THE INFLUENCE OF THE CAREGIVER ON HEALTHCARE OUTCOMES IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

A dissertation submitted to
Kent State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

by

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The Influence of the Caregivers on Measures of Disease Outcome in Depressed Patients with Chronic Obstructive Pulmonary Disease (COPD)

**Introduction**

According to the Centers for Disease Control (CDC) (2012), chronic obstructive pulmonary disease (COPD) is the 3rd leading cause of death in the United States and the 5th leading cause of death world-wide (World Health Organization [WHO], 2008). COPD is a progressive disease characterized by airflow limitation that is not fully reversible (Rabe et al., 2007). Thus, current treatment options are designed to slow disease progression and reduce symptoms. Treatment options to slow the progression of COPD include smoking cessation as well as pharmacotherapy, which are primarily the use of long-acting β-agonists, combination inhalers, and long-acting anticholinergics (Decramer & Cooper, 2010). Management plans to reduce symptoms include use of long-lasting β-agonists and anticholinergics, addition of inhaled glucocorticoids to regular inhaler therapy when symptoms increase, vaccination for influenza and pneumonia, participation in an exercise program, and long-term administration of oxygen (Rabe et al., 2007). Effective management of the complex treatment regimens by patients with COPD is imperative for symptom control, slowing progression, and improving quality of life (Kaplan & Ries, 2005; Restrepo et al.; 2008Rodriguez-Rosin, 2005); yet adherence in this population is much lower than in other chronic disease (DiMatteo, 2004).
Adherence in COPD

Adherence in COPD includes both medication adherence as well as adherence to healthcare behaviors such as smoking cessation, receiving vaccinations, and attending pulmonary rehabilitation. Adherence rates to COPD therapy are estimated to be 50% (Bourbeau & Bartlett, 2008), with differences in adherence rates depending on the type of therapy studied. DiMatteo, Giordani, Lepper, & Croghan (2002) reported that adherence to medical treatment in patients with pulmonary disease was 68.8%, which was much less than in patients with other types of chronic conditions. In an early study of adherence to inhaled medications, Dolce et al. (1991) reported that 54% of the participants had underutilized their medication, 50% of the participants had overused their medication in times of respiratory distress, and 31% of participants did not follow proper inhaler dosing techniques. Studies to determine adherence using pharmaceutical records have found that patients are adherent to the inhaler regimens <25% of the time, indicating that use of inhaled medication is sporadic at best (Bender, Pedan, & Varasteh, 2006; Haupt, Krigsman, & Nilsson, 2008).

Adherence research in COPD patients has extended beyond medication adherence to include adherence to pulmonary rehabilitation and exercise programs, smoking cessation, vaccine schedules, and long-term oxygen use. The adherence rate among patients prescribed oxygen ranges from 40%-70% (Cullen, 2006; Katsenos & Constantopoulos, 2011). In a study of patients referred to pulmonary rehabilitation, approximately 60% of those referred subsequently enrolled and completed the program (Young, Dewse, Fergusson, & Kolbe, 1999). Of those who did not complete pulmonary rehabilitation, 33% did not attend their first session and an additional 7% dropped out of the program. In studies looking at smoking cessation, 6.2% -34.5% of patients enrolled in a smoking cessation program abstained from smoking for a period greater than 12-
months (Anthonisen, et al., 1994; Brandt et al., 1997; Tonnesen, Mickelsen, & Bremann, 2006; Strassman et al., 2009). Finally, in a national survey of COPD patients, rates of pneumococcal vaccination in patients under the care of a pulmonologist and those who were not under the care of a pulmonologist were 39% and 26% respectively; while rates of influenza vaccination were 56% and 71% respectively (Barr et al., 2005).

Non-adherence to therapy has been associated with increased healthcare utilization due to acute exacerbation in patients diagnosed with COPD. In a study of 6,112 patients designed to look at adherence to inhaled medications, subjects with COPD who adhered were 44% less likely to have experienced a severe exacerbation of symptoms than those who were non-adherent (Vestbo et al., 2009). In a national cohort of 55,076 patients diagnosed with COPD, adherence to inhaled medications resulted in a 2.5% decrease in hospital admissions and a 1.8% decrease in emergency room visits; which resulted in an annual cost reduction per 1,000 patients of approximately $300,000 (Toy et al., 2010). Smoking has also been associated with increased hospitalizations in patients with COPD. Ex-smokers (smokers who had stopped smoking 5 years prior to study enrollment) were 70% less likely to be hospitalized and people who quit smoking between 1 and 5 years prior to study enrollment being 57% less likely to be hospitalized than their smoking counterparts (Godtfredsen, Vestbo, Osler, & Prescott, 2002). Finally, COPD patients enrolled in pulmonary rehabilitation programs are less likely to be hospitalized and have a decreased incidence of mortality (Garcia-Aymerich, Lange, Benet, Schnohr, & Anto, 2006).

There are many factors that have been associated with patient non-adherence to therapy regimens for COPD. Poor medication adherence has been correlated with younger age, smokers, low quality of life, and polypharmacy (Agh, Inotai, & Meszaros, 2011). In addition to dosing factors and polypharmacy effects, societal factors including patient-provider relationship, social
support, and device training as well as patient factors that include health beliefs, cognitive ability, self-efficacy, and psychological profile are have been related to non-adherence to medications in COPD (Lareau & Yawn, 2010). In a cohort study contrasting adherent versus non-adherent COPD patients, researchers reported that patient acceptance of the disease process, knowledge about and faith in the treatment, patient-clinician interaction, and routinization of drug therapy were all associated with degree of adherence (George, Kong, Thoman, & Stewart, 2005). COPD patient who were socially isolated, lacked social support, smoked, and were non-compliant with other healthcare activities tended to be non-adherent to a pulmonary rehabilitation program (Young et al., 1999).

**Depression and adherence in COPD.** The rate of depression among COPD patients is approximately 50%; but, the estimates of prevalence vary widely between studies due to differences in measurement tools and disease severity of the populations studied (Mauer et al., 2008; Mikkelsen, Middleboe, Pisinger, & Stage, 2004). In the general COPD population, the rate of reporting depressive symptoms ranged from a low of 13.2% to a high of 72.0% (Asnaashari, Talaei, & Haghighi, 2012; Bentsen, Gundersen, Assmus, Bringsvor, & Berland, 2013; Cazzola, Bettoncelli, Sessa, Cricelli, & Biscione, 2010; De, 2011; Hayashi et al., 2011; Janssen et al., 2010; Lou et al., 2012; Sharma et al., 2013; van Manen et al., 2002). Iguchi et al. (2013) reported a 48.6% rate of depression in patients with COPD who were admitted to a long-term rehabilitation facility. In a study of COPD patients admitted to the emergency room, 44.4% of patients with COPD reported depressive symptomology (Ng et al., 2007). In studies of older adults, 39% of veterans with COPD and 33.6% of Medicare patients with COPD showed signs of depression (Kunik et al., 2005; Qian et al., 2013). Although there is significant variance in rate of prevalence, it is generally agreed that the rate of depression in patients with COPD is greater
than in healthy adults or in patients with other types of chronic disease (Cazzola et al., 2010; Lou et al., 2012; Manen et al., 2002; Mauer et al., 2008; van Ede, Yzermans, & Brouwer, 1999; Zhang, Ho, Cheung, Fu, & Mak, 2011).

