Factors Associated With Chronic Obstructive Pulmonary Disease–Related Inpatient Readmissions

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BACKGROUND

- Chronic obstructive pulmonary disease (COPD) is a progressive condition characterized by fixed airflow limitation.
- Chronic lower respiratory diseases (including COPD) are recognized as a major public health concern and are the third-leading cause of death in the United States (US).[1]
- Patients with COPD experience a high rate of inpatient admission and readmission.[2-4]
  - In 2008, there were approximately 822,500 inpatient admissions related to COPD among patients aged 40 years and older in the US.[2]
  - Inpatient readmission rates within 30 days of an initial COPD hospitalization have been estimated at between 7.1% and 17.3%.[3]
  - Elderly patients experience a higher rate, with an estimated 20% of fee-for-service Medicare beneficiaries experiencing a 30-day all-cause inpatient readmission in a recent study.[4]

OBJECTIVE

To assess factors associated with COPD-related inpatient readmission among a commercially insured population with COPD.

METHODS

Study Design

- Retrospective cohort study using a nationally representative administrative claims database of a commercially insured population from 2007 to 2011.
- RTI International's institutional review board determined that this study met all criteria for exemption.

Data Source: PharMetrics Plus Database

- Commercially available source of electronic administrative claims data covering more than 150 million lives across the US.
- Information includes demographics, health plan enrollment, diagnoses, dates and place of service, diagnostic testing, procedures, inpatient and outpatient physician services, and prescription drug use.
- Data are tracked longitudinally for enrollees via deidentified and unique member identification numbers.

Patient Selection Criteria

- To assess inpatient readmission rates within 30 and 90 days following an initial COPD-related inpatient admission, two cohorts of patients were identified using the following criteria:
  - Patients with at least one inpatient OR an emergency department claim OR at least two outpatient claims on different dates with a diagnosis of COPD (*International Classification of Diseases, 9th Edition, Clinical Modification* [ICD-9-CM] 491.xx, 492.xx, 494.xx, 496.xx) between January 1, 2007, and December 31, 2011.
  - Patients at least 40 years old on the date of their first observed COPD diagnosis.
  - Patients with at least one inpatient admission with a primary diagnosis of COPD in 2011 (COPD-related hospitalization), with the discharge date of the first inpatient admission defined as the index date.
  - Patients with continuous health plan enrollment for at least 30 days (30-day cohort) or 90 days (90-day cohort) after the index date.

Study Measures

- Patient characteristics and comorbidities
  - Age, sex, geographic location, health plan type, and payer type reported on the index date.
  - Charlson Comorbidity Index (CCI) score,[5] measured in the up to 12 months before and after the index date, based on available health plan enrollment (with COPD excluded from the score).
  - Other relevant comorbidities (i.e., asthma, chronic renal failure [CRF], ischemic heart disease [IHD], lung cancer, other cancers, and pneumonia) measured in the up to 12 months before and after the index date, based on available health plan enrollment.
- Clinical characteristics
  - COPD complexity (i.e., high, moderate, or low complexity), based on an algorithm developed by Mapel and colleagues,[6] assessed in the 12 months pre–index date date.
  - Length of stay (LOS) for the initial inpatient admission.
- Outcomes
  - 30-day or 90-day COPD-related inpatient readmissions: inpatient admissions with a primary diagnosis of COPD occurring within 30 or 90 days after the index date, respectively.

Data Analyses

- Descriptive statistics were provided for all study measures.
  - Means and standard deviations were reported for continuous variables.
  - Percentages were reported for categorical variables.
- Logistic regression models were constructed to assess factors associated with COPD-related inpatient readmissions in the 30 and 90 days post–index date (separate models for each cohort).
  - The dependent variable was a binary indicator for whether the patient had a 30-day or 90-day COPD-related inpatient readmission.
  - The independent variables included patient characteristics, comorbidities, and clinical characteristics.
- All analyses were conducted using SAS version 9.3 (SAS Institute, Inc., Cary, North Carolina).

