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Mortality and Readmission at Safety Net and Non-Safety Net Hospitals for Three Common Medical Conditions

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Abstract

Safety net hospitals remain under financial strain, possibly affecting quality of care, and face uncertain financial consequences under the Patient Protection and Affordable Care Act. We compared risk-standardized mortality and readmission rates among fee-for-service Medicare beneficiaries admitted for acute myocardial infarction, heart failure, or pneumonia to urban hospitals within metropolitan statistical areas containing at least one safety net and non-safety net hospital. There was substantial variation in both mortality and readmission rates among safety-net and non-safety net hospitals for all three conditions, although safety-net hospitals had marginally worse outcomes. Herein we discuss the clinical and policy implications of these findings.

Keywords

Safety net hospitals; Vulnerable Populations; Quality of Care

The health care safety net is an unofficial network of physicians and hospitals within the United States committed to caring for disadvantaged populations without stable access to

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care, including the uninsured, the low-income underinsured, and Medicaid beneficiaries (1). However, its stability remains precarious. The Institute of Medicine has declared the nation's safety net to be "intact but endangered" (1). Recently, rising uninsurance and underinsurance rates (2, 3), combined with rising unemployment (4), have likely resulted in disproportionate financial strain on the safety net through rising rates of uncompensated care. This financial strain raises concerns about the quality of care provided by safety net hospitals, because worse baseline financial health and increased fiscal strain have been variably associated with lower quality of care (5–9). On top of this, prior studies have suggested that safety net hospitals and hospitals that disproportionately serve disadvantaged populations provide lower quality care or are less likely to be top performers (10–15). However, other research has found quality differences between safety net and non-safety net hospitals for acute myocardial infarction (AMI) care to be small to negligible on average with wide variation in hospital performance, including high-performing safety net hospitals and low-performing non-safety net hospitals (16).

The recently enacted Patient Protection and Affordable Care Act (PPACA) will have uncertain financial consequences for safety net hospitals (17). For instance, Medicaid eligibility will expand, leading hospitals to provide less uncompensated care. Alternatively, disproportionate share hospital funding will decline substantially, a major source of revenue for safety net hospitals. Our objective was to compare risk-standardized mortality and readmission rates among fee-for-service Medicare beneficiaries hospitalized for AMI, heart failure, and pneumonia at urban safety net hospitals and non-safety net hospitals located within the same metropolitan statistical area (MSA). By examining the quality of care at safety net hospitals prior to PPACA, using the two principal outcome performance measures currently publicly reported by the Centers for Medicare and Medicaid Service (CMS) (18), our work can inform the legislation's implementation. Furthermore, by restricting our comparison to safety net and non-safety net hospitals within urban MSAs, we minimize confounding from inclusion of non-safety net hospitals that do not operate in geographic areas that include a safety net hospital. Moreover, we minimize confounding from inclusion of non-urban hospitals. Although urban and rural hospitals can both function as safety net institutions, the challenges faced differ across geographic areas (19). Finally, because differential rates of insurance coverage and access to care have been associated with differences in quality of care (20), by limiting our study to fee-for-service Medicare beneficiaries, we reduce confounding from insurance status differences between populations receiving care at safety net and non-safety net hospitals.

METHODS

Study Cohort

The study population included fee-for-service Medicare patients 65 years or older hospitalized from January 1, 2006, through December 31, 2008 with AMI, heart failure, or pneumonia (Appendix (21), Exhibit A1). Data were obtained from the CMS Standard Analytic Files and Enrollment Database that included demographic information, principal discharge and secondary diagnosis codes, and procedure codes on each hospitalization. We included patients admitted to hospitals in MSAs that contained at least one safety net and one non-safety net hospital and who had 12 months of continuous Medicare fee-for-service enrollment before hospitalization to obtain past medical and procedure history. We excluded patients admitted to hospitals for which American Hospital Association data were not available and to hospitals that were located outside of the United States or in non-urban areas, as defined by U.S. Census MSAs. To further reduce heterogeneity, we excluded patients admitted to hospitals that admitted fewer than ten patients for the diagnosis of interest during our 3-year observational period because these hospitals infrequently cared for patients with these conditions.

