Academic medical centers (AMCs) fulfill numerous essential functions. Less appreciated, however, are the unique roles that AMCs play in the American health care system.1,2 Their raison d’être is the delivering local and regional health care. In particular, they are often education of successive generations of new physicians, and they are the primary health care providers for urban minority populations, and also the main locus for conducting research and pursuing innovation to which they accept in transfer those complex and seriously ill patients who cannot be cared for in other hospitals. Both of these important functions may contribute to their higher costs of care and, depending on the adequacy of risk adjustment, may negatively impact the clinical quality ratings at these institutions. In an era of aggressive health care reform, intense financial pressures, and performance report cards with inconsistently robust methodology, we must better characterize the unique patient populations of major teaching hospitals.

To quantify these distinctive features of AMCs, we used contemporary national Medicare data to compare the patient populations served by hospitals of varying teaching intensity. We focused on three common medical conditions (acute myocardial infarction, heart failure, and pneumonia), which together accounted for 9.7% of Medicare short-stay discharges in 2009 and 2010.
Method

Study population

We identified Medicare beneficiaries ≥ 66 years of age from the 50 states, the District of Columbia, Puerto Rico, Guam, and Virgin Islands who were hospitalized in short-term, acute care, general hospitals during 2009-2010 with a principal discharge diagnosis of acute myocardial infarction, heart failure, or pneumonia and were enrolled in fee-for-service coverage in the 12 months prior to their index admissions. We obtained our data from the Centers for Medicare and Medicaid Services (CMS) Medicare Provider Analysis and Review (MEDPAR) file. To identify our study cases, we used the International Classification of Disease Revision 9–Clinical Modification (ICD-9-CM) codes (see Supplemental Digital Table 1, http://links.lww.com/ACADMED/A172).

Hospital teaching intensity

In our primary analyses, we used one common method of categorizing teaching status and non-teaching status. We used the hospital’s membership in the Council of Teaching Hospitals and Health Systems (COTH); teaching hospitals had to be members of the Council to be classified as teaching hospitals. We defined hospitals as teaching hospitals if they indicated “yes” to the question “are you a teaching hospital?” on their Medicare cost reports and as nonteaching hospitals if they indicated “no” to the question “are you a teaching hospital?” on their Medicare cost reports. We controlled for distance traveled beyond the nearest hospital (log transformation of the difference in distance between the hospital to the second hospital and the treatment hospital) as either determined COTH status from the COTH membership directory, Tomator or minor teaching hospitals using three different IRB criteria: link teaching status with patient characteristics from MEDPAR data, 0.097 (median IRB of all teaching hospitals), 0.278 (75th percentile IRB of all teaching hospitals), and 0.629 (90th percentile IRB of all teaching hospitals).

Outcome variable and covariates

As originally defined by Rosenbaum and Rubin in 1983, the propensity score is the conditional probability of assignment to one category of hospitals rather than another. In our study, propensity scores provided a convenient summary of the distribution of particular treatment given a vector of observed covariates. Propensity scores are most commonly used to balance, match, or stratify patient populations to reduce the inevitable differences in measured and unmeasured covariates between treatment groups that are always present in nonrandomized studies and that lead to bias. In logistic models (American/other), admission origin (four mutually exclusive mutually exclusive), and to estimate propensity scores, the outcome variable ign groups: transfer from another hospital’s inpatient setting; transfer from the treatment group rather than a clinical outcome, such as mortality, from another hospital’s emergency department; transfer from another hospital’s emergency department; and other). Patient medical hospital type and not mortality, we included all discharges for analysis of the index admission was previously noted and, thus, unlikely to be a complication of care. Based on CMS mortality models, our models included 10 medical diagnoses and 15 comorbidities for acute myocardial infarction, 8 medical diagnoses and 14 comorbidities for heart failure, and 7 medical diagnoses and 22 comorbidities for pneumonia. We controlled for distance traveled beyond the nearest hospital (log distance) because proximity is a strong confounder of hospital teaching status. The main outcome of our logistic propensity model was transformation of the difference in distance between the hospital to the second hospital and the treatment hospital to the second hospital, and included both discharges. To avoid classifying complications from an initial hospitalization as comorbidities in a subsequent admission, we derived covariate information for both discharges from the first hospital (except for the location of an acute myocardial infarction, which we obtained from both hospitals).

