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Understanding Why Patients With COPD Get Readmitted

A Large National Study to Delineate the Medicare Population for the Readmissions Penalty Expansion

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PODCAST

BACKGROUND: The Hospital Readmissions Reduction Program (HRRP) penalizes hospitals for 30-day readmissions and was extended to COPD in October 2014. There is limited evidence available on readmission risk factors and reasons for readmission to guide hospitals in initiating programs to reduce COPD readmissions.

METHODS: Medicare claims data from 2006 to 2010 in seven states were analyzed, with an index admission for COPD defined by discharge *International Classification of Diseases, Ninth Revision*, codes as stipulated in the HRRP guidelines. Rates of index COPD admission and readmission, patient demographics, readmission diagnoses, and use of post-acute care (PAC) were investigated.

RESULTS: Over the study period, there were 26,798,404 inpatient admissions, of which 3.5% were index COPD admissions. At 30 days, 20.2% were readmitted to the hospital. Respiratory-related diseases accounted for only one-half of the reasons for readmission, and COPD was the most common diagnosis, explaining 27.6% of all readmissions. Patients discharged home without home care were more likely to be readmitted for COPD than patients discharged to PAC (31.1% vs 18.8%, $P < .001$). Readmitted beneficiaries were more likely to be dually enrolled in Medicare and Medicaid (30.6% vs 25.4%, $P < .001$), have a longer median length of stay (5 days vs 4 days, $P < .0001$), and have more comorbidities ($P < .001$).

CONCLUSIONS: Medicare patients with COPD exacerbations are usually not readmitted for COPD, and these reasons differ depending on PAC use. Readmitted patients are more likely to be dually enrolled in Medicare and Medicaid, suggesting that the addition of COPD to the readmissions penalty may further worsen the disproportionately high penalties seen in safety net hospitals.

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ABBREVIATIONS: AECOPD = acute exacerbation of COPD; AMI = acute myocardial infarction; CCS = Clinical Classifications Software; CHF = congestive heart failure; CMS = Centers for Medicare & Medicaid Services; HRRP = Hospital Readmissions Reduction Program; ICD-9 = *International Classification of Diseases, Ninth Revision*; IPPS = inpatient prospective payment system; LOS = length of stay; PAC = post-acute care; SNF = skilled nursing facility

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To address rising costs and quality concerns, the Hospital Readmissions Reduction Program (HRRP) was enacted, targeting inpatient discharges in the Medicare fee-for-service population for congestive heart failure (CHF), acute myocardial infarction (AMI), and pneumonia. The HRRP mandates up to a 3% reduction in all Medicare reimbursements should hospitals fail to stay below their expected readmission rates. In October 2014, the HRRP was expanded to include COPD.[1,2]

Recently, the Medicare Payment Advisory Commission reported a 0.7% decline in the all-cause risk-adjusted readmission rate to a low of 17.8% for 2012.[3] Although possibly due to HRRP, it is not clear whether this program will be beneficial for COPD and whether hospitals are the ideal stakeholder to be held responsible for COPD readmissions. Prior to enactment for CHF, extensive CHF-specific literature was available to guide hospitals.[4] In contrast, a specific randomized study of a US hospital intervention to evaluate the effect on the 30-day COPD readmission rate has yet to be conducted, and there is little evaluation of the cost of such interventions.[5] Thus, hospitals have little guidance to reduce readmissions among patients with COPD. More recent studies have identified post-acute care (PAC) as the primary driver of variation in Medicare costs,[6] yet we know little about the potential role of PAC in COPD readmissions. For example,

FOR EDITORIAL COMMENT SEE PAGE 1199

skilled nursing facilities (SNFs) are responsible for targeted COPD management, including education on proper inhaler use, determination of supplemental oxygen need, and use of physical therapy to mobilize patients, yet the effect of these interventions in the SNF setting on readmissions is unclear.[7]

As hospitals gear up to reduce COPD readmissions, it is essential to know whether certain patient demographics confer a higher risk of readmission than others as well as the timing and reasons for readmission. Additionally, the impact of PAC, primarily SNF use, on COPD readmissions is important to know. We used a large-scale administrative dataset of the Medicare population to explore these questions.

