Chronic Obstructive Pulmonary Disease Readmissions and Other Measures of Hospital Quality

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Abstract

Rationale: The Centers for Medicare and Medicaid Services recently implemented financial penalties to reduce hospital readmissions for select conditions, including chronic obstructive pulmonary disease (COPD). Despite growing pressure to reduce COPD readmissions, it is unclear how COPD readmission rates are related to other measures of quality, which could inform efforts on common organizational factors that affect high-quality care.

Objectives: To examine the association between COPD readmissions and other quality measures.

Methods: We analyzed data from the 2015 Centers for Medicare and Medicaid Services annual files, downloaded from the Hospital Compare website. We included 3,705 hospitals nationwide that had publicly reported data on COPD readmissions. We compared COPD readmission rates to other risk-adjusted measures of quality, including readmission and mortality rates for other conditions, and patient reports about care experiences.

Measurements and Main Results: There were modest correlations between COPD readmission rates and readmission rates for other medical conditions, including heart failure ($r = 0.39$; $P < 0.01$), acute myocardial infarction ($r = 0.30$; $P < 0.01$), pneumonia ($r = 0.38$; $P < 0.01$), and stroke ($r = 0.29$; $P < 0.01$). In contrast, we found low correlations between COPD readmission rates and readmission rates for surgical conditions, as well as mortality rates for all measured conditions. There were significant correlations between COPD readmission rates and all patient experience measures.

Conclusions: These findings suggest there may be common organizational factors that influence multiple disease-specific outcomes. As pay-for-performance programs focus attention on individual disease outcomes, hospitals may benefit from in-depth assessments of organizational factors that affect multiple aspects of hospital quality.

Keywords: chronic obstructive pulmonary disease; patient readmission; quality indicators; health care

Approximately 19.6% of patients hospitalized in the United States are readmitted within 30 days, accounting for an estimated expense of \$17 billion annually (1). In an attempt to improve clinical

outcomes and control rising healthcare costs, the Centers for Medicare and Medicaid Services (CMS) developed the Hospital Readmission Reduction Program (HRRP), which imposes financial penalties

on hospitals with excessively high readmission rates for specific conditions, such as heart failure (HF), acute myocardial infarction (AMI), and pneumonia (2). In October 2014, CMS added chronic

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At a Glance Commentary

Scientific Knowledge on the

Subject: Despite increasing focus on hospital performance measures, limited research has examined associations between quality measures. Financial penalties have recently targeted chronic obstructive pulmonary disease (COPD) readmissions, although few studies have identified effective ways to reduce these readmissions. Understanding the association of COPD readmissions and other quality measures could help focus efforts on common organizational factors that affect high-quality patient care.

What This Study Adds to the

Field: We analyzed data on hospital quality measures from the Centers for Medicare and Medicaid Services. We found that COPD readmission rates were associated with readmissions for other medical conditions and all domains of patient experience. These findings suggest that common organizational characteristics might influence multiple disease-specific outcomes. As health systems transition to value-based reimbursement models, understanding the relationship between different quality measures could help identify high-yield interventions to improve hospital quality.

obstructive pulmonary disease (COPD) to the list of diagnoses affected by HRRP.

COPD is one of the most common chronic conditions, affecting 12.7 million Americans, and costing as much as \$49.9 billion annually (3, 4). In recent years, COPD has become the third leading cause of mortality in the United States (5). With ongoing tobacco exposure and an aging population, the burden of COPD is expected to continue to rise (6). Each year, COPD causes more than 700,000 hospitalizations, and approximately 20% of patients hospitalized for COPD are readmitted within 30 days (7, 8).

Despite increasing attention on readmissions, limited research has examined the association between readmission rates and other quality metrics,

and few studies have included COPD in these analyses (9–11). Understanding these associations could help focus research efforts on identifying common organizational factors that affect multiple clinical outcomes. Furthermore, because few studies have identified organizational efforts that effectively reduce COPD readmissions, identifying associations between COPD readmissions and other quality measures may provide insight into common mechanisms for quality improvement (12). The primary objective of this study was to determine the association of COPD readmission with hospital characteristics and other measures of hospital quality, including readmission for other disease, mortality, and patient experience. Some of these results have been previously reported in an abstract (13).

