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CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD): AN ACTUARIAL ANALYSIS OF DRUG THERAPY TREATMENT PATTERNS FOR A COMMERCIALLY INSURED POPULATION

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Chronic obstructive pulmonary disease (COPD) was reported to be the 6th leading cause of death in 45-65 year olds and the 4th leading cause of death in the 65 and older population in the U.S. for 2006, accounting for 120,970 deaths.[1] An estimated 24 million U.S. adults have COPD: half of them (12 million) are undiagnosed.[2] COPD is an expensive disease with estimates that 2010 costs were $49.9 billion; $29.5 billion attributed to direct health care expenditures, $8 billion in indirect morbidity costs and $12.4 billion in indirect mortality costs.[3]

Although COPD is a progressive disease, pharmacologic therapy is the mainstay of treatment to improve and prevent symptoms, reduce the frequency and severity of exacerbations, improve health status, and improve the ability to exercise. Effective COPD treatment requires lifelong adherence to complicated treatment regimens and appropriate prescribing by physicians, yet patient adherence to drug therapy and physician adherence to prescribing guidelines is reported to be suboptimal. Two published literature reviews report that only 40%-60% of COPD patients adhere to their prescribed regimen with non-adherence characterized by overuse, underuse and improper use of drug therapy.[4] [5]

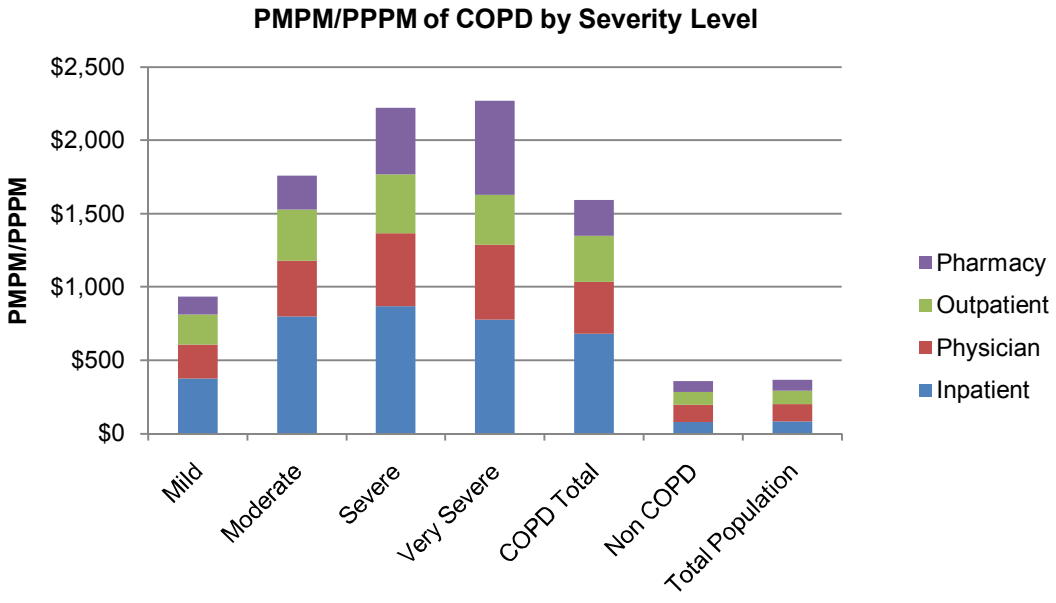
We analyzed Medstat 2007 commercial claim data to identify characteristics of COPD patients in a commercially insured population and, in particular, compliance patterns with established pharmacologic therapy guidelines. Commercial data shows the following claim-based prevalence rates for COPD, asthma, and COPD with asthma:

Mutually Exclusive Condition Categories	Annual Prevalence For a Commercially Insured Population
COPD*	0.7%
COPD with Asthma	0.2%
Asthma**	0.9%

Source: Medstat 2007. The diagnoses were based on claims.
***COPD is COPD w/o asthma**
****Asthma is asthma w/o COPD**

Our analysis focuses on the COPD cohort, which we categorized into severity levels using a published claims-based risk scoring methodology.[6] The claims data methodology does not use the classical clinical metric, Forced Expiratory Volume,(FEV1) or Forced Vital Capacity (FVC) values but, instead, uses clinically-related claims variables that may reflect COPD severity levels (see appendix B). We examined utilization and cost of medical services and pharmacologic treatment patterns by severity level. We identified 30% of diagnosed COPD patients as mild, 53% moderate, 14% severe and 3% very severe.

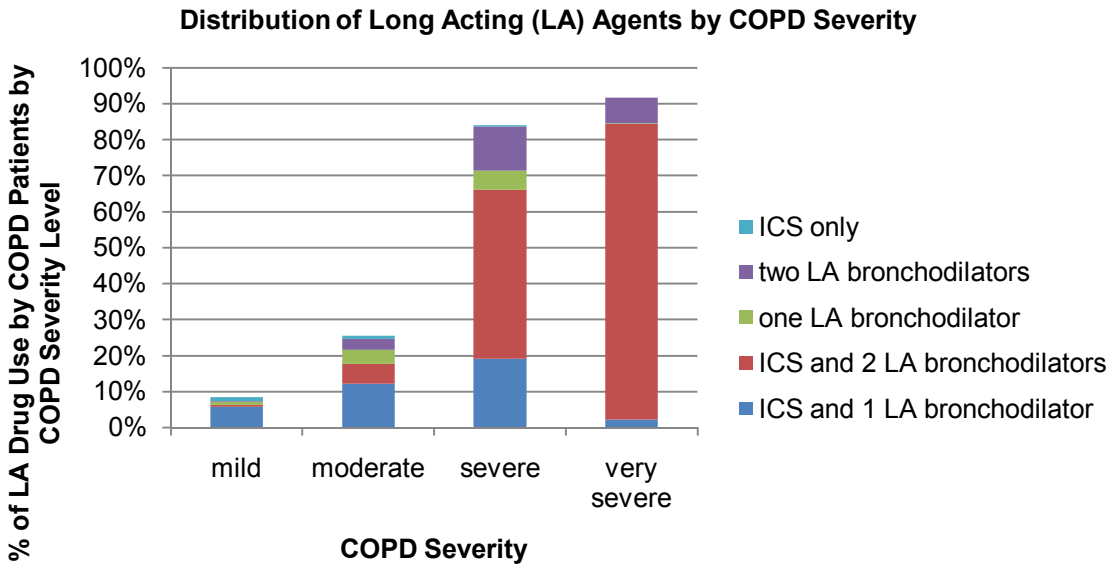
As expected, costs increase with severity level and COPD patients are significantly more expensive than those without COPD. In the following chart, PMPM means “per member per month” costs (for the non COPD and Total populations) and PPPM means “per patient per month” costs (for the COPD populations).



Source: Milliman analysis of MedStat Commercial 2007.
Demographically adjusted to Milliman HCG 2009 Standard Demographics.
Costs trended to 2009. PPPM is the average COPD per patient per month cost.
PMPM is the average per member per month cost of the non COPD population and the total population.
The non COPD population is all commercially insured members excluding COPD members
The total population is all commercially insured members with and without COPD members
The total population and non COPD population have not been demographically adjusted to the COPD population

To evaluate compliance with treatment guidelines, we applied the 2009 GOLD guidelines[7] to the four COPD risk categories. GOLD guidelines are from the **G**lobal Initiative for Chronic **O**bstructive **L**ung **D**isease (GOLD) launched in 1997 in collaboration with the National Heart, Lung, and Blood Institute, National Institutes of Health and the World Health Organization. The GOLD guidelines contain recommendations for the use of different classes of COPD drugs based on patient severity. Although claims data does not contain the clinical data (FEV1/FVC levels) suggested by the GOLD guidelines for establishing the severity level and corresponding treatment recommended for COPD patients, the claim based severity level designations are considered comparable.

We used the methodology described in Appendix B to quantify drug therapy experience which is shown in the graph below.