Several studies have shown an association of depression with quality of life as well as overall health status and functionality in patients with COPD. Quality of life is inversely related to depression in patients with COPD, with decreased quality of life being associated with depressive symptoms (Cully et al., 2006; Kil, Oh, Koo, & Suk, 2009). Depressed patients with COPD also report more COPD related symptoms than their non-depressed counterparts (Cleland, Lee, & Hall, 2007; Felker et al., 2001; Felker et al., 2010; Iguchi et al., 2013; Ng et al., 2007). Severity of perceived shortness of breath is often higher in depressed COPD patients, which inevitably leads to increased exacerbation (Al-Gamal & Yorke, 2013; Regvat, Zmitek, Vegnuti, Kosnik, & Suskovic, 2011). Decreases in quality of life as well as increased perception of symptoms influences overall function, with depressed COPD patients reporting decreased physical functioning (Aydin & Ulusahin, 2001; Kim et al., 2000). Unfortunately, depressed COPD patients also have higher 1-year and 3-year mortality rates than their non-depressed cohorts (Abrams, Vaughan-Sarrazin, & Vander, 2011; Fan et al., 2007; Yohannes, Baldwin, & Connolly, 2005).

In addition to decreased quality of life and functionality, depression in COPD patients has also been associated with decreased adherence to medication regimens; which can also influence health status and medical outcomes. Patients using medications for COPD were more likely to discontinue use of the medication and less likely to exhibit > 80% adherence to their medication regimen if they were depressed when compared to similar cohorts who were not depressed (Qian et al., 2013).
The result of poor health status and low medication adherence in depressed patients with COPD is increased exacerbation leading to greater healthcare utilization. In a study designed to determine factors influencing high resource utilization, researchers found the depressed COPD patients were more likely to have been admitted to the hospital, visited the emergency room on multiple occasions, or had multiple unscheduled outpatient visits (Garcia-Polo et al., 2012). Ito et al. (2012) examined depression and sleep disorders in patient with COPD and found that acute exacerbations and hospital admissions were greater in depressed COPD patients independent of whether or not they had a sleep disorder. Regvat et al. (2011) observed that COPD patients who were depressed had greater perceived dyspnea, leading to earlier and increased hospitalization due to exacerbation. A more recent study found that depressed COPD patients were 3.5 times more likely to be hospitalized, and that the length of stay was significantly longer than that of non-depressed COPD patients (Papaioannou, 2013). Additionally, several researchers have reported an increase in emergency room and hospital 30-day readmissions in depressed COPD patients (Abrams et al., 2011; Dahlen & Janson, 2002).

Unfortunately, depression is poorly managed in COPD patients for several reasons which include: 1) difficulty in diagnosing, 2) complexity of medication regimens and potential for interaction effects, and 3) inappropriateness of current depression standard of care for this population (Norwood & Balkisoon, 2005). Depression is very hard to diagnosis in the COPD patient due to the overlap of symptoms. Many of the diagnostic tools for screening depression are biased due to the inclusion of somatic symptoms relevant to both depression as well as COPD (Stage, Middleboe, Stage, & Sorensen, 2006). Additionally, studies to delineate efficacy of antidepressant use in COPD patients are few, and interaction effects with common inhalers are not fully understood (Mikkelsen, Middleboe, Pisinger, & Stage, 2004). Finally, studies that
outline appropriate standard of care for treating depression in COPD are limited (Mauer et al., 2008). There has been only 1 randomized trial examining the efficacy of using antidepressants in COPD patients diagnosed with severe depression. In this trial enrolling 30 patients, nortriptyline was found to be highly effective for improving short-term outcomes due to depression (Borson et al., 1992). In a pilot study of 56 COPD patients diagnosed with depression, a single 2-hour session of cognitive behavioral therapy (CBT) was found to significantly reduce symptoms of depression when compared to a control group that received COPD education (Kunik et al., 2001). A second study in 256 COPD patients was not able to show a statistically significant difference between group CBT and COPD education, although both modalities were found to reduce depressive symptoms (Kunik et al., 2007). Collaborative care models for treatment of depression in patients with COPD have shown the most promise. In a subgroup analysis of approximately 400 patients with COPD or asthma enrolled in the Improving Mood – Promoting Access to Collaborative Treatment for Late Life Depression study, nurse collaborative care intervention was associated with improved quality of depression care, depression outcomes, and physical functioning (Unutzer et al., 2002). Thus, not only is it imperative to develop algorithms for better management of depression in patients with COPD; since management is so poor, it is just as important to look at alternatives for helping the depressed patient self-manage his or her disease.

**Social support and adherence in COPD.** Researchers have determined that social support impacts the quality of self-management in patients with chronic illnesses such as COPD (Xiaolian et al., 2002; Gallant, 2003). In a cohort of Turkish patients with COPD, family support was found to be positively associated with improvements in self-efficacy and self-care (Kasikci & Alberto, 2006). When social support is not present, non-adherence may occur. Patients who
are non-adherent to self-management activities, such as participating in a pulmonary rehabilitation program, are more likely to be socially isolated and lack COPD-related social support (Young et al., 1999). Similarly, smokers with COPD who are married are more likely to quit smoking, and those who have a support person attend smoking cessation classes with them are more likely to abstain from smoking for a period of 12-months or greater (Murray, Johnson, Dolce, Lee, & O’Hara, 1995).

A relationship between social support and medical outcomes in patients with COPD has also been reported. Marino, Sirey, Raue, & Alexopoulos (2008) found that low levels of perceived social support were positively associated with decreased physical functioning in older adults with COPD. Additionally, low levels of social support have been associated with increased depression in adults with COPD (Kara & Mirici, 2004; McCathie, Spence, & Tate, 2002).

Results of meta-analysis have shown that practical (instrumental) social support provides the greatest positive impact on adherence in chronic disease management (DiMatteo, 2004). Patients with COPD have a high symptom load and often face challenges performing activities of daily living, thus requiring the help of others. The burden of providing instrumental support in this population often falls on the family or friends, with the majority of caregivers being either a spouse or child of the patient (Gardiner et al., 2010).

Informal caregivers of COPD patients have been found to have psychological distress, impaired health habits, detrimental physiological responses, increased psychiatric physical and psychiatric illness, and higher mortality (Schulz & Sherwood, 2008). In a sample of 43, 176 caregivers over the age of 45 years, increased caregiver strain was associated with greater psychological distress as well as increased symptoms of depression (Roth, Perkins, Wadley,
Temple, & Haley, 2009). Schulz and Beach (1999) reported that 4-year mortality in caregivers with high strain was 63% higher than in non-caregivers after adjusting for sociodemographic factors, prevalent disease, and subclinical cardiovascular disease. Finally, results of meta-analysis have shown that age, caregiver burden, lack of caregiver support, physical, cognitive, and behavioral impairment of the care recipient, and presence of caregiver depression are all associated with poor physical health in the caregiver (Pinquart & Sorenson, 2007).

Whereas research to determine the burden of caregiving on the informal caregiver of COPD patients has been performed, little research to determine the ability of the informal caregiver to provide adequate instrumental support to the patient is available. Trivedi, Bryson, Udris, and Au (2012) reported that adherence to antihypertensive medication and long lasting β-agonists was higher in COPD patients who had caregivers. Additionally, there were fewer smokers in the caregiver group. In a study of post-acute care following a hospitalization in Medicare patients, high levels of instrumental support provided by an informal caregiver were actually related to decreased functionality in these patients after 6-weeks; which the authors attributed to the caregiver actually performing the physical activities for the patient rather than rehabilitating the patient (Penrod, Kane, Finch, & Kane, 1998). In older patients with COPD, it is important to note that the spouse is often the caregiver and they often are elderly and have health concerns of their own (Gardiner et al., 2010). Results of the small amount of literature emphasize the importance of understanding the impact of the caregiver on patient outcomes in order to provide the necessary support mechanisms to improve management of COPD in the home.

