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Implications of DRG Classification in a Bundled Payment Initiative for COPD

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Abstract

OBJECTIVES—Institutions participating in the Medicare Bundled Payments for Care Improvement (BPCI) initiative invest significantly in efforts to reduce readmissions and costs for patients who are included in the program. Eligibility for the BPCI initiative is determined by diagnosis-related group (DRG) classification. The implications of this methodology for chronic diseases are not known. We hypothesized that patients included in a BPCI initiative for chronic obstructive pulmonary disease (COPD) would have less severe illness and decreased hospital utilization compared with those excluded from the bundled payment initiative.

STUDY DESIGN—Retrospective observational study.

METHODS—We sought to determine the clinical characteristics and outcomes of Medicare patients admitted to the University of Alabama at Birmingham Hospital with acute exacerbations of COPD between 2012 and 2014 who were included and excluded in a BPCI initiative. Patients were included in the analysis if they were discharged with a COPD DRG or with a non-COPD DRG but with an *International Classification of Diseases, Ninth Revision* code for COPD exacerbation.

RESULTS—Six hundred and ninety-eight unique patients were discharged for an acute exacerbation of COPD; 239 (34.2%) were not classified into a COPD DRG and thus were

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excluded from the BPCI initiative. These patients were more likely to have intensive care unit (ICU) admissions (63.2% vs 4.4%, respectively; $P < .001$) and require noninvasive (46.9% vs 6.5%; $P < .001$) and invasive mechanical ventilation (41.4% vs 0.7%; $P < .001$) during their hospitalization than those in the initiative. They also had a longer ICU length of stay (5.2 vs 1.8 days; $P = .011$), longer hospital length of stay (10.3 days vs 3.9 days; $P < .001$), higher in-hospital mortality (14.6% vs 0.7%; $P < .001$), and greater hospitalization costs (median = $13,677 [interquartile range = $7489-$23,054] vs $4281 [$2718-$6537]; $P < .001$).

CONCLUSIONS—The use of DRGs to identify patients with COPD for inclusion in the BPCI initiative led to the exclusion of more than one-third of patients with acute exacerbations who had more severe illness and worse outcomes and who may benefit most from the additional interventions provided by the initiative.

Rising costs have led to a number of federal initiatives to reform the US healthcare payment system and reimburse providers and hospitals based on outcomes rather than volume. As part of a multipronged strategy to control costs and address quality concerns, CMS hopes to tie more than 50% of payments to alternative value-based models by the end of 2018.[1] One such program is the Bundled Payments for Care Improvement (BPCI) initiative, which reimburses hospitals and providers based on episodes of care over time rather than individual fee-for-service (FFS) billing.

The BPCI initiative includes 4 distinct models. In Model 2, reimbursements cover the cost of an index admission, professional fees, and all Medicare part A and B costs, including postacute care and all-cause readmissions within 30, 60, or 90 days of an index hospitalization discharge.[2] Reimbursements for an episode of care within this model are based on an inpatient classification system developed in the 1980s that divides diagnoses into categories, known as diagnosis-related groups (DRGs), to determine payment. The DRG assignment is given by the hospital coders with the use of a semi-automated “grouper” computer coding system. Hospital coders input specific information (eg, primary and secondary *International Classification of Diseases, Ninth Edition* [*ICD-9*] codes, complications, procedures, sex, gender) into the grouper, which connects clinical attributes to resource utilization in order to assign a specific DRG.[3] At the University of Alabama at Birmingham (UAB), our medical coders use the grouper system Optum CAC (“computer assisted coding”). The planned reimbursement, or “target price,” for a given DRG in each BPCI initiative is based on historical data and adjusted for case mix and region. Hospitals may either owe Medicare for overages or gain shared savings with providers depending on whether total BPCI charges exceed or fall below the target price.