Source: Milliman analysis of MedStat Commercial 2007.
Demographically adjusted to Milliman HCG 2009 Standard Demographics.
LA: any combination or single use of long acting bronchodilators, inhaled corticosteroids (ICS), with or without SA (short acting) bronchodilators. Long acting bronchodilators include anticholinergics and beta agonists

Using the claims-to-severity mapping described in Appendix B, we compared drug therapy experience to the GOLD guideline recommendations. Drug therapy variations from guidelines can represent suboptimal therapy. We found several variations from GOLD guideline recommendations including:

- According to the GOLD guidelines, inhaled glucocorticosteroid (ICS) therapy is not recommended for mild or moderate risk COPD patients, yet 8% of mild and 19% of moderate COPD patients have claims for an ICS.
- The GOLD guidelines recommend long acting bronchodilator therapy for moderate, severe and very severe COPD patients, yet 20% of moderate, 14% of severe and 8% of very severe COPD patients are on short acting therapy only.
- The GOLD guidelines recommend adding a second long acting bronchodilator for symptom control in moderate, severe and very severe as bronchodilators with different mechanisms and durations of action may increase the degree of bronchodilation for equivalent or lesser side effects; yet 12% of moderate, 19% of severe and 2% of very severe are on only one bronchodilator in combination with an ICS.

We characterize these as apparent variations because, for individual patients, clinical considerations not apparent in the claims data could justify these therapies. (For example, a recent study indicates that some mild-moderate patients have repeated exacerbations and ICS treatment may be indicated.[8])

The literature reports less than optimal compliance with GOLD guidelines and our analysis supports that finding. For employers and insurers with COPD disease management (DM) programs, our methodology offers a way to measure program performance, and buyers of DM may want to consider asking that vendor's put fees at risk for achieving improved compliance. HEDIS criteria are not specific on compliance with guidelines, but physician pay for performance initiatives can be established to encourage adherence with therapeutic guidelines.

This paper was commissioned by Novartis Pharmaceuticals Corporation (NPC), which manufactures, markets, and develops a wide range of pharmaceutical products; NPC also was a founder of GOLD. For this paper, Novartis' role was limited to funding, provision of background information, evidence confirmation and contextual clarification. The authors' combination of claims based risk scoring to analyze COPD treatment patterns is, to the author's knowledge, novel, although similar approaches are well-established for other disease states. These techniques should be seen as tools for analyzing populations and not a substitute for clinical decisions for particular patients. This paper represents the research of its authors and Milliman does not intend to endorse any particular product or treatment.

BACKGROUND ON COPD

Prevalence, Mortality and Costs of COPD

Chronic obstructive pulmonary disease (COPD) was reported to be the 6th leading cause of death in 45-65 year olds and the 4th leading cause of death in the 65 and older population in the U.S. in 2006, accounting for 120,970 deaths.[9] An estimated 24 million U.S. adults have COPD: 12 million are physician diagnosed and 12 million are undiagnosed.[10]

COPD is the broader term that includes chronic bronchitis, which accounts for approximately 70% of COPD cases, and emphysema, which accounts for approximately 30% of COPD cases.[11] The prevalence of chronic bronchitis in 2008 was reported to be 43 /1000 population with women having twice the male rate. Prevalence increases with age with a rate of 32/1000 for ages 18-44, 55/1000 for ages 45-64 and 56/1000 for age 65+. The prevalence of emphysema was reported as 17/1000 population with the rate for men and women being similar. Emphysema prevalence increases with age with a rate of 2/1000 for ages 18-44, 20/1000 for ages 45-64 and 54/1000 for age 65+.[12]

COPD is an expensive disease with estimates of 2010 costs of $49.9 billion: $29.5 billion attributed to direct health care expenditures, $8 billion in indirect morbidity costs and $12.4 billion in indirect mortality costs.[13] COPD accounts for hospital discharges of 23/10,000 population (total population); 28/10,000 for ages 45-64 and116/10,000 for ages 65+.[14] COPD is coded for 4.7% of office visits for 45-64 year olds and 8.5% of office visits for 65-74 year olds.[15] The substantial medical costs are attributed to higher than average utilization of services. A study of COPD patients under age 65 enrolled in a managed care plan found that younger COPD patients used more emergency services than older COPD patients and incurred higher average COPD related medical charges.[16]

An American Lung Association survey revealed that half of COPD patients (51%) say their condition limits their ability to work.[17] A study of active employees' health care and disability claims from nine multistate companies found that employees with COPD were more than twice as likely to have a short-term disability claim and four times as likely to have a long-term disability claim compared to matched cohorts with adjustment for comorbidities not related to COPD.[18]

Cause and Treatment for COPD

COPD is a disease characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases. The chronic airflow limitation is caused by a mixture of small airway disease (chronic bronchitis) and destruction of the tissue around the lung air sacs (emphysema).[19] In the early stages of COPD, there may be minimal shortness of breath, while in very late stage, supplemental oxygen or mechanical respiratory assistance may be required. See American Lung Association web site for more details on the etiology of COPD http://www.lungusa.org/lung-disease/copd/resources/facts-figures/COPD-Fact-Sheet.html .

Smoking is the primary risk factor for COPD and approximately 85% to 90% of COPD deaths are caused by smoking.[20] Other risk factors include exposure to air pollutants, genetic factors, respiratory infections and asthma.[21]. An analysis of NHANES III survey data concluded that 19% of COPD in the 30 to 75 year old age group is attributable to occupational exposure; for never smokers, the occupational exposure fraction is estimated as 31%.[22]

The **G**lobal Initiative for Chronic **O**bstructive **L**ung **D**isease (GOLD) published the first consensus report in 2001 that established standards for diagnosis and treatment of COPD. These guidelines have been updated annually since 2004 through the most current 2009 edition. The U.S. National Heart, Lung and Blood Institute and the World Health Organization along with unrestricted educational grants from pharmaceutical manufactures support the development and updating of the guidelines by members of the GOLD Science Committee.

According to the GOLD guidelines, COPD severity is based on two measures: post-bronchodilator FEV1/FVC and FEV1 % predicted:

COPD Stage	Post-Bronchodilator FEV1/FVC	FEV1 % Predicted
Stage I: Mild	≤0.7	≥80%
Stage II: Moderate	≤0.7	50%-79%
Stage III: Severe	≤0.7	30%-49%
Stage IV: Very Severe	≤0.7	<30% or <50% with chronic respiratory failure

Effective management of COPD should be aimed at the following:[23]

- Relieve symptoms
- Prevent disease progression
- Improve exercise tolerance
- Improve health status
- Prevent and treat complications
- Prevent and treat exacerbations
- Reduce mortality

Smoking cessation is the single most effective and cost effective intervention to reduce the risk of developing COPD and stop its progression.[24] Studies show that mild to moderate COPD patients who quit smoking, with or without adherence to prescribed bronchodilators, experienced significantly less decline in their lung function compared with smokers.[25] Reducing exposure to indoor and outdoor air pollution is essential for those whose condition is related to this type of exposure. Non-pharmacologic treatment such as pulmonary rehabilitation, oxygen therapy, and surgical interventions can improve a person's quality of life. One factor that can help protect against COPD development or its progression is physical activity, which can help slow lung function decline.[26]

Pharmacologic therapy is the mainstay of COPD treatment to improve and prevent symptoms, reduce the frequency and severity of exacerbations, improve health status, and improve the ability to exercise. Most studies indicate that the existing medications for COPD do not modify the long term decline in lung function but instead decrease symptoms and/or complications.[27]

Since COPD is progressive, pharmacologic treatment tends to be cumulative with more medications required as the disease progresses. Bronchodilator medications (prescription drugs that relax and open air passages in the lungs) are central to the symptomatic management of COPD. According to the GOLD guidelines, short-acting bronchodilators are recommended for relief of intermittent symptoms, while persistent symptoms in moderate, severe and very severe COPD should be treated with one or more long-acting bronchodilators. Bronchodilator choice between beta2 agonists, anticholinergics or theophylline depends on availability and individual response -- symptom relief and side effects. Long acting inhaled bronchodilators are more effective and convenient than short acting bronchodilators. Combining bronchodilators of different pharmacological classes may improve efficacy and decrease the risk of side effects compared to increasing the dose of a single bronchodilator.[28]