**Current Study**

Research has shown that the rate of depression in patients with COPD is higher than in other chronic diseases and that depression in this population negatively impacts self-care (Qian
et al., 2013). Unfortunately, depression is poorly managed in COPD patients (Norwood et al., 2005); thus necessitating the development of alternative ways to manage COPD in the home. Often the burden of COPD management falls on an informal caregiver, who is expected to provide instrumental support by assisting with activities of daily living (Gardiner et al., 2010). The aim of this investigation was to identify what factors in the caregiver most influence medical outcomes in depressed patients with COPD who are managing their disease at home. It was postulated that caregivers who are physically and mentally healthy will be able to moderate the negative impact of depression in COPD patients on measures of health outcomes and adherence, thus decreasing healthcare utilization. The following hypotheses were tested:

**Hypothesis 1.** As depression severity increases in COPD patients (See figure 1):

1(a) Healthcare utilization will increase.

1(b). Perceived symptoms will increase.

1(c) Overall performance of healthy behaviors will decrease.

**Hypothesis 2.** As patient perceived symptoms increase, patient healthcare utilization will increase.

**Hypothesis 3.** As patient adherence decreases, patient healthcare utilization will increase.

**Hypothesis 4.** The presence of depression, anxiety, and/or physical comorbidity in the caregivers of COPD patients will moderate the relationship of depression on symptoms, adherence, and healthcare utilization as follows:

4(a) Strengthen the positive association between patient depression and symptoms.

4(b) Strengthen the negative association between patient depression and adherence to healthcare behaviors.
4(c) Strengthen the positive association between patient depression and healthcare utilization.
Figure 1: Proposed moderated mediation model with hypotheses.
Methods

Participants

Participants and their caregivers were recruited by a trained research assistant from the pulmonary physicians’ offices, pulmonary rehabilitation, and pulmonary function testing laboratories associated with Summa Health System. In addition to direct recruitment, patients identified through the physicians’ offices with diagnosis codes of ICD-491 (Chronic Bronchitis), ICD-492 (Emphysema), and ICD-496 (Chronis Airway Obstruction) were mailed informational letters.

There were 900 letters mailed to potential subjects identified as having a diagnosis of COPD through their respective pulmonary physician. Seventy-six subjects were approached and/or called regarding eligibility for the study. Of those identified as potential subjects, there were 3 who were not interested in participating, 4 who were not eligible, and 16 who did not respond when contacted by telephone to schedule an appointment. In total, there were 53 subjects and their caregivers scheduled to participate. Three of the scheduled subjects cancelled their appointment on more than one occasion, or were not home on their appointment day. Thus, the final sample consisted of 50 subjects and their caregivers.

Inclusion criteria. Subjects were eligible for the study if they had a diagnosis of COPD with moderate to severe airflow limitations based on the most recent Global Initiative for Chronic Obstructive Lung Disease (GOLD) Standards (Table 1). The GOLD Standards define airflow limitation in COPD in four stages based on post-bronchodilator spirometry testing (GOLD, 2013).
Table 1: GOLD Standards – Post-Bronchodilator FEV1 classification of COPD disease severity (GOLD, 2013).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mild</th>
<th>FEV1/FVC &lt; 0.70</th>
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<tr>
<td></td>
<td></td>
<td>FEV1 ≥ 80% predicted</td>
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<tr>
<td>Stage II:</td>
<td>Moderate</td>
<td>FEV1/FVC &lt; 0.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% ≤ FEV1 ≤ 80% predicted</td>
</tr>
<tr>
<td>Stage III:</td>
<td>Severe</td>
<td>FEV1/FVC &lt; 0.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% ≤ FEV1 ≤ 50% predicted</td>
</tr>
<tr>
<td>Stage IV: Very Severe</td>
<td>FEV1/FVC &lt; 0.70</td>
<td>FEV1 &lt; 30% or FEV1 predicted plus chronic respiratory failure*</td>
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*Respiratory failure: arterial partial pressure of oxygen (PaO2) < 8.0 kPa (60 mm Hg) with or without arterial partial pressure of CO2 (PaCO2) > 6.7 kPa (50 mm Hg) while breathing air at sea level.

In addition to a diagnosis of COPD, participants were required to have a caregiver who was also willing to participate in the study. The caregiver was defined as a person (i.e. spouse, family member, friend, or neighbor) who assisted the patient with at least one activity of daily living. Activities of daily living consisted of things such as transportation, housework, medication management, shopping, and personal hygiene.

**Exclusion criteria.** Subjects younger than 18-years of age were excluded from participation. Additionally, subjects who had visual or hearing impairment that prevented them from understanding verbal and written instructions were excluded. Subjects were required to be able to read and write in the English language at a proficiency level high enough to allow them to understand verbal and written instructions. Subjects who had a history of severe cognitive impairment that prevented them from understanding written and/or verbal instructions were excluded from the study.
Procedure

Approval to conduct this study was obtained from the Institutional Review Boards at Kent State University, Summa Health System, and Robinson Memorial Hospital prior to recruitment, enrollment, or collection of personal health information. Once the subjects and their eligible caregivers agreed to enroll in the study, a time was scheduled in the subjects’ homes to explain the study, obtain informed consent, and administer the survey instrument. Copies of the informed consents were given to both the subjects and their caregivers. Signed and dated copies were placed in the respective participant study files. In accordance with the Health Insurance Portability and Accountability Act (HIPAA), HIPAA Authorization was obtained from the subject to allow for release of personal health information to be used in the research study.

During the home visitation, a written and verbal questionnaire was administered to both the subject and their eligible caregiver that took approximately 90 minutes to complete. For the purpose of this study, only a subset of the entire survey packet was analyzed. Subjects with COPD were assessed for depression, perceived symptoms, adherence to health behaviors, COPD disease severity, and healthcare utilization. Caregivers were assessed for depression, state anxiety, and physical comorbidity. Demographic variables of age, gender, socioeconomic status, and health history were also collected from both the subject and the caregiver (Appendix A and B). The measures incorporated in the survey packet were counterbalanced, using a computerized random number generator, to control for the effects of study fatigue. At the completion of the visit, the subjects and the caregivers each received monetary compensation in the amount of $30.00.
**Measures**

**Depression.** The PrimeMD PHQ-9 is a self-report depression screening tool which scores each of the 9 DSM-IV criteria as ‘0’ (not at all) to ‘3’ (nearly every day), with a range of scores from 0-27 (Kroenke, Spitzer, & Williams, 2001). The assessment consists of 9 questions and takes less than 3-minutes to complete. In a study of 6000 primary care and ob-gyn patients, internal consistency (Cronbach’s α = .89 and .86 respectively) and test-retest reliability (r = .84, p<.01) were found to be excellent (Kroenke et al., 2001). The PHQ-9 was also found to be a good predictor of depression severity, with 93% of non-depressed patients scoring <10, while 88% of patients with a clinical diagnosis of major depression scored ≥ 10. PHQ-9 scores of 5, 10, 15, and 20 were found to represent mild, moderate, moderately severe, and severe depression respectively (Kroenke et al., 2001).

**Anxiety.** The Speilberger State Anxiety Inventory (STAI) is a self-report questionnaire designed to measure state anxiety. State anxiety items include: “I feel calm”, “I feel jittery”, “I am tense”, and “I feel pleasant.” All items are rated on a 4-point scale, with higher scores being associated with increased anxiety. The assessment consists of one page and takes approximately 3 minutes to complete. The STAI has a reliability score of .80 and an internal consistency range of .73 to .86 (Speilberger, 1983).

**Physical comorbidity.** The Charlson Comorbidity Index is a tool used to classify comorbid conditions that are likely to alter the risk of survival using a weighted-index based on severity of the comorbidity and number of comorbidities (Charlson, Pompei, Ales, & MacKenzie, 1987). The weighted comorbidity score is a significant predictor of 1-year survival (p<.001) in hospitalized patients as well as cancer patients (Charlson et al., 1987). The estimated
relative risk of death for each increasing comorbidity rank is 1.46 years (Charlson, Szatrowski, Peterson, & Gold, 1994).