Methods

We analyzed data from the 2015 CMS annual files downloaded from the Hospital Compare website to examine the association between COPD readmission rates and other measures of hospital quality (14). The data set included 4,759 hospitals nationwide, 3,705 of which had data on COPD readmission rates. We divided hospitals into quartiles based on COPD readmission rates to evaluate variation in hospital characteristics and patient experience. Analyzing the data by quartiles was done to be consistent with other research that examined the association between readmission rates and other quality measures (9, 15). We also examined the correlation between COPD readmission rates and other readmission and/or mortality rates.

Hospital Characteristics

We identified hospital characteristics, including ownership, teaching status, and safety net designation. Ownership was derived from CMS 2015 data and included private for-profit, private not-for-profit, or public ownership status. Teaching status was assigned to institutions that received payments for residents from the 2010 CMS Payment File. Safety net hospital designation was calculated based on previously validated methods by applying the Medicare Disproportionate Share Hospital adjustment formula to identify the highest 20% of hospitals based on

Medicare inpatient days attributable to patients eligible for both Medicare Part A and Supplemental Security Income (16). Data for calculations of safety net status were derived from Medicare Disproportionate Share Hospital Adjustment files for 2012–2013.

Quality Measures

Readmission/mortality. All-cause 30-day readmission and mortality rates in the 2015 CMS annual files were based on hospital admissions from June 30, 2011 to July 1, 2014, a period that precedes inclusion of COPD as a condition affected by HRRP. Readmission and mortality rates were risk-adjusted for characteristics of the hospital patient population using hierarchical general linear models with hospital-level random effects based on previously described methods (17). We compared COPD readmission rates with readmission rates for other conditions, including HF (n = 3,580), AMI (n = 2,197), pneumonia (n = 3,680), stroke (n = 2,694), coronary artery bypass graft (CABG) surgery (n = 1,041), and hip/knee surgery (hip and knee surgeries were combined in the data set; n = 2,509). We also compared COPD readmission rates with mortality rates for COPD (n = 3,624), HF (n = 3,536), AMI (n = 2,398), pneumonia (n = 3,674), stroke (n = 2,730), and CABG surgery (n = 1,041). Data on mortality after hip and/or knee surgery were not available.

Patient experience. We included data on patients' experience of their hospitalization using aggregated responses to the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey from July 1, 2014 to June 30, 2015. HCAHPS data were available for all hospitals with at least 100 responses to the survey, which included 2,828 hospitals from our study. We examined 11 domains of patient experience, including communication with nurses, communication with doctors, hospital staff responsiveness, pain management, communication on medication, hospital cleanliness, hospital quietness, discharge information, care transitions, overall hospital rating, and whether patients would recommend the hospital. From each of the domains, we used information on the HCAHPS linear score, which reflects mean survey responses as a continuous measure from 0 to 100. CMS risk-adjusts

each of the HCAHPS domains based on the patient population, survey mode, and quarterly weighting to obtain risk-adjusted scores (18).

To examine the financial implications of differences in patient experience across readmission quartiles, we used Achievement scores reported on the Hospital Compare website (14). Achievement scores compare risk-adjusted, “top-box” responses (percent of patients with the most positive response) for each domain to a threshold, which is set at the national median for that domain during a baseline period (19). These scores are used to determine reimbursement under value-based purchasing. Achievement scores were available for most domains with HCAHPS linear scores, but top-box scores for the cleanliness and quietness domains were combined to calculate a pooled Achievement score, and Achievement scores for the care transitions domain were not available (it was a new measure and did not have an established threshold). We compared the percent of hospitals that scored below the Achievement threshold (i.e., had an Achievement score of zero) between the highest readmission quartiles versus the lowest readmission quartiles.

Analyses

We compared differences between COPD readmission quartiles and hospital characteristics of quality using χ^2 tests and analysis of variance. To assess the associations of COPD readmission rates with readmission and mortality rates for

other conditions, we used Pearson correlation coefficients. We used R statistical package version 2.13.2 and GraphPad Prism 6 for statistical analyses (20, 21).