According to the GOLD guidelines, inhaled glucocorticosteroids with their antinflammatory action in the airways, are recommended as an addition to long acting inhaled bronchodilators in severe and very severe COPD patients who have repeated COPD exacerbations (for example 3 in 3 years). Long term use of inhaled glucocorticosteroids is associated with an increased risk of pneumonia.[29] Because of the long term side effects, chronic treatment with oral glucocorticosteroids should be avoided.[30]

Acute exacerbations of COPD may be triggered by infection with bacteria or viruses or by environmental pollutants and cause increased breathlessness often accompanied by wheezing, chest tightness, and increased cough and sputum. Treatment may be inpatient or outpatient depending on the severity of the exacerbation and can include, short acting bronchodilators, oral or systemic (infused) glucocorticosteroids, antibiotics and oxygen.[31]

The diagram below from the GOLD 2009 guidelines provides a summary description of treatment for COPD by level of disease severity.[32]

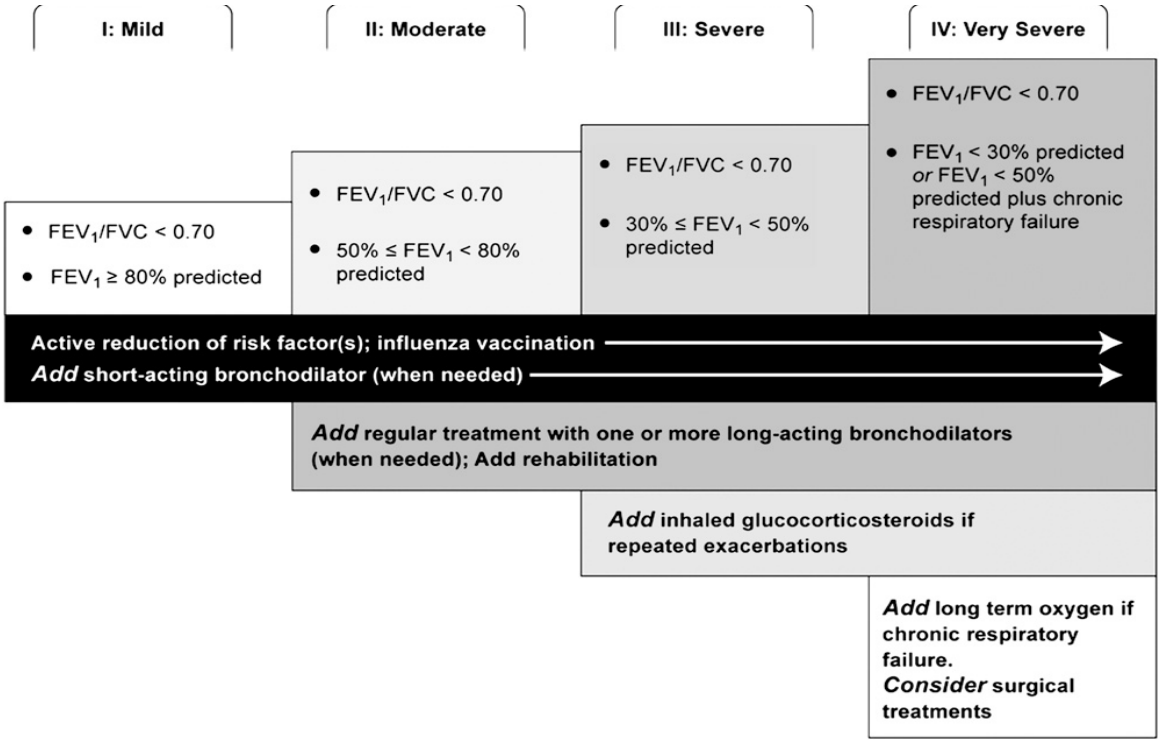


Diagram from GOLD 2009

Compliance with Drug Therapy and Guidelines Recommendations

Effective treatment of COPD requires lifelong adherence to complicated treatment regimens and appropriate prescription of recommended therapies by physicians. Both adherence to drug therapy by patients and adherence to prescribing guidelines by physicians is reported to be suboptimal. Two published literature reviews report that only 40%-60% of COPD patients adhere to their prescribed regimen with non-adherence characterized by overuse, underuse and improper use of drug therapy.[33] [34]

Other studies and literature reviews identify inconsistent use of pharmacologic therapy by physicians. An examination of the medical records of 169 COPD patients from the Community Tracking survey identified that adherence to recommended medication prescribing was only 56%.[35] Another study, which examined data from the 1996 National Ambulatory Medical Care Survey, found that a significant number of COPD patients were not receiving optimal therapy.[36] An analysis of 1,036 managed care COPD patients identified underuse of bronchodilators and overuse of inhaled glucocorticosteroids.[37] A recent study of 2,272 managed care COPD patients identified gaps in drug therapy care including limited use of systemic glucocorticosteroids for acute exacerbation of COPD and limited use of inhaled glucocorticosteroids for patients with frequent exacerbations.[38]

FINDINGS OF CLAIM DATA ANALYSIS

To identify the prevalence, costs and treatment patterns for COPD patients in a commercially insured population we examined a large commercial database (Medstat 2007) with all medical claims from millions of lives (see Appendix A). Medical claims databases capture all medical costs and services paid by benefits programs, which is ideal when studying payer impact. While medical claims data does not capture valuable clinical information, such as diagnostic values, the results of our analysis correspond well to the clinical literature's findings about disease progression and severity.

Although COPD is distinct from asthma, the conditions sometimes coexist, and for these cases, current management is similar to that of asthma.[39] For this reason, much of our analysis focuses on the cohort of COPD patients who do not have asthma.

Prevalence and Costs of COPD and Asthma

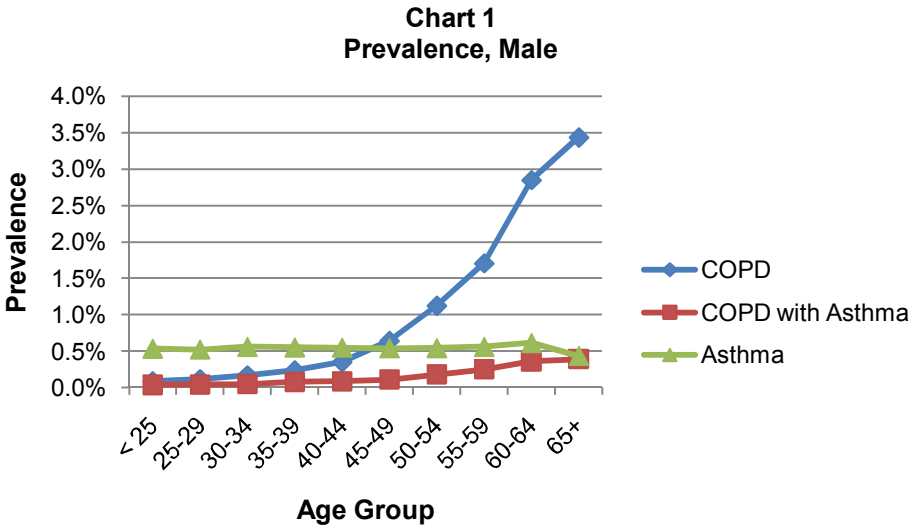
We start with the prevalence rates of people with COPD and asthma. We identify three mutually exclusive cohorts, COPD, COPD with asthma, and asthma. Charts 1 and 2 show the prevalence of these 3 cohorts in a typical commercially insured population by age and gender. Table 1 provides the prevalence by each cohort:

Table 1: Prevalence of COPD and Asthma

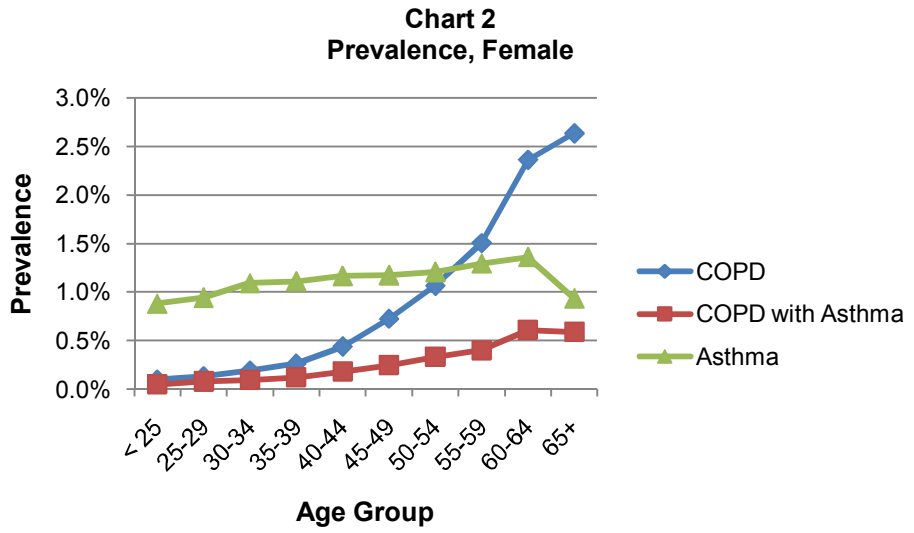
Mutually Exclusive Condition Categories	Annual Prevalence For a Commercially Insured Population
COPD*	0.7%
COPD with Asthma	0.2%
Asthma**	0.9%

Source: Medstat 2007
*COPD is COPD w/o asthma
**Asthma is asthma w/o COPD

The prevalence of COPD increases with age whereas COPD with asthma increases very slightly with age and asthma actually decreases in the oldest commercially insured age bands. Across all ages shown, COPD prevalence is slightly higher in women compared to men.



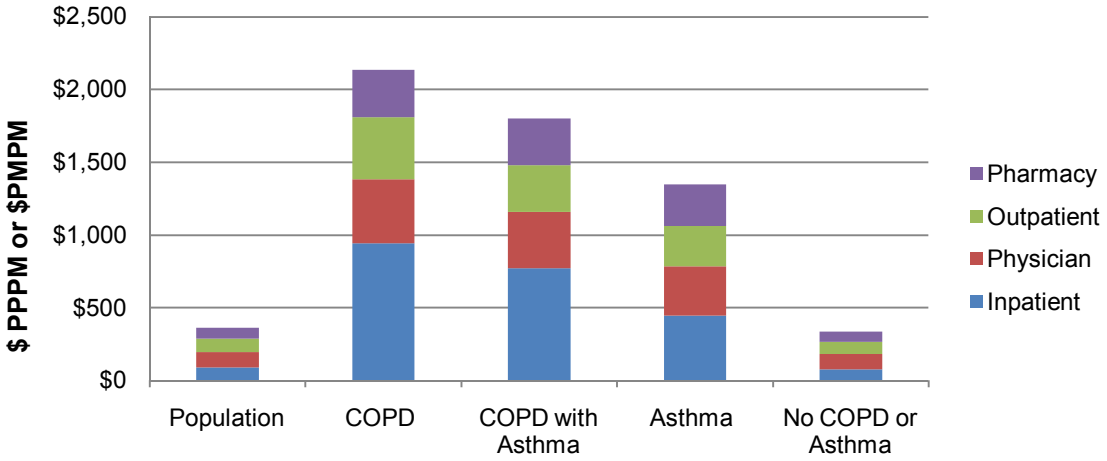
Source: Milliman analysis of Medstat 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics
COPD is COPD w/o asthma
Asthma is asthma w/o COPD



Source: Milliman analysis of Medstat 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics
COPD is COPD w/o asthma
Asthma is asthma w/o COPD

Chart 3 presents per patient per month (PPPM) paid costs (net of member copay) for each of the 3 disease cohorts plus paid PMPM for the total population and non disease cohort populations. These costs represent all paid claims including COPD and non COPD related costs. Patients with COPD are more expensive on average than COPD with asthma patients or asthma alone patients.

Chart 3
Total Paid Cost PMPM or PPPM

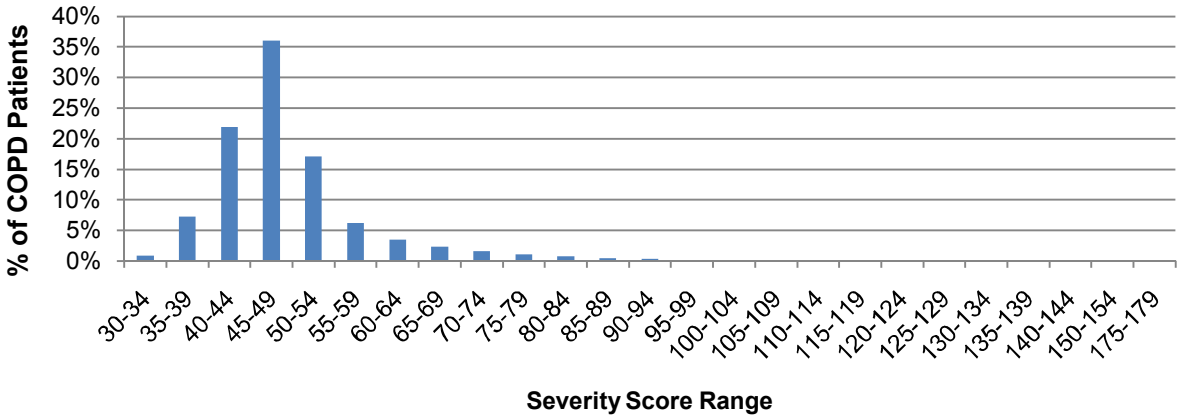


Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
Costs trended to 2009. PPPM is the average COPD per patient per month cost.
PMPM is the average per member per month cost of the no COPD or asthma population and the total population. The total population and non COPD population have not been demographically adjusted to the COPD population
COPD is COPD w/o asthma
Asthma is asthma w/o COPD

Severity Scoring the COPD Population

We analyzed the COPD commercially insured cohort to identify treatment patterns and adherence to treatment guidelines. The GOLD guidelines, described earlier, recommend drug therapies according to the severity level of an individual's COPD. The severity level is assigned based on FEV_1 values. Because claims data does not provide FEV_1 values, we used a severity scoring approach developed by Wu which is based on 12 variables in claims data.[40] The list of variables, weighting, scoring, and severity level assignment are provided in Appendix B. The distribution of scores is shown in Chart 4 for the COPD population in Medstat 2007.

Chart 4
Distribution of COPD Patients in MedStat 2007
by Wu COPD Severity Score Ranges



Milliman analysis of Medstat 2007 with application of Wu risking methodology. Wu EQ, Birnbaum HG, Cifaldi M, et al. Development of a COPD severity score. Current Medical Research and Opinions. 2006;22:1679-1687.

Table 2 shows the comparison of the severity scores for the Medstat analysis and the Wu analysis by percentiles showing a very similar distribution pattern.

Table 2: Comparison of the distribution of COPD patients' severity score between Medstat analysis and Wu's Analysis

Percentiles	Medstat n=44,366	Wu (2006) n=9,127	Medstat/Wu
Portion of COPD population at or below each severity score	Distribution of Severity scores	Distribution of Severity scores	
100%	176	184	96%
99%	88	92	96%
95%	70	69	101%
90%	61	60	102%
75%	52	51	102%
50%	48	48	99%
25%	44	45	98%
10%	41	42	97%
5%	39	40	96%
1%	35	37	95%
0%	33	36	91%

Wu does not explicitly correlate severity scores with the GOLD severity categories. Based on the distribution of scores produced from our analysis and several studies reporting distribution of individuals into GOLD severity

levels [41] [42] [43], we used the severity score ranges in Table 3 to assign individuals into GOLD severity levels.