Materials and Methods

Data Sources

We used data from the Medicare Provider Analysis and Review file, which contains encounter information and patient demographics for all hospitalized fee-for-service beneficiaries. Data from California, Florida, Illinois, New York, Ohio, Pennsylvania, and Texas were chosen because they are geographically diverse and large regions; in 2006, these states contained 42.5% of the total Medicare population. Other demographics were obtained from the Master Beneficiary Summary File. This study was approved by the Institutional Review Board at The University of Chicago (IRB12-1734) and subject to a data use agreement with the Centers for Medicare & Medicaid Services (CMS).

Study Population

We conducted a retrospective analysis of hospitalizations in acute inpatient prospective payment system (IPPS) hospitals for Medicare fee-for-service beneficiaries from January 1, 2006, to December 31, 2010. Using the exclusion criteria from the HRRP guidelines for COPD from CMS,[2] we excluded hospitalizations of patients discharged against medical advice, discharged to a non-IPPS hospital, or who died while an inpatient. For an IPPS hospital-to-hospital transfer, the length of stay (LOS) of all hospital encounters was combined; *International Classification of Diseases, Ninth Revision* (ICD-9), diagnosis codes and patient demographics were retained from the initial encounter; and discharge destination was retained from the terminal encounter. Hospital transfers were hospitalizations occurring on the same day or the following day a discharge from an eligible index admission.

Variables

Index Admission: As defined by CMS, an index admission for an acute exacerbation of COPD (AECOPD) was classified by specific primary and secondary ICD-9 discharge codes (e-Table 1).[2] The denominator was the number of total admissions in the sample.

Readmission: A readmission was a hospitalization at any hospital for any reason occurring within 30 days of discharge from an index admission, with the date of discharge counted as day 0. Transfers to a different hospital were not considered readmissions. This dichotomous variable denoted the first hospitalization occurring within the 30-day period. The readmission rate is the total number of readmissions divided by the total number of index admissions.

Patient Demographics: Age at index admission, sex, race, and comorbidities were obtained from the Medicare Provider Analysis and Review file. Dual enrollment status in Medicare and Medicaid was obtained from the Master Beneficiary Summary File. Baseline health status was the sum of the comorbid conditions from the Charlson Comorbidity Index based on discharge ICD-9 codes from the index admission, excluding codes for COPD because all patients carry this diagnosis.[8]

Index Admission Characteristics: Discharge destination was categorized as follows: SNF, home without home care, home with home care, and other (including intermediate care facility and long-term-care hospital). LOS was measured in days.

Time and Reasons for Readmission: Time to readmission was the number of days from discharge (day 0) to the first readmission up to day 30. Principal ICD-9 diagnosis codes, which reflect the condition chiefly responsible for admission, were grouped into Clinical Classifications Software (CCS) categories. CCS groups ICD-9 codes into a smaller set of clinically meaningful categories and is used in the HRRP for risk adjustment calculations.[9] To address disease misclassification from claims data, we also grouped the CCS codes into respiratory-related and respiratory-unrelated codes. The respiratory-related CCS codes were 56, 120, 122, 123, 125, 126, 127, 128, 129, 131, 132, 133, and 134 (e-Table 2).

Statistical Analysis

Summary statistics of patient characteristics were calculated for all patients hospitalized with an index admission for COPD. The effect of patient- and hospital-level characteristics on readmission was calculated using logistic regression with clustering at the level of the hospital. Linear trend tests were used to evaluate trends over time for the index

admission and readmission rates. For comparisons between patients who were readmitted with those who were not, independent sample *t* tests were used for mean age and χ^2 tests for sex, race, dual enrollment in Medicare and Medicaid, discharge destination, and number of comorbidities. The Wilcoxon rank sum test was used to determine statistical significance of the differences in LOS due to skewness. For all tests, a two-tailed $P < .05$ was considered statistically significant. All analyses were performed using Stata 13.0 software (StataCorp LP).

Results

Frequency of Index Admission and Readmission

Over the study period, there were 26,798,404 inpatient admissions to IPPS hospitals, and 947,084 were index COPD encounters (3.5%). There was a small but statistically significant increase ($P < .0001$) in the rate of admissions by year (Table 1). Patients were predominantly discharged to home without home care (60.4%) followed by home with home care (19.1%) and SNF (14.1%). A total of 191,698 (20.2%) index admissions resulted in readmission. The linear trend test revealed a small but statistically significant increase in the readmission rate over time ($P = .02$).