Adherence. The Health Adherence Behavior Inventory (HABIT) is an instrument designed to identify patients at risk for poor outcomes and complications from chronic disease because of non-adherence to treatment regimens (Parke, 2004). The HABIT includes 50-items that describe health-related behaviors, such as following a physician’s advice, getting prescriptions filled, limiting the intake of fatty foods, and avoiding smoking. The respondents are asked to identify whether or not each item is true or not true of their behavior, and takes approximately 5 minutes to complete. A score of ‘1’ is given for every true answer, and a total score is tallied at the end. Most items are presented in the affirmative, but 3 items are presented in the negative. The items presented in the negative are reversed scored.

The content validity of the HABIT was assessed by an expert panel of physicians and psychologists who were in 100% agreement that the items represented the domain of content related to adherence and health risk behaviors (Parke, 2004). The results of the HABIT are negatively correlated to overall health risk (r=-.437, p<.01), with higher scores on the HABIT being indicative of decreased risk of disease (Parke, 2004). The HABIT has an internal consistency, measured by Cronbach’s α, of .705 (Parke, 2004).

Symptoms. The Airways Questionnaire is a quick and simple measure used to determine quality of life in patients with respiratory disease (Quirk & Jones, 1994). It consists of 30-items related to symptoms experienced in respiratory diseases, and asks the respondents to answer ‘yes’ or ‘no’ based on the presence of that symptom. All ‘yes’ answers are given a score of ‘1’, and a total score is tallied at the end. The Airways Questionnaire is a single page and takes approximately 3 minutes to complete. The Airways Questionnaire has excellent internal
consistency (Cronbach’s α=.86) and has been correlated with all components and the total score for the St. George’s Respiratory Questionnaire, which is considered to be the standard measure used to determine quality of life in COPD patients (Alemayehu, Aubert, Feifer, & Paul, 2002; Hajiro et al., 1999).

**Medical chart review.** Healthcare utilization was defined as the sum of the number of emergency department visits and the number of hospital admissions the patient had in the 12-months prior to enrolling in the study. The admissions were determined from a review of the subjects’ electronic and/or paper medical record. Severity of airflow limitations, needed to classify disease severity, was determined from the most recent spirometry testing and/or physician documentation in the medical record.

**Statistical Analyses**

Statistical analyses were conducted using IBM SPSS 22.0 for descriptive statistics, assumptions testing, and correlational analyses. IBM AMOS 22.0 was used for structural equation modeling of mediation and moderation. Statistical significance was set at $p \leq .05$ for all analyses.

**Initial analyses.** Descriptive statistics, such as frequencies, percentages, means, and standard deviations were used to describe the study population.

Subjects found to have data missing on any of the variables included in the final model were removed using listwise deletion prior to performance of the final analyses. Overall, less than 10% of the entire sample had missing data and there was no pattern and/or explainable reason associated with the missing data. There were no subjects removed from the study due to observation of outliers.
Internal consistency estimates of reliability were evaluated for each of the survey instruments used to measure patient depression (PHQ-9), respiratory symptoms (AIRWAYS), and willingness to perform healthy behaviors (HABIT) as well as caregiver depression (PHQ-9) and anxiety (STAI) by calculating Cronbach’s α. Results of Cronbach’s alpha for the PHQ-9 was .812 in the patients and .849 in the caregivers. The Cronbach’s alpha for the AIRWAYS questionnaire in the patient population was .895 and the Cronbach’s alpha for the HABIT questionnaire in the patient population was .844. In the caregiver population, the Cronbach’s alpha for the STAI was .888. All Cronbach’s alpha results were ≥.80, indicating that the questionnaires had good reliability for both the patient and caregiver populations.

The data was analyzed to determine whether or not the assumptions of the statistical methods utilized were violated. The assumption of bivariate linearity of the endogenous variables was tested using curve-linear regression for each predictor/dependent variable pairs at a significance level of p ≤ .05. The assumption of bivariate linearity was met for all predictor/dependent variable pairs. The assumption of multicollinearity between the predictor variables was tested by calculating the variable inflation factor (VIF). The VIF is calculated by regressing each predictor variable on the remaining predictor variables. The VIF calculated for each regression was <3, indicating that the assumption of multicollinearity was not violated (Hair, Anderson, Tatham, & Black, 1995).

**Covariates.** Bivariate correlation analysis was performed to identify whether or not potential confounding variables explained observed associations between the dependent and predictor variables in the final model (See Table 2). Age was found to be a potential confounder variable based on correlation analyses and was controlled for in the final model.
Table 2: Bivariate correlations for potential covariates.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. COPD severity</td>
<td>.12</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Gender</td>
<td>.01</td>
<td>-.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Marital status</td>
<td>.25</td>
<td>-.04</td>
<td>-.07</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Live alone</td>
<td>.03</td>
<td>.06</td>
<td>.19</td>
<td>-.62**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Patient depression</td>
<td>-.44**</td>
<td>.08</td>
<td>.11</td>
<td>-.43**</td>
<td>-.70**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Patient symptoms</td>
<td>-.38**</td>
<td>.27</td>
<td>-.09</td>
<td>-.17</td>
<td>.15</td>
<td>.52**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Patient adherence</td>
<td>.15</td>
<td>-.01</td>
<td>-.15</td>
<td>.02</td>
<td>.07</td>
<td>-.41**</td>
<td>-.13</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>9. Utilization</td>
<td>-.27</td>
<td>.26</td>
<td>-.28</td>
<td>-.21</td>
<td>.08</td>
<td>.45**</td>
<td>.43**</td>
<td>-.04</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*p ≤ .05, **p ≤ .01

Structural equation model. Structural equation modeling (SEM) was chosen due to its ability to test and interpret a model with multiple predictor and dependent variables. Additionally, it allowed for determination of mediation affects using bootstrapping techniques. Bootstrapping was preferred to the Baron and Kenny approach of mediation estimation for several reasons: 1) The Kenny and Baron approach does not test for significance of the indirect effects of the mediation model, 2) Bootstrapping has been shown to reduce Type II error in mediation models, and 3) Bootstrapping is preferred when the sample size is small (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Maximum likelihood estimation was chosen over other estimation methods because the data was normally distributed.

Mediation analyses. A model to estimate the direct effect between patient depression and healthcare utilization after controlling for patient age was analyzed prior to adding the
proposed mediators. Measures of patient adherence and symptomology were entered and estimated individually. The bias-corrected bootstrap confidence intervals for each of the indirect effects were examined for significance. The indirect effects were found to be significant if the range between the lower and upper estimate bounds did not contain zero. If the indirect effect and the direct effect after controlling for the mediator were significant, then partial mediation was observed. Full mediation was observed when the direct effect and indirect effect was significant, but the direct effect after controlling for the mediator was non-significant. No mediation occurred if the indirect effect was not significant, if the direct effect of the independent variable on the mediator was insignificant, or if the direct effect from the mediator to the dependent variable was insignificant.

**Moderation analyses.** Caregiver depression, caregiver anxiety, and caregiver physical morbidity were included in the final SEM model as possible moderators of the relationship between patient depression and healthcare utilization, symptom severity, and adherence. Moderation was estimated using multi-group comparison of the critical ratios. The comparison groups were defined as follows: Caregivers with PHQ9 scores of ≥5 were considered to have clinically relevant levels of depression (Kroenke et al.2002); caregiver STAI scores of ≥32 were considered to have clinically relevant levels of state anxiety (Julian, 2011); and a Charlson Comorbidity Index score of 2 or above was chosen since it represented caregivers with at least one comorbidity regardless of age. For each moderator, the group differences in critical ratios were analyzed and a z-score was computed to determine significant differences between the model estimates based on group inclusion.