Table 3: Categorization of Wu Severity Scores into Gold Severity Categories

Wu Severity Score Ranges	GOLD Severity Category
<45	mild
45-55	moderate
55-75	severe
75+	very severe

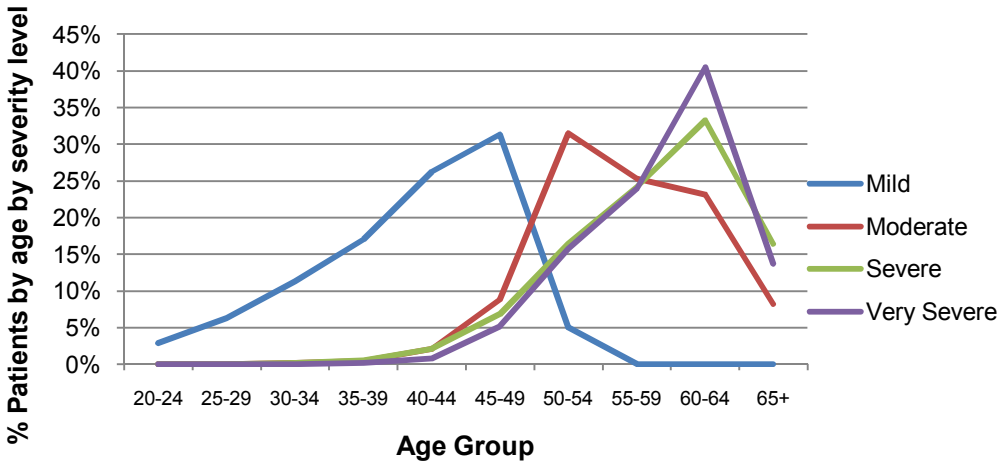
Using the above score/severity ranges, the portions of COPD patients in each GOLD severity category are, 30% mild, 53% moderate, 14% severe and 3% very severe.

Prevalence, Cost, Utilization and Treatment Patterns of the COPD Population

In this section, we present prevalence, cost, utilization and treatment pattern results using the risk categorizations shown in Table 3.

Since COPD progresses with age, we would expect to see a greater percentage of severe COPD patients in the older age ranges. Chart 6 distributes 100% of COPD patients in each severity level across age bands and shows the severe and very severe cohorts with 50% and 54% of patients in the 60+ age range. We believe the decline in severe prevalence for the oldest age shown (65+) reflects the relatively healthy status of people who continue to work beyond the normal retirement age of 65. People who have chronic conditions such as COPD that would make it difficult to work are less likely to continue to work past age 65; hence, the prevalence of severe illness, in this case, COPD, often peaks before age 65 in working populations.

Chart 6
Distribution of COPD by Age Group for eachSeverity Level

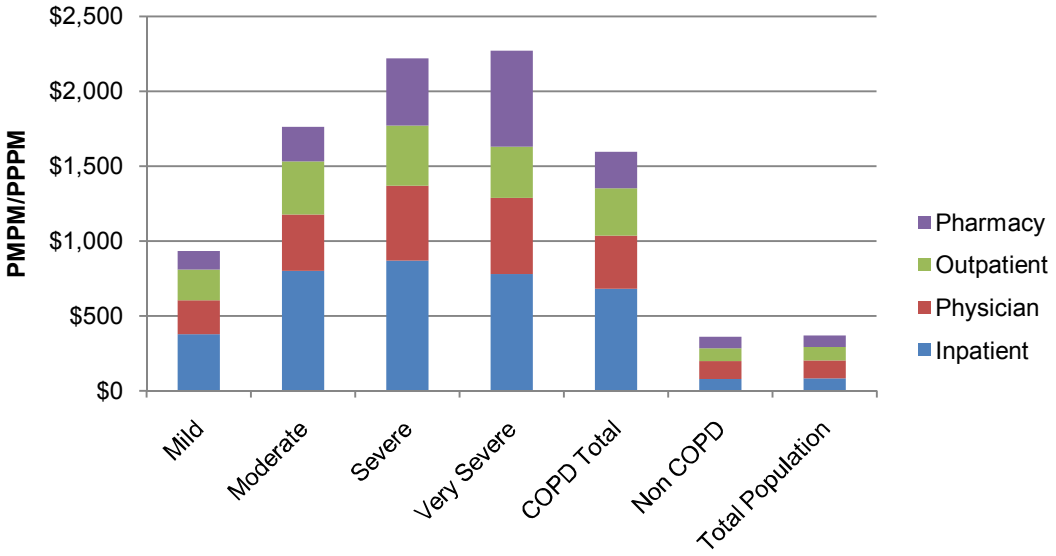


Source: Milliman analysis MedStat Commercial 2007.
Demographically adjusted to Milliman HCG 2009 Standard Demographics.

Chart 7 presents the costs of COPD patients by severity level and also presents costs for the non COPD population and the total population. The very severe COPD cohort incurs costs approximately 6x the cost of the non COPD population. As expected, costs increase with severity and, inpatient costs are the biggest contributor to total costs.

Pharmacy cost contributes more to the total spend as severity increases with mild and moderate pharmacy spend at 13% of total, severe 20% of total and very severe 28% of total.

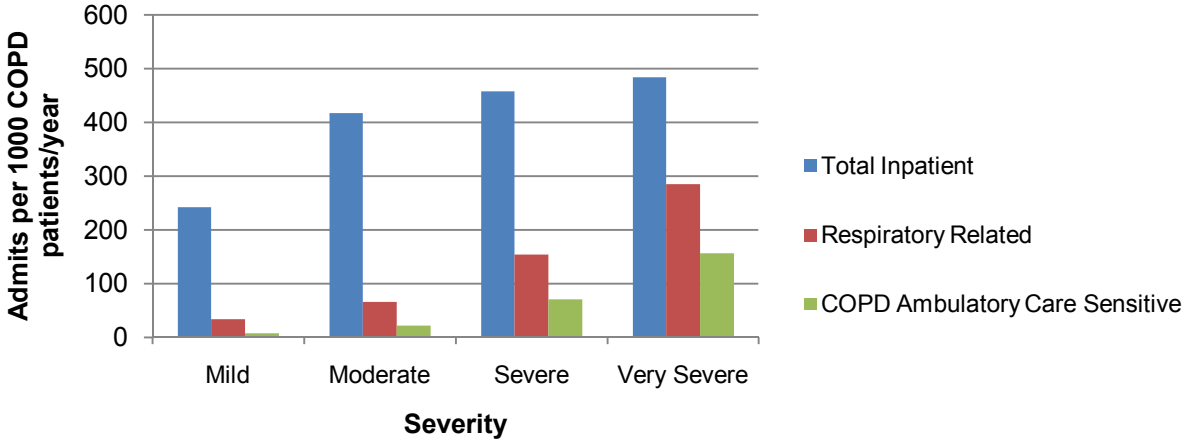
Chart 7
PMPM/PPPM of COPD by Severity Level



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
Costs trended to 2009. PPPM is the average COPD per patient per month cost.
PMPM is the average per member per month cost of the non COPD population and the total population.
The non COPD population is all commercially insured members excluding COPD members
The total population is all commercially insured members with and without COPD members
The total population and non COPD population have not been demographically adjusted to the COPD population

Chart 8 shows hospital utilization for COPD patients which is dramatically higher than the total commercially insured population's average hospital utilization of 66 admits/1000 members/year. Respiratory related admissions make up 34% and 59% of total admissions for severe and very severe COPD patients. COPD ambulatory care sensitive admissions (see Appendix B for description and coding) make up approximately 50% of respiratory related admissions. A portion of COPD ambulatory care sensitive admissions may be avoidable with more effective outpatient management, particularly adherence with appropriate drug therapy.