As a participant in Model 2 of the BPCI initiative for patients hospitalized with acute exacerbations (AEs) of chronic obstructive pulmonary disease (COPD), our institution has invested significant financial resources into the development of a multidisciplinary program to deliver specialized interventions to patients included in the BPCI initiative, including expedited follow-up visits in a COPD-focused clinic, home calls, medication assistance, and tobacco cessation counseling.[4] Knowledge of the characteristics and outcomes of patients who were ultimately included and excluded from the BPCI can guide the maturation of programs similar to ours.

Our study sought to: 1) determine the clinical characteristics of patients admitted with AEs of COPD who were included and excluded from the BPCI (based on DRG coding) and 2) evaluate differences in outcomes, hospital length of stay (LOS), and cost utilization between these groups. Based on our experiences participating in the BPCI, we hypothesized that patients excluded from the BPCI initiative would have a higher rate of intensive care unit (ICU) admission and use of mechanical ventilation, longer hospital LOS, and increased index admission costs than those who were included in the initiative.

METHODS

Establishment of the Study Cohort

We included Medicare beneficiaries who were admitted to UAB Hospital between January 1, 2012, and December 31, 2014, for an AE of COPD as defined by administrative data.[2] As the BPCI initiative currently stands, only Medicare FFS patients are included. However, we included all Medicare patients (FFS, managed Medicare, dual-eligible) in our analysis to increase the power of the study and because payment to private insurers may model the bundled payment approach in the future. Patients were included if they received a COPD DRG (190-192) upon discharge or an *ICD-9* code that had traditionally been used to identify an AE of COPD (primary code 491.21 or 491.22; or primary code 518.81, 518.82, 518.84 with 491.21, 491.22, or 496 as secondary).[5,6] In order to focus on COPD-specific DRGs, we excluded asthma DRGs (202-203) and therefore did not include *ICD-9* codes related to asthma, nonspecific lung disease, or unspecified bronchitis.[7]

We identified 990 patient encounters with a discharge diagnosis of AE of COPD based on COPD DRG assignment or *ICD-9* coding. Of these, 698 unique patients in 2 mutually exclusive groups were included for analysis: 1) those discharged with a COPD DRG (DRG group) and 2) those discharged with a COPD *ICD-9* code and a non-COPD DRG (*ICD-9* group). UAB's Institutional Review Board approved the study protocol (X121221005).

Data

Data were extracted from our hospital's clinical data warehouse (Cerner PowerInsight; Cerner Corporation World Headquarters; North Kansas City, Missouri). Demographic information and comorbidities were obtained from the time of index hospitalization. Encounter information obtained included clinical data from hospitalization (vital signs, arterial blood gas values, body mass index [BMI], smoking status, use of noninvasive positive pressure ventilation [NIPPV], invasive mechanical ventilation) and administrative data (hospital and ICU LOS, hospital disposition). All-cause readmissions were evaluated at 30 and 90 days from index hospital discharge; the latter was the length of a BPCI episode for our institution. Costs were obtained from the UAB Health Services Foundation.

Study Outcomes

The co-primary outcomes were the need for ICU admission and the use of mechanical ventilation in patients who were included and excluded from the BPCI initiative based on DRG classification. Secondary outcomes included index hospital LOS, ICU LOS, in-hospital mortality, readmission rate, and costs.

Statistical Analysis

We used descriptive statistics to compare the demographic and clinical characteristics between the DRG and *ICD-9* groups. Each categorical and continuous variable was compared by c^2 and independent sample *t* tests, respectively. Wilcoxon-rank sum test was used to compare costs to account for skewness. Aggregate costs of all-cause 30-day and 90-day readmissions per patient were calculated by summing the costs each patient incurred within 30 and 90 days from index hospitalization discharge. In similar secondary analyses, we compared the DRG group with the *ICD-9* group, excluding patients with a primary *ICD-9* code of respiratory failure (518.81, 518.82, 518.84) from the latter, as these patients would be more likely to have a higher severity of illness. Finally, we separated the DRG cohort into patients who had an AE of COPD *ICD-9* code and those who did not (dual coded vs DRG only) and compared these 2 groups. This analysis was performed to provide information on the subgroup of patients who may not truly have COPD, yet received a COPD DRG and were therefore part of the BPCI initiative. All hypothesis testing was 2-sided with significance set at $P < .05$. All analyses were performed using SPSS statistical software (version 22).