RESULTS

- For the 30-day cohort, 49,986 had a COPD-related inpatient admission in 2011.
  - 7.1% (n = 3,564) of patients had a COPD-related readmission within 30 days.
- For the 90-day cohort, 38,241 had a COPD-related inpatient admission in 2011.
  - 13.5% (n = 5,167) of patients had a COPD-related readmission within 90 days.
- Across both study groups, stratified by those with and those without an inpatient readmission, the median length of observation time prior to the index date was 12 months.
- Patient demographics and clinical characteristics are displayed in Table 1.
- Factors associated with a 30-day COPD-related readmission (Table 2):
  - Increasing LOS (vs. ≤ 3 days), being female; age 65+ years (vs. 40-54 years); higher CCI score; comorbidities including asthma, CRF, IHD, and pneumonia; and moderate or severe COPD complexity (vs. low complexity) were associated with significantly higher odds of 30-day readmission.
  - Residing in the South (vs. Northeast), having a commercial payer (vs. a noncommercial payer), and having the first observed COPD diagnosis in 2011 were associated with significantly lower odds of 30-day readmission.
- Factors associated with a 90-day COPD-related readmission (Table 2):
  - Similar results to the 30-day COPD-related readmission model were observed in the 90-day COPD-related readmission model, except that no difference in 90-day COPD-related readmission between males and females, or having a commercial versus a noncommercial payer were observed.

LIMITATIONS

- This study is subject to limitations common to retrospective analyses using claims data, including coding errors, incomplete claims, and unobservable factors that may also influence outcomes.
- No clinical data or electronic medical records were available to confirm diagnoses or clinical events.
- Because PharMetrics is a database covering a commercially insured population, findings from this study may not be generalizable to patients with COPD in fee-for-service Medicare or Medicaid programs, or other payer types.

CONCLUSIONS

- Longer LOS for the initial hospitalization, being elderly, having more complex COPD, and a greater comorbidity burden may contribute to an increased risk of 30-day and 90-day COPD-related readmission.
- These results may provide useful insights for health care organizations to target those likely to be readmitted after a COPD-related inpatient admission, enabling appropriate interventions and preventing future costly readmissions.

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Table 1. Demographic and Clinical Characteristics, by Cohort

Characteristic	30-Day COPD-Related Inpatient Readmission Cohort			90-Day COPD-Related Inpatient Readmission Cohort		
	All Patients (%) N = 49,896	Patients With an Inpatient Readmission (%) n = 3,564	Patients Without an Inpatient Readmission (%) n = 46,422	All Patients (%) N = 38,241	Patients With an Inpatient Readmission (%) n = 5,167	Patients Without an Inpatient Readmission (%) n = 33,074
Age in years, mean (SD)	68.9 (13.1)	71.3 (12.8)	68.7 (13.1)	68.7 (13.0)	70.6 (12.8)	68.4 (13.0)
40-54	13.1	9.0	13.4	13.7	9.6	13.1
55-64	29.0	23.9	29.4	30.1	25.1	29.5
65+	57.9	67.1	57.2	56.2	65.3	57.4
Female	51.5	53.0	51.4	51.8	52.2	51.7
Geographic region						
Northeast	24.7	27.3	24.5	24.3	25.0	24.1
South	31.8	27.9	32.1	32.0	29.5	32.4
Midwest	35.2	36.6	35.1	35.9	38.6	35.5
West	8.3	8.3	8.3	7.8	6.8	7.9
Health plan type - PPO	71.2	66.8	71.6	71.6	71.0	71.7
Payer type - commercial	48.3	42.6	48.8	48.6	47.4	48.8
CCI score, mean (SD)	5.4 (3.8)	6.6 (3.8)	5.3 (3.7)	5.3 (3.7)	6.6 (3.8)	5.1 (3.7)
0	4.9	1.7	4.7	5.1	1.7	4.7
1	9.5	4.7	9.2	9.9	4.9	9.2
2	12.2	8.2	11.9	12.6	7.8	11.9
≥ 3	73.4	85.5	74.3	72.4	85.6	74.2
LOS in days, mean (SD)	4.2 (7.3)	6.3 (8.7)	4.4 (7.4)	4.1 (6.2)	5.7 (8.7)	4.3 (6.6)
≤ 3	62.1	46.6	61.0	62.1	50.7	60.6
4-7	26.4	29.0	26.6	27.0	29.2	27.3
8-10	5.2	9.7	5.5	5.1	8.1	5.5
> 10	6.3	14.7	6.9	5.8	12.0	6.7
Other comorbidities						
Asthma	37.3	45.6	36.7	38.7	49.1	37.1
CRF	15.1	21.5	14.6	15.1	22.3	14.0
IHD	48.8	58.2	48.1	49.6	59.8	48.0
Lung cancer	8.9	11.6	8.7	8.0	10.5	7.6
Other cancer	45.3	47.4	45.1	45.4	48.0	45.0
Pneumonia	55.4	72.5	54.1	55.4	72.6	52.7
COPD complexity						
Low	28.8	19.6	29.5	27.2	19.3	28.5
Moderate	52.8	53.5	52.8	54.9	55.4	54.8
High	18.4	26.9	17.8	17.9	25.3	16.7
First observed COPD diagnosis in 2011	34.7	20.3	35.9	33.6	17.6	36.1