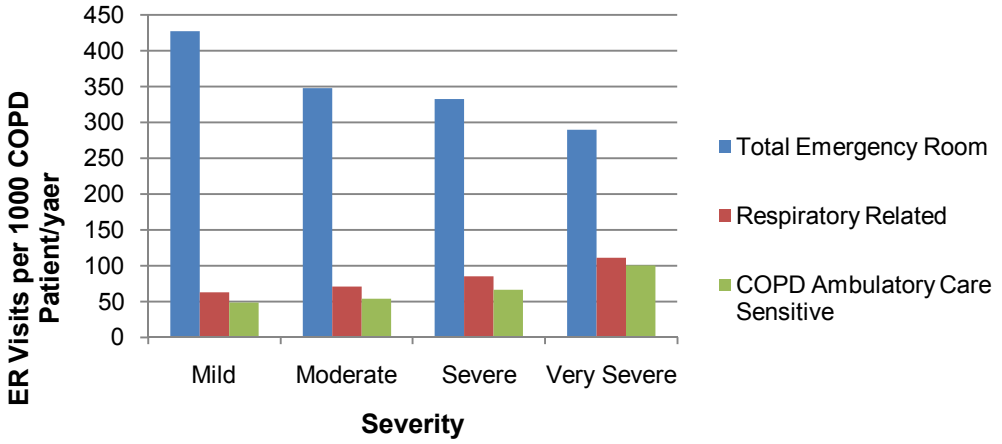
Chart 8
Inpatient Hospital Utilization by COPD Severity Level



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
Respiratory related: Inpatient admission with a primary diagnosis of acute bronchitis and bronchiolitis, pneumonia and influenza, COPD and allied conditions, other diseases of the respiratory system
COPD ambulatory care sensitive: Inpatient admission with a primary diagnosis of acute bronchitis and bronchiolitis or COPD and allied conditions

Chart 9 shows annual utilization of ER visits by the COPD cohort which is also dramatically higher than the total population rate of approximately 220/1000. Again, a portion of COPD ambulatory care sensitive ER admissions may be avoided with more effective outpatient management, particularly adherence with appropriate drug therapy. Interestingly, the annual rate of ER visits declines with increasing severity of COPD but the portion of visits that are respiratory related increases as a portion of total. We hypothesize that more severe COPD patients who present to an ER are more likely to be admitted as an inpatient, and, according to standard billing practices, the ER visit would not be billed separately.

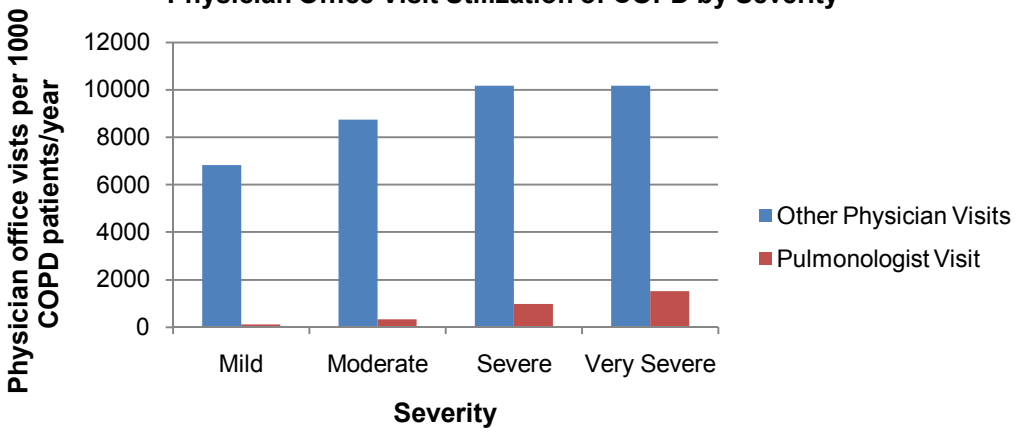
Chart 9
ER Utilization of COPD by Severity



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
Respiratory related: Inpatient admission with a primary diagnosis of acute bronchitis and bronchiolitis, pneumonia and influenza, COPD and allied conditions, other diseases of the respiratory system
COPD ambulatory care sensitive: Inpatient admission with a primary diagnosis of acute bronchitis and bronchiolitis or COPD and allied conditions

Physician office visit utilization is also significantly higher than the average 2900/1000 annual visits experienced by the total population. Chart 10 splits out the portion of total annual visits that are made to a pulmonologist which as expected, increases with COPD severity.

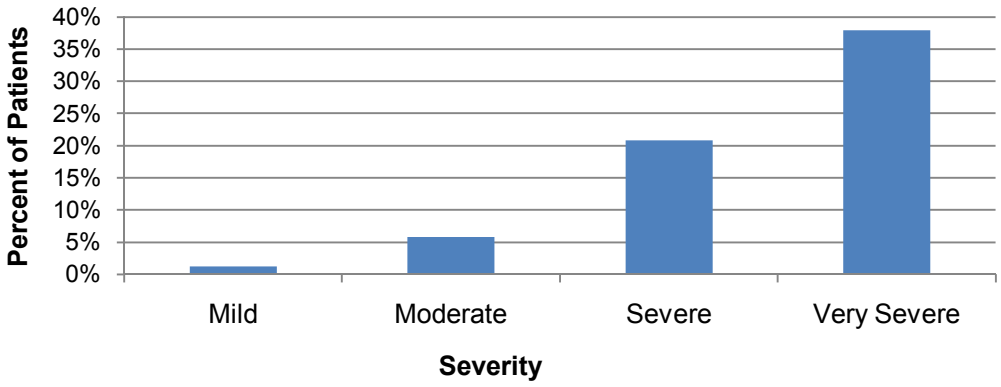
Chart 10
Physician Office Visit Utilization of COPD by Severity



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.

Chart 11 provides the portion of COPD patients who have one or more annual claims for home oxygen, which is close to 40% for the very severe COPD cohort. Oxygen therapy is a severity risking variable that receives significant weighting and thus would drive the risk score higher.

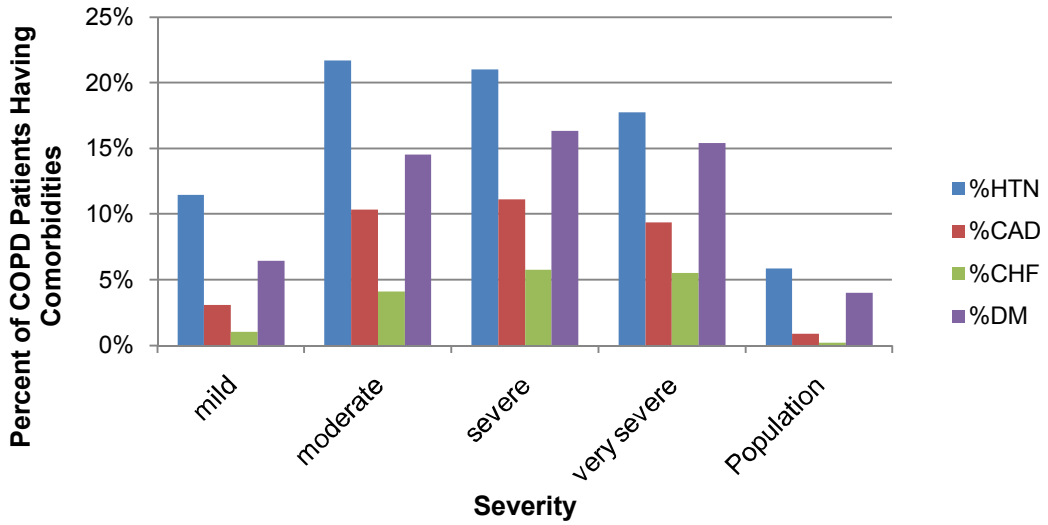
Chart 11
Percent Patients Having Home Oxygen Claims in COPD by Severity



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.

The prevalence rate of several major comorbidities including hypertension (HTN), coronary artery disease, (CAD), congestive heart failure (CHF) and diabetes mellitus (DM) are significantly higher in COPD patients than the general population as shown in Chart 12 and vary by severity level. Disease Management programs that target COPD patients need to manage the COPD patient across all comorbidities.

Chart 12
Percent of COPD Population Having Comorbidities

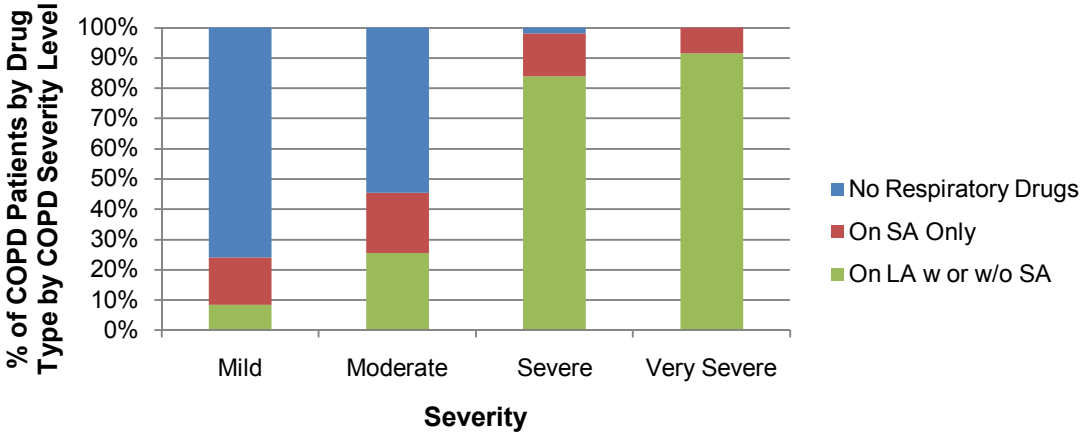


Source: Milliman analysis of MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
HTN: hypertension, CAD coronary artery disease, CHF: congestive heart failure, DM: diabetes
Population is total commercially insured population and is not demographically adjusted to the demographics of the COPD population

Drug Usage and Comparison with GOLD Guidelines

We identified the respiratory drug therapy characteristics of the COPD population and, as expected, found increasing use of respiratory drugs as COPD severity increased. GOLD guidelines state that regular treatment with long acting bronchodilators is more effective and convenient than treatment with short acting bronchodilators, [44] yet 20% of moderate, 14% of severe and 8% of very severe COPD patients are on short acting therapy only.