RESULTS

DRG Classification and Baseline Characteristics

Of the 698 unique patients included for analysis, 459 were discharged with a COPD DRG (DRG group) and 239 were discharged with a non-COPD DRG (*ICD-9* group) (Table 1). Patients in the *ICD-9* group more often were male, were white, and had a higher BMI ($P < .05$ for all comparisons) compared with patients in the DRG group. *ICD-9* patients also had a lower rate of depression, osteoporosis, and coronary artery disease. The most common DRG classifications for the *ICD-9* group were pulmonary edema and respiratory failure (DRG 189; n = 91) and respiratory failure with ventilator support less than 96 hours (DRG 208; n = 71).

Physiology and Severity of Illness

As shown in Table 2, oxygen saturation and pH were lower and partial pressure of carbon dioxide and respiratory rate were higher in the *ICD-9*–only group compared with the DRG group ($P < .05$ for all), suggesting greater disease severity in the former. Likewise, patients in the *ICD-9* group had higher rates of NIPPV (46.9% vs 6.5%; $P < .001$) and invasive mechanical ventilation (41.4% vs 0.7%; $P < .001$) during their index hospitalization. Patients in the *ICD-9* group who did not have a code for respiratory failure and had a primary *ICD-9* code of 491.21 or 491.22 (n = 34) also exhibited a higher rate of use of NIPPV (35.3% vs 6.5%) and invasive mechanical ventilation (32.4% vs 0.7%) compared with those in the DRG group ($P < .001$ for both). When we restricted our analysis to fee-for-service Medicare patients, we found similar differences in the use of NIPPV and mechanical ventilation between the DRG (n = 276) and *ICD-9* (n = 166) groups.

Hospital LOS and Discharge Disposition

Patients in the *ICD-9* group had a higher rate of ICU admission (63.2% vs 4.4%; $P < .001$), longer ICU LOS (mean = 5.2 [SD = 5.8] days vs 1.8 [SD = 1.1] days; $P = .011$), and longer hospital LOS (10.3 [SD = 15.6] days vs 3.9 [SD = 2.8] days; $P < .001$) compared with the DRG group (Table 2). Thirty-five (14.6%) patients in the *ICD-9* group died during their index hospitalization compared with 3 patients (0.7%) in the DRG group *(*$P < .001$). *ICD-9* patients were less likely to be discharged home than those in the DRG group (37.7% vs 69.1%; $P < .001$). Those in the subcohort of *ICD-9* patients without respiratory failure also had a longer hospital LOS (8.9 [SD = 6.4] days vs 3.9 [SD = 2.8] days; $P < .001$), higher rate of ICU admission (52.9% vs 4.4%; $P < .001$), and longer ICU LOS (4.0 [SD = 3.6] days vs 1.8 [SD = 1.1] days; $P = .008$) compared with the DRG group. *ICD-9* Medicare FFS-only patients also had higher rates of ICU admission and in-hospital mortality and longer hospital LOS.

Readmission Patterns and Cost Utilization

There were no statistically significant differences in 30- or 90-day all-cause readmission rates between the 2 groups (Table 3). The *ICD-9* group had a higher total median cost of index hospitalization than the DRG group (median = $13,677 [interquartile range = $7489-$23,054] vs $4281 [$2718-$6537]; $P < .001$). Total costs of index admission in the *ICD-9* group, excluding respiratory failure codes, were also significantly higher than costs in the DRG group ($15,793 [$10,890-$23,590]; $P < .001$). Aggregate costs per patient incurred in the 30 and 90 days after index hospitalization discharge were higher in the *ICD-9* group compared with the DRG group (mean = $3122 [SD = $12,564] vs $1667 [SD = $5872] in 30 days; $5376 [SD = $14,882] vs $4116 [SD = $10,493] in 90 days) (Table 3).

