performed planned subgroup analyses evaluating these same outcomes for patients with Medicare as the primary payer and for patients treated at rural hospitals.

All statistical analyses were completed with SAS software (version 9.2; SAS Institute), and tests were performed at the 5% significance level.

### Results

We identified 4895 acute care hospitals reporting to the AHA from 2005 through 2009; among this group, 1283 (26.2%) reported a CAH designation. Compared with their non-CAH counterparts, CAHs have fewer beds and operating rooms and are less likely to provide intensive care unit and inpatient rehabilitation services (Table). Regarding post-acute care, CAHs are more likely to provide swing bed services, have a skilled nursing facility, and be directly affiliated with a nursing home; however, they are less likely than non-CAHs to provide home health care services (Table). The hospital characteristics examined were generally similar between CAHs that were identifiable in the NIS and those that were not (eTable 1 in the Supplement).

Using the NIS, we identified 1 144 648 surgical admissions for these 6 procedures (hip and knee replacement, hip fracture repair, colorectal cancer resection, cholecystectomy, and TURP) from 2005 through 2009. After excluding patients who died (n = 8388), left against medical advice (n = 849), or had missing or unknown discharge data (n = 1375), our final cohort comprised 1 134 036 surgical admissions, including 22 543 (2.0%) in CAHs. Patients undergoing surgery at CAHs were older and had fewer comorbid conditions than those treated at non-CAHs (eTable 2 in the Supplement). Patients treated at CAHs were more likely to be white, to have lower incomes, and to have Medicare as their primary payer (eTable 2 in the Supplement).

In terms of discharge disposition, the unadjusted proportion of patients transferred to another hospital was higher among those treated in CAHs for each of the procedures examined (P < .01; Figure 1A), ranging from 0.8% (TURP) to 4.1% (hip fracture repair) for CAH patients and from 0.2% (TURP) to 1.2% (hip fracture repair) for non-CAH patients. Among patients who were not transferred, the unadjusted likelihood of receiving post-acute care ranged from 7.9% (cholecystectomy) to 81.2% (hip fracture repair) for CAH patients and from 10.4% (cholecystectomy) to 84.9% (hip fracture repair) for non-CAH patients (Figure 1B). For all procedures except TURP, use of post–acute care services was significantly lower for patients discharged from CAHs (P < .001; Figure 1B).

In multivariable analyses, the adjusted likelihood of a patient being transferred after surgery at a CAH remained higher for those undergoing hip replacement (odds ratio, 1.90; 95% CI, 1.01-3.57), colorectal cancer resection (3.37; 2.23-5.09), or cholecystectomy (1.67; 1.27-2.19) (Figure 2A). In the subset of patients with Medicare as their primary payer, treatment at a CAH was associated with a higher likelihood of being transferred for all operations except knee replacement (Figure 2B). We observed a similar relationship for colorectal cancer resection, cholecystectomy, and TURP in subset analyses limited to rural hospitals (Figure 2C).

Excluding patients transferred to another hospital, multivariable analyses identified no significant differences in use of post–acute care for any of the procedures examined (Figure 3A). In models limited to Medicare beneficiaries, pa-
tients treated in CAHs were less likely to use post–acute care after hip fracture repair (odds ratio, 0.65; 95% CI, 0.47-0.89) and hip replacement (0.70; 0.51-0.96) (Figure 3B). Among the subset of patients treated in rural hospitals, we observed lower use of post–acute care after hip fracture repair (Figure 3C) (odds ratio, 0.67; 95% CI, 0.48-0.92) and hip replacement (0.69; 0.49-0.96) performed at CAHs.

Discussion

Our study has 2 principal findings. First, we observed higher transfer rates across multiple surgical procedures for patients admitted to CAHs than for those undergoing the same procedures in non-CAHs. Second, patients treated at CAHs were no more likely to use post–acute care after surgical admissions than their counterparts at non-CAHs. In fact, the only observed difference in post–acute care was less frequent use of these services by CAHs for orthopedic procedures performed in rural hospitals and among the subgroup of patients with Medicare as their primary payer.

Although nationwide estimates of hospital transfer rates after inpatient surgery are limited, the overall rates reported herein are comparable to published figures for hip replacement,19 knee replacement,20 and abdominopelvic surgical procedures (including cholecystectomy and colectomy).21 The higher likelihood of transfer during a surgical admission to CAHs has several potential explanations. First, this difference may reflect a higher incidence of complications after surgery at CAHs. Moreover, even if patients treated at CAHs have similar complication rates to those treated at non-CAHs, higher transfer rates might be expected at CAHs because these hospitals have fewer clinical resources to manage such adverse events.5,22 Nevertheless, determining whether the higher transfer rates reflect more frequent and/or more serious complications at CAHs is difficult to do using administrative data because the cost-based reimbursement system does not incentivize coding complications at CAHs, whereas the PPS in place at non-CAHs requires meticulous coding of complications to ensure appropriate reimbursement.10,23

In addition to complications, differences in transfer rates may reflect the statutory requirement that CAHs maintain a

Unadjusted rates are shown for critical access hospital (CAH) and non-CAH facilities. Transferred patients are excluded from discharge data. *P < .001; †P < .01. CRC indicates colorectal cancer; TURP, transurethral resection of prostate.
mean duration of inpatient stay shorter than 96 hours.\(^3\) To comply with this regulation, some CAHs may lower their threshold for transfers. Finally, there may be unmeasured economic and/or social factors driving the greater propensity for transfer among postoperative patients at CAHs. Thus, although our data confirm higher transfer rates after inpatient surgery at CAHs, more work is needed to define the causes of this disparity.