Results

Study Sample

Dividing the 3,705 hospitals in our study into quartiles based on COPD readmission rates yielded the 926 lowest readmission hospitals (mean readmission rate $\pm$ SD, $15.8 \pm 0.02\%$), 1,027 mid-low readmission hospitals ($18.6 \pm 0.02\%$), 877 mid-high readmission hospitals ($20.9 \pm 0.02\%$), and 875 highest readmission hospitals ($24.0 \pm 0.03\%$). Hospitals with higher readmission rates were significantly more likely to be teaching hospitals (36% of highest readmission hospitals vs. 26% of lowest readmission hospitals; $P < 0.01$), private for-profit hospitals (19% highest readmission hospitals vs. 14% lowest readmission hospitals; $P < 0.01$), and safety net hospitals (23% highest readmission hospitals vs. 12% lowest readmission hospitals; $P < 0.01$) (Table 1).

Readmissions

There was significant correlation between COPD readmission rates and readmission rates for other conditions (Figure 1). Higher correlation was present between COPD readmission and readmission after hospitalization with medical conditions such as HF ($r = 0.39$; $P < 0.01$),

AMI ($r = 0.30$; $P < 0.01$), pneumonia ($r = 0.38$; $P < 0.01$), and stroke ($r = 0.29$; $P < 0.01$). Lower correlations were present with surgical conditions, including CABG ($r = 0.16$; $P < 0.01$) and hip/knee surgery ($r = 0.11$; $P < 0.01$).

Mortality

There was no significant correlation between COPD readmission and COPD mortality ($r = -0.01$; $P = 0.62$) (Figure 2). Although there were statistically significant correlations between COPD readmission and mortality for other conditions, including HF ($r = -0.06$; $P < 0.01$), pneumonia ($r = 0.06$; $P < 0.01$), and stroke ($r = -0.07$; $P < 0.01$), the correlation coefficients were all low, and there was no correlation between COPD readmissions and AMI mortality ($r = 0.01$; $P = 0.53$) or CABG mortality ($r = 0.02$; $P = 0.60$).

Patient Experience

All domains of patient experience were significantly associated with COPD readmissions (Table 2). Higher COPD readmission rates were associated with lower scores for communication with nurses (90.4 for highest readmissions vs. 91.0 for lowest readmissions; $P < 0.01$), communication with doctors (91.2 for highest readmissions vs. 91.7 for lowest readmissions; $P < 0.01$), hospital staff responsiveness (83.5 for highest readmissions vs. 84.8 for lowest readmissions; $P < 0.01$), pain management (86.6 for highest readmissions vs. 87.4 for lowest readmissions; $P < 0.01$), communication about medicines (77.2 for highest readmissions vs. 78.4 for lowest readmissions; $P < 0.01$), cleanliness (86.1 for highest readmissions vs. 86.9 for lowest readmissions; $P < 0.01$), quietness (81.4 for highest readmissions vs. 82.5 for lowest readmissions; $P < 0.01$), care transitions (80.4 for highest readmissions vs. 81.4 for lowest readmissions; $P < 0.01$), and discharge information (85.2 for highest readmissions vs. 86.6 for lowest readmissions; $P < 0.01$). Higher readmissions were also associated with a lower overall rating of the hospital (87.3 for highest readmissions vs. 88.5 for lowest readmissions; $P < 0.01$) and lower rates of recommending the hospital (86.5 for highest readmissions vs. 88.1 for lowest readmissions; $P < 0.01$).

Table 1. Characteristics of Hospitals across Chronic Obstructive Pulmonary Disease Readmission Quartiles

Hospital Characteristics	COPD Readmission Quartile				P Value
	Lowest (n = 926)	Mid-Low (n = 1,027)	Mid-High (n = 877)	Highest (n = 875)	
Teaching hospital status*					
Teaching, %	26	21	24	36	<0.01
Non-teaching, %	74	79	76	64	
Ownership status*					
Private for-profit, %	14	17	18	19	<0.01
Private not-for-profit, %	66	61	61	64	
Public, %	20	22	21	17	
Safety net status†					
Safety net hospital, %	15	18	21	26	<0.01
Non-safety net hospital, %	85	82	79	74	

Definition of abbreviation: COPD = chronic obstructive pulmonary disease.