Hospital Safety Net Status

Hospital safety net status was defined using a broadly inclusive definition that has been employed in previous research (22, 23) as either public hospitals or private hospitals with an annual Medicaid caseload greater than one standard deviation above their respective state's mean private hospital Medicaid caseload. Hospital public ownership and annual Medicaid caseload were obtained from the American Hospital Association Annual Survey. Additional hospital characteristics included teaching status, geographic location, total bed size, and hospital capacity to provide coronary artery bypass graft surgery or percutaneous coronary intervention.

Risk-Standardized Mortality Rates

We examined patient deaths from any cause within 30 days following an index hospitalization for AMI, heart failure, and pneumonia. For the mortality analyses for each condition, to avoid survival bias, we randomly selected one admission per year for patients with multiple admissions for the same diagnosis during any study year. Furthermore, patients who were transferred between acute care facilities were linked into a single episode of care with outcomes attributed to the index (first) hospital.

To calculate 30-day all-cause risk-standardized mortality rates for AMI, heart failure, and pneumonia, we used measures that were developed for CMS and have been endorsed by the National Quality Forum (24, 25). These measures utilize administrative data but produce estimates of mortality rates that are good surrogates for estimates from a medical record model (26). All three models include patient-specific information on age, sex, and clinical characteristics (Appendix (21), Exhibit A2) (27–29) and account for the clustering (non-independence) of patients within the same hospital (30).

Risk-Standardized Readmission Rates

We examined patient readmission for any cause within 30 days after being discharged alive following an index hospitalization for AMI, heart failure, and pneumonia. For the readmission analyses for each condition, we included all admissions per year for patients with multiple admissions for the same diagnosis during any study year. However, those hospitalizations that occurred within 30 days of a previous admission were counted only as a readmission and were not also considered as a new index admission. Furthermore, patients who were transferred between acute care facilities were linked into a single episode of care with outcomes attributed to the final hospital that discharged the patient to a non-acute setting.

To calculate 30-day all-cause risk-standardized readmission rates for AMI, heart failure, and pneumonia, we again used measurement methods that were developed for the CMS and have been endorsed by the National Quality Forum (31). Similarly, all three models include patient-specific information on age, sex, and clinical characteristics (Appendix (21), Exhibit A2) (32–34) and account for the clustering (non-independence) of patients within the same hospital.

Statistical Analysis

We compared safety net and non-safety net hospitals for patient-level differences in demographic and clinical characteristics, as well as for hospital-level differences in hospital characteristics. For all three conditions, we calculated the mean hospital-specific mortality and readmission rate for the full three-year pooled sample and stratified by hospital safety net status, weighting each hospital's mortality and readmission rate by the condition-specific number of hospitalizations to account for the variability in hospital sample sizes.

In addition, we calculated the mean aggregated MSA-specific mortality and readmission rate stratified by hospital safety net status and determined the average within-MSA difference between safety net and non-safety net hospitals. Because safety net hospitals differ from non-safety net hospitals in specific ways that may impact outcomes (i.e., safety net hospitals are more likely to be teaching hospitals and high volume hospitals), we also compared within-MSA differences between safety net and non-safety hospitals stratified by four characteristics of the safety net hospital that were not used to define safety net status: teaching status, capacity to provide cardiovascular revascularization procedures, condition-specific volume and bed size. For these exploratory analyses, we simply determined whether interpretations of the stratified within-MSA differences were the same or different and categorized differences as minor or major.

All analyses were performed separately for AMI, heart failure, and pneumonia and were conducted using SAS Software, Version 9.1.3 (SAS Institute, Inc., Cary, NC). All statistical tests were 2-tailed and used a type I error rate of 0.05.

Limitations

There are a number of points to consider before evaluating our study. First, we restricted our analysis to fee-for-service Medicare beneficiaries and our findings may differ using a different population. However, the quality of care observed for Medicare patients within a hospital is likely to be representative of all hospitalized adults, regardless of insurance coverage or income. When describing the problems of uninsurance in the United States, the Institute of Medicine proposed the likelihood of community effects and shared destiny, explaining that the quality, quantity, and scope of health services within a community can be adversely affected by having a large or growing uninsured population (35).

