

## RESEARCH LETTER

# Associations Between Hospital-Wide Readmission Rates and Mortality Measures at the Hospital Level: Are Hospital-Wide Readmissions a Measure of Quality?

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The Centers for Medicare & Medicaid Services (CMS) have sought to reduce readmissions in the 30 days following hospital discharge through penalties applied to hospitals with readmission rates that are higher than expected. Expected readmission rates for Medicare fee-for-service beneficiaries are calculated from models that use patient-level administrative data to account for patient morbidities. Readmitted patients are defined as those who are discharged from the hospital alive and then rehospitalized at any acute care facility within 30 days of discharge. These models explicitly exclude sociodemographic variables that may impact quality of and access to outpatient care. Specific exclusions are also applied based on diagnosis codes so as to avoid penalizing hospitals for rehospitalizations that are likely to have been planned.

More recently, a hospital-wide readmission measure has been developed, which seeks to provide a comprehensive view of each hospital's readmission rate by including the vast majority of Medicare patients. Like the condition-specific readmission measures, the hospital-wide readmission measure also excludes sociodemographic variables and incorporates specific condition-based exclusions so as to avoid counting planned rehospitalizations (e.g., an admission for cholecystectomy following an admission for biliary sepsis). Although not currently used for pay-for-performance, this measure has been included in the CMS Star Report along with other readmission measures.<sup>1</sup> CMS does not currently disseminate a hospital-wide mortality measure, but does disseminate hospital-level adjusted 30-day mortality rates for Medicare beneficiaries with discharge diagnoses of stroke, heart failure, myocardial infarction (MI), chronic obstructive pulmonary disease (COPD) and pneumonia, and principal procedure of coronary artery bypass grafting (CABG).

It is conceivable that aggressive efforts to reduce readmissions might delay life-saving acute care in some sce-

narios,<sup>2</sup> and there is prior evidence that heart failure readmissions are inversely (but weakly) related to heart failure mortality.<sup>3</sup> It is also plausible that keeping tenuous patients alive until discharge might result in higher readmission rates. We sought to examine the relationship between hospital-wide adjusted 30-day readmissions and death rates across the acute care hospitals in the United States. Lacking a measure of hospital-wide death rates, we examined the relation between hospital-wide readmissions and each of the 6 condition-specific mortality measures. For comparison, we also examined the relationships between condition-specific readmission rates and mortality rates.

## METHODS

We used publically available data published by CMS from July 1, 2011 through June 30, 2014.<sup>4</sup> These data are provided at the hospital level, without any patient-level data. We included 4452 acute care facilities based on having hospital-wide readmission rates, but not all facilities contributed data for each mortality measure. We excluded from analysis on a measure-by-measure basis those facilities for which outcomes were absent, without imputing missing outcome measures, because low volume of a given condition was the main reason for not reporting a measure. For each mortality measure, we constructed a logistic regression model to quantify the odds of performing in the lowest (best) mortality tertile as a function of hospital-wide readmission tertile. To account for patient volumes, we included in each model the number of eligible patients at each hospital with the specified condition. We repeated these analyses using condition-specific readmission rates (rather than the hospital-wide readmission rates) as the independent variable. Specifications for CMS models for mortality and readmissions are publically available.<sup>5</sup>

## RESULTS

After adjustment for patient volumes, hospitals in the highest hospital-wide readmission tertile were more likely to perform in the lowest (best) mortality tertile for 3 of the 6 mortality measures: heart failure, COPD, and stroke ( $P < 0.001$  for all). For MI, CABG and pneumonia, there was no significant association between high hospital-wide readmission rates and low mortality (Table 1). Using condition-specific readmission rates, there remained an inverse association between readmissions and mortality

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**TABLE 1.** Adjusted Odds of Performing in the Best (Lowest) Tertile for Medicare-Reported Hospital-Level Mortality Measures as a Function of Hospital-Wide Readmission Rates