Hospitals were divided into quartiles based on COPD readmission rates.

*Data not available for lowest (n = 8), mid-low (n = 6), mid-high (n = 7), and highest (n = 4).

†Data not available for lowest (n = 149), mid-low (n = 291), mid-high (n = 216), and highest (n = 121).

Figure 1. Correlation between risk-adjusted readmission for chronic obstructive pulmonary disease (COPD) and readmission for (A) heart failure, (B) acute myocardial infarction (AMI), (C) pneumonia, (D) stroke, (E) coronary artery bypass graft (CABG) surgery, and (F) hip/knee surgery. The *line* represents a linear regression, the *shaded area* the 95% confidence interval of the fit, and the *gray dots* represent data points (*light gray* indicates points without overlapping scores, and *dark gray* indicates multiple data points with the same values).

Figure 2. Correlation between risk-adjusted readmission for chronic obstructive pulmonary disease (COPD) and mortality for (A) heart failure, (B) acute myocardial infarction (AMI), (C) pneumonia, (D) stroke, (E) coronary artery bypass graft (CABG) surgery, and (F) COPD. The *line* represents a linear regression, the *shaded area* the 95% confidence interval of the fit, and the *gray dots* represent data points (*light gray* indicates points without overlapping scores, and *dark gray* indicates multiple data points with the same values).

Table 2. Association between Patient Experience Scores and Risk-adjusted Chronic Obstructive Pulmonary Disease Readmission Quartile

HCAHPS Domain	COPD Readmission Quartile (mean $\pm$ SD)				P Value
	Lowest (n = 744)	Mid-Low (n = 695)	Mid-High (n = 611)	Highest (n = 736)	
Communication with nurses	91.0 $\pm$ 2.2	90.9 $\pm$ 2.3	90.8 $\pm$ 2.4	90.4 $\pm$ 2.6	<0.01
Communication with doctors	91.7 $\pm$ 2.0	91.7 $\pm$ 2.2	91.5 $\pm$ 2.2	91.2 $\pm$ 2.3	<0.01
Hospital staff responsiveness	84.8 $\pm$ 3.5	84.6 $\pm$ 3.8	84.3 $\pm$ 3.8	83.5 $\pm$ 4.2	<0.01
Pain management	87.4 $\pm$ 2.1	87.4 $\pm$ 2.3	87.1 $\pm$ 2.3	86.6 $\pm$ 2.6	<0.01
Communication on medication	78.4 $\pm$ 3.6	78.1 $\pm$ 3.8	77.8 $\pm$ 3.8	77.2 $\pm$ 3.9	<0.01
Cleanliness	86.9 $\pm$ 3.4	86.7 $\pm$ 3.4	86.5 $\pm$ 3.5	86.1 $\pm$ 3.4	<0.01
Quietness	82.5 $\pm$ 4.6	82.7 $\pm$ 4.7	82.0 $\pm$ 4.9	81.4 $\pm$ 4.8	<0.01
Care transition	81.4 $\pm$ 2.4	81.2 $\pm$ 2.4	81.0 $\pm$ 2.5	80.4 $\pm$ 2.8	<0.01
Discharge information	86.6 $\pm$ 3.2	86.2 $\pm$ 3.4	85.9 $\pm$ 3.5	85.2 $\pm$ 4.1	<0.01
Overall rating of hospital	88.5 $\pm$ 2.9	88.3 $\pm$ 2.9	87.8 $\pm$ 3.1	87.3 $\pm$ 3.3	<0.01
Recommend hospital	88.1 $\pm$ 4.0	87.6 $\pm$ 3.9	87.1 $\pm$ 4.3	86.5 $\pm$ 4.5	<0.01

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems.

Hospitals were divided into quartiles based on COPD readmission rates.