Prior to performing the multi-group comparison, the overall model was examined for acceptable goodness of fit. The following fit indices were examined: ratio of chi-square to
degrees of freedom (cmin/df), the Comparative Fit Index (CFI), root mean square error of approximation (RMSEA), and p of close fit (pclose), The model was considered to have acceptable fit if it met the following thresholds for each of the reported fit indices: cmin/df <3, CFI >.90, RMSEA .50-.10, and pclose >.05 (Hu & Bentler, 1999). The Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Standardized Root Mean Square Residual (SRMSR) were not examined because they are greatly influenced by sample size and are no longer considered acceptable measures of model fit (Sharma, Mukherjee, Kumar, & Dillon, 2005).

**Power Analysis.** A power analysis was performed using methodology outlined by MacCallum, Browne, and Sugawara (1996) which determines the minimum sample size required to achieve a given level of power for any test of SEM model fit. Using computer software developed by Preacher & Coffman (2006) to perform the calculations, the minimum sample size required to achieve a power of 0.80 for RMSEA < .15 and 7 degrees of freedom was 123. The final sample analyzed in this study consisted of 46 data points, indicating that the study may be underpowered. There is still a considerable amount of debate as to the appropriate sample size required to perform SEM. Recent research has shown that when the constructs are well-defined and the effects are strong, small sample sizes (~50) may be adequate (Iacobucci 2010). If these assumptions do not hold true, a small sample size may lead to non-convergence. There were no non-convergence issues encountered during the analysis conducted for this study.
Results

Survey data was completed and analyzed for 50 patient-caregiver dyads. Of those subjects, 4 were removed from the final SEM analysis due to missing variable data. All analyses were controlled for patient age.

Study Population

Patient characteristics. The majority of patient subjects were Caucasian (92.0%, 46 out of 50) and male (62.0%, 31 out of 50). The average age of patients enrolled in the study was 63.7 ± 12.3 years, with patients ranging in age from 36 to 86 years. The mean years of education were 13.0 ± 2.8. Married subjects represented 62.0% (31 out of 50) of the population, and 26.0% (13 out of 50) of the subjects lived alone. Patient subjects enrolled in the study had an average Charlson Comorbidity Index score of 4.0 ± 2.2, indicating that subjects had multiple comorbidities in addition to their COPD.

Classification of disease severity in the subjects using the GOLD standards was as follows: 46.0% (23 out of 50) had moderate air flow limitation, 24% (12 out of 50) had severe airflow limitation, and 30.0% (15 out of 50) had very severe airflow limitation. Oxygen (O2) was prescribed for 48.0% (24 out of 50) of the patients, 32.0% (16 out of 50) of subjects were prescribed to use O2 full-time, and 75.0% (18 out of 24) of subjects reported using their O2 as prescribed by the physician. A majority of the patients enrolled in the study had attended pulmonary rehabilitation (58.0%, 29 out of 50). Current smoking was endorsed by 32.0% (16 out of 50) patients.
Subject mean scores on the Airways questionnaire, a measure of symptom severity, was 15.3 ± 7.3 (Range 2-29). The mean score on the HABIT, a measure of willingness to adhere to health habits, was 32.5 ± 7.1 (Range: 13-44). The rate of healthcare utilization among patients was quite high, with 42.0% (21 out of 50) of patients reporting at least one emergency room (ER) visit and 34.0% (17 out of 50) reporting at least one hospital admission within the previous 12-months. The mean number of ER visits was 1.0 ± 1.7 and the mean number of hospital admissions was 0.7 ± 1.1. A full description of the subject characteristics is included in Table 3.
Table 3: Description of patient study population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>63.7 (12.3)</td>
</tr>
<tr>
<td>% Male</td>
<td>62.0 (31/50)</td>
</tr>
<tr>
<td>% Caucasian</td>
<td>92.0 (46/50)</td>
</tr>
<tr>
<td>Education (years)</td>
<td>13.0 (2.8)</td>
</tr>
<tr>
<td>% Married</td>
<td>64.0 (32/50)</td>
</tr>
<tr>
<td>% Lived alone</td>
<td>26.0 (13/50)</td>
</tr>
<tr>
<td>% Current Smoker</td>
<td>32.0 (16/30)</td>
</tr>
<tr>
<td>Charlson Morbidity Index score*</td>
<td>4.0 (2.2)</td>
</tr>
<tr>
<td>GOLD Standard Classification**</td>
<td></td>
</tr>
<tr>
<td>% Moderate</td>
<td>46.0 (23/50)</td>
</tr>
<tr>
<td>% Severe</td>
<td>24.0 (12/50)</td>
</tr>
<tr>
<td>% Very severe</td>
<td>30.0 (15/50)</td>
</tr>
<tr>
<td>% Prescribed O2</td>
<td>48.0 (24/50)</td>
</tr>
<tr>
<td>% Pulmonary rehab</td>
<td>58.0 (28/50)</td>
</tr>
<tr>
<td>PHQ-9^</td>
<td>6.6 (6.3)</td>
</tr>
<tr>
<td>% Depressed (PHQ9 ≥5)</td>
<td>53.1% (26/49)</td>
</tr>
<tr>
<td>Airways++</td>
<td>15.3 (7.3)</td>
</tr>
<tr>
<td>HABIT^</td>
<td>32.5 (7.1)</td>
</tr>
<tr>
<td>Utilization</td>
<td></td>
</tr>
<tr>
<td>ER visits</td>
<td>1.0 (1.7)</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>0.7 (1.1)</td>
</tr>
</tbody>
</table>

*Charlson Comorbidity Index is a measure of life expectancy based on number and type of morbidities.
**GOLD standard is a measure of COPD disease severity.
+Patient health questionnaire (PHQ-9) is a measure of depression severity.
++Airways if a measure of patient symptoms related to COPD.
^Health Adherence Behavior Inventory (HABIT) is a measure of willingness to perform health behaviors.
**Caregiver characteristics.** The majority of caregivers were Caucasian (84.0%, 42 out of 50) and female (72.0%, 36 out of 50) with an average age of 55.9 ± 17.1 years. The primary caregivers were more likely to be a spouse (48.0%, 24 out of 50), followed by a neighbor or friend (24.0%, 12 out of 50), an adult child (16.0%, 8 out of 50), a sibling (8.0%, 4 out of 50), and a parent (4.0%, 2 out of 50). The mean years of education for caregivers were 12.8 ± 2.2. A full description of caregiver characteristics is included in Table 4.

*Table 4: Description of caregiver study population.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>55.9 (17.1)</td>
</tr>
<tr>
<td>% Female</td>
<td>72.0 (36/50)</td>
</tr>
<tr>
<td>% Caucasian</td>
<td>84.0 (42/50)</td>
</tr>
<tr>
<td>Education (years)</td>
<td>12.8 (2.2)</td>
</tr>
<tr>
<td>Charlson Comorbidity Index score*</td>
<td>2.2 (2.3)</td>
</tr>
<tr>
<td>STAI**</td>
<td>31.8 (10.1)</td>
</tr>
<tr>
<td>PHQ-9+</td>
<td>4.3 (5.0)</td>
</tr>
</tbody>
</table>

*Charlson Comorbidity Index is a measure of life expectancy based on number and type of comorbidities.
**Spielberger State Anxiety Inventory (STAI) is a measure of state anxiety severity.
+ Patient health questionnaire (PHQ-9) is a measure of depression severity.