Time to Readmission

Figure 1 shows the percentage of readmissions by day occurring within 30 days. The highest percentage of readmissions occurred on day 1 (6.0%) after discharge and decreased to approximately 2% on day 30 after discharge. Almost one-third (95% CI, 31.7% to 32.1%) of readmissions occurred by day 7, and 60.6% of readmissions occurred by day 15 (95% CI, 60.4% to 60.8%; median time to readmission, 12 days [interquartile range, 6-12 days]).

Reasons for Readmission

The 10 leading reasons for rehospitalization after the index COPD admission arranged in decreasing frequency are shown in Figure 2. COPD was the most common cause, accounting for 27.6% of all readmissions. CHF, a common clinical mimicker of COPD, explained 6.2% of all readmissions. The leading reasons for readmission did not vary by week after discharge (e-Table 3). A wide array of reasons was responsible for readmission; after the first five major diagnoses, the remaining 222 CCS codes had individual frequencies < 5%. Stratification showed that only 50.6% of readmissions were due to respiratory-related causes. Reasons for readmission varied by discharge destination. Although still the leading reason for readmission, the frequency of rehospitalization due to COPD was higher in patients initially discharged home without home care than in those discharged home with home care or to an SNF (31.1% vs 27.7% and 18.8%, respectively; $P < .001$).

Characteristics of Index and Readmitted Patients

Patients with an index COPD admission tended to be women (58.6%) and white (82.8%) with a median age of 74 years, similar to the general Medicare population (Table 2).[10] Compared with the general Medicare population (12%), a higher percentage (26.4%) of index patients was dually eligible.[11] Excluding COPD, 95% of these patients had between zero and three comorbid conditions, and the majority (41.3%) had no conditions other than COPD. Looking at comorbidities individually, prevalence was generally greater in the readmitted patients, with the prevalence of CHF being 7% greater in the readmitted group (e-Table 4).

Compared with index patients who were not readmitted, readmitted patients were more likely to be dually eligible (30.6% vs 25.4%, $P < .001$), have a longer LOS (5 vs 4 days, $P < .0001$), and have a lower rate of discharge to home without home care (53.7% vs 62.1%, $P < .001$). Readmitted patients, however, used more

TABLE 1] Frequency of Index COPD Admission and Readmission

Year	Total No. Admissions	COPD Index Admissions, %	Discharge Location, %				No. Readmissions	Index Admissions Readmitted, %
			Home	SNF	Home Care	Other		
2006	4,780,063	3.2	60.5	14.6	18.0	7.0	31,318	20.4
2007	4,759,018	3.2	60.1	14.8	18.2	6.9	31,167	20.4
2008	5,593,184	3.8	60.1	14.4	19.1	6.3	42,244	20.0
2009	5,820,556	3.7	60.7	13.8	19.2	6.3	44,267	20.4
2010	5,845,583	3.6	60.4	13.3	20.2	6.1	42,702	20.1
Total	26,798,404	3.5	60.4	14.1	19.1	6.5	191,698	20.2

SNF = skilled nursing facility.

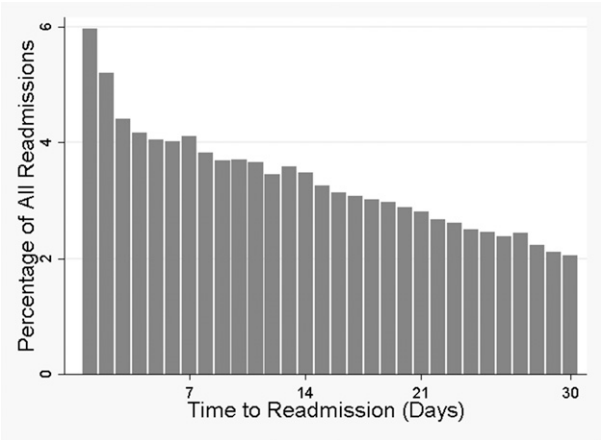

Figure 1 – *Percentage of readmitted patients by day after discharge from index COPD admission.*

PAC: 22.6% were discharged to an SNF and 18.1% to home with home care compared with patients not readmitted (18.2% and 13.1%, respectively; $P < .001$). Baseline health status estimated by the Charlson Comorbidity Index Sum showed that readmitted patients were sicker. A Comorbidity Index Sum of 0, indicating only COPD, was most common in patients who were not readmitted (42.8%), whereas a score of 2 was most common in those who were (36.5%, $P < .001$). Logistic regression (Table 3) shows that dual enrollment and discharge destination are independently associated with readmission risk, with the odds of readmission being 1.22 times greater in dually enrolled patients, 1.42 times greater in patients discharged to an SNF, and 1.36 times greater in patients discharged home with home care than home without home care.