Differences in patient experiences were also evident when comparing the proportion of hospitals that did not meet the Achievement threshold for multiple domains, including communication with doctors (51.8% of highest readmissions vs. 43% of lowest readmissions; $P < 0.01$), communication with nurses (38.9% of highest readmissions vs. 31.8% of lowest readmissions; $P < 0.01$), communication about medications (40.4% of highest readmissions vs. 28.1% of lowest readmissions; $P < 0.01$), responsiveness of hospital staff (46.1% of highest readmissions vs. 35.2% of lowest readmissions; $P < 0.01$), cleanliness and quietness of the hospital (50.1% of highest readmissions vs. 40.3% of lowest readmissions; $P < 0.01$), discharge information (33.9% of highest readmissions vs. 19% of lowest readmissions; $P < 0.01$), and overall rating of the hospital (49.3% of highest readmissions vs. 32.8% of lowest readmissions; $P < 0.01$) (Figure 3).

Discussion

We found significant associations between COPD readmissions and other quality measures, including readmissions for other medical conditions and measures of patient experience. These associations suggested that common organizational factors might influence multiple clinical outcomes. The correlations between COPD readmissions and readmissions for surgical conditions or mortality rates were weak, which might

reflect the influence of different microsystems and/or attention to different outcomes within hospitals. As health systems transition to value-based reimbursement models, understanding the relationship between different quality measures could help broaden

efforts to improve the overall quality of patient care.

With increasing attention on COPD readmission rates, there is debate about whether this measure is a valid marker of hospital quality (22). Despite a comprehensive examination of patient and

Figure 3. Percentage of hospitals that had a Hospital Consumer Assessment of Healthcare Providers and Systems Achievement score of zero (i.e., that did not meet the Achievement threshold) for multiple domains in the lowest chronic obstructive pulmonary disease readmission quartiles versus highest chronic obstructive pulmonary disease readmission quartiles.

hospital characteristics that affects COPD care, few factors have been associated with reduced readmission or mortality (23). In this study, we were not able to assess the cause of COPD readmissions or whether they were preventable. However, our results did show notable variation in COPD readmission rates across hospitals, and this metric was associated with other measures of hospital quality. These findings suggested that organizational factors that led to better quality based on patient experience and readmission rates for other medical conditions also reduced COPD readmissions. Additional research is needed to identify the common structural, cultural, and behavioral factors that affect these similar quality measures.

We identified significant correlations between COPD readmission rates and readmission rates for other conditions. Although correlation coefficients were not high for any of the comparisons (all correlation coefficients were less than 0.4), there were notable differences between types of readmission, with higher correlations to medical conditions than surgical conditions. Horowitz and colleagues identified similar correlations between HF, AMI, and pneumonia readmission rates, although they did not examine readmission rates for COPD or surgical conditions (10). Our findings indicated that organizational factors that affected disease-specific readmissions likely had a more widespread effect across medical conditions, although surgical conditions might require a different approach. Patients with chronic medical disease tend to have multiple comorbidities, and treatment guidelines are beginning to appreciate the need to address multimorbidity (24). Because more than 70% of readmissions after COPD hospitalization are due to conditions other than COPD, developing comprehensive strategies to reduce readmissions may affect multiple performance measures and improve the overall quality of patient care (25).

COPD readmission rates were not correlated with COPD mortality. One concern about the effects of HRRP has been that these two outcomes represent competing interests, and reductions in readmissions may increase mortality (26). Krumholz and colleagues examined the association between hospital readmission rates and mortality for HF, AMI, and pneumonia, and found minimal to no

correlation between the outcomes (9). To our knowledge, a similar analysis has not been conducted for COPD. Although few studies showed that efforts to reduce COPD readmissions were associated with increased mortality, others showed that intensive outpatient management of COPD exacerbations could reduce readmissions without increasing mortality (27, 28). Our results were consistent with the evidence that readmission rates are not associated with mortality for COPD, although we did not know what impact implementation of HRRP has had on this relationship.

There also were no significant associations between COPD readmission and mortality from other conditions. Many of the organizational factors that affect readmissions are likely to differ from organizational factors that affect mortality (9). Reported readmission rates focus on the 30 days after hospital discharge, whereas mortality rates focus on the 30 days after hospital admission and include the hospitalization (29). Because a substantial proportion of deaths for selected conditions occur during the index hospitalization, greater attention to inpatient care is likely to yield lower mortality, whereas improving readmission rates requires more attention on the postdischarge period (1, 30). To promote organizational characteristics that affect mortality, CMS adopted the Hospital Value-Based Purchasing Program, a pay-for-performance program that incentivizes hospitals based on multiple performance measures that reflect inpatient care, including 30-day mortality for AMI, HF, and pneumonia (31).

