Multimorbidity and COPD Medication Receipt Among Medicaid Beneficiaries With Newly Diagnosed COPD

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BACKGROUND: Multimorbidity is highly prevalent among patients with COPD. The association between multimorbidity and COPD medication management is not well researched. The aim of this study was to examine the association between multimorbidity and COPD medication receipt among Medicaid beneficiaries with newly diagnosed COPD. METHODS: A retrospective longitudinal dynamic cohort design was used, and data were extracted from Medicaid Analytic eXtract files from 2005 to 2008. Medicaid beneficiaries with newly diagnosed COPD ($N = 19,060$) were identified using the International Classification of Diseases, 9th Revision, Clinical Modification, for COPD. This code (for commonly co-occurring conditions with COPD) was used to create a multimorbidity variable. These conditions included anxiety, arthritis, bipolar disorder, cardiovascular diseases, depression, diabetes, hypertension, hyperlipidemia osteoporosis, and schizophrenia. Medicaid beneficiaries with newly diagnosed COPD were categorized as: (1) physical multimorbidity only, (2) psychiatric multimorbidity only, (3) both physical and psychiatric multimorbidity, and (4) no multimorbidity. Receipt of COPD medications (short- or long-acting bronchodilators, inhaled corticosteroids) was identified using National Drug Codes. Bivariate relationships between multimorbidity and COPD medication receipt were tested using the chi-square test of independence. The associations between multimorbidity and COPD medication receipt were analyzed with logistic and multinomial logistic regression analyses. RESULTS: Among Medicaid beneficiaries with newly diagnosed COPD, 81.9% had at least one co-occurring chronic condition. After controlling for subject characteristics, adults with multimorbidity were less likely to receive COPD medications compared with those without any inflammation-related multimorbidity. For example, those with physical multimorbidity were less likely to receive short-acting bronchodilators (adjusted odds ratio [OR] 0.76, 95% CI 0.69–0.83), long-acting bronchodilators (adjusted OR 0.84, 95% CI 0.76–0.92), and inhaled corticosteroids (adjusted OR 0.75, 95% CI 0.68–0.82) compared with those with no inflammation-related multimorbidity. CONCLUSIONS: The prevalence of multimorbidity is very high among Medicaid beneficiaries with newly diagnosed COPD. Our findings indicate poor COPD medication management among those with multimorbidity. *Key words: multimorbidity; COPD; medication management; Medicaid.* [Respir Care 2015;60(11):1592–1602. © 2015 Daedalus Enterprises]

Introduction

Multimorbidity is defined as the coexistence of 2 or more chronic conditions.[1-3] The high prevalence of multimorbidity has profound implications for the patient, payers, caregivers, and society.[4] Multimorbidity serves as a

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prototype example of the Agency for Healthcare Research and Quality's definition of a complex patient, who has "two or more chronic conditions where each condition may influence the care of the other condition(s) through limitations of life expectancy, interactions between drug therapies, difficulties in establishing adequate care coordination, and/or direct contraindications to therapy for one condition by other conditions themselves."[5] Multimorbidity is a major challenge among elderly patients ≥65 y old.[6] However, multimorbidity is no longer being considered as just an older person's issue due to its high prevalence among younger adults <65 y old.[7,8]

Multimorbidity is highly prevalent in patients with COPD. Using data from the National Health and Nutrition Examination Survey (1999–2008), it has been reported that adults (≥45 y old) with COPD had significantly higher rates of coexisting arthritis (54.6% vs 36.9%), diabetes (16.3% vs 12.8%), depression (20.6% vs 12.5%), osteoporosis (16.9% vs 8.5%), coronary heart disease (12.7% vs 6.1%), and congestive heart failure (12.1% vs 3.9%) compared with those without COPD.[9]

COPD is often managed with pharmacologic agents. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), many medications are approved for effective management of COPD symptoms and exacerbations. These include bronchodilators such as anticholinergics and β agonists, inhaled corticosteroids, theophylline, and other medications such as phosphodiesterase-4 inhibitors and antibiotics.[10,11] Existing evidence suggests that the presence of multimorbidity among adults with COPD may complicate overall COPD management due to interactions with therapies for other commonly co-occurring chronic conditions.[12] For example, β blockers, which are used to treat cardiovascular conditions, may interact with β agonists, which are the main pharmacologic therapy for COPD management.[13] Similarly, corticosteroids used to treat patients with COPD have been linked to impairment in the glucose metabolism process and thus may affect diabetes outcomes in patients with COPD and diabetes.[14,15] The presence of cardiovascular disease can affect the metabolism of COPD medications. For example, theophylline clearance is reduced in patients with COPD and cardiovascular disease and may lead to poor COPD-specific outcomes in those with cardiovascular disease and COPD.[16]