Discussion

To our knowledge, this study is the first to date to use a large Medicare dataset to evaluate beneficiaries admitted for COPD and readmitted under the HRRP COPD methodology. Only one-half of readmissions were due to respiratory causes. Readmitted patients had higher rates of dual enrollment, suggesting that readmission penalties may further increase penalties on safety net hospitals that typically care for dually enrolled patients. Finally, patients who used PAC were more likely to be readmitted and for different reasons than those not using PAC, indicating that PAC is an important player in COPD readmissions. Although preliminary HRRP results appear to be promising, it is unclear whether these results will translate to COPD.

Similar to work in other conditions by Jencks et al[12] and Dharmarajan et al,[13] we found a diverse spectrum of readmission diagnoses, with readmissions continuing throughout the month. For example, by day 15 postdischarge, 61% of all readmissions had already occurred (compared with 61% for CHF and 68% for AMI).[13] There were no major differences in readmission diagnoses

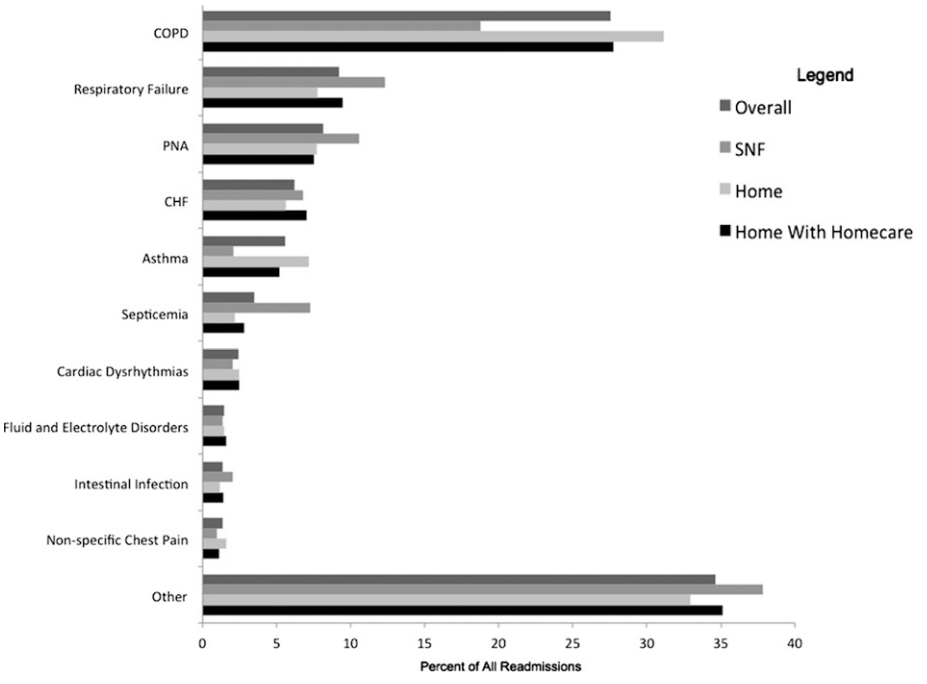

Figure 2 – *Leading reasons for readmission after COPD index admission. CHF = congestive heart failure; PNA = pneumonia; SNF = skilled nursing facility.*

TABLE 2] Characteristics of Patients Readmitted and Not Readmitted After Index Hospitalization