We used one-year “look-back” data (Medicare 2008–2010 inpatient records) both to determine each patient’s past history and comorbidities and to confirm whether a potential comorbidity on the index admission was previously noted and, thus, unlikely to be a complication of care. Based on CMS mortality models, our models included 10 medical diagnoses and 15 comorbidities for acute myocardial infarction, 8 medical diagnoses and 14 comorbidities for heart failure, and 7 medical diagnoses and 22 comorbidities for pneumonia.

We used one common method of categorizing teaching status and non-teaching status. We used the hospital’s membership in the Council of Teaching Hospitals and Health Systems (COTH); teaching hospitals had to be members of the Council to be classified as teaching hospitals. We defined hospitals as teaching hospitals if they indicated “yes” to the question “are you a teaching hospital?” on their Medicare cost reports and as nonteaching hospitals if they indicated “no” to the question “are you a teaching hospital?” on their Medicare cost reports. We controlled for distance traveled beyond the nearest hospital (log transformation of the difference in distance between the hospital to the second hospital and the treatment hospital) as either determined COTH status from the COTH membership directory, Tomator or minor teaching hospitals using three different IRB criteria: link teaching status with patient characteristics from MEDPAR data, 0.097 (median IRB of all teaching hospitals), 0.278 (75th percentile IRB of all teaching hospitals), and 0.629 (90th percentile IRB of all teaching hospitals).
Comparing Teaching Versus Nonteaching Hospitals: The Associate... : Academic Med... Página 3 de 7

Statistical analysis

We used bivariate analyses to compare demographic, clinical, and institutional characteristics, and used unadjusted 30-day all-cause mortality status as admission to a COTH hospital, as a non-COTH teaching hospital, and as a non-COTH non-teaching hospital for each patient. We estimated the odds of admission to a COTH hospital using various methods for differentiating levels of teaching intensity. We used the chi-square test for categorical variables and non-teaching hospitals as the reference group for all models, and we referred to the estimates as linear propensity scores. We estimated the distribution of the linear propensity scores of all patients for admission to a COTH hospital, using a kernel density estimator. We repeated these analyses using various methods for differentiating levels of teaching intensity (e.g., COTH membership or various IRR cut points). After estimating the propensity models, we tabulated the odds ratios (for admission to various types of hospitals) associated with various demographic and clinical characteristics. These ratios represent the odds of admission to each type of hospital when the characteristic is present, divided by the odds when that characteristic is not present, adjusted for other measured confounders.

For each of the three conditions, we constructed bar charts showing the distribution of propensity scores, by deciles, for admission to a COTH hospital. The probability of admission to a COTH hospital varies substantially by decile. We then grouped the propensity total population, geographic area, and the number and percentage of scores for COTH hospital admission of patients who were actually admitted to a COTH hospital into a non-COTH teaching and non-teaching hospitals into geographic area but a greater percentage of teaching hospitals (13 corresponding deciles. COTH, non-COTH, and nonteaching patients[22.4%] COTH hospitals, 20 [34.5%] non-COTH teaching hospitals, who were in the same decile have similar measured confounders, but 25 [43.1%] nonteaching hospitals). In contrast, California has a larger percentage of teaching hospitals and nonteaching hospitals into a COTH hospital. We then estimated the distribution of the linear propensity scores of all patients for admission to a COTH hospital. We used patients who were actually admitted to COTH hospitals as the reference group and their propensity score estimated the distribution of the linear propensity scores of all patients for admission to a COTH hospital. We used patients who were actually admitted to COTH hospitals as the reference group and their propensity score estimated the distribution of the linear propensity scores of all patients for admission to a COTH hospital.