**Structural Equation Model Fit**

The SEM model with standardized estimates and fit indices is described in Figure 2. The chi-square was $\chi^2(7, 46)=4.017, p=.778$ (cmin/df=.574). Thus, the null hypothesis was not rejected, thereby indicating that the predicted model was congruent with the observed data. Examination of additional fit indices verified that the overall model fit was acceptable (CFI≥1.000, RMSEA≤.001, and pclose=.914).
Figure 2: Estimates of structural equation model.

Cmin/df=.574; CFI≥1.000; RMSEA≤.001; pclose=.914
Note: *p≤.05, **p≤.01, ***p≤.001
Results of Mediation Analyses

The mean patient PHQ9 score was 6.6 ± 6.3, which is indicative of mild depression (Kroenke & Spitzer, 2002). Using the cut-off points defined by Kroenke et al. (2002), 46.9% (23 out of 49) had none or very minimal symptoms (Score 0-4), 26.5% (13 out of 49) had mild symptoms (Score 5-9), 10.2% (5 out of 49) had moderate symptoms (Score 10-14), 14.3% (7 out of 49) had moderately severe symptoms (Score 15-19), and 2.0% (1 out of 49) had severe symptoms.

After controlling for age, the direct effect of patient depression was significantly correlated to healthcare utilization in COPD patients (β=0.361, p=.012), with increasing levels of depression severity contributing to greater healthcare utilization. Patient depression was also significantly correlated to symptoms related to shortness of breath as well as to willingness to adhere to healthy behaviors (β=.472, p≤.001; β=-.386, p=.012 respectively). Higher levels of depression severity were associated with self-report of increased symptoms and decreased adherence to healthy behaviors.

There was no significant correlation observed between symptoms and healthcare utilization (β=.194, p=.243). Additionally, the direct effect observed between patient depression and healthcare utilization was no longer significant after controlling for symptoms (β=.270, p=.094). The indirect effect of patient depression on healthcare utilization through symptoms due to shortness of breath was also not significant (p=.256). These findings indicate that the relationship between patient depression and healthcare utilization may not be mediated by severity of patient symptoms.

The relationship between patient depression and healthcare utilization was also not explained by patient adherence to healthy behaviors. There was no significant correlation
observed between adherence and healthcare utilization ($\beta=.160, p=.244$). The direct effect between patient depression and adherence remained significant ($\beta=.423, p=.005$) after controlling for patient adherence. The indirect effect of patient depression on healthcare utilization through adherence to health behaviors was not significant ($p=.216$). A description of the direct and indirect effects due to the mediation analysis can be found in Table 5.

Table 5: Mediation estimates and significance of direct and indirect effects

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Direct Effect w/out Mediator (Significance)</th>
<th>Direct Effect Controlling for Mediator (Significance)</th>
<th>Significance Indirect Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ9-Airways-Utilization</td>
<td>.361 (.012)</td>
<td>.270 (.094)</td>
<td>.239</td>
</tr>
<tr>
<td>PHQ9-HABIT-Utilization</td>
<td>.361 (.012)</td>
<td>.424 (.005)</td>
<td>.274</td>
</tr>
<tr>
<td>PHQ9-Airways/HABIT-Utilization</td>
<td>.361 (.012)</td>
<td>.332 (.047)</td>
<td>.876</td>
</tr>
</tbody>
</table>

Results of Moderation Analyses

There were no statistical differences observed during multi-group comparison of critical ratios for patients who had depressed caregivers versus those who were cared for by non-depressed caregivers (See Table 6).
Table 6: Critical ratio comparisons for depressed versus non-depressed caregivers.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Estimate</th>
<th>p-Value</th>
<th>Estimate</th>
<th>p-Value</th>
<th>z-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airways^++-PHQ9^+</td>
<td>.359</td>
<td>.121</td>
<td>.652</td>
<td>.009</td>
<td>.862</td>
</tr>
<tr>
<td>HABIT^-PHQ9^+</td>
<td>-.238</td>
<td>.384</td>
<td>-.417</td>
<td>.116</td>
<td>-.470</td>
</tr>
<tr>
<td>Utilization-PHQ9^+</td>
<td>.239</td>
<td>.033</td>
<td>-.003</td>
<td>.997</td>
<td>1.693</td>
</tr>
<tr>
<td>Utilization-Airways^++</td>
<td>.025</td>
<td>.814</td>
<td>.135</td>
<td>.024</td>
<td>.198</td>
</tr>
<tr>
<td>Utilization-HABIT^-</td>
<td>.069</td>
<td>.432</td>
<td>.060</td>
<td>.262</td>
<td>-.086</td>
</tr>
</tbody>
</table>

^Patient health questionnaire (PHQ-9) is a measure of depression severity.
^++Airways is a measure of patient symptoms related to COPD.
^Health Adherence Behavior Inventory (HABIT) is a measure of willingness to perform health behaviors.

Additionally, there was no significant moderation found for patients who had caregivers with high anxiety versus those who had low anxiety (See Table 7). These findings did not change after controlling for patient age.
Table 7: Critical ratio comparisons for anxiolytic versus non-anxiolytic caregivers.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>No-Anxiety (n=27)</th>
<th>Anxiety (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airways++-PHQ9+</td>
<td>.427</td>
<td>.522</td>
</tr>
<tr>
<td>HABIT^ -PHQ9+</td>
<td>-.331</td>
<td>-.623</td>
</tr>
<tr>
<td>Utilization-PHQ9+</td>
<td>.173</td>
<td>.090</td>
</tr>
<tr>
<td>Utilization-Airways++</td>
<td>.102</td>
<td>-.009</td>
</tr>
<tr>
<td>Utilization-HABIT^</td>
<td>-.007</td>
<td>.024</td>
</tr>
</tbody>
</table>

^Patient health questionnaire (PHQ-9) is a measure of depression severity.
++Airways if a measure of patient symptoms related to COPD.
^Health Adherence Behavior Inventory (HABIT) is a measure of willingness to perform health behaviors.

Caregiver physical morbidity did significantly moderate the relationship between patient depression severity and health utilization (z-score: 2.219, p<.05) (See Figure 3). Depression severity was positively associated with healthcare utilization in patients who had healthy caregivers (β=.269, p=.023), but this relationship became non-significant in patients who had caregivers with at least one physical comorbidity (β=-.030, p=.646). The moderating effect of caregiver physical morbidity did not remain significant after controlling for patient age and COPD severity (z-score: 1.77, p=.078). Critical ratio differences for the moderation model are included in Table 8.
Figure 3: Moderation of patient depression and utilization by caregiver physical comorbidity.

Table 8: Critical ratio comparisons for caregivers with morbidity versus those without morbidity.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>No-Morbidity (n=19)</th>
<th>Morbidity (n=27)</th>
<th>z-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airways++-PHQ9+</td>
<td>.666</td>
<td>.522</td>
<td>-.499</td>
</tr>
<tr>
<td>HABIT^-PHQ9+</td>
<td>-.061</td>
<td>-.623</td>
<td>-1.878</td>
</tr>
<tr>
<td>Utilization-PHQ9+</td>
<td>-.020</td>
<td>.090</td>
<td>1.374</td>
</tr>
<tr>
<td>Utilization-Airways++</td>
<td>.080</td>
<td>-.009</td>
<td>-1.415</td>
</tr>
<tr>
<td>Utilization-HABIT^-</td>
<td>.061</td>
<td>.024</td>
<td>-.608</td>
</tr>
</tbody>
</table>

1Patient health questionnaire (PHQ-9) is a measure of depression severity.
2++Airways if a measure of patient symptoms related to COPD.
3^-Health Adherence Behavior Inventory (HABIT) is a measure of willingness to perform health behaviors.
Discussion

The purpose of this study was to determine what factors in informal caregivers influenced healthcare utilization, perception of symptoms related to shortness of breath, and willingness to adhere to healthcare behaviors in depressed patients with COPD. It was hypothesized that depressed patients with COPD were more likely to report symptoms related to shortness of breath and be less likely to adhere to health behaviors, thereby leading to increased healthcare utilization. Physical morbidity, depression, and anxiety in the caregiver were factors hypothesized to moderate the relationship between depressed patient symptoms, adherence, and utilization. It was thought that caregivers who were physically and mentally healthy would dampen the negative effect of patient depression on level of symptoms reported, willingness to adhere, and healthcare utilization.