Of the 459 patients who were included in the COPD DRG group, 115 did not have a COPD *ICD-9* code. Their clinical characteristics, severity of illness, and readmissions were similar to others included in the COPD DRG. Patients in the DRG-only group, however, did have a longer hospital LOS (mean = 4.5 [SD = 3.2] days vs 3.7 [SD = 2.8] days; $P = .013$) and a costlier index admission ($5172 [$3220-$7129] vs $4013 [$2651-$6204]; $P = .004$) (Tables 4 and 5).

DISCUSSION

We show that there is significant variation in the clinical characteristics, outcomes, and costs of patients hospitalized with AEs of COPD who are and are not included in the COPD BPCI initiative. More than one-third of patients with an *ICD-9* diagnosis of AE of COPD were excluded from the initiative despite having a higher severity of illness, greater ICU utilization, longer hospital and ICU LOS, and increased likelihood of mortality. Despite having *ICD-9* codes for an AE of COPD, these patients were given a wide range of non-COPD DRG classifications, which confirms the heterogeneity of the group excluded from the bundled payment initiative. These patients did not receive the additional interventions reserved for those included in the program, and the institution is neither incentivized for improved outcomes nor penalized for increased costs in this group. Our findings show that

the current system based on COPD DRGs excludes a large number of patients with COPD and respiratory failure who would potentially benefit from these interventions.

Patients in the DRG group had a significantly lower and less skewed total cost of index hospitalization than patients in the *ICD-9* group. This can be explained by the increased resource utilization in the *ICD-9* group, as these patients had a longer LOS and more days in the ICU. By excluding these patients from the COPD DRG, Medicare aimed to establish a clinically homogeneous group of patients with similar resource utilization,[8] and our data show that Medicare was successful in reaching this goal. This can benefit BPCI initiative participants by relieving the financial pressures caused by paying for more severely ill patients in which resource utilization is unavoidable. However, this also prevents these sicker patients from receiving postacute care that may be beneficial.

In addition, one-fourth of patients assigned to a COPD DRG did not have an *ICD-9* diagnosis of AE of COPD and were more likely to be admitted for other diseases. These patients had a longer hospital LOS and higher index admission costs, perhaps because their disease process is not directly addressed by the COPD-specific interventions provided through the BPCI initiative. Institutions should be mindful of potential misclassifications, as they will be financially responsible for all patients who are assigned to the BPCI. Misclassification of non-COPD patients will also dilute resources intended for patients with COPD, making the evaluation of any COPD-focused intervention difficult.

Our study results not only highlight the differences between the DRG and *ICD-9* groups, but also shed light on the implications of participation in the BPCI initiative. In a resource-limited healthcare setting, we were unable to provide COPD-focused interventions and transitional care services for all patients with the disease. Our resources were necessarily targeted to those patients with COPD for whom we were held financially responsible as defined by the BPCI. Although excluded patients may benefit from the BCPI interventions, and both we and other providers often felt strongly that they ought to be included, we did not have the capacity to accommodate patients for whom we did not carry financial responsibility. This exclusion was disconcerting to both the pulmonologists involved with the program and the referring providers.

Multiple variables are used to place an episode of care into a specific DRG. In an Australian study reviewing clinical documentation for impact on DRG allocation, Chin et al found that 48% of reviewed summaries resulted in reassignment of DRG and a reimbursement increase of $142,000 Australian dollars, with the most coding variance seen in respiratory infections.[9] Another study evaluated 2 episode-creation algorithms for diabetes and coronary artery disease and found that each method identified different patients with the 2 conditions. For diabetes, the 2 methods resulted in markedly different payments, with one capturing 69% of total diabetes-related payments and the other only 20%.[10] These studies highlight the potential for misclassification and misdiagnosis, as well as the financial impact that DRG classification can have on participants in the BPCI initiative.