Although multimorbidity is highly prevalent among younger adults with COPD, only a handful of studies have examined the impact of multimorbidity on health outcomes. Specifically, no study has examined the relationship between multimorbidity and COPD medication receipt in young adults (40–64 y of age) with COPD. Therefore, for the purpose of this analysis, we used administrative claims data for Medicaid enrollees, as Medicaid is an important payer of a major portion of the young adult population in

QUICK LOOK

Current knowledge

Multimorbidity is defined as the coexistence of 2 or more chronic conditions. The high prevalence of multimorbidity has profound implications for the patient, payers, caregivers, and society. Multimorbidity is highly prevalent among patients with COPD. It has been reported that adults (>45 y of age) with COPD have significantly higher rates of coexisting arthritis, diabetes, depression, osteoporosis, coronary heart disease, and congestive heart failure compared with those without COPD.

What this paper contributes to our knowledge

The prevalence of multimorbidity was very high in Medicaid beneficiaries with newly diagnosed COPD. Medicaid beneficiaries with newly diagnosed COPD and multimorbidity were less likely to receive COPD medications, including bronchodilators and inhaled corticosteroids. Medication management in patients with newly diagnosed COPD is suboptimal and requires process changes to improve patient treatment.

the United States.[17] Moreover, beneficiaries enrolled in the Medicaid program represent the lower socioeconomic stratum of the society. Prior evidence suggests that subjects with lower socioeconomic status have high rates of multimorbidity.[6,18] In addition, multimorbidity has a worse impact on patients in the lower socioeconomic stratum of society compared with higher socioeconomic groups.[19]

Therefore, the primary objectives of this study were to estimate the prevalence of commonly co-occurring chronic conditions (multimorbidity) in Medicaid beneficiaries with newly diagnosed COPD and also to examine the association between multimorbidity and receipt of common medications required to treat patients with COPD using multiyear and multistate Medicaid claims data. We hypothesized that due to competing demands associated with management of multimorbidity, the presence of multimorbidity would be associated with reduced COPD medication receipt.

Methods

Study Design

We used a retrospective longitudinal dynamic cohort design and extracted data from Medicaid Analytic eXtract files from 2005 to 2008. We identified Medicaid beneficiaries with diagnosed COPD in 2006 and 2007. The first-

service date with COPD diagnosis was recorded as the index date. The procedure used to identify the study population is described in detail below. The two distinct study observation periods were the baseline period (defined as 1 y before the index date) and the follow-up period (defined as 1 y after the index date). The baseline period was used to ascertain the presence of multimorbidity and other subject characteristics, whereas the follow-up period was used to measure the receipt of COPD medications.

Data Source

Medicaid Analytic eXtract files containing information on enrollment, inpatient visits, other therapy, and prescription drug utilization were used. The personal summary file provided information on eligibility, demographics (age, sex, and race), managed care enrollment, and utilization summary. The other 4 files contained information on fee-for-service claims for services used. Other therapy files included information regarding claims for Medicaid services provided at an out-patient level, such as clinic, physician, laboratory, and home-health services. Hospitalization diagnosis codes, procedures, hospitalization stay, and expenditures related to hospitalizations were extracted from the in-patient files. National Drug Codes for prescription drugs, supply days, fill dates, and payments for prescription drugs were obtained from the prescription drug files.

We used data for beneficiaries residing in the following states: California, Illinois, New York, and Texas. These states were chosen to capture the diverse geographic and racial/ethnic populations represented by Medicaid. We received approval from the institutional review board of West Virginia University for analysis of Medicaid Analytic eXtract data to conduct this study.

Area Resource File

We also determined each Medicaid beneficiary's contextual county-level variables using the Area Resource File. The Area Resource File is a comprehensive county-level data set compiled by the Bureau of Health Professions of the Health Resources Service Administration. The Area Resource File contains >6,000 variables providing information about the nation's counties. The information contained within the Area Resource File includes the type of health facilities in the various counties, number and type of health professions, resource scarcity measures, health status, economic activity, health-training programs, and socioeconomic and environmental characteristics. These files also include county codes and descriptors that allow linkage with several secondary data sets, such as Medicaid Analytic eXtract. We used the county codes and state information to link Medicaid Analytic eXtract files with the 2005 Area Resource File.