Characteristic	Total	Readmitted	Not Readmitted	*P* Value
Age, y	73.55 ± 10.87	73.37 ± 11.05	73.59 ± 10.82	< .0001
Female sex	58.59	56.61	59.09	< .001
Race				< .001
White	82.83	81.69	83.12	
Black	11.15	12.41	10.84	
Other[a]	6.03	5.90	6.04	
Charlson sum (excluding COPD as a comorbidity)				< .001
0	41.31	35.37	42.82	
1	36.51	37.64	36.22	
2	17.43	20.73	16.59	
3	4.26	5.59	3.92	
4	0.46	0.63	0.42	
≥ 5	0.02	0.04	0.02	
Dually enrolled in Medicare and Medicaid	26.42	30.58	25.37	< .001
LOS, d	4 (3-6)	5 (3-7)	4 (3-6)	.02
ICU use	26.26	27.91	25.85	< .001
Discharge destination				< .001
Home	60.39	53.69	62.09	
SNF	14.10	22.57	18.16	
Home with home care	19.05	18.08	13.09	
Other	6.46	5.66	6.66	

Data are presented as mean ± SD, %, or median (interquartile range). LOS = length of stay. See Table 1 legend for expansion of other abbreviation.
[a]Other race includes Asian, Hispanic, North American Native, and other.

grouped by week postdischarge, comparable with previously reported findings for CHF and pneumonia.[13] The present finding that only one-half of readmissions after COPD were due to respiratory-related diseases begs the question of attribution and is further confounded by the inability to assess the indirect effect of COPD on readmission, such as a hospitalization for steroid-induced hyperglycemia. Although the approach to reducing COPD readmissions should involve comprehensive disease management,[14-16] given the dearth of evidence on intervention effectiveness, expansion of the HRRP to COPD leaves hospitals with significant uncertainty about how to prevent readmissions.

Several aspects of the COPD measure methodology further differentiate it from the current conditions included in HRRP and merit discussion. First, COPD is defined by discharge ICD-9 codes, and the proposed algorithm has yet to be tested or validated. Stein et al[17] tested several ICD-9 coding algorithms similar to the COPD HRRP rule against physician chart review and found gross underestimation of AECOPD, with sensitivities ranging from 12% to 25% and positive predictive values as low as 81.5%. In contrast, use of coding data to identify pneumonia and AMI has been validated, with a sensitivity of 97.8% and positive predictive value of 96.2% for pneumonia.[18,19] There is a high probability of misclassification of a COPD admission for the readmissions penalty. Second, we currently lack an acceptable biomarker for COPD, unlike plasma cardiac troponin in AMI and B-type natriuretic peptide in CHF.[20-23] Because COPD symptoms overlap with many other diseases, biomarker absence makes clinching the diagnosis difficult and adds complexity to accurately code hospitalizations. Spirometry has potential as a useful tool to improve the ability to differentiate COPD from other diseases such as asthma or CHF, but at present, it is underused by providers.[24,25] Identification of this target COPD population will have substantial measurement error and may provide an opportunity for hospitals to game the system by excluding sicker patients who present with COPD from the readmission measure.

TABLE 3] Relationships Between Patient- and Hospital-Level Characteristics and Risk of 30-Day Readmission

Characteristic	OR (95% CI)	*P* Value
Age		
65-80 y	1	…
>80 y	0.97 (0.96-0.99)	<.001
Sex		
Male	1	…
Female	0.89 (0.88-0.90)	<.001
Race		
White	1	…
Black	1.06 (1.04-1.08)	<.001
Other	0.91 (0.88-0.93)	<.001
Charlson sum (excluding COPD as a comorbidity)		
0	1	…
1	1.22 (1.20-1.24)	<.001
2	1.43 (1.41-1.46)	<.001
3	1.61 (1.57-1.66)	<.001
4	1.64 (1.52-1.77)	<.001
≥5	2.25 (1.66-3.04)	<.001
Dually enrolled in Medicare and Medicaid	1.22 (1.20-1.24)	<.001
LOS, d	1.03 (1.03-1.03)	<.001
ICU use	1.03 (1.02-1.05)	<.001
Discharge destination		
Home	1	…
SNF	1.42 (1.40-1.45)	<.001
Home with home care	1.36 (1.34-1.38)	<.001
Other	0.84 (0.82-0.86)	<.001

See Table 1 and 2 legends for expansion of abbreviations.

Patients with COPD are also unique in that the time course of recovery can be substantial, further predisposing these patients to needing rehospitalization within 30 days. Seemungal et al[26] reported in a cohort of 101 patients that 25% had not returned to preexacerbation peak expiratory flow rate by day 35. The present findings support this point in that AECOPD was the leading cause for readmission after COPD. Additionally, there is suggestion of a frequent exacerbation phenotype of COPD independent of disease severity.[27] Further refinements of the COPD readmissions penalty might want to target this particular strata of patients because reduction in these high users of hospital care may have a greater impact on cost control than a blanket approach to all beneficiaries with COPD.