CCI = Charlson Comorbidity Index; COPD = chronic obstructive pulmonary disease; CRF = chronic renal failure; IHD = ischemic heart disease; LOS = length of stay; PPO = preferred provider organization; SD = standard deviation.

Table 2. Factors Associated With 30-Day and 90-Day COPD-Related Inpatient Readmission

Characteristic	30-Day COPD-Related Inpatient Readmission Cohort				90-Day COPD-Related Inpatient Readmission Cohort			
	Odds Ratio	95% CI		*P* Value	Odds Ratio	95% CI		*P* Value
		Lower Bound	Upper Bound			Lower Bound	Upper Bound	
LOS, days (vs. ≤ 3)								
4-7	1.32	1.22	1.44	< 0.0001	1.16	1.09	1.25	< 0.0001
8-10	2.01	1.77	2.28	< 0.0001	1.52	1.35	1.72	< 0.0001
> 10	2.26	2.03	2.52	< .0001	1.84	1.66	2.04	< 0.0001
Age, years (vs. 40-54)								
55-64	1.02	0.89	1.17	0.7503	1.00	0.89	1.12	0.9600
65+	1.18	1.04	1.34	0.0131	1.16	1.04	1.29	0.0088
Female (vs. male)	1.08	1.01	1.16	0.0368	1.05	0.98	1.11	0.1678
Geographic region (vs. Northeast)								
South	0.85	0.77	0.94	0.0018	0.89	0.82	0.97	0.0075
Midwest	1.01	0.92	1.11	0.8630	1.06	0.98	1.15	0.1298
West	0.90	0.78	1.03	0.1272	0.78	0.68	0.89	0.0002
Health plan type - PPO (vs. other)	0.95	0.88	1.03	0.2405	1.12	1.05	1.21	0.0016
Payer type - commercial (vs. other)	0.86	0.80	0.93	< 0.0001	1.05	0.98	1.11	0.1595
CCI score (vs. 0)								
1	1.33	0.98	1.80	0.0674	1.36	1.06	1.75	0.0158
2	1.69	1.27	2.25	0.0004	1.59	1.25	2.02	0.0002
≥ 3	2.20	1.68	2.88	< 0.0001	2.24	1.79	2.80	< 0.0001
Other comorbidities (vs. did not have the comorbidity)								
Asthma	1.27	1.18	1.36	< 0.0001	1.43	1.35	1.53	< 0.0001
CRF	1.22	1.12	1.34	< 0.0001	1.35	1.25	1.46	< 0.0001
IHD	1.16	1.08	1.25	0.0001	1.21	1.14	1.30	< 0.0001
Lung cancer	1.00	0.89	1.13	0.9581	1.02	0.91	1.14	0.7854
Other cancer	0.92	0.86	0.99	0.0256	0.93	0.87	0.99	0.0167
Pneumonia	1.69	1.56	1.83	< 0.0001	1.81	1.69	1.93	< 0.0001
COPD complexity (vs. low)								
Moderate	1.37	1.25	1.51	< 0.0001	1.35	1.24	1.46	< 0.0001
High	1.91	1.71	2.13	< 0.0001	1.85	1.68	2.04	< 0.0001
First observed COPD diagnosis in 2011	0.59	0.54	0.64	< 0.0001	0.48	0.44	0.52	< 0.0001

CCI = Charlson Comorbidity Index; CI = confidence interval; COPD = chronic obstructive pulmonary disease; CRF = chronic renal failure; IHD = ischemic heart disease; LOS = length of stay; PPO = preferred provider organization.