Study Population: Medicaid Beneficiaries With Newly Diagnosed COPD

Medicaid beneficiaries with diagnosed COPD were identified using in- and out-patient visits (physician office visits and clinic services only). Medicaid beneficiaries with at least one in-patient visit or 2 out-patient visits 14 d apart (obtained using the type of service codes) for COPD based on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), codes for chronic bronchitis (491.xx), emphysema (492.xx), or unspecified chronic airway obstruction (496.xx) were considered to have diagnosed COPD. These diagnosis codes have been used in prior published research (codes 491.xx, 492.xx and 496.xx) to identify COPD and to evaluate medical treatment and health outcomes in subjects with COPD.[20,21] Indeed, the sensitivity and specificity of using ICD-9-CM codes to identify subjects with COPD has been established.[22,23] Gershon et al[23] reported that identifying COPD using one or more ambulatory claims and/or one or more hospitalizations for COPD resulted in a sensitivity of 85.0% (95% CI 77.0–91.0) and a specificity of 78.4% (95% CI 73.6–82.7). However, we used one in-patient claim or at least 2 out-patient claims to identify subjects with COPD to increase the specificity of the algorithm. We included only Medicaid beneficiaries with newly diagnosed COPD. To obtain subjects with newly diagnosed COPD, we created a washout period (1 y before the index date of COPD diagnosis). Only Medicaid beneficiaries who did not have a COPD diagnosis in the washout period were considered to have newly diagnosed COPD and were included in our study population.

Other inclusion criteria included: 40–64 y of age (among non-elderly population, this age group is at the highest risk for COPD), continuous eligibility during the baseline and follow-up periods, no dual Medicaid/Medicare coverage (dual eligibility would represent high cost and severe beneficiaries), enrolled in fee-for-service plans throughout the study observation period, alive during the study observation period, and use of services (in- or out-patient).

Dependent Variables: COPD Medication Receipt

The common pharmacologic treatment for patients with COPD is the administration of maintenance bronchodilators and inhaled corticosteroids.[10,11] COPD medications were identified using the National Drug Codes obtained from various publicly available sources, such as the FDA, Multum Lexicon National Drug Codes from the Agency for Healthcare Research and Quality Medical Expenditure Panel Survey, National Committee for Quality Assurance database, and Department of Veterans Affairs. We identified the following binary dependent variables for COPD medication receipt: (1) receipt of short-acting bronchodi-

lators, including β agonists and inhaled anticholinergics (yes/no); (2) receipt of long-acting bronchodilators, including β agonists and inhaled anticholinergics (yes/no); and (3) receipt of inhaled corticosteroids (yes/no). Furthermore, we also created an aggregate variable with 4 categories for receipt of type of bronchodilator: (1) receipt of short-acting bronchodilators only, (2) receipt of long-acting bronchodilators only, (3) receipt of both types of bronchodilator, and (4) no bronchodilator use.

Key Independent Variable: Multimorbidity

When examining multimorbidity in patients with COPD, it is important to note that COPD is characterized mainly as an inflammatory disease that is associated with progressive and persistent air-flow limitation.[24] It has been suggested that there may be a high prevalence of inflammation-related chronic conditions in patients with COPD due to elevated levels of inflammatory mediators. Although the exact mechanisms have not yet been established, researchers suggest that either inflammation in COPD may have a spillover effect, or the inflammation may be part of systemic inflammation.[25] A review on systemic manifestations of COPD suggested that systemic inflammation in COPD may lead to various inflammation-related chronic diseases, such as arthritis, cardiovascular diseases, depression, diabetes, and osteoporosis.[26,27] Indeed, researchers have suggested that COPD should be considered as part of the chronic systemic inflammatory syndrome.[26] Therefore, to construct a multimorbidity variable in subjects with COPD, we selected chronic inflammatory conditions that commonly co-occur with COPD.[9] Our selection of conditions was also guided by Department of Health and Human Services priorities for research, policy, program, and practice.[28]

We created binary indicator variables for the presence of commonly co-occurring chronic conditions with COPD using the ICD-9-CM codes obtained from the Agency for Healthcare Research and Quality Clinical Classifications Software. Chronic physical conditions that were used to create the multimorbidity variable included arthritis, cardiovascular disease, diabetes, hypertension, hyperlipidemia, and osteoporosis. Chronic psychiatric conditions included anxiety, bipolar disorder, depression, and schizophrenia. These conditions were selected because of their common co-occurrence with COPD possibly due to common inflammation-related pathways and shared risk factors, such as tobacco smoking.[9] Any Medicaid beneficiary with newly diagnosed COPD who had one in-patient visit or at least 2 out-patient visits for these conditions during the baseline period were considered as having the chronic condition. We further operationalized the multimorbidity variable into 4 groups: (1) physical multimorbidity only, (2) psychiatric multimorbidity only, (3) both physical and psychiatric multimorbidity, and (4) no multimorbidity.