Descriptive statistics

Table 1 presents the adjusted odds ratios from the propensity models for admission to COTH or non-COTH teaching hospitals compared with non-teaching hospitals. Compared with white patients, black patients had 3.44 (95% confidence interval [CI] 2.96–4.02) times the odds (for acute myocardial infarction) to 2.58 (95% CI 2.91–3.67) times the odds (for pneumonia) of being admitted to COTH hospitals for patients transferred from another hospital’s inpatient setting (versus patients with another admission source, such as elective or direct) ranged from 3.40 (95% CI 1.89–5.63) for acute myocardial infarction to 4.62 (95% CI 4.16–5.12) for pneumonia. Corresponding odds ratios for transfer to a COTH hospital from another hospital’s emergency department ranged from 1.58 (95% CI 1.53–1.65) for heart failure to 2.29 (95% CI 2.15–2.44) for pneumonia. Patients with some chronic comorbidities, such as COPD, pneumonia, diabetes, and dementia, were less likely to be admitted to COTH hospitals, whereas patients with renal failure, chronic liver disease, or metastatic cancer were more likely.
Probabilities of admission to a COTH hospital for all discharges ranged from 0.031 to 0.786 across the three conditions. The deciles of propensity scores for all study patients for admission to a COTH hospital were more likely, Table 3 provides the specific hospital or major teaching hospital are available in Supplemental Digital Table 3 and Supplemental Digital Figure 1, http://links.lww.com/ACADMED/A172. Because this analysis used admission to a COTH hospital, had a high percentage of black patients, patients who were actually admitted to COTH hospitals as the reference, the percentage of patients within each propensity decile is 10%. Thus, summing across all deciles accounts for 100% of all patients actually admitted to COTH hospitals.

Conditional on their measured covariates, patients in lower deciles were less likely to be admitted to a COTH hospital, whereas patients in higher deciles were more likely. Table 3 provides the specific characteristics of patients in the highest and lowest probability deciles (10 and 1). Decile 10, characterized by the highest probability of admission to a COTH hospital, had a high percentage of black patients, ranging from 13.2% for acute myocardial infarction to 74.6% for heart failure; a very high percentage of patients transferred from other hospitals' inpatient settings (96.5%) or emergency departments (3.4%) for acute myocardial infarction; and a higher percentage of acute myocardial infarction patients with serious comorbidities, such as renal failure and chronic liver disease. Decile 1, representing the highest probability of acute myocardial infarction admission to a nonteaching hospital (and lowest probability of admission to a COTH hospital), had no black patients, no patients transferred from other hospitals, a lower percentage of patients with previous cardiovascular history, and a higher percentage of patients with chronic diseases, such as COPD and dementia. Similar findings were observed for heart failure and pneumonia patients.

Figure 1 shows the estimated density plots for the probability of admission to a COTH hospital for acute myocardial infarction, heart failure, and pneumonia in the national cohort. For each graph, the distribution of linear propensity scores for admission to a COTH hospital shifts to the right with increasing hospital teaching intensity. Although not well seen on these graphs because of the scale, a small number of patients with the highest propensity scores in COTH hospitals have very few comparable patients in nonteaching hospitals. Within the top 1% of propensity scores, the percentage of patients admitted to a COTH hospital was four to seven times higher than the percentage admitted to a nonteaching hospital.

Between-state variation in the use of teaching hospitals

Figure 2 illustrates significant differences across states in patients' characteristics at hospitals of varying teaching intensity, using Massachusetts and California as examples. For each condition, high-linear-propensity-score patients are much more likely to be cared for at COTH hospitals in Massachusetts, which has a large proportion of such tertiary/quaternary institutions. There were 109 acute myocardial infarction patients in Massachusetts within the top 1% of propensity scores admitted to COTH hospitals, whereas there was only 1 comparable patient at non-COTH teaching or nonteaching hospitals. Conversely, in California, with proportionately fewer teaching hospitals, the distribution of linear propensity scores across the three types of hospitals was quite similar, with few patients uniquely cared for only by COTH hospitals. The findings for heart failure and pneumonia were similar but not as striking.