Second, we restricted our analysis to only three conditions and thus our results may not be generalizable to other conditions. Third, because the mortality and readmission rates we used are the current focus of CMS efforts to publicly report quality of care at U.S. hospitals, hospitals engaged in quality improvement efforts may disproportionately focus their quality efforts on these measures, attenuating potential differences between safety net and non-safety net hospitals. Fourth, we used an inclusive definition of safety net hospitals, including all public hospitals and private hospitals with a Medicaid caseload at least one standard deviation above its state's mean, a definition that is practical and categorizes most hospitals predominantly caring for poor, vulnerable populations as safety net hospitals. Fifth, we restricted our analyses to urban hospitals operating within MSAs with at least one safety net and non-safety net hospital, ensuring that our comparison was of hospitals operating within similar geographic environments. While our findings may not apply to rural hospitals, many of which represent a safety net for rural residents without ready access to acute care facilities (19), we believe this limitation is a great strength of our approach, eliminating any confounding from inclusion of non-safety net hospitals that do not operate in geographic areas that include a safety net hospital as well as confounding from inclusion of rural safety net institutions that face different challenges than do urban safety net hospitals (36, 37).

Finally, we used a hierarchical modeling approach to estimate risk-standardized mortality and readmission rates, consistent with the CMS approach to performance assessment. This approach has been criticized because highly variable estimates are 'shrunk' to the mean, potentially underestimating differences (38, 39). However, highly variable estimates are 'shrunk' to the mean because they contain less information (40). The hierarchical model removes variability due to sample size in estimates; differences based on these estimates are thus smaller than differences based on observed rates (41). Nevertheless, because our study used three years of data and was limited to urban hospitals operating within an MSA with at

least one safety net and non-safety net hospital, all of the hospitals in our study had large volumes and the “shrinkage” effect would have been minimal in our analyses.

RESULTS

Among 366 MSAs in the United States, 142 had at least one safety net and one non-safety net institution with sufficient hospital volumes to be included in our analyses. Fourteen MSAs were in the Northeast Census Region (10%), 29 in the Midwest (20%), 75 in the South (53%) and 24 in the West (17%). For AMI analyses, there were 1263 hospitals, 310 safety net and 953 non-safety net hospitals. For heart failure, there were 1433 hospitals, 376 safety net and 1057 non-safety net hospitals. For pneumonia, there were 1447 hospitals, 384 safety net and 1063 non-safety net hospitals.

In general, for all three conditions, there were few substantial differences in demographic and clinical characteristics between patients receiving care at safety net and non-safety net hospitals (Appendix (21), Exhibit A3). However, safety net hospitals were more likely to be teaching institutions and had higher average condition-specific volumes when compared with non-safety net hospitals (p values < 0.001 ; Appendix (21), Exhibit A4).

30-Day Mortality Rates

Safety-net hospitals had modestly higher AMI and pneumonia mortality rates when compared with non-safety net hospitals (Exhibit 1): 16.6% versus 16.1% and 11.5% versus 11.1%, respectively, but there was no difference in heart failure mortality rates: 10.8% versus 10.6%. However, for all three conditions, there was substantial heterogeneity in estimated mortality rates among both safety net and non-safety hospitals, with extensive overlap in performance among the two groups (Exhibit 2 and Appendix (21), Exhibit A5).

Average absolute within-MSA differences in mortality rates between safety net and non-safety net hospitals were also modest: 0.68 percentage points for AMI, 0.04 percentage points for heart failure, and 0.34 percentage points for pneumonia. Furthermore, average within-MSA differences for AMI, heart failure and pneumonia mortality rates were generally the same when stratifying MSAs based on safety net hospital teaching status, revascularization capacity, volume or bed size, although several minor differences in interpretation were observed, particularly for pneumonia mortality (Appendix (21), Exhibits A6–9).