The results of this study supported our hypotheses regarding the impact of depression severity on symptoms related to shortness of breath, willingness to adhere to healthcare behaviors, and healthcare utilization in patients with COPD. Patients who reported higher levels of depression severity were more likely to complain of symptoms due to shortness of breath, were less likely to perform healthy behaviors, and had greater incidence of emergency room and hospital admissions. It was hypothesized that patient symptoms and adherence would explain the significant relationship between patient depression and healthcare utilization, but mediation was not observed.
In contrast to the hypotheses, depressed patients with COPD who had physically healthy caregivers were more likely to be admitted to a healthcare facility than patients whose caregivers had multiple morbidities. This relationship became non-significant after controlling for patient age and COPD severity. A review of our data found older patients with COPD were less likely to be depressed ($r=-.441$, $p=.002$), reported fewer symptoms ($-.378$, $p=.007$), and had fewer emergency room admissions ($r=.353$, $p=.012$). As expected, increased patient age was associated with greater comorbidity in the caregiver. Since the majority of informal caregivers in this study were spouses, it makes sense that caregivers would be older and have higher comorbidity scores. These findings indicate the possibility of a three-way interaction between patient depression, age, and caregiver comorbidity. It may be that in younger patients, depression severity and perceived symptoms are higher. Thus, the ability of the caregiver to provide functional support is greater. This finding highlights the need for further research to understand COPD in both younger as well as older populations, and how informal caregivers impact each of these groups.

**Limitations and Implications**

There were several weaknesses in the design of the study that may have impacted the observed results. Because of the cross-sectional nature of the study, the causal direction of the hypothesized relationships cannot be established. Several epidemiological studies have shown that depressed patients with COPD are more likely to be non-adherent (Qian et al., 2012), report greater symptoms (Cleland et al., 2007; Felker et al., 2001; Felker et al., 2010; Iguchi et al., 2013; Ng et al., 2007), and utilize more healthcare resources (Abrams et al., 2011; Dahlen et al., 2002; Garcia-Polo et al., 2012; Ito et al., 2012; Papaioannou et al., 2013), but these studies are correlational and not causative. Regvat et al. (2011) did report that increased symptoms and dyspnea led to increased hospital utilization in COPD patients.
The small sample size of this study may have also impacted the results found. A priori power analyses for SEM based on obtaining a moderate RMSEA fit for the entire model indicated a sample size of 98 dyads were necessary. As mentioned in the statistical plan, there is much controversy over sample sizes and how large a sample is required to perform SEM analysis. Early rules of thumb were that a minimum of 200 samples were required, or 5-20 samples per free parameter, but this wisdom has been criticized with the implementation of Monte Carlo simulation to determine sample size based on model design (Wolf, Harrington, Clark, & Miller, 2013). That being said, a sample size of 100 dyads was the original aim, but lack of resources and time prohibited further recruitment efforts. Recruitment difficulties were encountered due to lack of physician/clinician involvement in the on-site recruitment process, low response rate to the mailings, and low rate of physician visitation by this population. Recruitment from pulmonary rehab was most productive, but recruitment of patients entirely from this venue may not have been representative of the entire population. For future studies, community announcements and advertising may be merited. Additionally, recruitment from primary care offices as well as the pulmonology specialists may improve enrollment. Finally, a multi-center trial may be necessary to increase recruitment numbers.

Since the information used for this study came from a larger study design, the time to perform the interview process was considerable, thus the participants may have suffered fatigue by the end of the interview process. In order to reduce the influence of fatigue on the outcomes, the study measures included in the questionnaire packet were counterbalanced using a random number generator program. Additionally, the questionnaire packet was self-report; thus, there was no guarantee that the participants answered accurately and honestly. It was explicitly
explained to the participants that all data was confidential and that they could leave any questions they did not feel comfortable answering blank.

**Future Direction**

Due to the unique complexity of managing COPD as well as the large number of individuals requiring instrumental support to perform activities of daily living, understanding the role of the informal caregiver in providing the support necessary to meet the needs of the patient is essential. The healthcare community is in need of larger, multi-center studies to not only delineate the needs of the COPD patient across the continuum of care, but also to determine how the caregiver impacts overall care. Studies such as this may lead to development of care coordination programs similar to those that have been studied in other chronic disease models.

Additionally, while not looked at in this study, there are some indications that age may impact how we manage the COPD patient. COPD is the sixth leading cause of lost work days in the United States after back problems, mood disorders, motor vehicle accidents, acute respiratory infections, and arthopathies (Tinkleman et al., 2005). This indicates that impairment due to COPD may occur at an earlier age than other chronic diseases. There is some evidence that chronic disease self-management in younger, working age individuals is different than in the elderly (Munir et al., 2009). Understanding the differences in needs and self-management styles in working-age versus elderly COPD patients is necessary to reduce to overall impact of the disease on quality of life.
Conclusions

In conclusion, this study was able to show that depression was related to increased symptoms, lower adherence, and increased healthcare utilization in patients with COPD. Additionally, caregiver physical morbidity may moderate the relationship between patient depression and healthcare admissions under some circumstances. Further research is necessary to understand these findings and to further explore how the informal caregiver can impact in home management of the COPD patient. Evidence of caregiver influence on patient outcomes in COPD is necessary in order to develop programs to improve coordination of care in this patient population across the continuum.
References


Ng, T., Niti, M., Tan, W., Cao, Z., Ong, K., & Eng, P. (2007). Depressive symptoms and chronic obstructive pulmonary disease. *Archives of Internal Medicine, 167*, 60-67.


http://digitalcommons.pcom.edu/psychology_dissertations/110


Appendix A

Patient Demographics and Information

1. What is your age? _______ years old. Date of Birth: ____________________

2. What is your gender? _____ Male(0) _____ Female(1)

3. What is your ethnic group? (please select only one)
   _____ African American(1)
   _____ Asian(2)
   _____ Caucasian, non-Hispanic(3)
   _____ Hispanic (Cuban, Latino, Mexican, Puerto Rican, Spanish)(4)
   _____ Native American/Hawaiian-Pacific Islander(5)
   _____ Other (describe)(6)_____________________________________

4. How many years of formal education have you completed? _____ years
   _____ 0-8 years (0)
   _____ Some high school (1)
   _____ Graduated high school (2)
   _____ Some college (3)
   _____ Associates degree or equivalent (4)
   _____ Bachelor’s degree or equivalent (5)
   _____ Master’s degree or above (6)
   _____ Completed doctorate degree (7)

5. What is your current marital status? (please select only one)
   _____ Married (1)
   _____ Separated (2)
   _____ Divorced (3)
   _____ Widowed (4)
   _____ Single (5)
   _____ Live-in Partner (6)

6. What is your relationship with the caregiver? (please select only one)
   _____ Spouse(1)         _____ Mother(5)
   _____ Son(2)            _____ Brother(6)
   _____ Daughter(3)       _____ Sister(7)
   _____ Father(4)         _____ Other(8) (please describe)_______________
7. What is your current living arrangement? (please select only one)
   _____ Live alone(1)
   _____ Live with spouse/partner(2)
   _____ Live with spouse/partner and children(3)
   _____ Live with roommates (not spouse or partner)(4)
   _____ Live with parent(s)(5)
   _____ Other(6) (please describe)____________________