Other Independent Variables

As the relationship between multimorbidity and medication receipt is generally confounded by many external factors, we controlled for a comprehensive set of covariates based on the Andersen health-care utilization model.[29] This conceptual framework has been extensively used in prior studies to understand the use of health services.[30] The Andersen health-care utilization model suggests that use of health services is associated with a patient's predisposing characteristics (eg, age, sex), enabling resources (eg, socioeconomic status, environmental factors), and need characteristics (eg, clinical conditions). On the basis of these characteristics, we collected information on the following variables, which may influence the relationship between multimorbidity and COPD medication receipt.

Predisposing or Subject Characteristics. These variables included demographic characteristics such as sex, race (white, African-American, other), and age (40–49, 50–59, 60–64 y). Enabling characteristics included Medicaid eligibility due to income (yes/no) and medical needs (yes/no). Need characteristics included number of other clinical conditions (none, 1–3, 4–6, >6), alcohol abuse (yes/no), substance abuse (yes/no), tobacco use (yes/no), and polypharmacy (<10 drug classes, ≥10 drug classes). Each state administering Medicaid coverage to eligible beneficiaries has different policies; for example, states have restrictions on medications that can be covered. To account for policy differences, we included a dummy variable for the states (California, Illinois, New York, and Texas) in our analyses.

External Environment or County-Level Characteristics. These variables included above high-school education density (quartiles), unemployment density (quartiles), poverty density (quartiles), metro status (metro/non-metro), primary care provider shortage (yes/no), mental health shortage (yes/no), primary care provider density (quartiles), specialist provider density (quartiles), hospital bed density (quartiles), rural health clinics (yes/no), psychiatric hospital (yes/no), pulmonologist density (high [ie, above 75th percentile], low [ie, below 75th percentile]), and cardiologist density (high [ie, above 75th percentile], low [ie, below 75th percentile]). In the results section, we primarily highlight the relationship between multimorbidity and medication receipt after controlling for other independent variables that may influence medication receipt.

Statistical Analyses

Bivariate Analyses. Chi-square tests of independence were used to determine subgroup differences in the presence of multimorbidity and receipt of COPD medications in subjects with newly diagnosed COPD. We also present the results from unadjusted analyses with odds ratios (ORs), 95% CIs, and levels of statistical significance.

Multivariate Analyses. Binary and multinomial logistic regression analyses were used to examine the relationship between multimorbidity and COPD medication receipt. Parameter estimates are represented as adjusted OR with 95% CI. All analyses were conducted using SAS 9.3 (SAS Institute, Cary, North Carolina).

Results

The final study population consisted of 19,060 Medicaid beneficiaries (40–64 y old) with newly diagnosed COPD. The algorithm used to define the study cohort is shown in Figure 1. The majority of the Medicaid beneficiaries with newly diagnosed COPD were women (59.5%), white (48.6%), 50–59 y old (48.4%), and residents of California (54.5%).

Prevalence of Multimorbidity

Overall, among Medicaid beneficiaries with newly diagnosed COPD (n = 19,060), 36.3% had physical multimorbidity, 13.5% had psychiatric multimorbidity, 32.1% had both, and 18.1% did not have any multimorbidity. With regard to chronic conditions, 37.8% of subjects had hypertension, 35.8% had musculoskeletal disorders, 26.3% had depression, 19.8% had diabetes, 18.5% had schizophrenia, 17.9% had cardiovascular conditions, 12.3% had hyperlipidemia, 12.7% had anxiety, and 11.4% had bipolar disorder. A detailed description of study population characteristics by the presence of multimorbidity is presented in Table 1.

COPD Medication Receipt

Findings from the bivariate and multivariate analyses on COPD medication receipt with multimorbidity as the key independent variable are depicted in Table 2. Approximately 64% of Medicaid beneficiaries with newly diagnosed COPD had at least one prescription for short-acting bronchodilators during the follow-up period. The percentages of Medicaid beneficiaries with long-acting bronchodilators and inhaled corticosteroids were 39.2% and 43.3%, respectively. Results from the unadjusted logistic regression analyses of COPD medication receipt revealed that Medicaid beneficiaries with mental illness were less likely
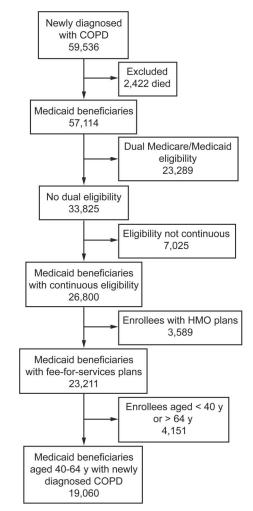