30-Day Readmission Rates

Safety-net hospitals had marginally higher AMI and pneumonia readmission rates when compared with non-safety net hospitals (Exhibit 1): 20.3% versus 20.0% and 18.7% versus 18.4%, respectively, but modestly higher heart failure readmission rates: 25.2% versus 24.6%. However, again, for all three conditions, there was substantial heterogeneity in estimated readmission rates among both safety net and non-safety hospitals, with extensive overlap in performance among the two groups (Exhibit 3 and Appendix (21), Exhibit A10).

Average absolute within-MSA differences in readmission rates between safety net and non-safety net hospitals were also modest: 0.36 percentage points for AMI, 0.69 percentage points for heart failure, and 0.49 percentage points for pneumonia. Furthermore, average within-MSA differences for AMI, heart failure and pneumonia readmission rates were generally the same when stratifying MSAs based on safety net hospital teaching status, revascularization capacity, volume or bed size, although several minor differences in interpretation were observed (Appendix (21), Exhibits A6–9).

DISCUSSION

Among urban safety net and non-safety net hospitals located within the same MSAs, there was broadly similar performance in care for AMI, heart failure and pneumonia using the mortality and readmission measures publicly-reported by CMS. Although non-safety net hospitals had significantly better performance on average for five of six outcomes we studied, for each outcome the average within-MSA absolute difference was small, ranging between 0.05 and 0.7 percentage points. Moreover, there was substantial overlap in outcomes between safety net and non-safety net hospitals, such that there were many MSAs wherein safety net hospitals were performing better than non-safety net hospitals. These findings suggest that, despite the challenges safety net hospitals face, many perform as well or better than their same-MSA non-safety net hospitals.

Concerns have been raised that the current outcome measures publicly-reported by CMS, particularly the readmission measures, disadvantage hospitals that care predominantly for poor, vulnerable populations, as pending reforms to financially penalize hospitals with “excessive” readmission rates are feared to exacerbate inequalities (42, 43). However, our findings provide some reassurance, by demonstrating small average differences between urban safety net and non-safety net hospitals, with substantial heterogeneity in performance. Moreover, differences between safety net and non-safety net hospitals were larger for mortality than readmission. Furthermore, the heterogeneity we observed was not a result of confounding other hospital characteristics with safety net status. Average within-MSA differences for AMI, heart failure and pneumonia mortality and readmission rates were generally the same when stratifying MSAs based on safety net hospital teaching status, revascularization capacity, volume or bed size, although several minor differences in interpretation were observed, particularly for pneumonia mortality.

The PPACA is expected to have a number of consequences on the nation’s safety net (17). Principally through expansion of Medicaid eligibility, approximately 34 million persons will have health insurance coverage by 2019. For safety net hospitals, greater rates of insurance should lead to increased revenue, as provision of uncompensated care will likely decrease. However, even after Medicaid expansion, 23 million persons are expected to remain uninsured, including undocumented immigrants, those who cannot afford coverage despite subsidies, and individuals who do not enroll in Medicaid despite eligibility. Caring for a large population of undocumented immigrants may create challenges for maintaining local governmental support. Finally, while incentives to place health care professionals in underserved areas should benefit safety net hospitals, PPACA reduces Medicaid disproportionate share hospital funding annually by \$20 billion by 2020, a central source of revenue for public hospitals that may or may not exceed anticipated increased revenue from Medicaid expansion. Amidst these financial uncertainties, safety net hospitals will increasingly need to compete with non-safety net hospitals within their markets, demonstrating better or equal performance, to attract patients and remain viable sources of care in their communities.

Despite caring for more vulnerable and financially disadvantaged populations, our results suggest that many urban safety net hospitals can achieve equal or better outcomes than non-safety net hospitals within their MSA. Our findings contrast with studies that have suggested that safety net hospitals and hospitals that disproportionately serve disadvantaged populations were associated with higher mortality and readmission rates for AMI, heart failure, and pneumonia (12, 13). However, these studies examined hospital outcomes without attempting to focus comparisons on hospitals operating within the same geographic area, as we have done by restricting our study to urban hospitals operating within MSAs with at least one safety net and non-safety net hospital to reduce confounding. In fact, the

magnitude in differences observed was similar to our previous work examining AMI mortality rates at safety net and non-safety net hospitals nationwide (16).