In order for the BPCI initiative to be successful, patients who are correctly classified into a DRG code should also receive cost-saving interventions that result in higher quality of care

and fewer readmissions. By paying a fixed amount for an episode of care, Medicare presents participating institutions with the challenge of finding a less expensive, faster, and more effective way to deliver care that does not come at greater expense. Although there have been numerous studies evaluating the predictors of COPD readmissions,[11-13] there are currently no interventions that have been specifically demonstrated to reduce these readmissions.[14] Some studies have shown that integrated disease management interventions can lead to improvement in disease-specific quality of life and reduction in hospital admissions[15]; however, these findings are not consistently reported[16] and the long-term effectiveness of these interventions is unknown.

Previous studies have evaluated BPCI participants in nonspine surgical orthopedic episodes and found reduced LOS, fewer discharges to postacute care units, and fewer readmissions compared with non-BPCI participants.[17,18] The findings of a recent study evaluating more than 30,000 lower extremity joint replacement episodes add confirmatory evidence that the BPCI initiative is successful in reducing Medicare payments while preserving quality of care for orthopedic episodes.[19] Hip and knee arthroplasty were ideal treatments to evaluate early trials of bundled payments; however, the extension of episode-based payment to chronic diseases presents new challenges. Episodes for chronic conditions, including COPD, congestive heart failure, and end-stage renal disease, have a clinical trajectory that is dramatically different from that of elective surgical procedures. Patients with chronic diseases can present with multiple interrelated conditions that require coordinated and long-term management.[20] This complicates the DRG classification of a specific episode and can add to the heterogeneity of patients in a single DRG or misclassification of patients to an alternative DRG, as was seen with one-fourth of patients in our cohort. In addition, far greater cost variability has been observed in patients with COPD and stroke compared with lower extremity joint replacement and hip fracture, which places providers and institutions at a higher financial risk when volunteering for a BPCI initiative for these conditions.[21]

Limitations

Our study has several limitations. First, the selection of patients was based on *ICD-9* and DRG coding to determine episodes of AEs of COPD, which may not accurately reflect the reason for admission.[22] The purpose of this study was to evaluate a classification system based on medical records documentation and administrative coding; therefore, the authenticity of COPD in each patient was not confirmed by evidence of airflow obstruction on pulmonary function testing. This process reflects the real-world case determination processes a medical center and CMS would utilize to identify patients qualifying for the BCPI. Second, we acknowledge that inclusion of respiratory failure *ICD-9* codes accounted for some of the observed differences between the *ICD-9* and DRG groups. However, we found similar results in our subgroup analysis excluding respiratory failure codes from the *ICD-9* group. Third, our single center study had a relatively small sample size, which reduced its power. Despite this, we did observe a number of statistically and clinically significant differences between the characteristics and outcomes of the *ICD-9* and DRG groups, which we believe provide important information. Finally, we did not have access to outpatient cost data, which is known to contribute to cost variability.[23]

CONCLUSIONS

The sole use of DRGs to identify COPD exacerbations led to the exclusion of over one-third of patients with AEs of COPD who had more severe illness and worse outcomes and may benefit most from the additional interventions provided by bundled payment initiatives. In addition, this approach led to the misclassification of patients without COPD in the BPCI initiative (one-fourth of the total) who utilized resources intended for patients with COPD. Comprehensive data from implementation of the BPCI initiative across a range of chronic diseases will not be available for several years; however, the current study provides new information to future BPCI initiative participants about the program's design and potential consequences for COPD reimbursement and quality of care. Exclusion of the sickest patients from the BPCI initiative presents an ethical and logistical predicament for healthcare professionals. Alternative strategies should be explored to maximize the benefits of the initiative for chronic diseases like COPD, including the development of a bundled payment model that includes respiratory failure.