Fig. 1. Flow chart. HMO = health maintenance organization.

to receive short-acting bronchodilators (OR 0.69, 95% CI 0.62–0.77), long-acting bronchodilators (OR 0.73, 95% CI 0.66–0.82), and inhaled corticosteroids (OR 0.73, 95% CI 0.66–0.81). Similarly, those with both physical and psychiatric chronic conditions were less likely to receive short- and long-acting bronchodilators and inhaled corticosteroids.

Findings from the multivariate logistic regression analyses (see Table 2) of COPD medication receipt in Medicaid beneficiaries with newly diagnosed COPD revealed that those with any multimorbidity (ie, physical conditions, serious mental illness, or both) were significantly less likely to receive COPD medications. For example, those with physical conditions only were less likely to receive short-acting bronchodilators (adjusted OR 0.76, 95% CI 0.79–0.83), long-acting bronchodilators (adjusted OR 0.84, 95% CI 0.76–0.92), and inhaled corticosteroids (adjusted OR 0.75, 95% CI 0.68–0.82) compared with those with no multimorbidity.

Table 1. Description of Study Population Characteristics by Multimorbidity Categories Among Medicaid Beneficiaries With Newly Diagnosed COPD

Characteristic	Physical Only		Psychiatric Only		Both		None		P
	n	Row %	n	Row %	n	Row %	n	Row %	
Total	6,919	36.3	2,572	13.5	6,121	32.1	3,448	18.1	
Cohort									
2005–2007	3,841	35.8	1,502	14.0	3,448	32.2	1,930	18.0	
2006–2008	3,078	36.9	1,070	12.8	2,673	32.1	1,518	18.2	
Sex									<.001
Females	3,998	35.3	1,478	13.0	4,009	35.4	1,849	16.3	
Males	2,921	37.8	1,094	14.2	2,112	27.3	1,599	20.7	
Race/ethnicity									<.001
White	2,990	32.2	1,419	15.3	3,134	33.8	1,729	18.6	
African-American	2,127	41.8	492	9.7	1,584	31.2	882	17.3	
Others	1,802	38.3	661	14.1	1,403	29.8	837	17.8	
Age, y									<.001
40–49	1,650	26.0	1,216	19.2	2,249	35.5	1,229	19.4	
50–59	3,578	38.7	1,094	11.8	2,966	32.1	1,596	17.3	
60–64	1,691	48.6	262	7.5	906	26.0	623	17.9	
State									<.001
California	3,927	37.8	1,430	13.8	3,218	31.0	1,822	17.5	
Illinois	1,478	36.0	504	12.3	1,471	35.8	657	16.0	
New York	685	26.2	450	17.2	911	34.8	569	21.8	
Texas	829	42.8	188	9.7	521	26.9	400	20.6	
Poverty eligibility									<.001
Yes	6,380	36.5	2,387	13.7	5,637	32.3	3,072	17.6	
No	539	34.0	185	11.7	484	30.6	376	23.7	
Medical eligibility									<.001
Yes	590	28.9	290	14.2	780	38.2	382	18.7	
No	6,329	37.2	2,282	13.4	5,341	31.4	3,066	18.0	
No. of clinical conditions									<.001
None	97	20.5	94	19.9	58	12.3	224	47.4	
1–3	1,078	30.4	655	18.5	605	17.1	1,210	34.1	
4–6	1,668	37.3	727	16.3	1,114	24.9	964	21.6	
>6	4,076	38.6	1,096	10.4	4,344	41.1	1,050	9.9	
Alcohol abuse									<.001
Yes	436	23.9	317	17.4	845	46.3	226	12.4	
No	6,483	37.6	2,255	13.1	5,276	30.6	3,222	18.7	
Substance abuse									<.001
Yes	581	22.0	483	18.3	1,241	47.0	335	12.7	
No	6,338	38.6	2,089	12.7	4,880	29.7	3,113	19.0	
Tobacco Use									<.001
Yes	723	28.5	366	14.4	1,147	45.2	302	11.9	
No	6,196	37.5	2,206	13.4	4,974	30.1	3,146	19.0	
Polypharmacy									<.001
Yes	3,984	40.4	897	9.1	4,189	42.5	793	8.0	
No	2,935	31.9	1,675	18.2	1,932	21.0	2,655	28.9	
Area Resource File county-level variables									<.001
Above high-school education density									
Q1	3,663	36.4	1,359	13.5	3,424	34.1	1,609	16.0	
Q2	1,056	38.4	297	10.8	828	30.1	567	20.6	
Q3	1,364	35.5	564	14.7	1,152	30.0	763	19.9	
Q4	836	34.6	352	14.6	717	29.7	509	21.1	