In conclusion, urban safety net hospitals had marginally higher, but clinically-modest, mortality and readmission rates for all three conditions when compared with non-safety net hospitals within the same MSA, with the exception of heart failure mortality which was no different. There was also substantial heterogeneity in performance, such that for many MSAs, safety net hospitals were performing better than non-safety net hospitals. These results suggest that safety net hospitals can achieve equal or better outcomes than non-safety net hospitals within their MSA, despite caring for more vulnerable and financially disadvantaged populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Exhibit 1

Thirty-day all-cause risk-standardized mortality and readmission rates for urban hospitals located within a metropolitan statistical area (MSA) that contained at least one safety net and non-safety net hospital that hospitalized fee-for-service Medicare beneficiaries for acute myocardial infarction, heart failure, and pneumonia from 2006–2008, stratified by hospital safety net status.

	Safety Net Hospitals	Non-Safety Net Hospitals	Mean Within-MSA Difference Between Safety Net and Non-Safety Net Hospitals
Acute Myocardial Infarction			
Mean 30-Day Mortality Rate (95% Confidence Interval)	16.6 (16.4, 16.9)	16.1 (16.0, 16.2)	0.68 (0.34, 1.03)
Mean 30-Day Readmission Rate (95% Confidence Interval)	20.3 (20.1, 20.4)	20.0 (19.9, 20.1)	0.36 (0.11, 0.61)
Heart Failure			
Mean 30-Day Mortality Rate (95% Confidence Interval)	10.8 (10.6, 10.9)	10.6 (10.5, 10.7)	0.04 (−0.22, 0.29)
Mean 30-Day Readmission Rate (95% Confidence Interval)	25.2 (24.9, 25.4)	24.6 (24.5, 24.7)	0.69 (0.38, 1.00)
Pneumonia			
Mean 30-Day Mortality Rate (95% Confidence Interval)	11.5 (11.3, 11.7)	11.1 (11.0, 11.2)	0.34 (0.03, 0.65)
Mean 30-Day Readmission Rate (95% Confidence Interval)	18.7 (18.5, 18.8)	18.4 (18.3, 18.5)	0.49 (0.25, 0.73)

Source: Authors analysis of the Centers for Medicare and Medicaid Services' Standard Analytic Files and Enrollment Database, used in conjunction with the American Hospital Association Annual Survey.

Exhibit 2

Histogram frequency distributions for safety net and non-safety net hospital 30-day risk-standardized mortality rates for patients admitted for heart failure, 2006–2008.

Source: Authors analysis of the Centers for Medicare and Medicaid Services' Standard Analytic Files and Enrollment Database, used in conjunction with the American Hospital Association Annual Survey.

Note: Because there were substantially greater numbers of non-safety net hospitals than safety net hospitals, rather than plot the mortality rate distributions using number of hospitals along the y axis, we used density, or the number of hospitals per unit of area, with the unit of area set at 1 for each distribution. Additional histogram distributions for patients admitted for acute myocardial infarction and pneumonia to safety net and non-safety net hospitals can be found in the Appendix (21), Exhibit A5.

Exhibit 3

Histogram frequency distributions for safety net and non-safety net hospital 30-day risk-standardized readmission rates for patients admitted for heart failure, 2006–2008.

Source: Authors analysis of the Centers for Medicare and Medicaid Services' Standard Analytic Files and Enrollment Database, used in conjunction with the American Hospital Association Annual Survey.

Note: Because there were substantially greater numbers of non-safety net hospitals than safety net hospitals, rather than plot the readmission rate distributions using number of hospitals along the y axis, we used density, or the number of hospitals per unit of area, with the unit of area set at 1 for each distribution. Additional histogram distributions for patients admitted for acute myocardial infarction and pneumonia to safety net and non-safety net hospitals can be found in the Appendix (21), Exhibit A10.