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Table 1

Characteristics of Patients Hospitalized With COPD Exacerbation From 2012-2014

	TOTAL (N = 698)	**DRG (n = 459)**	***ICD-9* ONLY (n = 239)**	***P***
Female, n (%)	370 (53.0)	263 (57.3)	107 (44.8)	.002
Age (years), mean (SD)	68.6 (11.1)	68.87 (11.3)	68.0 (10.6)	.314
Race, n (%) Black	245 (35.1)	175 (38.1)	70 (29.3)	.021
White	447 (64.0)	282 (61.4)	165 (69.0)	
Other	6 (0.9)	2 (0.4)	4 (1.7)	
BMI (kg/m^2), mean (SD)	28.5 (11.4)	27.7 (8.2)	30.0 (15.9)	.013
Tobacco use, n (%) Never smoker	96 (14.6)	73 (16.6)	23 (10.6)	.114
Former smoker	360 (54.8)	234 (53.5)	126 (57.8)	
Current smoker	201 (30.6)	132 (30.1)	69 (31.7)	
Comorbidities, n (%) Depression	117 (16.8)	93 (20.3)	24 (10.0)	.001
Anxiety	79 (11.3)	59 (12.9)	20 (8.4)	.076
Heart failure	122 (17.5)	78 (17.0)	44 (18.4)	.640
Cirrhosis	12 (1.7)	8 (1.7)	4 (1.7)	.947
Diabetes	173 (24.8)	119 (25.9)	54 (22.6)	.333
Osteoporosis	68 (9.7)	53 (11.5)	15 (6.3)	.026
Chronic kidney disease	72 (10.3)	54 (11.8)	18 (7.5)	.081
Coronary artery disease	129 (18.5)	101 (22.0)	28 (11.7)	.001
Lung cancer	30 (4.3)	22 (4.8)	8 (3.3)	.371

BMI indicates body mass index; COPD, chronic obstructive pulmonary disease; DRG, diagnosis-related group; ICD-9, *International Classification of Diseases, Ninth Revision*.

Table 2

Comparison of Severity of Illness for Index Admission

	DRG (n = 459)	***ICD-9* (n = 239)**	***P***
Respiratory rate, mean (SD)	20.8 (3.9)	22.2 (7.4)	.001
SpO_2, mean (SD)	94.4 (5.2)	93.0 (9.8)	.010
pH, mean (SD)[a]	7.4 (0.1)	7.36 (0.1)	.026
pCO_2, mean (SD)[a]	47 (11.9)	59 (21.9)	<.001
NIPPV in hospital, n (%)	30 (6.5)	112 (46.9)	<.001
Intubation, n (%)	3 (0.7)	99 (41.4)	<.001
Hospital length of stay (days), mean (SD)	3.9 (2.8)	10.3 (15.6)	<.001
ICU admission, n (%)	20 (4.4)	151 (63.2)	<.001
ICU length of stay (days), mean (SD)	1.8 (1.1)	5.2 (5.8)	.011
Disposition, n (%) Home	317 (69.1)	90 (37.7)	<.001
SNF	30 (6.5)	34 (14.2)	
Home health	86 (18.7)	50 (20.9)	
In-hospital death	3 (0.7)	35 (14.6)	
Home oxygen use on discharge, n (%)	21 (4.6)	19 (9.3)	.019

DRG indicates diagnosis-related group; *ICD-9*, *International Classification of Diseases, Ninth Revision*; ICU, intensive care unit; NIPPV, noninvasive positive pressure ventilation; pCO_2, partial pressure of carbon dioxide; SNF, skilled nursing facility; SpO_2, oxygen saturation.

[a]Arterial blood gas obtained on 45/459 (9.8%) of DRG group and 167/239 (70%) of *ICD-9* group (P <.001).