(continued)

Table 1. Continued

Characteristic	Physical Only		Psychiatric Only		Both		None		P
	n	Row %	n	Row %	n	Row %	n	Row %	
Unemployment density									<.001
Q1	5,082	35.9	2,015	14.2	4,682	33.1	2,376	16.8	
Q2	961	37.4	295	11.5	746	29.0	568	22.1	
Q3	674	38.0	202	11.4	531	29.9	368	20.7	
Q4	202	36.1	60	10.7	162	28.9	136	24.3	
Poverty density									<.001
Q1	537	33.9	271	17.1	476	30.1	299	18.9	
Q2	975	36.2	370	13.7	785	29.1	564	20.9	
Q3	1,312	37.4	434	12.4	1,014	28.9	748	21.3	
Q4	4,095	36.3	1,497	13.3	3,846	34.1	1,837	16.3	
Metro									<.001
Yes	6,013	36.4	2,285	13.8	5,340	32.3	2,891	17.5	
No	906	35.8	287	11.3	781	30.9	557	22.0	
Primary care provider shortage									<.001
Yes	6,658	36.4	2,469	13.5	5,899	32.3	3,264	17.8	
No	261	33.9	103	13.4	222	28.8	184	23.9	
Psychiatric health specialist shortage									<.001
Yes	6,239	36.6	2,301	13.5	5,494	32.2	3,022	17.7	
No	680	33.9	271	13.5	627	31.3	426	21.3	
Primary care provider density									<.001
Q1	335	41.7	75	9.3	226	28.1	168	20.9	
Q2	1,221	38.0	363	11.3	946	29.4	683	21.3	
Q3	998	37.0	340	12.6	801	29.7	559	20.7	
Q4	4,365	35.4	1,794	14.5	4,148	33.6	2,038	16.5	
Specialist density									<.001
Q1	326	40.9	71	8.9	226	28.4	174	21.8	
Q2	1,139	37.7	346	11.4	909	30.0	631	20.9	
Q3	1,089	37.6	361	12.5	838	29.0	605	20.9	
Q4	4,365	35.4	1,794	14.5	4,148	33.6	2,038	16.5	
Hospital bed density									<.001
Q1	389	38.9	112	11.2	299	29.9	200	20.0	
Q2	1,179	37.9	378	12.2	895	28.8	659	21.2	
Q3	3,934	36.7	1,451	13.6	3,555	33.2	1,765	16.5	
Q4	1,417	33.4	631	14.9	1,372	32.3	824	19.4	
Rural health clinic									<.001
Yes	2,962	39.4	866	11.5	2,192	29.2	1,498	19.9	
No	3,957	34.3	1,706	14.8	3,929	34.0	1,950	16.9	
Psychiatric hospital									<.001
Yes	4,302	35.5	1,731	14.3	4,041	33.4	2,030	16.8	
No	2,617	37.6	841	12.1	2,080	29.9	1,418	20.4	
Pulmonologist density									<.001
High	4,747	35.5	1,926	14.4	4,462	33.3	2,249	16.8	
Low	2,172	38.3	646	11.4	1,659	29.2	1,199	21.1	
Cardiologist density									<.001
High	4,386	35.2	1,816	14.6	4,205	33.7	2,069	16.6	
Low	2,533	38.5	756	11.5	1,916	29.1	1,379	20.9	

Data are based on 19,060 Medicaid beneficiaries with newly diagnosed COPD obtained from Medicaid Analytic eXtract files from 2005 to 2008. *P* values represent significant group differences in multimorbidity rates by beneficiary characteristics.
Q = quartile

Table 2.   COPD Medication Use in Medicaid Beneficiaries With Newly Diagnosed COPD