In contrast to transfers, we observed no overall differences in use of post–acute care in use of post–acute care after orthopedic procedures performed for Medicare beneficiaries and at rural hospitals. This difference identified in subgroup analyses may be due to patient selection, local practice patterns, or limited availability of post–acute care services in many rural communities.\(^2,4\) Although it is difficult to define what the appropriate use of post–acute care should be,\(^10\) our results suggest that CAHs use these services at rates that are similar to those for non-CAHs, at least after surgical admissions.

Our findings should be considered in the context of several limitations. Because privacy laws preclude data linkage for facilities in several states, our analysis was limited to a subset of hospitals in the NIS, and we could not apply the NIS sampling weights. Nonetheless, our final sample included data from more than one-third of all CAHs and non-CAHs, and the characteristics of included and excluded CAHs were similar. Moreover, unlike Medicare claims, NIS data provide information on patients of all ages and payer types. A second limitation is that we could not follow up patients after hospital discharge. Thus, we were unable to examine hospital readmissions, use of post–hospitalization outpatient services, and the degree to which patients end up using post–acute care nursing and/or rehabilitative services after an initial routine discharge. Finally, our study used administrative data, and we therefore cannot exclude the possibility that unmeasured differences in patient characteristics, hospital capabilities, and local care environments contributed to disparities in transfer rates and use of post–acute care. Nonetheless, we attempted to minimize this concern by adjusting our models for multiple patient and hospital characteristics.

Despite these limitations, our results highlight several relevant issues regarding surgical care provided at CAHs. From a quality perspective, higher transfer rates at CAHs after the often-elective procedures examined herein raise concerns regarding the relative frequency and/or severity of postoperative complications at these facilities. Because of the differen-

---

**Figure 2. Adjusted Odds of Transfer From Critical Access Hospital (CAH) Facilities by Surgical Procedure**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Less likely at CAH</th>
<th>More likely at CAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip fracture repair</td>
<td>1.85 (0.99-3.46)</td>
<td></td>
</tr>
<tr>
<td>Hip replacement</td>
<td>1.90 (1.01-3.57)</td>
<td></td>
</tr>
<tr>
<td>Knee replacement</td>
<td>1.69 (0.82-3.46)</td>
<td></td>
</tr>
<tr>
<td>CRC resection</td>
<td>3.37 (2.23-5.09)</td>
<td></td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>1.67 (1.27-2.19)</td>
<td></td>
</tr>
<tr>
<td>TURP</td>
<td>2.47 (0.86-7.14)</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3. Adjusted Odds of Discharge With Post–Acute Care From Critical Access Hospital (CAH) Facilities by Surgical Procedure**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Less likely at CAH</th>
<th>More likely at CAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip fracture repair</td>
<td>0.84 (0.65-1.07)</td>
<td></td>
</tr>
<tr>
<td>Hip replacement</td>
<td>0.82 (0.62-1.09)</td>
<td></td>
</tr>
<tr>
<td>Knee replacement</td>
<td>0.78 (0.58-1.06)</td>
<td></td>
</tr>
<tr>
<td>CRC resection</td>
<td>1.00 (0.82-1.21)</td>
<td></td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>1.06 (0.91-1.24)</td>
<td></td>
</tr>
<tr>
<td>TURP</td>
<td>1.03 (0.75-1.41)</td>
<td></td>
</tr>
</tbody>
</table>

---

A, All patients. B, Patients with Medicare as the primary payer. C, Patients admitted to rural hospitals. Comparisons are adjusted for patient variables and hospital characteristics; non-CAH patients are the referents. Error bars and parenthetical ranges represent 95% CIs. CRC indicates colorectal cancer; TURP, transurethral resection of prostate.
tial incentives for coding complications at CAHs vs non-CAHs, a better understanding of this issue will require future studies based on more granular clinical data. However, if the higher transfer rates reflect practice patterns driven by the length-of-stay requirement at CAHs rather than by complications, then our findings suggest that an unintended consequence of this policy may be avoidable fragmentation of care for surgical patients treated in CAHs. On the cost side of the equation, inpatient transfers can increase expenditures for surgical episodes by up to 25%. Understanding why transfers are more common at CAHs could therefore have significant implications for the CMS and other private payers.