We examined the role of dual enrollment status in the risk for COPD readmission, which was not studied extensively previously. Patients admitted for an index COPD admission are more likely to be dually eligible than beneficiaries in general, and among patients with COPD, those who are dually eligible are more likely to be readmitted. This finding supports concerns about the readmissions program augmenting disparities in care by increasing already disproportionate penalties for safety net hospitals.[28] Safety net hospitals, which are in the highest quartile of the CMS disproportionate share hospital index, were more likely to receive a penalty than hospitals with lower disproportionate share hospital indexes in the first year of HRRP (44% vs 30%).[29]

Dually eligible beneficiaries, who are poorer, sicker, and less educated than the average beneficiary, may have unique challenges beyond the control of hospitals and independently increase the likelihood of readmission. For example, 85% of patients with COPD misuse metered-dose inhalers, which is related to poor health literacy.[30] Because bronchodilators are a treatment cornerstone, it may be more difficult to improve health and avoid readmission in dually eligible beneficiaries admitted for COPD than in those admitted for CHF, AMI, or pneumonia. Socioeconomic characteristics, including limited social support and financial hardship, could further impede hospital care efforts postdischarge. Because the readmission equation does not adjust for socioeconomic factors, these results may foreshadow unintended consequences when expanded to COPD readmissions: Hospitals serving the most vulnerable populations could be unfairly penalized and may avoid treating dually eligible beneficiaries.

Discharge destination is key to differentiating beneficiaries readmitted for COPD, and we found that a larger percentage of readmissions from home than from an SNF were due to COPD. These findings could be explained by high-quality SNF care that overcomes the physical and cognitive patient-related barriers for proper inhaler use that could not be remedied at home. Alternatively, we might explain the lower rates of rehospitalization for COPD by SNF patients generally being sicker with more comorbidities, leading to competing reasons for hospitalization instead of COPD. Inappropriate triage of patients with COPD during discharge planning by the inpatient provider may also play a role. Regardless, the variation in readmission diagnoses by

discharge destination, coupled with higher readmission rates from PAC (expected because PAC patients are generally sicker), highlights a critical area of investigation to improve COPD care. The decision-making process to determine PAC need and type should be studied for COPD readmissions because a policy target on PAC facilities could have a greater impact than the HRRP.

The present analysis has several limitations. Although claims data limit the extent of clinical information available and, therefore, precluded further investigation of reasons for readmission indirectly related to COPD, they served as a starting point to identify specific patient-level factors for readmission risk and allowed us to closely model the methodology for the COPD measure in a large cohort. Generalizability is a concern due to limiting the data to beneficiaries in several states, with the most recent year being 2010. The HRRP is federal policy targeted specifically to the Medicare population, and we believe that the choice of states captures the heterogeneity of beneficiaries.[31] The rate of unplanned readmissions decreased 0.3% from 2009 to 2011, leading us to believe that there has been no major trend change in COPD readmissions more recently. Additionally, the study population after exclusion of patients who died during the index hospitalization may not reflect the entire COPD Medicare population. Finally, we did not exclude planned rehospitalizations. However, analysis of the national COPD readmission rate showed that planned readmissions accounted for 0.7% of readmissions in 2011.[32]

In conclusion, Medicare patients admitted to the hospital for AECOPD are readmitted the majority of the time for reasons other than COPD and have the highest risk of readmission in the period immediately after discharge. Appropriate use of PAC is a potential target to reduce COPD readmissions because patients discharged to PAC are readmitted for reasons different from those who are discharged home. Readmitted beneficiaries are more likely to be dually eligible, which may worsen the disparate penalties we are already seeing on safety net hospitals under the HRRP. Adding COPD to the penalty may be problematic due to several unique characteristics of COPD, including its diagnostic uncertainty, coding misclassification, and lack of evidence on effective hospital interventions to curb readmission rates. Policymakers should proceed with caution until further research on evidence-based policy targets for COPD are conducted. Now that COPD has been added to the HRRP, ongoing rigorous evaluation of intended and unintended consequences would be prudent.

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Additional information: The e-Tables can be found in the Supplemental Materials section of the online article.

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