COPD Medication	n	Row %	Unadjusted Logistic Regression Analysis of COPD Medication Receipt			Adjusted Logistic Regression Analysis of COPD Medication Receipt		
			OR	95% CI	P	Adjusted OR	95% CI	P
Short-acting bronchodilators								
Total	12,177	63.9						
Multimorbidity								
Physical only	4,540	65.6	0.93	0.85–1.02		0.76	0.69–0.83	<.001
Psychiatric only	1,506	58.6	0.69	0.62–0.77	<.001	0.61	0.55–0.69	<.001
Both	3,814	62.3	0.81	0.74–0.88	<.001	0.54	0.49–0.59	<.001
None	2,317	67.2						
Long-acting bronchodilators								
Total	7,474	39.2						
Multimorbidity								
Physical only	2,842	41.1	0.93	0.86–1.01		0.84	0.76–0.92	<.001
Psychiatric only	914	35.5	0.73	0.66–0.82	<.001	0.69	0.62–0.77	<.001
Both	2,240	36.6	0.77	0.71–0.84	<.001	0.62	0.56–0.68	<.001
None	1,478	42.9						
Inhaled corticosteroids								
Total	8,260	43.3						
Multimorbidity								
Physical Only	3,091	44.7	0.96	0.89–1.04		0.75	0.68–0.82	<.001
Psychiatric only	978	38.0	0.73	0.66–0.81	<.001	0.64	0.57–0.71	<.001
Both	2,618	42.8	0.89	0.82–0.97	<.01	0.60	0.54–0.66	<.001
None	1,573	45.6						

Data are based on 19,060 Medicaid beneficiaries with newly diagnosed COPD obtained from Medicaid Analytic eXtract files from 2005 to 2008. P values represent significant group differences in likelihood of respective COPD medication use by multimorbidity compared with the reference group (none) obtained from unadjusted and adjusted logistic regression analyses. Adjusted logistic regression analyses controlled for cohort year, sex, race, age, state, poverty eligibility, number of other clinical conditions, serious mental illness, alcohol abuse, substance abuse, tobacco use, polypharmacy, and county-level variables (including above high-school education density [quartiles], unemployment density [quartiles], poverty density [quartiles], metro status, primary care shortage, mental health shortage, primary care provider density [quartiles], hospital bed density [quartiles], psychiatric hospital, pulmonologist density, and cardiologist density).
OR = odds ratio

Similarly, subjects with both physical and psychiatric multimorbidity were 46% less likely to use short-acting bronchodilators (adjusted OR 0.54, 95% CI 0.49–0.59), 38% less likely to use to long-acting bronchodilators (adjusted OR 0.62, 95% CI 0.56–0.68), and 40% less likely to use inhaled corticosteroids (adjusted OR 0.60, 95% CI 0.54–0.66) compared with those with no multimorbidity. In addition, certain subject characteristics, ecosystem-level variables, and policy-environment variables were significantly associated with COPD medication receipt.

To understand the overall bronchodilator use in Medicaid beneficiaries with newly diagnosed COPD, we created an aggregate bronchodilator-use variable with 4 categories (short-acting only, long-acting only, both, and none). The majority (47.2%) of beneficiaries who used at least one bronchodilator ($n = 13,310$) in the follow-up period were in the both-bronchodilator-use group. Findings from multinomial logistic regression analyses (Table 3) revealed that subjects in any of the multimorbidity categories were less likely to receive short-acting bronchodilators only and combined short- and long-acting bronchodilators. The presence of psychiatric multimorbidity and both physical and

psychiatric multimorbidity was associated with reduced receipt of long-acting bronchodilators.

Discussion

In this study, we examined the impact of multimorbidity on COPD medication receipt in Medicaid beneficiaries with newly diagnosed COPD. In this study cohort, approximately three fourths of subjects had multimorbidity. Although no study has comprehensively examined the prevalence of all commonly occurring comorbidities in subjects with COPD, the rates for some of the subject conditions obtained from our analyses are somewhat consistent with those found in other studies that evaluated comorbidity burden in subjects with COPD.[9,31]

In this study, we found that after controlling for subject characteristics and county-level socioeconomic and healthcare environment, Medicaid beneficiaries with newly diagnosed COPD and multimorbidity were less likely to receive COPD medications, including bronchodilators and inhaled corticosteroids. To the best of our knowledge, this is the first study to examine the relationship between mul-

Table 3. Multinomial Logistic Regression Analysis of Type of Bronchodilator Used in Medicaid Beneficiaries With Newly Diagnosed COPD