COPD readmission rates in our study were associated with HCAHPS linear scores and lack of Achievement scores for all patient experience domains. Although the differences in linear scores across readmission quartiles were small, associations with the lack of Achievement scores indicated that these differences could affect hospital reimbursement. The largest difference in patient experience between high readmission hospitals versus low readmission hospitals occurred with responses related to whether or not patients would recommend the hospital. There is extensive literature on the association between patient satisfaction and quality of care (32). Although some have argued that patients may not be qualified to effectively

judge their care, our findings suggested that patients tended to recommend higher quality hospitals with respect to COPD readmissions (33).

Many of the HCAHPS domains focus directly on patient care that could influence readmission, such as communication and discharge information. These domains are integral components of some of the few organizational efforts that have been shown to reduce COPD readmissions, such as integrated disease management programs and patient education programs (34, 35). Other elements of patient experience were also associated with COPD readmissions in our study, such as cleanliness and quietness of the hospital. These domains might reflect an underlying organizational emphasis on patient-centered care that creates a culture of quality.

Previous studies found inconsistent relationships between patient experience and clinical outcomes (11, 36–39). Studies on readmissions rates for HF, AMI, and pneumonia found lower readmissions among hospitals with higher HCAHPS scores (11, 36). Studies on surgical readmissions were less clear, with some studies demonstrating an association between experience and readmission and others showing no association (37, 38). To our knowledge, previous research has not examined the association between patient experience and COPD readmissions. Our findings add to the literature and suggest that more patient-centered care is associated with better quality for patients who are hospitalized with COPD.

It is notable that COPD readmission rates in our study differed by hospital type. There were higher readmission rates in teaching and safety net hospitals. These hospitals tend to care for more vulnerable and complex patient populations, and are more likely to be penalized in pay-for-performance models; risk-adjustment methods might not completely account for the medical and socioeconomic challenges affecting their patient populations (40–42). We also identified higher readmission among private, for-profit hospitals. Our analyses covered the period before inclusion of COPD among conditions affected by HRRP. Hospitals during this time did not have a financial incentive to reduce readmissions, and many hospitals benefitted from increased healthcare use (1). Similar findings were found for HF

readmissions before implementation of HRRP (43). After implementing HRRP, HF readmission rates declined for all types of hospitals, including private for-profit systems (44).

A potential limitation of this study was that the risk-adjustment methods we relied on might not completely control for the severity of the medical, socioeconomic, and environmental factors that affect readmissions. Nevertheless, the methods are being used to penalize hospitals under HRRP, and they were validated in previous studies (45, 46). Our analysis focused on the period before inclusion of COPD among the conditions affected by HRRP, and might not reflect reality in the post-HRRP era. With targeted incentives to prevent COPD readmissions, the association between COPD readmissions and other quality metrics might change. At the same time, studying these relationships before adoption of HRRP limited the potential

impact of hospitals gaming the system to avoid financial penalties (22). The period represented by the 2015 data included the time in which HRRP was implemented for other medical conditions. The quality metrics presented on the Hospital Compare website are composite measures for the 3 previous years, and we were not able to isolate yearly readmission rates to examine trends. Additional research is needed to determine how including COPD among the conditions affected by HRRP influences these associations. Although our study suggested that common organizational factors might affect multiple quality metrics, we were unable to identify which of these factors influenced outcomes among hospitals in our study.

Conclusions

Although there continues to be limited data on how to effectively reduce COPD readmissions, results of this

study demonstrated that COPD readmissions are associated with readmissions for other medical conditions and domains of patient experience. These findings implied that common organizational factors might affect multiple disease-specific outcomes and the overall quality of healthcare. With most financial incentives focused on individual quality metrics, hospitals might miss an opportunity to more broadly implement common elements of quality. As researchers, regulators, and hospital administrators search for methods to improve hospital quality, understanding the organizational factors that are common to different disease outcomes might help identify high-yield interventions to improve patient care. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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