Chart 13
Distribution of COPD Patients by Drug Usage



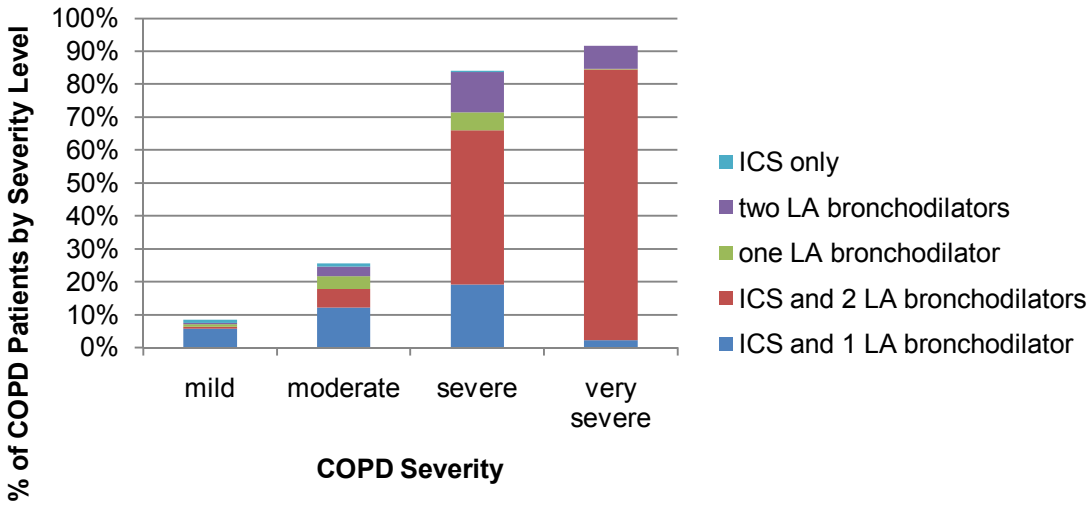
Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
SA (short acting bronchodilators) without inhaled corticosteroids or LA bronchodilators.
LA : any one or combination of long acting bronchodilators, inhaled corticosteroids, with or without SA bronchodilators. Long acting bronchodilators include anticholinergics and beta agonists

We used the methodology described in Appendix B to examine the use of long acting drug therapy in COPD patients compared to GOLD guideline recommendations. Chart 14 provides the distribution of drug therapy types (ICS and bronchodilators) by COPD severity. The data identified 2 practices:

- The GOLD guidelines state that ICS therapy is not recommended for mild or moderate risk COPD patients yet 8% of mild and 19% of moderate COPD patients have claims for an ICS.
- The GOLD guidelines recommend adding a second long acting bronchodilator for symptom control in moderate, severe and very severe as bronchodilators with different mechanisms and durations of action may increase the degree of bronchodilation for equivalent or lesser side effects; yet 12% of moderate, 19% of severe and 2% of very severe are on only one bronchodilator in combination with an ICS.

Although ICS therapy is recommended for severe and very severe COPD patients with repeated COPD exacerbations, a recent study indicates that some mild-moderate patients have repeated exacerbations and ICS treatment may be indicated.[45]

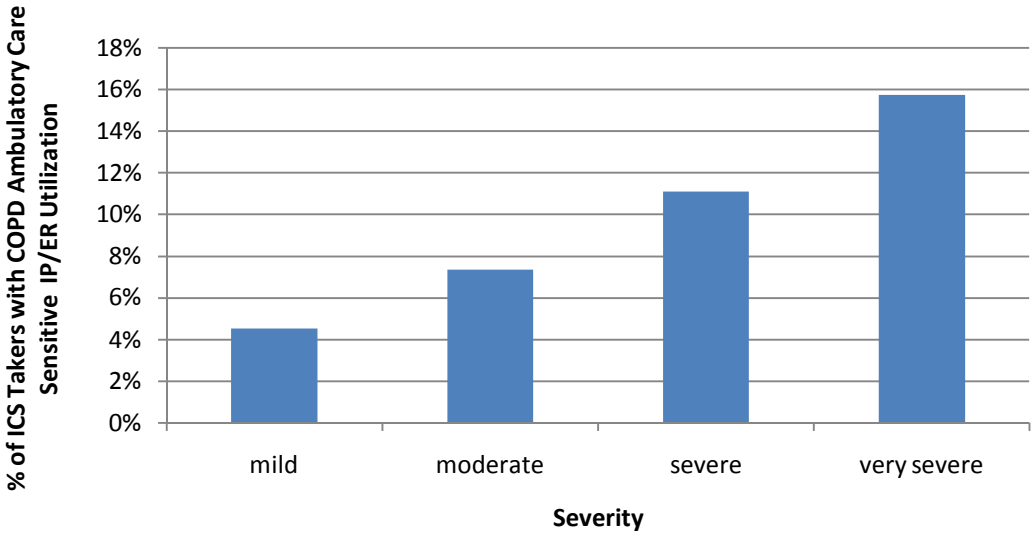
Chart 14
Distribution of Long Acting (LA) Agents by COPD Severity



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics.
LA : any combination or single use of long acting bronchodilators, inhaled corticosteroids, with or without SA bronchodilators

Chart 15 shows the portion of ICS takers with a COPD ambulatory care sensitive admission or ER visit which would be considered a COPD exacerbation and could be a justification for ICS use. Only 5% of the mild and 7% of the moderate ICS users had a COPD ambulatory care sensitive admission or ER visit. Of course the rate is reflective of the impact of ICS use on COPD exacerbations.

Chart 15
COPD Ambulatory Care Sensitive IP/ER Utilization for COPD patients using ICS and 1 bronchodilator, ICS and 2 bronchodilators, or ICS only



Source: Milliman analysis MedStat Commercial 2007.
Demographically Adjusted by Milliman HCG 2009 Standard Demographics

IMPLICATIONS FOR PAYERS

The literature reports less than optimal compliance with GOLD guidelines and our analysis supports that finding. Employers/payers should consider several tactics to enhance the care of their employees/members with COPD.