Type of Bronchodilator	n	Row %	Adjusted OR	95% CI	P
Short-acting bronchodilators only					
Total	5,836	30.6			
Multimorbidity					
Physical only	2,149	31.1	0.82	0.73, 0.92	<.001
Psychiatric only	731	28.4	0.66	0.57, 0.76	<.001
Both	1,928	31.5	0.61	0.54, 0.68	<.001
None	1,028	29.8			
Long-acting bronchodilators only					
Total	1,133	5.9			
Multimorbidity					
Physical only	451	6.5	1.04	0.85, 1.27	
Psychiatric only	139	5.4	0.77	0.60, 0.98	<.05
Both	354	5.8	0.78	0.63, 0.96	<.05
None	189	5.5			
Both bronchodilators					
Total	6,341	33.3			
Multimorbidity					
Physical only	2,391	34.6	0.72	0.64, 0.80	<.001
Psychiatric only	775	30.1	0.53	0.46, 0.61	<.001
Both	1,886	30.8	0.44	0.39, 0.49	<.001
None	1,289	37.4			

Data are based on 19,060 Medicaid beneficiaries with newly diagnosed COPD obtained from Medicaid Analytic eXtract files from 2005 to 2008. P values represent significant group differences in likelihood of bronchodilator use by multimorbidity compared with the reference group (none) obtained from multinomial logistic regression analyses. Adjusted logistic regression analyses controlled for cohort year, sex, race, age, state, poverty eligibility, number of other clinical conditions, serious mental illness, alcohol abuse, substance abuse, tobacco use, polypharmacy, and county-level variables (including above high-school education density [quartiles], unemployment density [quartiles], poverty density [quartiles], metro status, primary care shortage, mental health shortage, primary care provider density [quartiles], hospital bed density [quartiles], psychiatric hospital, pulmonologist density, and cardiologist density).
OR = odds ratio

timorbidity and COPD medication receipt in Medicaid beneficiaries with newly diagnosed COPD. Therefore, we cannot compare our findings and can only speculate reasons for lower receipt of COPD medications in those with multimorbidity. Provider and patient factors may affect COPD medication receipt. Providers may be cautious in prescribing COPD medications due to adverse effects and competing demands from other conditions. Studies have suggested that certain COPD medications are associated with adverse effects that could complicate management of allied co-occurring conditions. For example, bronchodilators such as long-acting β agonists and inhaled anticholinergics are associated with cardiovascular complications such as unstable angina and myocardial infarction.[32-35] Similarly, inhaled corticosteroids may increase blood glucose levels in those with prediabetes or diabetes.[15,36] Therefore, it is important to weigh the benefits and safety issues in the health-care management of patients with COPD and multimorbidity. Our findings underscore the need to develop clinical practice guidelines that are specific to patients with COPD and multimorbidity.

It is also possible that patients may not prioritize COPD management when they have multiple chronic conditions. A recently conducted qualitative study in Australia that examined the "patients' perspectives on the impact of a new COPD diagnosis in the face of multimorbidity" indicated that subjects with existing chronic conditions ascribed low importance to the management of a new COPD diagnosis.[37] Moreover, subjects with COPD and multimorbidity were challenged by multiple-medication use and thus had poor COPD self-management capacity. Although this study was conducted in Australia and had a limited sample size, it provides an important understanding of the relationship between multimorbidity and COPD medication receipt.

The advantages of our study are: the use of administrative claims data, which provided us the ability to identify medical conditions using diagnosis codes; availability of prescription medication claims; examination of a high-risk and low-income population; and ability to track capture utilization over time. Our study was strengthened by linking Medicaid files with the Area Resource File to comprehensively adjust for health-care environment, which could have affected the relationship between multimorbidity and COPD medication receipt. Limitations include: a lack of generalizability due to inclusion of beneficiaries with fee-for-service claims only, restriction of Medicaid data to 4 states, and exclusion of dual Medicare/Medicaid

enrollees. Due to the unavailability of laboratory data, we were not able to control for COPD severity or stage of COPD diagnosis, which can be an important covariate when assessing the relationship between multimorbidity and COPD medication receipt. Additionally, COPD diagnosis was based on ICD-9-CM diagnosis codes, which may not be the most accurate method to identify COPD. However, the validity of ICD-9-CM codes in identifying COPD has been established in prior studies.[22,23] Our study was also limited by the use of diagnosis codes to identify depression. Although prior studies have used ICD-9-CM codes to identify depression, evidence exists that using diagnosis codes within claims data may lead to underestimation of depression.[38]

Conclusions

Despite these limitations, to the best of our knowledge, this is the first study to extensively examine the relationship between multimorbidity and COPD medication receipt. Our findings highlight the high prevalence of multimorbidity in non-elderly low-income adults with newly diagnosed COPD and poor COPD medication management in these subjects. Future research needs to examine provider factors, such as provider knowledge and experience in managing patients with multimorbidity, and patient factors, such as preferences and attitudes that may affect COPD management in the presence of multimorbidity.

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