Alternative hospital teaching intensity classification methods

We observed similar findings to all the preceding analyses when we used various IRB criteria rather than COTH status to categorize hospital teaching intensity (according to the same U.S. national data) (see Supplemental Digital Tables 4–9 and Supplemental Digital Figures 2–4, http://links.lww.com/ACADMED/A172, for complete data).

Discussion

Teaching hospitals, especially COTH members, serve a number of important clinical functions in addition to their educational and research missions. Two of these functions—caring for minority populations and serving as a referral center for transfer patients, many of whom are complex and severely ill—are readily apparent in our study of three common conditions. Both illustrate the added value of teaching hospitals in the care of patient cohorts who are generally at higher risk of adverse outcomes.
Care of minority populations

COTH hospitals provide a disproportionate percentage of the care of black patients, as previous studies of minority, underserved, and poor populations cared for at COTH hospitals, including potentially higher-risk patients. These populations have worse overall health outcomes, presumably resulting from their institutions.16–18 In the study by Kahn and colleagues,18 black or generally lower education and socioeconomic status, lack of regular follow-up, and other factors, Medicare patients who received hospital care at teaching hospitals had worse outcomes than those who received care at nonteaching hospitals.16,18–20 These populations have less equitable care for such patients at these hospitals, and mortality and more equitable care for such patients at these hospitals, and mortality and more equitable care for such patients at teaching hospitals. The high concentration of minority populations at teaching hospitals also presents an opportunity for health system improvement.21 Major teaching hospitals can collect and analyze disparities data and train the next generation of physicians to provide just and equitable care regardless of race, ethnicity, gender, or socioeconomic status.

Referral center for complex and severely ill transfer patients

Our study also confirms another unique function of teaching hospitals. Other studies have demonstrated that the necessity to be transferred especially COTH members—their role as the predominant destinations of groups of patients at exceptionally high risk for mortality, for transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our propensity score decile analyses demonstrate that aggregate patient characteristics vary in direct proportion to hospital teaching intensity. Although overlap does exist, there are certain types of patients at COTH hospitals who are rarely seen at nonteaching hospitals. Our data from Massachusetts and California suggested that the distribution of patients among hospitals of varying teaching intensity varies regionally, presumably because of both the relative availability of AMC and local referral patterns.

Limitations

Our analyses were based on contemporary Medicare data and may not be applicable to other age groups and payers. As with any study based on administrative data, there are inherent limitations in the accuracy with which patient clinical status is characterized. Furthermore, as in any observational study, there is the potential for unmeasured confounders.

Conclusions

In addition to their medical education and research missions, teaching hospitals play a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our study confirms that COTH hospitals remain referral centers for complex and severely ill transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our study confirms that COTH hospitals remain referral centers for complex and severely ill transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our study confirms that COTH hospitals remain referral centers for complex and severely ill transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our study confirms that COTH hospitals remain referral centers for complex and severely ill transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


Our study confirms that COTH hospitals remain referral centers for complex and severely ill transfer patients. Most transfer patients are too complex or too ill to be transferred at their original hospital, or they require specialized services or procedures that are uniquely available at the receiving hospital.22 The buffering function of COTH hospitals plays a major role in the varying teaching outcomes of patients, and mortality for Medicare patients with acute MI. JAMA. 2000;284:1252–1263


44. Escarce JJ, Kelley MA. Admission source to the medical intensive care unit predicts hospital death independent of APACHE II score. JAMA. 1990;264:2389–2394


Supplemental Digital Content

ACADMED_89_1_2013_10_23_SHAHIAN_1201161_SDC1.pdf [PDF] (745 KB)

© 2014 by the Association of American Medical Colleges