- Coverage. Examining benefit design for coverage of COPD management services including smoking cessation and GOLD guideline recommended therapies are first steps for access to best practice treatment.
  - Coverage of comprehensive smoking cessation programs that include behavior counseling, and pharmacotherapy should be considered. Comprehensive smoking cessation coverage is approximately $0.50 PMPM.[46]
  - Value based benefit design for COPD drug therapy with reduced or waived copays for COPD maintenance drugs is a consideration. Employer and patient costs associated with VBID need to be estimated along with current compliance levels and the impact of price elasticity.[47] Some employers use VBID programs which waive copays as a reward for patients who achieve a period of drug therapy compliance.
- On site wellness programs with smoking cessation components
- Disease management programs
  - DM vendors have provided programs for COPD for over 15 years and a COPD program is part of the typical DM package. These programs generally use an RN case manager telephonic model. Evidence for cost reduction has been weak. To measure value from DM vendors, employers should consider the following:
    - Stratify patients (such as the Wu methodology) to identify higher risk patients.
    - Contract for aggressively managing the severe and very severe portion of the population only. Our analysis identified approximately 17% of the COPD population falling into the severe and very severe categories, which have opportunities for short-term cost impact. Patients in these severity levels will need long term monitoring and outreach. DM programs typically mail educational materials to lower severity people; but such activity has not been reported to have cost or clinical impact.
    - Require DM fees be put at risk for particular outcomes such as:
      - Reduction of COPD ambulatory care sensitive inpatient admissions and ER visits
      - Increased patient compliance with drug therapy
      - Physician compliance with treatment guidelines including appropriate prescribing of ICS
      - Smoking cessation program uptake among smokers
    - Require quarterly reporting on enrollment rate (completion of assessments), number of live contacts/month, etc.
- Physician P4P programs for compliance with treatment recommendations and patient compliance with drug therapy
- Medical home. For medical home model providers, similar outcomes to that recommended for DM programs should be monitored and reported.
- Pharmacy benefit manager compliance promotion or monitoring programs
- Monitoring health plan HEDIS scores for COPD. HEDIS quality measures include spirometry testing to confirm a diagnosis of COPD in patients age 40 and older as well as dispensing a systemic corticosteroid within 14 days of an inpatient or emergency department discharge for COPD and a bronchodilator within 30 days of discharge. [48]

APPENDIX A: DESCRIPTION OF KEY DATA SOURCES AND THEIR APPLICATION

Medstat claims data. This dataset contains all paid claims generated by approximately 28 million commercially insured lives. The Medstat database represents the inpatient and outpatient healthcare service use of individuals nationwide who are covered by the benefit plans of large employers, health plans, government and public organizations. The MarketScan database links paid claims and encounter data to detailed patient information across sites and types of providers, and over time. The annual medical database includes private sector health data from approximately 100 payers. For this study, we used MedStat 2007.

Milliman's 2008 Health Cost Guidelines (HCGs). The Guidelines provide a flexible but consistent basis for the determination of health claim costs and premium rates for a wide variety of health plans. The Guidelines are developed as a result of Milliman's continuing research on healthcare costs. First developed in 1954, the Guidelines have been updated and expanded annually since that time. The Guidelines are continually monitored as they are used in measuring the experience or evaluating the rates of health plans, and as they are compared to other data sources. The Standard Demographics in the Guidelines were developed to be representative of the age and sex distribution for a typical large insured group. The Standard Demographics were developed using data from large insurers combined with Department of Labor Sources. We use the Guidelines to demographically adjust our target population to a typical working age population.

Milliman Medical Index (MMI). The MMI examines key components of medical spending and the changes in these components over time. The MMI incorporates proprietary Milliman studies to determine representative provider-reimbursement levels over time, as well as other reliable sources, including the Kaiser Family Foundation/Health Research and Educational Trust 2008, *Annual Employer Health Benefit Survey* (Kaiser/HRET), to assess changes in health plan benefit levels by year. The MMI includes the cost of services paid under an employer health-benefit program, as well as costs paid by employees in the form of deductibles, coinsurance, and copayments. The MMI represents the total cost of payments to healthcare providers, the most significant component of health insurance program costs, and excludes the non-medical administrative component of health plan premiums. The MMI includes detail by provider type (e.g., hospitals, physicians, and pharmacies), for utilization, negotiated charges, and per capita costs, as well as how much of these costs are absorbed by employees in the form of cost sharing. We used the annual MMI cost trends to trend the MedStat cost data to 2009 dollars.

APPENDIX B: METHODOLOGY

Data Sources:

MedStat Commercial Data 2007

Standard Demographics from Milliman Health Cost Guideline 2009

Claims Cost Trends from Milliman Medical Index 2009

Identification of disease cohorts. An individual was classified into one of the three mutually exclusive respiratory disease cohorts:

COPD: 1+IP or 1+ER or 1+physician outpatient visit E&M claim with COPD ICD9 Dx in any position and no such claims with asthma diagnosis

Asthma w/o COPD: 1+IP or 1+ER or 2+physician outpatient visit E&M claims with Asthma ICD9 Dx in any position and no such claims with COPD diagnosis

COPD & Asthma 1+IP or 1+ER or 1+ physician outpatient visit E&M claim with COPD &Asthma ICD9 Dx in any position

COPD ICD9 Dx Codes

491.xx	Chronic Bronchitis
492.xx	Emphysema
496.xx	Chronic Airway obstruction, not elsewhere classified.

Asthma ICD9 Dx Codes

493.xx	Asthma

COPD& Asthma ICD9 Dx Codes

493.2	Chronic Obstructive Asthma (asthma with COPD)

Physician Visit E&M Codes	
99201 – 99205	99401 – 99404
99211 – 99215	99406 – 99409
99217 – 99220	99411 – 99411
99241 – 99245	99412 – 99412
99304 – 99337	99420 – 99420
99341 – 99350	99429 – 99429
99381 – 99387	99455 – 99456
99391 – 99397	99499 – 99499

Respiratory drug claims were identified using a comprehensive list of NDC codes for the following drug categories (available upon request):

Inhaled Corticosteroids
SA Inhaled Beta Agonist
SA Anticholinergic
SA Beta Agonist-Anticholinergic
LA Inhaled Beta Agonist
LA Anticholinergic
Inhaled Corticosteroid-LA Beta Agonist
Methylxanthines

Respiratory Related Admissions and Respiratory Related ER Visits were identified if the inpatient or ER claim had any of the following ICD-9 codes in the primary position of the claim.

Respiratory Related Dx	
466.xx	acute bronchitis and bronchiolitis
480.xx to 487.xx	pneumonia and influenza
490.xx to 492.xx, 494.xx, 496.xx	COPD and allied conditions
510.xx to 514.xx, 518.0x to 518.3x, 518.8x	other diseases of the respiratory system

COPD ambulatory care sensitive admissions or ER visits (a subset of respiratory related admissions) were identified with one of the below diagnoses in the primary position of the claim. This is the Agency for Healthcare Quality's (AHRQ) coding logic for COPD ambulatory care sensitive admissions.[49] Ambulatory care sensitive admissions are admissions for exacerbations of chronic disease that could be avoided with more effective outpatient care. For COPD in particular, that outpatient care is dominated by drug therapy.

COPD ambulatory care sensitive DX	
466.xx	acute bronchitis and bronchiolitis
490.xx, 491-491.21, 491.8-492.8, 494.xx, 496.xx	COPD and allied conditions

We calculated the COPD Severity Score for each patient using the Wu methodology.[50] The raw score for an individual is calculated by multiplying each of the 12 variable's factor loading by an indicator of the presence or count of each variable and summing the products. The 12 variables are:

	Variable	Factor Loading
1.	Hospitalization due to AECB/CB – number of days	0.34
2.	Oxygen therapy – current	0.57
3.	Acute exacerbation of chronic bronchitis – number of episodes	0.4
4.	Emphysema – current	0.46
5.	Spirometry claims – number of claims	0.27
6.	Pulmonologist visit – number of claims	0.38
7.	Anticholinergics – number of claims	0.73
8.	Oral corticosteroids – number of claims	0.58
9.	Inhaled corticosteroids – number of claims	0.63
10.	Short acting beta-agonist – number of claims	0.81
11.	Long acting bronchodilators – number of claims	0.75
12.	Patient's age at the mid-point of the study period	0.3

We identified these variables in the claims for each COPD patient using the following logic:

1. Hospitalization due to AECB/CB – number of days:
   Total length of stay in days for any inpatient claim coded with ICD-9 491.21 in the primary position

2. Oxygen therapy:
   One or more claims with HCPCS:
   E1390, E 1391, E1392, E0443, E0444

3. AECB – number of episodes
   Inpatient or ER claims or E&M physician office visit with ICD-9 491.21 in the primary position

4. Emphysema – current
   IP, ER or E&M physician office visit claim with ICD-9 492.xx in any position

5. Spirometry claims – number of claims
   Count of claim for any of the following CPT codes:
   94010, 94014, 94015, 94016

6. Pulmonologist visit
   Physician office visit claim with Provider Type (STDPROV) = 295 (Pulmonary Disease Specialist)

7.-11. Number of scripts for the NDC codes for each drug class

12 Age at mid-year using the Date of birth field

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