	Hospital-Wide Readmission Rate Tertile [Range of Adjusted Readmission Rates, %]*		
	1st Tertile, n = 1359 [11.3%-14.8%], Adjusted Odds Ratio† (95% CI)	2nd Tertile, n = 1785 [14.9%-15.5%], Adjusted Odds Ratio† (95% CI)	3rd Tertile, n = 1308 [15.6%-19.8%], Adjusted Odds Ratio† (95% CI)
Mortality measure (no. of hospitals reporting)			
Acute myocardial infarction (n = 2415)	1.00 (referent)	0.88 (0.71–1.09)	1.02 (0.83–1.25)
Pneumonia (n = 4067)	1.00 (referent)	0.83 (0.71–0.98)	1.11 (0.94–1.31)
Heart failure (n = 3668)	1.00 (referent)	1.21 (1.02–1.45)	1.94 (1.63–2.30)‡
Stroke (n = 2754)	1.00 (referent)	1.13 (0.93–1.38)	1.48 (1.22–1.79)‡
Chronic obstructive pulmonary disease (n = 3633)	1.00 (referent)	1.12 (0.95–1.33)	1.73 (1.46–2.05)‡
Coronary artery bypass (n = 1058)	1.00 (referent)	0.87 (0.63–1.19)	0.99 (0.74–1.34)
Condition-specific readmission rate tertile			
Mortality measure			
Acute myocardial infarction	1.00 (referent)	0.88 (0.71–1.08)	0.79 (0.64–0.99)
Pneumonia	1.00 (referent)	0.91 (0.78–1.07)	0.89 (0.76–1.04)
Heart failure	1.00 (referent)	1.15 (0.96–1.36)	1.56 (1.31–1.86)‡
Stroke	1.00 (referent)	1.65 (1.34–2.03)‡	1.70 (1.23–2.35)‡
Chronic obstructive pulmonary disease	1.00 (referent)	0.83 (0.70–0.98)	0.84 (0.71–0.99)
Coronary artery bypass	1.00 (referent)	0.59 (0.44–0.80)‡	0.47 (0.34–0.64)‡

NOTE: Abbreviations: CI, confidence interval. \*Tertiles with slightly different total numbers since data were downloaded were only presented to nearest 0.1%. †Adjusted for number of eligible Medicare fee-for-service hospitalizations for the condition at the hospital level. ‡ $P \leq 0.001$  versus referent group.

for heart failure and stroke, but not for COPD. In contrast, hospitals with the highest CABG-specific readmission rates were significantly less likely to have low CABG-specific mortality ( $P < 0.001$ ).

## DISCUSSION

We found that higher hospital-wide readmission rates were associated with lower mortality at the hospital level for 3 of the 6 mortality measures we examined. The findings for heart failure parallel the findings of Krumholz and colleagues who examined 3 of these 6 measures (MI, pneumonia, and heart failure) in relation to readmissions for these specific populations.<sup>3</sup> This prior analysis, however, did not include the 3 more recently reported mortality measures (COPD, stroke, and CABG) and did not use hospital-wide readmissions.

Causal mechanisms underlying the associations between mortality and readmission at the hospital level deserve further exploration. It is certainly possible that global efforts to keep patients out of the hospital might, in some instances, place patients at risk by delaying necessary acute care.<sup>2</sup> It is also possible that unmeasured variables, particularly access to hospice and palliative care services that might facilitate “good” deaths, could be associated with both reduced readmissions and higher death rates. Additionally, because deceased patients cannot be readmitted, one might expect that readmissions and mortality might be inversely associated, particularly for conditions with a high postdischarge mortality rate. Similarly, a hospital that does a particularly good job keeping chronically ill patients alive until discharge might exhibit a higher readmission rate than a hospital that is less adept at keeping tenuous patients alive until discharge.

Regardless of the mechanisms of these findings, we present these data to raise the concern that using readmis-

sion rates, particularly hospital-wide readmission rates, as a measure of hospital quality is inherently problematic. It is particularly problematic that CMS has applied equal weight to readmissions and mortality in the Star Report.<sup>1</sup> High readmission rates may result from complications and poor handoffs, but may also stem from the legitimate need to care for chronically ill patients in a high-intensity setting, particularly fragile patients who have been kept alive against the odds. In conclusion, caution is warranted in viewing readmissions as a quality metric until the associations we describe are better explained using patient-level data and more robust adjustment than is possible with these publically available data.

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