8. Which best describes your current location? (please select only one)
   _____ Rural(1)
   _____ Industrial(3)
   _____ Residential(2)
   _____ City(4)
   _____ Other (5) (please describe)________________________

9. What is your current employment status? (please select only one)
   _____ Disabled and unable to work(1)
   _____ Full-time homemaker(2)
   _____ Retired(3)
   _____ Working full time (35 hours or more a week)(4)
   _____ Working part-time (less than 35 hours a week)(5)
   _____ Unemployed(6)
   _____ Other(7) (please describe)____________________

10. If currently employed, does your job involve exposure to smoke, fumes, dust or other environmental toxins? _____ No(0) _____ Yes(1)

11. What type of health insurance coverage do you have? (please select only one)
   _____ None(1)
   _____ Medicare(2)
   _____ Medicaid(3)
   _____ Both Medicare and Medicaid(4)
   _____ Private health insurance(5)
   _____ Both private health insurance and Medicare(6)
   _____ Other(7) (please describe)____________________

12. What is your approximate annual total household income? (please select only one)
   _____ Less than $10,000 per year(1)
   _____ More than $10,000 but less than $25,000 per year(2)
   _____ More than $25,000 but less than $50,000 per year(3)
   _____ More than $50,000 but less than $75,000 per year(4)
   _____ More than $75,000 but less than $100,000 per year(5)
   _____ More than $100,000 per year(6)
13. Please list any additional medical problems (examples: diabetes, high blood pressure):
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

14. Please list all medication, including herbal medications, which you are currently taking:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

15. Do you currently use any home health care services? _____ Yes(1) _____ No(0)
If yes, how often do they come to your home? _________________________________

16. Do you currently smoke? _____ Yes(1) _____ No(0)
If yes, how much do you smoke a day? _______________________________________

17. Did you ever smoke? _____ Yes(1) _____ No(0)
If yes, how many years did you smoke? ______  How many packs per week? ______

18. Does anyone in your home smoke? _____ Yes(1) _____ No(2)

19. How long have you had your respiratory illness? __________________________

20. Do you attend a support group (COPD or Other)? _____ No(0) _____ Yes(1)
If yes, what type? _________________________________________________________

21. Do you or did you ever attend Pulmonary Rehabilitation? _____ No(0) _____ Yes(1)

22. If you use oxygen, how is it prescribed?
_____ Full Time(1)
_____ At night only(2)
_____ During the day only(3)
_____ During activities requiring physical exertion only(4)
_____ As Needed(5)
23. If you use oxygen, do you use it as prescribed? _____ Yes(1) _____ No(0)
   If no, why not? __________________________________________________________

24. If you use oxygen, approximately how many hours a day do you use it?
   _____ Hours per day

25. Does your caregiver accompany you to your doctor’s appointments?
   _____ Yes, they attend ALL appointments(1)
   _____ Yes, they attend MOST appointments(2)
   _____ Yes, they attend SOME appointments(3)
   _____ No, they do not attend appointments(0)

26. If your caregiver attends doctor’s appointments with you, are they an active participant
    (ask questions, seek information from doctor, etc.)? _____ No(0) _____ Yes(1)
    If yes, how do they participate?
    _______________________________________________________________________
    _______________________________________________________________________
    _______________________________________________________________________
    _______________________________________________________________________
    _______________________________________________________________________
    _______________________________________________________________________

27. Have you visited the ER in the past 12 months? _____ No (0) _____ Yes(1)
    If yes, how many times? __________

28. Have you been admitted to the hospital in the past 12 months? _____ No(0)
    _____ Yes(1)
    If yes, how many times? __________
Appendix B

Caregiver Demographics and Information

1. What is your age? _______ years old. Date of Birth: ______________

2. What is your gender? _____ Male(0) _____ Female(1)

3. What is your ethnic group? (please select only one)
   _____ African American(1)
   _____ Asian(2)
   _____ Caucasian, non-Hispanic(3)
   _____ Hispanic (Cuban, Latino, Mexican, Puerto Rican, Spanish)(4)
   _____ Native American/Hawaiian-Pacific Islander(5)
   _____ Other (describe)(6)_____________________________________

4. How many years of formal education have you competed? _____ years
   _____ 0-8 years (0)
   _____ Some high school (1)
   _____ Graduated high school (2)
   _____ Some college (3)
   _____ Associates degree or equivalent (4)
   _____ Bachelor’s degree or equivalent (5)
   _____ Master’s degree or above (6)
   _____ Completed doctorate degree (7)

5. What is your current marital status? (please select only one)
   _____ Married (1)
   _____ Separated (2)
   _____ Divorced (3)
   _____ Widowed (4)
   _____ Single (5)
   _____ Live-in Partner (6)

6. What is your relationship with the patient? (please select only one)
   _____ Spouse(1)  _____ Mother(5)
   _____ Son(2)  _____ Brother(6)
   _____ Daughter(3)  _____ Sister(7)
   _____ Father(4)  _____ Other(8) (please describe)__________________

7. What is your current living arrangement? (please select only one)
8. Which best describes your current location? (please select only one)
   _____ Rural(1)   _____ Industrial(3)
   _____ Residential(2)   _____ City(4)
   _____ Other (5) (please describe)________________________

9. What is your current employment status? (please select only one)
   _____ Disabled and unable to work(1)
   _____ Full-time homemaker(2)
   _____ Retired(3)
   _____ Working full time (35 hours or more a week)(4)
   _____ Working part-time (less than 35 hours a week)(5)
   _____ Unemployed(6)
   _____ Other(7) (please describe)________________________

10. What is your approximate annual total household income? (please select only one)
    _____ Less than $10,000 per year(1)
    _____ More than $10,000 but less than $25,000 per year(2)
    _____ More than $25,000 but less than $50,000 per year(3)
    _____ More than $50,000 but less than $75,000 per year(4)
    _____ More than $75,000 but less than $100,000 per year(5)
    _____ More than $100,000 per year(6)

11. Please list any additional medical problems (examples: diabetes, high blood pressure):
    ____________________________________________________________________
    ____________________________________________________________________
    ____________________________________________________________________
    ____________________________________________________________________

12. Do you currently smoke? _____ Yes(1) _____ No(0)
    If yes, how much do you smoke a day? ________________________________

13. Did you ever smoke? _____ Yes(1) _____ No(0)
    If yes, how many years did you smoke? _____ How many packs per week?_______
14. Does anyone in your home smoke? _____ Yes(1) _____ No(2)

15. Do you attend a support group (COPD or Other)? _____ No(0) _____ Yes(1)
   If yes, what type?__________________________________________________________

16. Do you or did you ever attend Pulmonary Rehabilitation with the patient? _____ No(0)
   _____ Yes(1)

17. If the patient uses oxygen, how was it prescribed?
   _____ Full Time(1)
   _____ At night only(2)
   _____ During the day only(3)
   _____ During activities requiring physical exertion only(4)
   _____ As Needed(5)

18. If the patient uses oxygen, do they use it as prescribed? _____ Yes(1) _____ No(0)
   If no, why not?______________________________________________________________

19. If the patient uses oxygen, approximately how many hours a day do they use it?
   _____ Hours per day

20. Do you accompany the patient to their doctor’s appointments?
   _____ Yes, I attend ALL appointments(1)
   _____ Yes, I attend MOST appointments(2)
   _____ Yes, I attend SOME appointments(3)
   _____ No, I do not attend appointments(0)

21. If you attend the patient’s doctor’s appointments, are you an active participant (ask
    questions, seek information from doctor, etc.)? _____ No(0) _____ Yes(1)
   If yes, how do you participate?
   __________________________________________________________________________