Table 3

Cost of Index Admission and Readmissions

	DRG (n = 459)	***ICD-9* (n = 239)**	***P***
Total index hospitalization cost			<.001
mean (SD)	$5181 ($3437)	$23,153 ($55,062)	
median (IQR)	$4281 ($2718-$6537)	$13,677 ($7489-$23,054)	
Aggregate cost of 30-day readmissions per patient[a] (n = 660)			.004
mean (SD)	$1667 ($5872)	$3122 ($12,564)	
Aggregate cost of 90-day readmissions per patient[b] (n = 660)			<.001
mean (SD)	$4116 ($10,493)	$5376 ($14,882)	

DRG indicates diagnosis-related group; *ICD-9*, *International Classification of Diseases*, *Ninth Revision*; IQR, interquartile range.

[a] 30-day all-cause readmissions: 65/456 (14.3%) in DRG versus 40/204 (19.7%) in *ICD-9* (*P* = .080).

[b] 90-day all-cause readmissions: 122/456 (26.8%) in DRG versus 63/204 (31.0%) in *ICD-9* (*P* = .266).

Table 4

Clinical Characteristics of Dual-Coded and DRG Patients With COPD[a]

	DUAL-CODED (n = 344)	DRG ONLY (n = 115)	*P*
Respiratory rate on admission, mean (SD)	20.6 (3.9)	21.3 (3.8)	.099
SpO_2 on admission, mean (SD)	94.4 (5.1)	94.5 (5.6)	.847
pH, mean (SD)	7.40 (0.1)	7.39 (0.1)	.790
pCO_2, mean (SD)	47.8 (12.6)	45.3 (9.5)	.154
NIPPV in hospital, n (%)	24 (7.0)	6 (5.2)	.509
Intubation, n (%)	3 (0.9)	0 (0.0)	.315
Hospital length of stay (days), mean (SD)	3.72 (2.8)	4.49 (3.2)	.013
ICU admission, n (%)	16 (4.7)	4 (3.5)	.594
ICU length of stay (days), mean (SD)	2.1 (1.3)	1.2 (0.4)	.227
Disposition, n (%)			.352
Home	233 (67.7)	84 (73.0)	
SNF	24 (7.0)	6 (5.2)	
Home health	68 (19.8)	18 (15.7)	
In-hospital death	1 (0.3)	2 (1.7)	
Home oxygen use on discharge, n (%)	17 (4.9)	4 (3.5)	.516

COPD indicates chronic obstructive pulmonary disease; DRG, diagnosis-related group; ICU, intensive care unit; NIPPV, non-invasive positive pressure ventilation; pCO_2, partial pressure of carbon dioxide; SNF, skilled nursing facility; SpO_2, oxygen saturation.

[a]Patients who had a DRG of 190-192 and a non-COPD *International Classification of Diseases, Ninth Revision* code.

Table 5

Cost of Index Admission and Readmissions of Dual-Coded and DRG Patients With COPD[a]

	DUAL-CODED (n = 344)	DRG ONLY (n = 115)	*P*
Total hospitalization cost (n = 459)			.004
mean (SD)	$4916 ($3184)	$5973 ($4013)	
median (IQR)	$4013 ($2651-$6204)	$5172 ($3220-$7129)	
Aggregate cost of 30-day readmission per patient[b] (n = 456)			.825
mean (SD)	$1810 ($6432)	$1231 ($3676)	
Aggregate cost of 90-day readmission per patient[c] (n = 456)			.363
mean (SD)	$4010 ($10,561)	$4437 ($10,323)	

COPD indicates chronic obstructive pulmonary disease; DRG, diagnosis-related group; IQR, interquartile range.

[a]Patients who had a DRG of 190-192 and a non-COPD *International Classification of Diseases, Ninth Revision* code.

[b]30-day all-cause readmissions: 49/343 (14.3%) in dual-coded versus 16/113 (14.2%) in DRG-only group (*P* = .973).

[c]90-day all-cause readmissions: 88/343 (25.7%) in dual-coded versus 34/113(30.1) in DRG-only group (P = .356).