Our findings are also relevant to MedPAC efforts to elucidate overall costs of the CAH program, including their recent projection that post–acute care provided by CAHs is responsible for nearly $1 billion in excess annual Medicare payments. Although our observations suggest that the proportion of CAH patients using post-acute care is equal to or lower than that for non-CAH patients, the MedPAC projection may reflect a greater intensity (eg, higher use of nursing facilities vs home health care), scope, and/or duration of post–acute care for CAH patients that do use these services. Alternatively, such excess costs may be explained by nuances of CAH reimbursement policy rather than use issues. To this point, the CAH reimbursement formula used by the CMS actually shifts some costs incurred during the inpatient admission to the post–acute care swing bed. Given this accounting policy, true post–acute care may actually make up a smaller portion of the annual payments to CAHs than originally estimated. That being said, the CMS policy in this area will obviously be informed further by future studies examining the intensity and duration of post–acute care for surgical patients treated in CAHs vs non-CAHs as well as the possibility that there are overall use differences after admissions for medical conditions not considered in our study.

Finally, our results provide particular insight on the potential implications of bundled payment programs for CAHs, an important consideration given that section 3023 of the Affordable Care Act instructs the CMS to consult with CAHs when launching the National Pilot Program on Payment Bundling. It is well established that post–acute care significantly increases the costs of a surgical episode under the current PPS. For example, total payments related to joint replacement episodes are 50% higher for patients discharged to a skilled nursing facility than for those with routine discharges. Because they appear to use post–acute care less frequently, CAHs may actually fare well with emerging CMS bundled payment initiatives for joint replacement surgery. On the other hand, higher costs at CAHs for the index hospitalization may negate any potential gains from post–acute care. Moreover, higher transfer rates could make bundled payments financially challenging for CAHs, especially if payments after the transfer are attributed to the initial hospitalization.

Ultimately, studies that combine total episode payments (from index surgical admission through completion of post–acute care) with detailed clinical outcomes data will be essential to further strengthen the evidence base around current CAH payment policies. Whatever these data show, policy makers and payers should be cognizant that significant changes to CAH reimbursement may impair the ability of these small hospitals to provide essential health care to vulnerable rural communities.

Conclusions

We found that hospital transfers occur more often after surgical admissions at CAHs. However, the proportion of patients at CAHs using post–acute care is equal to or lower than that of patients treated in non-CAHs. These results will affect the ongoing deliberations concerning CAH payment policy and its implications for health care delivery in rural communities.
Postoperative Care at Critical Access Hospitals

The Right Triangle

Matthew J. Resnick, MD; Daniel A. Barocas, MD, MPH

The article by Gadzinski and colleagues1 raises important questions about how best to maintain access to surgical care in underserved communities. As suggested by Kissick,2 health care delivery is bound by an “iron triangle,” wherein alterations in access exert influences on the other apices of the triangle, namely, cost and quality. To maintain access to care in underserved regions, the Medicare program elected to subsidize critical access hospitals (CAHs) through exemption from the Medicare Prospective Payment System, largely ensuring the financial health of rural health care access. However, “access enhancement” may have unintended consequences. Indeed, the study findings have important policy implications with respect to our ongoing attempts to optimize the dimensions of our iron triangle.

Fundamentally, the health care delivery system must be structured in a fashion that maintains access to care for individuals living in underserved areas, particularly for primary and nonelective care. However, one cannot help but question whether encouraging access to specialty care at CAHs through cost-based reimbursement is the appropriate means to an end. Although one might tolerate slight variation in quality of care, considering the limitations posed to underresourced medical centers, efforts must be made to minimize quality variation across different practice settings. Similarly, one might expect costs to be higher in underserved areas, but the overages should be predictable, measurable, and contained, and the delivery system should be sustainable over time. Does the Medicare response to the CAH model satisfy these criteria? Perhaps not entirely—access is maintained, but variation in quality of care among CAHs is evident, and the cost overages are higher than policy makers find acceptable.

How might we leverage the findings from Gadzinski and colleagues1 into actionable health care policy? Integrated delivery systems have begun to organize and aggregate into large, regional “hub-and-spokes” models. Through affiliations between large referral centers and community-based facilities, patients in outlying areas have immediate access to the local hospital for routine nonelective surgical care, and the system provides logistical support for transferring complex nonelective or elective care to a larger referral center. Patient flow is frequently bidirectional so that routine elective surgery and other services may pass from the referral center back to the community hospitals, thereby satisfying mutual financial interests. The transfer of processes of care, clinical care pathways, technology, and other systems intended to standardize the quality of care provided may also be bidirectional.

The Affordable Care Act may accelerate the formation of these regional networks as accountable care organizations, with newfound incentives to focus on individual hospitals’ core functionalities and optimize shared savings. Indeed, there is already evidence that commercial accountable care organization contracts can “bend the cost curve.”3–4 There remains no obvious mechanism to ensure the financial viability of indi-